INTERNATIONAL CONSENSUS STANDARDS FOR COMMERCIAL DIVING AND UNDERWATER OPERATIONS

6TH EDITION

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL

INTERNATIONAL CONSENSUS STANDARDS FOR COMMERCIAL DIVING AND UNDERWATER OPERATIONS

6TH EDITION

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The Mission of the ADCI is:

- **To promote the highest possible level of safety in the practice of commercial diving and underwater operations.**
- **To promote proper and adequate training and education for industry personnel.**
- **To foster open communication within the underwater industry.**
- **To hold all members accountable in adherence to the International Consensus Standards for Commercial Diving and Underwater Operations.**

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FOREWORD/RECORD OF CHANGES

The members of theADCI have agreed to abide by these **International Consensus Standards for Commercial Diving and Underwater Operations.** These consensus standards represent the collective operatin g philosophy and best industry practices of ADCI member companies and have been developed to present the minimum standards necessary for the conduct of commercial diving operations, either offshore or inland. As in any activity for which minimum standards have been developed, there can be no substitute for careful planning and assessment of the job to be conducted and the conditions likely to be encountered.

Great care must be given to proper and complete planning and assessment of any commercial diving operation. These standards set forth a minimum threshold below which no company should consider an operation to be safe. No set of standard procedures can anticipate all operating conditions that may be encountered.

No standard can ever substitute for common sense, sound judgment or a continuing concern for safety. Deviation from standards and codes should always be made on the side of increasing safety. In an emergency situation, it is recognized that full compliance with standards and codes may not be possible. In such instances, a carefully crafted emergency response plan must be implemented in order to minimize the risks.

Record of Changes

A technical publication is of value only insofar as it is maintained in current, up-to-date condition. TheADCI periodically updates the **International Consensus Standards for Commercial Diving and Underwater Operations** to reflect new developments and procedures in the commercial diving and underwater operations fields. These updates will be in the form of periodic changes or major revisions and should be recorded on the “Record of Changes” page and shall be published at www.adc-int.org following approval of the board of directors.

Copies of the **International Consensus Standards for Commercial Diving and Underwater Operations** are available from:

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All individuals, contractors, clients, members of ADCI, or other bodies concerned with the safety of commercial diving and underwater operations are requested to submit to the above address constructive criticism and recommendations for improvement of these consensus standards. The ADCI board of irectors is responsible for final approval of any changes to these consensus standards.

For any issued change or updates to this 6th edition, go to the Association ADCI website

www.adc-int.org

RECORD OF CHANGES

This 6th edition of the **International Consensus Standards for Commercial Diving and Underwater Operations** supersedes the 5th edition, dated 2004.

Change No.	Date	Description of Change	Page No.

SECTION 1.0

GENERAL PROVISIONS

Association of Diving Contractors International, Inc.

1.0 GENERAL PROVISIONS

1.1 SCOPE AND APPLICATION

1.1.1 PURPOSE

The purpose of these consensus standards is to provide best industry practices in a clear and complete format in order to contribute to the safety and well-being of all those working in the commercial diving industry, especially commercial divers, tenders, deck support personnel and supervisors.

These consensus standards apply to all types of underwater work, whether inland or offshore, involving commercial diving. It is intended that these standards will complement applicable government rules and regulations as well as supplement industrial codes of safe practice for diving and underwater operations by providing a consensus of industry best practices for underwater diving operations.

Nothing contained in this manual shall be construed to take the place of any law, rule or regulation of any governmental agency.

1.1.2 PRESERVATIVE ACTS

These consensus standards represent the generally applicable standards that apply to normal or typical situations. The ADCI recognizes that variations from these standards may be needed and appropriate where emergency and unanticipated situations arise.

1.1.3 IMPLEMENTATION OF CERTIFICATION AND EQUIPMENT REQUIREMENTS

Except where noted, all new certification and equipment requirements will take effect upon the formal adoption of this document. Noted changes to take effect after the formal adoption of this document will be annotated by a superscript (1, 2 or 3) after the stated requirement. The legend for the superscripts is as follows:

1 – Compliance required after 6 months from formal adoption

2 – Compliance required after 12 months from formal adoption

3 – Compliance required after 24 months from formal adoption

SECTION 2.0

DIVING PERSONNEL MEDICAL AND TRAINING REQUIREMENT

Association of Diving Contractors International, Inc.

2.0 DIVING PERSONNEL MEDICAL AND TRAINING REQUIREMENTS

2.1 GENERAL

Each person engaged in diving and underwater operations shall possess the necessary qualifications for the job assignment. Designation of skill levels in these standards incorporates three primary elements:

- Technical training
- Field experience
- Demonstrated proficiency

Persons assigned to specific diving and underwater activities shall possess the following:

1. Knowledge and skills gained through a combination of formal training and/or experience in the following:
   - Diving procedures and techniques.
   - Emergency procedures.
   - Physiology and physics as they relate to diving.
   - Diving equipment.
   - First aid and CPR.
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 divers or otherwise exposed to hyperbaric conditions, physical qualifications for such activities must be met as outlined in **Section 2.3 Diver Medical Requirements.** Such physical qualifications must be documented on an ADCI **medical history and physical examination form,** or an equivalent form.
4. For persons who operate decompression chambers, knowledge and experience with chamber operations.

A person lacking the required experience and proficiency outlined above may be assigned a task, under the direction of an experienced and qualified individual, in order to obtain the experience and level of proficiency required.

Personnel trained and certified by recreational agencies such as, but not limited to, the National Association of Underwater Instructors (NAUI), the Professional Association of Diving Instructors (PADI), the Young Men's Christian Association (YMCA) or other such organizations are not sufficiently well-trained to participate in or conduct commercial diving activities without additional formal training from an accredited source.

For contractors operating in the United States, OSHA considers an employer to be in compliance with the diver training requirements of the Code of Federal Regulations for any employed diver with a valid ADCI Commercial Diver Certification Card for the appropriate training level.

2.2 COMMERCIAL DIVING TRAINING REQUIREMENTS

2.2.1 ENTRY-LEVEL QUALIFICATIONS

All personnel entering the profession of commercial diving shall be a high school graduate or equivalent. The entry-level minimum skill designation on the diving crew is a tender/diver. The entry-level tender/diver satisfies the minimum entry-level qualifications of diving proficiency, technical proficiency and experience by successfully completing a formal course of study.

A formal course of study for a tender/diver shall be completed at any accredited school, military school or equivalent whose curriculum, at a minimum, conforms to ANSI/ACDE-01-2009.[2] This standard can be found in the reference section.

The -ADCI recognizes formal training certificates issued from within other nations. Certificates of that nature will be evaluated together with presented documentation such as dive logs/supervisor logs, etc., to determine whether the individual is eligible in all respects for issuance of an ADCI commercial diver card.

Certificates known to be in existence from other nations are

Surface-Supplied Diver Certificates:

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

Closed-bell Diver Certificates:

- Australian Diver Accreditation Scheme Part 4
- Canadian Bell Diver
- Canadian Category 2 Diver
- Canadian Category 3 Diver
- Dutch Part 2 Bell Diver
- French Class 3
- UK HSE Part II (Transitional Part II — issued between 7/1/81 and 12/31/81)
- UK HSE Closed Bell
- Italy OTS.BF
- New Zealand Part 2
- Norwegian NPD Bell Diver
- South African Class 1

Persons possessing certificates identified above are entitled to apply for the ADCI's commercial diver certification card as outlined in this standard. This certification card identifies the bearer as a formally trained commercial diver at the entry-level category. Certification categories of a higher level may be issued to individuals based upon verifiable and documented evidence of having completed the prerequisites for that category.

The ADCI does not perform as an educational organization and as such does not endorse, certify or accredit any school participating in the training of personnel. Member schools are expected to obtain and preserve appropriate accreditation from agencies under whose jurisdiction their educational requirements must be maintained.

2.2.2 MINIMUM REQUIRED EXPERIENCE AND PROFICIENCY

1. **Advancement** beyond the designation of tender/diver requires completion of actual participation in commercial diving operations and demonstrated proficiency during working dives.
2. **Field experience** is defined as those days spent (offshore, inland lakes, harbors, rivers, etc.) participating as a crew member in diving operations at the level of competency determined by prior training and demonstrated proficiency.
3. **Diving proficiency** establishes the required minimum number of open-water working dives required to obtain various designations.

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.

4. **Advancement** to higher designations requires completion of training and experience for all lower designations.

Minimum Qualifications:

- **Entry-Level Tender/Diver**
  Commercial diver training of at least 625 documented hours of formal instruction in subjects set forth in the ANSI Standard.[2]
- **Advanced Certifications**
  As defined in Matrix in Section 3.
- **Others**
  Technical proficiency as appropriate to the specific diving mode as detailed under the ADCI certification card program requirements or appropriate section for these standards.

2.3 DIVER MEDICAL REQUIREMENTS

It is recommended that candidates attending formal commercial diver training programs and schools follow the ADCI medical and examination guidelines outlined in this section.

2.3.1 GENERAL

For persons engaged as divers, or otherwise subjected to hyperbaric conditions, the following ADCI medical examinations (or equivalent) are required:

1. An initial medical examination.
2. Periodic examinations are recommended on an annual basis.
3. A re-examination after a diving-related injury or illness as needed to determine fitness to return to diving duty.

2.3.2 PHYSICAL EXAMINATION

1. For persons engaged as divers or otherwise subjected to hyperbaric conditions, the initial exam and periodic medical re-examination include the following:

- Work history.
- The tests required in Section 2, Table 1 as appropriate.
  - Any tests deemed necessary to establish the presence of any of the disqualifying conditions listed in this section.
  - Any additional tests the physician deems necessary.

2. All persons engaged as divers or otherwise subjected to hyperbaric conditions are required to get an annual exam. More frequent or extensive examination(s), including a complete medical re-examination, should be required if there have been any incidents (illness, accidents, etc.) during the course of that year that may have caused a change in the individual's medical condition.

2.3.3 RE-EXAMINATION AFTER INJURY OR ILLNESS

1. Any person engaged as a diver, or otherwise exposed to hyperbaric conditions, will 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) or known decompression sickness with audio-vestibular, central nervous system dysfunction or arterial gas embolism.
2. The person should not be permitted to return to work as a diver, or otherwise be subjected to hyperbaric conditions, until he or she is released by a physician to do so.
3. The examining physician should determine the scope of the examination in light of the nature of the injury or illness.

2.3.4 TABLE 1 - MEDICAL TESTS FOR DIVING

Test	Initial	Annual	Comments
History & Physical	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 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	
Pregnancy Test	X	X	Recommended prior to saturation diving.
Sickle Cell Screen	X		
PPD	X	X	
Comprehensive Metabolic Profile	X	X	Optional, including cholesterol and triglycerides required for divers over 40.

2.3.5 PHYSICIAN’S WRITTEN REPORT

A written report outlining a person’s medical condition and fitness to engage in commercial diving 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 a completed copy of the standard **ADCI medical history form** or its equivalent.

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

2.3.6 DISQUALIFYING CONDITIONS

A person having any of the following conditions, as determined by a physician’s examination, shall be disqualified from engaging in diving or other hyperbaric activities.

- History of seizure disorder other than early childhood febrile conditions.
- Cystic or cavitary disease of the lungs, significant obstructive or restrictive lung disease or recurrent pneumothorax.
- Chronic inability to equalize sinus and middle ear pressure.
- Significant central or peripheral nervous system disease or impairment.
- Chronic alcoholism, drug abuse or history of psychosis.
- Significant hemoglobinpathies.
- Significant malignancies.
- Grossly impaired hearing.
- Significant osteonecrosis.
- Chronic conditions requiring continuous control by medication.
- Pregnancy.

2.3.7 WITHDRAWAL FROM HYPERBARIC CONDITIONS FOR DIVERS

It shall be determined on the basis of the physician's examination whether a person'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 would apply to the person's work activities.

2.3.8 MEDICAL RECORD KEEPING

1. An accurate medical record for each person subject to the medical specifications of this section should be established and maintained. The record should include those physical examinations specified herein, including the **ADCI medical history/physical examination forms** and the physician's written report.
2. The medical record shall be maintained for a minimum of five years from the date of the last hyperbaric exposure unless otherwise prescribed by law.

2.4 MEDICAL GUIDELINES AND RECOMMENDATIONS

2.4.1 INTRODUCTION

The following recommendations are set forth by the ADCI and are intended to be used with the ADCI medical history/physical examination forms. They deal with specific aspects of the subject's physical fitness to dive by item number. These standards are offered with what we 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. 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 diving. Examinations should not be performed by non-physicians.

The spectrum of commercial diving 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 all divers. Some consideration must be given to the subject's medical history, work history, age, etc.

There is no minimum or maximum age limit, providing all the medical standards can be met. The ADCI does, however, restrict issuance of commercial diver certification 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 a company or 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 must have a list of the essential job functions (job description) to review with each commercial 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 within these standards refer to boxes on the ADCI medical history/physical examination form. These forms are available for download on the ADCI website.

If any further clarification of this recommended standard is desired, please contact the ADCI.

2.4.2 ADCI PHYSICAL EXAMINATION STANDARDS

Patient history is recorded on pages 2-15 through 2-16 of the form set. Pages 2-17 and 2-18 are used to record specific findings during the conduct of the examination.

The following headings refer to and explain the numbered boxes on the **ADCI physical examination form** on pages 2-17 and 2-18. A sample copy of these forms is enclosed in this standard. Use of these forms ensures quality and consistency throughout the commercial diving industry. These forms may be obtained from the ADCI website.

1	**Name**	Record.
2	**Social Security Number or Passport Number**	Record.
3	**Height**	No set limits.
4	**Weight**	The weight standards listed in this section should apply. If a diver exceeds these standards and the cognizant physician feels the increase is due to muscular build and physical fitness, a variance is appropriate. Furthermore, individ¬uals who fall within these weight standards but who present an excess of fatty tissue should be disqualified.
5	**Body Fat**	Optional. According to US Navy, 23% for males, 34% for females.
6	**Body Mass Index (BMI)**	Optional. Calculation for BMI = (weight in pounds x 703) height in inches^2.
		The maximum BMI allowable according to the U.S. Navy height and weight table is 28.
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 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 Scalp**	The causes for rejection may be: 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	**Fundus**	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 (include breasts)**	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.
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.
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	**Propioception/ 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 discernable 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.
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 impingement 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**	Recommended.

2.4.3 ADCI MEDICAL HISTORY AND EXAMINATION FORMS

Association of Diving Contractors International

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	
☐	☐	Convulsions or Seizures	☐	☐	Cardiac Angiogram or ECHO	☐	☐	Herniated Disc or Sciatica
☐	☐	Epilepsy	☐	☐	PFO Repair	☐	☐	Shoulder Injury
☐	☐	Concussion or Head Injury	☐	☐	High Blood Pressure	☐	☐	Elbow Injury
☐	☐	Disabling Headaches	☐	☐	Asthma or Wheezing	☐	☐	Arm/wrist/hand Injury
☐	☐	Loss of Balance/Dizziness	☐	☐	Coughing up Blood	☐	☐	Hip/Leg/Ankle Injury
☐	☐	Severe Motion Sickness	☐	☐	Tuberculosis	☐	☐	Knee Injury or "Trick Knee"
☐	☐	Unconsciousness	☐	☐	Shortness of Breath	☐	☐	Foot Trouble or Injuries
☐	☐	Fainting Spells	☐	☐	Chronic Cough	☐	☐	Dislocations
☐	☐	Wear Contacts/Glasses	☐	☐	Pneumothorax	☐	☐	Swollen Joints
☐	☐	Color Vision Defect	☐	☐	Lung Disease or Surgery	☐	☐	Broken Bones or Fractures
☐	☐	Eye Disease or Injury	☐	☐	Gallbladder Disease or Stones	☐	☐	Varicose Veins
☐	☐	Eye Surgery	☐	☐	Stomach Trouble or Ulcers	☐	☐	Muscle Disease or Weakness
☐	☐	Hearing Loss	☐	☐	Stomach Bleeding	☐	☐	Numbness or Paralysis
☐	☐	Ear Disease or Injury	☐	☐	Frequent Indigestion	☐	☐	Sleep Disorders
☐	☐	Ear Surgery	☐	☐	Jaundice	☐	☐	Diabetes
☐	☐	Perforated Eardrum	☐	☐	Liver Disease or Hepatitis	☐	☐	Goiter or Thyroid Disease
☐	☐	Difficulty Clearing	☐	☐	Rectal Bleeding/Blood in Stools	☐	☐	Blood Disease
☐	☐	Nose Bleed	☐	☐	Hemorrhoids (Piles)	☐	☐	Anemia: Sickle Cell or Other
☐	☐	Airway Obstruction	☐	☐	Gas Pains	☐	☐	Skin Rash or Disease
☐	☐	Hay Fever or Allergies	☐	☐	Crohn's Disease/Ulcerative Colitis	☐	☐	Staph Infections
☐	☐	Chest Pain	☐	☐	Rupture or Hernia	☐	☐	Tumor or Cancer
☐	☐	Heart Murmur	☐	☐	Kidney Disease	☐	☐	Claustrophobia
☐	☐	Rheumatic Fever	☐	☐	Kidney Stones	☐	☐	Mental Illness/Depression/Anxiety
☐	☐	Heart Attack	☐	☐	Protein, Sugar or Blood in Urine	☐	☐	Nervous Breakdown
☐	☐	Abnormal Heart Rhythm	☐	☐	Joint Pain/Arthritis	☐	☐	Any Sexually Transmitted Disease
☐	☐	Heart Disease	☐	☐	Back Strain or Injury	☐	☐	Contagious Disease
☐	☐	Cardiac Stent or Angioplasty	☐	☐	Spine Problems	☐	☐	Other Illness or Injury or Any Other Medical Condition

		For Females ONLY	☐	☐	Painful Menses	
☐	☐	Irregular Menses	☐	☐	Pregnancy	Last Menstrual Period ____________

PLEASE EXPLAIN THE DETAILS OF EACH ITEM CHECKED YES ____________

13. LIST ALL SURGERIES YEAR

14. LIST ALL HOSPTALIZATIONS 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:

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Association of Diving Contractors International

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	
☐	☐	Convulsions or Seizures	☐	☐	Cardiac Angiogram or ECHO	☐	☐	Herniated Disc or Sciatica
☐	☐	Epilepsy	☐	☐	PFO Repair	☐	☐	Shoulder Injury
☐	☐	Concussion or Head Injury	☐	☐	High Blood Pressure	☐	☐	Elbow Injury
☐	☐	Disabling Headaches	☐	☐	Asthma or Wheezing	☐	☐	Arm/wrist/hand Injury
☐	☐	Loss of Balance/Dizziness	☐	☐	Coughing up Blood	☐	☐	Hip/Leg/Ankle Injury
☐	☐	Severe Motion Sickness	☐	☐	Tuberculosis	☐	☐	Knee Injury or "Trick Knee"
☐	☐	Unconsciousness	☐	☐	Shortness of Breath	☐	☐	Foot Trouble or Injuries
☐	☐	Fainting Spells	☐	☐	Chronic Cough	☐	☐	Dislocations
☐	☐	Wear Contacts/Glasses	☐	☐	Pneumothorax	☐	☐	Swollen Joints
☐	☐	Color Vision Defect	☐	☐	Lung Disease or Surgery	☐	☐	Broken Bones or Fractures
☐	☐	Eye Disease or Injury	☐	☐	Gallbladder Disease or Stones	☐	☐	Varicose Veins
☐	☐	Eye Surgery	☐	☐	Stomach Trouble or Ulcers	☐	☐	Muscle Disease or Weakness
☐	☐	Hearing Loss	☐	☐	Stomach Bleeding	☐	☐	Numbness or Paralysis
☐	☐	Ear Disease or Injury	☐	☐	Frequent Indigestion	☐	☐	Sleep Disorders
☐	☐	Ear Surgery	☐	☐	Jaundice	☐	☐	Diabetes
☐	☐	Perforated Eardrum	☐	☐	Liver Disease or Hepatitis	☐	☐	Goiter or Thyroid Disease
☐	☐	Difficulty Clearing	☐	☐	Rectal Bleeding/Blood in Stools	☐	☐	Blood Disease
☐	☐	Nose Bleed	☐	☐	Hemorrhoids (Piles)	☐	☐	Anemia: Sickle Cell or Other
☐	☐	Airway Obstruction	☐	☐	Gas Pains	☐	☐	Skin Rash or Disease
☐	☐	Hay Fever or Allergies	☐	☐	Crohn's Disease/Ulcerative Colitis	☐	☐	Staph Infections
☐	☐	Chest Pain	☐	☐	Rupture or Hernia	☐	☐	Tumor or Cancer
☐	☐	Heart Murmur	☐	☐	Kidney Disease	☐	☐	Claustrophobia
☐	☐	Rheumatic Fever	☐	☐	Kidney Stones	☐	☐	Mental Illness/Depression/Anxiety
☐	☐	Heart Attack	☐	☐	Protein, Sugar or Blood in Urine	☐	☐	Nervous Breakdown
☐	☐	Abnormal Heart Rhythm	☐	☐	Joint Pain/Arthritis	☐	☐	Any Sexually Transmitted Disease
☐	☐	Heart Disease	☐	☐	Back Strain or Injury	☐	☐	Contagious Disease
☐	☐	Cardiac Stent or Angioplasty	☐	☐	Spine Problems	☐	☐	Other Illness or Injury or Any Other Medical Condition
		For Females ONLY	☐	☐	Painful Menses			
☐	☐	Irregular Menses	☐	☐	Pregnancy			Last Menstrual Period ______

PLEASE EXPLAIN THE DETAILS OF EACH ITEM CHECKED YES ______

13. LIST ALL SURGERIES ______ YEAR

14. LIST ALL HOSPTALIZATIONS ______ 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: ______

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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

	Yes	No
Heliox	☐	☐
Trimix	☐	☐
Nitrox	☐	☐

Maximum Depth ______________________

Maximum Duration (Days) ______________________

20. DIVING EXPERIENCE (Number of years experience):

Air ____

Mixed Gases ____

Saturation ____

Have you passed an oxygen tolerance test? Yes ☐ No ☐

Name of Diving School ______________________

21. INDICATE THE NUMBER OF DECOMPRESSION INCIDENTS

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	☐	☐	
Oxygen Toxicity	☐	☐	
CO_2 Toxicity	☐	☐	
CO Toxicity	☐	☐	
Ear/Sinus Squeeze	☐	☐	
Ear Drum Rupture	☐	☐	
Deafness	☐	☐	

	Yes	No	Details
Lung Squeeze	☐	☐	
Near Drowning	☐	☐	
Asphyxiation	☐	☐	
Vertigo (Dizziness)	☐	☐	
Pneumothorax	☐	☐	
Nitrogen Narcosis	☐	☐	
Loss of Consciousness	☐	☐	

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
☐	☐	Chest X-Ray	
☐	☐	Longbone Series	
☐	☐	Back (Spine) X-Ray	
☐	☐	ENG	
☐	☐	EEG	
☐	☐	EMG	

Yes	No		Give Date
☐	☐	Nerve Condition Studies	
☐	☐	Pulmonary Function Studies	
☐	☐	Audiogram	
☐	☐	EKG	
☐	☐	Exercise (Stress) EKG	
☐	☐	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 SEPARATION FROM THE COMPANY. I AUTHORIZE ANY OF THE DOCTORS, HOSPITALS, OR CLINICS MENTIONED ABOVE TO FURNISH THE COMPANY MEDICAL EXAMINER WITH A COMPLETE TRANSCRIPT OF MY MEDICAL RECORD FOR PURPOSES OF PROCESSING MY PHYSICAL EXAM.

Date ______________ **Signature** ______________________

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Association of Diving Contractors International

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/____ Corr. to 20/____	R. 20/____	R. 20/____	
L. 20/____ Corr. to 20/____	L. 20/____	L. 20/____	

15. Field of Vision (Degrees) R ° L ° | 16. Contact Lenses ☐ Yes ☐ No

NORMAL	ABNORMAL	Check each item in appropriate column (enter NE for Not Evaluated)	REMARKS
		17. Head, Face, Scalp	
		18. Neck	
		19. Eyes	
		20. Fundus	
		21. Ears – General (internal and external canal)	
		22. Eustachian Tube Function	
		23. Tympanic Membrane	
		24. Nose (Septal Alignment)	
		25. Sinuses	
		26. Mouth and Throat	
		27. Chest	
		28. Lungs	
		29. Heart (Thrust, Size, Rhythm, Sounds)	
		30. Pulses (Equality, etc.)	
		31. Vascular System (Varicosities, etc.)	
		32. Abdomen and Viscera	
		33. Hernia (All Types)	
		34. Endocrine System	
		35. G-U System	
		36. Upper Extremities (Strength, ROM)	
		37. Lower Extremities (Except Feet)	
		38. Feet	
		39. Spine	
		40. Skin, Lymphatics	
		41. Anus and Rectum	
		42. Sphincter Tone	
		43. Pelvic Exam	

NEUROLOGICAL EXAMINATION

44. 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	Glossophayrngeal			
X	Vagus			
XI	Spinal Accessory			
XII	Hypoglossal			

45. REFLEXES

DEEP TENDON

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

PATHOLOGICAL

	Left Present	Left Absent	Right Present	Right Absent
Babinski				
Hoffman				
Ankle Clonus				

SUPERFICIAL

	Present	Absent	NE
Upper Abdomen			
Lower Abdomen			
Cremasteric			

46. CEREBELLAR FUNCTION

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

47. MUSCLE

	STRENGTH 1	2	3	4	5	TONE Normal	Abnormal
Right Upper Extremity							
Left Upper Extremity							
Right Lower Extremity							
Left Lower Extremity							

48. PROPIOCEPTION

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

49. NYSTAGMUS

	Present	Absent
End Point Lateral Gaze		
Pathological		

50. SENSATION

	Normal	Abnormal
Hot		
Cold		

	Normal	Abnormal
Sharp		
Soft		

Two Point Discrimination	
Normal	
Abnormal	

51. RHOMBERG

Absent	
Present	

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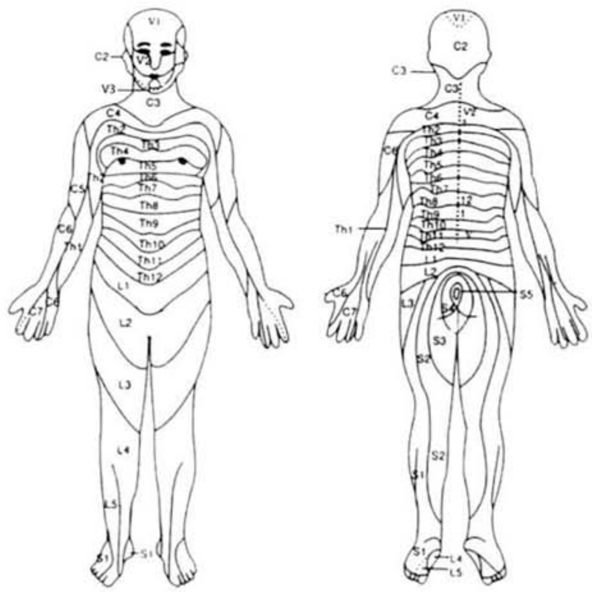
52. MISCELLANEOUS REMARKS



LABORATORY FINDINGS

53. Urinalysis

Color ______
Appearance ______
Sp. Gravity ______
Ph ______

	0	1+	2+	3+	4+
Sugar					
Blood					
Ketones					
Bilirubin					
Protein					

54. Blood Tests

CBC
Normal ☐
Abnormal ☐

Sickle Cell ☐ Pos ☐ Neg

Attach Reports
RPR ☐ Pos ☐ Neg
HIV ☐ Pos ☐ Neg

55. Pulmonary Function

FVC ______
FEV1 ______
FEV1/FVC ______

56. X-rays

	Normal	Abnormal	(Describe)
Chest	☐	☐	
Lumbar Spine	☐	☐	
Long Bone Series	☐	☐	
Other	☐	☐	

57. Electrocardiogram

Static ______
Exercise Stress ______

58. Audiogram

Hz	500	1000	2000	3000	4000	6000	8000
Left							
Right							

59. Comprehensive Metabolic Panel Attach Report

Normal ☐
Abnormal ☐

Lipid Panel (if done)

Normal ☐
Abnormal ☐

Comments: ______

60. Drug Screen

☐ Not collected
☐ Collected, results sent to employer

Work Status:

☐ Fit for diving
☐ Cleared for supervisor
☐ Cleared for topside work only
☐ Cleared with restrictions: ______
☐ Further evaluation needed: ______
☐ Unfit for diving : ______
☐ Unfit ______

Comments: ______

Examinee Signature ______
Examinee Name ______
Physician Signature ______
Physician Name ______
Address ______
Phone Number ______

Date of Examination ______

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2.4.4 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.

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.

2.4.5 DISCLAIMER

Because of the lack of medical literature concerning commercial diving, these guidelines were developed as a consensus among 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.

2.4.6 BMI TABLES

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

2.4.6 BMI TABLES - Continued

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

2.4.7 BODY FAT TABLE AND BODY FAT PERCENTAGES COMPARISON TABLE

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

SECTION 3.0

DIVING PERSONNEL RESPONSIBILITIES, QUALIFICATIONS AND CERTIFICATIONS

Association of Diving Contractors International, Inc.

3.0 DIVING PERSONNEL RESPONSIBILITIES, QUALIFICATIONS AND CERTIFICATIONS

Titles, duties, responsibilities and capabilities of personnel engaged in commercial diving and underwater operations will vary widely. The employer 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 certification designations in this section indicate the minimum duties and responsibilities of dive team members.

3.1 COMMERCIAL DIVER CERTIFICATION PROGRAM

Certification cards issued by recreational agencies are not recognized as qualifying an individual to perform commercial diving activities in the absence of additional formal commercial diving training from an accredited source.

3.1.1 GENERAL REQUIREMENTS

Member companies of the ADCI employ persons to perform as certified commercial divers in the following categories:

- Entry-level tender/diver.
- Air diver.
- Mixed-gas diver.
- Saturation diver.
- Air-diving supervisor.
- Mixed-gas diving supervisor.
- Saturation-diving supervisor.
- Life-support technician.
- Saturation technician.

These individuals must be properly trained in accordance with the current edition of the **ADCI International Consensus Standards for Commercial Diving and Underwater Operations** and will then continue their path of career progression through on-the-job training and demonstrated field and leadership experience. All ADCI general member company diving personnel need to hold a current ADCI certification card reflective of the assigned tasks to be performed. This certification card needs to be obtained within 90 days of employment with a general member company.[1]

3.1.2 QUALIFICATIONS AND CERTIFICATIONS

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.

3.1.3 SCOPE AND APPLICABILITY

ADCI has established a program whereby properly trained commercial divers, life-support technicians and saturation technicians can obtain a certification card that indicates their qualification and competency level as defined in the **ADCI International Consensus Standards for Commercial Diving and Underwater Operations.**

With the exception of the entry-level tender/diver certification, certification cards issued under this program will be valid for a period of five years from date of issue. Cards can be obtained only by presentation of acceptable documentation that the individual for whom the card is requested has recorded evidence of having completed the requisite training and on-the-job experience necessary to support card issue at the appropriate level of classification.

3.1.4 CERTIFICATION AND TRAINING MATRIX

CERTIFICATION AND TRAINING MATRIX										
REQUIREMENT	**ENTRY-LEVEL TENDER/ DIVER**	**AIR DIVER**	**AIR-DIVING SUPERVISOR**	**MIXED-GAS DIVER**	**MIXED-GAS DIVING SUPERVISOR**	**BELL/ SAT DIVER**	**BELL/SAT DIVING SUPERVISOR**	**LIFE-SUPPORT TECHNICIAN**	**SATURATION TECHNICIAN**
Formal Training	625 hours								
Field Days		100	200	100 Air 50 Mixed Gas	350 Air or Mixed Gas	200 Air or Mixed Gas	100 as Mixed-gas Diving Supervisor	100 Days as an Assistant LST	180 Days as an Assistant Saturation Technician
Working Dives		30	50	50 – Air 10 – Mixed Gas	150 Air or Mixed Gas	100 Air or Mixed Gas			
Operations on System						30 Working **Days**			
Assistant Supervisor Training Field			30 Working Days		30 Working Days		60 Working Days		
EXAM			EXAM REQUIRED		EXAM REQUIRED		EXAM REQUIRED	EXAM REQUIRED	EXAM REQUIRED

3.1.5 DOCUMENTATION ACCEPTED

1. ADCI certification cards may be requested by ADCI member companies by certifying that the person for whom the card is requested fully qualifies to perform duties in the diver classification requested. Member companies are required to have on file, and to retain for a period of five years, copies of information that show evidence that the individual for whom the card is requested does, in fact, possess the necessary training, field experience and required number of working dives.

2. Personnel are required to show evidence of a properly maintained commercial diver's log book.

3. Individual personnel seeking to obtain an ADCI certification card are required to have verifiable evidence necessary to support the application and will, in the case of the diving supervisor level, be required to obtain and provide verifiable endorsements from ADCI (**or other certification authorities recognized by the ADCI**) member companies for whom they shall have records of performance as an assistant diving supervisor or diving supervisor.

4. ADCI Associate Member Commercial Diving Schools:

   Application for the entry-level certification cards may be made by filing with ADCI a listing of the members of each class together with their **assigned identifying numbers**, their dates of birth and a photograph of each member that meets the requirements of this standard. Certification cards will be prepared for each individual identified and returned to the requestor. The cards may be issued ONLY to individuals who actually graduate. Any card furnished to the school for issue to an individual who DOES NOT graduate will be returned to ADCI for disposal and removal of information from the master database.

5. Non-ADCI Member Commercial or Government/Military Diving Schools:

   Application for entry-level certification cards for non-ADCI member commercial or government/military diving schools will be accepted under the following provisions:

   a. That they be formally recognized as an accredited school by a government body.

   b. That the course of instruction offered generally parallels that of the Association of Commercial Diving Educators as recognized in the ADCI International Consensus Standards for Commercial Diving and Underwater Operations to comprise not less than **625** hours of formal instruction in the subjects set forth therein or, as appropriate, the contents of this standard addressed to training and education.

c. That the course of instruction offered will in all cases parallel that established in the American National Standards Institute document ANSI/ACDE-01-2009; the Secretariat, the Association of Commercial Diving Educators (ACDE); or formal procedures recognized by this association and considered to be at least equal to the procedures necessary for application by a member company of ADCI.

3.1.6 CARD ISSUE

The ADCI commercial diver (or other appropriate) certification card will be a 2 1/8-inches x 3 3/8-inches, .030-inch-thick plastic laminated card suitably identified as issued by theADCI. In the event that a color photo cannot be furnished, a black and white photo will be considered acceptable. With the exception of the entry-level tender/diver certification, all ADCI certification cards, are valid for five years from the date of issuance. The entry-level tender/diver certification card is valid for two years from the date of issuance.

A photograph of the bearer will be laser-scanned onto the card, and the card itself will be protected from being changed or counterfeited by a holographic overlay that is affixed onto the card prior to it being top-coated with a Duraguard™ finish.

3.1.7 DATABASE MAINTENANCE

The ADCI will maintain a database of certified card recipients based upon card issue. The database will contain the sequential number for each card, the name, a unique identifier provided by the applicant, as well as the date of issue and the expiration date for all cards issued.

The database information will be maintained confidential. Its existence will be used as a verification tool for replacement of lost cards, renewal of cards, and as a means of generally tracking the numbers of certified commercial divers within industry. The format and content of the database will not be released or changed without ADCI Board of Directors approval.

3.1.8 PHOTO INSTRUCTIONS FOR COMMERCIAL DIVER CERTIFICATION CARDS

1. Photo should be taken against a light background color.
2. Photo should be taken of subject with full-face view from a distance of approximately 4 feet from the camera lens.
3. Full-color photograph is preferred.
4. Identify photograph by writing subjects' name below the photo on the bottom margin.
5. Do not apply a paper clip directly to the face of the photograph.

Please remember that the photo will be trimmed to 1.25 inches in height and 1.0 inches wide. Ensure that the submitted photograph is consistent with the ability to have that size photograph laser-scanned onto the certification card.

FRONT SIDE

Association of Diving Contractors International

Cert. # Cert. Nr.

Expires:

MIXED-GAS DIVER

Name: I.D. # I.D. Assigned

Commercial Diver Certification Card

MIXED-GAS DIVER

Association of Diving Contractors International

Cert. # Cert. Nr.

Expires:

BELL/SATURATION DIVER

Name: I.D. # I.D. Assigned

Commercial Diver Certification Card

BELL/SATURATION DIVER

Association of Diving Contractors International

Cert. # Cert. Nr.

Expires:

SURFACE-SUPPLIED AIR DIVER

Name: I.D. # I.D. Assigned

Commercial Diver Certification Card

SURFACE-SUPPLIED AIR DIVER

Association of Diving Contractors International

Cert. # Cert. Nr.

Expires:

ENTRY-LEVEL TENDER/DIVER

Name: I.D. # I.D. Assigned

Commercial Diver Certification Card

ENTRY-LEVEL TENDER/DIVER

BACK SIDE

The Association of Diving Contractors International, Inc. (ADCI) issues this certification card to the bearer relying only upon statements or information received that the named individual has completed all training, field experience and necessary on-the-job performance to warrant identification as a commercial diver, life-support technician or saturation technician at the level of experience stated heron. ADCI accepts no responsibility or liability for the failure of the bearer to perform his or her duties at any stated level of ability.

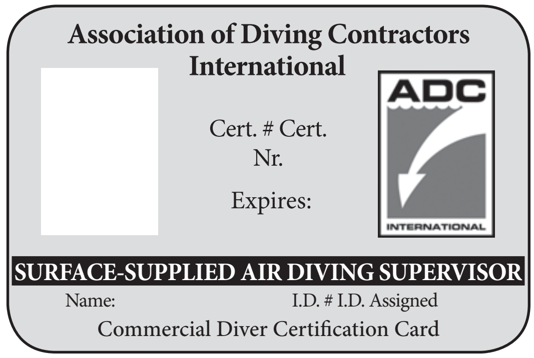
Additional specialized training and/or qualifications gained while engaged in the practice of commercial diving are as recorded in his or her company-maintained personnel records and appropriate diver's log books.

At a minimum, all commercial diving operations must be undertaken with a minimum of a three-man diving team in accordance with International Consensus Standards for Commercial Diving Operations, (current edition).

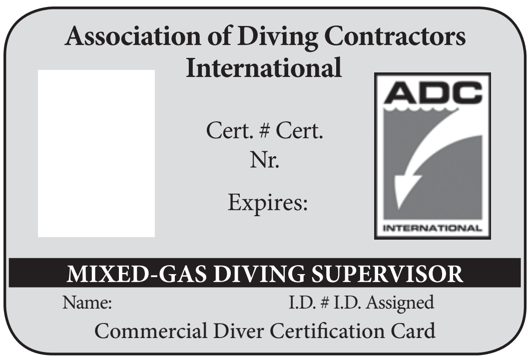
Questions should be directed to ADCI at (281) 893-8388,
Fax (281) 893-5118 or via email at /www.adc-int.org.

FRONT SIDE

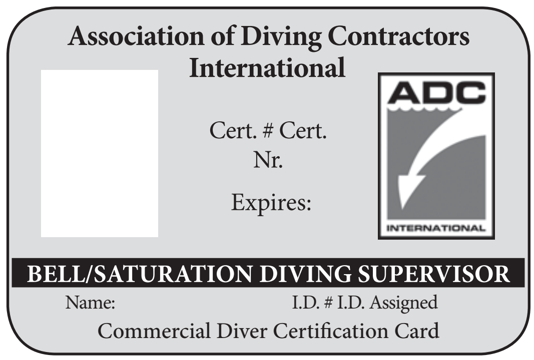
LIFE-SUPPORT TECHNICIAN



SURFACE-SUPPLIED AIR DIVING SUPERVISOR

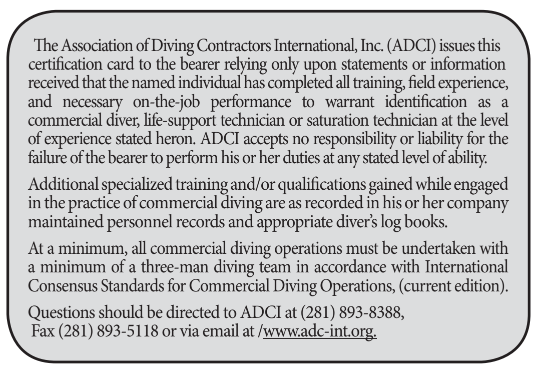


MIXED-GAS DIVING SUPERVISOR



BELL/SATURATION DIVING SUPERVISOR

SATURATION TECHNICIAN



The Association of Diving Contractors International, Inc. (ADCI) issues this certification card to the bearer relying only upon statements or information received that the named individual has completed all training, field experience, and necessary on-the-job performance to warrant identification as a commercial diver, life-support technician or saturation technician at the level of experience stated heron. ADCI accepts no responsibility or liability for the failure of the bearer to perform his or her duties at any stated level of ability.

Additional specialized training and/or qualifications gained while engaged in the practice of commercial diving are as recorded in his or her company maintained personnel records and appropriate diver's log books.

At a minimum, all commercial diving operations must be undertaken with a minimum of a three-man diving team in accordance with International Consensus Standards for Commercial Diving Operations, (current edition).

Questions should be directed to ADCI at (281) 893-8388,
Fax (281) 893-5118 or via email at /www.adc-int.org.

BACK SIDE

3.1.9 APPLICATIONS

COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

The Association of Diving Contractors International
5206 FM 1960 West, Suite 202
Houston, TX 77069

New Application _____

Renewal _____

APPLICATION FROM ADCI MEMBER COMPANY (rev. 1/2009)

Name	Passport Number or Other Numerical Identifier	Photograph Number	**CLASSIFICATION** Entry-level Tender/Diver (2 years) Air Diver Mixed-gas Diver Bell/Sat Diver Saturation Technician	

NOTE: All applications must be submitted on their respective exam and certification pplications (new combined application).

In making this application, I understand and acknowledge that the ADCI is relying in full upon my statement that the individual(s) for whom card issue is requested has met the training and experience criteria of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations. By such action, I specifically release the ADCI from any and all liability, which may extend to the issue and use of the requested card(s) to the individual(s) identified above.

I further understand that validity of the requested commercial diver card(s) is as noticed at www.adc-int.org and that prior to expiration, a replacement card must be obtained by submission of a revised application form to note any changes. I verify that all applicants for whom commercial diver certification cards are requested properly maintain a commercial diver log book, and that the log book is available for verification of the level of certification requested.

Applications for certification can be submitted only for personnel permanently employed by the submitting general member company. Associate member schools applying for graduating students do not fall into this category.

On behalf of the following persons, I do hereby apply for the issue of ADCI commercial diving certification cards:

_______________________ _______________________

Company | Company Address

_______________________ _______________________

Signature (Company Representative)

_______________________ _______________________

Printed Name (Company Representative)

_______________________ _______________________

Date | Email

COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

The Association of Diving Contractors International — **New Application _____**
5206 FM 1960 West, Suite 202
Houston, TX 77069 — **Renewal _____**

INDIVIDUAL APPLICATION (Rev. 1/2009)

____________________ Name (Please Print) ____________________ Passport Number or Other Numerical Identifier ____________________ Address		**Classification** Entry-Level Tender/Diver (2 years) Air Diver Mixed-gas Diver Bell/Sat Diver Saturation Technician	

NOTE: All applications must be submitted on their respective exam and certification applications (new combined application).

In making this application, I understand and acknowledge that the ADCI is relying in full upon my statement that the individual for whom card issue is requested is fully qualified to receive same by having met the training and experience criteria of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations. By such action, I specifically release the ADCI from any and all liability, which may extend to the issue and use of the requested card to the individual identified above.

I further understand that validity of the requested certification card is as noticed at www.adc-int.org and that prior to expiration, a replacement card must be obtained by submission of a revised application form to note any changes.

To support the validity of this request for a commercial diver certification card, I offer the following evidence that I am fully qualified to bear and display such a card:

1. Copies of my diver's log book for the period ____________ 20___ through _________ 20___.
2. A copy of my diploma or certificate of course completion from ________________________.
3. A listing of all commercial diving companies for whom I have worked: (Use separate sheet if necessary).

____________________ ________________ ____________________________________

____________________ ________________ ____________________________________

4. If applying for a supervisor card: Satisfactory completion of supervisor certification exam and documentation of qualifications must be submitted.
5. Photo required for new applicants

____________________ ________________ ____________________________________

Printed Name — Phone — Email

____________________________________ ____________________________________

Signature — Date

COMMERCIAL DIVER CERTIFICATION CARD APPLICATION

The Association of Diving Contractors International — **New Application _____**
5206 FM 1960 West, Suite 202
Houston, TX 77069 — **Renewal _____**

INDIVIDUAL REPLACEMENT APPLICATION
(LOST OR STOLEN CARD ONLY) (rev. 1/2009)

______________________ Name (Please Print) ______________________ Passport Number or Other Numerical Identifier ______________________ Address		**Classification** Entry-Level Tender/Diver (2 years) Air Diver Air-Diving Supervisor Mixed-gas Diver Mixed-gas Diving Supervisor Bell/Sat Diver Bell/Sat Diving Supervisor Life-support Technician Saturation Technician	

In making this application, I understand and acknowledge that the ADCI is relying in full upon my statement that the individual for whom card issue is requested is fully qualified to receive same by having met the training and experience criteria of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations. Through this action, I specifically release the ADCI from any and all liability, which may extend to the issue and use of the requested card to the individual identified above.

I further understand that validity of the requested commercial diver certification card is as noticed at www.adc-int.org and at the expiration of same, a new card may be applied for if so desired by presentation of all required documentation.

______________________________________ ______________________

Printed Name — Phone — Email

______________________________ ______________________________

Signature — Date

SUPERVISOR EXAM AND CERTIFICATION APPLICATION

(NEW COMBINED APPLICATION) (rev. 1/2009)

The Association of Diving Contractors International
5206 FM 1960 West, Suite 202
Houston, TX 77069

APPLICANT INFORMATION

Full Name: ______________________ ______________________ ______________________
Last First M.I.

Address: ____ ______________________
Street Address Apartment/Unit #

____________________________________ ________________ ________________
City State ZIP Code

Phone: (_____) ______________________ Email Address: ______________________________

Passport Number or Other ID Number: ____

Supervisor Test and Certification Applied for: ☐ Air Diving ☐ Mixed-gas ☐ Bell/Sat

COMPANY

Proctor: ______________________________ Job Title: ______________________

Company: ______________________________ Phone: (_____) ________________

Address: ____

____

Email: ____

Proctoring Location: ____

If you agree to the terms of the two statements below, please check both boxes.

☐ I understand that taking and passing this examination does NOT automatically guarantee issuance of an ADCI supervisor's certification card and that issuance of any requested ADCI supervisor's certification card will be based upon examination performance, as well as the training and experience criteria of the ADCI International Consensus Standards for Commercial Diving Operations, Section 2.0.

☐ I certify that the person taking the actual final exam is the candidate whose name appears on this application.

____ ______________________
Signature Date

LIFE-SUPPORT TECHNICIAN EXAM AND CERTIFICATION APPLICATION

(NEW COMBINED APPLICATION) (rev. 1/2009)

The Association of Diving Contractors International
5206 FM 1960 West, Suite 202
Houston, TX 77069

APPLICANT INFORMATION

Full Name: ______________________ ______________________ ______________________
Last First M.I.

Address: ____ ______________________
Street Address Apartment/Unit #

____ ______________ ______________
City State ZIP Code

Phone: (_____) ______________________ Email Address: ______________________________

Passport Number or Other ID Number: ____

COMPANY

Proctor: ______________________________ Job Title: ______________________

Company: ______________________________ Phone: (_____) ______________________

Address: ____

____

Email: ____

Proctoring Location: ____

If you agree to the terms of the two statements below, please check both boxes

☐ I understand that taking and passing this examination does NOT automatically guarantee issuance of an ADCI Life-support technician certification card and that issuance of any requested ADCI LST certification card will be based upon examination performance, as well as the training and experience criteria of the ADCI International Consensus Standards for Commercial Diving Operations, Section 2.0

☐ I certify that the person taking the actual final exam is the candidate whose name appears on this application.

____ ______________________
Signature Date

3.2 ENTRY-LEVEL TENDER/DIVER

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.2.1 RESPONSIBILITIES

The tender/diver is assigned by the diving supervisor or designated diving person in charge (DPIC) to perform various duties, which may include:

- Continuously tend a diver.
- Preparate and support the dive until its completion.
- Support any in-water decompression as required.
- Assist the diver in dressing and undressing.
- Confirm that the diver's equipment is functioning properly and inform the diving supervisor that the diver is ready.
- Tend the diver's umbilical (keeping at least one hand on the umbilical at all times) and be aware of the diver's depth and location at all times. Set up and operate all equipment as directed by the diving supervisor, DPIC or his or her representative.
- Perform routine maintenance on diving equipment.
- Repair such equipment as he or she is qualified to check-out to repair.
- Assist in topside work as required or directed.
- Be alert for and immediately report conditions that may be hazardous or unsafe.
- Maintain certification in first aid and CPR.
- Properly operate a decompression chamber as required for decompression or treatment as directed.
- Maintain communication with the chamber occupants.
- Properly complete all paperwork as required by employer policy and/or governmental regulations.
- Do not perform any other task while operating the chamber.
- Perform tasks as a diver or standby diver when directed by the supervisor. A tender/diver who dives shall be subject to the duties and responsibilities of a diver within the limitations of his or her assignment.
- When required, ride the chamber with the diver during decompression or treatment. This inside tender/diver must be familiar with and alert for the symptoms of oxygen toxicity.
- 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.
- Immediately report all symptoms or suspected symptoms of DCS to the diving supervisor as early and accurately as possible.
- Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation.
- Maintain a diver log book documenting all hyperbaric exposures.
- Read, understand and comply with all employer's policies and applicable governmental regulations, as they relate to their qualifications or performance while engaging in diving operations.

In the event a tender/diver is assigned a task for which he or she does not feel qualified either by training and/or experience, he or she shall immediately inform the diving supervisor, DPIC or his or her representative.

3.2.2 QUALIFICATIONS AND CERTIFICATIONS

- ADCI Entry-level/tender diver certification card.
- Before being exposed to hyperbaric conditions, the tender/diver must be medically certified as "fit to dive."
- Valid CPR and first aid certification.
- High school graduate or equivalent and no less than 18 years old.

3.2.3 CERTIFICATION CARD DESCRIPTION

All graduates of ADCI member schools who complete a commercial diver training-program consisting of a minimum of 625[2] hours of formal instruction in accordance with the provisions of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations, including reference to the American National Standard for Divers (ANSI) Secretariat of the Association of Commercial Diving Educators (ACDE), are eligible.

This card will be issued to all graduates of recognized commercial diver training-programs consisting of 625[2] hours. Non-members of ADCI may apply to receive this type of certification card by presenting evidence that they have attended a recognized course of formal instruction consistent with the provisions of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations.

3.2.4 CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.3 SURFACE-SUPPLIED AIR DIVER

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.3.1 RESPONSIBILITIES

The diver is assigned by the supervisor to perform specific tasks in the water and topside.

A diver must be medically certified as fit to dive, have completed a formal commercial diving course of instruction, 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 divers shall be in possession of an up-to-date diver's log book, which can be used to establish levels of experience.

Each diver, while carrying out his or her duties and responsibilities, shall:

- Accomplish all tasks assigned by the diving supervisor. In the event the diver is assigned a task for which he or she does not feel competent either by training and/or experience, the diver shall immediately inform the diving supervisor.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- Read, understand and comply with all employer's policies and applicable governmental regulations, as they relate to their qualifications or performance while engaging in diving operations.
- Have reviewed and be familiar with the Job Hazard Analysis (JHA).
- Maintain a high level of physical fitness.
- Comply with all commands or instructions from the diving supervisor or designated diving person in charge (DPIC) during the conduct of diving operations.
- Ensure that the deepest depth attained during his or her dive has been established before ascent.
- Safely transition from the water to the decompression chamber without avoidable delay.
- Act as a standby diver when directed to do so. Be capable and qualified to carry out all of the duties and responsibilities of the diver as set forth above. (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 diver shall:
    a) Have attached his or her diving helmet or mask to the standby diver's umbilical in a wrench-tight status and then check for proper flow of breathing medium and for adequate communications. The diving helmet or mask shall be ready to be donned by the standby diver when directed by the diving supervisor. The standby diver shall remain in the immediate vicinity of the diver water entry location and be ready to enter the water when directed by the diving supervisor.
    b) Remain at the station throughout the entire dive, to include all in-water decompression.

c) Constantly remain abreast of events of the dive.

d) Not be assigned any tasks that might interfere with duties as a standby diver while there is a diver in the water.

- Act as a chamber operator as required by the diving supervisor.
- Comply with regulations or instructions concerning the use, maintenance, repair and testing of all diving equipment provided for the operation.
- 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.
- Immediately report all symptoms or suspected symptoms of DCS to the diving supervisor as early and accurately as possible.
- Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation.
- 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 himself/herself.
- Assist in the training of new personnel or tender/divers.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following treatment or a hyperbaric exposure outside the no-decompression limits.
- Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site.
- Ensure that diving equipment has been correctly maintained, prepared and tested before each dive. This requirement should never be delegated to others.
- Maintain a diver's log book that details all dives, medical examinations, courses taken, certification level achieved and personal equipment maintenance.
- Ensure that medical certificates are up-to-date and recorded in the diver's log book.

3.3.2 QUALIFICATIONS AND CERTIFICATION

- ADCI diver certification card for the level of proficiency.
- Before being exposed to hyperbaric conditions, the diver must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.3.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued byADCI to applicants who have:

Completed a formal course of instruction at a recognized commercial diving school, military training or equivalent consisting of at least 625[2] hours of instruction.

a) Completed at least 100 field days participating in commercial diving operations.

b) Completed at least 30 working dives.

3.3.4 CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.4 SURFACE-SUPPLIED AIR DIVING SUPERVISOR

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.4.1 RESPONSIBILITIES

A qualified person shall be designated as the diving supervisor for each diving operation. The diving supervisor 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 diving supervisor shall posses the proper ADCI supervisor certification 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, the diving supervisor's duties shall include, but not necessarily be limited to, the following:

- Be fully cognizant of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed, and the employer's basic safe practices/operations manual. See that all rules and regulations are followed.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- While actually on duty, be in immediate control and available to implement emergency procedures. The diving supervisor is not permitted to dive unless another qualified diver is present who has also been appointed and designated to assume responsibility.
- The diving supervisor must also ensure, prior to commencing a diving operation, in addition to parties directly involved in the diving operation, that masters of craft, pilots of submersibles, harbor masters, managers of offshore installations, pipelines, civil engineering sites, inland waterways, and all persons responsible for anything that affects the diving operation are advised that diving or underwater operations are to be undertaken.
- Ensure diving operations are carried out from a suitable and safe location on the surface.
- Develop or modify and produce pre- and post-dive checklists for the operation.
- Develop and implement emergency/contingency procedures.
- 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.
- Facilitate a Job Hazard Analysis for each task undertaken.
- Establish a dive plan ensuring that sufficient breathing mixtures, supplies and proper equipment are available for safe and timely completion of the job task.
- <u>Assign</u> the duties of all members of the dive team and personally direct them throughout the diving operation.
- 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.
- <u>Ensure that the diving equipment designated for use is:</u>
  - Suitable for the planned diving operation.
  - Compliant with regulatory requirements for the diving mode used.
  - Inspected prior to each dive and is in good working order.
- Ensure that all relevant operating instructions, manuals, decompression tables, treatment schedules and regulatory publications are available at the dive location and are maintained to reflect current changes and/or developments.
- <u>Ensure the detailed briefing of his or her diving team and support personnel, including:</u>
  - Tasks to be undertaken.
  - Unusual hazards or environmental conditions.
- Maintain a depth, bottom time and breathing mix profile at the dive location for each diver during the dive.
- Ensure that each diver is continuously tended while in the water.
- <u>Ensure the dive is terminated when:</u>
  - The diver requests termination.
  - The diver fails to respond to communication or communication is lost between the diver and dive team members at the dive location.

- Communication is lost between the vessel operator and the diving supervisor during liveboating operations.
- The diver begins to use his or her diver-carried reserve breathing gas supply.
- Weather or site conditions are degrading to the extent that diver safety may be compromised.

- Ensure after every dive:
  - The physical condition and wellbeing of the diver is checked by visual observation and verbal questioning.
  - The diver is instructed to report any physical problems or symptoms of decompression sickness or arterial gas embolism.
  - 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.
- Ensure after any treatment or dive outside the no-decompression limits:
  - The diver is instructed to remain awake and in the vicinity of a decompression chamber for at least one hour.
  - A trained dive team member is available to operate the decompression chamber.
- Report all accidents or incidents involving personnel as required by employer's rules and relevant governmental regulations.
- Maintain and submit reports required by employer and relevant governmental regulations concerning diving operations and equipment maintenance, testing or repair.
- View and ensure accuracy of diver's personal log book and affix signature to properly record activities.
- Maintain a supervisor's log book that details all dives and medical treatment supervised.

3.4.2 QUALIFICATIONS AND CERTIFICATIONS

- Successful completion of the ADCI supervisor exam.
- ADCI supervisor certification card for the diving mode.
- Before being exposed to hyperbaric conditions, the supervisor must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.4.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued by ADCI to certified air divers who have:

a) Successfully completed the ADCI air-diving supervisor's certification examination.

b) Completed an additional 100 field days participating in commercial diving operations during which they shall have performed at least 50 working dives and performed a minimum of 30 days as an assistant surface-supplied air-diving supervisor.

3.4.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.5 HeO_2/MIXED-GAS DIVER

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.5.1 RESPONSIBILITIES

The diver is assigned by the supervisor to perform specific tasks in the water and topside.

A diver must be medically certified as "fit to dive," have completed a formal commercial diving course of instruction, 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 divers shall be in possession of an up-to-date diver's log book, which can be used to establish levels of experience.

Each diver, while carrying out his or her duties and responsibilities, shall:

- Accomplish all tasks assigned by the diving supervisor. In the event the diver is assigned a task for which he or she does not feel competent either by training and/or experience, the diver shall immediately inform the diving supervisor.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- Read, understand and comply with all employer's policies and applicable governmental regulations, as they relate to qualifications or performance while engaging in diving operations.
- Maintain a high level of physical fitness.
- Comply with all commands or instructions from the diving supervisor or designated diving person in charge (DPIC) during the conduct of diving operations.
- Ensure that the deepest depth attained during the dive has been established before the ascent.
- Safely transition from the water to the decompression chamber without avoidable delay.
- Act as a standby diver when directed to do so. Be capable and qualified to carry out all of the duties and responsibilities of the diver as set forth above. (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 diver shall:
  a. Have attached his or her diving helmet or mask to the standby diver's umbilical in a wrench-tight status and then check for proper flow of breathing medium and for adequate communications. The diving helmet or mask shall be ready to be donned by the standby diver when directed by the diving supervisor. The standby diver shall remain in the immediate vicinity of the diver water entry location and be ready to enter the water when directed by the diving supervisor.
  b. Remain at the station throughout the entire dive, to include all in-water decompression.
  c. Constantly remain abreast of events of the dive.
  d. Not be assigned any tasks that might interfere with the duties of a standby Ddver while there is a diver in the water.
- Act as a chamber operator as required by the diving supervisor.
- Comply with regulations or instructions concerning the use, maintenance, repair and testing of all diving equipment provided for the operation.
- 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.
- Immediately report all symptoms or suspected symptoms of DCS to the diving supervisor as early and accurately as possible.
- Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation.
- 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 himself or herself.
- Assist in the training of new personnel or tender/divers.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following treatment or a hyperbaric exposure outside the no-decompression limits.
- Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site.
- Ensure that the diving equipment has been correctly maintained, prepared and tested before each dive. This requirement should never be delegated to others.
- Maintain a diver's log book that details all dives, medical examinations, courses taken, certification level achieved and personal equipment maintenance.
- Ensure that medical certificates are up-to-date and recorded in the diver's log book.

3.5.2 QUALIFICATIONS AND CERTIFICATIONS

- ADCI diver certification card for the level of proficiency.
- Before being exposed to hyperbaric conditions, the diver must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.5.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued by ADCI to certified HeO_2/MIXED-GAS divers who have:

a. Completed at least 100 field days as an air diver.
b. Completed at least 50 working dives as an air diver.
c. Completed at least 50 field days participating in surface mixed-gas diving operations during which they shall have:

- Performed at least 10 working mixed-gas dives.

3.5.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.6 HeO_2/MIXED-GAS DIVING SUPERVISOR

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.6.1 RESPONSIBILITIES

A qualified person shall be designated as the diving supervisor for each diving operation. The diving supervisor is in charge of the planning and execution of the diving operation, including responsibility for the safety and health of the dive team.

The diving supervisor shall posses the proper ADCI supervisor certification 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, the duties shall include, but not necessarily be limited to, the following:

- Be fully cognizant of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed and the employer's basic safe practices/operations manual. See that all rules and regulations are followed.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- While actually on duty, be in immediate control and available to implement emergency procedures. The diving supervisor is not permitted to dive unless another qualified diver is present who has also been appointed and designated to assume responsibility.
- The diving supervisor must also ensure, prior to commencing a diving operation, in addition to parties directly involved in the diving operation, that masters of craft, pilots of submersibles, harbor masters, managers of offshore installations, pipelines, civil engineering sites, inland waterways, and all persons responsible for anything that affects the diving operation are advised that diving or underwater operations are to be undertaken. Make available a copy of the safe practices/operations manual to the person in charge of the vessel or facility, with written modifications necessitated by specific operating conditions.
- Ensure diving operations are carried out from a suitable and safe location on the surface.
- Develop or modify and produce pre- and post-dive checklists for the operation.
- Develop and implement emergency/contingency procedures.
- 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.
- Perform a job safety analysis for each task undertaken.
- Establish a dive plan ensuring that sufficient breathing mixtures, supplies and proper equipment are available for safe and timely completion of the job task.
- Assign the duties of all members of the dive team and personally direct them throughout the diving operation.
- Personally verify that all personnel on the dive team are qualified and physically able to perform tasks assigned. He or she must 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 divers' health and safety in the water or under hyperbaric conditions.

- Ensure that the diving equipment designated for use is:
  - Suitable for the planned diving operation.
  - Compliant with regulatory requirements for the diving mode used.
  - Inspected prior to each dive and is in good working order.
- Ensure that all relevant operating instructions, manuals, decompression tables, treatment schedules and regulatory publications are available at the dive location and are maintained to reflect current changes and/or developments.
- Ensure the detailed briefing of his or her diving team and support personnel, including:
  - Tasks to be undertaken.
  - Unusual hazards or environmental conditions.
- Make modifications to standard procedures or safety procedures necessitated by the specific diving operation.
- Maintain a depth, bottom time and breathing mix profile at the dive location for each diver during the dive.
- Ensure that each diver is continuously tended while in the water.
- Ensure the dive is terminated when:
  - The diver requests termination.
  - The diver fails to respond to communication or communication is lost between the diver and dive team members at the dive location.
  - Communication is lost between the vessel operator and the diving supervisor during liveboating operations.
  - The diver begins to use his or her diver-carried reserve breathing gas supply.
  - Weather or site conditions are degrading to the extent that diver safety may be compromised.
- Ensure after every dive:
  - The physical condition and wellbeing of the diver is checked by visual observation and verbal questioning.
  - The diver is instructed to report any physical problems or symptoms of decompression sickness or arterial gas embolism.
  - 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.
- Ensure after any treatment or dive outside the no-decompression limits:
  - The diver is instructed to remain awake and in the vicinity of a decompression chamber for at least one hour.
  - A trained dive team member is available to operate the decompression chamber.
- Report all accidents or incidents involving personnel as required by employer's rules and relevant governmental regulations.
- Maintain and submit reports required by employer and relevant governmental regulations concerning diving operations and equipment maintenance, testing or repair.
- View and ensure accuracy of diver's personal log book and affix signature to properly record activities.
- Maintain a supervisor's log book that details all dives and medical treatment supervised.

3.6.2 QUALIFICATIONS AND CERTIFICATIONS

- Successful completion of the ADCI supervisor exam.
- ADCI supervisor certification card for the diving mode.
- Before being exposed to hyperbaric conditions, the supervisor must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.6.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued by ADCI to certified mixed-gas divers who have:

a. Successfully passed the ADCI HeO_2/mixed-gas diving supervisor's certification examination.
b. Completed at least 350 field days as an air or mixed-gas diver.
c. Completed at least 150 working dives as an air or mixed-gas diver.
d. Completed at least 30 working days as an assistant mixed-gas diving supervisor.
e. Individual is also qualified to work as an air diving supervisor.

3.6.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.7 BELL/SATURATION DIVER

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.7.1 RESPONSIBILITIES

The diver is assigned by the supervisor to perform specific tasks in the water and topside.

A diver must be medically certified as fit to dive, have completed a formal commercial diving course of instruction, 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 divers shall be in possession of an up-to-date diver's log book, which can be used to establish levels of experience.

Each diver, while carrying out his or her duties and responsibilities, shall:

- Accomplish all tasks assigned by the diving supervisor. In the event the diver is assigned a task for which he or she does not feel competent, either by training and/or experience, the diver shall immediately inform the diving supervisor.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- Read, understand and comply with all employer's policies and with applicable governmental regulations as they relate to qualifications or performance while engaging in diving operations.
- Maintain a high level of physical fitness.
- Comply with all commands or instructions from the diving supervisor or designated diving person in charge (DPIC) during the conduct of diving operations.
- Act as a standby diver when directed to do so. Be capable and qualified to carry out all of the duties and responsibilities of the diver as set forth above. (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 diver shall:
    a. Have attached his or her diving helmet or mask to the standby diver's umbilical in a wrench-tight status and then check for proper flow of breathing medium and for adequate communications. The diving helmet or mask shall be ready to be donned by the standby diver when directed by the diving supervisor. The standby diver shall remain in the immediate vicinity of the diver water entry location and be ready to enter the water when directed by the diving supervisor.
    b. Monitor bell manifold and applicable analyzers.
    Constantly remain abreast of events of the dive.
- Comply with regulations or instructions concerning the use, maintenance, repair and testing of all diving equipment provided for the operation.
- 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.
- Immediately report all symptoms or suspected symptoms of DCS to the diving supervisor as early and accurately as possible.
- Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation.
- 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 himself or herself.
- Assist in the training of new personnel or tender/divers.
- Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site.
- Maintain a diver's log book that details all dives, medical examinations, courses taken, certification level achieved and personal equipment maintenance.
- Ensure that medical certificates are up-to-date and recorded in the diver's log book.

3.7.2 QUALIFICATIONS AND CERTIFICATIONS

- ADCI diver certification card for the level of proficiency.
- Before being exposed to hyperbaric conditions, the diver must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.7.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued by ADCI to certified divers who have:

a. Completed at least 200 field days as an air or mixed-gas diver.
b. Completed at least 100 working dives as an air or mixed-gas diver.
c. Performed for at least 30 working days in support of bell/saturation diving operations.

3.7.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

3.8 BELL/SATURATION DIVING SUPERVISOR

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[1]

3.8.1 RESPONSIBILITIES

A qualified person shall be designated as the diving supervisor for each diving operation. The diving upervisor is in charge of the planning and execution of the diving operation, including responsibility for the safety and health of the dive team.

The diving supervisor shall posses the proper ADCI supervisor certification 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, the diving supervisor's duties shall include, but not necessarily be limited to, the following:

- Be fully cognizant of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed and the employer's basic safe practices/pperations manual. See that all rules and regulations are followed.
- Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations.
- While actually on duty, be in immediate control and available to implement emergency procedures. The diving supervisor is not permitted to dive unless another qualified diver is present who has also been appointed and designated to assume responsibility.
- Ensure diving operations are carried out from a suitable and safe location on the surface.
- Develop or modify and produce pre- and post-dive checklists for the operation.
- Develop and implement emergency/contingency procedures.
- 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.
- Perform a Job Safety Analysis for each task undertaken.
- Establish a dive plan ensuring that sufficient breathing mixtures, supplies and proper equipment are available for safe and timely completion of the job task.
- <u>Assign</u> the duties of all members of the dive team and personally direct them throughout the diving operation.
- Personally <u>verify</u> that all personnel on the dive team are qualified and physically able to perform tasks assigned. He or she must 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 divers' health and safety in the water or under hyperbaric conditions.

- Ensure that the diving equipment designated for use is:
  - Suitable for the planned diving operation.
  - Sufficient to regulatory requirements for the diving mode used.
  - Inspected prior to each dive and is in good working order.
- Ensure that all relevant operating instructions, manuals, decompression tables, treatment schedules and regulatory publications are available at the dive location and are maintained to reflect current changes and/or developments.
- Ensure the detailed briefing of his or her diving team and support personnel, including:
  - Tasks to be undertaken.
  - Unusual hazards or environmental conditions.
- Make modifications to standard procedures or safety procedures necessitated by the specific diving operation.
- Maintain a depth, bottom time and breathing mix profile at the dive location for each diver during the dive.
- Ensure that each diver is continuously tended while in the water.
- Ensure the dive is terminated when:
  - The diver requests termination.
  - The diver fails to respond to communication or communication is lost between the diver and dive team members at the dive location.
  - Communication is lost between the vessel operator and the diving supervisor during liveboating operations.
  - The diver begins to use his or her diver-carried reserve breathing gas supply.
  - Weather or site conditions are degrading to the extent that diver safety may be compromised.
- Ensure after every dive:
  - The physical condition and wellbeing of the diver is checked by visual observation and verbal questioning.
  - The diver is instructed to report any physical problems or symptoms of decompression sickness or arterial gas embolism.
  - 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.
- Ensure after any treatment or dive outside the no-decompression limits:
  - The diver is instructed to remain awake and in the vicinity of a decompression chamber for at least one hour.
  - A trained dive team member is available to operate the decompression chamber.
- Report all accidents or incidents involving personnel as required by employer's rules and relevant governmental regulations.
- Maintain and submit reports required by employer and relevant governmental regulations concerning diving operations and equipment maintenance, testing or repair.
- View and ensure accuracy of diver's personal log book and affix signature to properly record activities.
- Maintain a supervisor's log book that details all dives and medical treatment supervised.
- Ensure prior to each bell run:
  - All bell checks are performed, internally and externally, and recorded.
  - All pertinent vessel or facility operators are properly notified.
  - All support equipment and personnel are prepared for the operation.
  - Clear communications are established with vessel operators, DP operators, ROV operators, crane operators and any other pertinent operational personnel.
- Ensure the bell run is terminated when:
  - Vessel is unable to or in danger of losing station keeping ability (weather or mechanical failure).
  - There is loss of hot water, gas, primary electrical power or any other life-support equipment
  - The atmosphere in the bell cannot be controlled (e.g., buildup of CO_2).
  - Weather, sea or external conditions endangering the bell.
  - There is loss of clear communication with critical operation personnel such as the DP vessel operator on a DP diving vessel.
  - There is loss of the DP alert system on a DP vessel.
  - The DP officer issues a yellow or red light on a DP vessel.

- There is danger to topside crew preventing or degrading the performance of bell retrieval operations such as an approaching weather front or lightning.
- Primary communication with the bell is lost.
- There is a suspected or confirmed presence of hydrocarbon gas in the bell.
- Any time that the safety and wellbeing of the saturation divers warrants termination.

• Ensure after each bell run:
- Any maintenance or repairs are performed to bring all redundant systems back on line.
- Perform proper record keeping relative to LARS performance and upcoming maintenance issues.
- Debrief deck crew regarding any issues encountered during bell recovery.
- The deck foreman, LST and sat techs are fully aware of any maintenance or repair issues and preparations are being made to be ready for the next bell run.

3.8.2 QUALIFICATIONS AND CERTIFICATIONS

- Successful completion of the ADCI supervisor exam.
- ADCI supervisor certification card for the diving mode.
- Before being exposed to hyperbaric conditions, the supervisor must be medically certified as "fit to dive."
- Valid CPR and first aid certification.

3.8.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued byADCI to certified divers who have:

a. Successfully completed the ADCI bell/saturation diving supervisor's certification examination.
b Completed at least 100 field days as a mixed-gas diving supervisor.
c Performed for at least 60 days as an assistant bell/saturation diving supervisor.

3.8.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix**).

3.9 LIFE-SUPPORT TECHNICIAN

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[2]

3.9.1 RESPONSIBILITIES

The life-support technician is utilized in the saturation diving mode and reports directly to the diving supervisor. The life-support technician must possess the knowledge and ability to perform the duties listed below within the scope of the assignment.

This knowledge and skill will have been obtained by a combination of on-site experience and training. It is required that life-support technicians maintain a personal log book that includes the details of their work experience and qualifications. The duties and responsibilities of life-support technicians will vary depending on the diving mode employed, but at a minimum they shall control and constantly monitor the hyperbaric environment and system in which divers live while saturation diving. Their duties in this diving mode include, but are not limited to:

- Maintain proper atmosphere (e.g., correct levels of oxygen, carbon dioxide and other gasses) and pressure in the saturation complex according to employer's policy and as directed by the diving supervisor.
- Maintain proper environment (i.e., temperature and humidity) at levels suitable for current depth as the diver's comfort dictates.
- Decompress divers according to established schedules as directed by the diving supervisor.
- Maintain communication with divers.
- Calibrate, at regular intervals, all monitoring instruments that require, by their design, periodic calibration, or at any time the accuracy of the instrument is suspect.
- Maintain an accurate record of events, in the form of a saturation log, pertaining to the diving system. All readings taken and actions during the shift must be entered in the log.

The information in the saturation log shall include:

- Oxygen and carbon dioxide readings.
- Depth changes and temperature and humidity readings.
- Gas changes and BIBS usage details.
- Carbon dioxide scrubber changes.
- Medical lock runs, with record of items locked in or out.
- Individual diver's sleep cycles.
- Showers, flushes and drains.
- Calibration of instruments.
- Bell on and off systems and crew TUPs.
- Changes to settings on the environmental control system and record of equipment status.
- Chamber hygiene and disinfection and diver's ear prophylaxis.
- Any event outside normal chamber routines.
- Any articles entering the system.

- Maintain the diver's requirements within the diving complex. All matters that concern the diver's safety and well being are promptly carried out. These include such items as food, drinks, entertainment, personal hygiene, laundry and sanitary matters, etc.
- Be aware at all times of all items being sent in or out of the system, and supervise all such operations. Prevent prohibited items from entering the system.
- Advise the diving supervisor of the diver's status at regular intervals or as conditions dictate.
- Be alert for emergencies.
- Keep traffic in the control van to a minimum.
- Conduct such operations as may be required or directed by the diving supervisor.
- Perform assigned diving supervisor tasks. Be responsible to ensure that all gasses to be used during the dive have been properly analyzed and have been receipted for and logged in before being placed online.
- Maintain adequate supply of the correct breathing mixture to the diver.
- Maintain correct supply over-pressure for depth and apparatus.
- Have standby banks ready.
- Follow the tables in use correctly and accurately.
- Switch breathing mixtures at the proper time and depth.
- Record gas consumption data as directed.
- Assist in the maintenance of all diving equipment.
- Assist in the training of tender/divers and new personnel.
- Report any potentially unsafe situations or conditions to the diving supervisor.
- Maintain certification in first aid and CPR, and have a through working knowledge of emergency procedures and the diagnosis and treatment of decompression sickness.
- Be aware at all times of the actions carried out by personnel temporarily under his or her supervision. The life-support technician must be informed beforehand of any activity to be carried out on the diving complex, its support equipment, or in the near vicinity by other personnel.

3.9.2 QUALIFICATIONS AND CERTIFICATIONS

- Training and experience applicable to the equipment under their charge.
- A working knowledge and understanding of the physics and physiology of diving.
- Basic understanding of saturation theory and safe operations.
- Specific certification and training as required by industry, regulatory agencies and manufacturers.

3.9.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued byADCI to personnel who have:

a. Successful completion of the ADCI life-support technician exam
b. Performed at least 100 field days as an assistant life-support technician.

3.9.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix**).

3.10 SATURATION TECHNICIAN

All ADCI general member company diving personnel need to hold a current ADCI certification reflective of the assigned tasks to be performed.[2]

3.10.1 RESPONSIBILITIES

The saturation technician is responsible for the set-up, maintenance and repair of the saturation diving complex, including but not limited to:

- Life-support systems (primary and secondary).
- Electrical and electronic systems.
- Pneumatic systems.
- Hydraulic systems.
- Piping systems.
- Gas storage and transfers systems.
- Compressors.
- Environmental control systems.
- Calibration and testing of all components.
- PVHO repairs.
- Maintenance logs.
- PMS (preventive maintenance system) program and data entry.
- Certification documentations.
- Critical spares on board warehouse.
- Analytical instrumentation.
- Launch and recovery systems.
- TUP mating systems.
- Communication and video systems.
- Other ancillary equipment (e.g., jet pumps, power generators, etc.).

3.10.2 QUALIFICATIONS AND CERTIFICATIONS

- Training and experience applicable to the equipment under their charge.
- A working knowledge and understanding of the physics and physiology of diving.
- Basic understanding of saturation theory and safe operations.
- Specific certification and training as required by industry, regulatory agencies and manufacturers.

3.10.3 CERTIFICATION CARD DESCRIPTION

This type of card will be issued byADCI to personnel who have:

a. Training and experience applicable to the equipment in the saturation diving complex.
b. Working knowledge and understanding of the physics and physiology of diving.
c. Basic understanding of saturation theory and safe operations.
d. Specific certification and training as required by industry, regulatory authorities and manufacturers.

3.10.4. CERTIFICATION CARD REQUIREMENTS

(Requirements located in Section 3.1.4: **Certification and Training Matrix.**)

SECTION 4.0

DIVING MODES: DEFINITIONS, REQUIREMENTS AND GUIDELINES

Association of Diving Contractors International, Inc.

4.0 DIVING MODES: DEFINITIONS, REQUIREMENTS AND GUIDELINES

4.1 GENERAL INTRODUCTION

All equipment and manning levels referenced in Section 4 should be considered the recommended minimum 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 shall 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 shall be performed to determine the type of diving mode to be employed, equipment needed and job manning requirements.

Prior to the commencement of any diving operation, a Job Hazard Analysis shall be completed and all members of the dive team, including master of the vessel (as well as other involved personnel) shall be present at a pre-dive safety meeting.

4.2 SELF-CONTAINED DIVING (SCUBA)

All equipment and manning levels referenced in Section 4 should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

Scuba procedures should not be used for the conduct of commercial 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 self-contained diving operations.

4.2.1 MINIMUM PERSONNEL REQUIREMENTS

Commercial scuba diving 0-100 fsw (0-30 m) with no decompression:

- One diving supervisor.
- One Diver.
- One tender/diver who shall be properly equipped and capable of performing the duties of a standby diver. (When two divers are simultaneously in the water and can maintain visual contact, they can act as standby diver for each other.)

4.2.2 OPERATIONAL GUIDELINES

1. Two-way audio-communications between the diver and topside are required.
2. The planned time of a scuba diving operation shall not exceed either the no decompression limits or the air supply duration of the cylinders exclusive of the reserve supply. The cylinder pressure shall be determined immediately before each dive. Dive depths shall not exceed 100 fsw (30 m).
3. Scuba dives shall not be conducted against currents exceeding one knot.
4. Scuba dives shall not be conducted in enclosed or physically-confining spaces.
5. During all scuba dives, a standby diver shall be available while a diver is in the water.
6. Scuba divers shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations.
7. Diving on scuba will only be allowed during daylight hours.
8. All divers on scuba shall wear a buoyancy compensator and whistle or other audio signaling device.
9. During periods of low or poor surface visibility, the diver shall also carry a lighted beacon.
10. Scuba divers shall be equipped with a diver-carried EGS.
11. Scuba divers shall be equipped with a submersible pressure gauge (tank contents gauge).

Diver worn/carried emergency gas supply (bailout) must have a minimum calculated four-minute supply at the anticipated depth. Refer to Section 6: Diver Worn or Carried Emergency Gas Supply.

4.2.3 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 shall 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. 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.

4.3 SURFACE-SUPPLIED AIR DIVING

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

At no time shall any member of the dive team be asked to perform an activity that prevents that person from the immediate and continuous performance of dive supervisor's assigned duties and responsibilities.

During the planning phase of the intended operation, a Job Hazard Analysis (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.

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. If the nature of the work does not subject the second diver in the water to the same hazard as the primary diver, (e.g., deep ditch cave in from hand jetting, etc.), the second diver in the water can serve as the standby diver. Additionally, the second/standby diver must remain in close proximity to the primary diver. NOTE: EACH WORKING DIVER MUST BE CONTINOUSLY TENDED BY A SEPARATE DIVE TEAM MEMBER.

Individuals other than a member of the dive team 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 diving supervisor or designated person in charge.

If diving operations are conducted in a physically confining space, refer to Penetration Diving in Section 5.

4.3.1 SURFACE-SUPPLIED AIR DIVING 0-100 fsw (0-30m) WITH NO DECOMPRESSION

The following are minimum requirements for surface-supplied air diving operations:

1. Minimum Personnel

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 diving supervisors 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 diving operations are intended to take place in a remote location, or where an air gap from the diving station to the water exceeds 15 feet (4.6 m), at least a fourth member of the dive team should be considered.

Shallow Operations with Large Crews

When a diving operation takes place in less than 100 fsw (30 m) and the on-shift crew size is eight or more, then a diving supervisor who is not part of the diving rotation must be part of the crew.

4.3.1.1 Minimum Personnel Requirements

- One air-diving supervisor.
- One diver.
- One tender/diver who shall be properly equipped and capable of performing. the duties of a standby diver.

a. Diving Supervisor

A qualified person shall be designated as the diving supervisor for each diving operation. The diving supervisor 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 diving supervisor shall posses the proper ADCI supervisor certification 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.

b. Diver

Must have training and/or experience in the following areas:

- Air-diving procedures and techniques.
- Emergency procedures.
- Diving accident treatment procedures.
- Proper operation and use of all equipment related to air diving including decompression chambers.
- Use of air-diving equipment
- Familiarity with the type of work engaged in.

c. Tender/Diver

- Must have the same qualifications as an Air Diver, with a lower level of experience required.

d. An additional dive crew member is normally required when any diving operation is conducted that has an increased likelihood of diver entrapment or potential for rendering the diver unconscious or incapacitated from chemical, physical, electrical or topside hazards, such as, but not limited to, the following when present or planned:

- During the conduct of the job hazard analysis, the diving supervisor must consider whether the use of any surface-tended equipment by the diver will require an additional individual 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.
- Diving in remote locations where assistance from non-diving crew personnel is not immediately available within communication range of the diving supervisor may require additional members to be added to the dive team.

4.3.1.2 Operational Guidelines

1. The approximate depth of each dive shall be determined prior to the start of operations.
2. The breathing mixture supplied to the diver must be composed of a mixture of gasses that is appropriate for the depth of the dive. When using mixed gas or enriched air, all gasses must be analyzed before they goes on-line for O^2 content and for proper mixture necessary to support the maximum depth of the planned dive.
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 known, and an evacuation plan should be in place.

4.3.1.3 Minimum Equipment Requirements

- One air source and volume tank to support two divers.
- Topside secondary air source.
- Adequate supply of gasses for the planned dive profile.
- Two hose groups consisting of:
  - Air hose.
  - Strength member/strain relief. (The strength member may be the entire hose assembly, if so designed.)
  - Communications cable.
  - Pneumofathometer hose.
- One set of air decompression and treatment tables.
- One control station consisting of:
  - Communication systems.
  - Depth gauges and gas distribution system with the capability to supply and control two divers at the maximum work depth.
- Two time-keeping devices.
- One basic first aid kit with means of manual resuscitation (pocket mask or others). Local regulatory authorities may require additional equipment and training
- Emergency O_2 administration kit.
- Two Sets of divers' personal diving equipment consisting of:
  - Helmet or mask.
  - Diver-worn EGS.
  - Weight belt if needed.
  - Protective clothing.
  - Tools as required.
  - Safety harness.
  - Knife.
- Spare parts as required.
- Log books, dive sheets, safe practices manual, first aid handbook and written JSA applicable to job.

4.3.2 SURFACE-SUPPLIED AIR DIVING 0-100 fsw (0 – 30m) WITH PLANNED DECOMPRESSION

4.3.2.1 Minimum Personnel Requirements

- One air-diving supervisor.
- One diver.
- One standby diver.
- Two tender/divers.

a. Diving Supervisor

A qualified person shall be designated as the diving supervisor for each diving operation. The diving supervisor 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 diving supervisor shall posses the proper ADCI supervisor certification 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.

b. Diver

Must have training and/or experience in the following areas:

- Air diving procedures and techniques.
- Emergency procedures.
- Diving accident treatment procedures.
- Proper operation and use of all equipment related to air diving, including decompression chambers.
- Use of air diving equipment.
- Familiarity with the type of work engaged in.

c. Tender/Diver

4.3.2.2 Operational Guidelines

1. The approximate depth of each dive shall be determined prior to the start of operations.
2. All breathing media other than air shall be verified for proper composition prior to being placed on-line.
3. A decompression chamber shall be ready for use at the dive location and accessible by the diver within the allowed time frame as prescribed by the decompression schedule.
4. Each diver shall be continuously tended while in the water by a separate dive team member.
5. Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive, including decompression, 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.

4.3.2.3 Minimum Equipment Requirements

- Two independent air sources and volume tank to support two divers.
- Dive station emergency air source.
  - One double-lock decompression chamber and adequate air source to recompress the chamber to 165 fsw.
  - Adequate supply of gasses for the planned dive profile and a potential treatment.
- Two hose groups consisting of:
  - Air hose.
  - Strength member/strain relief. (The strength member may be the entire hose assembly, if so designed.)
  - Communications cable.
  - Pneumofathometer hose.
- One set of air decompression and treatment tables.
- For planned in-water decompression:
  - Third source of diver's emergency air supply, in addition to diver's umbilical and EGS.
- One control station consisting of:
  - Communication systems.
  - Depth gauges and gas distribution system with the capability to supply and control two divers at the maximum work depth.
- Two time-keeping devices.
  - One basic first aid kit with bag-type manual resuscitator with transparent mask and tubing.

- Two sets of diver's personal diving equipment consisting of:
  - Helmet or mask.
  - Diver-worn EGS.
  - Weight belt if needed.
  - Protective clothing.
  - Tools as required.
  - Safety harness.
  - Knife.
  - Spare parts as required.
  - Log books, dive sheets, safe practices manual, first aid handbook and written JHA applicable to job.

4.3.3 SURFACE-SUPPLIED AIR DIVING 101-190 fsw (30 – 57 m)

4.3.3.1 Minimum Personnel Requirements

- One air diving supervisor.
- One diver.
- One standby diver.
- Two tender/divers.

a. Diving Supervisor

A qualified person shall be designated as the diving supervisor for each diving operation. The diving supervisor 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 diving supervisor shall posses the proper ADCI supervisor certification 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.

b. Diver

Must have training and/or experience in the following areas:

- Air diving procedures and techniques.
- Emergency procedures.
- Diving accident treatment procedures.
- Proper operation and use of all equipment related to air diving, including decompression chambers.
- Have experience in the use of air diving equipment.
- Familiarity with the type of work engaged in.

c. Tender/Diver

- Must have the same qualifications as an air diver, with a lower level of experience required.

4.3.3.2 Operational Guidelines

1. The approximate depth of each dive shall 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. When using mixed gas or enriched air, all gasses must be analyzed for proper mixture necessary to support the maximum depth of the planned dive or decompression.
3. A decompression chamber shall be ready for use at the dive location and accessible by the diver within the allowed time frame as prescribed by the decompression schedule.
4. Each diver shall be continuously tended while in the water by a separate dive team member.
5. Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive, including decompression.
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.

4.3.3.3 Minimum Equipment Requirements

- Two independent air sources and volume tanks to support two divers.
- Dive station emergency air source.
- One double-lock decompression chamber and adequate air source to recompress the chamber to 165 fsw.
- Adequate supply of gasses for the planned dive profile and a potential treatment.
- Two hose groups consisting of:
  - Air hose.
  - Strength member/strain relief. (The strength member may be the entire hose assembly, if so designed.)
  - Communications cable.
  - Pneumofathometer hose.
- One set of decompression and treatment tables.
- For planned in water decompression:
  - One diving stage or other support platform.
  - Third source of diver's emergency air supply, in addition to diver's umbilical and EGS.
- One control station consisting of:
  - Communication systems.
  - Depth gauges and gas distribution system with the capability to supply and control two divers at the maximum work depth.
- Two time-keeping devices.
- One basic first aid kit with bag-type manual resuscitator with transparent mask and tubing.
- Two sets of diver's personal diving equipment consisting of:
  - Helmet or mask.
  - Weight belt if needed.
  - Protective clothing.
  - Tools as required.
  - Safety harness.
  - Knife.
- Spare parts as required.
- Log books, dive sheets, safe practices manual, first aid handbook and written JSA applicable to job.

4.4 ENRICHED-AIR DIVING (NITROX)

4.4.1 DEFINITION

Nitrogen-oxygen diving (also called enriched-air or NITROX diving) is a technique whereby the O^2 percentage in the breathing mixture is elevated above 21 percent, and the balance of N^2 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 N^2 uptake.

Advantages of nitrogen-oxygen (NITROX) diving over air diving:

- Extended bottom times for no-decompression diving.
- Reduced decompression time.
- Reduced residual nitrogen in the body after a dive.
- Reduced possibility of decompression sickness.
- Reduced nitrogen narcosis.

The disadvantages include:

- Increased risk of CNS oxygen toxicity.
- Long duration dives can result in pulmonary oxygen toxicity.

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

4.4.2 GENERAL

The use of NITROX 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.

Dives using NITROX may be used with any schedule from the U. S. Navy Air Decompression tables. Surface decompression using oxygen is not recommended when diving NITROX due to the increased uptake of oxygen during decompression. Should Sur D O^2 be used, particular attention must be given to total oxygen uptake when planning the dive profile.

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.

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. EAD is then 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. 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:

$$EAD = \left(\frac{FN_2}{0.79} * (d + x)\right) - x$$

Another form of the equation can be shown as:

$$EAD = \left(\frac{FN_2 * (d + x)}{0.79}\right) - x$$

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).
- 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. When diving on air, the EAD is the actual depth. On a hypoxic mix (<21 percent O_2), the EAD would be deeper than the actual depth. On a hyperoxic mix (>21 percent O_2), the EAD will be shallower than the actual depth.

4.4.3 REQUIREMENTS

The following requirements, when used with U.S. Navy Air Decompression tables, 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 O_2 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.
3. Maximum oxygen percentage of the NITROX mix shall be 40 percent (except when used as a decompression or therapeutic media).
4. All NITROX gasses 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:

Abort the dive and decompress the diver as though he or she had breathed AIR throughout the entire dive <u>at the actual depth of the dive (not the EAD).</u>

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.

4.4.4 TRAINING

All diving supervisors and divers associated with any commercial diving operation using NITROX shall be trained according to an accepted diving industry standard. Recreational training standards by themselves are not considered adequate for commercial operations. All training must be fully documented. The specific training shall include the following topics:

- Definition of nitrox.
- Historical perspective.
- Advantages and limitations.
- Gas laws and calculations.
- Equivalent air depth formulas and tables.
- Physiological aspects of oxygen.
- Gas supply and analysis.
- Equipment considerations.

4.4.5 OPERATIONAL PROCEDURES

4.4.5.1 Repetitive Dives

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.

4.4.5.2 Diving at Altitude

Diving at altitude using NITROX is allowed using NOAA Altitude tables to modify the standard NITROX EAD tables.

4.4.5.3 Omitted Decompression

Follow procedures outlined in the U.S. Navy Dive Manual.

4.4.5.4 Decompression Chamber Requirement

On all dives where decompression is planned, or deeper than 100 feet, or liveboating deeper than 60feet, a fully operational decompression chamber will be required to be on site.

4.4.6 GAS SUPPLIES

4.4.6.1 NITROX Breathing Gas Certifications and Labeling

All NITROX gas containers shall be certified as to the N_2O_2 mixture by the vendor or dive contractor supplying the gas and be clearly marked by gas mixture percentage on each container.

4.4.6.2 NITROX Mix Testing

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 diving supervisor to confirm gas mixture prior to use

(on-line at the point of distribution-manifold).

4.4.6.3 NITROX Mix Tolerance

All NITROX gasses shall be within +/- 1 percent of the certified mixture.

4.4.6.4 Breathing Gas Purity

Nitrogen or air must be filtered prior to being mixed with oxygen. It is essential that all gasses 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).

4.4.6.5 Cleaning for N_2O_2 Service

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 O_2 at low delivery pressures without formal O_2 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.

4.4.7 THERAPEUTIC PROCEDURES

In the event therapeutic treatment is required following an NITROX dive, the same procedure will be followed as though the diver had made an air dive.

NOTE: The diver's O_2 uptake must be tracked closely should an O2 treatment table be used.

Primary Reference Documents:

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

4.5 SURFACE-SUPPLIED MIXED-GAS DIVING (HeO_2)

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

The following are minimum requirements for surface-supplied mixed-gas (HeO_2) diving operations:

1. Minimum Personnel

- One mixed-gas diving supervisor (not part of the dive rotation).
- One diver.
- One standby diver.
- Two tender/divers.

4.5.1 OPERATIONAL GUIDELINES

1. The appropriate depth of each dive shall be determined prior to the start of operations.
2. The breathing mixture supplied to the diver must be composed of a mixture of gasses that is appropriate for the depth of the dive. When using mixed gas, all gasses must be analyzed for O_2 content and for proper mixture necessary to support the maximum depth of the planned dive.
3. A decompression chamber shall be ready for use at the dive location and accessible by the diver within the allowed time frame as prescribed by the decompression schedule.
4. Each diver shall be continuously tended while in the water by a separate dive team member.
5. A diver shall be stationed at the underwater point of entry when diving is conducted in an enclosed or physically-confining space.
6. Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive,

including decompression.

7. Except when heavy gear (e.g., MK V type equipment) is worn, a diver-worn or carried emergency gas supply (EGS) shall be utilized.
8. HeO_2 dives require a designated manifold operator.

4.5.2 MINIMUM EQUIPMENT REQUIREMENTS

All HeO_2 operations will require an open bell. In the event that an open bell cannot be deployed due to confined space or accessibility, an alternate supply of emergency gas, excluding the diver's, umbilical shall be supplied.

- Two gas sources to support two divers (Including planned decompression).
- Readily available dive station emergency gas source.
- One double-lock decompression chamber and adequate air source to recompress the chamber to 165 fsw.
- Adequate supply of oxygen for the planned dive profile and a potential treatment.
- Two umbilical groups (reference Section 6: Hoses).
- One set of decompression and treatment tables.
- One open bottom bell and umbilical and launch recovery system with a secondary means of bell recovery for all operations.
- One control station consisting of:
  - Appropriate communication systems with back up (helium scrambler recommended).
  - Depth gauges and gas distribution system with the capability to supply and control two divers and the open bottom bell at the maximum work depth.
- An oxygen analyzer fitted in-line on the downstream gas supply to diver(s) shall have a hi/low visual and/or audio alarms[2].
- Two time-keeping devices.
- One basic first aid kit with bag-type manual resuscitator with transparent mask and tubing.
- Two sets of diver's personal diving equipment consisting of:
  - Helmet or mask.
  - Weight belt if needed.
  - Protective clothing.
  - Tools as required.
  - Safety harness.
  - Knife.
- Spare parts as required.
- Log books, dive sheets, safe practices manual, first aid handbook and written JHA applicable to job.

4.6 SATURATION DIVING

All equipment and manning levels identified should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

The following are minimum requirements for saturation diving operations (based upon 24-hour operations and a single bell run). On multi-day projects, consideration should be given to the number of divers in saturation and the maximum bell run duration to ensure adequate rest and to avoid fatigue.

1. Minimum Personnel:
   - Two bell/saturation supervisors.
   - Two saturation divers.
   - Two surface standby divers (saturation qualified).
   - Two life-support technicians.
   - Two saturation technicians.
   - Four tender/divers.

(With the exception of the supervisors and technicians, one member of the dive team should be a diver medical technician or equivalent.)

4.6.1. OPERATIONAL GUIDELINES

All saturation diving operations shall have a reserve volume of gas stored at the dive site equivalent to 1.5X the volume required to pressurize the system to deepest planned working dive, after the system is pressurized.

1. The approximate depth of each dive shall be determined prior to the start of operations.
2. A surface standby diver shall be available when the closed bell leaves the dive location until the divers are in the saturation deck chamber.
3. All closed bell operations (lock-off to lock-on) will be conducted with a minimum of two-man bell runs.
4. Independent primary and secondary supplies of gasses shall be provided for the working diver and the bell diver gas sources and volume tanks to support two divers.
5. A copy of the emergency tap code shall be available to the bell occupants and dive control station personnel.
6. There shall be a means and procedure to evacuate divers under pressure during an emergency.
7. The breathing mixture supplied to the diver must be composed of a mixture of gasses that is appropriate for the depth of the dive. When using mixed gas, all gasses must be analyzed for proper mixture necessary to support the maximum depth of the planned dive.
8. A decompression chamber for the surface standby diver shall be ready for use at the dive location and accessible by the diver within the allowed time frame as prescribed by the decompression schedule.
9. There must be a secondary means to recover the bell.
10. There must be a means to monitor the bell atmosphere for hydrocarbons or other contaminants.
11. A means of decontaminating the diver and/or bell atmosphere is required.
12. There must be a way of removing an incapacitated diver from the water into the bell.
13. Humidity and atmosphere shall be controlled and monitored.
14. Hot water temperature and flow to the diver and inside bell heater must be controlled.
15. The working diver shall be tended from the bell by the standby bellman/saturation diver.
16. A diver-worn emergency gas supply (bailout) shall be utilized (reference Section 6: Diver-worn Emergency Gas Supply).

4.6.2 MINIMUM EQUIPMENT REQUIREMENTS

- All PVHO shall be designed and constructed to local regulatory codes and standards.
- LARS and a secondary system to recover the bell.
- All LARS winches with redundant power supply.
- Redundant independent power supplies for system, control console and environmental controls.
- Secondary means to control environmental system.
- All equipment required for surface mixed-gas diving operations.
- Emergency evacuation system (e.g., HRC or SPHLB), in addition to the primary bell.[3]

See Saturation Diving Inspection and Checklist Protocol in Section 10: ADCI COMPLIANCE AUDIT PROCEDURES for further details on minimum equipment requirements for saturation diving systems.

SECTION 5.0

UNDERWATER OPERATIONS: PROCEDURES, CHECKLISTS AND GUIDELINES

Association of Diving Contractors International, Inc.

5.0 UNDERWATER OPERATIONS: PROCEDURES, CHECKLISTS AND GUIDELINES

5.1 SAFE PRACTICES/OPERATIONS MANUAL

1. Each employer shall develop and maintain a safe practices/operations manual as required by applicable government regulations and the ADCI 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 divers. The safe practices/operations manual shall meet or exceed the requirements of the ADCI International Consensus Standards for Commercial Diving and Underwater Operations.
2. The ADCI International Consensus Standards for Commercial Diving and Underwater Operations may be used as a set of minimum guidelines to assist companies in developing their own specific safe practices/operations manual. Each employer is responsible for completing, modifying and/or complementing any of the procedures, checklists and standards in accordance with applicable governmental regulations and as dictated by specific policies and practices of the employer.
3. The safe practices/operations manual shall, at a minimum, contain the following information:
   a. A copy of applicable government regulations for the conduct of commercial diving or other underwater operations.
   b. For each diving mode engaged in:
      I. Safety procedures and checklists for commercial diving operations.
      II. Assignments and responsibilities of dive team members.
      III. Equipment procedures and checklists.
      IV. Emergency procedures for fire, equipment failure, adverse environmental conditions, medical injury and illness.
4. The ADCI strongly recommends that each safe practices/operations manual contain 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. Additionally, such a statement should reference the employer's ADCI-required drug and alcohol program (reference Section 5.3: Drug and Alcohol Screening).

5.2 EMERGENCY AID

1. Each employer shall develop and maintain a list of the available sources of emergency aid, equipment and professional assistance with call signs, phone numbers or other means and instructions for establishing contact with them for locations where operations are conducted.
2. Each contractor shall make the contact list available at the company's principal place of business, at the field operations office and to those who may have a need for it to fulfill the company's emergency response plan.
3. 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:
   - Decompression chamber.
   - Hospital or medical treatment facility.
   - Air or ground transportation.
   - On-call physician.
   - Coast Guard or other national Rescue Coordination Centers.
4. 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.

5.3 DRUG AND ALCOHOL SCREENING

1. A pre-employment drug screening program shall be in place.
2. A routine, random and "for cause" drug screening program shall be in place.

5.4 FIRST AID

1. First aid supplies appropriate to the type of operation being conducted shall be provided and kept readily accessible in a clearly marked container at the work site.
2. 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 required. Local regulatory authorities may require additional equipment and training (e.g., emergency O2 administration kit).
3. A recommended list of the contents for a first aid kit is set forth below to reflect what should be considered the **minimum** contents. Each operator should review this list and make additions or substitutions as necessary to ensure that effective and timely first aid can be furnished.

Minimum Surface Diving First Aid Kit Checklist/Inventory:

- 100 "Band-Aid" Strips – assorted.
- One triangular bandage.
- One roll adhesive tape.
- Two ammonia inhalants.
- One package absorbent cotton.
- One bottle eye wash.
- One gauze bandage, 1 inch x 10 yards.
- 20 aspirin tablets.
- One gauze bandage, 2 inches x 10 yards.
- Four antiseptic wipes.
- One elastic bandage, 3 inches x 5 yards.
- One pair of scissors.
- 10 non-adherent pads, 2 inches x 3 inches.
- Six pairs of latex examination gloves.
- Four oval eye patches.
- One cold pack.
- One gel pack, burn dressing kit.
- One tourniquet.
- One rescue airway.
- One pair of tweezers.
- One trauma dressing, 8 inches x 10 inches.
- One first aid booklet.
- Two one-way CPR shields.
- One contents card (inventory).
- One first aid cream.
- One waterproof case.
- One 1-1/2-ounce tube of triple antibiotic.
- Four biohazard bags.
- 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:

- One bottle oral analgesic.
- One package Alka Seltzer Plus.
- One tube Benadryl cream.
- One bottle antacid tablets.
- One tube Neosporin opthalmic ointment.
- One basic poison antidote kit.
- One bottle insect repellent.
- One bottle Immodium AD.
- One bottle Sudafed tablets.
- One bottle/tube sunscreen, 15+ SPF.
- One bottle Robitussin DM cough syrup.
- One bottle nasal spray.
- One bottle ear drops.

NOTE: This list will not be adequate for saturation diving and other large scale surface diving operations.

5.5 DIVER'S PERSONAL LOG BOOKS

All divers shall maintain a personal dive log book (ADCI commercial diver log book) or equivalent to detail hyperbaric exposures. The log book must be identified to the diver using it by photograph, signature and home address. As a minimum, the following information shall be entered in the log book:

- Diving contractor's name and address.
- Date of the dive.
- The name or other designation and location of the diving site or vessel from which the
- diving operation was carried out.
- Maximum depth reached on the dive.
- The time left surface, bottom time and the time reached surface for each hyperbaric exposure.
- Surface interval, if dive includes time for decompression.
- Type of breathing apparatus and breathing mixture used.
- Task performed.
- Designation of the decompression table and schedule used.
- Any DCS or injury incurred during the dive.
- Comments section.
- Supervisor's signature.
- Place for a counter-signature or stamp of the diving company.

As applicable, additional pages must be provided to show:

- Dates of diving physicals, signed by the examining physician.
- A record of all relevant training sessions.
- A record of all equipment testing and maintenance.
- A record of the diver's helmet type, serial number and verified completion of annual helmet inspection as required by the equipment manufacturer.

5.6 DESIGNATED DIVING SUPERVISOR

1. A qualified person shall be designated in charge of each diving operation. The responsibilities of such designated persons should include job planning, coordination, record keeping and proper response to any job-related emergency, as well as knowledge of the appropriate governmental regulatory agency regulation. **(Reference Section 3: Diving Personnel Responsibilities, Qualifications and Certifications.)**

All ADCI general member company supervisors must possess a current ADCI supervisor certification card reflecting the level of diving being conducted.[1]

5.7 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 diving supervisor.

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.

5.8 PLANNING AND ASSESSMENT

The planning of a diving or underwater operation shall include a dive operations plan.

During the planning and assessment phases of a diving or underwater operation, before diving operations commence, a plan must 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) in that 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.

5.8.1 JOB/PROJECT SAFETY

- Dive operations should be planned in accordance with regulatory authorities and ADCI consensus standards.
- An ADCI certified diving supervisor shall be in charge of the diving operation.
- All diving personnel shall be ADCI certified for the task they are assigned.
- An emergency response Ppan shall be available, posted and reviewed by all personnel.
- A Ppe-dive safety meeting shall be conducted.
- The job and all tasks shall be defined, reviewed and understood by the dive team and vessel personnel.
- The supervisor will perform a job-specific JHA.

5.8.2 DIVING AND SUPPORT PERSONNEL

- Ensure all divers are trained and experienced for the task they are to perform.
- Verify that all divers are physically and mentally fit to dive.
- Ensure that all personnel on the job have direct communication with all parties directly involved in the dive operation.

5.8.3 EQUIPMENT

- Ensure that dive gear and support equipment has been inspected/checked and ready for dive operations. (See basic example of pre-dive checklist in Section 10: ADCI Compliance Audit Procedures.)
- Ensure all emergency and support equipment has been inspected/checked and is fully functional.
- Ensure all needed methods of communication are available and functioning.
- Ensure all first aid/CPR (resuscitator) equipment and kits, as well as backboard, are well-supplied and available.
- Ensure that all dive flags/shapes/signals are prominently displayed during dive operations.

5.9 JOB HAZARD ANALYSIS (JHA)

(See Section 11: Reference Materials for a sample JHA form.)

Before any underwater task is begun, a job safety analysis (JHA) shall 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 either reduce, eliminate or guard against hazards. On the JHA, sentences should be short and simple. The ADCI sample JHA form in the Section 11: Reference Materials can be copied and used as is or modified to suit individual company needs.

1. **Sequence of Basic Job Steps**

   Break the job into observable steps. Do not be too general or overly detailed.

- If the job is complex, break it into several tasks and prepare a JHA for each task.
- Begin with an active verb, e.g., disconnect, check, invert, assemble, isolate, start, stop, etc.
- Number each step.

2. Potential Hazards

- Identify possible hazards associated with each step and list that hazard opposite the job step.
- Consider potential accident causes (strain, sprain, slip, fall, cut, crush, etc.).
- Consider environmental and health hazards (vapors, gasses, heat, noise, toxicity, etc.).

3. Recommend Safe Procedures and Protection

- Develop solutions for each potential hazard and list the solution opposite the hazard.
- Detail controls, e.g., ventilate, isolate, allow to cool, secure, guard, train, etc.
- List personal protective equipment (PPE) required, e.g., gloves, eye protection, respirators, fall protection, etc.

4. Assign Responsibility

- Assign a specific person the responsibility of implementing the safety procedures or protection required.

5. Personnel Involved

- Identify the persons preparing, reviewing and approving the JHA.
- 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

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.

5.10 TEAM BRIEFING

1. Before commencing with any underwater operation, the dive team members shall be briefed on:
   - The tasks to be undertaken.
   - Safety procedures for the diving mode.
   - Any unusual hazards or environmental conditions likely to affect the safety of the underwater operation.
   - Any modifications to operating procedures necessitated by the specific underwater operation.
2. Before each dive, the diver shall be instructed to report and record any physical conditions, problems or adverse physiological effects that may render the diver unfit to dive.

5.11 TERMINATION OF DIVE

1. The working interval of a dive shall be terminated when:
   - Directed by the dive supervisor and/or the person in charge.
   - The diver requests termination.
   - The diver fails to respond correctly to communications or signals from a dive team member.
   - Communications are lost and cannot be quickly re-established with the diver, the tender/diver and/or the diving supervisor.
   - In liveboating operations, the person controlling the vessel requests termination.
   - The diver begins to use the diver-carried reserve breathing gas or the dive-location reserve breathing gas.

5.12 POST-DIVE PROCEDURES

1. After the completion of each dive, the diver shall:
   - Be questioned as to his or her physical condition.
   - Be instructed to report any physical problems or adverse physiological effects, including symptoms of decompression sickness or gas embolism.
   - Be advised of the location of an operational decompression chamber.
   - Be alerted to the potential hazards of flying after diving.
   - Be alerted to the potential hazards of traveling to higher elevations from the dive site.
2. After the completion of any dive outside the no-decompression time/depth limits, the following are recommended:
   - Take reasonable steps to have the diver remain awake and in the vicinity of the decompression chamber for at least one hour.
   - Instruct such divers to remain within two hours travel time of the decompression chamber for an additional five hours.
   - Instruct such divers of the hazards of flying after diving.

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

5.13 COMPANY RECORD OF DIVES (DIVE LOG) REQUIREMENTS

Each employer shall establish and maintain a record of each diver's hyperbaric exposure. This record shall contain the following:

- Name and address of the company.
- Location, time and date of diving operations.
- Names of the dive supervisor, diver and tender/diver.
- Depth of dive.
- Bottom time.
- Approximate water temperature and thermal protection used.
- Environmental conditions (approximate sea state, underwater visibility and underwater currents).
- Decompression tables and schedule used.
- Elapsed time since last pressure exposure if less than 24 hours or repetitive dive designation.
- Breathing mixture used and composition.
- Type of work performed.
- Type of diving equipment worn.
- Any unusual conditions.
- For each dive for whom decompression sickness is suspected or symptoms are evident, the following additional information shall be recorded and maintained:
  - Description of decompression sickness symptoms, including depth and time of onset.
  - Description and results of treatments.

5.14 DECOMPRESSION PROCEDURE ASSESSMENT

Each employer shall:

- Investigate and evaluate each incident of decompression sickness based on the recorded information, consideration of the past performance of the decompression table used, and individual susceptibility.
- Take appropriate corrective action to reduce the probability of recurrence of decompression sickness.
- Prepare a written evaluation of the decompression procedure assessment, including any corrective action taken.

5.15 MINIMUM REST HOUR POLICY

Except in an emergency, diving operations personnel may work no more than 18 continuous hours when that work includes loading equipment; traveling to the job site by air, land or sea; setting up the dive station; standing by to commence diving operations; participating in diving operations; or any combination of same. After 18 continuous hours of performance, such persons must be provided a minimum of eight consecutive hours away from the dive station and engaged in no alternate work activity.

Excluded from the above are any hours during the initial 18-hour period where diving operations personnel may have been afforded an opportunity for an uninterrupted period of sleep in excess of four hours. That opportunity may be considered to have been afforded during such times as during transport to the job site by land, sea or air.

When duty at the dive station does not include activities under paragraphs 1 and 2 above, diving operations personnel will not be permitted to work more than 16 hours in any 24-hour period or 60 hours in any 96-hour period, except in an emergency. Furthermore, such persons must be given at least eight consecutive hours off duty between work periods.

An emergency exists when a there is direct threat to the continued health and wellbeing of an individual or individuals or a significant loss of property may take place as the direct result of an unplanned event.

5.15.1 COVERAGE

This policy is intended to apply to all members of the operating dive team, including diving supervisors, divers, life-support technicians and tenders. Excluded from this policy are persons falling into the contractors' management category, such as those performing duties of a project manager, project superintendent, diving superintendent or other individuals whose activities are not required to take place at the actual dive station during a regularly scheduled shift/watch.

5.16 HAZARDS TO UNDERWATER OPERATIONS

1. 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 underwater demolition, movement of surface vessels, lifting of material directly over the underwater operations, etc.
2. 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.
3. In no case shall the diver be required to dive against his or her will.

5.17 DIFFERENTIAL PRESSURE (Delta P)

A significant number of fatalities in the diving industry involve a differential pressure (Delta P) situation. Delta P is invisible to a diver and strikes suddenly, without warning. Once entrapped by Delta P, there is almost no way to escape. This section provides information about how to recognize and avoid Delta P. Additional information about Delta P hazards is also available on the ADCI video, The Hazards of Working in "Delta-P" Work Environments . For ordering information, go to www.adc-int.org/products.php.

5.17.1 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.
5. Positive pressure being released from HP subsea wells or pipelines.

5.17.2 EXAMPLES OF DELTA P

- Clogged intake screen (type 1 from above).
- Outlet screen/trash rack on dams (type 1 from above).
- Hole in a water storage tank (type 1 from above).
- Open sluice gates (type 1 from above).
- Opening in a barrier between two areas (type 1 from above).
- Transfer pipes (type 1 from above).
- Water tower drain (type 1 from above).
- Diver installing a section of pipe with flange protectors over the ends without a vent (type 2 from above).
- An existing hole in an underwater pipeline (type 2 from above).
- Cutting into an underwater pipeline or other void with Delta P (type 2 from above).
- Pump house intake (type 3 from above).
- Air lifts or dredges (type 3 from above).
- Draw from thrusters on a ship (type 4 from above).

5.17.3 RECOMMENDATIONS

- Attend a pre-job meeting to understand where the hazards may be.
- Know the layout of the facility you are working in. (Review plans of facility or as-builts, if available.)
- Understand where the potential for Delta P may exist..
- Ensure high-quality, well-informed leadership, backed up by the provision of adequate information, instruction and training, for the dive teams and other relevant personnel.
- Make sure the diver and supervisor know how the piping and valve systems work together.
- Make your concerns regarding potential Delta P hazards clear to personnel of the company you are working for.
- Check and ask about any pumps, suctions, gates or valves.
- Physically verify that all gates or valves around the divers' work area are properly positioned and locked/tagged out as applicable.
- Perform any lockout/tagout procedures necessary to perform the job as safely as possible.
- Calculate the water forces in the potential Delta P areas.
- Check for flow using a flow meter if applicable.

- Brief the diver as to the location of any possible suction. Use of a simple illustration can be very beneficial.
- Be cautious when diving on a structure where damage is suspected.
- Where possible, establish an exclusion zone of such a size as to incorporate a suitable safety margin around a hazard.
- Keep the divers' umbilical taut to prevent the umbilical from getting caught in a Delta P situation.
- Limit the amount of umbilical given to the diver.
- Keep in communication with topside and make sure topside and any other divers in the water know exactly where you are at all times.
- Verify that all the divers' equipment is properly hooked up, and ensure that there are no loose articles that could get drawn in.
- On dynamic positioning (DP) vessels, the divers' umbilical should be at least 20 feet shorter than the distance to the nearest hazards, such as propellers and thrusters. The standby divers' umbilical must be at least 10 feet shorter than the distance to the closest hazard.
- The standby divers' umbilical must be long enough to be able to reach the primary diver at all times.
- Install screens or guards over openings when possible.
- If cutting into a low pressure area, cut slats spaced apart instead of holes in order to allow water to keep flowing even if the diver is in front of part of that opening.
- Special attention should be given to air lifts and dredges in all depths, especially those greater than 33 feet.
- A remote pre-dive survey may need to be conducted prior to divers entering the water. This may be done using an ROV, drop camera, flow meter, etc. (see remote pre-dive survey methods below).
- Consider the condition of the structure. Failing parts of the structure can allow a Delta P hazard.

Control measures should be implemented as possible in the following order of importance:

1. Eliminate the hazard:
   - Dive on the downstream side of the hazard.
   - Equalize water levels or fill any voids
   - Substitute divers by using remotely operated vehicles (ROV).
2. Use engineering controls to eliminate the hazard (engineering controls should distance the diver from or prevent the formation of a Delta P hazard):
   - Limit the length of the diver's umbilical or lifeline.
   - Construct guards/screens or close valves to minimize entrapment potential.
   - Separate the diver from the hazard by using more than one valve (redundancy) when possible.
3. Use of safe systems at work:
   - Use lockout/tagout procedures to isolate valves, pumps intakes and propulsion devices.
   - Evaluate the effectiveness of the control measures prior to the diver entering the water.
   - Divers and crew should be given training to recognize pressure hazards and risks. The pre-dive safety meeting should encompass the risks of Delta P hazards.
4. Personal protective equipment (PPE):
   - Use of surface-supplied air breathing apparatus incorporating an umbilical with appropriate strength member.
   - Full face mask or helmet that incorporates topside communications.

5.17.4 REMOTE PRE-DIVE SURVEY METHODS

The use of some kind of water movement detection device is recommended when a potential Delta P situation exists. Even if the indicator on a valve or gate indicates that it is in the closed position, the indicators may not be functioning properly. For example, in the case of a bent control stem, the effective length of the stem will shorten, resulting in the indicator showing that the valve is in the closed position even though the valve or gate may not be completely closed.

Historically, a weighted mop head or similar device (telltale) was often lowered in front of a potential Delta P hazard. If it was drawn towards the area, or sucked in, that would indicate a Delta P hazard. This method is still used today and can be an effective means of determining the presence of a Delta P hazard. However, technology has advanced with the use of digital readout flow meters, which can be lowered through the water column and will electronically display the flow rate (typically in ft/s). This can be converted to knots if desired (see formulas below).

5.17.5 FORMULAS

The following formulas can and should be used to calculate the potential forces and flows that the diver may encounter while diving near a potential Delta P hazard. These formulas can also be used to express the potential dangers of a Delta P hazard to the client.

Force due to differential pressure calculation (U.S. standard)

F=D x density x Area

Where: F = Pounds of force

D = Difference in water level (ft)

density = 62.4 pounds per cubic foot of fresh water

density = 64.1 pounds per cubic foot of sea water

A = πr^2 for a circle (r is radius in feet)

A = Length x height (in feet) for a rectangle or square

Example: A hole that is 1-foot x 2 feet is located 10 feet below water on a sinking ship. How much force would be on an object placed over the hole?

F=(10')(64.1)(2ft^2) = 1,282 lbs.

Force due to differential pressure calculation (metric)

F=D x density x Area

Where: F = Kilograms of force (kgf)

D = Difference in water level (m)

density = 1025 kg ·m^3 for sea water

density = 1000 kg ·m^3 for fresh water

A = πr^2 for a circle (r is radius in meters)

A = Length x height (in meters) for a rectangle or square

Calculation of water flow through an opening (U.S. standard)

Q=3600 x (A) x (√ D)

Where: Q = Flow rate (gpm)

A = Area of opening (ft^2)

D = Depth of water above the opening (ft)

Calculation of water flow through an opening (metric)

Q=4.43 x (A) x (√ D)

Where: Q = Flow rate (m^3/s)

A = Area of opening (m^2)

D = Depth of water above the opening (m)

Example: At what rate will water flow into a sinking ship through a 1-foot x 2 feet rectangular hole located 10 feet below the water surface?

(√ 10') = 22,768 gpm **Q = 3,600 ($2ft^2$)** **(√ 10') = 22,768 gpm**

Convert feet per second to knots = (fps) x 0.5925 = knots

5.17.6 MISCELLANEOUS FACTS

- 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.
- Even small forces may be compounded by factors such as the immobilization of limbs.
- The application of as little as 77 pounds (35 kilograms) on the torso can impair respiration and disrupt blood flow.

5.17.7 REFERENCES

Association of Diving Contractors International, Inc. "The Hazards of Working in Delta-P Work Environments," 1999. DVD.

For order information, go to www. .adc-int.org/products.php

Fisher, A.S.; Gilber, M.J.; Anthony T.G. "Differential Pressure Hazards in Diving," Health and Safety Executive RR761, (2009): pp 107.

Tucker, Wayne C. "Diver's Handbook of Underwater Calculations." San Pedro: Best Publishing Company, 1980. Print.

5.18 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 aftereffects, 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.

5.19 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, stage 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.

5.20 REQUIRED DECOMPRESSION CHAMBER AVAILABILITY

1. For any dive in excess of 100 fsw, dives deeper than 60 fsw (18.29 meters) when liveboating or where dives require decompression, a dual-lock decompression chamber having a minimum capability of 6 ATA (equivalent to 165 fsw/50.3 meters) shall be available and ready for use at the dive site.
2. Prior to mobilization on jobs not normally requiring a decompression chamber, a job hazard analysis shall be performed to determine whether a decompression chamber will be required at the dive location. Those considerations may include, but not be limited to:

- Dive site location with respect to a known and identified location of a decompression chamber that will be available under emergency circumstances.
- Multi-day and/or repetitive diving operations.
- Potential for diver fouling or entrapment.

Other potential hazards or factors that may cause the diver to incur decompression obligations.

- Liveboating operations.
- Remote locations.

5.21 INSPECTION OF LIFE-SUPPORT SYSTEMS, EQUIPMENT AND TOOLS

1. Before diving or other underwater operations commence, personnel shall 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 6: Life-Support Equipment: Requirements, Maintenance and Testing.**
   - To ensure the highest standard of safety, checklists shall be used to confirm that the systems, equipment and tools are in safe working order.
2. Operational systems, equipment and tools used in underwater operations shall be inspected daily and monitored throughout the operations by designated persons.
3. Each person engaged as a diver in the diving operation shall inspect his or her personal diving equipment and confirm its operational readiness prior to each use. The diving supervisor or his or her designated alternate shall be likewise required to check the equipment of each diver before the diver enters the water.

5.22 THERMAL EXPOSURES TO DIVING PERSONNEL

PROCEDURES FOR DIVING IN COLD WATER AND COLD WEATHER

(Cold water is defined as water that is less than 40°F/4°C.)

5.22.1 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.
3. Make sure the suit fits properly and that all the seals are in good condition.
4. 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.
5. Keep hydrated at all times.
6. Exercise on a regular basis.
7. Do not exercise in cold water to try and stay warm. Exercise will cause the body temperature to fall more rapidly.
8. Bring the diver up if the diver is showing minor or severe symptoms of hypothermia. Minor symptoms include uncontrolled shivering, slurred speech, imbalance and/or poor judgment. Severe symptoms include loss of shivering, impaired mental status, irregular heartbeat and/or very shallow pulse or respiration (this is a medical emergency).
9. Upon exiting cold water:
   - 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.
   - Get the diver to a dry and relatively warm area as soon as possible.
   - The diver should remove any wet dress, dry off and don warm, protective clothing as soon as possible.
   - Hot, non-alcoholic beverages should be available to the diver.

5.22.2 TENDER AND TOPSIDE

1. Topside personnel should wear warm, proper protective clothing.
2. Plan extra time to perform tasks under cold conditions.

5.22.3 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 (barge 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.
   - Use proper lubricants in the diver's air compressor.
   - 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.

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

5.23 DIVING OPERATIONS WARNING DISPLAY

For areas that support marine traffic, an appropriate warning display shall be exhibited near the work site so that it has all-around visibility. 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.

5.24 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY

A calculated 4 minute minimum of EGS is required for the deepest depth to be attained.

1. 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 MKV, or equivalent) is involved.
2. A diver-worn or carried emergency gas supply shall provide a physiologically appropriate mixture and a minimum four-minute capacity for the depths involved.
3. 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.

Note: Consideration of the reserve breathing gas cylinder duration should be a part of pre-dive planning.

4. 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.

The following information is provided to aid in selecting a reserve breathing cylinder size appropriate for the intended dive operation.

Consumption can be determined by the following calculation:

EMERGENCY GAS SUPPLY DURATION FORMULA
DA = VA DA = Duration in minutes
CD VA = Available volume
CD = Consumption rate at depth
Consumption rate at depth = Volume/minute X depth in bars or atmospheres
Gauge pressure minus depth in pressure + Regulator delivery pressure = Usable gas pressure
***Refer to Bailout Calculations for Cylinders in Section 11**

NOTE: The available volume depends on the type (rated volume and rated pressure) and number of cylinders used, the measured gauge pressure and the recommended minimum cylinder pressure.

5. 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.

5.25 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 supervisor, winch operator, person in charge, and other key personnel as determined necessary during the conduct of the job safety analysis.

5.26 DIVE PLATFORM POSITIONING

Vessels from which diving and other underwater operations are conducted shall afford a safe working platform. Safe operations from dynamically positioned vessels are covered in Section 8 of these standards.

5.27 PERSONAL PROTECTIVE EQUIPMENT

The appropriate ANSI (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:

- Protective head gear.
- Protective footwear.
- Protective eyewear.
- A personal flotation device to appropriate regulatory standard.
- Hearing protection.
- Safety harness with approved double-locking elastic lanyard.
- Respiratory equipment.

5.28 SAFETY PROCEDURE GUIDELINES

The following are minimum guidelines that may require modification for each diving or underwater operations mode to meet individual company needs.

5.28.1 SAFE PRACTICES/OPERATIONS MANUAL

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

5.28.2 EMERGENCY AID

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

5.28.3 FIRST AID

- First aid kit.
- First aid manual.
- Bag-type manual resuscitator.

5.28.4 PLANNING AND ASSESSMENT

- Dive plan.
- Job hazard analysis.
- Site assessment.
- Evaluate environmental pollution containment and response readiness where applicable.
- Diving model/equipment system(s).
- Means of water entry and exit.
- Breathing gas supplies, including reserves (set up and tested).
- Thermal protection (all dive team members).
- Dive team assignments/briefing and fitness to dive.
- ROV team assignments/briefing and readiness to conduct operations.
- Inert gas status of dive team members (repetitive dive designations).
- Decompression and/or treatment procedures (including altitude).
- Communications procedures and methods for all personnel involved in the operation.
- Emergency procedures.
- Dive station setup.
- Any necessary modifications to the safe practices/operations manual.
- 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.

5.28.5 HAZARDS TO DIVING OPERATIONS

- Surface vessel, vehicular traffic or aircraft operations.
- Overhead crane/gantry operations.
- Pedestrian traffic.
- Vessel and dive equipment weather limitations.

5.28.6 UNDERWATER HAZARDOUS CONDITIONS

- Umbilical fouling and/or entrapment.
- Differential pressures.
- Lockout/tagout.
- Contaminated or toxic liquid.
- Limited access/confined space/penetration.
- Use of explosives or seismic activities.
- Underwater sonar.

- Cathodic protection.
- Marine life.
- High currents/severe tidal conditions.
- Foreign waterborne materials, such as logs, ice floe, etc.

5.28.7 RECORD KEEPING

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

5.29 LIFE-SUPPORT EQUIPMENT PROCEDURES CHECKLIST

The following are minimum guidelines that may require modification for each diving mode to meet individual company needs.

5.29.1 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.

5.29.2 GENERAL EQUIPMENT

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

5.29.3 PREPARING THE BREATHING GAS SUPPLIES

The ADCI does not recommend the use of 100 percent O_2 as an in-water breathing media. However, should O_2 (in excess of 50 percent) be used for in-water breathing media, the equipment should be O_2 clean and designed for use with pure oxygen.

1. Check that primary and suitable back-up breathing gas supplies are available and that breathing gasses 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.
   i. 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.
   ii. 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.
   iii. Minimum flow requirements for helmets/masks should be based on manufacturer's recommendations.

Example: Air flow requirements can be calculated by:

$$\textbf{FLOW} = \frac{D + 33}{33}(\textbf{ACFM})(n)$$

ACFM = Flow required based on manufacturer's recommendations

n = Number of divers

D = Depth in feet

   - Standby diver must be included in the equation. Thus, if the dive will be performed by one individual, (n) will be 2.
   - D equals the depth of the intended dive.
   - 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. Compressors:
   - Determine that sufficient fuel, coolant, lubricants and anti-freeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated and serviced.
   - 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.
   - 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 gasses. Check that the compressor inlet is located in an area free of potential contamination.
   - Check that compressors are not covered during operation.
   - Check all filters, cleaners and oil separators for cleanliness.
   - Bleed off all condensed moisture from filters and from the bottom of volume tanks.
   - Check all manifold drain plugs.
   - Check that all valves are properly aligned.
   - Check that all belt-guards are properly in place on drive units.
   - Check all pressure-release valves, check valves and automatic unloaders

5.29.4 ACTIVATING THE BREATHING GAS SUPPLIES

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

5.29.5 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. Check breathing gas hoses and fittings for leaks and flow.
4. Ensure that breathing gas hoses (umbilicals) are properly marked to determine the distance the umbilical is paid out from the dive control station.
5. Ensure that breathing gas hoses (umbilicals) are suitable for the gasses to be used and have been maintained in proper conditions of cleanliness.

5.29.6 TESTING OF EQUIPMENT WITH BREATHING GAS SUPPLY ACTIVATED

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

5.29.7 DECOMPRESSION CHAMBER CHECKOUT (PRE-DIVE ONLY)

1. Check that the chamber is completely free and clear of all combustible materials.
2. Check primary and back-up air supply to chamber and all pressure gauges.
3. Check that the chamber is clean and free from contaminants. Check all chamber BIBS supplies. Verify that sufficient appropriate breathing media is available and that overboard dump systems (if fitted) are functional.
4. Verify the medical kit is available and in close proximity to the chamber.
5. Check all doors and seals.
6. Check that chambers meet code requirements with respect to periodic tests required by ASME/PVHO or equivalent.
7. Check that all valves are in the correct position.
8. Hook up and test all communications.

5.29.8 FINAL PREPARATIONS

1. Verify that all necessary records, logs and timesheets are on the diving station.
2. Check that appropriate decompression and treatment tables are readily at hand.

5.30 HAND-HELD POWER TOOLS

The following are minimum requirements for hand-held power tools. Prior to use of any hand-held power tools, a job safety analysis shall be performed.

5.30.1 ELECTRICAL HAZARDS

1. All hand-held electrical tools, including hand-held electrical equipment, shall be de-energized at the surface before being placed into or retrieved from the water.
2. All underwater AC (alternating current) electrical equipment cabled from topside shall be powered via a ground fault circuit interrupter (GFCI) between the topside power source and the tool.
3. GFCIs are used to assist in protecting divers against electrocution when using AC power underwater. GFCIs used shall meet all applicable regulatory requirements.
4. Have plug and receptacles compatible with cabling and dedicated ground cable.

5.30.2 SWITCHES AND CONTROLS

All hand-held power tools (e.g., hydraulic and pneumatic tools, water blaster guns) shall have a constant pressure switch or control (except for underwater welding and burning equipment).

- Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.

5.31 WELDING AND BURNING

The following are minimum requirements for underwater welding and burning.

CAUTION: Underwater welding and burning should be performed only by qualified personnel with prior training in these operations and should only while utilizing surface supplied diving equipment with communication to the diver.

As a minimum, the following shall be taken into consideration:

- Diver dress to ensure protection from shock.
- Proper equipment and setup (DC power, polarity, etc.).
  - Addressing the potential for existing explosive gasses and the creation of explosive gasses through the burning and welding process; also ensuring proper venting.
  - Ensuring that any members or compartments that can contain combustible gasses are either flooded or pressurized with an inert gas (nitrogen, carbon dioxide, argon, etc.) prior to cutting into them.

Underwater welding and burning creates hydrogen/oxygen mixtures that are HIGHLY explosive. Ensure that all closed compartments, structures or pipelines subjected to the heat of underwater burning or welding are flooded or purged with water and vented. Ensure that gasses cannot be trapped by providing a vent location at the highest point. If unsure whether a compartment or pipe is fully flooded, vent holes shall be cold cut initially. Cold cutting: A technique that does not generate sufficient heat that could cause the ignition of flammable gasses or hydrocarbons.

5.31.1 GENERAL REQUIREMENTS

- The diver shall wear adequate protective clothing (generally a rubber wetsuit or dry suit in good condition), including insulated gloves, while engaged in underwater welding or burning operations. Additionally, a diving helmet should be worn to keep the diver's head dry, to prevent the possibility of shock.
- While only partially immersed in the water, the diver is at risk of severe electrical shock when burning or welding. From the standpoint of electrical shock danger, the splash zone is the most hazardous location for divers while burning or welding. When working in the splash zone, divers must always wear a full wet or dry suit and insulating rubber gloves, in good condition, to insulate their bodies and hands.
- The diver shall use an appropriate welding shade to protect his or her vision when working in water with visibility.
- The diver shall be careful not to get between the ground and the work.
- The ADCI does not recommend burning or welding while using the scuba mode.

5.31.2 EQUIPMENT AND SETUP REQUIREMENTS

Use only a DC power source for underwater burning or welding. There is extreme danger with the use of AC current in the water.

The welding power source should be checked out by knowledgeable personnel before use.

Select your machine by the amperage required at the torch head to burn the steel with the rod to be used. A high-end machine will burn on the low end; a low-end machine will not burn on the high end. On extended or critical burning jobs, a backup welding machine should be considered.

- All underwater burning or welding operations shall be conducted utilizing straight polarity.
- This can be remembered by the acronym P.I.G. (positive is ground). This will help prevent electrolysis to the torch or electrode holder.

Welding machine polarity could have been internally changed and differ from the external markings on the machine (e.g., indicated positive on the machine could actually be negative and vice versa).

To confirm straight polarity, insert the ground and the rod tip approximately 2 inches apart into a bucket of salt water. Energize the rod by closing the safety disconnect switch. A stream of bubbles should travel from the rod tip toward the ground clamp. If not, reverse the polarity and test again.

- The ground shall be connected from the welding machine directly to the work. (In-water ground is not recommended.)
- A positive current safety disconnect switch (e.g., knife switch) shall be a part of the electrical circuit and shall be located at the dive control station in such a manner that it cannot be accidentally knocked or vibrated closed. It shall be capable of being immediately operated by the person in communication with the diver. The switch shall be rated for the maximum amperage utilized and shall remain open except during actual welding or burning. Due to the potential for arcing, the disconnect switch shall not be placed in a location that has the potential for oxygen or combustible gas buildup.
- Welding cables, electrode holders, underwater torches, and connections shall be properly insulated and capable of carrying the maximum amperage required by the work. Poorly insulated cables lying on a steel deck could allow for a current shunt around the safety disconnect switch. Electrode holders and torches shall be designed for underwater work.
- Ensure that all equipment is in good condition and that all manufacturers' recommendations are followed for the particular equipment being utilized. The underwater torch should have a good collet and washer, and it should be ensured that there is no oxygen leakage. All components of the system that may come into contact with oxygen shall be kept free of any grease or oil.
- In torches utilizing spark arrestors, ensure that the spark arrestor is in place.

5.31.3 SAFETY RECOMMENDATIONS

Prior to the command to "MAKE IT HOT," the diver should squeeze the trigger to vent any possible build-up of hydrogen gas.

- The diver should say "MAKE IT HOT" top side and then should say "MAKING IT HOT" and close the knife switch. When the diver completes a rod or burn, he or she should say "MAKE IT COLD" top side, then open the switch and say "IT'S COLD."
- Always keep tight control of the knife switch; never allow it to be closed when the diver is not burning, since this could cause injury to the diver or damage to the work site. Never mount the switch in a way that it could fall closed.
- Special consideration, planning and hazard identification should be considered for any habitat operations, including, but not limited to, habitat living parameters, atmospheric contaminant monitoring and ingress/egress of the habitat.
- Gasses from the burning/welding operation will collect in enclosed spaces as well as within shaped structural members such as under H-beams. ALWAYS ensure that adequate flooding/purging/venting has been accomplished prior to burning/welding. When in doubt, use cold cutting techniques to create vents.
- Trapped combustible gasses, such as methane from decaying organic material, may exist in submerged compartments in a barge or ship hull. Trapped gasses may also be present within a pipeline.
- When burning, if possible, start at the highest point and work downward to allow for gas venting. When burning large sections where entrapment from falling steel is a potential hazard, ensure that the section being cut is well-secured from topside, and cut the most difficult section first. The diver's body and umbilical should be outside of any potential danger zone when finishing the cut. Extreme care should be exercised when burning anything with tension upon it (cable, etc.), as it may spring back with tremendous force.

The diver must be aware of his or her location, as well as his or her umbilical, at all times when burning, in order to avoid the potential for entrapment or injury from falling steel or molten slag.

- Ensure that the disconnect switch (knife/contactor switch) is open when changing rods or laying down the electrode holder or torch.
- Ensure the disconnect switch (knife/contactor switch) is open prior to raising or lowering the torch/electrode holder or ground.

5.32 EXPLOSIVES

The following are minimum requirements for employing explosives. Prior to the use of explosives, a Job Safety Analysis shall be performed.

5.32.1 GENERAL

Employers must transport, store and use explosives in compliance with 29 CFR 1910.109, 29 CFR 1926.912 and the requirements of this section. Other state and local regulations may apply.

5.32.2 TRANSPORT AND STORAGE

Single-component explosives shall be transported and stored in magazine boxes. Blasting caps will not be stored with explosives.

5.32.3 CIRCUIT TESTS

Electrical continuity of explosive circuits shall not be tested with divers in the water.

5.32.4 AREA CLEARANCE

Divers shall be out of the water before explosives are detonated.

5.32.5 DETONATION DEVICES

All detonation devices shall be maintained under the custody of the diving supervisor when divers are in the water or when personnel on the surface are in the vicinity of explosives.

5.32.6 UNEXPLODED ORDINANCE

Unexploded ordinance, (or UXOs/UXBs, sometimes acronymized as UO) are explosive weapons (bombs, bullets, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded. If they are encountered, they should not be disturbed by untrained personnel, and appropriate authorities should be notified. The location of the unexploded ordinance should be noted.

5.33 UNDERWATER LIFT BAG OPERATIONS GUIDELINES

5.33.1 PURPOSE

- The purpose of this section is to identify potential hazards and recommend safety precautions when working with underwater lift bags.
- This recommended procedure is applicable for all sectors of the commercial diving community, both inland and offshore.

5.33.2 PRECAUTIONS

- When performing tasks underwater, divers are often required to move or lift objects using the assistance of underwater lift bags.
- Using underwater lift bags can pose a threat of uncontrolled ascent to the diver or object.
- Extra precautions should be taken through the performance of pre-dive hazard assessments.

<u>No standard can cover all potentialities that might be encountered. JHAs, common sense and extra attention by the entire dive team are considered essential components for approaching operations of this nature. JHAs should be updated as work progresses to reflect the current conditions.</u>

Note: 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. 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.

5.33.3 DEFINITIONS

Anchor point: (Also referred to as dead man anchor.) 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.

Dump line: 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 outfitted 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: 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: 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.

5.33.4 RESPONSIBILITY

The dive supervisor 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 that he or she is performing tasks utilizing underwater lift bags in a safe and responsible manner.

5.33.5 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. Possible disruption of DP system during deflation of lift bags.
8. Possible entrance of deflated air into the diving bell.
9. Unplanned free ascent.
10. Diver fouling on lift bag or rigging during unplanned ascent.

5.33.6 RECOMMENDED WAYS TO MITIGATE POTENTIAL HAZARDS ASSOCIATED WITH UNDERWATER LIFT BAG OPERATIONS

1. Situational awareness on the part of the diver and topside personnel.
2. Proper education and training (Boyles' Law/Archimedes' Principle/hydrostatic pressure/absolute pressure; see ADCI Physics and formulas in Section 11).
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 whereever 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 (lbs./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. On DSV/DPV: The volume of air escaping from the lift bag during the deflation phase may affect the vessel's DP system; prior notification to the bridge should be made before initiating deflation.
11. It is important that lift bags are not deflated in the area directly underneath the diving bell, as this could pose a hazard to personnel inside of the bell.
12. Ensure anchor points, when applicable, are heavier than the greatest potential lift of the lift bag(s).

5.33.7 OPERATIONAL CONSIDERATIONS WHEN USING UNDERWATER LIFT BAGS

1. Weather and environmental conditions

   Factors to consider include:

   a. Current.

   b. Seabed obstructions.

   c. Seabed conditions.
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.

   c. Determination 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.

4. When making your calculations, it is important to assess the best position and number of lift bags required to avoid damage to the object (bending or buckling). Determination of the inflation sequence, when using multiple lift bags, is important to establish a safe and damage-free lift.

NOTE: Extreme caution must be used when inflating underwater lift bags. Do not use excess buoyancy to "break out" or "free" a load from the seabed. Remember: In shallower water, air entering the bag will experience a greater percentage of change in volume as it rises than at deeper depths. Underwater lift bags inflate more rapidly at more shallow depths.

5.34 UNDERWATER EXCAVATION OPERATIONS GUIDELINES

5.34.1 PURPOSE

1. The purpose of this document is to identify potential hazards and recommend safety precautions when conducting underwater operations below the mud line (deep ditch).
2. This recommended procedure is applicable for all sectors of the commercial diving community, both inland and offshore.

5.34.2 FACTORS TO CONSIDER

1. When performing a variety of tasks, divers are often required to excavate areas or enter excavated areas.
2. Hand-jetting and airlifting material from the natural bottom can pose a threat of burial.
3. Extra precautions should be taken through the performance of pre-dive safety assessments.
4. Variations in bottom conditions can cause changes in stability, which might warrant a more conservative approach to operations than the outlined recommendations of this document.
5. No standard can cover all potentialities that might be encountered. JHAs, common sense and extra attention to detail by the entire dive team are to be considered essential components for approaching operations of this nature. JHAs should be updated as work progresses to reflect the current conditions.

No standard can cover all potentialities that might be encountered. JHAs, common sense and extra attention to detail by the entire dive team are to be considered essential components for approaching operations of this nature. JHAs should be updated as work progresses to reflect the current conditions.

5.34.3 DEFINITIONS

Ditch: An excavation area/trench/channel created to gain access to the working area.

Deep ditch: Any excavation or channel that is 6 feet or deeper from natural bottom (top of subsurface ditch) to the bottom of the subsurface ditch.

Natural bottom: Depth of the seabed prior to any excavation.

5.34.4 RESPONSIBILITY

The dive supervisor is responsible for the welfare and safety of the dive team. The diver is responsible for ensuring that he or she is performing the assigned tasks in a safe and responsible manner.

5.34.5 POTENTIAL HAZARDS ASSOCIATED WITH DEEP-DITCH OPERATIONS

1. Ditch wall collapses and traps the diver and/or his or her umbilical.
2. Unintentional creation of a tunnel by the diver while hand-jetting.
3. Malfunction of jet nozzle or other component of hand-jetting tool.
4. Injury to diver or his or her equipment due to jet hose or water directed from the hand-jet.
5. Injury to topside personnel due to component malfunction of hand-jetting equipment.
6. Injury to diver or damage to his or her equipment due to airlift suction.

5.34.6 RECOMMENDED WAYS TO MITIGATE POTENTIAL HAZARDS ASSOCIATED WITH DEEP-DITCH OPERATIONS

1. Situational awareness on the part of the diver and topside personnel:

The diver should always inspect the condition of the ditch wall prior to beginning or resuming work.

a. Hose management/regular communication.

b. Diver should routinely ensure that an adequate slope to depth ratio be established and maintained. At a minimum, it is recommended that for every 1 foot/meter excavated downward, 3 feet/meter need to be excavated in an outward direction (3:1 ratio).

2. Periodic and regular physical checks need to be made by the diver on his or her exact location. The diver should periodically remove himself or herself from the ditch and return to natural bottom to assess any potential hazards to him or herself, his or her umbilical, or hand-jet equipment.

There are no guarantees that equipment malfunctions will not occur during the course of operations. Routine pre-dive and post-dive checks of all equipment and systems are the best ways to guard against malfunction.

3. The diver should always ensure that he or she is capable of handling the force of pressure being emitted from the jet nozzle. Proper balance, footing and positioning of the diver is the best way to ensure that back or frontal spray from the jet nozzle does not injure the diver or damage his or her equipment.

Sending gas to the diver's pneumo and partially activating the diver's "free flow" are other recommended practices while conducting deep-ditch operations.

5.34.7 MINIMUM PERSONNEL REQUIREMENTS FOR DEEP-DITCH OPERATIONS

On all deep-ditch operations, a minimum of five crew members are required, consisting of:

- One diving supervisor.
- One diver.
- One standby diver.
- Two diver/tenders.

(The stand-by diver's equipment and thermal protection shall be dressed/outfitted to at least equal that of the diver.)

5.34.8 MINIMUM EQUIPMENT REQUIREMENTS FOR DEEP-DITCH OPERATIONS

Redundant jetting equipment and a greater length of jet hose shall be present at the dive site. In addition, the redundant jetting equipment shall be primed and running at an idle pressure at all times that the primary system is in use.

NOTE: Deep-Ditch Operations are considered construction work. A helmet that totally surrounds the diver's head is the only acceptable form of head gear for personnel working in this type of setting.

5.34.9 PERSONNEL QUALIFICATIONS

All members of the dive team should be trained and experienced for the tasks to be performed. In the case of deep-ditch operations, underwater personnel should be properly screened to ensure that they understand the scope of work to be performed, the potential hazards involved, and the procedures for rescuing a trapped or injured diver.

5.35 HIGH-PRESSURE WATER BLASTING

5.35.1 INTRODUCTION

High-pressure water jets are employed in a variety of ways to accomplish cleaning and cutting tasks underwater. These units typically operate at pressures of 1,000 to 40,000 psig and higher.

Water blasters are dangerous and can cause serious injuries. Recommended practices and procedures do not replace the proper training necessary to operate high-pressure water blasting systems. Injuries caused by water blasters are highly susceptible to infection and should be given immediate treatment. Anyone who suffers an injection should immediately stop working, report to their supervisor and seek medical advice on treatment.

5.35.2 GENERAL

- Personnel assigned to water blasting operations, particularly diving personnel, should be trained by qualified personnel and properly demonstrate their knowledge and ability to perform a task prior to being required to do so.
- Serious harm and injury may result from the misuse of water-blasting equipment and from the use of improperly selected fittings, hoses or attachments. 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.
- All dive team members (divers, tenders and supervisors) should be familiar with the equipment intended for use and with the hazards associated with their operation.
- 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.
- Prior to use in diving operations, the water-blasting equipment should be fully assembled and functionally tested, including emergency shutdown or dump valve operation.

5.35.3 PLANNING AHEAD FOR WATER BLASTER SAFETY

- Be a good observer. Look out for yourself and others. Review what to look for and act on what you see. Use your Stop Work Authority.
- JSA: Unsafe work conditions and unsafe behavior are the main reasons for injuries and accidents. Identify and minimize risk, and assign responsibilities to produce a safe working environment.
- Stop Work Authority: Every worker has the responsibility to stop an unsafe act or task. Shut down the operation and reassess the potential problem. Revise your JSA and resume safe operations.
- Report all incidents: Properly report all incidents, document the event, and obtain medical care if needed. Reporting incidents, no matter how minor, is the key to injury prevention.

5.35.4 POTENTIAL HAZARDS

- The safety point for water blasters is the rupture disc. Do not use coins to replace the disc. There are reasons that cause discs to rupture (wrong tip or blockage).
- Using the wrong tips in the underwater gun will rupture the disc or lower discharge pressure.
- Diver inadvertently directs the front pressure stream onto himself or herself, his or her umbilical, or equipment.
- The baffle tube comes loose from the control valve block and exposes the retro nozzle assembly. Unaware of the situation, the diver continues blasting and inadvertently directs the stream from the exposed retro nozzle onto him or her.
- A hose or fitting failure allows leaking pressure stream to contact and injure topside personnel or diver.
- Topside personnel inadvertently direct the front or retro pressure stream onto themselves or others when preparing, testing or using the system.
- Airborne debris created when using the water blaster topside causes persons in the area to have particles carried by mist into their eyes.
- Topside personnel strain their backs while handing hose.
- Water supply to the pump is used up, shut off or blocked, and the pump overheats and damages occur. (The water cools and lubricates the pump machinery and, if the pump is operated dry, it will quickly heat up and seize.)
- Tools or items of equipment fall or are dropped and cause injury to personnel or damage to the pump.

5.35.5 PRIOR TO COMMENCEMENT OF UNDERWATER WATER BLASTING OPERATIONS

A survey of the underwater site should be undertaken to identify potential hazards. A job hazard analysis should be done or reviewed by the dive team.

<u>The job hazard analysis should include, but not be limited to, the following provisions:</u>

- Tending of the diver's umbilical and the high-pressure water hose during water blasting operations.
- System to be pressurized only on request from the diver.
- Ability to quicklyshut down pressure to the gun.
- System pressure is shut down prior to the diver leaving the worksite.

- Only one diver is allowed in the water during water blasting operations except where operations are conducted using penetration or confined space procedures where an outside tender is required. The water blaster nozzle shall never be lowered to the diver in a pressurized state.
- Due to the high noise levels generated, commands and signals should be agreed to and reviewed between the diver and topside.
- Ear protection for the diver is necessary. Limit diver exposure time due to the noise hazard.
- Trigger mechanism shall be of a dead-man type and shall not be tied back or wedged in the flow or "open" position under any circumstances.
- Careful check of the retro jet nozzle guard, as this could present a hazard to the diver and his or her hose if it is not properly guarded and diffused.
- Nozzle selection should be appropriate for the work intended (the smaller angle of rifle barrel nozzle being the most dangerous due to its cutting ability).
- The ADCI recommends against the miss-matching of high-pressure hoses, water blast guns and any high-pressure connections between different company units.

5.36 PENETRATION DIVING

PENETRATION DIVES SHALL BE RIGOROUSLY RISK ASSESSED.

5.36.1 DEFINITIONS

Penetration dive: A dive that requires a diver to access an area that is both a physically confining space and one in which there is no direct access to the surface or bell for recovery of the diver from the water by the tender.

Physically confining space: Any underwater space that would restrict the diver's ability to rotate himself or herself head to toe, 180 degrees, in any plane.

Direct access to the surface: A dive location where the diver can be easily pulled to the surface by a surface tender, or to a bell by an inside bell tender. This does not necessarily mean that there is not an obstruction on the surface directly above the diver during the dive, but that there is nothing to restrict the diver from being pulled back to the point of entry at the water surface or bell by a topside tender or bell tender.

Diver working around corners: A situation where the umbilical may become fouled or where line pull signals may become dissipated due to the dive site configuration creating an impossibility of a straight line pull between a surface tender and the diver.

Confined space: A confined space is an enclosed space and is descriptive of topside conditions only. In certain instances, in order to access the dive site, the dive crew may have to transit or work from a confined space. Generally, a confined space:

- Is large enough and arranged so an employee could fully enter the space and work.
- Has limited or restricted entry or exit. Examples are tanks, vessels, silos, storage bins, hoppers, vaults, excavations and pits.
- Is not primarily designed for human occupancy.
- Is not flooded.

All topside operations performed from/in confined spaces shall conform to appropriate regulatory requirements.

5.36.2 PERFORMING PENETRATION DIVING

When performing penetration diving, if the entrance to the penetration is underwater and not readily accessible from the surface, then the diver shall be tended at the entrance of the penetration by an in-water tender at all times. The purpose of the in-water tender is to tend the penetrating diver's umbilical and to assist should the diver require assistance in the event of a fouled umbilical or entrapment.

In these conditions, the dive team must include an additional tender/diver.

When any diver is working around corners where the umbilical is likely to become fouled or line-pull signals may be dissipated, other in-water diver/tenders may be sent down to tend the lines of the first diver at the obstructions and to pass along any line-pull signals.

5.36.3 MINIMUM PERSONNEL REQUIREMENTS FOR PENETRATION DIVING OPERATIONS

- One diving supervisor.
- One diver.
- One in-water tender (standby diver).
- Two topside tenders.

(One of the topside tenders can act as the topside Standby Diver)

5.36.4 EXAMPLES OF PENETRATION DIVING

- The most common example of a penetration dive is that of a diver entering a pipe and traveling along its interior. This would generally meet both criteria listed above for penetration diving (physically confining space and no direct access to the surface).
- Generally, working under a vessel or barge would not be considered a penetration dive, as the diver can usually be easily pulled to the surface at the location of the topside tender.

There is a clear and distinct difference between working beneath a vessel and working in a pipeline. In the former case, the diver may be directly retrieved by the surface tender without danger of entrapment or entanglement as the umbilical is generally maintained in a horizontal direct line to the diver. In case of a diver entering an underwater pipeline, the umbilical will often turn a corner at the entrance to the pipeline, or even within the pipeline, and therefore it must be tended at such points by another diver acting as in-water tender. When performing long penetrations, additional in-water tenders may be needed, and calculations should be performed to ensure adequate volume and pressure of gas is delivered to the diver.

5.37 POTABLE WATER DIVING OPERATIONS

5.37.1 GENERAL

The intent of these guidelines is to address some of the more obvious requirements necessary for the conduct of safe commercial diving operations in potable water tanks and reservoirs.

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

5.37.2 OPERATING PROCEDURES

5.37.2.1 Non-isolated Storage Facility Operations

While the water facility operator may choose to isolate the facility from the system during underwater maintenance activities, it is recognized that isolation of the storage facility in order to undertake routine underwater maintenance may be inconvenient, or even impossible, as a result of system operating or design limitation.

Any diving operation conducted with the water storage facility in a non-isolated status may present potential hazards to the diver. This is due to the differential pressure created by the head of water versus the decreased pressure at the valve outlet location.

Under such conditions, a thorough JHA evaluation of the situation must be considered during planning and assessment and proper steps taken to ensure that the diver and equipment will not be subjected to the differential pressure. (See Section 5:17: Differential Pressure.)

Steps must be taken to ensure that the diver is aware of the fact that a particular valve will be open and that a differential pressure hazard exists. Care must be taken to furnish the diver with a detailed location of open valves and instruct the diver to remain clear of any such openings. The water facility operator MUST take part in discussions relative to diver safety in a non-isolated facility and be prepared to take appropriate action as agreed.

5.37.3 ISOLATED STORAGE FACILITY OPERATIONS

In the event that the water facility operator elects to isolate the water storage facility for the conduct of underwater maintenance activities, the facility shall be removed from service and isolated from the system prior to the commencement of any diving activity. All system primary and secondary inlet and outlet valves must be verified as locked and tagged "closed" by the designated person in charge (diving supervisor) of the diving operation.

In the event that storage facility valves must be inspected during diving operations, system valves farther upstream or downstream must be closed.

All valves critical to isolation of the water storage facility must be tagged in either the open or closed position as agreed during planning and assessment. Security of the valve(s) position must be assured, and that no valve can be opened without the expressed permission of both the water facility's designated person in charge and the designated person in charge of the diving operation (diving supervisor).

Divers shall not enter the riser pipe in an elevated tank unless the tank has been isolated, locked, and tagged in accordance with Lockout/Tagout procedures.

5.37.4 EQUIPMENT AND PERSONNEL REQUIREMENTS

NOTE: It is strongly recommended that equipment used in these operations be solely dedicated to potable water operations only.

5.37.4.1 Equipment

All diving and other equipment used for underwater inspection of potable-water storage facilities shall, wherever possible, be dedicated for that purpose only. If not feasible, all equipment intended for use in a potable-water storage facility shall be certified as having been thoroughly disinfected prior to arrival at the job site, and the dressed diver shall again be disinfected at the potable-water site.

Equipment to be used in potable-water storage facilities should, at a minimum, be disinfected by first removing all visible debris, dirt or other substances and then totally immersed in 200 PPM chlorine solution for a minimum of two minutes prior to use in potable water. Total immersion means that all outside surfaces of the equipment that will have contact with the potable water must be in continuous contact with the 200 PPM chlorine solution. The dressed divers shall be sprayed with a 200 ppm chlorine solution immediately before entering the water. Further information on disinfection procedures is available from the ANSI/AWWA Disinfection Standard.

Any equipment previously used in a contaminated water diving environment should not be used inside a potable water facility.

Scuba shall not be used in potable water facility operations.

- **Diver clothing.** Each diver shall wear a vulcanized rubber or other smooth surface material dry suit in good condition, free from tears, scrapes, damaged areas or other imperfections that may impair the integrity of the suit or serve as a site for bacteriological contamination. Further, the diver's dress, including the diving helmet and suit, shall provide complete encapsulation and isolation of the diver's body from the potable water.
- **Diving helmet.** The diver shall wear a diving helmet (a hard helmet that totally surrounds the diver's head in a dry environment) that is equipped with live voice communications and a neck dam that can be sealed to the suit, and can be fitted to accept a bailout system with shut-off valve. Further, the helmet shall, just as all of the diver's equipment and clothing, be considered a potential source of bacteriological contamination. The use of a diver band mask (any configuration of mask and breathing regulator that does not totally surround the diver's head with a dry helmet) shall be specifically prohibited except in the case of an emergency.

5.37.5 SAFETY

No standard can cover all situations that might be encountered. JHAs, common sense and extra attention by the entire dive team are considered essential components for approaching operations of this nature. JHAs should be updated as work progresses to reflect the current conditions.

5.37.6 GENERAL REQUIREMENTS

- For all diving operations intended to take place in an elevated structure, a means of rescue of personnel from the top of the structure shall be provided. A safe and effective means of lowering injured personnel from the top of such tanks will be provided.
- A means for rescue of diving personnel from an enclosed space or elevated height must be furnished as applicable, when required.

When diving operations are being conducted on elevated tanks, increased manning levels shall be considered.

5.38 CONTAMINATED WATER DIVING OPERATIONS

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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 shall be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

The information presented in this section has been generated as guidance material only that must be considered when planning the conduct of contaminated water diving operations.

A primary consideration during contaminated water diving operations is to minimize the length of time during which members of the dive team are exposed to contaminants. Dives should be scheduled to require no in-water decompression so as to limit the diver's exposure to waterborne hazards.

5.38.1 TRAINING

a. All personnel who are likely to participate in contaminated water diving operations should receive training consistent with regulatory requirements for the area where operations are to be conducted, such as 29 CFR 1910.120 (U.S. OSHA) – Hazardous Waste Operations and Emergency Response (HAZWOPER).

b. Specific training must be furnished in:

- Dry suits.
- Personal protective equipment for topside and diving personnel.
- Decontamination procedures, including preparation of the disinfectant or other solution intended for use.
- Decontamination of personnel and equipment used during operations.

5.38.2 SITE EVALUATION

When operations will take place where the water is suspected or known to be contaminated, a site assessment must be conducted. This assessment should include:

- Any suspected contaminants and potential hazards.
- Testing of the dive environment: It is not always possible to tell whether an environment is contaminated either by sight or smell. Any diving environment should be approached with caution, and when contamination is suspected, the water should be tested prior to commencing operations.
- Wind: In situations where there may be toxic fumes, the dive station, compressor and topside personnel must be situated up-wind from any source of contamination to the air.
- Current: Both on the surface and underwater, the diver should approach any known point-source of contaminant from the up-current side whenever possible. This will allow the current to carry contaminants away from the diver.
- Perimeter: Whenever possible, a perimeter should be established around the dive station and dive site to keep unprotected persons away from any possible contamination.
- Established zones: Zone management should be employed when applicable to keep unprotected personnel and equipment outside of the hot zone.

5.38.3 TOPSIDE PERSONNEL PROTECTIVE EQUIPMENT: EPA SELECTION GUIDELINES

To aid in the selection of complete protective ensembles, including chemical protective clothing and respirators, the United States Environmental Protection Agency's (EPA) Office of Emergency and Remedial Response has designated four levels of chemical hazards, ranging from extremely dangerous or unknown (Level A) to situations where only basic work-wear (Level D) is the required protection. The OSHA standard recommends the use of these guidelines, which can assist employers in complying with the protective equipment requirements of the standard.

The following is a brief review of the EPA guidelines. These are explained in greater detail in Appendix B of the OSHA standard and Table 1 (in this section).

- **Level A** calls for a vapor-tight suit (total-encapsulating) that is non-permeable to the chemicals to which a worker will be exposed. Also necessary is an approved, positive-pressure, self-contained breathing apparatus (SCBA) or a NIOSH-approved, positive-pressure air-line respirator with escape SCBA having no less than a five-minute air cylinder. Outer and inner chemical-resistant gloves and chemical-resistant boots with a steel toe and shank should also be used.
- **Level B** necessitates the same level of respiratory protection and complete skin coverage as Level A. However, protective clothing does not have to be vapor tight.
- **Level C** calls for a full-face piece, or half-mask air-purifying respirator; splash garments used with outer and inner chemical resistant gloves; and chemical resistant boots with a steel toe and shank.
- **Level D** calls for basic work-wear such as long sleeve coveralls, hard-soled shoes and face shields or goggles.

a. Before any diving operation is conducted in contaminated water, a risk assessment is vital. Personal protective equipment (PPE) must be selected based on its known ability to protect workers from the specific hazards present or suspected. This applies to the diver and the topside personnel. There are four different categories of topside PPE, from the least protective (Level D) to total encapsulation (Level A). Requirements for these levels are set forth in Table 1 in this section.

b. The key variables that must be considered when selecting PPE are:

- Identification of the hazard(s).
- Route of potential hazard to employees, e.g.., inhalation, skin absorption, ingestion and eye or skin contact.
- The performance of PPE materials, seams, visors and all other vital components
- Matching PPE durability of materials such as seam, tear, burst and abrasion strength to dive site-specific conditions.
- Matching site environmental conditions to PPE effect on employees (e.g.., heat stress, hypothermia, dehydration, duration of task, etc.).
- Equipment selection (PPE). Site-specific variables must be considered and protection geared to the worst case situation if those variables are not positively identified. The more that is known about the site, the easier it will be to customize suitable PPE to ensure protection of the dive team topside members.

<table>
<tr><th colspan="5">TABLE 1
GUIDELINES FOR SELECTION OF PERSONAL PROTECTIVE EQUIPMENT</th></tr>
<tr><th>EPA Level</th><th>Respiratory Protection</th><th>Protective Clothing</th><th>Hand and Foot Protection</th><th>Additional Protection</th></tr>
<tr><td>A</td><td rowspan="2">An approved positive-pressure, full face-piece, self-contained breathing apparatus (SCBA)

or

An approved, positive-pressure, supplied-air respirator with escape SCBA (minimum 5-minute duration)</td><td>Totally encapsulating chemical protective suit specifically designated to resist permeating by chemicals that are encountered</td><td rowspan="3">Gloves: Outer and inner chemical-resistant gloves

Boots: Chemical-resistant, with steel toe and shank</td><td>• Coveralls
• Long underwear
• Hard hat
• Two-way radio communications system</td></tr>
<tr><td>B</td><td rowspan="2">Hooded chemical-resistant clothing made of materials resistant to the chemicals encountered (overalls and long-sleeved jacket; coveralls; one-or two-piece chemical splash suit; disposable chemical-resistant overalls).</td><td>Above, plus:
Face shield

Boot covers (disposable, chemical-resistant)</td></tr>
<tr><td>C</td><td>An approved full face-piece or half-mask air-purifying respirators</td><td>Above, plus: all items that precede it Escape tank</td></tr>
<tr><td>D</td><td></td><td>Coveralls.</td><td>Boots: Chemical-resistant, with steel toe and shank</td><td>Above, plus: all items that precede it Safety glasses or splash goggles

Gloves</td></tr>
</table>

5.38.4 DIVER-WORN OR CARRIED EQUIPMENT AND ACCESSORIES

a. Selection of the diver-worn equipment must be based on the level of contamination protection required. The following equipment configurations are only recommendations. Responsibility for selection of equipment and diving technique must be made by the persons engaged in the diving activity as identified in the dive plan and/or job safety analysis.

b. Equipment that supports the diver must also be compatible with the contaminants that may be encountered.

c. There are three levels of protection for diver-worn equipment and accessories, from the most protective (Level One) to the least protective (Level Three. Requirements for these levels are set forth in Table 2 in this section.

d. All diver-worn equipment should be tested for integrity and function prior to the diving operation.

TABLE 2 DIVER-WORN OR CARRIED EQUIPMENT AND ACCESSORIES		
LEVEL ONE (Most Protective)	**LEVEL TWO**	**LEVEL THREE (Least Protective)**
• For diving in waters containing biological contamination, petroleum fuel, lubricating oils and industrial chemicals known to cause long-term health risks or death • Helmeted surface-supplied diver with mated non-porous dry suit with attached boots, gloves, and a return line exhaust or double exhaust valve system **NOTE:** The use of Level One protection should take into consideration the chemical compatibility of the equipment being used and the resultant permeation of waterborne contamination into the equipment. (Consult manufacturer's data). Diving in waters containing strong chemicals or nuclear contamination where even minor exposure could cause a serious threat will require special consideration and planning, equipment precaution, and training	• Biological or chemical contamination that will cause short-term health effect but will not cause lasting injury, disability or death • Surface-supplied umbilical with dry suit with attached and sealed hood, gloves and boots • Full-face mask that overlays the dry suit hood face seal	• Recommended for diving in waters that are considered to pose a minimal health risk • Scuba/surface-supplied umbilical with half-mask or full mask, chafing overalls, and hand and foot protection

Any actual or suspected breach of a Level One diving system is cause for the immediate termination of diving operations.

5.38.5 DECONTAMINATION PROCEDURES

In certain highly contaminated diving situations, the following procedures may be applied but are not necessarily applicable for every job:

a. The area surrounding the diving control station may be divided into three zones for proper isolation of contamination. The zone immediately surrounding the point of water entry/exit is deemed "high contamination." The zone where divers and gear progress after initial decontamination is termed "low contamination." The final zone into which the divers progress after they have been decontaminated and all diving gear removed is "clean."

b. An effective color-coding system may be employed to communicate clearly the demarcation point of the decontamination area. One system might be to use red to identify all "high" areas, yellow for "low" areas and green for "clean" areas. If at all feasible, the "clean" zone should be positioned up-wind of the contaminated zones.

c. **Initial freshwater rinse:** Spray off bulk of contaminants using high-pressure, clear freshwater rinse. If effluent does not require capture, begin hosing diver as he or she initially exits water to limit quantity of contaminants transferred to the dive station.

- Take precautions to direct water flow away from potential points of leakage of diver's rig, such as exhaust valves, seal junctions, etc. A high-pressure jet of water directed at such potential breach points may inject contaminants inside of the protective gear and into contact with the diver. Care should be taken to ensure the removal of the bulk of contaminants at this stage in order to afford the greatest efficacy of subsequent decontamination steps.

d. **Oversuit:** If a reasonable expectation exists for encountering bulky, adherent contaminants in the course of a dive, the use of a disposable oversuit is strongly encouraged. Disposable, hazardous material protective suits may be secured to a diver after he or she has been outfitted with the entire diving rig.

- No effort to make the oversuit water-tight should be attempted. Such action could complicate the dive by creating air pockets that could affect buoyancy of the diver. As the diver arrives on the dive station, the oversuit should be cut away to allow for decontamination of the diver and equipment. At this time, removal of dive gear such as harnesses, weight belts, emergency gas supply (bailout) tanks, etc., should be performed with these items themselves being properly decontaminated.

e. **Scrub down:** After the diver has been initially rinsed and his or her equipment removed, he or she may be scrubbed with a stiff-bristle synthetic brush and a cleaning solution as applicable. Long-handled brushes may facilitate the cleaning process. Hand-held brushes may be employed for detailed cleaning of the dive helmet and the neck-dam interface.

- Once the diver has been thoroughly scrubbed with cleaning solution applied from head to toe, he or she should be rinsed with fresh water. Care should be taken to ensure the diver has been cleaned of all visible contamination, most notably in the area adjacent to the neck-dam, helmet and dry suit.
- The composition of the cleaning solution should be appropriate for the contaminant to be removed.

f. **Undress diver:** Once the diver has been adequately decontaminated and moved into the "low contamination" zone, the dive gear should be removed. First, disconnect the locking mechanism from the helmet to dry suit and remove the helmet. Then, remove the dry suit and gloves and finally, the undergarments.

- If there are no indications that the diving rig has been breached during the dive, the diver may proceed to the "clean" zone and, if applicable, take a post-dive shower.
- If there are positive indications of dermal exposure to contaminants, additional decontamination measures may be required.

g. **Clean equipment:** After removal from the diver, all equipment should undergo secondary decontamination.

h. **Capture effluent:** In some circumstances it will be necessary to capture all fluids used to rinse, wash and re-rinse the diver and equipment and dispose of them in a manner appropriate for hazardous materials. If necessary, the above procedures will need to be altered to ensure that all decontamination procedures take place within a water-impermeable capturing area.

5.38.6 HAZARD EVALUATION AND IDENTIFICATION[1]

a. When the threat of a chemical hazard is suspected, consider conducting a historical review of the site. Items such as spill history, known chemicals present, volume of chemicals, active discharges, air quality, present and past nature of operations, and presence of extremely hazardous substances should be examined. Facility safety officers, plant supervisors or technicians may provide useful information.

b. When planning contaminated water diving operations, water temperature needs to be taken into account when determining the proper equipment to be used.

c. Check with local, state or federal water quality agencies for current advisories on biotoxins, waterborne pathogens, microbial contamination, fish or shellfish advisories, beach closures or storm events, any of which may indicate pollutants to be present.

d. When hazardous contaminants are suspected, consider water or sediment sampling and analysis. The selected laboratory can provide proper containers and procedures for sample collection, handling and shipping.

e. If the pollutants have been identified, rapid on-site test kits for selected chemicals in sediment or water are, in some cases, available.

If severe contamination is known to be present at the planned site of diving operations, consideration should be given to using an ROV if possible.

f. Hand-held detectors for monitoring a class of airborne chemicals, such as volatile organics, can be utilized for:

- Initial entry into the staging area during mobilization if the air quality is unknown.
- Continuous monitoring with alarms during diving operations to rapidly notify the participants if air quality changes.
- Scanning the diver upon water exit and after decontamination to determine if contaminants are present.

g. Lists of very dangerous chemicals that may readily penetrate diving equipment or cause substantial harm after a brief exposure can be obtained from the suit manufacturer. If a diver or topside crew member suspects exposure, blood, urine or other biological samples may be gathered for medical review.

Notes

SECTION 6.0

LIFE-SUPPORT EQUIPMENT: REQUIREMENTS, MAINTENANCE AND TESTING

Association of Diving Contractors International, Inc.

6.0 LIFE-SUPPORT EQUIPMENT: REQUIREMENTS, MAINTENANCE AND TESTING

6.1 GENERAL

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.

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.

The diving supervisor 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 shall be permitted to commence until all systems and equipment have been thoroughly tested for proper functionality.

6.2 MAINTENANCE RECORDS

Suitable equipment logs shall be established and maintained in a correct and current condition.

Life-support equipment shall have a unique identity traceable to the equipment/maintenance log.

Entries made in the equipment log shall 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.

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

6.3 DIVER'S DRESS

6.3.1 GENERAL

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

6.3.2 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.
3. Protect the diver from the environment, e.g., temperature or hazardous material.

6.3.3 HOT WATER SUITS

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 110º F (44º C).
3. Have a means to allow the diver to bypass incoming water prior to it entering the suit.

6.3.4 HARNESSES[2]

A working diver shall be equipped with a full body diving harness that:

a. Is designed to:
   I. Provide a method to securely attach the umbilical to the diver.
   II. Lift an unconscious or injured diver and his or her equipment from the water in an emergency.
   III. Be utilized for underwater use.
b. Has an overall breaking strength of no less than 2,000 pounds.
c. Is equipped with a positive buckling device (i.e., designed to prevent strap pull-through and accidental release by the diver). It shall not be possible to release the harness by a single action.
d. Is equipped with 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. If the harness has multiple attachment points of different strengths, those suitable for umbilical attachments are to be clearly identified.

e. Is equipped with adjustable leg straps.

f. Is fitted with at least one lifting (recovery) ring, accessible when the diver is fully dressed, suitable for recovery of the diver from the water in an emergency using a hoisting device or other suitable means.

g. Is designed to maintain the diver in a heads-up position during recovery (using the lifting ring) from the water in an emergency.

h. Allows 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.

i. Is to be visually inspected prior to use for any signs of deterioration or damage. Any harness whose material condition is in doubt shall not be used until a determination is made by the diving supervisor.

j. Is to be regularly maintained in accordance with the manufacturer's recommendations.

k. Is certified by the manufacturer as detailed below.

- **Certification and Testing of Diving Harnesses**

  A new diving harness shall be certified by the manufacturer or supplier to confirm that:

  a. 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.

  b. Each complete full-body harness, including adjustment systems, buckles, etc., shall withstand a tensile load of at least 2,000 punds for five minutes, applied in the direction of lift, without sustaining damage that would render it inoperable or unsafe to use.

  c. Each harness is clearly marked in a durable manner with the following minimum information:
     - Manufacturer's name and country of origin.
     - Product model and number.
     - Month and year of manufacture.
     - Unique serial number for that harness.
     - Breaking strength.

6.3.5 WEIGHT BELTS

Weight belts shall:

a. Be of sufficient weight to maintain the diver at working depth.

b. Not be used as an attachment for the diving umbilical.

c. Be equipped with an appropriate release buckle.

d. Be attached to the diver in a manner to avoid accidental disengagement.

6.3.6 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY

Diver-worn or carried emergency gas supply (bailout) shall have a minimum calculated four-minute supply at the anticipated depth. (See bailout calculations in Section 11: Reference Materials).

EGS systems shall:

1. Have a cylinder(s) meeting the requirements in Section 6.11.2
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. The diver-carried EGS or mask/helmet shall have a positive means of isolating it from the primary gas supply.
5. When diving a gas mixture other than air, sample/test to verify contents.
6. Bottles must be clearly marked with content, date, pressure and the name of the individual performing this verification.

EMERGENCY GAS SUPPLY DURATION FORMULA

$$Da = \frac{Va}{Cd}$$

Da = Duration in minutes

Va = Available volume in scf

Cd = Consumption at depth in scfm

NOTE: The available volume depends on the type (rated volume and rated pressure) and number of cylinders used, the measured gauge pressure and the recommended minimum cylinder pressure.

6.4 HELMETS AND MASKS

6.4.1 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 shall be maintained and inspected in strict compliance with the manufacturer's recommendations. Suitable logs shall 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 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.
6. Be maintained in accordance with manufacturer's specifications and have all modifications that affect safety or performance documented in the equipment log.

6.4.2 HEAVYWEIGHT DIVING HELMETS

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

1. Meet the requirements of paragraph 6.4.1.
2. Have a helmet group consisting of a helmet, breastplate and associated valves and connections.
3. Be equipped with a quick-dump valve to prevent over-inflation.

6.4.3 LIGHTWEIGHT DIVING HELMETS

Lightweight diving helmets shall:

1. Meet the requirements of paragraph 6.4.1.
2. Be fitted to accept diver-worn EGS.
3. Be fitted to allow for positive and ready removal from the diver in all uses.

6.4.4 CLOSED-CIRCUIT AND GAS-RECLAIM-SYSTEM HELMETS

Closed-circuit and gas-reclaim helmets shall:

1. Meet general requirements of Section 6.4.4
2. Be fitted to function on open circuit.

6.4.5 BIBS (BUILT-IN BREATHING SYSTEMS)

Individual breathing equipment utilized in PVHO 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.
6. Be maintained in accordance with manufacturer's specifications.

6.5 HOSES

6.5.1 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). Be suitable/rated by manufacturer for 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.
8. Be of suitable design to prevent collapse when used for operation with higher external pressure than internal pressure.

6.5.2 BREATHING GAS HOSES (LP)

Breathing gas hose assemblies shall:

1. Meet requirements of paragraph 6.5.1.
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).
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.

Note: The axial load weight may be removed after the initial test pressure has been applied, providing no leakage is evident.

6.5.3 UMBILICALS

Diver umbilical and dive hose assemblies shall:

1. Meet the requirements of paragraph 6.5.1.
2. Be marked from the diver/bell end in 10-foot intervals up to 100 feet and marked in 50-foot intervals thereafter.

Note: To ensure uniformity throughout the commercial diving industry, ADCI Standard 006 recommends the following color coding be used by all participants.

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

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).

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).
5. Have a minimum break strength of the hose assembly, including terminating hardware (e.g., "D" ring or attaching points), of 1,000 pounds.
6. Pneumo hose shall be annually pressure-tested for leakage.

The umbilical assembly used for the standby diver must be of sufficient length to reach the primary diver at his or her furthest possible excursion from the dive station.

6.5.4 OXYGEN HOSES

1. Oxygen hoses shall meet the requirements of Section 6.5.4 and be suitable for 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."
4. Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.

6.6 COMPRESSOR SYSTEMS

6.6.1 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 paragraph 6.5.1.
6. Have electrical controls, wiring and drive units meeting the jurisdictional requirements, when so equipped.

6.6.2 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.

6.6.3 TESTING

Compressors used for breathing gas shall be functionally tested per the following schedule, and shall 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.
4. After any repairs that may affect the compressor's performance.

6.6.4 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) shall be kept on file and available upon request.
4. Compressors used for breathing gas transfer other than atmospheric air shall be checked every six months to ensure they do not induce contaminants into the gas being processed.

6.7 LAUNCH AND RECOVERY SYSTEMS (LARS)

6.7.1 GENERAL

Launch and recovery systems intended for the launch and recovery of a diver or divers between the surface dive location and the work location by either bell or stage shall:

1. Be designed, manufactured installed and tested in accordance with applicable design codes, standards and regulations.
2. Be designed such that the drive system and not the brakes control operation under normal conditions.
3. Be fitted with two independent braking systems capable of holding 1.25 times the safe working load of the winch.
4. Be designed so that the load can be stopped, and held in position, if the power supply fails, is disengaged, is switched off, or if operating control is released.
5. Have controls located or equipped such as to afford the operator both a view and control of the lifting operation, or appropriate signalman.
6. After any installation, alteration, repair or failure, be thoroughly examined and be functionally and load tested to 1.25 times the safe working load of the handling system.
7. Have wire ropes and fittings that are:
   - Installed, terminated and maintained in accordance with design criteria and/or manufacturer's recommendations.
   - Visually inspected every six months for damage, deterioration or deformation.
   - Periodically examined and tested to recognized applicable codes and standards.
   - Have wire ropes and fittings that are rated eight times the load.
8. Have a spooling arrangement fitted if fleeting angle exceeds 2 degrees.

6.8 DIVER ENTRY AND EGRESS SYSTEMS

6.8.1 DIVING LADDER AND STAGE

Diving ladders and stages 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.
4. Ladders must extend a minimum of 3 feet below surface where installed.
5. Stages must be equipped with a safety chain and internal handholds for dive safety during launch and recovery.

6.8.2 OPEN-BOTTOM BELLS

Open-bottom bells shall:

1. Have an upper section that provides an envelope capable of maintaining a bubble of breathing mixture for a diver when the diver is standing on the lower section with his or her body through the open bottom and his or her head in the bubble.
2. Have lifting eyes rated for lifting 500 pounds for each occupant, plus the weight of the bell.
3. Be protected against and maintained free from injurious corrosion.
4. Able to accommodate two divers with gear in an uncramped position.
5. Be fitted with internal handholds for divers.
6. Have provisions for mounting of breathing gas cylinder(s) and regulator for emergency breathing at all depths of intended operation.

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

6.10 TIMEKEEPING DEVICES

Devices utilized to monitor a diver's exposure time under pressure shall be suitable for purpose and easily readable.

6.11 COMPRESSED GAS EQUIPMENT

6.11.1 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.
9. Be cleaned for oxygen service and have slow-opening valves when used in systems containing greater than 50 percent oxygen.
10. Be inspected internally and externally at least annually for damage or corrosion.
11. Be pneumatically tested to MAWP annually, utilizing the breathing mixture normally used.
12. Be hydro 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.
13. Have a unique identity with results of all tests being recorded in the equipment log.

6.11.2 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.
9. A record shall 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.

6.11.3 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.
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.

6.12 PRESSURE VESSELS FOR HUMAN OCCUPANCY

6.12.1 GENERAL

Pressure vessels for human occupancy (PVHOs), associated with diving operations cover a wide range of applications, including, but not limited to, deck decompression chambers, diving bells, saturation living chambers, transfer locks and hyperbaric emergency evacuation systems.

PVHOs and associated systems are specialized equipment that are operated within the harsh environment of the diving industry and present potential risks to personnel supporting diving operations. PVHOs typically have unique attributes such as acrylic viewports and quick-opening pressure closures that have requirements for maintenance and safe operation.

The ADCI, in its technical and advisory capacity to the diving industry, has adopted a set of recommended standards for PVHOs specifically to minimize the risks involved with their safe operation. These standards were conceived as recommendations to be incorporated into industry practice. The standards cover P.V.H.O design, fabrication, inspection, maintenance and repair. A PVHO is governed by industry standards, classification societies and national and applicable regulatory authorities (see "References" at the end of Section 6).

6.12.2 PVHO DESIGN AND CONSTRUCTION REQUIREMENTS

All PVHOs shall meet the following minimum requirements:

1. PVHOs and their associated systems shall be built in accordance with ASME, PVHO-1 and/or in conformance with the requirements of a classing society competent in PVHO diving systems.
2. Have a pressure relief device as per ASME, PVHO-1 or the code/standard of construction. Normally this is no more than 10 percent above MAWP (maximum allowable working pressure) of the PVHO.
3. Any doors, hatches or quick-acting closures associated with a TUP (transfer under pressure) system shall be equipped with an interlock system to prevent accidental opening under pressure. This would include medical locks, equipment locks and bell TUPquick closures.
4. Have a control panel with a dedicated pressure gauge indicating depth for each pressurized compartment. The gauges shall:
   - Be maintained with a calibration of each depth gauge within six months.
   - Be arranged so as to allow comparison with another gauge while in operation.

6.12.2.1 Surface Diving Decompression Chambers

Surface diving decompression chambers shall:

1. Meet requirements of Section 6.12.2.1
2. Be dual-lock and multiplace (except emergency rescue chambers or chambers designed to mate with another P.V.H.O., if regulatory codes allow).
3. Have sufficient internal dimensions to accommodate a person lying in a horizontal position with another person attending (except designated diving bells, transfer locks and emergency rescue chambers).
4. Permit ingress and egress of personnel and equipment while the occupants remain pressurized.
5. Have a means of operating all installed man-way locking devices, except disabled shipping dogs, from both sides of a closed hatch.
6. Have illumination of the interior sufficient to allow operation of any controls and allow for visual observation, diagnosis and/or medical treatment.
7. Have a viewports that allows the interior to be observed from the exterior.
8. Have a minimum pressure capability of 6 ATA (165 fsw) [50.3 m]; or the maximum depth of the dive for dives deeper than 10 ATA (300 fsw) [91.5 meters].
9. Be capable of a minimum pressurization rate of 2 ATA (18.3 meters) and at least 1 ATA (9.2 meters) per minute thereafter.
10. Be capable of a decompression rate of 30 fsw (9.2 meters) per minute to 33 fsw [10.06 meters].
11. Have a means to maintain an atmosphere below a level of 25 percent oxygen by volume.
12. Have a means of maintaining an atmosphere not to exceed 1 percent surface equivalent carbon dioxide by volume.

13. Have mufflers/silencers on blowdown and exhaust outlets.
14. Have suction guards on exhaust line openings inside each compartment.
15. Have piping arranged to ensure adequate circulation.
16. Have all installed flexible hoses meet the requirements of Section 6.5: Hoses.
17. Have all penetrations clearly marked as to service.
18. Have piping in accordance with ANSI B31.1 and/or ASME/PVHO-1 or the classification society to which it was built.
19. Have the relief valve pressure settings tested annually and the test recorded in equipment log.
20. Have an installed breathing system with a minimum of one mask per occupant per lock, plus one spare mask assembly per lock.
21. Have the capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work.
22. Have a non-return valve on through hull penetrators supplying any built-in breathing system (BIBS).
23. Have a primary and secondary two-way voice communication system between the occupants and the operator.
24. Have a secondary communication system; this may be sound-powered telephones with growler signal devices.
25. Be equipped with a readily available means for extinguishing fire.
26. When fitted, have electrical systems designed and installed fit for purpose for the environment in which they will operate.
27. Chamber and BIBS exhaust should not vent into an enclosed space.
28. The chamber and its general area and controls should be adequately illuminated for operations at night.
29. If external lights are used to illuminate the chamber internally, they shall not be placed in a manner to subject viewports to heat buildup and damage.
30. If the chamber is located away from the dive control station, there must be a means of communications between the two locations.
31. All chambers shall have an emergency breathing media immediately available to the BIBS in addition to the treatment gas.

6.12.2.2 Saturation Chambers

Saturation PVHO chambers, regardless of use; living chambers; TUP chambers; or any man-rated components of a saturation complex designed and intended for a human to be housed in shall have all the requirements of decompression chambers plus the following:

1. Have sufficient internal dimensions to accommodate the PVHO-rated occupancy of each person standing and lying on their assigned bunk in a horizontal position and personal storage.
2. The ability to analyze the ambient environment, including temperature, humidity, oxygen and CO2, on a continuous basis.
3. Oxygen and CO2 analysis gas sampling shall be from dedicated equipment with visual and audio alarms to ensure a predetermined high or low level is brought to the attention of the sat control life-support technicians
4. Chambers shall have the ability to analyze the gas samples in the chambers from a low and high point in the chamber. (This ensures gas stratification is identified and monitored.)
5. Chambers shall have an environmental control system capable of maintaining a physiologically suitable temperature and humidity during normal operations.
6. Metabolic oxygen make-up shall be controlled in a manner that will maintain a constant desired level.
7. Medical or equipment locks shall be located in strategic locations to ensure the PVHO occupants have the ability to receive supplies, food, drink and miscellaneous needs during normal operation as well as during emergency operations.
8. In chambers designated as sanitary and shower areas, the toilet receptacle shall have a raised vented seat to ensure a seal cannot be created by the occupant sitting on the toilet seat.
9. The toilet assembly shall have a safety interconnect device that will not allow the flushing of the toilet while the occupant is seated.

6.12.2.3 Diving Bells, Submersible Decompression Chambers, Closed Bells[3]

Submersible decompression chambers/diving bells shall:

1. Meet the PVHO design and construction requirements where applicable.
2. Have sufficient internal dimension to accommodate the intended number of divers and their equipment.
3. Have protection against mechanical damage to valve penetrators, sealing surfaces, onboard gas, etc.
4. Have view ports to allow occupants to observe their external surroundings, also sufficient to allow observation of the interior from the exterior.
5. Have protection against mechanical damage on all view ports.
6. Have all piping penetrations equipped with a shutoff valve on both sides of the pressure boundary.
7. Have all penetrations, valves, gauges and piping clearly marked as to service and operation. A diagram or photographic records of the bell valves (internal and external) should be available at the dive control station.
8. Have identified points for connection of emergency services.
9. Have all installed flexible hoses meet the requirements of paragraph 6.5: Hoses.
10. Be equipped with sufficient primary and emergency electrical power for 24 hours.
11. Have a means by which occupants may read internal depth pressure and external depth pressure at all times.
12. Have an installed oxygen analyzer readable by the occupants.
13. Have an internal method of analyzing CO2. (Chemical tubes are acceptable.)
14. Have a means of removing CO2.
15. Have a primary two-way communication system between the diving supervisor and all divers supported from the bell, including the bell occupants.
16. Have a secondary communication system connected to the dive control center. This may be a sound-powered telephone with growler signal devices.
17. Be equipped with a ”through-the-water” emergency communication system.
18. Be equipped with an acoustical beacon (must have sufficient power to last a minimum of 24 hours).
19. Have internal electrical systems that are designed for the environment in which they will operate to minimize the risk of fire, electrical shock or galvanic action of the PVHO.
20. Have electrical penetrators designed and installed fit for purpose for the environment in which they will operate that are tested to a minimum of two times the design working pressure of the bell and capable of withstanding applied pressure in either direction.
21. Have a capability of recovering an injured diver from the water (block and tackle/boom vang).
22. Have identified, installed and tested a secondary lift point capable of supporting the submerged weight of the bell.
23. Have a means of maintaining a physiologically suitable temperature during normal operations.
24. Have a means of controlling hot water flow to a diver locked out of the bell.
25. Have gas piping designed and arranged so that a venting or flushing of the bell will not adversely affect the breathing gas supply of any divers supported from the bell.
26. Be equipped with one individual breathing device for each occupant capable of providing breathing gas from both a surface-supplied source and the onboard emergency gas (plus one spare mask assembly).
27. Have sufficient onboard gas to allow a diver to remain outside the bell for 30 minutes at the maximum depth rating of the bell, at a breathing rate of 1.5 cfm.
28. Have a gauge indicating the pressure in the onboard emergency gas cylinders, readable by the bell occupants.
29. Have metabolic oxygen onboard to support the number of occupants for a period of 24 hours at a consumption rate of at least 0.5 liters per minute, per occupant. Note: Mixed gas in sufficient quantity may be substituted.
30. Have an oxygen supply so arranged that oxygen flow into the bell is limited to a controlled rate or volume relative to the bell internal pressure.
31. Have a first aid kit in a clearly marked and suitable container.

32. Have a basic tool kit.
33. Have a water-resistant copy of emergency procedures.
34. Have umbilical that meets the requirements of Section 6.5: Hoses, and provides breathing gas; pressurization and exhaust; communications and power; hot water; and other required services. The bell standby diver's umbilical must be capable of quick release action by the bellman once he is out of the bell in an emergency. If the bell standby diver's umbilical is stored outside of the bell, it must be adequately stowed to avoid damage during launch and recovery of the bell. The end of the bell standby diver's umbilical must be arranged to allow the standby diver to attach his or her mask or helmet and test it before the main diver exits the bell.
35. When fitted, have ballast release mechanisms that are designed to prevent accidental release.
36. Be designed so that the diver can freely exit and re-enter the bell if it is resting on the seabed. This normally requires a standoff frame and/or clump weight.
37. If diving below 500 fsw (152 meters), there must be a means of heating the divers' inspired gas.
38. Have a copy of the emergency tap code available to the bell occupants and dive control station personnel. (Emergency tap codes should be posted on the outside of the bell.)
39. Have a copy of the emergency tap code attached outside the bell near a viewport.
40. There shall be a means and written procedure to evacuate divers under pressure during an emergency.
41. No dive shall be made that exceeds the depth rating of the saturation system.
42. Maximum system working pressure shall not exceed the lowest-rated maximum working pressure of any component.

6.12.3 EMERGENCY EVACUATION SYSTEMS (EES)[3]

An EES is a dedicated PVHO that is designed for transport/evacuation of divers in saturation in an emergency situation. Any planned saturation diving operation shall require an EES.

There are two types of hyperbaric evacuation systems:

1. A PVHO adapted and designated for use in an evacuation. **(Not to include the primary bell.)**
2. A dedicated rescue system where a pressure chamber is fitted into or forms a part of a purpose built lifeboat.

Emergency evacuation systems shall:

1. Meet the requirements of sections 6.12.2.1 and 6.12.2.2: Saturation Chambers, as applicable.
2. Be outfitted to accommodate the maximum number of divers who may be under pressure.
3. Be fitted with a locating device.
4. Have oxygen or mixed gas on board to support the number of occupants for a period of 72 hours at a metabolic oxygen consumption rate of .017 cfm/0.48 liters per minute, per occupant.
5. Have a primary and secondary means to remove carbon dioxide from the atmosphere (e.g., battery and lung powered), as well as a means to monitor CO_2 and O_2 levels (PPO_2 meters are recommended).
6. Have onboard batteries to meet the demand of the electrical load for 72 hours.
7. Have a suitable first aid kit clearly marked, in a suitable container, and accessible.
8. There must be a detailed written procedure for evacuation of the EES contained in emergency procedures.
9. The EES shall be connected to the saturation system and pressurized to the shallower storage depth as a minimum, during all diving or decompression operations.
10. The EES shall be capable to transfer supply and equipment under pressure.
11. Contain appropriate warning signs. (Refer to IMO warning sign document in the IMO Code of Safety for Diving Systems a.536 (13))
12. Have the means to be recovered, towed and lifted.
13. Shall be tested for positive buoyancy to verify design, after any structural modifications or annually.

The HRC shall have a compatible life-support control system (LSCS)[3] available within 24 hours maximum of the HRC location and shall be stored in a different location than the saturation system. HRC LSCS shall, at a minimum:

- Have two-way communication.
- Have gas control panels.

- Have gas suitable for a maintaining depth.
- Have emergency gas for BIBS.
- Be able to monitor oxygen and CO_2
- Have a written copy of procedures in place to maintain the environment.

MAINTENANCE OF PRESSURE VESSELS FOR HUMAN OCCUPANCY ADDENDUM

INTRODUCTION

The ADCI, in its technical and advisory capacity to the diving industry, has adopted a set of guidelines for the repair and maintenance of PVHO equipment that it recommends be incorporated into industry practice.

The diving business is, by its nature, an industry that operates within a harsh environment. Consequently, the design, construction and maintenance of diving equipment and the associated operational procedures are governed by industry and national standards, as well as national and international regulations (Appendix A). PVHO tankage and its associated hardware and associated systems are specialized equipment, rules for which were conceived specifically to minimize the risk involved.

GENERAL PRECAUTIONS FOR ACRYLIC VIEWPORTS

These are general precautions for the cleaning, operational inspection, installation and maintenance of acrylic viewports used in pressure vessels for human occupancy. **For additional information, it is recommended that ASME PVHO-2 be referenced. This document covers design, inspection and maintenance for acrylic viewports.**

CLEANING

When cleaning is required, viewports should be carefully cleaned, and surfaces must not be scratched. An acceptable cleaning agent is mild soap and water.

Do not use solvents of any type (alcohol, acetone, etc.) for any purpose on the window, gaskets or O-rings.

CAUTION: Only hand-cleaning is allowed. The use of power-driven tools is not permitted.

After cleaning, inspect the window for blemishes such as cracks, chips, dings, scratches, crazing, blisters or discoloration. (Crazing is the development of a network of fine spiderweb-type cracks on the surface of the window; it can be caused by either stress or exposure to solvents.)

IN-SERVICE INSPECTION

Operational inspections should be conducted prior to each chamber pressurization. Visually inspect the accessible exterior, interior and bearing surfaces for the presence of blemishes in the form of crazing, cracks, scratches, blisters and discoloration. A common flashlight will assist in locating blemishes such as chips, cracks, or crazing and in determining the condition of bearing surfaces.

Blemishes on the low-pressure face can serve as initiators of cracks and subsequent failure in flat disk and conical frustum viewports. For diving bells and submersible diver lock-out compartment viewports, both faces should be considered low-pressure faces.

The depth of the blemish can be measured with a depth micrometer with a pointed rod (Brown and Sharpe, or equivalent or an optical comparator). Consideration should be given to the concentration of scratches, cracks or crazing occurring in the center of the viewing area, as this may be an indication of stress.

INSTALLATION

Viewports should be properly cleaned and carefully installed to ensure proper fit and safe operation. All viewport surfaces should be free of defects.

All metal contact surfaces must be smooth and clean. Surface should be free of all defects and foreign matter. An oxygen compatible lubricant, which is compatible with acrylic, should be used. Retaining bolts should also be cleaned, inspected and lubricated.

O-ring and gasket sealing surfaces must be completely free of any foreign material, such as cleaning agents and solvents, rust, sand, grit, paint chips, etc.

All paint that will come in contact with the viewport should be fully cured.

MARKINGS

Viewport identification markings must be preserved on each viewport during cleaning and handling. Corresponding viewport documentation should be maintained with the PVHO documentation package.

NOTE: Further information can be found in ANSI ASME/PVHO-1, Section 2.

DAMAGE BY ACCIDENT

Major structural damage may be caused by an accident or mishandling. This may include things like:

PRESSURE HULL DAMAGE

- Dents.
- Gouges.
- Damaged penetrator (stripped threads).
- Mating flange.
- Lift lug or tie-down eye (bent, broken or hole elongation).
- Support base (frame deformation).

DOORS

- Damaged sealing surface.
- Bent/broken hinge.
- Damaged dogging mechanism.

VIEWPORT DAMAGE

- Crazing.
- Cracked/chipped.
- Weld spatter.
- Paint thinner damage.
- Overheated/blistered (permanent deformation).

DAMAGE BY CORROSION

GENERAL

More important than damage done by an accident, and often unseen until more extensive, is the damage done by corrosion. Most damage by corrosion can be avoided with a diligent preventative maintenance program, however, even with the best preventative maintenance programs, damage can still occur.

TYPICAL CORROSION DAMAGE MAY INCLUDE

- Pit corrosion (shell and heads).
- Crevice corrosion.
- Penetrators.
- Viewport sealing surfaces.
- Door faces.
- Sealing surfaces.
- O-ring grooves.
- Support legs/saddles.

CORROSION ALLOWANCE

Pressure vessels are typically built with a corrosion allowance in the calculated required metal thickness. This information is usually found on the pressure vessel certificate. Examination of corrosion-affected areas should be done in a manner necessary to determine if the corrosion has gone beyond the calculated allowable amount and may require remedial action.

REPAIR OF A PVHO

The owner should be aware of the requirements of the regulatory authority and of interested third parties, as their requirements will have a direct bearing on the repair specification.

PVHO repair must be approached properly, regardless of how well the work is done or the quality of the material used. Without a conscious effort to comply with existing rules and regulations, it is possible to have an expensive repair that does not meet the requirements and is unacceptable.

It is important that a defined method is used when approaching the repair of a PVHO.

Recommended steps for approaching any repair are as follows:

- Appraisal.
- Plan.
- Execution.
- Documentation.

APPRAISAL

1. The initial step is to appraise the damage. This means more than a casual look at the vessel and agreeing that it has been damaged. All damage should be investigated to determine the cause and what measures can be taken to prevent a reoccurrence.
2. Measure or otherwise quantify the damage so you can answer questions about the extent of the visible damage. Be aware that there may be areas of hidden damage. Make a sketch or map of the damaged area; photos may be helpful. Make a written report, describing the nature and extent of the damage. Be accurate, and include as much detail as possible. Be honest in your appraisal; remember that the goal is to save the PVHO vessel and to put it safely back into service.
3. Damage to the pressure boundary of the vessel will require that any repairs be done in accordance with the code of manufacture. Likewise, damage to the attached piping shall be repaired to the code to which it was built. Only components meeting the applicable code requirements should be used for repairs or replacements.
4. Gather all of the existing documentation on the vessel. This information will be needed by engineering, code repair shop, authorized code inspector, insurance adjuster, classing society surveyor, etc.
5. Depending on the type and extent of damage, it may be necessary to perform in a nondestructive examination (NDE) to determine the extent of damage. It may be necessary to grit-blast the vessel to bare metal to determine the exact scope of work.
6. Prepare a written report and budget for the repairs.

NOTE: If the decision as to the disposition of the repair is yours to make, don't skip this step. It will become your tool to control the repair project.

PLAN

1. Make a technical plan for the repair. The plan should clearly establish the scope of work for the fabricator, as well as the scope of responsibility. This plan, if correctly drawn up, can function as the specification for the work and as part of a purchase order.
2. The plan should clearly state the codes, standards, rules, regulations and quality of workmanship that will govern the work. Don't forget the paperwork requirements. Be very specific about the paperwork and paper deliverables for which the fabricator or repair shop is responsible.
3. Prepare the drawings and/or calculations as necessary to affect the planned repair. An engineer, either in-house or outside, may need to be engaged to verify all details have been addressed.

You should then obtain agreement from the regulator (jurisdiction) or classing society that:

- The proposed repairs and techniques are within the code.
- The proposed materials meet the code requirements.
- The repair plan will be approved.

Most repairs will require an initial survey to look at the vessel and assess your repair plan.

EXECUTION

1. Having obtained the concurrence of the required parties, and armed with your repair plan, budget, drawings and specifications, you are now ready to talk with a qualified fabricator or repair shop.
2. The least problematic choice is the original vessel fabricator. This is not always possible, but the likelihood is that the original fabricator will have the records that will make the repair and documentation go more smoothly.

   Unfortunately, many of the fabricators that have built PVHOs in the last 15 years are either out of business or may not have retained the records on your vessel. The ASME requires records to be retained for only five years. It is a good idea to require, as part of your purchase agreement with any fabricator or repair facility, that you receive a copy of all paperwork. If the vessel was registered with the National Board of Pressure Vessel Inspectors, you can get copies of the certificate by contacting the National Board.
3. The next best choice would be a fabricator that is currently building and certifying PVHO vessels. The fabricator should be authorized to apply the ASME “U” stamp and/or the “R” stamp from the National Board. The scope and criteria to differentiate between minor and major repairs is provided in the National Board Code ANSI- NB23. Alternatively, for PVHOs constructed to other codes, the repair shop should be certified to do repairs to the code to which the PVHO vessel was built.

TESTING

1. Prior to, during and after repairs, various types of testing may be employed. Test results should be retained as part of the equipment record.
2. All non-destructive examinations should be done in accordance with ASME Section-V: Non Destructive Examination, by personnel competent in the type of test employed.

3 Pressure tests should be done in accordance with a written procedure and appropriate safety precautions.

DOCUMENTATION

1. All repairs and alterations are to be recorded in the equipment log. This should be accompanied by references to certificates and identification markings. Pressure testing should likewise be documented and recorded in the log. Any alteration or modification should be reflected in all drawing revisions.
2. All certificates, drawings, calculations and reports should be retained for the service life of the equipment.

A professional approach to the repair of PVHOs will yield professional results, thereby preserving a valuable asset and ensuring the safety of the occupants and operators.

It is impossible to guarantee that accidents will not happen. However, the probability can be significantly reduced by a good PREVENTATIVE MAINTENANCE PROGRAM and consistent safe practices.

REFERENCES

- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and 2
- ASME Section V : Non Destructive Examination
- ANSI — ASME/PVHO-1 and 2
- ANSI B31.1: Code for Pressure Piping, Power Piping
- Association of Diving Contractors International Consensus Standards for Commercial Diving Operations
- 29 CFR Part 1910: OSHA Rules for Commercial Diving
- 46 CFR Part 197: USCG Rules for Commercial Diving Operations
- IMO (International Maritime Organization) Code of Safety for Diving Systems, a.536 (13)
- IACS (International Association of Classing Societies)
  - ABS (American Bureau of Shipping)
  - DNV (Det Norske Veritas)
  - Lloyds Registry
  - National Board of Boiler & Pressure Vessel Inspectors ANSI-NB23

SECTION 7.0

EMERGENCY PROCEDURES, ASSESSMENTS AND REPORTING OF ACCIDENTS

Association of Diving Contractors International, Inc.

7.0 EMERGENCY PROCEDURES, ASSESSMENTS AND REPORTING OF ACCIDENTS

7.1 BASIC EMERGENCY PROCEDURES GUIDELINES

The following emergency procedures that may affect the health and safety of personnel are offered as minimum guidelines to assist companies in developing their own specific detailed emergency procedures. The steps that are listed may not be in order of preference. Each emergency will dictate its own priorities. In general, every emergency will cause the dive to be aborted until the cause has been fully remedied.

The pneumofathometer should always contain the same mixture as the diver breathing media. Emergency procedure drills should be performed on a periodic basis to ensure familiarity by the crews.

7.1.1 LOSS OF BREATHING MEDIA

1. Re-establish breathing media supply by:
   - Diver going on diver-worn or carried EGS (bailout);
   - Activating topside secondary breathing media supply; or
   - If applicable, put breathing media to diver's pneumo hose and have diver insert pneumo hose into helmet/mask.
2. Alert standby diver.
3. Diver goes to bell/stage/surface, as applicable.
4. If required, send standby diver to diver's assistance.
5. Terminate dive.

7.1.2 LOSS OF COMMUNICATIONS

1. Attempt to reestablish electronic communications.
2. If communication cannot be reestablished, attempt to communicate through line-pull signals.
3. If applicable, put breathing media to diver's pneumo.
4. Alert standby diver.
5. Diver proceeds to downline/bell stage or surface as applicable (if bell, attempt to use bell communications).
6. Bring diver to first stop once line-pull signals are established.
7. If required (unable to establish any form of communications with diver), send standby diver to diver's assistance prior to bringing diver to his or her first stop.
8. Terminate dive.

7.1.3 FOULED OR ENTRAPPED DIVER

1. Avoid panic and ensure diver does not ditch equipment.
2. Diver informs topside.
2. Alert standby diver.
4. Diver determines extent of entrapment.
5. Diver attempts to free himself or herself.
6. If required, send standby diver to diver's assistance.
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.

7.1.4 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. Standby diver should remain with injured diver.
5. Monitor diver's breathing. If diver stops breathing, overpressure his or her regulator, if possible.

6. If applicable, standby diver assists injured diver to surface, following proper decompression procedures, except when severity of injury indicates a greater risk than omitting decompression.
7. Institute planned diver recovery procedure.
8. Request required medical assistance and emergency evacuation, if required.

7.1.5 SEVERANCE OF DIVER'S UMBILICAL - GAS HOSE ONLY

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

7.1.6 SEVERANCE OF COMPLETE UMBILICAL

1. Diver activates bailout bottle and returns to bell/stage/surface. If applicable, diver activates and uses emergency gas on bell/stage.
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. Otherwise, send standby diver down the downline or bell stage cable.
6. Terminate dive and follow proper decompression procedure.

7.1.7 FIRE

Topside fire:

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

Fire inside PVHO:

1. Each chamber must have a means of extinguishing a fire in the interior.
2. Notify topside there is a fire in the chamber; evacuate to another chamber or lock if available or possible.
3. Divers inside the chamber should put on the BIBS with emergency gas.
4. Secure electrical power to non-essential systems.
5. Extinguish fire.
6. Vent the chamber.
7. Establish condition of the chamber occupants.

7.1.8 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.

7.1.9 ADVERSE ENVIRONMENTAL CONDITIONS

As a minimum, a JHA or specific procedure should be developed to address the following, as applicable:

- Adverse environmental conditions, including but not limited to:
  - Weather.
  - Sea state.
  - Currents.
  - Lightning.
  - Winds.
  - Methane/swamp gas.
  - Dangerous marine life.

7.1.10 OXYGEN TOXICITY 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 gasses.
3. Deploy standby diver.
4. Continue decompression on appropriate table unless a 50/50 nitrox mix is available for in-water decompression use.

7.1.11 OXYGEN TOXICITY DURING TREATMENT

1. Diver reports to topside.
2. Instruct diver to remove oxygen mask for 15 minutes. After all symptoms disappear, start oxygen again. Do not count time not on oxygen. Recommence decompression where oxygen stopped.
3. Tender shall be locked in.
4. If oxygen toxicity symptoms occur for the second time, repeat step 2.
5. If oxygen toxicity symptoms occur for the third time, discontinue oxygen and immediately request medical advice and assistance from designated point of contact.

7.1.12 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 management of conditions as soon as possible.
5. Additional emergency procedures should be developed as needed, possibly including, but not limited to:
   - Loss of power supplies.
   - Loss of SDC (bell).
   - Loss of ROV.
   - Adverse environmental conditions.

7.2 ACCIDENT REPORTING

Association of Diving Contractors International Requirements:

ADCI requires ALL member companies and associate member schools to report industry-related fatalities/catastrophic injuries.

Procedures:

ADCI member companies can submit the reports on either their own company documents or the ADCI accident report form (See Section 7.2.1: Accident Report Form).

FOR U.S.-BASED COMPANIES:

Federal Regulatory Requirements

46 CFR – Department of Transportation – Coast Guard

Subchapter V-Marine Occupational Safety and Health Standards, Part § 197.484, requires the person in charge to notify the officer in charge, marine inspection, as soon as possible after a diving casualty occurs, if the casualty involves any of the following:

- Loss of life.
- Diving-related injury to any person causing incapacitation for more than 72 hours.
- Diving-related injury to any person requiring hospitalization for more than 24 hours.

Part §197.486 defines the form of the written report of casualty and requires:

- That the report be furnished on Form CG-2692 when the diving installation is on a vessel; or
- That a written report, in narrative form, be used when the diving installation is on a facility.

In either instance, the report must furnish the following information:

- Name and official number (if applicable) of the vessel or facility.
- Name of the owner or agent of the vessel or facility.
- Name of the person in charge.
- Name of the diving supervisor.
- Description of the casualty, including presumed cause.
- Nature and extent of the injury to persons.

29 CFR – Department of Labor – Occupational Safety and Health Administration

Subpart T – Commercial Diving Operations, §1910.440, requires that an employer record the occurrence of any diving-related injury or illness that requires any dive team member to be hospitalized for 24 hours or more, specifying the circumstances of the incident and the extent of any injuries or illnesses.

In May 1994, OSHA further clarified and defined the reporting requirement to state:

Employers are required to orally report any occupational fatality or catastrophe involving in-patient hospitalization of three or more workers within eight hours, per 29 CFR §1910.8. The report must include the following information:

- Company name.
- Location and time of incident.
- Number of fatalities or hospitalized employees.
- Contact person for the company.
- Phone number(s) for the company contact person.
- Brief description of the incident.

EXEMPTIONS FROM FATALITY AND CATASTROPHIC ACCIDENT REPORTING DO NOT EXIST!

Even though most commercial diving companies are exempt from record-keeping requirements (SIC7389), all are required to:

- Orally report as defined above.
- Maintain a log of occupational injuries and illnesses.

ADCI member companies are urged to furnish ADCI with a copy of any report required by either 29 CFR or 46 CFR. In those instances, where the report is initially submitted in an oral format (29 CFR), furnish to ADCI information derived from log entries required by that regulation. Reports should be furnished to ADCI at the same time as submitted to regulatory authorities to ensure that ADCI is able to properly respond to enquiries regarding the actual circumstances rather than having to rely upon media releases that often are inaccurate or embellished.

It is NOT the intent of ADCI to disclose identities of companies, individuals or circumstances contained in reports received, unless these are commonly known as perhaps having been disclosed through a press release or safety notice by the company involved. The PURPOSE of the "system" is to gather information that can then be used in developing accurate statistical data, or where information received may warrant development of a safety notice or other guidance document intended to promote improved safety. The contents of reports may also be used to defend our industry from the actions of unscrupulous parties whose goals are clearly only those of defamation.

7.2.1 ACCIDENT REPORT FORM

ACCIDENT REPORT

To: **Association of Diving Contractors International**

info@adc-int.org, 281-893-5118

From: ______________________________

(Company Name)

Subject: **Casualty/Accident Report**

Date of incident: ______ / ______ / ________

Location of incident: ______________________________

Description of event: ______________________________

Nature and extent of injury/injuries: ______________________________

SECTION 8.0

VESSELS AND FLOATING PLATFORMS FOR DIVING OPERATIONS

Association of Diving Contractors International, Inc.

8.0 VESSELS AND FLOATING PLATFORMS FOR DIVING OPERATIONS

8.1 GENERAL STATEMENT

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 industry, DSVs vary accordingly, ranging from sectional pontoons and crane barges to purpose-built diving vessels with special four-point anchor systems or dynamically positioned vessels. From small craft for day-long projects to 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 diving contractor to select or reject the 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 the 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 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 vessels can withstand severe weather conditions, their ability to move out of the moor is limited to the ability of the anchor support vessel to bring the anchors in. Therefore, great care should be taken to not exceed these operational limits prior to getting the DSV out of harm's way.

- Generally, DSVs are commonly utilized to safely and efficiently provide:
- Transit to and from the work site for the personnel and equipment required.
- Position maintenance during diving operations with adequate accuracy and security.
- Deck space for the life support and safety equipment required.
- Deck space for the tooling required for the divers to perform the work.
- Communications for emergency and commercial purposes.
- Accommodation and messing facilities.

Additional services (encompassing medical facilities, communications, power supplies, craneage, life saving appliances, fire-fighting appliances, etc.).

Each diving contractor will examine the DSV for adequacy in each of the applicable categories above, assuring compliance with their company safety policies and those of the ADCI.

8.2 LIVEBOATING

8.2.1 MINIMUM REQUIREMENTS

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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 ADCI recommends that alternate methods other than liveboating are explored.

If a diving operation requires a hand-held tool that is separately tended from the diver, it is highly recommended that it be performed by methods other than liveboating. However, if the job can be performed only through liveboating, only one surface-powered tool can be used at a time. Small umbilicals, (e.g., CP probes and pipe trackers) should be married to the diver's umbilical.

The following are minimum requirements for liveboating operations:

1. Depth/Limits

   The maximum depth limit for liveboating operations is 170 fsw (51m).

- **No liveboating operation may include planned in-water decompression.**
- **No liveboating operation shall be conducted on scuba.**
- **No liveboating shall be performed within another vessel or barge's anchor spread.**

2. Minimum Personnel

In all cases, personnel and equipment shall be selected to ensure maximum safety during operation. On small boats/vessels of less than 33 feet (10.05 meters), it may be permissible for the crew to consist of no fewer than three persons (diving supervisor, diver and tender/diver) due to space limitations.

a. Liveboating diving operations (0 – 100 fsw [30 meters]) (Vessels larger than 33 feet / 10.05 meters)
- One diving supervisor
- Two divers
- 2 tender/divers

b. Liveboating diving operations (101 - 170 fsw [51 meters])
- One diving supervisor
- Three divers
- Two tender/divers

8.2.2 DIVING SUPERVISOR

Must be experienced and knowledgeable in liveboating operations.

8.2.3 PROCEDURES

1. Continuous and easily understandable communications will be maintained between the dive station and wheelhouse at all times.

a. The boat will be maneuvered in such a manner so as to permit the tender/diver or diving supervisor to continuously monitor the direction of the diver's umbilical with respect to the dive control station.

b. The propellers of the vessel are to be stopped before the diver enters or exits the water.

c. Liveboating shall not be done:
- In seas that impede the station-keeping ability of the vessel.
- In other than daylight hours.
- During periods of restricted visibility. (Restricted visibility means any condition in which vessel navigational visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.)
- Any time existing conditions make liveboating unsafe in the opinion of the vessel captain and/or supervisor.

d. A standby diver will be continuously prepared to enter the water when directed by the diving supervisor.

e. All liveboating operations shall be tended from the bow, and the boat shall be operated from the wheelhouse or flying bridge.

8.2.4 MINIMUM EQUIPMENT

a. The vessel shall be acceptable to the diving company and the diving supervisor.

b. A "kill switch" shall be in the immediate vicinity of the operator of the boat for instantaneous shutdown of the engines.

c. For operations on dynamically positioned vessels, see **DP System Section 8.3.3**

d. On all liveboating jobs, a diver-worn or carried emergency gas supply bottle shall be worn by the diver.

e. A means will be used to prevent the diver's hose from becoming entangled in the propellers of the vessel.

f. During liveboating operations, a third diving hose connected to the manifold shall be available for emergency use except in the case of a vessel 33 feet/10.05 meters or less.

8.2.5 VESSEL OPERATOR

The vessel operator must be experienced in liveboating operations and familiar with the scope of underwater tasks including depth and duration of dive.

Any vessel larger than 33 feet / 10.05 meters will require a boat ready to be launched with crew in the event of an emergency.

8.3 DYNAMICALLY POSITIONED VESSELS

8.3.1 INTRODUCTION

These guidelines relate to and are intended to assist in the design and operation of dynamically positioned (DP) diving support vessels. Their purpose is to provide a basis from which designers, suppliers, builders, vessel owners, diving contractors, masters, diving supervisors, and charterers can develop the most suitable equipment and operating procedures for each vessel and to provide a yardstick against which the suitability of dynamically positioned vessels for diving operations can be assessed.

Implementation of the guidelines will vary from vessel to vessel, and the characteristics of each vessel will affect its suitability for particular operations. Even in the short term, this may alter in the light of changes in personnel and system components. It is therefore important that these guidelines be used not only by owners in preparing vessels (or diving operations), but also by potential charterers in assessing vessels suitable for their particular needs.

The general conduct of diving operations from DP vessels should follow the same principles as for other diving operations. In addition, no effort should be spared to establish DP operational reliability and ensure that the effects on the divers are minimized if the vessel does lose station. All those connected with the operation should keep this in mind at all times.

In accordance with IMO, the ADCI requires, at a minimum, vessels to be DP2.

8.3.2 PRINCIPLES

8.3.2.1 Introduction

These guidelines are built around three main and interrelated principlesthat are simply stated in this section. The remaining sections contain guidance on their implementation. Though they cover many aspects of DP diving systems and operations, they are not definitive, and decisions about operations not covered should still be based on these main principles.

8.3.2.2 Single-point Failures

A “catastrophic failure” is defined in these guidelines as a failure that would in itself cause risk to divers. In effect, this means that the failure would cause the vessel to move from its intended position. A fundamental principle of all DP diving vessel design and operation is that no single fault should cause a catastrophic failure. This principle immediately introduces the concept of redundancy. In doing so, it must be stressed that redundancy can be achieved in several ways (not merely by duplication).

8.3.2.3 Capabilities and Limitations of DP Diving Systems

Any system can operate satisfactorily provided it is not subjected to conditions that are outside its operating capabilities. A fundamental principle of DP diving vessel operation is that the operating requirements of the system are never allowed to exceed the vessel’s capabilities in any respect. This principle requires that the vessel’s capabilities and limitations are clearly understood and updated with experience and that indications are provided when predetermined limits are being approached.

8.3.2.4 Personnel Capabilities

Any equipment or system can work as intended only if it is operated correctly. The more complicated the equipment or system, the greater the demands upon personnel operating it. A fundamental principle of DP diving vessel operation is that relevant personnel should be fully capable of performing the tasks entrusted to them. This requires them to have the necessary background and experience or to have received appropriate training and guidance.

8.3.3 DP SYSTEM

8.3.3.1 Introduction

Implementation of the first principle (single-point failures) involves correct system design. In the context of these guidelines, the DP system is defined as “all equipment and components involved in retaining the vessel in its required position.” The principle states that “no single fault should cause a catastrophic failure.” To ensure that a DP system adheres to this principle, a failure modes and effects analysis of the main components should always be carried out. Where such an analysis indicates that a single fault could lead to a catastrophic failure, the relevant component, sub-system or its operating procedures should be redesigned to avoid or take account of the effects of the single point of failure. In this section, some design considerations concerning the main components of DP systems are examined. Recommendations concerning condition monitoring are included based on the premise that to react correctly, system operators must be aware of the failure of any main components.

8.3.3.2 Thrust Units

1. Configuration

Thrust unit installations should be designed to minimize potential interference of wash with other thrust units, sensor systems, the diving system and the divers, and the effect of hull surfaces on thrust unit efficiency within the constraint of ship design.

2. Redundancy

Thrust units and, where appropriate, rudders, should be situated to achieve fore and aft, athwart ships, and rotational thrust must be configured so that the loss of any one thrust unit always leaves sufficient thrust in each direction to ensure that the vessel holds position and heading when operating within its forecast operational capability.

3. Failure Mode

In the event of pitch, azimuth, motor speed control malfunction, or when control error becomes unacceptable, the function controlled may remain the same as it was at the time of failure, the pitch may be automatically set to zero, or the thrust unit may be automatically stopped and deselected. Under no circumstances should thrust units assume maximum thrust condition on failure.

4. Emergency Stop

Means should be available whereby any thrust unit may be stopped from any DP control without using the DP computer to generate the command. The means provided should be adequately protected against inadvertent operation.

5. Condition Monitoring

The following list indicates the main functions that, where applicable, should be monitored either by permanent remote means or by local means at frequent intervals.

- Status (online/offline).
- Thruster motor stator winding temperature (high only).
- Thrust unit rpm/pitch ordered and indicated (with display or 80 percent thrust output).
- Oil pressure.
- Hydraulic power-pack status.
- Azimuth ordered and indicated.
- Thrust-bearing temperature.
- Power supply loss.
- Lube oil/hydraulic fluids — pressure/temperature/level.
- Response to command signal deviation.

Note: Monitoring of diesel engines, where used to drive thrusters by direct drive, should be in accordance with design parameters of the system.

8.3.3.3 Power System

1. Power Factors

Power system design should, so far as possible, provide for generators to be run at power factors that effectively match the characteristics of the load.

2. Redundancy

The power source system, whether individual diesels or central electricity generation plants, should be capable of producing sufficient power to meet the vessel's operational capability subsequent to the failure of any single power unit.

3. Power Management

Arrangements should be provided to ensure that when diving operations are being carried out, non-essential loads are shed in reverse order of importance before power consumption reaches maximum available supply. Power supplies to thrusters to maintain station, as well as to the diving system, should be safeguarded. Arrangements should also be made to ensure that sufficient power is always available to enable the vessel to retain position within a predetermined accuracy in prevailing and foreseeable conditions if any one on-line power unit fails. This may mean providing for running up and bringing online additional power units as power consumption increases.

4. Essential Services

Essential services such as fuel, oil, ventilation and generator cooling should also be designed to avoid system failures stemming from failures of critical components, e.g., filters, pumps, power supplies, etc.

5. Operating Limits

Power operating limits should be specified and alarmed for diesel engines, turbines, motors and generators to avoid engine damage and power factor problems.

6. Distribution Network

Power distribution systems should be such that no single failure can prevent distribution or sufficient power to thrusters to permit the operation of the vessel within its full operational limitations.

7. Condition Monitoring

The following list indicates the main functions that, if applicable, should be monitored either by permanent remote means or by routine local means at frequent intervals.

- Distribution Network
  - Circuit breaker status (auto connect/disconnect equipment).
  - Bus bar voltage.
  - User current levels.
  - Load-shedding trips (online and tripped).
  - Backup power supplies availability (emergency generator or accumulator batteries).
- Diesel Engines
  - RPM.
  - Oil pressure/temperature.
  - High main bearing temperature indication.
  - Auto-start equipment and sequence.
  - Bank and individual exhaust temperature.
  - Oil level.
  - On-line fuel tank level.
  - Fuel pressure.
  - Fuel rack setting (if applicable).
  - Clutch status (if applicable).
  - Jacket water pressure and temperature.
  - Salt water-cooling pressure.
  - Change air pressure (where applicable).
- Generator/Motors
  - Bearing lube oil flow and temperature.
  - Terminal voltage.
  - Current.
  - Stator winding temperature (high only).
  - Frequency (low)/speed.
  - Status (shutdown, standby, online).

8.3.3.4 DP Information Input Systems

1. Position Sensor Redundancy

It is recommended that at least three independent position sensors be available. These need not all work on different principles, but if similar systems are to be considered as independent, they should not be subject to common mode failures (e.g., no single factor should affect more than one system). Whenever DP diving operations are being carried out, at least three independent sensors should be deployed, connected to the DP computer(s), and in use. It is recommended that the third sensor, if not online, should be ready for immediate use as a backup. To aid the correct use of sensors in particular circumstances, manufacturers must provide information about the performance and operational limitations of any position reference sensors supplied for use by DP diving support vessels.

2. Vertical Reference Units/Systems

Two vertical reference units/vertical reference systems should be operating whenever DP diving operations are being carried out and position reference sensors requiring their input are in use. At least one of them should be online.

3. Wind Sensors

Care should be taken in the placement of thewind sensors to minimize the effect of turbulence from superstructures. The effect of helicopter downdraft, though normally limited, should be borne in mind. Two wind sensors should be installed in physically separated positions to take account of failures and false readings resulting from external factors. In some circumstances where interference is unavoidable, the inaccuracies caused by switching off wind sensors may be less than those caused by their false information.

4. Heading Reference Sensors

Two independent heading reference sensors (e.g., gyrocompass) should be running with either both online or one online and one available as immediate back up during DP diving operations. Automatic or manual selection of the on-line compass may be provided.

5. Reliability

Sensors should be designed and proven for continuous reliability in the exposed positions in which they operate.

6. Condition Monitoring

Monitoring of DP information input systems should include:

- Facilities for regular full-function checks.
- Alarms for transducer or circuitry failures.
- Detection of data deviation or corruption.
- Alarm for power supply loss.

7. Position Data Processing

Data from all position sensors should be automatically processed (not manually selected):

- To reject spurious data.
- To stabilize output in the event of failure.
- To select preferred data.
- To alarm if system develops bad geometry or signal loss occurs.
- To permit a smooth changeover between systems.
- To monitor the sensor status.

8.3.4 COMPUTER/CONTROL SYSTEM

1. Purpose

The primary purpose of the DP control system computer is to calculate and order the necessary thrust unit operations required to maintain a vessel in its chosen position. Though it is possible to use the computer for many ancillary functions (e.g., data processing and presentation, power management, etc.), care should be taken to ensure that these cannot prejudice its proper operation in its primary role.

2. Control System Redundancy

There should be at least one backup method of controlling the vessel's thrust units in order to retain position in the event of a failure of the online control system. A second automatic control system can best fulfill this role. If a second automatic system is not fitted, then a joystick control system would be an acceptable backup, provided:

- It affords manual control of fore and aft, athwartships and rotational thrust with automatic control of heading.
- The joystick control lever is situated in the DP control area and located in such a position that the operator has a clear view of the vessel and everything in its vicinity.
- The joystick control system and its power supply are independent of the failed automatic control unit, but provision is made to ensure smooth continuity of thrust unit operation on failure of the automatic control unit.
- Data from a gyrocompass are input directly to the joystick control system.
- A simple display of vessel position relative to its required position is provided independent of the failed unit, but with the means to ensure its correct alignment with the failed unit at the time of failure.
- It is used only to maintain position for short periods of time, e.g., to recover divers in an emergency. It is recommended that the automatic control system(s) incorporate a joystick facility to assist in maneuvering the vessel onto location.

3. Power Supplies

Provision should he made to ensure that power supplies to computer(s)/controller(s) are safeguarded at all times. This could involve provision of duplicated conversion machinery and a backup battery supply. Batteries should have sufficient capacity to maintain the necessary supplies for at least 30 minutes, and a warning of batteries not being fully charged should be provided.

4. Services Redundancy

Where possible, the design should ensure that services are duplicated and are so divided that if local ventilation and cooling fail, or fire or flooding occurs, sufficient services are retained to enable the divers to be recovered safely.

5. DP Console Location

The DP console should be situated so that the DP operator can observe DP controls, see outside the vessel and be aware of deck operations and the vessel's relationship to surface structures, etc.

6. Monitoring Information

Overall monitoring information should be displayed or made available for call-up in a manner that avoids information overload on the DP operator. Data should be displayed in the simplest manner for easy assimilation. The following information should be available to assist in monitoring overall DP performance:

- Thrust unit configuration and rpm or pitch levels ordered and indicated (with display of 80 percent thrust).
- Consumed online power as percentage of total of available (with special indications at 80 percent).
- Available thrust units on standby.
- Position sensor status and validity.
- DP system status and validity.
- Vessel's target and indicated position.
- Vessel's target and indicated heading.
- Alert-level status (manually operated).
- Limited history event recording system.

This should provide an automatic record of changes in the main parameters concerned with the vessel's performance, such as:

- Wind speed and direction.
- Position and heading errors.
- Position reference sensor availability and use.
- Thrust unit availability and use.
- Power unit availability and use.
- Computer availability and use.

8.3.5 COMMUNICATION SYSTEMS

1. Internal Voice Communications

As a minimum requirement, voice communications should be available to ensure the immediate and clear transfer of information between all responsible parties.

As a minimum requirement, direct communications should be provided between DP console and dive control; dive control bell and diver; dive control and life support control; dive control and bell handling control; dive control, DP console and ship's derrick or crane; DP console and master's cabin; dive control, DP console and senior diving supervisor's cabin; and DP console and engine (control) room.

All essential voice communications systems should be provided with 100 redundancy where practicable, either through duplication or provision of an alternative system. Terminals should be situated close to the normal operating positions of personnel for whom they are provided. Primary systems should provide clear voice reproduction and should not detract from users' abilities to perform their main functions.

2. DP Alert System

A system of lights shall be provided in the saturation control room, air or mixed-gas diving control area, working deck and, where applicable, the ROV or submersible control position manually activated from and repeated in the DP control room. The following lights should be used:

- Steady green light to indicate vessel under automatic DP control, normal operational status and confirming the alert system is functional.
- Flashing yellow light to indicate degraded DP operating alert.
- Flashing red light to indicate DP emergency.

A distinctive alarm should sound in the saturation control room, air or mixed-gas diving area, master's cabin, operations superintendent's cabin (if applicable), and senior diving supervisor's cabin in conjunction with the flashing red light. Provision of a means of cancelling the audio and flashing functions of the signals from the receiving positions when they have been noted should be made.

8.3.6 MAINTENANCE OF EQUIPMENT

Proper maintenance of equipment is essential to its correct performance. Clear instructions about the type and frequency of maintenance required by all components of DP systems should be compiled by vessel owners with the aid of manufacturers and suppliers. These should be issued to vessels together with a system to monitor their correct implementation.

8.3.7 CAPABILITIES AND LIMITATIONS

8.3.7.1. Introduction

The second principle (capabilities and limitations of DP diving systems), involves knowledge of a vessel's capabilities and the operating requirements. An awareness of the special limitations of diving from a DP vessel should be present at all times amongst those concerned with the operation. In addition, certain principles should be adopted to minimize the possibility and effects of the risks to divers due to uncontrolled vessel movements. Notwithstanding these principles, the authority of appropriate personnel to order the termination of DP diving operations, if they consider such operations hazardous even when conditions are within the guideline limits, should not be diminished.

8.3.7.2 Vessel's Operational Capability

The maximum continuous operational station-keeping capabilities for DP diving should be forecast for each DP diving support vessel. They should be expressed in terms of direction and magnitude of wind, associated wave drift force and current combinations. They should be defined as "those environmental conditions in which the vessel could maintain chosen position and heading to a satisfactory confidence level with any single-thrust or power unit failed and with power available for the foreseeable diving requirements and the vessel's essential services."

Capability plots or envelopes of these maximum tolerable environmental forces and their relative heading should be produced to assist in defining this information. These should include a statement of the position and heading tolerances, as well as the corresponding confidence levels associated with the capability plots. It should be clearly appreciated that they are only a guide to a vessel's position-keeping capabilities and an indication of those capabilities under certain conditions.

Capability plots should be based initially on vessel design information but should be modified in the light of practical experience. Care should be taken that such modifications are properly reviewed and authorized by the vessel's owner. Detailed explanations of the assumptions made in producing these plots should be provided. For example, the power consumption of the diving system and emergency domestic load, the definition of wind speed and thrust output, the assumed wave drift and current conditions, and details of the means to identify the position-keeping tolerance and corresponding confidence levels should be included.

It should be noted that the requirement to hold station and heading within operational limits with any single-thrust or power unit failed assumes a "worst case" failure. Therefore, in determining the operational limit "envelope," the chosen "worst case" thrust unit will probably vary depending on the relative direction of environmental forces. This should be taken into account.

When determining the vessel's position-holding capability, consideration should also be given to any interactions between thrust units, hull and relative water movement. To simplify the calculation/presentation task, it is proposed that the current force be based on a one-knot current running in the same direction as the chosen wind and wave forces and that the number of "directions" chosen for these coincident forces may be limited to 30û increments.

8.3.7.3 Degraded Operational Capability

The principle of ensuring that no single fault can cause a catastrophic failure allows the vessel to be operated with confidence within its designed operational limitations. If the operational capability is degraded, the operation of the vessel should reflect the new status. There is one principal source of degradation of operational capability, namely loss of redundancy of a subsystem.

8.3.7.4 Positioning Accuracy

The positioning accuracy of a DP vessel is subject to several sources of error that can act cumulatively. A forecast of the position and heading tolerances and the corresponding confidence levels should be included with capability plots and should be taken into account when planning operations close to other vessel installations. Excursions around the intended position, even if causing no worse problems, tend to swing the bell in a manner that, if it becomes excessive, may be dangerous. With surface-supplied air or mixed-gas diving operations, excessive excursions of the vessel could cause hazard to the diver. Reduction to the minimum achievable level should be a matter of priority both on setting up on DP and, if necessary, in the course of DP operations.

8.3.7.5 Operating Procedures

The objective of all operations should be to ensure that a vessel operates effectively and safely. To achieve this, using the design principles already stated, carefully prepared operating procedures should be adopted. These should themselves be based on three main principles:

- Systems are checked on installation and after relevant modification, before starting new charters, and immediately before and periodically during use.
- Operational capability is matched by operational status.
- The procedures adopted should take account of the limitations of the system.
- These principles lead to several outline operating procedures, which are explained below.

1. DP Proving Trials

All the precautions and procedures described herein will be to no avail if the DP system includes uncorrected faults remaining after its original construction. Before a DP diving vessel undertakes DP diving operations after construction or any relevant modification, it should undergo a full series of trials.

These should include testing and tuning in harbor, followed by sea trials, during which the vessel's position-keeping system should be thoroughly tested under normal and breakdown conditions, and should culminate in a DP bell dive. It is stressed that commissioning of systems, piece by piece, cannot replace the need for thorough testing of the total system under working conditions. It is likely that such trials, if properly conducted, would take several days. Where possible, they should be performed partly in a situation where accurate monitoring of the vessel's position can be achieved and partly in open water under realistic environmental conditions. The results of these trials should be used to confirm or refine the vessel's performance capability statements.

As an indication of appropriate DP proving trials, checks of the following could be made:

- **In Harbor**
  - Correct fitting and mounting of all equipment and cabling.
  - Correct wiring of all power supplies, data cabling and equipment.
  - Correct functioning of all equipment (including data input systems, computers, interfacing equipment, thruster units and power supplies) by electronic and functional testing.
  - Effective shielding of all potential sources of electrical interference (including those that may be used only intermittently)
  - Software checks and tuning.
  - Correct functioning of all condition monitoring systems and alarms.
- **At Sea**
  - Correct functioning of all data input systems.
  - Correct functioning of computers and interfacing.
  - Correct functioning of power management systems.
  - Correct functioning of thrust units, including response times.
  - Optimum position-keeping performance by fine-tuning of software.
  - Insure position-keeping accuracy using independent means.
  - Correct functioning of all automatic and manual change-over arrangements and procedures from primary to backup systems.
  - Correct functioning of offset and heading change control.
  - Satisfactory operation of DP system, with bell running and then with divers in water.
  - Position-keeping per ordinance in rough weather.

It is stressed that this list is not definitive, but is included as an indication of the type of testing required.

2. New Charter Assessments

In fulfilling their responsibilities under national regulations, diving contractors and field operators whose operations involve the use of DP diving vessels should, before they permit DP diving operations to be carried out, satisfy themselves about the vessel's suitability for the operations planned. This could involve a thorough assessment of a vessel's DP arrangements in line with these guidelines, including a study of relevant documentation, such as operations manual, FMEA report, capability plot and any other form of DP system assessment available together with summaries of the experience of personnel involved with DP operations based on their operators logs. It should also include a short sea trial during which the actual capability of the vessel and crew to support DP diving in both primary and breakdown conditions is assessed. Such trials could, if the vessel is satisfactory, be completed in eight to 10 hours.

3. Operating Checks

A program of functional checks designed to test the operation of a DP system, including the selection and operation of backup systems, should be performed whenever setting up on DP. For example, these could include (but are not limited to) simulation of failures of online components such as a DP computer, a position reference sensor, a gyro, a generator or a thrust unit. They could also include commanding offsets in both direction and heading. In addition to the successful completion of these checks, the vessel should have held station automatically within the defined degree of accuracy until the master and senior diving supervisor are confident that the system is reliably set up before diving operations are permitted to start. This may take at least 30 minutes.

Repositioning of a vessel under DP control would not require a repeat of this check period. It is recommended that some or all of these checks be repeated periodically while on DP, but when diving is not being carried out and positionkeeping is not crucial. By doing so, the continued correct functioning of the system can be checked while the readiness of operators to deal with emergencies is enhanced. Instructions for the performance of these checks should be prepared and written by the vessel owner with the assistance of the DP system manufacturer and could be produced in the form of a checklist in a card or folder for ease of use. A more comprehensive arrangement could be provided by a purpose-built simulator.

4. DP Alerts

When diving on DP, a clear system to indicate and guide responses to operational capability is important. This system should be based on a minimal number of standard operating status levels representing the capability of the DP system to retain the vessel on station within safe limits. It is recommended that these levels should represent the following conditions:

- **Normal Operational Status (Green Light)**

  The vessel can be defined as in normal operational status when all of the following conditions apply:
  - The vessel is under DP control, and the DP system is operating normally with appropriate backup systems available.
  - Thruster outputs and total power consumption (where applicable) do not exceed 80 percent of maximum thrust and total available power, respectively, for more than brief and isolated periods.
  - Vessel's indicated position and heading is within predetermined limits for all but brief and isolated periods. These limits should he determined for each location.
  - No risk of collision exists.

- **Degraded Operational Status (Yellow Alert)**

  The vessel can be defined as being in degraded operational status when any of the following conditions applies:
  - There is a failure in a sub-system, leaving the DP system in an operational state (possibly after reconfiguration) but with no suitable backup available so that an additional fault occurrence could result in DP system breakdown and assumption of emergency status.
  - Available power units are reduced to the extent that failure of one more could prevent the vessel holding position or heading in existing or foreseeable conditions.
  - Available thrust units are reduced to the extent that failure of one more could prevent the vessel holding position or heading in existing and foreseeable conditions.
  - With all available thrust and power units online, any thrust unit output exceeds 80 percent of its maximum thrust, or total power consumption exceeds 80 percent of total available power for more than brief and isolated periods. Vessel's indicated position deviates beyond predetermined limits for more than brief and isolated periods.
  - Risk of collision exists.
  - Weather conditions are judged to be becoming unsuitable for DP diving.

- **Emergency Status (Red Alert)**

  A vessel can be defined as in emergency status if either of the following conditions applies:
  - System failure results in inability to maintain positioning or heading control.
  - Any external condition exists, including imminent collision, which prevents the vessel from maintaining position.

5. Alert Level Responses

The following responses could be made to different alert levels. Visual and audible signals should be manually initiated by the DP operator.

- **Normal Operational Status (Green Light)**

  Full DP diving operations can be undertaken.

- **Degraded Operational Status (Yellow Alert)**

  The master and senior diving supervisor should be informed. The diving supervisor should be informed. The diving supervisor should order the diver(s) to return immediately to the bell and obtain a seal. A decision should be taken by the senior diving supervisor, in conjunction with the master, in the light of prevailing conditions and any possible mitigating actions available, whether to abort the dive or, where surface-supplied diving is being conducted, prepare to return to the surface. Under this condition, air or mixed-gas divers should be ordered to return to the surface.

- **Emergency Status (Red Alert)**

  The diver(s) should be ordered immediately to return to the bell and obtain a seal. The diving supervisor should order the bell to be recovered as soon as possible after consideration of hazards involved in doing so (e.g.., fouling of anchor wires, jacket members, etc.) or, where surface-supplied diving is being conducted, prepare to return to the surface. The DP operator should use all means available to maintain the vessel in position until the divers are sealed in the bell and the bell is clear of obstructions. The diving supervisor and master should be verbally informed as soon as possible. Under this condition, air or mixed-gas divers should be ordered to return to the surface.

6. Communications

Communications between the dive control position and the DP console should be regular and frequent. Each watch-keeper should inform the other about any change in operational circumstances that occurs or that is planned.

The following list gives an indication of the type of information that should be passed:

- **Dive Control to DP Operator**
  - Bell status.
  - Diver status.
  - Intention to use water jetting or other underwater equipment.
  - Possibility of divers, bell equipment, etc., blanking or moving acoustic reference signals.
  - Any situation that could develop into an emergency.
- **DP Operations to Dive Control**
  - Intention to move vessel.
  - Any change in operational status.
  - Background information on causes of changes in operational status.
  - Any forecast or actual significant changes in weather.
  - Ship and helicopter movements in the vicinity.
  - Intention to handle down-lines of any description, including repositioning taut wire weight.
  - Intent to bring small boats alongside.
  - Intent to place anything into the water.

The following list indicates the type of information needed by the DP operator about activities in the vessel:

- Intention to perform and notification of completion of any electrical or mechanical system maintenance or modification that could directly affect online DP equipment or make standby equipment unavailable.
- Intention to start and stop ancillary air/hydraulic units that may reduce pressure on DP or diving-associated equipment.
- Intention to start and stop pumping of bilges, discharge of sewage, galley waste, etc.
- Intention to start and stop the use of radio and radar equipment that may affect the DP system.
- Intention to handle equipment that may affect the trim of the vessel.
- Imminent arrival or departure of helicopter or vessel alongside.

The following list indicates the type of information that should he passed between the DP operator and the platform:

- **Platform to DP Operator**
  - Planned movements of vessels and helicopters.
  - Planned crane lifts or outside platform work that could interfere with the diving operation, beacon or transponder sites.
  - Intention to discharge mud, galley waste, etc.
  - Planned blackouts in communications or power and hazardous operations (e.g., well-tests).
  - Weather information.
  - Other subset operations.
- **Taut Wire Systems**
  - Regular inspection and maintenance of the wire should be carried out. It should also be cut back and re-secured to the weight frequently to ensure that wear does not become excessive at either the weight or the sheave.
  - Care should be taken in the choice of its position in the vessel to minimize the mechanical limitations of the system. This is particularly important in higher sea states due to the movement of the vessel. It should also be situated as far as practicable from the moon pool or other diving position.
  - Care should be taken to ensure that the taut wire does not lift off the bottom or, if it does, that an indication of it having done so is given automatically to the DP operator. Measures should be taken to prevent danger to divers if the taut wire is moved and to avoid interference with the taut wire by divers.
  - The taut wire should be lowered to a position as far as possible from subsea pipelines, flow lines or cables, any of which may move. The mechanical limitations to the angle at which the taut wire can effectively operate introduce a limit to the distance from the intended position to which a vessel may deviate. This is of particular importance in shallow water.

- **Short-rRange Radio Systems**
  - Vessel operators should be aware of the possibility of temporary loss of information (e.g., due to blanking by other vessels, helicopters, platform equipment, or occasionally rain squalls), and action should be taken to avoid or minimize the effects of this.
  - Remote beacons or transponders mounted on manned production platforms are vulnerable to manual interference. Steps should be taken to ensure that they are not tampered with or "blanked off" and that their power supplies are not interrupted. This could include providing battery backup, connection to the platform's essential service supplies, and placement in accessible positions in accessible positions. A warning signal should indicate that the main power supply has been cut and the system is working on batteries. The owner of the platform should be responsible for the security of equipment located on the platform.
  - Where possible, alterative frequencies or codes should be prepared to cover the possibility of interference but should be allocated with care.
  - The vessel's position and resulting reference station geometry should be carefully considered whenever a move is contemplated.
  - Interference from radar can cause temporary signal failure or error.

7. Down-line Handling and Interference with DP Sensors

The handling of all down-lines from DP ships requires special care in the following respects:

- **Taut Wire Errors**

  Long, horizontally-slung objects that can pivot when suspended in the water can and have come into contact with taut wires that are providing positioning information. Care should be exercised to avoid this.

- **Snagging of Divers**

  Any down-line can snag a diver. Down-lines should be handled only by people experienced in doing so and under supervision of the diving supervisor, if necessary, via the bridge. This is particularly relevant when the vessel is being moved.

- **Moving Acoustic Beacons or Transponders**

  Acoustic devices should be moved only by divers under the supervision of the diving supervisor and on the direct authority of the master, who should be continuously advised of their movement.

- **Down-lines**

  Down-lines should be made up to include a breaking section to reduce the chances of injury to divers.

8. Uncontrolled Movement

The conduct of diving operations from DP vessels, as opposed to other types, requires particular attention to the risk to divers due to vessel movement. The effect of the vessel moving off station can cause failure of main lift wires, life-support and/or communication arrangements between the vessel and bell, vessel and diver(s), or bell and diver(s).

Operating and emergency procedures should be established to minimize the risks, and adequate arrangements should be made for the provision of emergency life-support, communications and relocation devices to allow a successful recovery. The bell or divers should always be positioned with care, and whenever possible, above the level of potential obstructions. The possibility of releasing the tension on the winch wire, umbilical, and clump weight wire, while the bell is deployed, should be considered to avoid dragging it if position is lost.

Generally, divers should not enter confined spaces when diving from DP vessels. However, in special circumstances and with due regard to the provision of particular means to ensure their safety in case of DP failure, such operations may be permitted.

9. Operations Plot and Emergency Plans

A plot displaying the relative positions of the vessel, the bell, divers, the worksite and any known obstruction (e.g., platform, other vessels, mooring wires, wellheads, etc.) together with ship's heading and wind direction and speed should be maintained at all times at the DP control position. The DP watch-keepers should ensure that this plot is always kept up-to-date and that planned emergency procedures have been approved by the diving supervisor to provide for the action to be taken in case of DP or other emergency. These plans should be produced in advance of any diving operations and be reviewed and modified as appropriate.

10. Vessel Movement Limitations

When the bell is launched or divers are deployed, DP diving vessels should be moved only with the full knowledge and consent of those concerned (in particular the divers) under very restricted and controlled circumstances, as follows:

- Under automatic DP control.
- Generally, the vessel should not be moved while divers are in the water. However, in special circumstances and with due regard to hazardous obstructions, the master, with the agreement of the diving supervisor, should be able to authorize limited vessel movements with the divers in the water directed by the diving supervisor. Such movements should not exceed the limitations of the reference sensors and should be made at slow speed. Heading changes should not exceed 15%. When moving, bell divers should be in the close vicinity of the bell (i.e., on the clump weight). .
- Limited movements of the vessel that are greater than those described above should be made only where divers have been recovered to the vessel and with bell divers inside the bell recovered to the vessel or positively clear of any potential hazardous obstructions, including the seabed.
- When moving the vessel on DP, particular consideration should be given to:
  - Where the bell is cross-hauled or the vessel's vertical axis of rotation does not coincide with the moon pool, in addition to the limitations established above, heading changes should not exceed an angle that causes a 10-meter movement of the bell.
  - The possible snagging of down-lines with the bell winch wire and umbilical.

11. DP Operations in Vicinity of Platforms, Etc.

Particular care must be exercised when operating on DP in close proximity to fixed objects, such as production platforms, mooring buoys, etc. When DP diving is undertaken in the vicinity of anchor wires and cables, the inaccuracy in the knowledge of their actual position at any particular time, and the resulting need to keep the bell and bell wires as far from them as possible, should be taken into account.

12. Visual Reference Points

When close to fixed structures, their value as a visual reference to provide an early additional indication of DP failure should be considered.

13. DP Operations In Vicinity of other DP Vessels

When operating on DP close to one another, DP vessels are potentially subject to several forms of mutual interference. These include thruster wash, which may affect both hulls and taut wires; acoustic and radio position reference sensor signals; and intermittent shelter from wind and sea. These factors should be considered when planning such operations and due allowance made for them. This may take the form of assuming less-accurate position-keeping tolerance than would nominally be expected, but it could also include coordination of choice of position reference sensors and frequencies and careful choice of the relative positions of the vessels.

14. DP Operations in Shallow Water

During shallow-water operations, there are indications that the limitations of acoustic and taut-wire reference sensors, in terms of the distance from the intended position at which these sensors can operate correctly, can introduce an extra hazard above those normally associated with their use in deep water. The need to use a surface reference sensor as one of the sensors in such operations is therefore of particular importance. The effect or the strong tidal streams and currents sometimes associated with shallow water should also be taken into account in relation to the position-keeping capabilities of DP vessels.

15. Weather Precautions

Due regard should be paid to any indications of impending weather changes, in particular sudden wind shifts and/or gusts. In winter, sudden changes in direction and increases in strength of wind often occur. The use of onboard meteorological instruments, including barometers, barographs, wind sensors (both fixed and portable), and wet and dry thermometers is necessary to ensure that timely action is being taken to reduce the possibility of loss of position.

In conditions where wind and waves are from opposite sides of the fore and aft line of a vessel, particular care is required, as a wind shift to coincide with wave direction is likely to cause rapid change in resultant force on the vessel. A warning of instability when the weather is from roughly ahead or astern, to be obtained from thrust unit movements alternating frequently through 180° using appreciable thrust. A case has occurred of a complete power failure resulting from a DP ship being struck by lightning. All reasonable precautions in accordance with good marine practice should be taken to ensure that forecasts of changing weather conditions are obtained and acted upon.

These precautions should include:

- Obtaining regular and frequent weather forecasts for the area of operations and use of facsimile facilities and charts.
- Seeking information by radio from other units in the vicinity about prevailing weather conditions in their areas.
- Use of experience and a “seaman’s eye” in assessing the prevailing conditions and likely trends.
- The presentation of environmental information measured by the DP system and any trends in conditions that it can provide.

16. Collision Risk

Care should be exercised at all times to ensure that the correct lights and shapes are displayed in accordance with the latest international collision regulations . By the present rules, whereas power-driven and sailing vessels are required to keep out of the way of a vessel restricted in its ability to maneuver (e.g., a DP diving vessel), a vessel engaged in fishing when underway is required only “so far as possible” to do so.

The master of a DP diving vessel should give early warning that it is unable to maneuver to any vessel that appears to be on a collision course using visual and sound signals. The potential use, if properly employed, of a simple automatic collision warning system should not be overlooked. In conditions of reduced visibility, decisions about the suitability of conditions for diving should rest with the master of the vessel.

8.3.8 PERSONNEL CAPABILITIES

The third principle (personnel capabilities) concerns the ability of the personnel onboard to perform the tasks entrusted to them. There should be sufficient personnel having suitable training and experience to ensure the safety of the vessel and all those on board.

8.3.8.1 Authorities

Nothing in these guidelines shall supersede the spirit or letter of legislation covering the authorities of masters of merchant vessels, of supervisory staff responsible for diving, project control, and of offshore installations. It is, however, of fundamental importance that the authorities of all personnel concerned with the management of diving operations conducted from DP vessels be thoroughly and clearly defined. . The sections below give general guidelines.

1. The Master

The master of the vessel is ultimately responsible for the safety of his or her vessel and all personnel on board and has ultimate authority to forbid the start or order the termination of diving and DP operations on grounds of safety to personnel or the vessel.

2. Operations Superintendent

The operations superintendent, where present, is responsible for the conduct of all operations carried out from the vessel. As such, he or she has authority to forbid the start or order the termination of diving and DP operations for safety or other reasons. The operations superintendent may not order the start of diving or DP operations.

3. The Diving Supervisor

The diving supervisor is appointed by the employer of the divers to be in overall charge of all diving operations from the vessel and is responsible for all aspects of diving safety. He or she has ultimate authority to permit or forbid the start and order the termination of any diving operations on grounds of diving safety. Other diving supervisors may, as necessary, be appointed by the diving contractor but should be under the control of the diving supervisor. For the purposes of these guidelines, it is assumed that any additional diving supervisors have been vested with the authority and operational responsibility of the diving supervisor when on duty and until relieved.

4. The Client’s Representative

The client’s onboard representative should, in conjunction with the contractor’s senior onboard representative, be responsible to the client for the proper performance or all work in accordance with the contract. He or she may request the start of DP or diving operations and should have the authority to veto the start or order the termination of diving or DP operations on any grounds.

5. Project Liaison

In view of the additional safety factors involved in DP operations, it is essential that close liaison be maintained between the various authorities concerned. Some organizations may include additional supervisory roles, but the above four authorities should represent the minimum forum for planning meetings concerning DP supported diving operations.

6. Priorities

Priorities should be clearly established for dealing with a DP emergency. The authorities of the master and diving supervisor are of fundamental importance at such times. They should cooperate closely to these priorities so that there is no room for doubt or dissension. Priorities should take into account that:

- The safety of life is the first priority. The master has ultimate authority to assess and decide on courses of action in this respect. The advice of the supervisor should be taken into account.
- The safety of property is of lower priority. No effort should be made to safeguard property at the expense or safety to life, but the potential danger to life which some threats to property pose should not be overlooked. The advice of the client's representative and offshore installation owner should be heeded where possible in respect of the safety of offshore installations and equipment.

7. Manning for DP Diving Operations

The requirements for numbers of qualified DP operators will vary. However, every DP vessel engaged in diving operations should meet the following requirements:

- The master of a DP diving support vessel, when performing DP diving operations, should be appropriately trained to be responsible for operating the DP system without supervision.
- DP Operators should be present in the DP control room whenever DP diving operations are being carried out. One of them should hold an appropriate deck officer's qualification to be in charge of the navigational watch. One should be responsible for operating the DP system without supervision. The other should have received suitable instruction on the principles and operation of DP systems. The second watch-keeper may leave the DP control room to attend to ship's business.
- An appropriately trained technician capable of minor fault-finding and maintenance of the DP system should be onboard at all times when DP operations are taking place.
- The period of time for which the watch-keeper referred to above continuously operates the DP system should be limited to avoid loss of concentration. It is unlikely that continuous periods of longer than two hours would be satisfactory, and in some circumstances this may need to be shortened.
- Engine rooms (or engine control rooms) should be manned at all times when on DP.

8.3.8.2 Training and Experience

The amount of training and experience needed by personnel to perform their functions safely varies. However, the following minimum standards are recommended, but some may need to be exceeded in some cases:

- No person should be responsible for operating the DP system in a DP diving vessel without supervision while diving operations are in progress, until he or she has:
  - Received suitable instructions on the principles and operation of DP systems.
  - Attained satisfactory practical experience by completing a suitable period of supervised DP watch-keeping offshore during which he or she has simulated the main subsystem failures, including failure of automatic computer control. It is suggested that a suitable period would be at least 200 hours.
  - Satisfactorily completed approximately 50 hours supervised DP watch-keeping on the vessel concerned during which he or she has simulated the main sub-system failures. To assist the owners to monitor this training, it is recommended that all DP operators maintain a personal log of their DP experience.
  - The technician(s) responsible for minor fault finding and maintenance of the DP control system should have satisfactorily completed a suitable training course.

8.3.8.3 Operations Manual and Records

Clear guidance about the operation of each individual DP diving vessel should be contained in an operations manual prepared specifically for that vessel. The manual should contain sections on at least the subjects outlined in the following subparagraphs.

1. Vessels Operational Limitations and Alert Procedure

The limitations and procedures as defined in Section 8.3.7.5(4) DP Alertsshould be clearly stated.

2. Manning

This section should detail the minimum manning arrangements for the vessel when operating on DP and during diving operations.

3. Responsibilities, Authorities and Duties

The duties, responsibilities and authorities of senior personnel should be described based on the guidance in Section 8.3.8.

4. DP Operations

A description of the DP system fitted on the vessel and guidance on the performance of all DP operations, including procedures for:

- Operating checks.
- Operations of position-reference sensors.
- Duration of DP operating periods.
- Operations in the vicinity of platforms, etc.
- Standard alert levels (with description of warning signals).
- Precautions with regard to weather.
- Measures to prevent collision.

5. Diving Operations

An up-to-date description of the diving system(s) and guidance on the conduct of diving operations as they may be affected by the DP vessel itself, including procedures for:

- Actions to be taken in case of changes in alert-level status.
- Operation of divers in free-flooding and enclosed spaces
- Precautions to guard against thrust unit wash or suction effect.
- Surface support and down-line handling.
- Information to be provided to dive control positions.
- Preparation and use of emergency plans.
- Moving vessel.

6. Priorities

Guidance should be given on the priorities to be adopted in case of emergency. These should follow the guidance given in 8.3.8.1 (No. 6).

7. Communications

Guidance and procedures concerning the transfer of information should be modified to suit the particular vessel. This section should also contain a description of the voice communication systems and alarm systems that are available and should define emergency situations.

8. Records and Report

Details of all records and reports required by the master, senior diving supervisor and others.

8.3.8.4 Information Feedback

Lessons learned in the course of practical DP operations can be of use to others besides those immediately involved. Arrangements for the dissemination of information should he established, so that relevant practical experience and the lessons learned can be made available to others to improve the safety of DP diving operations. This may include dissemination within the vessel and/or the company, and to designers, manufacturers and shipyards.

8.3.8.5 References

International Maritime Organization Publication 645 Guidelines for Vessels W/D

8.3.9 SURFACE-SUPPLIED DIVING FROM DYNAMICALLY POSITIONED VESSELS

All equipment and manning levels should be considered the recommended minimum for approaching this diving application, 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.

1. Minimum Personnel
   - One air or mixed-gas diving supervisor (NOT part of the dive rotation).
   - One manifold operator.
   - Two divers.
   - One standby diver.
   - Three tender/divers.

8.3.9.1 Surface-oriented Diving

Surface diving off of a DP vessel requires:

- Open-bottom bell with emergency on-board gas.
- Diver/tender at depth.
- Bell umbilical management and surface umbilical management plan (should be filed with JHA).
- Both divers to have access to surface and on-board gas.
- All umbilicals must be tethered to the main bell wire or secondary lift wire.

NOTE: During diving operations, it is recommended that all structures or debris should be deeper than the deepest point of the bell to protect the bell, in the event of runoff or black ship circumstances. Operations where the bell is below the shallow point of the underwater obstruction shall require a management of change (MOC).

The following requirements for surface diving operations are in effect only when the vessel is operating in the DP mode. “DP mode” is defined as whenever there is any form of motive power in operation, e.g., thrusters or propellers. The requirements are based on the premise that at no time should the length of 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. Very great care is needed in the 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 them, particularly when the bell or divers pass the potential wash zone. These precautions could include appropriate computer software to avoid any hazardous effects on the operation of the bell or divers.

The use of thrust diagrams when planning dives can also help. Inhibiting or deselecting certain thrusters may be necessary, and the resulting reduction in the vessel’s operational limitations should be taken into account. Divers’ umbilical lengths and the manner of deploying them (e.g., over the side, from the bell, etc.) should be so chosen that divers and their umbilical are physically restrained from going to positions where they or their equipment could come into contact with thrust units or be adversely affected by their wash. Furthermore, care should always be taken to prevent umbilical developing a bight, and to respond at once to any indications of a diver being in difficulty, such as unusual tension on or at the angle of the umbilical. There is no simple approach to the problem due to the differences encountered in the vessels and worksites.

Surface diving can be performed from a DP vessel in the DP mode whether over the side or through the moon pool, if the following conditions are met:

- Written procedures, as most regulations in effect in other nations, must be prepared for emergency situations (e.g., changes in alert-level status, alarms, loss of communications, moving the vessel, etc.).
- The diving crew must be familiar with the vessel’s overall design and operating characteristics (e.g., position of thrusters, propellers, intakes, obstructions, etc.).
- The diving supervisor must be provided with relevant DP alarms and communications systems to the bridge and/or DP control station.
- The topside tenders must be able to listen to all communications between the divers and the supervisor and must be able to talk directly to the supervisor.
- The bell umbilical and/or diver’s umbilical supplying the wet bell and/or divers with appropriate services must be secured to the main lift wire (or secondary lift wire).
- The excursion umbilical is secured to the wet bell so that the length of the umbilical from the tending point to the diver work site shall never be greater than the distance from the tending point to the nearest thruster. The umbilical must be appropriately marked.

Safe Umbilical Length Formula

A squared + B squared = C squared
The square root of C squared = Distance to hazard

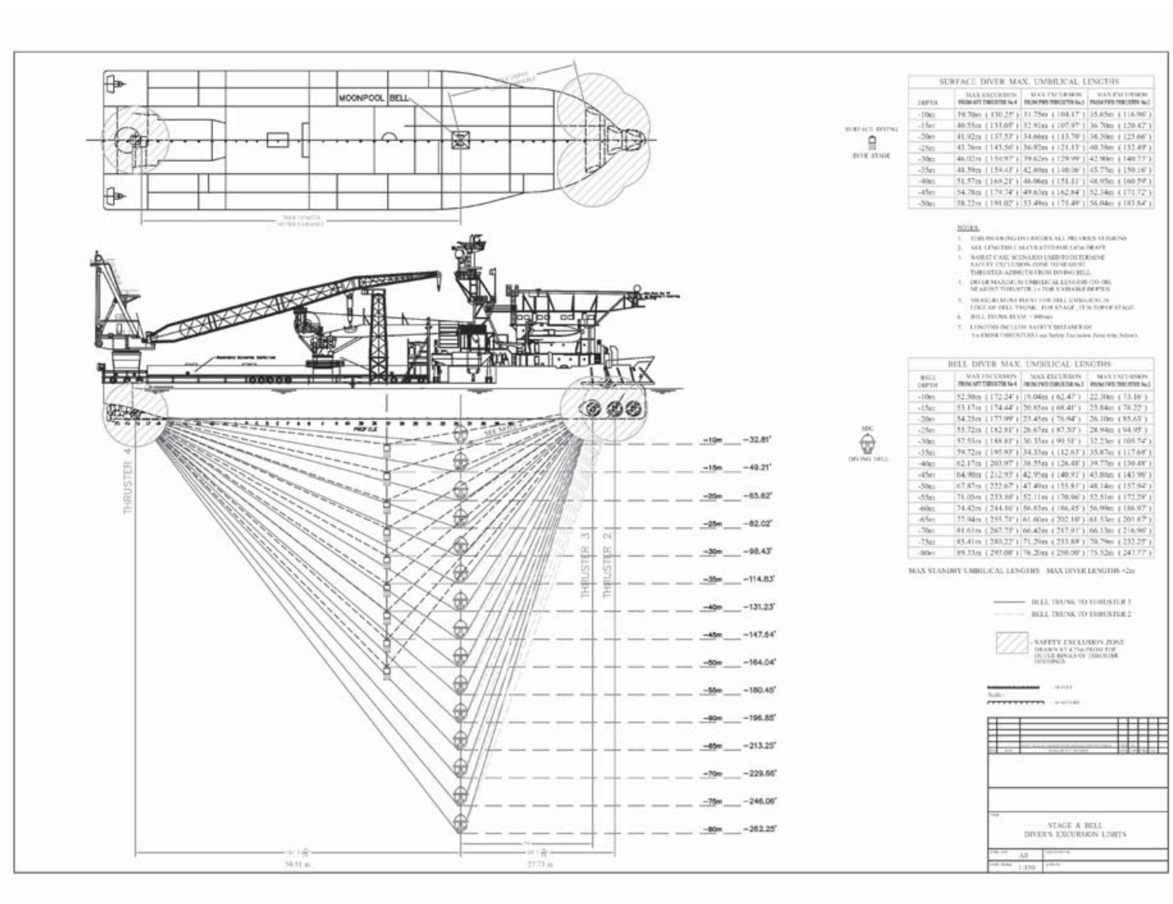
A = Distance to nearest hazard (stern thruster)
B = Shallowest depth diver will leave bell
C = Distance from depth to nearest hazard

Items 1 and 2 below must be subtracted from (C) to determine maximum safe umbilical length.

1. MAIN umbilical must be 20 feet shorter than (C) closest hazard.
2. STANDBY umbilical must be 10 feet shorter than (C) closest hazard.
(See sample of bell umbilical management and surface umbilical management diagram on the following page)

8.3.9.2. BELL UMBILICAL MANAGEMENT AND SURFACE UMBILICAL MANAGEMENT

- SAMPLE DIAGRAM ONLY -



SECTION 9.0

REMOTE OPERATED VEHICLES (ROVs)

Association of Diving Contractors International, Inc.

9.0 REMOTE OPERATED VEHICLES (ROVs)

9.1 INTRODUCTION

The purpose of the guidance contained in this section is directed to the use of ROVs within the commercial diving and underwater industry and to provide general material intended to contribute to the highest possible degree of safety during the conduct of ROV operations. **For specific guidelines and procedures for ROV diver operations, refer to Section 9.3.**

9.2 BACKGROUND

Implementation of these guidelines will vary depending upon the class of ROV used, and it is important to recognize that the great diversity and variety of vehicles make it difficult to definitively state into which class a particular ROV may fall.

The term "remote operated vehicle" (ROV) covers a wide range of equipment, with no single vehicle able to be described as typical. Not only are there numerous differences between basic design, but the same basic ROV can be modified to carry out different tasks. For the purpose of this standard, five different classifications are identified, but it should be recognized that there can be subdivisions within these classes. For example, ROVs launched and recovered in a "garage" or "cage" with a tether management system may be subdivided from those that are free-swimming. Likewise, a large work-class ROV may be tracked just as a small observation vehicle can be mounted to tracks for specialized operations in the observation mode.

9.2.1 CLASSIFICATION SYSTEM

Class I – Pure Observation. Pure observation vehicles are generally considered to be physically limited to video observation and fitted with a video camera, lights and thrusters. However, this is not a fixed "rule," and these types of vehicles have evolved to have an ability to perform other tasks if properly fitted with additional sensing devices.

Class II – Observation with Payload Option. These vehicles are generally somewhat larger than those of a pure observation nature and are capable of carrying additional sensors, such as still cameras, cathodic potential measurement devices, additional video cameras, sonar systems and small manipulators. Class II vehicles should be capable of operating without loss of original function while carrying at least two additional sensors.

Class III – Work Class Vehicles. These vehicles are large enough to carry additional sensors and/or manipulators and commonly have a multiplexing capability to allow additional sensors and tools to operate without being "hard-wired" through the umbilical system. These vehicles are generally larger and more powerful than class I and II vehicles. Wide variations of power, depth rating and capability are possible.

Class IV – Towed or Tracked Vehicles. Towed vehicles may be pulled through the water by a surface craft or winch. Some may have limited propulsion power for limited maneuverability.

a. Tracked vehicles have an ability to move across the bottom. Some may have a limited mid-water column "swimming" capability.
b. Vehicles within this class may derive from those of classes I through III, and thus, their physical attributes may vary widely.

Class V – Prototype or Development Vehicles. Vehicles in this class include those under development or special purpose vehicles that do not fit within one of the other classes.

9.2.2 ROV TASKS

Observation. Observation is the least complicated work mode. It can normally be undertaken by the use of a video camera without additional equipment and is generally conducted by ROVs of the Class I or Class II variety. If the monitoring of divers is entailed, the vehicle will normally be maintained in a near stationary position.

Survey. Surveying activity normally consists of some form of observation of the intended area of operations, whether on the seabed or within an enclosed area such as a pipeline, outfall or tank-like structure. Survey can also be employed as a post construction or equipment installation verification tool.

The general purposes of surveying activity may be:

a. Fixing geographical coordinates.
b. Ensuring the target structure or device is within a permitted corridor or area.
c. Verification of burial.
d. Determination of physical damage.
e. Examination of pipelines or structures.
f. Verification of debris removal.
g. Identification.

Inspection. It is often difficult to distinguish between inspection and survey, particularly as an ROV may carry out both types of tasks in a single dive. Inspection tasks usually concentrate on specific, pre-defined areas of concern and include detailed visual and/or other types of inspection using on-board sensors such as cathodic protection (CP) measurement devices.

Construction. These tasks normally require a larger vehicle capable of deployment of at least one manipulator. Construction vehicles may be employed in such tasks as removal of debris, intervention, connection or removal of lifting devices, or actuation of valve components.

Intervention. Many work-class ROV's have specially designed tool packages able to interface with subsea manifolds, wellheads or control pods to effect installation, removal, maintenance or repair functions.

9.2.3 ROV TOOLS

Tool packages can be varied to suit requirements, with new devices being constantly developed and upgraded. This section provides a brief introduction to some of the more common tools.

When installing or using ROV tools, all relevant manufacturer and industry safety instructions should be applied. Just as with any other piece of equipment, an appropriate maintenance log should be preserved. When operating ROVs in areas where considerable current or surge may be present, planning and assessment techniques should be employed to ensure that the mounted tools will not create a hazard to either the personnel or the vehicle.

Cameras. Cameras can be mounted in a fixed position, on a pan-and-tilt assembly, or held by a manipulator. Video systems with the ability to view in conditions of low-light intensity and still cameras to furnish high-resolution documentation are available. Pan-and-tilt assemblies furnish a capability to allow training of the camera system to permit omnidirectional viewing.

NDT Sensors. The more commonly used sensors for NDT activity are cathodic potential (CP) probes, ultrasonic thickness measurement devices and flooded member detection systems.

Acoustic and tracking. Numerous acoustic systems are available, such as tracking and measurement devices, scanning, profiling, side-scan, sub-bottom profiling, bathymetric and pipe tracking.

Cleaning. ROVs can be used as a platform for cleaning devices used for structures and/or vessels. These devices can range from simple rotary wire or nylon brush systems to more sophisticated units capable of removing calciferous marine growth.

Station-kKeeping. Many ROVs are capable of maintaining heading, depth and position. Attachment devices are available to permit the ROV to be located in a virtually fixed location. Some of these devices are:

a. Docking cones and similar stabbing devices.
b. Suction pads and water pumps for hydrostatic attachment on smooth surfaces.
c. Manipulator-mounted hydraulic devices to grip structural members.

Note: Attachment devices should be fitted with a "fail-safe" feature to permit disengagement if power to the vehicle should fail.

9.2.4 ENVIRONMENTAL CONSIDERATIONS

To ensure safety and efficiency of the intended operation, it is necessary to take into consideration both the probable and unanticipated environmental considerations of the intended work site.

Water Conditions. ROVs can operate anywhere from very shallow locations to depths in excess of several thousand meters. Increased depth capabilities are being achieved as the need develops for the conduct of deeper operations. Individual ROVs should not be used below their design depth. When operating ROVs, consideration should be given to:

- **Umbilical length and associated drag.** These influence the specification of the topside handling system.
- **Transit time.** Crew members assigned to monitoring the ROV may become distracted during a long transit with the ROV at extreme depths.

Variations in temperature, salinity, depth and acoustic noise should be considered for their possible adverse affects on acoustic tracking and positioning systems. Water characteristics may also have an effect. The following factors should be taken into account when assessing the use of a vehicle for a given task:

- **Visibility.** Poor visibility can adversely affect an operation and may require the use of sophisticated equipment, such as acoustic imaging systems. Vehicle operation near the seabed may stir up fine-grained sediment that remains in suspension to reduce visibility in low- or zero-current conditions.
- **Temperature.** Extreme temperatures (both high and low) may affect the reliability of electronics and cause material fracture that leads to structural or mechanical damage, particularly in arctic conditions. Hydraulic oil and lubricants that offer stable properties over the intended temperature range should always be used.
- **Salinity.** This may vary substantially near river mouths, in tidal estuaries and near outfalls. The resulting variation in water density may affect ROV buoyancy, trim and the accuracy of sonar data.
- **Pollutants.** The presence of petroleum products or other pollutants can cloud optical lenses, damage plastic materials, affect visibility, block sound transmission or cause a sudden loss of buoyancy. Where pollutants are present, precautions should be taken to protect the in-water portions of vehicles and the topside personnel who handle the ROV during launch, recovery and maintenance.
- **Water movement.** ROVs are sensitive to water movement, and extra care should be taken in shallow water where surge or thrust from surrounding vessel propellers or thrusters can have an effect on vehicle control.

• **Currents** can create considerable problems in ROV operations, but quantitative data on particular current profiles are rarely available.

Simulations and analysis can provide good current prediction, but currents do not remain constant for long, even those close to the seabed. Currents also vary with location, and surface currents can be rapidly affected by wind. Tidal meters and historical data are useful indicators of current strength and direction for particular areas and depths.

Factors that may affect ROV operations, including their maneuverability in current, include:

- Length and diameter (mass) of umbilical.
- Propulsion power.
- Depth and orientation to the direction of the current – a non-uniform current profile.
- Umbilical “strumming” or “spinning” in deep water (this may require the use of specially designed umbilicals).
- Vehicle hydrodynamics (i.e., surface area and profile).
- **Sea state and swell** can affect every stage of an ROV operation.

Safety must always be carefully considered when launching or recovering an ROV, particularly from a support vessel in rough seas. ROV operators should understand the effect of a heaving support ship on the umbilical attached to a relatively motionless ROV and should be aware that the ROV handling system can be overloaded or that personnel on deck may be exposed to a risk of accident.

In rough conditions, personnel involved with launch and recovery must wear all necessary personal protective equipment and fully understand their own role as well as the roles of others involved in the operation. Good communication is vital for avoiding accidents.

In certain situations, deployment systems incorporating motion compensation can either reduce or better accommodate the effect of wave action and thereby permit ROV operations to be conducted in higher-than-normal sea states while maintaining high safety standards.

- **Weather**. While ROVs themselves are not normally sensitive to weather, the cost and efficiency of ROV operations can be affected by weather in a number of ways:
  - Wind speed and direction can make station-keeping difficult for the support vessel and adversely affect ROV deployment and recovery.
  - Rain and fog can reduce surface visibility and create a hazard for the support vessel.
  - Adverse combinations of wind, rain, snow, etc., can make the work of ROV crews hazardous for personnel on deck.
  - Hot weather can affect the ROV electronics and related systems. Likewise, hot weather can have an adverse effect on ROV crew personnel on deck.

Operations should therefore be carefully monitored with regard to the safety of both personnel and equipment affected by adverse weather conditions.

- **Seabed characteristics.** When planning an ROV operation, local seabed conditions and topography should be known in advance. Rocky outcroppings or submerged structures can make collision more likely and add to the risk of abrasion of the vehicle umbilical, or affect signal transmission from sonar or other devices.

9.2.5 OPERATIONAL CONSIDERATIONS

In order to assure the safe and efficient use of ROVs, operators should ensure that the chosen ROV system has been satisfactorily tested prior to use and that it is capable of meeting the operational requirements of the job. The ROV supervisor should commence an operation only after carefully considering:

- System and crew readiness.
- The effects of environmental factors anticipated during the operation.
- Potential risk factors that may be present during the operation.
- The nature and urgency of the intended tasks.

All of these plus a variety of other considerations must be made a part of the job hazard analysis conducted during planning and assessment.

- **Operating procedures.** The operating procedures shall consist, as a minimum, of the ROV contractor's safe practices/operations manual (company procedures) together with any site-specific requirements and procedures. Contingency procedures for emergency action are also a requirement. The management chain of command for an ROV project shall be clearly defined, and the ROV supervisor shall be identified in writing. If operations will continue beyond a single shift per day, an alternate ROV supervisor must be designated.
- **Planning and assessment.** Specific operating procedures necessary for accomplishment of the intended tasks will be largely determined during the planning process. This process is intended to analyze potential hazards, areas of possible job interference and an assessment of other risks as may be deemed to be possible during the conduct of operations.
- **ROV systems' location and integrity.** During the planning and assessment phase, consideration must be given to the site from which the ROV operations will be conducted. Dependent upon the project, this may be from an offshore platform, vessel, pier, shoreline, small boat or other site. Considerations that must be factored into the operational plan include, but are not limited to:
  - The type of structure or vessel from which the ROV operations will be conducted and an evaluation of whether there is sufficient working area for the ROV, its associated systems and the ROV crew members.
  - Whether the dive control station is in an area of hazard, such as where ignition of gas, vapor or liquid could cause a fire or explosion.
  - Whether surrounding or associated operations can create a hazard either to the ROV, its systems or crew personnel. Examples of this might be where crane or other associated overhead operations are being conducted.
  - The proximity of the ROV to a required handling system with consideration of lateral or horizontal distances that must be traversed in order to launch or fully recover the vehicle.
- **Handling systems.** Handling systems, whether for ROVs or other uses, can be inherently dangerous if care and attention during their use is not maintained.

Detailed operating procedures for each handling system should be readily available at the job site, and ROV operators must be knowledgeable regarding the safe working loads to which that system is limited. When the system is to be secured to a deck by a welding process, non-destructive examination methods should be employed to ensure appropriate integrity of the installation.

- **Testing and periodic examination.** A procedure should be developed for a responsible person to examine ROV handling systems:
  - At least every six months for physical damage, misalignment or evidence of wear at critical points.
  - After any major alteration or repair that may affect its integrity.
  - After having been relocated from one position or site to another.
- **Cables, umbilicals and associated hardware** should be examined at least every six months in accordance with the manufacturer's recommendations and any such regulatory guidance in effect. Appropriate log books and records should be maintained.
- **Communications**. Effective and reliable communications are critical to the safety and success of any operation. All personnel involved in the operation shall be fully aware of the work being undertaken and the status of any unusual situation that may or does arise during the work performed.
  - **Diving operations.** The diving supervisor has ultimate responsibility for the safety of the entire operation when diving operations are taking place. Communications must be maintained at all times between the diving supervisor and ROV supervisor. Refer to Section 9.3 for ROV diver operations.
  - **Vessel control.** The ROV supervisor shall ensure and maintain effective communication with vessel movement control personnel whenever ROV operations are in progress.
- **ROV operating sites.** ROVs are required to operate from different locations with varying levels of support for the ROV system and crew. Due consideration should be given to the limitations of each location on safety and efficiency. Suitable deck strength, extra supports, external supplies and ease of launch and recovery should be considered.

Prior to mobilization, the ROV supervisor should inspect the site and decide on the optimum location for the ROV system. Umbilical or cable runs should be carefully established to protect against physical damage or interference. Additionally, the length and fleet angles for these runs must be evaluated to protect system integrity and functionality.

When considering the use of vessels of convenience for support of ROV operations, operational limitations may be encountered. Some of these limitations may relate to:

- Lack of maneuverability.
- Lack of navigational accuracy.
- Mooring or anchoring systems.
- Deck space.
- Electrical power reserves.
- Propeller guards.
- Limited personnel accommodations.
- Familiarity with intended type of operations.
- Minimal (or excessive) freeboard.

When intending to conduct operations from a fixed platform, there are a number of specific areas of consideration, such as:

- A need to comply with specific, often onerous, zoning requirements relating to hydrocarbon safety, or other specific regulations of the operator.
- Difficulties of installing surface support equipment.
- Training requirements for ROV crew personnel related to platform-oriented operations.
- Deployment and recovery complications (including tidal effects) caused by the height difference between the platform deck and waterline.
- Hazards created by surrounding activities on the structure.

- **Anchored, moored or DP vessel operating sites** present similar hazards as those of the fixed platform variety, although zoning and hydrocarbon safety requirements will normally apply only to drilling rigs. Where DP vessels are to be utilized, it must be remembered that the vessel propellers/thrusters are in constant use. Care must be assured that the ROV umbilical does not come into incidence with rotating equipment and that the umbilical will not be adversely affected by thrust or wash from same.

- **Navigation.** The use of acoustic location beacons on some ROVs contribute to navigation, positioning and tracking. In some cases, an ROV can be placed beside a submerged object to establish an accurate position for that object.

In some situations, there is a potential danger of acoustic interference, such as shadowing or noise, if several vessels are operating in the same area or if large-scale construction or survey projects are present. This can be a particular problem if the DP vessel relies on acoustic signals for positioning. Frequencies for acoustic beacons should be selected to avoid interference. In larger projects, these tasks of coordination of frequencies employed may necessitate some form of central control.

- **Manuals and documentation.** To ensure the safe and efficient operation of ROVs, appropriate log books, checklists and manuals are required on site. It is the contractor's responsibility to ensure that each ROV supervisor is supplied with necessary documentation.

Regulations and legislation appropriate to the intended area of operations must also be understood and available at the site of operations.

- **Umbilicals.** Umbilicals can be broadly categorized by their weight and material composition, but they vary in strength, power and signal transmission characteristics.
  - Lightweight umbilicals are generally reinforced with Kevlar for strength, and use some form of appropriate abrasion-resistant material for jacketing.
  - Medium-weight umbilicals may comprise a jack, a stainless-steel braid and a Kevlar® central member.
  - Heavy-weight, or armored, umbilicals can be used for lifting.

ROV supervisors and operators should be aware that the umbilical is limited by its breaking load, safe working load and minimum bend radius.

Periodic and routine inspection and maintenance of umbilicals should be performed in accordance with the manufacturer's design and instructions, and re-termination should be performed as per those instructions.

- **Launch and recovery.** The ROV supervisor is responsible to ensure that a safe launch and recovery of the ROV can be performed and that all members of the ROV and support crew understand what is required. These evolutions should progress in a smooth and logical manner with all personnel involved fully aware of the situation at all times.

The ROV handling system's design parameters should furnish calculations to define launch and recovery limitations based on weather, sea state, support vessel motion and other parameters appropriate to the intended operation.

- **Physical hazards.** In addition to those discussed above, a number of other physical hazards may be encountered during ROV operations. These include:
  - **Intakes/discharges.** ROVs are vulnerable to suction or turbulence caused by water intakes and discharges. The ROV supervisor should establish the presence of any such intake and discharge locations that may create a hazard and establish procedures to minimize their effect.
  - **Diving operations.** When conducting ROV operations in the vicinity of diving operations, certain hazards are introduced, such as possible entanglement of umbilicals, physical contact, electrical hazards and the fact that ROV propellers or thrusters can present a hazard. Close liaison between the ROV and diving supervisors is required.
    - The physical hazards to divers caused by the power, mass and possible inertia of the ROV should not be underestimated.
    - Communication between the ROV and diving supervisors must be effective and continuous and is mandatory. A loss of this communication requires emergency procedures and an immediate stop of the ROV propellers/thrusters/tracks.
  - **Electrical.** ROV electrical requirements are significant and able to create hazardous situations if not properly handled. Care must be taken to ensure that all personnel are protected from any electrical hazards at all times, whether during maintenance, pre-launch, pos- launch or operational conditions.
  - **Water blasting.** Some ROVs carry high-pressure water-blasting equipment. These systems have been known to cause accidents and fatalities and severe damage to equipment when not used correctly. Care must be taken during testing and operation to prevent accidents both during topside and in-water activity.

9.2.6 PERSONNEL

All ROV personnel should be competent to carry out the tasks required of them. The qualifications of ROV personnel are determined by training, experience and actual evaluations of the individual by the employer.

- **Manning.** Safety of personnel is paramount during operations and maintenance; it is the responsibility of the contractor to provide a skilled team of sufficient numbers to ensure safety at all times. When defining the team size, the contractor should consider:
  - Nature of the work being undertaken.
  - Deployment method.
  - Location.
  - Vehicle classification.
  - Operational period.
  - Ability to respond to emergency requirements.

The contractor should provide a sufficient number of properly trained and experienced personnel, able to operate all equipment and provide support function to the ROV team. For safe operations, the team may also need to include additional deck support personnel and other management or technical support personnel. However, personnel not normally employed by the ROV contractor (e.g. clients, vessel crews, etc.) can create a hazard to themselves and others if they lack familiarity with the contractor's procedures, rules and equipment. Therefore, their competence and suitability should be carefully considered before their inclusion in the ROV team.

Safe working practice dictates that personnel should not work alone when dealing with:

- High voltage.
- Heavy lifts.
- High-pressure machinery.
- Umbilical testing.
- Potential fire hazards (welding, burning, etc.).
- Chemicals capable of generating toxic fumes.

9.3 ROV AND DIVER OPERATIONAL PROCEDURES

9.3.1 INTRODUCTION

These recommended guidelines and procedures have been written to cover general guidelines regarding ROV-diver operations. These procedures are intended as guidelines for supervisors and operators.

The essential factor to successfully and effectively conducting simultaneous ROV operations with diver intervention is **COMMUNICATION.** This word will be used often in these procedures. A clear line of communication between ROV crews and dive control is critical.

A job safety analysis is a critical ingredient to assuring that all factors necessary to support the highest levels of safety have been considered.

9.3.2 DEFINITIONS

ROV Remote Operated Vehicle

TMS Tether Management System

LARS Launch and Recovery System

HPU Hydraulic Power Unit

FSW Feet Sea Water

MSW Meter Sea Water

9.3.3 ROV AND DIVE TEAM OPERATIONAL PROCEDURES

COMMUNICATION IS KEY TO A SAFE AND EFFICIENT OPERATIONS.

9.3.3.1 Pre-dives

In addition to standard pre-dive briefings:

- It is important that all divers and dive supervisors are familiar with all aspects of the ROV.
- Location of thrusters, diver toolbox, manipulator arms, tether and camera locations should be areas of focus during this orientation.
- Camera location is important in order to emphasize to diving personnel the pilot's field of vision.
- Tether is not to be used as a crossover/swim line for divers.
- When mounting a diver toolbox on ROV, place it in a location that takes into consideration that most diving tools have lanyards on them. The diver needs to be able to access the toolbox and tools without getting lanyards or the divers themselves fouled in thrusters.
- Thruster location is important to divers. Divers will have pneumos and tooling with lanyards. Even with thrusters nulled and the pilot holding a dead stick, thrusters will rotate. Divers need to secure all lanyards and pneumo hoses before approaching an ROV.

9.3.3.2 Subsea Operations

- Before the ROV approaches a diver, the diving supervisor must be notified. Slow, easy movements of the ROV are required to prevent injury to diver.
- When the diver approaches the ROV, the diving supervisor must be notified as well as the ROV supervisor or pilot. The ROV should stop all movements in order to allow the diver to approach. When possible, the diver should approach from the front of the ROV, to allow the ROV pilot to view him or her. If the ROV needs to dial in vertical thrust down, in order to hold position, the pilot should notify the dive supervisor that the thrusters are operating during diver's approach.

- Using manipulators with divers:
  - The ROV should place the manipulator in such a position that diver can place a tool in the jaws.
  - The ROV pilot should then inform the diving supervisor that the manipulator jaw is closing. Once this is acknowledged, only then should the pilot close the ROV jaws.
  - The ROV should never try to take a tool from the diver; the diver must place the tool in the manipulator jaws to minimize manipulator movements.
- The ROV tether should never be used for a diver crossover/swim-line.
- When establishing a swim line for a diver:
  - After the ROV has acquired the hook for the crossover line, the diver should pay out the crossover line as the ROV flies to the connection point.
  - The diver should not let out excessive amounts of line during this operation. Line should be kept taut; if the pilot requires additional slack, he or she can then notify the dive supervisor.
  - After the crossover line is established, the diver should secure it so that excessive slack is not floating about for ROV to get tangled in thrusters.
- Tag lines should be cut short or made ROV-friendly from surface. ROV-friendly tag lines are ones that are removable from surface, after tag lines have served their purpose, in over-boarding equipment. If the diver is required to cut tag lines, the pieces cut off should be tied to a retrieval shackle, on down line. The cut off pieces should then be recovered to surface for disposal, to mitigate the possibility of fouling ROV thrusters with rope floating about subsea.
- As stated earlier, the diver should not use the tether as a crossover line. The diver should also try to go under the ROV tether. This will help prevent any entanglement problems with the diver, should the ROV lose hydraulics.
- If the ROV is in a no-visibility situation:
  - The diver should return to the stage or bell, if the ROV needs to perform tasks. If the ROV is not needed and the diver is required to stay on location, the ROV should go dead stick. The pilot should then inform the dive supervisor that the ROV is in a no-visibility situation and should remain clear from the diver. The ROV pilot should allow the ROV to rise above no-visibility to an area where visibility can be obtained. <u>The ROV should not, for any reason, be flying in a no-visibility situation with a diver in the area.</u>
- The ROV pilot should be aware of all lines in the water. There will usually be at least one down line, running from the surface to the diver work location. Additionally, one or more crossover lines will also be present. This crossover line will run from the stage or bell (when applicable) to the work location.

9.3.3.3 ROV and Diver Intervention

- During multi-ROV/multi-diver operations, the ROV should answer to the designated call sign of that system, (e.g., XL19, XL16, Quest, etc). No generic "ROV" communication should be used over radio.
- Dive teams should be referred to as designated teams (e.g., shallow team, deep team, manifold team, etc.).
- It is recommended that dive teams be divided/assigned to particular ROVs.
- When assigning ROVs/divers, the following will be taken into consideration:
  - Launch point of ROV.
  - Deployment point of dive teams.
  - Task at hand.
  - Routing of ROV tethers and diver umbilical.
- Field of operations should be assigned to each ROV/dive team. The ROVs should then work within these areas during operations. If at any time, the ROV is required to leave the established fields of operation, both the ROV and diving supervisors should be notified, to make necessary changes. Both supervisors should ensure all dive and ROV members are aware of any ROV entering designated work area.
- All communications over the radio should be acknowledged and repeated for verification, prior to any task being carried out.

9.3.3.4 Surface Navigation-Survey Crew

The survey (tracking of the ROV) should, in certain instances, be handled by a third-party contractor. In this case, the ROV crews should have to rely upon the survey crew extensively during the course of any multi-ROV operation. Good, clear communication is critical between these two crews. The following recommended guidelines will cover some of the steps that should be established for the successful interface between the two crews.

- The ROV crews should run video and communication lines between the ROV control vans and the survey control van. The two crews should be in constant communication during any and all dives.
- The survey crew should run computer video lines to the ROV control vans and place a monitor in each ROV control van to provide tracking information. The screen on the navigation monitor should display the surface support vessel, the ROV and any subsea structures in the area, etc. This should assist the ROV pilots in navigating the ROV to, from and around the scope of operation.
- The tracking of the ROV is established by the use of the following equipment:
  - ROVs should be tracked by using the LBL or USBL modes. In the LBL mode, the ROV should have a mini ROV NAV system installed. If in USBL mode, the ROV should have a mini beacon installed.
  - A navigation monitor should also be placed in the bridge of the surface support vessel. This should enable the captain of the vessel to track the ROV's movements and keep the surface vessel in the desired position during ROV operations.

9.3.4 PRE-DIVE PROCEDURE

1. Verify sea state conditions are safe to dive.
2. Inform client representative, survey and vessel captain of intent to dive.
3. Verify all cables are secured and clear from entanglement.
4. Verify all static compensators are full and bled of air.
5. Verify all hydraulic compensators are full and bled of air.
6. Inspect system cursor (if applicable).
7. Verify ground strap is attached.
8. Verify good communications from control van to winch/LARS area.
9. Verify with other ROVs the intent to conduct deck checks.
10. Turn on power to TMS; verify TMS hydraulic pressure (if applicable), communications (if applicable), and that current draw is not excessive.
11. Calibrate pan-and-tilt system. (If applicable)
12. Verify TMS tether-in and tether-out functions properly.
13. Verify TMS latch and unlatch functions properly.
14. Turn off power to TMS HPU (if applicable).
15. Turn on instrument power; verify telemetry indicators are good (if applicable).
16. Ensure that the gyro is operational and in the slave setting (if applicable).
17. Verify all GFD values are at acceptable values.
18. Turn on all cameras; verify quality video is received, test-operate all VCRs and re-install SIT cover.
19. Enable light power; verify all lights are variably controlled through controls (if applicable).
20. Turn on sonar power; verify that sonar passes self-test and telemetry is established.
21. Turn on altimeter power and verify reading.
22. Turn on power to "function" manipulator and verify valid telemetry.
23. Verify all personnel are clear of ROV area.
24. Turn on ROV HPU (verify that hydraulic pressure and current draw are not excessive).
25. Test any and all ancillary tooling, with client representative in attendance, if required.
26. Turn on all survey and tracking devices.
27. Verify proper pressures on compensators and system pressure gauges.
28. Verify clearance of operation and speed of pan-and-tilt units.

29. Verify proper operation and speed of five-function manipulator.
30. Verify proper rotation of thrusters and that no excessive noise is heard.
31. Shut down HPU (if applicable).
32. Turn on RF beacon and test the receiver.
33. Turn on the emergency flasher.
34. Remove SIT camera cover.
35. Remove ground strap.
36. Launch ROV.
37. Enter launch time, dive number and task in operations log book

9.3.5 POST-DIVE PROCEDURE

1. Turn off power and attach ground strap to the ROV.
2. Install all camera covers. (It is very important to ensure the SIT camera cover is installed.)
3. Turn off emergency flasher.
4. Turn off emergency RF beacon.
5. Wash down system with fresh water.
6. Visually inspect ROV and TMS for damage and debris.
7. Inspect thrusters for damage, debris or excessive wear.
8. Check and fill all compensators and bleed off air.
9. Inspect umbilical at the top of the mushroom for signs of wear.

9.3.6 MULTI-ROV OPERATIONAL PROCEDURES

This section describes the recommended actions necessary to safely deploy multiple ROV systems for operations. It will also address the personnel and equipment safety issues associated with deploying the ROV systems.

The steps presented in the pre-dive checklist must be completed before an ROV system can be deployed.

- Once all pre-dive checks are completed and the hydrophone pole is deployed (if applicable), all personnel shall man their assigned duty stations. The ROV supervisors should conduct a brief tasking meeting. At this time, it should be decided which ROV will be the primary (or lead) of the dive. The primary ROV shall have right of way over other ROVs in that theatre of operations.
- The ROV superintendent should inform the captain of the vessel of intent to dive.

  NOTE: It is recommended that only one ROV is launched at a time. Before any functions are conducted that would cause any substantial power draw, the pilot of that ROV is to inform the other ROV of his or her intentions.

- The lead ROV pilot shall man the ROV consoles in the control van.
- The lead ROV co-pilot shall man the winch.
- The lead ROV supervisor shall be the LARS observer and relay information to the winch operator.
- The ROV pilot shall verify with the captain of the vessel that the captain will maintain a heading that puts the vessel bow into the seas if practical, which should reduce any rocking motion of the vessel.
- The LARS observer shall make sure all non-essential personnel remain clear of the launch area.
- On the ROV pilot's command, the winch operator should boom the LARS A-frame over the side of the vessel. The winch operator must make sure that no tension is put on the umbilical during this maneuver.
- When the A-frame is at its full limit, over the side of the vessel, the slack should be taken out of the umbilical and slight tension put on it.
- The LARS observer should be watching the seas and swells and set the timing for the winch operator to lower the ROV system.
- At the LARS observer's command, the winch operator should tension up (low tension) the umbilical to compress the shock absorbers on the swing frame approximately 3/4 of their stroke, then open the swing frame latches and begin to lower the ROV system.
- Due to the extreme forces exerted upon the ROV system while traversing the interface zone, the winch operator must rely upon the LARS observer to set his or her timing for lowering the ROV system (through the interface zone). Once the ROV system is successfully deployed through the interface zone, the LARS observer will return to the control van and assume the responsibilities of supervising the overall operation.

- When the ROV system is approximately 50 feet below the surface, the ROV pilot should give the winch operator the command to all stop. This should allow the ROV pilot to turn on the TMS and ROV HPUs and the winch operator to change the winch to high tension (if applicable).
- Once the HPUs have been turned on, the ROV pilot should give the winch operator the command to continue down to a safe standby depth 200 fsw.
- At this time, the secondary ROV will perform the above-mentioned steps for launch.
- Once the secondary ROV has made it through the interface zone and has hydraulics up, the OK can be given to the lead ROV to continue descent.
- If a third or subsequent ROV is to be deployed, the above steps should be carried out for each ROV.
- During the descent of the ROV systems, all ROVs should continually monitor the attitude and distance of the other ROV's umbilical. This is to prevent any entanglement of the umbilicals during ROV descent. This can be done using the ROV's sonar.
- During the descent of the ROV systems, the winch operator must be aware of the umbilical and watch for snap-loading it, due to the rocking of the support vessel. If this occurs snap-loadingmay be lessened by not paying out umbilical when the vessel rocks towards the launch side of the vessel.
- The lead ROV system should be stopped approximately 50 feet above the work site.
- The secondary ROV should be stopped at 70 feet above the work site and subsequent systems at ascending intervals.
- Upon reaching working depth, the ROV pilots should give the command for the winch operator to "all stop on the winch." At this time, the winch operator should stop paying out umbilical, ensure that the winch brake is set, and turn the winch HPU off. After the winch HPU is turned off, the winch operator shall go into the control van and assume the responsibilities as co-pilot.
- Once the ROV system has been stopped at the proper working depth, the ROV pilot shall monitor the depth display to determine if there is any heaving of the system due to the rocking of the support vessel. If the system is heaving up and down, the pilot should monitor the heaving action, set his or her timing and wait for a lull. When there is a lull in the heaving that the pilot has determined will last long enough, he or she should disengage the ROV from the TMS.
- Upon determining that the timing is right to disengage the ROV, the pilot will give the ROV a little up thrust command, tether out on the TMS and open the TMS latches. Once the latch indicator indicates that the TMS latches are open, the ROV pilot will change the vertical thrust command from a little up to medium down while continuing the tether out command on the TMS.
- Upon successfully separating the TMS and ROV, the pilot may proceed to the work site while continuing to pay out tether from the TMS. The tether should be kept snug but not tight.
- All subsequent ROVs may deploy to their respective work sites after the lead ROV has established itself to its work site. Note that before departing the TMS, a confirmation must be obtained from the other ROVs currently at their work sites.
- Extreme care and constant monitoring of the work areas is to be maintained, as there may be a number of umbilicals, wire ropes, sonar reflectors/buoys and crane wires in the water at the same time. Never fly blind from one area to another, including returning to the TMS. Always inform the other ROV systems of your intent and when you have completed your move.

9.3.6.1 System Recovery

This section of will describe the actions necessary to safely recover an ROV system from operations. It will also address the personnel and equipment safety issues associated with recovering an ROV system.

- Upon making the decision to return to the TMS for recovery to the surface, the ROV pilot must first ensure that the vehicle and the tether are free of any obstructions.
- Once the vehicle and the tether are free of any obstructions, the ROV pilot should put the joystick commands in the reverse position.
- The pilot may then use the rear-facing camera to fly back to the TMS, keeping the tether in view at all times.
- While flying back to the TMS, the pilot must make sure to clear the tether of any obstacles and keep enough slack in the tether to compensate for any heaving action that may be acting upon the TMS.
- The ROV pilot must make sure to take any turns out of the tether prior to docking the ROV and TMS together.
- The pilot must ensure that he or she is bringing the ROV back to the TMS at a depth that would have the ROV approaching the TMS at least 10 to 20 feet below the TMS. Whenever possible, the ROV should not be tethered back in to the TMS at a depth above that of the TMS.
- Upon visually seeing the TMS in the rear-facing camera, the pilot should start judging the amount of heave action acting upon the TMS, if any, and start determining the timing for latching the ROV back into the TMS.
- As the pilot is determining the timing for re-entry into the TMS, he or she should ensure that the TMS latches are open.
- Once the pilot has determined the timing, he or she should then position the ROV directly under the TMS and orientate the ROV to

the compass heading the ROV was on at the time the ROV was deployed from the TMS. Then, the pilot should bring in the remaining tether while exerting a small amount of down thrust. The pilot must then fly the lifting bail of the ROV into the docking guide of the TMS.

- When the lifting bail of the ROV is in the docking guide of the TMS, the pilot should look to see if the fail-safe latch indicator is on. If the fail-safe latch indicator is on, the pilot should then apply a half up thrust command, tether in, and close the TMS main latches. The pilot should then look to see if the latch indicator is on. If the latch indicator is on, it is safe to start the ascent of the ROV system to the surface. If the fail-safe or main latch indicators do not come on, the pilot must give the ROV a vertical down command and tether out, then fly the ROV down and away from the TMS. Then determine what caused the failed latch attempt and try again.
- When the ROV pilot has successfully latched the TMS and ROV together, he or she should give the winch operator the command to bring the system to the surface and inform the vessel captain that the ROV is back in the TMS.
- The winch operator must make sure all non-essential personnel are clear of the area.
- The winch operator must make sure that the winch brake releases and begin to bring in the ROV system.
- The ROV pilot should periodically communicate to the winch operator the depth of the ROV.
- The ROV supervisor should report to the LARS skid to serve as the LARS observer and assist the winch operator with the recovery of the ROV system.
- When the ROV pilot reports to the winch operator that the ROV system has reached 100 fsw, the winch operator should stop the ascent of the ROV system and switch to low tension (if applicable), then continue the ascent at approximately 30 feet per minute. The winch operator must rely upon the LARS observer to establish the timing to retrieve the ROV system through the interface zone.
- As the winch operator retrieves the ROV system from the interface zone, he or she must slowly winch in the ROV system until it comes into contact with the swing frame. Upon initial contact with the swing frame, the damping ring should counteract any swinging of the ROV system.
- When the swinging of the ROV system has subsided, the winch operator should winch in slowly until the shock absorbers on the swing frame have compressed approximately 3/4 of their stroke, and then close the latches on the swing frame until the latch indicators disappear.
- When the latches have been closed, the winch operator should slowly pay out enough umbilical to take the tension off of the umbilical.
- The winch operator should then begin to boom the ROV system inboard while manipulating the swing frame in order to keep the ROV system level.
- The winch operator should continue to boom the ROV system inboard until the ROV system sets down onto the LARS skid. Post-dive checks should then take place.
- Inform the captain of the vessel, survey and client representative that the ROV is back on deck.
- Ensure hydrophone pole is up (if applicable).

9.3.6.2 Data Collection

The following are only recommended guidelines for data collection.

Data collection is a very important aspect of any ROV operation. The actual work that is to be done is only half of the operation, and the job is not complete without the concise and orderly collection of the pertinent data.

This section will detail the necessary steps and procedures required for the systematic and orderly collection of data encountered during an ROV operation.

Video Recording

It is recommended that all contractor ROV system control vans be outfitted with a minimum of two video recorders. One should be designated as the job footage recorder and the other one as the “black box” recorder.

Black Box

The ADCI recommends, when possible, that a black box recorder be available. It is also recommended the black box video recorder is in the record mode at all times during any ROV operation. Like the black box recorder on any aircraft, it records continuously during the operation. This is done so that if something goes wrong, the event will be captured on the video. Because of the use and nature of the black box recorder, the following guidelines shall be used:

- The black box recorder will be labeled "black box."
- The black box recorder will be turned on prior to any dive and left on until the system is back on deck.
- When the black box VCR reaches the end of the tape, and there is no information recorded that needs to be saved, the tape will be rewound and recorded over. It is suggested that a rotation of tapes or discs be performed, allowing 12 consecutive hours of operations to be recorded before previous operations are taped over.

9.3.7 EMERGENCY VEHICLE RECOVERY PROCEDURE

The following is to serve as recommended general guidelines for emergency recovery procedures while operating onboard the vessel. This is only a reference document, and all decisions concerning ROV equipment and ROV personnel will be made by the ROV supervisor on site. For individual system procedures, please refer to that system's emergency recovery procedures. Various determining factors will include, but not be limited to, weather conditions, sea state, current conditions, navigation, vehicle status and vessel status. A pre-job meeting will be held with the ROV crew, vessel personnel and client representatives. All pertinent personnel arriving after the beginning of job shall also be briefed. In case of one or more of the following events occurring, the primary consideration is, and shall always be, **personnel safety**.

9.3.7.1 Vehicle HPU Failure

Vehicle HPU failure will normally be indicated by a hard fault to ground on the HPU ground fault detector causing a GFI on the HPU breaker. Telemetry and video should still be operational and should aid in a successful recovery.

- The ROV supervisor should inform all pertinent personnel on the vessel of situation.
- If liveboating, the ROV pilot should inform the captain to hold the vessel steady and into the seas. If the vessel is tied up to another vessel or structure, the pilot should inform the captain of the situation and to stand by for immediate response.
- If the ROV vessel is positively buoyant, the pilot should have the winch operator begin to slowly raise the TMS while the pilot begins to tether in. If, for some reason, the vehicle is negative or descending very slowly, the pilot can tether in immediately. Before attempting to dock into the TMS, the winch operator should slowly lower the TMS to assist in latching the vehicle.
- Once the ROV is in the TMS with visual verification and the TMS caged light is illuminated, the winch operator should lower the TMS and the pilot should toggle the TMS latch switch.
- The vehicle can now be recovered following normal operating procedures.
- Once the vehicle is on deck, repairs should begin.

9.3.7.2 Vehicle Instrumentation Failure

- If loss of telemetry to the vehicle occurs, the vehicle should continue to have video signals and HPU controls should automatically enter fail-safe mode. In ail-safe mode, the vehicle should automatically zero all horizontal thruster controls and enter auto depth mode to maintain depth when the telemetry signal was lost. This should aid in latching the ROV into the TMS and normal recovery thereafter.
- If loss of all instrumentation occurs, HPU and instrument breakers should be shut down if they have not already tripped.
- Recover ROV as per HPU failure.

9.3.7.3 Tether Separation

- If there are indications that the tether has been separated (no latch indication, tether counter continues far past zero), the TMS should be shut down and raised to the surface.
- The ROV supervisor should alert the captain and appoint lookouts at posts around the vessel.
- The ROV supervisor should confer with survey personnel and the captain to track the ROV if still receiving survey transponder beacon signal from the ROV. The captain should keep vessel within 100 feet of the vehicle during its ascent. If the vessel were tied to a structure, the ROV supervisor should inform the captain to untie the vessel from the structure as soon as the TMS is recovered to surface.

- If no signal is being received from transponder beacon, the ROV supervisor should have surveyors raise hydrophone pole.
- If survey information indicates the vehicle transponder is functional and the vehicle is not ascending, survey should take fix on the ROV's location, and the captain should get GPS coordinates. The ROV contractor's office should be informed immediately and personnel on the vessel wait for further instructions.
- If survey information indicates the vehicle was ascending and loses signal at shallow depths (out of hydrophone operational cone), lookouts should be alerted and an RF beacon locator used to track the ROV.
- Once the ROV is located on the surface, the vessel should position itsself so that the ROV is on the starboard mid section of vessel (recovery zone). The ROV crew should place a recovery sling onto the ROV. At this point, the crane on the starboard side of the vessel should be used to recover the ROV and place it back onto the LARS frame.
- Recovery personnel should be outfitted with life vests and should attempt to hook the vehicle at the lifting bell, if possible. Depending on where the tether parted, using choker slings, or even using the tether itself, may aid in recovery.
- Once the vehicle is on deck, ROV crew should secure the ROV to the LARS.
- The ROV contractor's office should be informed immediately.
- The crew should begin tether replacement and any other repairs required.

9.3.7.4 TMS Failure

- If indications arise that the TMS is no longer operational, the ROV supervisor should inform the vessel captain immediately. If the vessel is anchored to a structure, the captain should stand by for immediate response and alert other vessels in the area to stay clear.
- If the vessel is liveboating, the captain should slowly begin moving the vessel to a clear area while the ROV pilot follows the vessel, to ensure the tether is clear.
- If possible, the captain should put the vessel screws in neutral until the tether is secured. If this is not possible, the captain should then position the vessel so that current should carry the tether away from the stern of the boat. The captain should not use bow thruster unless an emergency arises.
- The ROV pilot should obtain visual of TMS and have the winch operator raise the TMS to surface at a speed determined by the pilot.
- Depending on amount of tether deployed and surface conditions, the ROV pilot should stop ascension as the TMS is recovered to surface. The tether should be hauled onto deck by the deck officer and secured so as to not let the tether drift to the stern of the boat. The tether amount and angle should be monitored at all times, until the TMS is returned to water.
- Repairs to the TMS should begin immediately, while the ROV pilot, captain and survey personnel keep in constant communication and verify the location of the ROV.
- Once the TMS is repaired, the tether should be deployed be deck officer as the TMS is launched into the water. Once the TMS is in the water, the ROV pilot should obtain visual contact as soon as possible and follow the TMS down to safe latching depth. The ROV and TMS should then be recovered to surface as per normal procedures, and complete system checks should take place. The ROV contractor's office should be informed of the incident.
- If the TMS is not repairable on deck, the ROV should be brought along the starboard side of the vessel (recovery zone), where preparations should be made to lift the ROV onto the LARS with the starboard side crane. Once the TMS and ROV are on the LARS and secured, repairs should begin, and the ROV contractor's office should be notified.

9.3.7.5 Launch and Recovery System Failure

- In event of LARS failure, the ROV pilot, if not already latched into the TMS, should do so immediately.
- The ROV supervisor should immediately inform the client representative and the captain of the vessel of the situation. The captain should slowly guide the vessel to a clear area if it is not tied up, or remain in place if the vessel is moored to a platform or barge.
- The ROV crew should begin to effect repairs to the LARS once the vessel is cleared in position to do so.
- The ROV contractor's office should immediately be informed of situation.
- Once repairs are effected, the ROV should be recovered immediately, and complete system checks should be performed.
- If repairs are not possible because of equipment limitations, the ROV supervisor should immediately report to the contractor's office to arrange express shipment of required replacement parts. If weather conditions permit, the ROV should be kept in water until such repairs can be made with continuous monitoring of system. (HPUs may be shut off.)

- Depending on which component of the LARS is not functional, various attempts to recover the ROV may be made using the system charge cart.
- The charge cart can be connected to the winch to haul the vehicle to surface. Once the TMS is sucked into the latching collar, hydraulics must be readily available to the swing frame latch circuit to close latches. Once the latches have the TMS mushroom in place, hydraulic supply can be switched between functions to land vehicle.
- If winch failure occurs, recovery of the vehicle may be attempted using crane sheaves to haul the umbilical to deck. The umbilical will be laid out across the back deck until the TMS mushroom is in the docking collar and latches are engaged. Extreme care should be taken during this procedure to to prevent damage to the umbilical during this procedure, although there is considerable risk of this occurring. **This procedure should occur only if all other conditions point to it (e.g., weather deterioration, vessel damage, etc.).**
- If A-frame damage has occurred but the winch is still operational, the ROV and TMS will be recovered into the docking collar. If the A-frame must be landed at this time, crane rigging to the A-frame boom and opening of hydraulic flow to the boom rams will be completed. Once the crane is secured to the boom, the hydraulic lines will be opened to allow free flow, and the boom can then be manipulated into its landing position. **This procedure should occur only if all other conditions point to it (e.g., weather deterioration, vessel damage, etc.).**

9.3.7.6 Vehicle Entanglement

- In case of vehicle entanglement, the ROV supervisor should immediately inform the captain of the vessel, client representative and survey personnel. Survey personnel should record the current location of the ROV and plot boat drop for the vessel. The captain should also lock the location into the vessel's GPS in case of survey equipment failure.
- The ROV crew should watch entanglement of the ROV on the black box tape to discern any useful information to aid in recovery.
- If the vehicle cannot be recovered through ROV power, the pilot should haul the tether in with the TMS until it is tight. If tether management does not aid in freeing the ROV, then the ROV supervisor should call the ROV contractor's office to inform of current situation.
- Depending on the depth of the vehicle entanglement and operation considerations, inquiries should be made to the client for possible use of divers in freeing the vehicle.
- Last considerations include the use of a winch to pull the vehicle free. **However, this option should be used only after consultation with the ROV contractor's office or if extremely dangerous working conditions exist.**

9.3.7.7 ROV System Power Failure

- In the instance of complete system power failure, the ROV pilot should immediately shut off all system breakers and inform the client representative, the captain of the vessel, and survey crew of situation. Survey crew should track the vehicle, while the captain maneuvers the vessel to clear the area if the situation dictates.
- The ROV crew should trace down the source of the problem, beginning with generator status. If a problem is found, the crew should begin repairs immediately. The ROV contractor's office should be informed of the situation.
- If repairs cannot be effected immediately, the ROV supervisor should inform the client and captain of situation and give an ETA on repairs. The ROV supervisor should instruct the captain to post lookouts on all corners of bridge to spot the ROV in the event of tether separation the while system is down. If system components are needed but not in stock, the ROV supervisor should inform the ROV contractor's office for immediate shipment of parts. In the event of this situation, the TMS can be recovered to deck and the ROV can be recovered using the starboard crane on the vessel. All electrical safety practices must be followed.
- If the source of the problem is determined to be with the generator and repairs cannot be implemented in a timely manner (10 minutes), the ROV crew should change power cables to the backup generator or ship's emergency power. The supervisor should contact the ROV contractor's office to inform them of the situation and arrange for repair parts or shipment of new generator.

Once again, these procedures should be used as guidelines only, and the supervisor will make all final decisions on site. Any circumstances considered out of the normal scope of operations will require consultation with the ROV contractor's office before extreme actions are taken. These procedures are to be addressed to the entire ROV crew and any relevant personnel onboard the vessel.

Notes

SECTION 10.0

ADCI COMPLIANCE AUDIT PROCEDURES

Association of Diving Contractors International, Inc.

10.0 ADCI COMPLIANCE AUDIT PROCEDURES

10.1 INTRODUCTION AND PURPOSE OF AUDITS

The Association of Diving Contractors International (ADCI) offers three different types of audits for contractors and associate member schools that conduct diving operations. The first type of audit that the contractors and schools will become familiar with is the ADCI self-audit report. This report is conducted internally by company personnel and should be submitted with all other application information as part of the application process or as mandated by the association on a periodic basis. The purpose of this audit is to provide applying companies and schools with a clear idea of the necessary recommended and required items for compliance with the ADCI consensus standards. When required, the ADCI will direct existing members to submit a revised self-aAudit protocol so that updated information about the contractor or school will be available for review.

The second type of audit that the association offers is the ADCI diving contractor audit report. This protocol is to be completed by a third party designated by the ADCI executive director, in agreement with the submitting contractor. This audit is performed as the last step of the application process for contractor or associate member school applicants. This audit protocol can also be utilized as part of the membership review process for a contractor or associate member school. The purpose of this audit is to provide a degree of assurance to the ADCI board of directors that the company applying for admission or under review is capable of adherence to the ADCI consensus standards.

The third type of audit that the ADCI offers is the saturation diving inspection and checklist protocol. This protocol is utilized with contractors who are engaged in saturation diving operations. This protocol is to be completed by a third party, designated by the ADCI executive director, in agreement with the submitting contractor. The purpose of this audit is to provide a degree of assurance to the ADCI board of directors that the company engaging in saturation diving operations is capable of adherence to the ADCI consensus standards' recommended guidelines for saturation diving operations.

10.2 SELF-PERFORMED COMPLIANCE AUDIT (ADCI SELF-AUDIT REPORT)

Available on the following page.

10.3 THIRD-PARTY COMPLIANCE AUDIT

ADCI Diving Contractor Audit Report (on Page 184)

ADCI Saturation Diving Inspection and Checklist Protocol (on Page 207)

ADCI Pre-dive Safety Checklist (on Page 225)

SELF-PERFORMED COMPLIANCE AUDIT (ADCI Self-audit Report)

INFORMATION PROVIDED BY APPLICANTS WILL BE CONSIDERED CONFIDENTIAL

General Instructions for Completion

1. The following document includes references to the ADCI International Consensus Standards for Commercial Diving and Underwater Operations, with referenced sections noted in bold numeric typeface.
2. Companies completing this audit form should furnish brief statements where appropriate. Where entries are required (such as where multiple personnel or items of equipment are noted), this information can be provided on a separate attachment.
3. It is recognized that not all sections of this audit form may apply. For example, where a company does not have an ISO procedure in effect, that can be noted, or where a health certificate or diver insurance, etc., is not required, insertion note stating "not applicable" is satisfactory.
4. Companies performing self-audits may furnish attachments, as they consider necessary and appropriate. ADCI will make contact with the submitter for any additional information or clarification considered necessary. On-site audits can be conducted in a manner to permit the auditor to view documents retained in keeping with the company's administrative procedures.
5. **IT IS NOT ACCEPTABLE TO MERELY REFER TO THE COMPANY'S SAFE PRACTICES/OPERATIONS MANUAL ON THE FOLLOWING AUDIT FORM. EACH QUESTION SHOULD BE ANSWERED IN A MANNER TO ASSURE THE AUDITING EVALUATOR THAT THE SUBMITTING COMPANY IS IN COMPLIANCE WITH THE REQUIREMENTS.**

ADCI SELF AUDIT REPORT
CONFIDENTIAL

Member Candidate or Member Company	
Company Representative	
ADCI or Company-designated Auditor o; Self-audit	
Address	
Date	
Report Number	

This audit protocol sets out a list of questions, which the auditor will address with a view to determining compliance with the ADCI International Consensus Standards for Commercial Diving and Underwater Operations. These questions are structured to cover the following areas in a manner that is consistent with the information presented in the consensus standards.

The auditor may, if he or she feels it appropriate, amplify answers to questions in areas of concern identified during the application documentation review or during the course of the audit.

The applicant company shall be furnished an advance copy of these audit procedures for review and preliminary completion prior to arrival of the ADCI representative(s) on site. These audit procedures will be made available at www.adc-int.org.

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			
2	Man-rated Lifts			
3	Open Bell (Class 1)			

4.8 Pressure Vessel for Human Occupancy – Section 6				
Item	**Description**	**Numbers**	**Last Inspection or Testing Date(s)**	**Comments**
1	DDC			
2	Systems			
3				
4				

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	
This form should be used by new member applicants and may be used by existing members as an internal record to maintain pertinent information of employees or other personnel used in the conduct of commercial diving or other underwater operations. Existing members are **NOT** required to submit complete information on these personnel but are required to have complete records on each diver employed or used during the conduct of commercial diving operations. Identify personnel by ADCI commercial diver certification card number.	
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 CONTRACTOR AUDIT REPORT

Chapter I: Contractor's Information

1. GENERAL INFORMATION	
Contractor's Name	
Contractor's Address	
Contractor's Telephone	
Contractor's Facsimile	
Contractor's Email	
Contractor's Website	
Business License Number	
Contractor's Business Scope	
Organization Chart	(Copy for attached)
President or General Manager's Name	
Safety Manager's Name	
QA/QC Manager's Name	
Diving Manager's Name	
Diving Supervisors' Names	
Number of Divers	
Number of Tenders	
Number of Other Personnel	
Others	

2. PERSONNEL INFORMATION

DIVING SUPERVISORS' LIST

Name of Diving Supervisors	Number and Valid Date of Certificate of Appointment Letter of Supervisors	Number of Diver Log Book	Number and Valid Date of Other Certifications or Required Documentation	Valid Date of Health Certificate	Medical Record

DIVERS' LIST					
Name of Divers	Number and Valid Date of Certificate of Divers	Number of Diver Log Book	Number and Valid Date of Other Certifications or Required Documentation	Valid Date of Health Certificate	Medical Record

OTHER PERSONNEL LIST (LST / DMT / SATURATION TECHNICIANS)				
Name of Other Personnel	Number and Valid Date of Certificate	Number and Valid Date of Other Certifications or Required Documentation	Valid Date of Health Certificate	Medical Record

EQUIPMENT LIST (1)			
Items	Name of Equipment	Availability	Remark

EQUIPMENT LIST (2)			
Items	Name of Equipment	Availability	Remark

DIVING CONTRACTORS' AUDIT FORM

Chapter II: Personnel Requirements

1. DIVING SUPERVISORS			
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Supervisor Training Course	Yes ❑ No ❑	
2	Supervisor Certification	Yes ❑ No ❑	
3	Supervisor Appointment Letter	Yes ❑ No ❑	
4	Supervisor Log Book	Yes ❑ No ❑	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes ❑ No ❑	
6	Health Certificate and Valid Current Physical	Yes ❑ No ❑	

2. DIVERS			
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Diver Training Course	Yes ❑ No ❑	
2	Diver Certification	Yes ❑ No ❑	
3	Diving Log Book	Yes ❑ No ❑	
4	Current Diving Physical: Fit for Diving?	Yes ❑ No ❑	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes ❑ No ❑	
6	NDT Certificate (if needed)	Yes ❑ No ❑	
7	Welding Certificate (if needed)	Yes ❑ No ❑	
8	Water-jetting Operating Certificate (if needed)	Yes ❑ No ❑	
9	H2S Training Certificate (if needed)	Yes ❑ No ❑	

DIVING CONTRACTORS' AUDIT FORM

Chapter III: Equipment and System

SCOPE

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 ❑ No ❑	
2	Unique Identity	All equipment must have a unique identity traceable to the equipment log.	Yes ❑ No ❑	
3	Content of Entries	Entries made in the equipment log must describe the nature of the work performed, including the dates of modification, repair or test; the name of the individual performing the work or test; and the particular piece of equipment involved.	Yes ❑ No ❑	
4	Signature	Any equipment repair and maintenance must be signed by divers or technicians.	Yes ❑ No ❑	
5	Instruction	Inspection and maintenance for any helmets or masks must be in accordance with instruction of manufacturer.	Yes ❑ No ❑	

DIVER'S DRESS

Dry Suits

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT 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 ❑ No ❑	
2	Material	Be constructed of material suitable to the environment in which it is to be used.	Yes ❑ No ❑	
3	Environmental Protection	Protect the diver from the environment, whether temperature or hazardous material.	Yes ❑ No ❑	

Hot Water Suits

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Water Flow	Flow sufficient water to maintain the diver in thermal balance at the desired temperature.	Yes ❑ No ❑	
2	Temperature Withstanding	Be capable of withstanding operating temperature.	Yes ❑ No ❑	
3	Bypass Device	Have a means to allow the diver to bypass incoming water prior to it entering the suit.	Yes ❑ No ❑	
4	Backup System	If diving in extreme environment, have a backup hot water supply, or alternatively, terminate the dive immediately and bring the diver to the surface if hot water supply is lost.	Yes ❑ No ❑	

Harnesses

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

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

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
Helmets & Masks				
General				
1	Suitability for Usage	Be appropriate for the task intended.	Yes ❑ No ❑	
2	Capability of Ventilation	Be capable of ventilating the required gas when supplied at the pressure recommended by the manufacturer of the equipment at any depth at which they are operated.	Yes ❑ No ❑	
3	PP CO_2	Be capable of maintaining the diver's respired CO_2 partial pressure below 0.02 ATA.	Yes ❑ No ❑	
4	Communication	Be fitted with two-way communications	Yes ❑ No ❑	
5	Non-return Valve	Be equipped with a non-return valve in the main gas supply that closes readily and positively. Have check valves with springs not exceeding 3 psi cracking pressure.	Yes ❑ No ❑	
6	Material	Be made of corrosion-resistant material.	Yes ❑ No ❑	
7	Over-pressure Protection	Be protected from over-pressurization.	Yes ❑ No ❑	
8	Marking	Each helmet or mask should have a unique serial number.	Yes ❑ No ❑	
9	Maintenance	Each helmet or mask must be subject to regular planned maintenance and a **record** of such maintenance should be available.	Yes ❑ No ❑	
10	Inspection and Testing	Inspection and function test at atmospheric pressure at least annually with **record** or **certificate.**	Yes ❑ No ❑	
Hoses				
Breathing Gas Hoses				
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure.	Yes ❑ No ❑	
2	Flow Rating	Flow rating to meet intended use.	Yes ❑ No ❑	
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes ❑ No ❑	
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes ❑ No ❑	
5	Collapse Prevention	Be kink-resistant or arranged to prevent kinking.	Yes ❑ No ❑	
6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with **record.**	Yes ❑ No ❑	
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with **record.**	Yes ❑ No ❑	
8	Suitability	Be suitable for breathing gas service.	Yes ❑ No ❑	
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 ❑ No ❑	

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

6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with **record.**	Yes ❑ No ❑	
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with **Record.**	Yes ❑ No ❑	
8	Oxygen Cleaning	Hose assemblies used in systems containing greater than 50% oxygen are to be cleaned for oxygen service.	Yes ❑ No ❑	
9	Marking	Hoses used for 100% oxygen service should be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY."	Yes ❑ No ❑	
10	Lubricants	Lubricants used to assemble fittings on hoses for oxygen service must be compatible with oxygen.	Yes ❑ No ❑	
11	Hose and Fittings	Hose and fittings must be brass or other alloys suitable for O^2 use.	Yes ❑ No ❑	
Compressor Systems				
Compressors & Gas Pumps for Life Support				
1	Personnel Protection	Have suitable personnel protection around rotating machinery.	Yes ❑ No ❑	
2	Instruction	Have the necessary instruction to facilitate operations	Yes ❑ No ❑	
3	Suitability	Be of the proper type, pressure and flow rate, suitable for service intended.	Yes ❑ No ❑	
4	Pollution Protection	Have its air intake positioned to be clear of exhaust fumes and other contaminants.	Yes ❑ No ❑	
5	Piping	Have piping system in accordance with recognized codes of standards.	Yes ❑ No ❑	
6	Flexible Hoses	Have flexible hoses in accordance with "hoses requirement."	Yes ❑ No ❑	
7	Electrical Controls	Have electrical controls, wiring and drive units meeting the jurisdictional requirements when so equipped.	Yes ❑ No ❑	
8	Oxygen Transfer	Be cleaned for oxygen service when used with mixtures of greater than 50% oxygen and equipped using rising stem type valve.	Yes ❑ No ❑	
9	Access	Be easily accessible to diving personnel, both for routine maintenance and during an emergency.	Yes ❑ No ❑	

Recording of Maintenance and 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 ❑ No ❑	
2	Quality Tests	Results of air quality tests must be retained to document their results and accomplishment.	Yes ❑ No ❑	
3	Unique Identity	Compressors must have a unique identity incorporating manufacturer, model, serial number, maximum rates outlet pressure, rated flow capacity and safety valve settings.	Yes ❑ No ❑	

4	Planned Maintenance	Compressor units must be subjected to planned maintenance.	Yes ❑ No ❑	
		Volume Tanks		
1	Manufacture	Be designed, fabricated, inspected, tested and certified in accordance with recognized codes or statutory or classification society requirements.	Yes ❑ No ❑	
2	Pressure Gauge	Be equipped with a pressure gauge.	Yes ❑ No ❑	
3	Check Valve	Be equipped with a check valve on the inlet side.	Yes ❑ No ❑	
4	Relief Valve	Be equipped with a relief valve as required by code of manufacturer.	Yes ❑ No ❑	
5	Drain Valve	Be equipped with condensate drain valve located at its lowest point.	Yes ❑ No ❑	
6	Annual Inspection	Be inspected internally and externally within 1 year for damage or corrosion with **record.**	Yes ❑ No ❑	
7	Pneumatically Testing	Be pneumatically tested to maximum working pressure within 1 year for the breathing mixture normally used with **record.**	Yes ❑ No ❑	
8	Hydrostatic Testing	Be hydrostatically tested to 1.2 times maximum working pressure within 5 years or after any repair, modification or alteration to the pressure boundary and **stamped** with the test date.	Yes ❑ No ❑	
9	Record and Certificate	Have a unique identity with results of all tests being recorded in the equipment **log** with **certificate**.	Yes ❑ No ❑	
		Filtration		
ITEM	**DESCRIPTION**	**DIVING OPERATIONS REQUIREMENT**	**AUDIT RESPONSE**	**REMARK**
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 ❑ No ❑	
		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 ❑ No ❑	
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 ❑ No ❑	
3	Testing Record	Documentation of these tests must be kept on file and available upon request.	Yes ❑ No ❑	
Diver Entry & Egress System				
		Diving Ladder and Stage		
1	Capability	Be capable of supporting the weight of two divers plus their gear.	Yes ❑ No ❑	
2	Material	Be made of corrosion-resistant material or be maintained free corrosion.	Yes ❑ No ❑	

3	Purpose	Be suitable for the purpose intended	Yes ❑ No ❑	
4	Ladder Length	Ladder must extend a minimum of 1 meter (3 feet) below surface where installed.	Yes ❑ No ❑	
5	Safety Chain and Hand Holds	Stage be provided with a safety chain and internal hand holds for diver safety during launch and recovery.	Yes ❑ No ❑	
6	Cylinder and Regulator	Stage be provided with breathing gas cylinder and regulator for emergency breathing if required.	Yes ❑ No ❑	
PVHO – Chamber				
		Diving Pressure Vessels		
1	Manufacture	Equipment must be built in accordance with recognized regulations and codes and must be subject to a planned maintenance system.	Yes ❑ No ❑	
2	Annual Inspection	Each pressure vessel must be examined and tested for mechanical damage or deterioration and must likewise be examined and tested after any repair, modification or alternation within 1 year with **record.**	Yes ❑ No ❑	
3	Pressure Testing	Each pressure vessel and piping must be pressure leak tested annually with Record to maximum working pressure.	Yes ❑ No ❑	
		Decompression Chambers (DDC)		
ITEM	**DESCRIPTION**	**DIVING OPERATIONS REQUIREMENT**	**AUDIT RESPONSE**	**REMARK**
1	Accordance	Meet requirements of item 5.7.1.	Yes ❑ No ❑	
2	Type	Be twin-lock and / or multiple-place.	Yes ❑ No ❑	
3	Dimension	Have sufficient internal dimensions to accommodate two persons lying in a horizontal position (except designated diving bells, transfer locks and emergency rescue chambers).	Yes ❑ No ❑	
4	Ingress and Egress	Permit ingress and egress of personnel and equipment while the occupants remain pressurized.	Yes ❑ No ❑	
5	Locking Device Operating	Have a means of operating all installed man-way locking devices from both sides of a closed hatch, except disabled shipping dogs.	Yes ❑ No ❑	
6	Internal Illumination	Have illumination of the interior sufficient to allow operation of any controls and allow for visual observation, diagnosis or medical treatment.	Yes ❑ No ❑	
7	Visual Capability	Have a visual capability that allows the interior to be observed from the exterior.	Yes ❑ No ❑	
8	Pressure Capability	Have a minimum pressure capability of 6 ATA, or the maximum depth of the dive for dives deeper than 10 ATA.	Yes ❑ No ❑	
9	Pressurization Rate	Be capable of a minimum pressurization rate of 18.3 meters (60 feet) and at least 9 meters (30 feet) per minute thereafter.	Yes ❑ No ❑	
10	Decompression Rate	Be capable of a decompression rate of 9-10 meters (30 feet) per minute.	Yes ❑ No ❑	

11	Oxygen Concentration	Have a means to maintain an atmosphere below a level of 23.5% oxygen by volume.	Yes ❑ No ❑
12	CO_2 Concentration	Have a means of maintaining an atmosphere below 1% surface equivalent carbon dioxide by volume.	Yes ❑ No ❑
13	Mufflers or Silencers	Have mufflers/silencers on blow down and exhaust outlets.	Yes ❑ No ❑
14	Suction Guards	Have suction guards on exhaust line openings inside each compartment.	Yes ❑ No ❑
15	Piping Arrangement	Have piping arranged to ensure adequate circulation.	Yes ❑ No ❑
16	Flexible Hoses	Have all installed flexible hoses meet the requirements of **item 6.5: Hoses.**	Yes ❑ No ❑
17	Penetrations Mark	Have all penetrations clearly marked as to service.	Yes ❑ No ❑
18	Regulation for Piping	Have piping in accordance with recognized codes/regulations or classification society to which it was built.	Yes ❑ No ❑
19	Calibration for Depth Gauge	Have a calibration of each depth gauge within 6 months with **certificates.**	Yes ❑ No ❑
20	Pressure-relief Device	Have a pressure-relief device as per recognized codes of construction.	Yes ❑ No ❑
21	Relief-valve Pressure Testing	Have the relief valve pressure setting tested with 1 year with **certificates.**	Yes ❑ No ❑
22	Breathing System	Have an installed breathing system with a minimum of one mask per occupant per lock plus one spare mask per lock. (In sat systems, more may be required). For DDC, minimum of two in inner lock and two for outer lock.	Yes ❑ No ❑
23	Supply Capability of Breathing Gas	Have the capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work (4.5ACFM).	Yes ❑ No ❑
24	Non-return Valve	Have a non-return valve on through-hull penetrators supplying any built-in breathing system (BIBS).	Yes ❑ No ❑
25	Communication System	Have a two-way voice communication system between the occupants and the operator and also between other occupants in separate compartments of the same PVHO or an attached PVHO. There shall be a secondary means of communication.	Yes ❑ No ❑
26	Extinguishing Fire	Be equipped with a readily available means for extinguishing fire.	Yes ❑ No ❑
27	Electrical System	When fitted, have electrical systems designed for the environment in which they will operate.	Yes ❑ No ❑
28	Exhaust Space	Chamber exhaust and BIBS should not vent into an enclosed space	Yes ❑ No ❑
29	External Illumination	The chamber, its general area and controls should be adequately illuminated for operations at night.	Yes ❑ No ❑

30	Heat Buildup to Viewports	If external lights are used to illuminate the chamber internally, they must not be placed in a manner that subjects viewports to heat buildup.	Yes ❑ No ❑	
31	Communications Between Two Locations	If the chamber is located away from the dive control station, there must be a suitable means of communications between the two locations.	Yes ❑ No ❑	

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 ❑ No ❑	
When used to indicate a diver's depth:				
2	Range and Graduation	Be of appropriate range and graduation.	Yes ❑ No ❑	
3	Consistent	Be graduated in units consistent with the decompression tables to be utilized.	Yes ❑ No ❑	
4	Calibration	Be calibrated to a known standard every 6 month with certificate	Yes ❑ No ❑	
5	Discrepancy	Be recalibrated when a discrepancy exists exceeding 2% of full scale.	Yes ❑ No ❑	
6	Calibration Mark	Be marked with a label, tag or sticker indicating date of last calibration and date due, which will not interfere with full-scale visibility.	Yes ❑ No ❑	
7	Deviation	Have a tag or label indicating amount of deviation (+/-) to the calibration standard.	Yes ❑ No ❑	
8	Calibrations Log	Have calibrations documented in the equipment **log.**	Yes ❑ No ❑	
9	Pressure-limiting Device	A pressure-limiting device may be fitted to gauges being over-pressurized.	Yes ❑ No ❑	
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 ❑ No ❑	

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

Handling Systems				
General *Handling systems intended for the launch or recovery of a diver or divers between the surface dive location and the work location by either bell or stage must:*				
ITEM	**DESCRIPTION**	**DIVING OPERATIONS REQUIREMENT**	**AUDIT RESPONSE**	**REMARK**
1	Manufacture	Be designed, manufactured, installed and tested in accordance with applicable design codes, standards and regulations.	Yes ❑ No ❑	
2	Suitability	Be designed such that the drive system and not the brakes control operation under normal conditions.	Yes ❑ No ❑	
3	Break Function	Be fitted with a mechanical brake capable of holding 1.25 times the safe working load of the winch.	Yes ❑ No ❑	
4	Break Function	Be designed so that the load can be stopped and held in position if the power supply fails, is disengaged, is switched off, or if operating control is released.	Yes ❑ No ❑	

5	Controls	Have controls located or equipped to afford the operator both a view and control of the lifting operation.	Yes ❑ No ❑	
6	Function Testing	After any installation, alteration repair or failure, be thoroughly examined and be functionally and load-tested to 1.25 times the safe working load of the handing system	Yes ❑ No ❑	
7	Wire and Ropes	Have wire ropes and fittings that are installed, terminated and maintained in accordance with design criteria and/or manufacturer's recommendations.	Yes ❑ No ❑	
8	Inspection	Visually inspected every 6 months for damage, deterioration or deformation.	Yes ❑ No ❑	
9	Certificates	Periodically examined and tested to recognized applicable codes and standards.	Yes ❑ No ❑	
10	Working Load	Have wire ropes and fittings that are rated 8 times the system's safe working load.	Yes ❑ No ❑	
11	Spooling Device	Have a spooling arrangement fitted if fleeting angle exceeds 2 degrees.	Yes ❑ No ❑	
12	Man Rating Winch	Man rating winch has been equipped.	Yes ❑ No ❑	
13	Secondary Means of Recovery	Secondary system available for backup.	Yes ❑ No ❑	
14	Standby Diver's LARS	Standby diver's launch and recovery system.	Yes ❑ No ❑	

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 ❑ No ❑	
		The manual has met the requirement of the ADCI CS.	Yes ❑ No ❑	
		The manual contains related government regulations, safety procedures, checklists, assignments and responsibilities of diving personnel, equipment procedures and checklists, emergency procedures, etc.	Yes ❑ No ❑	
		The manual contains a definitive statement regarding the use of drugs or alcohol.	Yes ❑ No ❑	
2	Emergency Aid	Developed and maintained a contact list for emergency response.	Yes ❑ No ❑	
		The emergency contact list has been made available at the contractor's principal place of business and at the dive site.	Yes ❑ No ❑	
		The contact list includes decompression chamber, hospital, air or ground transportation, on-call diving physician, national rescue center, etc.	Yes ❑ No ❑	
		Two-way communications are available at the dive site as required.	Yes ❑ No ❑	

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

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

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

Diving Contractors' Audit Form
Chapter V: HSEQ System

HSE System			
Basic Information			
ITEM	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	Is there designated management responsible for HSEQ?	Yes ❑ No ❑	
2	Is there any organization chart of HSE?	Yes ❑ No ❑	
3	Is there a designated person **specifically** in charge of HSE?	Yes ❑ No ❑	
4	Is there any certificate of membership qualification issued by diving industry organization (association)?	Yes ❑ No ❑	
5	Is there any qualification certificate of in-water survey organization issued by classification society?	Yes ❑ No ❑	
6	Is there any HSE certificate?	Yes ❑ No ❑	
7	Are all operation employees covered by personal injury insurance?	Yes ❑ No ❑	
8	Is all the operation equipment covered by equipment loss insurance?	Yes ❑ No ❑	
9	Is there any award for HSE performance in the past 3 years?	Yes ❑ No ❑	
A. Policy			
1	Is there any HSE system?	Yes ❑ No ❑	
2	Can the HSE system files be modified per the requirement of the client when the contract is signed?	Yes ❑ No ❑	
3	Is the HSE policy committed literally?	Yes ❑ No ❑	
4	Is the HSE policy signed by management, and can it be seen obviously by the general public?	Yes ❑ No ❑	
5	Do all staff know the HSE policy?	Yes ❑ No ❑	
6	Are there procedures to organize and implement HSE policy?	Yes ❑ No ❑	
B. Basic Management			
1	Are there any methods or regulations to identify, assess and control the dangers in work?	Yes ❑ No ❑	
2	Are there regulations to communicate with all operation persons for work method, HSE guidelines and emergency procedures?	Yes ❑ No ❑	
3	Is there any procedure to control the HSE behavior of subcontractors?	Yes ❑ No ❑	
4	Are there regulations to deal with the relationship of safety and production; safety and work process; safety and performance; and safety and expense control?	Yes ❑ No ❑	
5	Is there any system of regular safety meetings and pre-job meetings?	Yes ❑ No ❑	
6	Is there a set procedure to communicate between personnel in management and operation concerning safety issues?	Yes ❑ No ❑	

C. Emergency Response Plan			
1	Is there an emergency response plan?	Yes ❑ No ❑	
2	Is there compliance with the client's emergency response plan?	Yes ❑ No ❑	
3	Is the company's emergency response plan linked up to the client's plan?	Yes ❑ No ❑	
4	If you carry out the client's emergency response plan, are workers trained and familiar with it?	Yes ❑ No ❑	
5	Is there any system to conduct emergency response drills?	Yes ❑ No ❑	
6	Is there a record of drills conducted?	Yes ❑ No ❑	
D. Accident Reporting System			
1	Is there any procedure to report, investigate, trace and communicate accidents/incidents, nearmisses and occupational diseases?	Yes ❑ No ❑	
2	Has there been any serious accident(s) in the last 3 years? If yes, please submit the report.	Yes ❑ No ❑	
E. Training			
1	All staff has the training required for the use of PPE?	Yes ❑ No ❑	
2	Are all special certificates available for the conduct of operations? Please provide the name list, classification and S/N.	Yes ❑ No ❑	
3	Is there periodic HSE training for new employees, and are there refresher courses for veteran personnel?	Yes ❑ No ❑	
4	Is there any written policy requiring safety training, safety meetings and JSAs?	Yes ❑ No ❑	
5	Are all training requirements in written guidelines and/or memos?	Yes ❑ No ❑	
6	Is the training from established procedures?	Yes ❑ No ❑	
7	Is the training recorded in employee's record?	Yes ❑ No ❑	
F. Inspection and Audit			
1	Is there any HSE checkup procedure?	Yes ❑ No ❑	
2	Is there any HSE audit system including type, frequency, personal involved and treatment of defects found?	Yes ❑ No ❑	
3	Is there any method to handle defects found by the client based on the contract?	Yes ❑ No ❑	
4	Any audit accomplished in the last 3 years? Please submit the type, names of auditors and conclusion.	Yes ❑ No ❑	
G. Safety Analysis			
1	Is there any safety analysis for previous projects?	Yes ❑ No ❑	
2	Are there any regulations in written form for safety analysis?	Yes ❑ No ❑	
H. Management to Subcontractor			
1	Are there any HSE policies and procedures for subcontractors' compliance with established safety guidelines?	Yes ❑ No ❑	
2	Is there any HSE procedure of subcontractor selection?	Yes ❑ No ❑	
3	Is there any procedure to supervise and evaluate a subcontractor?	Yes ❑ No ❑	
4	Is there any policy for safety training for subcontractor employees during operation?	Yes ❑ No ❑	

I. Equipment and Material			
1	Is the equipment well maintained, per requirements?	Yes ❑ No ❑	
2	Is any record available for all inspection and maintenance of equipment?	Yes ❑ No ❑	
J. Labor Protection			
1	Is there appropriate PPE available for employees?	Yes ❑ No ❑	
2	Is there any procedure for inspection and maintenance of PPE?	Yes ❑ No ❑	
K. Employee Health			
1	Are there periodic requirements for medical examinations for operational personnel?	Yes ❑ No ❑	
2	Is there any procedure of first aid, CPR and DAN O^2 training for operational personnel?	Yes ❑ No ❑	
3	Is there a diving physician assigned to the dive team for the operation?	Yes ❑ No ❑	
4	If no diving physician is assigned, is there any certified diving physician available to contact in case of emergency?	Yes ❑ No ❑	
5	Are there established procedures to deal with diving incidents or diving medical issues?	Yes ❑ No ❑	
6	Are there any specific guidelines for periodic rest periods for employees out in the field?	Yes ❑ No ❑	
L. QA/QC System			
1	Is there any QMS system?	Yes ❑ No ❑	
2	Passed the QMS audit & certified?	Yes ❑ No ❑	
3	Is there any continuing training plan for diving personnel?	Yes ❑ No ❑	
4	Are records maintained of the above training?	Yes ❑ No ❑	
5	Is there any control procedure for the selection of subcontractors?	Yes ❑ No ❑	
6	Are all records of diving operations recorded according to standard?	Yes ❑ No ❑	
7	Are all divers' log books recorded according to standard?	Yes ❑ No ❑	

Saturation Diving Inspection and Checklist Protocol

DIVING CONTROL CENTER

ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Paperwork and Documentation	Copies of safe operations and procedures manual, emergency response plan and procedures, logs, and all applicable certification documentation is available at the dving control station.	Yes ❑ No ❑	
2	System Information and Pre-Dive Checks	All pre-dive checks are available at the dive control station. (If DPV: Bell and Surface Umbilical management diagram/BUMS and SUMS, thruster diagrams.)	Yes ❑ No ❑	
3	Location	Dive control station is located in a safe location, suitable for diving personnel to conduct operations, and accessible to all required controls and gauges.	Yes ❑ No ❑	

4	First Aid Kit /Medical Kit and Defibrillator-Bag Type Manual Resuscitator		Yes ❑ No ❑	
5	Fire-suppression System or Device		Yes ❑ No ❑	
6	Emergency Breathing Apparatus	Emergency breathing gas apparatus must be available for all occupants, plus one spare.	Yes ❑ No ❑	
7	Audio and Video Monitoring and Recording Equipment	Capability to audio- and video-monitor and record all personnel under pressure.	Yes ❑ No ❑	
8	Gas Analyzers/Diver Monitoring System: Online gas supplies to the bell shall be equipped with analyzers with high/low alarms and indicators lights.	Capability to monitor and analyze the gas within the saturation diving complex. A. Oxygen. B. CO_2. C. Temperature. D. Humidity.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
9	Alarms A. (If DPV: Alarms to Indicate Change or Loss of Station) B. Reclaim C. Gas Supply to Divers D. Hot Water System E. PVHO components of saturation system shall be equipped with analyzers with high / low alarms and indicator lights. F. Fire	Alarms for the systems (Hi/Low)	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
10	Communications A. Divers B. The Vessel Control Room (Bridge) ROV Operators C. Sound-powered Phone With Growler/Signal Device D. Launch and Recovery Systems (LARS)	The dive supervisor must have the capability to have direct communications with: In-water. If ROV operations are in concert with diving operations, the dive control station must have direct communication with ROV operators. To allow for the supervisor to communicate directly with the bell and system occupants. Dive control station must have direct communications with a primary and secondary LARS personnel.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
11	Saturation System Gas Supplies (1.5 times system volume at max pressure, plus one 8-hour bell run)	Adequate breathing media **(Primary and secondary backup, as well as a third source of emergency gas)** must be available for immediate delivery to the diver, bell, and all other components of the saturation diving complex.	Yes ❑ No ❑	

12	Gauges	All required gauges are available to the diving supervisor to monitor depth and all of the gas supply pressures of the bell, divers and all other components.	Yes ❑ No ❑	
		A. Depth.	Yes ❑ No ❑	
		B. Gas supply.	Yes ❑ No ❑	
		C. Cross-over valves.	Yes ❑ No ❑	
		D. Current calibration and sticker (depth gauge 6-mo. calibration cert.).	Yes ❑ No ❑	
13	Emergency Breathing Apparatus with Communications Capability	In the event that the dive control station atmosphere has been compromised, an emergency breathing apparatus must be available for the diving supervisor and other personnel necessary.	Yes ❑ No ❑	
14	Electrical System (ground fault capability where required or necessary, with labels and schematics)	A. Warning signs are visible.	Yes ❑ No ❑	
		B. Documentation of electrical system is available for review.	Yes ❑ No ❑	
		C. Emergency secondary back-up.	Yes ❑ No ❑	
		D. Emergency lighting.	Yes ❑ No ❑	
		E. Good housekeeping (electrical leads and wires are situated in a manner that they are not a tripping hazard to personnel in the diving control station).	Yes ❑ No ❑	
15	Hot Water System Monitoring (temp alarms and alarm indicator lights)	The diving supervisor must have the ability to constantly monitor the temperature and delivery of hot water to the divers.	Yes ❑ No ❑	
16	Manifold/ Panel Valves and Plumbing (designed and fit for purpose, with direction of flow arrows or lines)	A. Manifold valves are adequate for the media being delivered.	Yes ❑ No ❑	
		B. Plumbing and valves are properly maintained and free of rust or other corrosion.	Yes ❑ No ❑	
		C. All valves are clearly labeled.	Yes ❑ No ❑	

Total number of PVHO(s) in the complex:		
Maximum working pressure of the system:		
Maximum number of chamber(s) occupants:		
Maximum volume of chamber(s):		

SATURATION COMPLEX				
ITEM	**DESCRIPTION**	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	Saturation System Classed (Construction Code)		Yes ❑ No ❑	**What is the PVHO Construction Code?**
2	Current Diving System Safety Certificate (IMO requirement).		Yes ❑ No ❑	
3	Testing	Tested annually to maximum allowable working pressure or if modification to the pressure boundary was made (non-welding).	Yes ❑ No ❑	
4	Fire-suppression System-External Chamber(s) Location	Fire suppression equipment and methods are available for the entire area of the saturation complex.	Yes ❑ No ❑	**What is the certification date?**
5	Chambers' Viewports (Within date inspected for crazing, clarity, scratches or any damage. External protection.)	A. Manufactured in accordance with a recognized standard. (ASME/PVHO 1).	Yes ❑ No ❑	
		B. Certification date.	Yes ❑ No ❑	
		C. External lights are mounted in a manner that will not damage view ports.	Yes ❑ No ❑	
		D. Viewport protective device.	Yes ❑ No ❑	
6	Saturation Complex (External Condition)	A. Free of damage and excessive corrosion as defined by construction code.	Yes ❑ No ❑	
		B. Doors/hatches are numbered and properly labeled.	Yes ❑ No ❑	
		C. Penetrators are fitted with a stop pressure loss.	Yes ❑ No ❑	
		D. Seals and mating areas/faces must be free of debris and in good condition.	Yes ❑ No ❑	
		E. Lock (med./food) are equipped with a safety interlocked system that is fitted with a clamping device that secures the outer lock door.	Yes ❑ No ❑	
		F. All valves are marked, labeled and free from rust or corrosion. Designed, built and fit for purpose.	Yes ❑ No ❑	
		G. Fitted with relief valves to address over-pressurization. ASME re-sealable valves to fit 10% over MAWP.	Yes ❑ No ❑	
		H. Two-way communications between the med./food lock and the dive control station are available.	Yes ❑ No ❑	
		I. The environmental control unit (ECU) is fit to purpose and designed to meet dynamic and static loads.	Yes ❑ No ❑	
		J. The ECU is fitted with a non-return valve.	Yes ❑ No ❑	

7	Saturation Complex (Internal Condition)	A. Free of internal damage and excessive corrosion (see construction code).	Yes ❑ No ❑	
		B. Tested for hull integrity to maximum allowable working pressure (recommend the use of 20% He).	Yes ❑ No ❑	
		C. All gas hull penetrators are fitted with valves to stop pressure loss.	Yes ❑ No ❑	
		D. Seals on mating areas/faces must be free of debris/damage and in operational condition.	Yes ❑ No ❑	
		E. All valves are marked, labeled and free from rust or corrosion. Designed, built and fit for purpose.(e.g. brass, or alloy for O_2 percentage mixtures).	Yes ❑ No ❑	
		F. Proper protection on piping for all exhausts (suction guard).	Yes ❑ No ❑	
		G. Diffusers fitted for all inlet piping.	Yes ❑ No ❑	
		H. Two-way communication between diving personnel inside of each compartment of the saturation complex and the dive control station.	Yes ❑ No ❑	
		I. Back-up communications available (sound-powered phone with call button or growler).	Yes ❑ No ❑	
		J. BIBS, equipped with an overboard dump system, is available for each diver in every compartment, plus one spare mask/ hose assembly for back-up in each compartment.	Yes ❑ No ❑	
		K. Documentation for testing of BIBS prior to each sat run.	Yes ❑ No ❑	
		L. Adequate berthing for divers (bunks).	Yes ❑ No ❑	
		M.Adequate internal lighting for personnel to properly identify all valves and equipment.	Yes ❑ No ❑	
		N. Adequate lighting for outside visual and video monitoring.	Yes ❑ No ❑	
		O. Doors/hatches must be able to be secured and unsecured from both sides.	Yes ❑ No ❑	
		P. Doors/hatches can be secured in the open position.	Yes ❑ No ❑	
		Q. Doors hatches clearly labeled/numbered.	Yes ❑ No ❑	
		R. Sanitary facilities adequate to accommodate the divers for the duration of the saturation run.	Yes ❑ No ❑	
		S. Shower and sinks are available for diving personnel.	Yes ❑ No ❑	
		T. All toilets fitted with safety interlocks for flushing.	Yes ❑ No ❑	
		U. Means available for fire suppression. (i.e.e.g., hyperbaric extinguisher or built-in system).	Yes ❑ No ❑	
		V. Internal (caisson) depth gauges for divers to read their current depth. Enter calibration date in remark section.	Yes ❑ No ❑	
		W. The environmental control unit (ECU) is designed and fit for purpose to control the inside atmosphere of the saturation complex.	Yes ❑ No ❑	
		X. When applicable, oxygen injection is sited at the ECU discharge point.	Yes ❑ No ❑	

BELL LAUNCH AND RECOVERY SYSTEM (LARS)				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Weight of equipment to be lifted is documented for both air and in-water (bell).		Yes ❏ No ❏	
2	Safe working load (SWL) is clearly marked on the crane, winch, A-frame or davit, etc		Yes ❏ No ❏	
3	Man-riding Winches	A. Winches are man-rated and certified by manufacturer or other competent entity.	Yes ❏ No ❏	
		B. Operating instructions and emergency procedures are displayed and available for operator review.	Yes ❏ No ❏	
		C. Testing records and documentation are available for review.	Yes ❏ No ❏	
		D. The main brake will automatically activate when returned to the neutral position or if there is a loss of power.	Yes ❏ No ❏	
		E. A secondary backup brake is present.	Yes ❏ No ❏	
		F. The Operating lever is clearly marked, indicating all positions (raise, lower, neutral)	Yes ❏ No ❏	
		G. The operating lever returns to the neutral position when released by the winch operator.	Yes ❏ No ❏	
		H. Clutch mechanism has a means of preventing disengagement during operation.	Yes ❏ No ❏	
		I. Secondary means of power is available for the operation of the winch.	Yes ❏ No ❏	
		J. Winch is capable of accepting the full length of the wire being used.	Yes ❏ No ❏	
		K. Winch guards are fitted to the drum to prevent entanglement with clothing or other objects from with the machinery.	Yes ❏ No ❏	
		L. Level-winding component is part of the winch to ensure even spooling of bell wire and other man-rated winch wires.	Yes ❏ No ❏	
		M. Wire and umbilical are marked at designated intervals.	Yes ❏ No ❏	
		N. Emergency breathing apparatus with communications is available for winch operator.	Yes ❏ No ❏	
4	Main Lift Wires	A. Lift wires are non-rotating and designed and fit for purpose.	Yes ❏ No ❏	
		B. Connection of the bell wire has suitable retaining means for the removable pin.	Yes ❏ No ❏	
		C. Periodic inspection and lubrication is performed and documented for the main lifting wires.	Yes ❏ No ❏	
		D. Testing records and documentation are available for review.	Yes ❏ No ❏	
5	Secondary Means of Recovery	A. An independent secondary means of recovery is available for the bell.	Yes ❏ No ❏	
		B. Secondary means of recovery has the ability to position the bell where it can mate-up with the chamber system.	Yes ❏ No ❏	
		C. Winch meets man-riding requirements.	Yes ❏ No ❏	

6	Guide Wires	A. Guide wire system is fitted to restrict lateral or rotational movement of the bell in the water. B. Guide wire winch is used as secondary means of bell recovery. (If yes, all of the requirements for man-riding and man-rated lifting equipment will apply.)	Yes ❑ No ❑ Yes ❑ No ❑	
7	Cross-haul System (Management of change study to insure safe operational practices are followed)	A. Testing records and documentation are available for review for the winch and its purpose. B. Testing records and documentation are available for wire rope(s) and its purpose.	Yes ❑ No ❑ Yes ❑ No ❑	
8	Heave Compensation (This is only warranted in areas of extreme sea states or design parameter.)	A. A heave compensation system is fitted to the launch and recovery system (LARS). B. Operating instructions are available at the dive control station.	Yes ❑ No ❑ Yes ❑ No ❑	
9	Lift Attachment Points	A. Main attachment point is of an approved and industry-recognized design (pad eye). B. There is a secondary attachment point on the diving bell. C. Testing records and documentation are available for review.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
10	Bell Clamp	A. Safety interlock system is fitted to clamping mechanism (bell and chamber). B. Testing records and documentation are available for review.	Yes ❑ No ❑ Yes ❑ No ❑	
11	Hydraulic Unit	A. Hydraulic unit is in operational condition. B. Testing and maintenance documents are available for review.	Yes ❑ No ❑ Yes ❑ No ❑	
12	Fire Suppression	Plans, equipment and procedures are in place for the suppression of fires in the area of LARS/handling system.	Yes ❑ No ❑	

DIVING BELL[2]

ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	PVHO (Bell)	A. Bell must be built and designed to a recognized code or class and fit for purpose. B. Testing and inspection documents are available for review.	Yes ❑ No ❑ Yes ❑ No ❑	
2	Hatches	A. Hatches allow for free access to divers or personnel (even when resting on the sea floor or the deck). B. Hatches can be secured in the open position. C. Seals on mating faces are clean and free of damage. D. All hatch seals and sealing surfaces should be inspected prior to pressurization.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
3	Viewports	A. Designed and fit for purpose. B. Conforms to ASME/PVHO 1. C. Free of scratches and cracks. D. Testing and inspection documentation is available for review.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	

4	Ballast Release System (NOTE: Not all bells are equipped with a ballast release system.)	A. Ballast weight system is designed to prevent accidental release. (Bell's physical position should not cause the ballast release system to be compromised.)	Yes ❑ No ❑	
		B. Weights are designed and fitted for release from inside of the bell.	Yes ❑ No ❑	
		C. Two independent actions must be performed to release the weights.	Yes ❑ No ❑	
		D. Fail safe is in place for systems that are operated pneumatically or hydraulically from being compromised by pressure changes internally or externally in the bell.	Yes ❑ No ❑	
		E. Testing and inspection documentation is available for review.	Yes ❑ No ❑	
5	Bell Buoyancy and Stability (Note: Not all bells are designed to be buoyant.)	A. Documentation of test for buoyancy and stability is available for review.	Yes ❑ No ❑	
6	Bell (External)	A. Manufacturer information and serial number are clearly visible on the outside of the bell.	Yes ❑ No ❑	
		B. Anodes are clearly visible and in satisfactory condition.	Yes ❑ No ❑	
		C. Paint and insulation is in good condition.	Yes ❑ No ❑	
		D. All penetrators are designed and fit for purpose.	Yes ❑ No ❑	
		E. All gas penetrators are fitted with devices to prevent catastrophic pressure loss.	Yes ❑ No ❑	
		F. All penetrators are clearly marked, indicating function.	Yes ❑ No ❑	
		G. All valves are marked indicating function.	Yes ❑ No ❑	
		H. Emergency manifold available.	Yes ❑ No ❑	
		I. Connections for emergency gas/hot water (in accordance with IMO).	Yes ❑ No ❑	
		J. A copy of emergency tapping code has been attached /posted on the bell externally.	Yes ❑ No ❑	
		K. The lift attachment point (pad eye) has been designed and it is fit for the purpose.	Yes ❑ No ❑	
		L. There is a secondary lift attachment point on the diving bell.	Yes ❑ No ❑	
		M. Testing and inspection documents for the lift attachment points (primary and secondary) is available for review.	Yes ❑ No ❑	
		N. Sufficient onboard gas is available (as mandated).	Yes ❑ No ❑	
		O. Testing and inspection documentation for the onboard gas cylinders is available for review.	Yes ❑ No ❑	
		P. Transponder and strobe are fitted to the bell for tracking its location.	Yes ❑ No ❑	
		Q. Testing and inspection documentation for the transponder is available for review.	Yes ❑ No ❑	
		R. External lights illuminating the bell (recommend 360 degrees).	Yes ❑ No ❑	
		S. External battery pack is available and fit for purpose.	Yes ❑ No ❑	
		T. Testing and inspection documentation for the external battery pack is available for review.	Yes ❑ No ❑	
		U. Testing and maintenance documentation for the all bell umbilicals is available for review.	Yes ❑ No ❑	

7	Bell (Internal)	A. Bell volume accommodates the designed manning level according to class and or construction code.	Yes ❑ No ❑	
		B. Paint and internal insulation is in good condition.	Yes ❑ No ❑	
		C. All gas and electrical penetrators are designed and fit for purpose.	Yes ❑ No ❑	
		D. All penetrators are clearly labeled, indicating their function.	Yes ❑ No ❑	
		E. All valves are clearly labeled, indicating their function.	Yes ❑ No ❑	
		F. Bell is equipped with internal and external depth gauges.	Yes ❑ No ❑	
		G. Calibration documentation for the depth gauges is available for review.	Yes ❑ No ❑	
		H. Bell heating system is available for divers.	Yes ❑ No ❑	
		I. Hot water system is available for bell divers.	Yes ❑ No ❑	
		J. System for heating divers' gas is available.	Yes ❑ No ❑	
		K. Gas monitoring equipment to analysis bell atmosphere is available.	Yes ❑ No ❑	
		L. Testing and maintenance documentation for the bell gas monitoring system is available for review.	Yes ❑ No ❑	
		M.Bell equipped with CO_2 scrubber and spare canisters.	Yes ❑ No ❑	
		N. Adequate internal bell lighting.	Yes ❑ No ❑	
		O. All gas inlet piping is fitted with diffusers.	Yes ❑ No ❑	
		P. Bell occupants survival equipment.	Yes ❑ No ❑	
		Q. Inspection and maintenance documentation for bell occupants survival equipment are available for review.	Yes ❑ No ❑	
		R. Bell breathing gas supplies.		
		1. Gas cylinder pressures can be read from the inside of the bell.	Yes ❑ No ❑	
		2. Testing and inspection documents for onboard bell gas cylinders are available for review.	Yes ❑ No ❑	
		3. Secondary gas backup supply is independently available for bellman and divers.	Yes ❑ No ❑	
		4. A full-face mask or BIBS that can access gas from either primary or secondary bell gas supplies.must be available for all bell occupants.	Yes ❑ No ❑	
		5. System for monitoring and safe delivery of O_2 is available to prevent excess O_2 build-up.	Yes ❑ No ❑	
		S. Communications available between diving control and all divers/bellmen.		
		1. Through-water communications is available between the bell and dive control.	Yes ❑ No ❑	
		2. Sound-powered phone with growler or signaling device is available for communication between dive control and bell occupants.	Yes ❑ No ❑	
		3. Tapping Code is posted inside of Bell.	Yes ❑ No ❑	
		T. A system for recovery of an injured diver is available at the bell (block-nd-tackle with jam cleat).	Yes ❑ No ❑	
		U. First aid kit is equipped and fit for purpose.		
		1. Maintenance documents for the bell first aid kit are available for review.	Yes ❑ No ❑	

		V. Seating for bellmen is fitted with restraining harness.	Yes ❏ No ❏	
		W. Divers' umbilicals are in certification and fit for use.	Yes ❏ No ❏	
		X. bell emergency procedures manual is available for reference by bell occupants.	Yes ❏ No ❏	
LIFE-SUPPORT CONTROL CENTER (LSCC)				
ITEM	**DESCRIPTION**	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	All manuals and written procedures are available for use and review.		Yes ❏ No ❏	
2	Logs and other required sheets are available for use and review.		Yes ❏ No ❏	
3	Environment	1. Lighting in the LSCC is fit for use.	Yes ❏ No ❏	
		2. LSCC atmosphere and temperature are suitable and fit for use.	Yes ❏ No ❏	
4	Communications	1. All communications are hard-wired.	Yes ❏ No ❏	
		2. Two-way communications between LSCC and all compartments within the saturation complex.	Yes ❏ No ❏	
		A. Secondary back-up communications available.	Yes ❏ No ❏	
		3. Two-way communications are available between LSCC and diving control.	Yes ❏ No ❏	
		4. Two-way communications are available between all food locks (exterior) and LSCC.	Yes ❏ No ❏	
		5. Two-way communications are available between the LSCC and emergency evacuation system (EES).	Yes ❏ No ❏	
		6. Maintenance documents for communications are available for review.	Yes ❏ No ❏	
5	Gauges	1. Life-support panel is fitted with gauges to monitor the depth of all compartments in the saturation complex.	Yes ❏ No ❏	
		2. Life-support panel is fitted with gauges to monitor the gas supply pressures.	Yes ❏ No ❏	
		A. Gauges are fitted to show the line pressures coming in and also leaving the panel.	Yes ❏ No ❏	
		B. Panel cross-over valves are designated and fit for purpose and does not compromise accurate gas readings.	Yes ❏ No ❏	
		C. Gauges are clearly labeled with date of calibration.	Yes ❏ No ❏	
6	Panel Pipework/Valves	1. All pipework and valves must be designed and fit for purpose.	Yes ❏ No ❏	
		2. Testing and inspection documents for pipework and valves are available for review.	Yes ❏ No ❏	
7	LSCC Electrical Equipment	1. Emergency lighting available and fit for purpose.	Yes ❏ No ❏	
		2. All warnings and labels for electrical equipment are displayed.	Yes ❏ No ❏	
		3. Testing and maintenance documentation for LSCC electrical equipment is available for review.	Yes ❏ No ❏	

8	LSCC Fire-suppression System	1. Fire-suppression system for the LCSS is designed and fit for purpose. 2. Testing and inspection documentation for the LSCC fire-suppression system is available for review.	Yes ❑ No ❑ Yes ❑ No ❑	
9	First Aid Kit	1. First aid kit is available and fit for purpose. 2. Maintenance documents for the LSCC first aid kit are available for review.	Yes ❑ No ❑ Yes ❑ No ❑	
10	Breathing Apparatus	1. Emergency breathing apparatus, fitted with communications is available for all personnel assigned to the LSCC. 2. Maintenance and inspection documentation for the LSCC.	Yes ❑ No ❑ Yes ❑ No ❑	
11	Alarms	1. Vessel and facility alarms are audible and linked to LSCC. 2. Oxygen analyzer with (audio/visual) high/low alarm must be fitted in the LSCC. 3. Testing and inspection documentation for the LSCC oxygen alarms and analyzers are available for review.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
12	Video Monitoring	Video monitoring and recording of the entire saturation complex is available for personnel in the life-support control center (LSCC).	Yes ❑ No ❑	
13	General Atmosphere and Temperature Monitoring	1. CO_2 analyzers are fitted throughout the saturation complex and monitored in the LSCC. 2. Primary backup CO_2 analyzers are fitted throughout the saturation complex and monitored in the LSCC. 3. O_2 analyzers are fitted throughout the saturation complex and monitored in the LSCC. 4. Primary backup O_2 analyzers are fitted throughout the saturation complex and monitored in the LSCC.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	
14	System Gas Supplies	1. Primary and secondary gas supplies are available for all compartments of the saturation complex at all times. 2. Primary and secondary gas supplies are independently set up to provide breathing gas to the diver, bell and all chamber compartments. 3. Metabolic O_2 make-up system must be designed and fit for purpose. 4. Metabolic O_2 make-up system is fitted with a fail-safe to ensure safe flow and delivery. 5. System is in place for the delivery of treatment gas (via BIBS) to bell occupants and all occupants in the saturation complex.	Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑ Yes ❑ No ❑	

MAIN BELL UMBILICAL			
ITEM	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	1. Main ell umbilical is designed and fit for purpose.	Yes ❑ No ❑	
	2. Testing and inspection documents for the main bell umbilical are available for review.	Yes ❑ No ❑	
	3. Main bell umbilical deployment system is designed and fit for purpose.	Yes ❑ No ❑	
	4. Umbilical winch is fitted with a fail-safe that suspends the paying out of the umbilical when it is at rest or in neutral.	Yes ❑ No ❑	
	5. Testing and maintenance documents for the umbilical winch are available for review.	Yes ❑ No ❑	
	6. Main bell umbilical is attached to the bell with a strain relief system.	Yes ❑ No ❑	

DIVER HEATING SYSTEM			
ITEM	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	**Hot water system for divers is designed and fit for purpose.**		
	1. A secondary backup hot water system is available.	Yes ❑ No ❑	
	2. Testing and maintenance documentation is available for review (gauge calibration, electrical, pressure vessels, etc.).	Yes ❑ No ❑	
	3. Dive control has indication displays of the temperature of the hot water supplied to the diver.	Yes ❑ No ❑	
	4. Alarm system is fitted to the system to alert dive control if temperature limits have been compromised (Hi-Lo/audio/visual).	Yes ❑ No ❑	
	5. Hot water system is located in an area that will not pose a risk of fire or contamination of breathing air (compressors).	Yes ❑ No ❑	
	6. Hot water system is fitted with spill tray, when required.	Yes ❑ No ❑	
	7. Fuel tank is designed to mitigate accidental overflow, when required.	Yes ❑ No ❑	
	8. Fire suppression system and procedures are in place in the event of fire.	Yes ❑ No ❑	
	9. Testing and maintenance documentation for fine suppression equipment is available for review.	Yes ❑ No ❑	

DIVING UMBILICAL(S)				
ITEM	**DESCRIPTION**	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	**Diving umbilicals are designed and fit for purpose.**			
		1. Umbilical are properly marked for visual identification of the amount paid out.	Yes ❑ No ❑	
		2. Standby diver/bellman's umbilical is greater in length than the primary diver's.	Yes ❑ No ❑	
		3. Procedures for bell and surface umbilical management are available for review.	Yes ❑ No ❑	
		4. Testing, maintenance and inspection documents for diving umbilicals are available for review.	Yes ❑ No ❑	

INDIVIDUAL DIVING EQUIPMENT				
ITEM	**DESCRIPTION**	**REQUIREMENT**	**RESPONSE**	**REMARK**
1	**Helmets**			
		1. Helmets are labeled with unique serial number (as recommended by manufacturer).	Yes ❑ No ❑	
		2. Helmets are designed and fit for purpose.	Yes ❑ No ❑	
		3. Testing, maintenance and inspection documents are available for review.	Yes ❑ No ❑	

ITEM	DESCRIPTION / REQUIREMENT	RESPONSE	REMARK
2	**Diver-Worn Emergency Gas Supply (Bailout Bottle/Emergency Rebreather)**		
	1. Diverworn emergency gas supply for all bell occupants.	Yes ❑ No ❑	
	2. EGS is designed and fit for purpose (4-minute minimum EGS duration for deepest depth of dive).	Yes ❑ No ❑	
	3. All EGS cylinders/SLS are marked with the name and mixture percentages.	Yes ❑ No ❑	
	4. Testing and inspection documents for cylinders /SLS are available for review.	Yes ❑ No ❑	
3	**Whips and Connectors for EGS and Helmets**		
	1. Fittings and connections are fit for purpose (as recommended by manufacturer).	Yes ❑ No ❑	
	2. Testing and maintenance documents for whips and connectors are available for review.	Yes ❑ No ❑	

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.	Yes ❑ No ❑	
	2. Testing, maintenance (filters, etc.) and operation documentats for all pumps and compressors are available for review.	Yes ❑ No ❑	
	3. Fire-suppression system and procedures are available in the event of a fire.	Yes ❑ No ❑	
	4. Testing and inspection documentation for fire-suppression equipment are available for review.	Yes ❑ No ❑	
	5. Compressors are equipped with safety devices.	Yes ❑ No ❑	
	a. Solenoid switches.	Yes ❑ No ❑	
	b. Relief valves.	Yes ❑ No ❑	
	c. Other manufacturer-recommended or supplied safety devices.	Yes ❑ No ❑	

AIR AND GAS RECEIVERS

ITEM	DESCRIPTION / REQUIREMENT	RESPONSE	REMARK
1	**All air and gas receivers are designed and manufactured to a recognized code and fit for a purpose.**	Yes ❑ No ❑	
	1. Testing and inspection documentation is available for review.	Yes ❑ No ❑	

ELECTRICAL SUPPLIES

ITEM	DESCRIPTION / REQUIREMENT	RESPONSE	REMARK
1	**All electrical supplies and equipment are designed and fit for purpose.**	Yes ❑ No ❑	
	1. Testing and inspection documentation is available for review.	Yes ❑ No ❑	

EXTERNAL ENVIRONMENTAL CONTROL UNIT

ITEM	DESCRIPTION / REQUIREMENT	RESPONSE	REMARK
1	**All components of the external environmental control unit are designated and fit for purpose.**	Yes ❑ No ❑	
	1. Testing and inspection documentation is available for review.	Yes ❑ No ❑	

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

GAS RECLAIM (DIVER)[2]				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	**Reclaim system is designed and fit for purpose.**		Yes ❑ No ❑	
	1. All helmets and masks designated for use with the gas reclaim system are designed and fit for purpose.		Yes ❑ No ❑	
	2. Compressors and pumps used as parts of the gas reclaim system are designed and fit for purpose.		Yes ❑ No ❑	
	3. Gas reclaim system is located in the dive control center.		Yes ❑ No ❑	
	4. Audio/visual Hi/Low alarm is fitted on the gas reclaim panel.		Yes ❑ No ❑	
	5. Operating procedures for the gas reclaim system are available in the dive control center.		Yes ❑ No ❑	
	6. Gas reclaim system is fitted with an O_2 flow control device to prevent exceeding established metabolic consumption levels.		Yes ❑ No ❑	
	7. O_2 and HeO_2 flow control are fitted with a fail-safe in the event of power failure.		Yes ❑ No ❑	
	8. Gas analyzers:		Yes ❑ No ❑	
	a. O_2 analyzer with hi /low alarm is fitted on the downstream supply to the diving bell at the dive control center.		Yes ❑ No ❑	
	b. CO_2 analyzer with hi /low alarm is fitted on the downstream supply to the diving bell at the dive control station (completely independent of the O_2 analyzer).		Yes ❑ No ❑	
	c. Testing, maintenance and calibration documentation for all gas analyzers is available for review.		Yes ❑ No ❑	

GAS RECLAIM SYSTEM AND PURIFICATION (CHAMBER)			
ITEM	**DESCRIPTION / REQUIREMENT**	**RESPONSE**	**REMARK**
1	**Gas Bags**		
	1. Bag for recovering gas is located in an area that allows for full inflation.	Yes ❏ No ❏	
	2. Over-inflation alarm and monitor are fitted available at the dive control center.	Yes ❏ No ❏	
	3. A relief valve or bursting disc is in place for possible over-inflation of the bag.	Yes ❏ No ❏	
	4. Testing, maintenance and inspection documentation for the gas bags, relief valves, and bursting discs is available for review.	Yes ❏ No ❏	
2	**O_2 and CO_2 Analyzers**		
	1. O_2 and CO_2 analyzers are fitted in the gas reclaim system for the chamber.	Yes ❏ No ❏	
	2. Testing, maintenance and inspection documentation for the chamber reclaim system is available for review.	Yes ❏ No ❏	
3	**Compressors and pumps for chamber gas reclaim systems are designed and fit for purpose.**		
	1. Testing, maintenance and inspection documentation is available for review.	Yes ❏ No ❏	
4.	**Pipe-work/Valves**		
	1. All valves are clearly labeled.	Yes ❏ No ❏	
	2. All valves are operable and free of corrosion.	Yes ❏ No ❏	
	3. Testing and inspection documentation is available for review.	Yes ❏ No ❏	
5	**Cylinders Containing Used Gas**		
	1. Cylinders are clearly marked.	Yes ❏ No ❏	
	2. Testing and inspection documentation is available for review	Yes ❏ No ❏	
6	Operating instructions for the chamber reclaim system are available at the dive control center.	Yes ❏ No ❏	

EMERGENCY EVACUATION SYSTEM[3] (HYPERBARIC RESCUE CHAMBER/SELF-PROPELLED HYPERBARIC LIFE BOAT)			
ITEM	**DESCRIPTION / REQUIREMENT**	**RESPONSE**	**REMARK**
1	List the type of dedicated EES fitted to the system. (NOTE: The system diving bell **cannot** be used as the EES.)		
	1. EES is designed and fit for purpose.	Yes ❏ No ❏	
	2. Deployment drills documentation for the EES and applicable LARS is available for review (minimum one deployment annually is required, ADCI CS 6th Ed..)	Yes ❏ No ❏	
	3. EES is clearly marked in accordance with international, flag state or regulatory requirements.	Yes ❏ No ❏	
	4. EES has been float tested, as outlined in ADCI CS 6th Ed. (annually or when system undergoes modification).	Yes ❏ No ❏	
	5. There is a dedicated hardwire two-way voice communication system between the EES and the dive control center.	Yes ❏ No ❏	
	6. A copy of the emergency tapping code is indelibly posted on the EES both internally and externally.	Yes ❏ No ❏	
	7. Locator devices are:		
	a. Fitted with strobe light.	Yes ❏ No ❏	
	b. Fitted with distress beacon.	Yes ❏ No ❏	
	c. Fitted with radar reflector.	Yes ❏ No ❏	

	8. EES gas supply has:		
	a. O_2 and other life support gas required, based on operational parameters; onboard to support the number of occupants for a period of 72 hours at metabolic oxygen consumption rate.	Yes ❑ No ❑	
	9. A primary and secondary means to remove CO_2 from the EES atmosphere (e.g. battery and lung-powered).	Yes ❑ No ❑	
	10. EES has onboard batteries to meet the demand of the electrical load for 72 hours.	Yes ❑ No ❑	
	11. EES has a suitable first aid kit (containing sea sickness tablets) in a suitable container that is clearly marked and accessible.	Yes ❑ No ❑	
	12. ESS is capable to transfer supplies and equipment under pressure.	Yes ❑ No ❑	
	13. EES has a detailed written procedure for evacuation and deployment available at the dive control center.	Yes ❑ No ❑	
	14. Connected to the saturation system and pressurized to shallower storage depth as a minimum (during all diving or decompression operations).	Yes ❑ No ❑	
	15. Compatible life-support control system (LSCS) is available within 24 hours (maximum) of the EES location.		
	a. LSCS is stored at a different location than the saturation system.	Yes ❑ No ❑	
	16. EES LSCS contains:		
	a. Two-way communications with the EES and sound-powered phones with growler.	Yes ❑ No ❑	
	b. Gas control panels.	Yes ❑ No ❑	
	c. Gas suitable for maintaining depth.	Yes ❑ No ❑	
	d. Emergency gas for BIBS.	Yes ❑ No ❑	
	e. Fitted with O_2 and CO_2 analyzers.	Yes ❑ No ❑	
	f. Written copy of procedures.	Yes ❑ No ❑	
	17. Shall have a means to recover and tow.	Yes ❑ No ❑	
	18. Gas cylinders on the EES are labeled with contents.	Yes ❑ No ❑	
	19. Testing and inspection documentation is available for review.	Yes ❑ No ❑	
	20. EES (External)		
	a. Paint work is free from corrosion and rust.	Yes ❑ No ❑	
	b. Seals on mating faces are clean and undamaged.	Yes ❑ No ❑	
	c. Viewports are free of cracks or scratches in accordance with ASME/PVHO 2.	Yes ❑ No ❑	
	d. Testing and certification documents for viewports are available for review.	Yes ❑ No ❑	
	e. All hollow and electrical penetrators are designed and fit for purpose.	Yes ❑ No ❑	
	f. Valves are labeled and free from rust and corrosion.	Yes ❑ No ❑	
	21. EES (Internal)		
	a. Paint work is free from rust and corrosion.	Yes ❑ No ❑	
	b. Seals on mating faces are clean and undamaged.	Yes ❑ No ❑	
	c. Valves are labeled and free from rust and corrosion.	Yes ❑ No ❑	
	d. Valve in EES are secured in the open or closed position.	Yes ❑ No ❑	
	e. All penetrators are labeled.	Yes ❑ No ❑	
	f. All hollow penetrators are fitted with devices to prevent loss of pressure.	Yes ❑ No ❑	
	g. All gas inlets are equipped with diffusers.	Yes ❑ No ❑	
	h. EES is equipped with overboard-dump type BIBS for each occupant, plus one spare.	Yes ❑ No ❑	

	i. Lighting is sufficient enough for reading of gauges and surveillance from the outside.	Yes ❑ No ❑	
	j. Toilet must be designed and fit for purpose, with safety interlock.	Yes ❑ No ❑	
	k. EES Doors/Hatches:		
	i. Are capable of being opened from either side.	Yes ❑ No ❑	
	ii. Are able to be secured in the open position.	Yes ❑ No ❑	
	iii. Are fitted with a means of pressure equalization.	Yes ❑ No ❑	
	l. EES is fitted with seating restraints for all occupants.	Yes ❑ No ❑	
	m. Fire-suppression system is available for easy access by EES occupants.	Yes ❑ No ❑	
	n. Testing and inspection documents for the EES fire-suppression system are available for review.	Yes ❑ No ❑	
	o. Minimum 1 gallon of drinking water is available for each EES occupant.	Yes ❑ No ❑	
	p. EES provisions are provided as outlined by IMO.	Yes ❑ No ❑	
	q. Procedures are in place for maintaining adequate temperature and atmosphere in the EES.	Yes ❑ No ❑	
	r. A suitable means is available to remove CO2 from the EES atmosphere for at least 72 hours.	Yes ❑ No ❑	
	s. ECU is fitted to the EES.		
	i. ECU is capable of providing heating, cooling, and CO2 scrubbing, humidity control.	Yes ❑ No ❑	
	t. EES is equipped with a depth gauge.	Yes ❑ No ❑	
	u. Calibration labels and documents for the EES depth gauge are available for review.	Yes ❑ No ❑	
	22. Launch and recovery systems (LARS) for EES:		
	a. Designed and fit for purpose, meeting SOLAS and class requirements.	Yes ❑ No ❑	
	b. Detailed and written procedures for the EES LARS are easily accessible and available for review.	Yes ❑ No ❑	
	c. LARS is rated and capable of handling the EES and its occupants.	Yes ❑ No ❑	
	d. Secondary backup LARS is available.	Yes ❑ No ❑	
	e. Testing, maintenance and inspection documents for LARS are available for review.	Yes ❑ No ❑	
	23. Connection of the EES to the saturation complex:		
	a. Safety interlock system is fitted to the clamping mechanism between the EES flange and the flange on the connection to the saturation chamber/complex.	Yes ❑ No ❑	
	b. Testing and maintenance documents of the safety interlock system are available for review.	Yes ❑ No ❑	

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 ________________________________

Name________________________________ Title ________________________________

Name________________________________ Title ________________________________

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 ____________ **Defibrillator/Bag Type Manual Resuscitator** ________________

(Required by ADCI/USCG) (Required by ADCI/USCG)

Primary Breathing Gas **Air** ____________________ **HeO_2** __________ (%_______)

Compressor(s) Fluids/Fuel/Filters: ____________________________

(Standby Air) Compressed Air Banks/Bottle

Pressure (PSI/Bar) ____________________ Check on Delivery and Activation of Gas ______________Valves______________

Gas Supply

HeO_2: Number of Banks/Bottles: ______________ Online Pressure (PSIG/Bar): ______________

50/50: Number of Banks/Bottles: ______________ Online Pressure (PSIG/Bar): ______________

O2: Number of Banks/Bottles: ______________ Online Pressure (PSIG/Bar): ______________

Air: Number of Banks/Bottles: ______________ Online Pressure (PSIG/Bar): ______________

Bailout: Air: ______________ HeO_2 _____ (%_____)

COMMUNICATIONS: ____________________________ (Ensure all communications are hooked up and tested.)

Two-way communications on site for emergencies: ____________________________ (Required by ADCI/USCG)

CHAMBER(S): ________________________________

All gas is hooked up and delivery tested: ______________ O_2 online: _____ (PSIG/Bar: _____)

BIBS and backup BIBS: ________________________ Backup gas supply ready for delivery: ____________________

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.)

BELL/STAGE: ________________________________ (Ensure that all breathing gasses and delivery systems have been checked.)

Compressed Air (PSIG/Bar: __________) HeO_2 (PSIG/Bar: __________) 50/50 (PSIG/Bar: ____________)

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: ____________________

Notes

SECTION 11.0

REFERENCE MATERIALS

Association of Diving Contractors International, Inc.

11.1 GLOSSARY OF TERMS

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 absolute. Total pressure, including atmospheric, to which a diver, bell, etc., is subjected.

ATM (atm)

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 un-pressurized (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.

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 gasses 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 gasses.

DDC

Deck decompression chamber, 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, whose 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

Tender/divers, 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 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 regularly scheduled as necessary 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.

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 spport vessel.

EES

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

EGS

Emergency gas supply (bailout).

Embolism

See **Gas Embolism.**

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)

A foot of seawater. 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 gasses 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.

LARS

Launch and recovery system.

Liveboating

The practice of supporting a diver from a vessel that is underway.

Life-support Control System (LSCS)

Fly-away package for EES system. A system designed for the support of deployed Emergency evacuation systems (HRC or SPHLB).

LP

Low pressure (less than 500 PSI).

LST

Life-support technician/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 mixed gas (HeO_2) 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

Meters of sea water.

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 (Check 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 come in contact with oxygen without reaction.

Oxygen Toxicity (CNS O_2)

A condition usually not encountered unless PPO_2 approaches or exceeds 1.6 ATA. However, could be encountered as low as 1.4 ATA.

Oxygen Toxicity (Pulmonary O_2)

A condition from long exposures to increased PPO_2, causing a direct pulmonary irritation. Can occur during treatment tables 4, 7, 8, and also through back–to-back administration of treatment table 6.

Partial Pressure

That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

Person in Charge (Barge Captain - Installation Manager)

In relation to the craft/barge/structure, includes the captain or any other person made responsible by the owner for the vessel or facility, its operation, and the safety, health and welfare of those on board.

Pneumofathometer (Kluge - Pneumo)

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

Pounds per square inch gauge (pounds per square inch absolute minus 1 atmosphere.

PVHO

Pressure vessel for human occupancy.

Relief Valve

A pressure-relieving device that prevents pressure from rising above a preset level.

ROV

Remotely operated vehicle.

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

A diving mode in which the diver receives his or her 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 television cameras and cabling can also be carried as a component part of the umbilical or 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.

11.2 PHYSICS AND FORMULAS

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 .445
Round up to next whole number.

PSIG to Depth (fsw)

Depth = PSIG divided by .445
Round up to next whole number.

PSIG to Atmosphere Absolute (ATA)

$$\text{ATA} = \frac{(\text{PSIG} + 14.7)}{14.7}$$

Carry two decimal places.

Atmospheres Absolute (ATA) to PSIG

(ATA – 1) x 14.7 = PSIG

Depth (fsw) to Atmospheres Absolute (ATA)

$$\text{ATA} = \frac{\text{Depth} + 33}{33}$$

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

ATA | **% of Gas**

PP = Partial Pressure
% = Percent by Volume of the Identified Gas
ATA = Atmospheres Absolute

GAY-LUSSAC'S LAW

$$P2 = \frac{P1 \text{ x } T2}{T1}$$

Volume is constant.
T1 = Initial Temperature (absolute)
T2 = Final Temperature (absolute)
P1 = Initial Pressure (absolute)
P2 = Final Pressure (absolute)

CHARLES' LAW

$$V2 = \frac{V1 \text{ x } T2}{T1}$$

Pressure is constant.
T1 = Initial Temperature (absolute)
T2 = Final Temperature (absolute)
V1 = Initial Pressure (absolute)
P2 = Final Pressure (absolute)

Boyles' Law (Pressure/Volume Relationship)

$$\frac{DL + 33}{DA + 33} \text{ x } OV = NV$$

DL= Depth Left
DA = Depth Arrived
OV = Original Volume
NV = New Volume

Henry's Law

(The Law of Gas Absorption and Solubility) EXPLANATION:

- "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."
- Gas diffuses and dissolves in blood, because of the difference in partial pressure, between inhaled and exhaled air.
- 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.
- Whatever gasses that have been dissolved in 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

$$R^{o} = F^{o} + 460^{o}$$

Degrees Celsius to Absolute

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

Degrees Fahrenheit to Celsius

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

Degrees Celsius to Fahrenheit

$$(9 \times C^{o}) \div 5 = 32^{o} = \text{Fahrenheit (carry 1 decimal place)}$$

Gas Volume Requirement Formula if Using an LP Compressor

$$SCFM = ATA \times ACFM \times N$$

Gas Volume Requirement Formula if Using an HP Gas Bank

$$SCF = ATA \times ACFM \times N \times T$$

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 .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 (O_2/HeO_2/N_2O_2)

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_2O_2	1.42 – 3.00 ATA
166 – 225 fsw	64/36% HeO_2	2.17 – 2.80 ATA

Example of Calculating Surface Interval

Reached surface (RS) @ 2305 hrs.
Left surface (LS) @ 0317 hrs. (carry over 24-hr. clock)
0317 hrs. could be expressed, ONLY FOR THE PURPOSE OF CALCULATION, as 2717 hrs. 2717 minus (-) 2305 = 4:12
4 hrs. and 12 min.

Calculating In-water Travel Time

1. Depth left (ft/m) minus (-) depth arrived (ft/m) = distance traveled (ft/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 (x) by 60 (number of seconds in a minute). Decimal will then convert to actual seconds.

EXAMPLE:

215 fsw – 87 fsw = 128 fsw Ascent rate: 30 fpm
128 fsw ÷ 30 fpm = 4.26 (4 minutes and .26 or 26% of a minute)
26 x 60 = 15.6 seconds (round up to next whole second) = 16 seconds
4 minutes and 16 seconds is your travel time from 215’ to 87’

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
MFW	Meters of Fresh Water
MSW	Meters of Sea Water
MWP	Maximum Working Pressure
PP	Partial Pressure
$PP0^2$	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

11.3 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	1.016x106	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	9.99x104	.061023	3.53x105	1.30x103	2.113x103	1.056x103	2.641x104
16.387	16.3837	.016386	1	5.78x10-4	2.14x10-3	.034632	.017316	4.329x103
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	3.53x105	1.308x106	2.11x10-3	1.056x10	2.641x104
1000.03	1,000	1	61.0251	.0353154	1.308x103	2.11342	1.05671	.264178
473.179	473.166	.47316	28.875	.0167101	6.188x104	1	0.5	.125
946.359	946.332	.9463	57.75	.0334201	1.237x103	2	1	.25
3,785	3,785	3.785	231	.133681	49511x103	8	4	1

11.4 BAILOUT CALCULATIONS (Cu. Ft.)

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
1000	445.00	31.30	1.5	3000	30	595.00	2405.00	24.05	0.51
975	433.88	30.55	1.5	3000	30	583.88	2416.13	24.16	0.53
950	422.75	29.79	1.5	3000	30	572.75	2427.25	24.27	0.54
925	411.63	29.03	1.5	3000	30	561.63	2438.38	24.38	0.56
900	400.50	28.27	1.5	3000	30	550.50	2449.50	24.50	0.58
875	389.38	27.52	1.5	3000	30	539.38	2460.63	24.61	0.60
850	378.25	26.76	1.5	3000	30	528.25	2471.75	24.72	0.62
825	367.13	26.00	1.5	3000	30	517.13	2482.88	24.83	0.64
800	356.00	25.24	1.5	3000	30	506.00	2494.00	24.94	0.66
775	344.88	24.48	1.5	3000	30	494.88	2505.13	25.05	0.68
750	333.75	23.73	1.5	3000	30	483.75	2516.25	25.16	0.71
725	322.63	22.97	1.5	3000	30	472.63	2527.38	25.27	0.73
700	311.50	22.21	1.5	3000	30	461.50	2538.50	25.39	0.76
675	300.38	21.45	1.5	3000	30	450.38	2549.63	25.50	0.79
650	289.25	20.70	1.5	3000	30	439.25	2560.75	25.61	0.82
625	278.13	19.94	1.5	3000	30	428.13	2571.88	25.72	0.86
600	267.00	19.18	1.5	3000	30	417.00	2583.00	25.83	0.90
575	255.88	18.42	1.5	3000	30	405.88	2594.13	25.94	0.94
550	244.75	17.67	1.5	3000	30	394.75	2605.25	26.05	0.98
525	233.63	16.91	1.5	3000	30	383.63	2616.38	26.16	1.03
500	222.50	16.15	1.5	3000	30	372.50	2627.50	26.28	1.08
475	211.38	15.39	1.5	3000	30	361.38	2638.63	26.39	1.14
450	200.25	14.64	1.5	3000	30	350.25	2649.75	26.50	1.21
425	189.13	13.88	1.5	3000	30	339.13	2660.88	26.61	1.28
400	178.00	13.12	1.5	3000	30	328.00	2672.00	26.72	1.36
375	166.88	12.36	1.5	3000	30	316.88	2683.13	26.83	1.45
350	155.75	11.61	1.5	3000	30	305.75	2694.25	26.94	1.55
325	144.63	10.85	1.5	3000	30	294.63	2705.38	27.05	1.66
300	133.50	10.09	1.5	3000	30	283.50	2716.50	27.17	1.79
275	122.38	9.33	1.5	3000	30	272.38	2727.63	27.28	1.95
250	111.25	8.58	1.5	3000	30	261.25	2738.75	27.39	2.13
225	100.13	7.82	1.5	3000	30	250.13	2749.88	27.50	2.34
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**
1000	445.00	31.30	1.5	3000	50	595.00	2405.00	40.08	0.85
975	433.88	30.55	1.5	3000	50	583.88	2416.13	40.27	0.88
950	422.75	29.79	1.5	3000	50	572.75	2427.25	40.45	0.91
925	411.63	29.03	1.5	3000	50	561.63	2438.38	40.64	0.93
900	400.50	28.27	1.5	3000	50	550.50	2449.50	40.83	0.96
875	389.38	27.52	1.5	3000	50	539.38	2460.63	41.01	0.99
850	378.25	26.76	1.5	3000	50	528.25	2471.75	41.20	1.03
825	367.13	26.00	1.5	3000	50	517.13	2482.88	41.38	1.06
800	356.00	25.24	1.5	3000	50	506.00	2494.00	41.57	1.10
775	344.88	24.48	1.5	3000	50	494.88	2505.13	41.75	1.14
750	333.75	23.73	1.5	3000	50	483.75	2516.25	41.94	1.18
725	322.63	22.97	1.5	3000	50	472.63	2527.38	42.12	1.22
700	311.50	22.21	1.5	3000	50	461.50	2538.50	42.31	1.27
675	300.38	21.45	1.5	3000	50	450.38	2549.63	42.49	1.32
650	289.25	20.70	1.5	3000	50	439.25	2560.75	42.68	1.37
625	278.13	19.94	1.5	3000	50	428.13	2571.88	42.86	1.43
600	267.00	19.18	1.5	3000	50	417.00	2583.00	43.05	1.50
575	255.88	18.42	1.5	3000	50	405.88	2594.13	43.24	1.56
550	244.75	17.67	1.5	3000	50	394.75	2605.25	43.42	1.64
525	233.63	16.91	1.5	3000	50	383.63	2616.38	43.61	1.72
500	222.50	16.15	1.5	3000	50	372.50	2627.50	43.79	1.81
475	211.38	15.39	1.5	3000	50	361.38	2638.63	43.98	1.90
450	200.25	14.64	1.5	3000	50	350.25	2649.75	44.16	2.01
425	189.13	13.88	1.5	3000	50	339.13	2660.88	44.35	2.13
400	178.00	13.12	1.5	3000	50	328.00	2672.00	44.53	2.26
375	166.88	12.36	1.5	3000	50	316.88	2683.13	44.72	2.41
350	155.75	11.61	1.5	3000	50	305.75	2694.25	44.90	2.58
325	144.63	10.85	1.5	3000	50	294.63	2705.38	45.09	2.77
300	133.50	10.09	1.5	3000	50	283.50	2716.50	45.28	2.99
275	122.38	9.33	1.5	3000	50	272.38	2727.63	45.46	3.25
250	111.25	8.58	1.5	3000	50	261.25	2738.75	45.65	3.55
225	100.13	7.82	1.5	3000	50	250.13	2749.88	45.83	3.91
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
1000	445.00	31.30	1.5	3000	80	595.00	2405.00	64.13	1.37
975	433.88	30.55	1.5	3000	80	583.88	2416.13	64.43	1.41
950	422.75	29.79	1.5	3000	80	572.75	2427.25	64.73	1.45
925	411.63	29.03	1.5	3000	80	561.63	2438.38	65.02	1.49
900	400.50	28.27	1.5	3000	80	550.50	2449.50	65.32	1.54
875	389.38	27.52	1.5	3000	80	539.38	2460.63	65.62	1.59
850	378.25	26.76	1.5	3000	80	528.25	2471.75	65.91	1.64
825	367.13	26.00	1.5	3000	80	517.13	2482.88	66.21	1.70
800	356.00	25.24	1.5	3000	80	506.00	2494.00	66.51	1.76
775	344.88	24.48	1.5	3000	80	494.88	2505.13	66.80	1.82
750	333.75	23.73	1.5	3000	80	483.75	2516.25	67.10	1.89
725	322.63	22.97	1.5	3000	80	472.63	2527.38	67.40	1.96
700	311.50	22.21	1.5	3000	80	461.50	2538.50	67.69	2.03
675	300.38	21.45	1.5	3000	80	450.38	2549.63	67.99	2.11
650	289.25	20.70	1.5	3000	80	439.25	2560.75	68.29	2.20
625	278.13	19.94	1.5	3000	80	428.13	2571.88	68.58	2.29
600	267.00	19.18	1.5	3000	80	417.00	2583.00	68.88	2.39
575	255.88	18.42	1.5	3000	80	405.88	2594.13	69.18	2.50
550	244.75	17.67	1.5	3000	80	394.75	2605.25	69.47	2.62
525	233.63	16.91	1.5	3000	80	383.63	2616.38	69.77	2.75
500	222.50	16.15	1.5	3000	80	372.50	2627.50	70.07	2.89
475	211.38	15.39	1.5	3000	80	361.38	2638.63	70.36	3.05
450	200.25	14.64	1.5	3000	80	350.25	2649.75	70.66	3.22
425	189.13	13.88	1.5	3000	80	339.13	2660.88	70.96	3.41
400	178.00	13.12	1.5	3000	80	328.00	2672.00	71.25	3.62
375	166.88	12.36	1.5	3000	80	316.88	2683.13	71.55	3.86
350	155.75	11.61	1.5	3000	80	305.75	2694.25	71.85	4.13
325	144.63	10.85	1.5	3000	80	294.63	2705.38	72.14	4.43
300	133.50	10.09	1.5	3000	80	283.50	2716.50	72.44	4.79
275	122.38	9.33	1.5	3000	80	272.38	2727.63	72.74	5.20
250	111.25	8.58	1.5	3000	80	261.25	2738.75	73.03	5.68
225	100.13	7.82	1.5	3000	80	250.13	2749.88	73.33	6.25
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
1000	445.00	31.30	1.5	3500	120	595.00	2905.00	99.60	2.12
975	433.88	30.55	1.5	3500	120	583.88	2916.13	99.98	2.18
950	422.75	29.79	1.5	3500	120	572.75	2927.25	100.36	2.25
925	411.63	29.03	1.5	3500	120	561.63	2938.38	100.74	2.31
900	400.50	28.27	1.5	3500	120	550.50	2949.50	101.13	2.38
875	389.38	27.52	1.5	3500	120	539.38	2960.63	101.51	2.46
850	378.25	26.76	1.5	3500	120	528.25	2971.75	101.89	2.54
825	367.13	26.00	1.5	3500	120	517.13	2982.88	102.27	2.62
800	356.00	25.24	1.5	3500	120	506.00	2994.00	102.65	2.71
775	344.88	24.48	1.5	3500	120	494.88	3005.13	103.03	2.81
750	333.75	23.73	1.5	3500	120	483.75	3016.25	103.41	2.91
725	322.63	22.97	1.5	3500	120	472.63	3027.38	103.80	3.01
700	311.50	22.21	1.5	3500	120	461.50	3038.50	104.18	3.13
675	300.38	21.45	1.5	3500	120	450.38	3049.63	104.56	3.25
650	289.25	20.70	1.5	3500	120	439.25	3060.75	104.94	3.38
625	278.13	19.94	1.5	3500	120	428.13	3071.88	105.32	3.52
600	267.00	19.18	1.5	3500	120	417.00	3083.00	105.70	3.67
575	255.88	18.42	1.5	3500	120	405.88	3094.13	106.08	3.84
550	244.75	17.67	1.5	3500	120	394.75	3105.25	106.47	4.02
525	233.63	16.91	1.5	3500	120	383.63	3116.38	106.85	4.21
500	222.50	16.15	1.5	3500	120	372.50	3127.50	107.23	4.43
475	211.38	15.39	1.5	3500	120	361.38	3138.63	107.61	4.66
450	200.25	14.64	1.5	3500	120	350.25	3149.75	107.99	4.92
425	189.13	13.88	1.5	3500	120	339.13	3160.88	108.37	5.21
400	178.00	13.12	1.5	3500	120	328.00	3172.00	108.75	5.53
375	166.88	12.36	1.5	3500	120	316.88	3183.13	109.14	5.88
350	155.75	11.61	1.5	3500	120	305.75	3194.25	109.52	6.29
325	144.63	10.85	1.5	3500	120	294.63	3205.38	109.90	6.75
300	133.50	10.09	1.5	3500	120	283.50	3216.50	110.28	7.29
275	122.38	9.33	1.5	3500	120	272.38	3227.63	110.66	7.90
250	111.25	8.58	1.5	3500	120	261.25	3238.75	111.04	8.63
225	100.13	7.82	1.5	3500	120	250.13	3249.88	111.42	9.50
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 7L CYLINDERS (METRIC)

Depth msw	Depth Kg/cm²	Bar	Pressure absolute	Rate Ltrs/ Min	Cylinder Bar Luxfer® S080	Cylinder Bar	Cylinder Kg/cm² Luxfer® S080	Cylinder Kg/cm²	Cylinder Ltrs FV Luxfer® S080	Cylinder Ltrs FV Luxfer® 106W	Cylinder Ltrs FV	Cylinder Ltrs at 300 bar Luxfer® S080	Cylinder Ltrs at 300 bar Luxfer® S106W	Cylinder Ltrs at 300 bar	Delivery Pressure depth in Kg/cm2 +10.54604 Kg/cm2 reg press.	Usable Gas Pressure Luxfer® S080	Usable Gas Pressure	Usable Gas Ltrs/Cyl Luxfer® S080	Usable Gas Ltrs/Cyl Luxfer® S106W	Usable Gas Ltrs/ Cyl	Duration Minutes at Depth Luxfer® S080	Duration Minutes at Depth Luxfer® S106W	Duration Minutes at Depth
300	30.7692	30.1743	31.80	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	41.32	169.77	264.59	1997.80	3113.79	1816.38	1.48	2.30	1.34
290	29.7436	29.1685	30.77	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	40.29	170.79	259.71	2009.87	3056.32	1782.85	1.54	2.34	1.36
280	28.7179	28.1627	29.75	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	39.26	171.82	260.74	2021.94	3068.38	1789.89	1.60	2.43	1.42
270	27.6923	27.1569	28.72	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	38.24	172.84	261.76	2034.01	3080.45	1796.93	1.67	2.52	1.47
260	26.6667	26.1511	27.70	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	37.21	173.87	262.79	2046.08	3092.52	1803.97	1.74	2.63	1.53
250	25.641	25.1453	26.67	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	36.19	174.89	263.81	2058.15	3104.59	1811.01	1.82	2.74	1.60
240	24.6154	24.1394	25.65	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	35.16	175.92	264.84	2070.22	3116.66	1818.05	1.90	2.86	1.67
230	23.5897	23.1336	24.62	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	34.14	176.95	265.86	2082.29	3128.73	1825.10	1.99	2.99	1.74
220	22.5641	22.1278	23.59	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	33.11	177.97	266.89	2094.36	3140.80	1832.14	2.09	3.13	1.83
210	21.5385	21.122	22.57	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	32.08	179.00	267.92	2106.43	3152.87	1839.18	2.20	3.29	1.92
200	20.5128	20.1162	21.54	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	31.06	180.02	268.94	2118.50	3164.94	1846.22	2.31	3.46	2.02
190	19.4872	19.1104	20.52	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	30.03	181.05	269.97	2130.57	3177.01	1853.26	2.44	3.64	2.13
180	18.4615	18.1046	19.49	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	29.01	182.07	270.99	2142.64	3189.08	1860.30	2.59	3.85	2.25
170	17.4359	17.0988	18.47	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	27.98	183.10	272.02	2154.71	3201.15	1867.34	2.75	4.08	2.38
160	16.4103	16.093	17.44	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	26.96	184.12	273.04	2166.78	3213.22	1874.38	2.92	4.34	2.53
150	15.3846	15.0872	16.41	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	25.93	185.15	274.07	2178.85	3225.29	1881.42	3.12	4.62	2.70
140	14.359	14.0813	15.39	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	24.91	186.18	275.09	2190.92	3237.36	1888.46	3.35	4.95	2.89
130	13.3333	13.0755	14.36	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	23.88	187.20	276.12	2202.99	3249.43	1895.50	3.61	5.32	3.11
120	12.3077	12.0697	13.34	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	22.85	188.23	277.15	2215.06	3261.50	1902.54	3.91	5.75	3.36
110	11.2821	11.0639	12.31	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	21.83	189.25	278.17	2227.13	3273.57	1909.58	4.26	6.26	3.65
100	10.2564	10.0581	11.29	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	20.80	190.28	279.20	2239.20	3285.64	1916.63	4.67	6.85	4.00
90	9.23077	9.05229	10.26	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	19.78	191.30	280.22	2251.27	3297.71	1923.67	5.16	7.56	4.41
80	8.20513	8.04648	9.24	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	18.75	192.33	281.25	2263.34	3309.78	1930.71	5.77	8.43	4.92
70	7.17949	7.04067	8.21	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	17.73	193.36	282.27	2275.41	3321.85	1937.75	6.52	9.52	5.55
60	6.15385	6.03486	7.18	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	16.70	194.38	283.30	2287.48	3333.92	1944.79	7.49	10.92	6.37
50	5.12821	5.02905	6.16	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	15.67	195.41	284.33	2299.55	3345.99	1951.83	8.79	12.78	7.46
40	4.10256	4.02324	5.13	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	14.65	196.43	285.35	2311.62	3358.06	1958.87	10.60	15.39	8.98
30	3.07692	3.01743	4.11	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	13.62	197.46	286.38	2323.69	3370.13	1965.91	13.31	19.31	11.26
20	2.05128	2.01162	3.08	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	12.60	198.48	287.40	2335.75	3382.20	1972.95	17.84	25.83	15.07
10	1.02564	1.00581	2.06	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	11.57	199.51	288.43	2347.82	3394.27	1979.99	26.87	38.85	22.66
1	0.10256	0.10058	1.13	42.5	207	300	211.081	305.91	12	12	7	2484	3600	2100	10.65	200.43	289.35	2358.69	3405.14	1986.33	49.00	70.74	41.27

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**
300	30.7692	30.1743	31.80	42.5	300	305.91	10	3000	41.32	264.59	2594.83	1.92
290	29.7436	29.1685	30.77	42.5	300	305.91	10	3000	40.29	259.71	2546.93	1.95
280	28.7179	28.1627	29.75	42.5	300	305.91	10	3000	39.26	260.74	2556.99	2.02
270	27.6923	27.1569	28.72	42.5	300	305.91	10	3000	38.24	261.76	2567.05	2.10
260	26.6667	26.1511	27.70	42.5	300	305.91	10	3000	37.21	262.79	2577.10	2.19
250	25.641	25.1453	26.67	42.5	300	305.91	10	3000	36.19	263.81	2587.16	2.28
240	24.6154	24.1394	25.65	42.5	300	305.91	10	3000	35.16	264.84	2597.22	2.38
230	23.5897	23.1336	24.62	42.5	300	305.91	10	3000	34.14	265.86	2607.28	2.49
220	22.5641	22.1278	23.59	42.5	300	305.91	10	3000	33.11	266.89	2617.34	2.61
210	21.5385	21.122	22.57	42.5	300	305.91	10	3000	32.08	267.92	2627.40	2.74
200	20.5128	20.1162	21.54	42.5	300	305.91	10	3000	31.06	268.94	2637.45	2.88
190	19.4872	19.1104	20.52	42.5	300	305.91	10	3000	30.03	269.97	2647.51	3.04
180	18.4615	18.1046	19.49	42.5	300	305.91	10	3000	29.01	270.99	2657.57	3.21
170	17.4359	17.0988	18.47	42.5	300	305.91	10	3000	27.98	272.02	2667.63	3.40
160	16.4103	16.093	17.44	42.5	300	305.91	10	3000	26.96	273.04	2677.69	3.61
150	15.3846	15.0872	16.41	42.5	300	305.91	10	3000	25.93	274.07	2687.74	3.85
140	14.359	14.0813	15.39	42.5	300	305.91	10	3000	24.91	275.09	2697.80	4.12
130	13.3333	13.0755	14.36	42.5	300	305.91	10	3000	23.88	276.12	2707.86	4.44
120	12.3077	12.0697	13.34	42.5	300	305.91	10	3000	22.85	277.15	2717.92	4.79
110	11.2821	11.0639	12.31	42.5	300	305.91	10	3000	21.83	278.17	2727.98	5.21
100	10.2564	10.0581	11.29	42.5	300	305.91	10	3000	20.80	279.20	2738.04	5.71
90	9.23077	9.05229	10.26	42.5	300	305.91	10	3000	19.78	280.22	2748.09	6.30
80	8.20513	8.04648	9.24	42.5	300	305.91	10	3000	18.75	281.25	2758.15	7.03
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

11.5 MEDICAL CONDITION REFERENCE CHART

MEDICAL CONDITION	CAUSE	PREVENTION	SYMPTOMS	TREATMENT
SQUEEZE Damage done to tissues that do not pressurize with the ambient pressure	G - Gas-filled space R - Rigid walls A - Ambient press. change V - Vascular penetration E - 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 - O_2 falls below .16 ATA	- Gas analysis. - Cylinder line-ups. - Pre dive check-outs procedures. - Monitor O_2 sensors throughout the dive.	C - Cyanosis (bluing of skin) I - Increased pulse rate L - Lack of muscle control L - Lack of concentration I - Inability to perform delicate tasks W- Weakness L - Loss of consciousness D - Drowsiness	In water: Perform emergency procedure for rig/helmet. Surface: 100% O_2 by mask. CPR if necessary. Transport to medical facility.
HYPERCAPNIA (CO_2 Toxicity) An excess of CO_2 built up in the blood	- Skip breathing - Excessive working at depth - Over breathing rig/ helmet - Inadequate lung ventilation - Rig malfunction	- Follow pre dive. - Moderate work pace. - Avoid skip breathing. - Avoid over-breathing diving Apparatus.	I - Increased respiration C - Confusion H - Headache I - Inability to concentrate L - Loss of consciousness D - Drowsiness	In water: - Notify topside. - Decrease work rate. - Breathe normally. - Follow EPs - Abort dive (if necessary). - Seek medical Attention. Surface: - Remove diving Apparatus. - Neuro to rule out AGE. - 100% O_2 by mask. - Transport to medical facility.
NITROGEN NARCOSIS A narcotic feeling caused by the effects of inert gasses 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. Work up dives.	C - Confusion L - Lack of concern for job or safety A - Apparent stupidity S - Sense of well being I - Impaired judgment	- Ascend above depth of onset - Will normally resolve in :01.
INNER EAR BAROTRAUMA (IEB) Inner ear contains no gas and is not subject to barotraumas. However, it is located next to the middle ear and affected by the same conditions that produce MIDDLE EAR BAROTRAUMA	- Common cold - Abnormal anatomy - Dysfunctional Eustachian tube - Running nose, head cold or congestion - TYPES: round window rupture, oval window rupture, violent shift in fluid in the inner ear, hemorrhage into inner ear	- Do not perform forceful valsalva maneuver. - No diving with a cold. - Stay ahead of the pressure. - Proper training.	- Vertigo - Hearing loss - Nystagmus - Nausea/ vomiting - Imbalance - Roaring tinnitus - Symptoms of MEB will be Present.	- May be the result of AGE. - Avoid straining. - Transport to medical facility.

MEDICAL CONDITION	CAUSE	PREVENTION	SYMPTOMS	TREATMENT
MIDDLE EAR BAROTRAUMA Most common type of barotrauma (MEB)	- Common cold - Abnormal anatomy - Dysfunctional Eustachian tube - Running nose, head cold, or congestion	- No diving with a cold. - Stay ahead of the pressure. - Proper training.	- Fullness or pain in ear - Slight bloody drip from oral/nasal via cavityEustachian tube - Mild hearing loss	- Notify topside. - Stop travel, ascend/ descend a few feet. - Attempt to clear. - Abort dive if Necessary.
EXTERNAL EAR BAROTRAUMA Occurs if external auditory canal is blocked	- Wax impaction - Tight wet suit hood - Ear infection	- Pull wet suit hood from face to allow water in and pressurize. - Do not dive with ear infection. - Do not use ear Plugs.	- Canal swelling - Possible hemorrhaging - 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 - Faulty air compressor system	- Do proper pre-dive checks. - Compressor intake located away from engine exhausts. - Proper maintenance of compressors.	- Tightness across forehead - Headache - Nausea - Confusion - Vomiting	- Remove patient from CO exposure. - Neuro to rule out AGE. - 100% O_2. - Transport to medical facility
CNS O_2 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.		VENTID - C V - Visual disturbance E - Ears ringing or roaring N - Nausea T- Tingling/twitching D - Dizziness C - Convulsions	- Off O_2. - Wait for symptoms to subside. - Wait :15. - Back on O_2 at point of interruption. - Further incidents consult CDP.
AGE The most serious diving injury; alveolar rupture with air bubbles entering capillaries of the lungs and traveling to the heart and then distributed throughout the 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 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	- Breath normally. - Never hold your 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 the first :10 after surfacing from a dive is to be a sign of AGE by non-medical personnel.	- Immediate Recompression. - Complete neuro exam. - 100% O_2. - Transport to medical facility below 1,000 ft. above sea level - If patient has relief upon entering chamber, treat original disorder. - Contact certified dive physician.
PULMONARY O_2 TOXICITY	Occurs during long exposures to increased PPO_2, causing a direct pulmonary irritant; can occur during treatment tables 4,7,8 and back-to-back TT6		C - Coughing, severe B - Breath; shortness of S - Substernal chest pain	- Discontinue O_2 Use. - Consult certified diving physician.

MEDICAL CONDITION	CAUSE	PREVENTION	SYMPTOMS	TREATMENT
SUBCUTANEOUS EMPHYSEMA	Results of expansion of gas that is leaked from the mediastinum into the subcutaneous tissues of the neck		- "Rice Krispies" feeling in neck - Voice change - Symptoms of mediastinal may be present - Feeling of fullness - Difficulty swallowing	- Neuro exam to rule out AGE. - 100% O_2. - Consult certified diving physician. - Transport to medical facility.
MEDIASTINAL EMPHYSEMA	Gas expands and forces gas into the loose mediastinal tissue in the middle of the chest		- Chest pain behind sternum - Pain may worsen with deep inspiration, coughing or swallowing - Tightness to dull ache from mild to moderate	- Neuro exam to rule out AGE. - 100% O_2. - Consult certified diving physician. - Transport to medical facility.
TYPE II DCS	- Individual variations - Excessive exercise while working - Previous injury - Cold, during decompression - CO_2 intoxication - AGE - Alcohol - Dehydration - Fatigue	- Individual variations - Excessive exercise while working - Previous injury - Cold, during decompression - CO_2 intoxication - AGE - Dehydration - Fatigue - Ensure proper fitness to dive - Proper training of dive personnel	- Unconsciousness - Weakness - Paralysis - Numbness - Ringing/Roaring in ears - Blurred vision - Dizziness - Fatigue - Tingling/twitching	- Complete Neuro to rule out AGE - Immediate recompression - 100% O_2 - Contact certified diving physician - Transport to medical facility below 1000 ft. above sea level.
TYPE I DCS	- Individual variations - Excessive exercise while working - Previous injury - Cold, during decompression - CO_2 intoxication - AGE - Alcohol - Dehydration - Fatigue	- Individual variations - Excessive exercise while working - Previous injury - Cold, during decompression - CO_2 intoxication - AGE - Alcohol - Dehydration - Fatigue - Ensure proper fitness to dive - Proper training of dive personnel	- Pain - Marbling - Swelling of lymph nodes	- Complete Neuro to rule out AGE or TYPE II. - Immediate recompression. - 100% O_2. - Consult certified diving physician - Some forms of TYPE I D.C.S do not require Immediate recompression.
PNEUMOTHORAX Over–inflation, causing air to enter space between lung and covering and chest wall	- Not exhaling on ascent	- Breathe normally. - Never hold your breath on ascent - Evaluate diver's physical. - Proper training of divers/proper medical screening & functioning equipment.	- Chest pain, lateral or top of shoulder suddenly or sharp - May have rapid or shallow breathing - Diver may guard affected side - Diver may be pale	- Neuro to rule out AGE. - 100% O_2. - Contact certified diving physician. - Transport to medical facility.

11.6 EMERGENCY RESPONSE DRILLS

NOTE: The ADCI recommends that companies develop and perform the necessary emergency response drills (ERDs) applicable to their operations. The following drills are examples that can be utilized and/or modified.

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: ABV/Dizzy on Ascent	
Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	FIRST DIVE AFTER LUNCH. Diver 2 has two holds on descent, with a descent time of 1 minute and 30 seconds. At about 10 feet on ascent, Diver 2 will halt ascent and take about 3 rapid turns around the down line. He/she will report vertigo and will be OK in about 20 seconds at 10 feet. When asked, Diver 2 will state that he/she has just gotten over a cold and took two red Sudafed pills at 0730 that morning in order to be able to dive. The rest of the dive, if controlled, is uneventful.
Table/Schedule: N/A	
RS:	
SI:	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: Actual	
Project:	

Casualty Drill Will Continue Until: Diver is recovered and cause is determined.			
Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Launch and Recovery of Emergency Evacuation System (EES)

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**Catastrophic fire has caused the captain to order the emergency evacuation of all personnel from the vessel. Diving personnel in the saturation complex must be transferred to the EES. Launch and recovery of the EES must be initiated.**
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:

Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Bell-to-Bell Transfer

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

DIVE PROFILE	SCENARIO
Previous Dive	
Table/Schedule:	
RS:	
SI:	**During the course of diving operations, the diving bell suffers damage, preventing the transfer lock/TUP from mechanically sealing. A bell-to-bell transfer must be initiated.**
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: CO_2 Buildup (In Demand-type Breathing Rig)			
Supervisor:		**Job No.**	
Subject:		**Date:**	
Key Participants/Remarks: Communications/Log Keeper, Diving Supervisor, Standby Diver (if deployed), Tenders.			

DIVE PROFILE	SCENARIO
Previous Dive	**Diver has CO_2 buildup approximately 15 minutes into the dive. Symptoms are light-headedness, breathing hard and irritability, and eventually, diver passes out if proper action is not taken. Once diver is ventilated, the dive continues normal.**
Table/Schedule: None	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Diver is ventilated.			
Start Time:		**Stop Time:**	
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	
Supervisor's Debrief:			
Participants' Remarks:			

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Contaminated Breathing Gas Supply

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Diving supervisor, communications/logs operator, tender, standby diver (if deployed).

DIVE PROFILE	SCENARIO
Previous Dive	**Approximately 10 minutes into the dive, the diver says the air tastes funny. If no action is taken, within 3 minutes the diver will pass out. If or when the diver shifted to EGS or a backup breathing gas source, the taste goes away. The diving supervisor *MUST* send someone to inspect the primary breathing source of problems.**
Table/Schedule: NONE	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Breathing gas source is shifted.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: DCS/Type I/Pain in Right Elbow

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**During the last dive of the day, Diver 2 from the previous dive informs a fellow member of the dive team that his/her right elbow is very sore. When asked, he/she will state that it started at about 30 minutes after surfacing. It is not aggravated with movement and not a result of any mechanical injury. It is about a 7 on a 1 to 10 scale, up from about a 4 when first noticed. There are no other symptoms. Symptoms will completely resolve on descent in the chamber.**
Table/Schedule: 60'/55 minutes	
RS:	
SI: 45 minutes	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: @ 30 minutes SI	
Project:	

Casualty Drill Will Continue Until: At 60 feet in, the chamber and correct TT determined.

Start Time:	**Stop Time:**	
Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: DCS/Type II/Pain Left Forearm, Numbness Left Hand

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**During the last dive of the day, Diver 2 from the previous dive reports to a fellow member of the dive team that his/her left forearm hurts somewhat. When asked, he/she will state that it started about 15 minutes surface interval (SI) while he/she was in the shower. The pain will be hard to pinpoint and is not made worse by movement. It is at a 6 on a 1 to 10 scale and has gotten a little worse since first noticed. During a neuro, numbness is found on the back of the left hand. Diver will be asymptomatic at 11 minutes into the first O_2 period.**
Table/Schedule: 70'/50 minutes	
RS:	
SI: 30 minutes	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: @15 minutes SI	
Project:	

Casualty Drill Will Continue Until: 11 minutes @ 60' and the Proper TT is determined.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Diver Shocked While Underwater Welding

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Communications/logs operator, diving supervisor, tenders, switch operator, standby diver (if deployed).

DIVE PROFILE	SCENARIO
Previous Dive	**While welding underwater, the diver reports being shocked. The topside personnel should disconnect the knife switch. If power is not secured in a timely manner, the diver will become unconscious (not answering communications or line-pull signals).**
Table/Schedule: NONE	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Power to the welding equipment is secured

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

<u>Grade Casualty Drill with 1-5 or N/A as follows:</u>

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Fouled Diver, Hose Change

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Standby Diver, Tenders, Phone Talker, Dive Supervisor

DIVE PROFILE	SCENARIO
Previous Dive	**Diver fouled on bottom and is unable to become free. When asked, the diver states he/she is wrapped around the downline several times and cannot tell which way to move to become free. Standby will be deployed but is unable to clear the diver and will state that the umbilical needs to be changed out with another umbilical from the surface. Standby will acquire another umbilical and change out umbilicals on the primary diver.**
Table/Schedule: N/A	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Umbilical is changed out in the water.

Start Time:		**Stop Time:**	
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Mechanical, Badly Sprained Right Ankle

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

DIVE PROFILE	SCENARIO
Previous Dive	**While returning to the down line, Diver 1's right foot gets fouled in debris on the bottom. He/she does not report this. The tenders will continue to take up slack until Diver 1 lets out a yell to stop. Diver 1 reports that his/her foot is clear but got severely twisted in the process. When asked, Diver 1 will state that he/she can make it to the down line but will require assistance up the ladder.**
Table/Schedule: N/A	
RS:	
SI:	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: Bottom	
Project:	

Casualty Drill Will Continue Until: Injured diver is on deck and recommendation made.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: POIS/AGE/Pneumothorax, Weakness

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**LAST DIVE OF THE DAY. During cleanup, Diver 1 from the last set complains of a moderate pain on the left lateral side of his/her chest that started about 11 minutes after surfacing from the dive. It hurts more when inhaling but is not getting worse. Reports a 6 on a 1 to 10 scale. Neuro reveals notable weakness in the diver's left shoulder, when he/she is asked to shrug shoulders. There are no other symptoms. Diver will be asymptomatic 5 minutes after reaching treatment depth.**
Table/Schedule: N/A	
RS:	
SI:	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: @ 15 minutes SI	
Project:	

Casualty Drill Will Continue Until: Diagnosis, treatment depth and TT determined.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: POIS/Mediastinal/Pain, Cough

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**LAST DIVE BEFORE LUNCH. Upon reaching surface, Diver 1 starts to cough. When unhatted, he/she will complain of a burning sensation and pain in the center of his/her chest that is worse when taking a deep breath. The cough gets slightly worse and persists. A neuro reveals no other symptoms.**
Table/Schedule: N/A	
RS:	
SI:	
Current Dive	
Table/Schedule: Actual	
RS:	
Time of Onset: @ RS	
Project:	

Casualty Drill Will Continue Until: Neuro and proper diagnosis and treatment are made.

Start Time:		**Stop Time:**	
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Tender Collapses Due to Heat Exhaustion

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Dive supervisor, tenders, extra personnel on the side.

DIVE PROFILE	SCENARIO
Previous Dive	**Shortly after the diver enters the water (approximately 10 minutes), the No. 1 tender will pass out. Upon further investigation, it is discovered that this tender is suffering from heat exhaustion.**
Table/Schedule: NONE	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Tender is given appropriate first aid.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Unconscious Penetration Diver

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Dive supervisor, communications/logs operator, standby diver, tenders.

DIVE PROFILE	SCENARIO
Previous Dive	**Shortly after entering the penetration area (at least 10 feet but not more than 15 feet), the diver stops and does not answer communications or line-pull signals. Standby has to rescue diver.**
Table/Schedule: NONE	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Unconscious Diver is on the dive platform.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Unconscious Tender

Supervisor:	**Job No.**
Subject:	**Date:**

Key Participants/Remarks:

Diving supervisor, tenders, extra personnel on the side.

DIVE PROFILE	SCENARIO
Previous Dive	**Shortly after the diver enters the water (approximately 10 minutes), the No. 1 tender will pass out. Upon further investigation, it is discovered that this tender made the *previous* dive.**
Table/Schedule: NONE	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until: Tender is at correct treatment depth.

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. **Poor/Wrong Procedures/Major Safety Violations**
2. **Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor**
3. **Average/No Safety Violations/Required Some Prompting by Supervisor**
4. **Above Average/No Safety Violations/Required Minimal Prompting by Supervisor**
5. **Outstanding/No Safety Violations/Required No Prompting by Supervisor**

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Unconscious Bell Diver (in the Bell)

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	After repeated attempts by diving control to contact the bell, the diver was directed to return to the bell, to discover the bell man unconscious. Unconscious bell siver (in the bell) response procedure initiated.
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:			
Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	
Supervisor's Debrief:			
Participants' Remarks:			

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Unconscious Bell Diver (Out of the Bell)

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	After failing to respond to radio communications from dive control, the bell, and line pulls from the bell, the Bell Standby was sent to the location of the diver. Initiate unconscious bell diver response procedure.
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:			
Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Loss of Breathing Media to Diver

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**While diver was working on the bottom, delivery of diver's primary breathing gas was interrupted. Supervisor needs to initiate emergency gas to diver and resolve primary gas failure.**
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:			
Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Hydrocarbons in the Bell

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	**Hydrocarbon alarm in the bell has gone off. Hydrocarbons response procedure initiated.**
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:

Start Time:	**Stop Time:**

Symptoms presented as briefed? (If not, explain in remarks.)	**YES**	**NO**

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

ASSOCIATION OF DIVING CONTRACTORS INTERNATIONAL, INC.

EMERGENCY RESPONSE DRILLS

Category/Type/Symptom: Recovery of Unconscious Surface Diver

Supervisor:	**Job No.**
Subject:	**Date:**
Key Participants/Remarks:	

DIVE PROFILE	SCENARIO
Previous Dive	After no response from the diver via radio communication or line pulls, the standby was sent down to the diver's location. Standby diver reports the diver unconscious. Unconscious diver response procedure to be initiated.
Table/Schedule:	
RS:	
SI:	
Current Dive	
Table/Schedule:	
RS:	
Time of Onset:	
Project:	

Casualty Drill Will Continue Until:			
Start Time:	**Stop Time:**		
Symptoms presented as briefed? (If not, explain in remarks.)		YES	NO

Grade Casualty Drill with 1-5 or N/A as follows:

1. Poor/Wrong Procedures/Major Safety Violations
2. Below Average/Minor Safety Violations/Required Frequent Prompting by Supervisor
3. Average/No Safety Violations/Required Some Prompting by Supervisor
4. Above Average/No Safety Violations/Required Minimal Prompting by Supervisor
5. Outstanding/No Safety Violations/Required No Prompting by Supervisor

ITEM / AREA	GRADE	ITEM / AREA	GRADE
• Recognized Initial Problem		• Questions Asked	
• Notified the Company Office		• Dive Profile Checked	
• Notified Emergency Services		• Dive Partner Checked	
• Dive Stations Covered		• Surface O_2 – Stretcher on Scene	
• Emergency Assignments		• Correct Diagnosis of Symptom	
• Dive Team Efforts		• Correct Treatment Table	
• Standby Diver Deployed		• Correct Depth	
• Control of Injured Personnel		• Travel Rate	
• Neurological Exam		• Post Treatment	
• Affected Area Checked		• Other	

Supervisor's Debrief:

Participants' Remarks:

11.7 JOB SAFETY ANALYSIS

JOB SAFETY ANALYSIS

Company:	**Location:**	**Date:**	**Page______of______**	**New** ❑ **Revised** ❑
Job or Task:				
No.	**Basic Job Steps**	**Potential Hazards**	**Recommended Safe Procedures/Protection**	**Responsibilty**
Prepared By:		**Reviewed By:**		**Approved By:**
Distribution:				

11.8 ANSI/ACDE-01-2009 STANDARDS

**ANSI (AMERICAN NATIONAL STANDARD INSTITUTE) AND
ACDE (ASSOCIATION OF COMMERCIAL DIVING EDUCATORS) STANDARDS**

The Association of Diving Contractors International, Inc. (ADCI), hereby recognizes and endorses this standard as one being acceptable for an entry-level commercial diver trainee.

Introduction

The American National Standards Institute (ANSI) Standard for Commercial Diver Training requires that a diver at work must have received adequate training to safely undertake the work involved in the diving operation. As part of this requirement, each diver must possess a valid certificate of training. This may be:

a. A certificate of training issued by an Association of Commercial Diving Educators (ACDE) accredited school; or

b. Commercial diving experience or combination of both commercial experience and training; or

c. The equivalent of the training requirements as outlined in the ANSI standard.

Competence Assessment

During 1993, in its endeavor to foster better vocational training and education, the Association of Commercial Diving Educators (ACDE) encouraged the development of standards-based qualifications that focused on essential competence at the workplace and that were assessable, as well as understood, by employers, trainees and trainers.

With the agreement of the industry, ACDE decided in 1995 that such an approach was appropriate to diver qualification and that certificates should be issued on the basis of competence rather than merely the completion of a training course. ACDE subsequently developed the competence standard and related assessment requirements as set out in this document.

Competence is determined through written tests, instructor evaluation, log book records and the trainee's performance, attitude and ability to conduct in-water diving-related work tasks. In conjunction with a diver training course, divers will be assessed by schools that have been accredited for this purpose. Theoretical competence forms the foundation for the application and is required when practical ability and skills depend on some element of knowledge and understanding. Where both theory and practice are indicated, divers will be assessed both ways. Assessment records on each trainee will be maintained by individual training sites.

Although not spelled out as a specific competence, all divers recommended for a certificate shall have achieved specified in-water times during training and assessment. Those times for training are set out in the published Commercial Diver Training Minimum Standard and are further clarified in the standard where needed to avoid ambiguity.

To obtain a certificate of training, a student shall achieve a minimum of 625 hours of formal instruction.

Competence Standard

This new standard was derived from the 1993 American National Standard for commercial diver training. This revised standard is more defined and specifies minimum requirements.

The competence standard represents abilities that a diver must demonstrate under testing before he or she can be issued a commercial diving certificate. This standard pertains whether the certificate is the result of training or experience, or both.

The competence standard is divided into sections that represent important aspects of a diver's ability and can be identified as such by employers. These include, for example, practical diving — the ability of the diver to leave the surface, remain at the underwater work site until the job is finished or his or her time is up, and return safely to the surface. Each section is further divided into main headings and subheadings. The latter provides the essential details on which the diver will be assessed.

Statement

The aim of the standard is to:

- Improve the quality of training, with both theoretical and practical applications, for entrants to commercial diving.
- Reduce the risk of diving accidents attributable to inadequate training.
- Establish consistent minimum training requirements to insure continuity of training within the ACDE.
- Require that graduates be qualified and competent to dive and perform underwater work assignments before receiving a certificate.

This standard was developed to establish what is to be taught, the minimum length of training required for each section, the minimum qualifications for instructors, and the minimum facilities and equipment required to support that training as outlined in Section 1. In developing this standard, subject matter that is similar, or closely related, is grouped together. Subject matter has been further subdivided into topics of manageable size for instructional purposes and detailed lesson planning. Such grouping is not intended as a training schedule.

After the effective date of the standard, the (ACDE) hereby recognizes and endorses this standard as the acceptable minimum training standard for the entry level commercial diver trainee. All commercial divers who can document an equivalent level of training through a combination of field experience and/or formal diver training prior to the original issue date (1993) are specifically exempt from its application.

ACDE provides accreditation to all of its member schools and ensures that a national system of commercial diver training is maintained. Diver training institutions wishing to become a member of ACDE are inspected and evaluated to ensure their training standards provide training for commercial diving at the level of this standard.

Questions regarding this standard and/or applications for membership in ACDE should be addressed to:

ACDE Inc.
c/o Santa Barbara City College
721 Cliff Drive
Santa Barbara, CA 93109
Telephone: 805-965-0581 x2426
Fax: 805-560-6059

Deviation from the standard may be made only to exceed or supplement the required training.

The order of sections presented by ACDE for training requirements is not restricted to the section sequence contained herein. Differences in facilities, equipment, local administrative requirements, state and federal laws and/or similar conditions may warrant modification of any established sequence. It is the responsibility of each school to provide for the efficient implementation and administration of this standard and to ensure that each topic presented herein is presented in a way that provides a maximum gain in knowledge and skill for each trainee. The minimum standard will be reviewed periodically to reflect changes in technology, techniques and other developments that are likely to occur in the commercial diving industry.

COMMERCIAL DIVER TRAINING MINIMUM STANDARDS

1.0 GENERAL REQUIREMENTS

1.1 Facility
Training facilities shall meet all federal, state and local requirements and laws. They should possess adequate space, equipment and safety regulations to offer safe and competent training. Aside from federal, state and local requirements, at a minimum, facilities will include classrooms with adequate lighting, tables, desks, seating, blackboards/whiteboards, audio-visual equipment, technical library, texts and training materials to support the student learning environment. Training facilities must be available to support practical, in-water training as well as rigging, welding, chamber operations, etc.

1.2 Staff
Each training facility should have adequate support staff to maintain high-quality teaching standards, facility, equipment, records and emergency procedures. Staff members should be selected for their competency in performing their assigned tasks.

1.3 Instructors
Schools should employ instructors with a minimum of two years of full-time working experience in the field of commercial surface-supplied diving, or area of instruction taught, and should meet state educational requirements for vocational instructors. If required, instructors must meet state and/or city codes. All instructors should have current first aid and CPR certificates and be trained in emergency policies and procedures.

1.4 Equipment
All diving and support equipment will be properly maintained in accordance with manufacturer's specifications.

Practical training (hands-on) should be conducted with equipment that the trainee will use in the industry. Knowledge of newly developed equipment should be taught. Manufacturer's operational manuals must be available, as well as instruction manuals, equipment and tools for hands-on helmet and mask repair and maintenance. This must be in addition to equipment used for working dives.

All commercial diver training facilities will provide, at a minimum, at least two different types of diving helmets common to the industry, including a "demand" and a "freeflow" type helmet.

Other diving and support equipment that must be provided on site includes, but is not limited to, the following: diving air compressors (hp and Ip), surface-supplied diving systems, bail-out bottles, recompression chambers, air and mixed-gas supply manifolds, diver's hot water supply systems, gas racks, welding machines, underwater cutting and welding equipment, hydraulic/pneumatic tools, air lift, water jet, topside and underwater rigging and mechanical projects, equipment for teaching the operation and maintenance of marine engines and compressors, lifting devices and other rigging equipment common to the diving industry, properly constructed umbilicals, and first aid and CPR training equipment.

1.5 Training Aids

Books and training aids should contain current information and be appropriate for individual courses and modules. Up-to-date audiovisual aids should be used with all applicable instruction. Students should be supplied with an ACDE/ADC commercial diving log book, which must be maintained and updated on a regular basis.

1.6 Physical Examinations

Each entrant should pass a medical examination before being accepted into a training program. The medical examination should be current within the last year from the class finish date. Limits and standards for physical condition of the entrant should be spelled out in the medical examination form according to the current ADCI medical requirements for commercial divers. The examining physician should be instructed in writing exactly what qualities to look for in a potential entrant, and the recommended tests and techniques to be employed should be listed.

1.7 Physical Fitness

The importance of physical fitness will be emphasized to students throughout the training program.

1.8 Industry Input

Close liaison with the safety, education and medical committees of the ADCI should be maintained to ensure that training meets industry requirements and needs. Contact with commercial diving companies and equipment manufacturers should be maintained to ensure awareness of changes and improvements in equipment, procedures, safety requirements, etc.

1.9 Employment

Students shall be informed about employers' hiring policies regarding drugs and alcohol. Responsibilities of tenders, tender/divers and divers shall be included in the training. Rules and regulations for the United States Coast Guard, Association of Diving Contractors (ADC) Consensus Standards and OSHA shall be an integral part of the training.

1.10 Safety

Safety and compliance with federal, state and ADC standards should be emphasized throughout the training program. Students will be instructed that the basic responsibility for both personal and operational safety lies with each individual.

1.11 Documentation

Documentation of all training successfully completed must be available to the student, including transcripts, diplomas and certificates. Students will be issued and required to maintain an official ADCI/ACDE log book. Upon completion of training, an official ACDE certification card will be issued to each graduating student.

1.12 Drug Policy

Safety is of paramount importance. ACDE is committed to maintaining a safe, healthy work and training environment and is dedicated to providing a drug- and alcohol-free workplace.

A substance abuse policy should be strictly enforced. This will provide a means to minimize the use of intoxicants by personnel, staff, employees and trainees, and will enhance safe conduct of operations. The goals should be to attain the highest work and training standards possible and to promote a safe work environment, free of drugs and alcohol.

The goals and objectives of maintaining safety in a drug-free work environment are attainable through cooperation at every level and by explicitly and forcefully prohibiting the use, manufacture, distribution, dispensation and possession of illicit drugs, drug paraphernalia and alcohol at all training locations and diving operations.

2.0 PRINCIPLES OF DIVING PHYSICS
Required Hours: 12.5

2.1 Objectives:

To provide the trainee with an understanding of the physics of air and water pressure applicable to diving.

2.2 Outline of Instruction:

a) Normal air
  1) Definition
  2) Composition
  3) Properties
  4) Characteristics
  5) Gas laws affecting air

b) Water
  1) Composition, salt and fresh water
  2) Characteristics
  3) Weight/salt and fresh water

c) Terminology and values used in pressure (partial, barometric, atmospheric, gauge and absolute)
  1) Mechanical pressure
  2) Other ambient pressures related to diving

d) Buoyancy in water
  1) Archimedes' principle
  2) Example and application

e) Definitions
  1) Buoyancy
  2) Density
  3) Area
  4) Volume

f) Gas laws
  1) Boyle's
  2) Charles'
  3) Henry's
  4) General gas law
  5) Guy Lusac's
  6) Daltons'

g) Summary
  1) Characteristics of air and water
  2) Laws governing gasses
  3) Pressure: absolute and relative
  4) Computation of pressure at various atmospheres
  5) Buoyancy in water
  6) Effect of pressure on gas absorption
  7) Effect of temperature on pressure

3.0 FORMULA APPLICATION
Required Hours: 12.5

3.1 Objectives:

a) To familiarize the trainee with diving physics formulas.

b) To provide practical experience in using diving physics formulas.

3.2 Outline of Instruction:

a) Gauge and absolute pressure at various depths

b) Volume of cylinders

c) Time duration of air supply from air flasks

d) Air supplies required by divers

e) Flow requirements for masks and hats

f) Required capacity of air compressor

g) Hose test formula

h) Application of physics formulas

AIR DECOMPRESSION TABLES AND DECOMPRESSION PROCEDURES

Required Hours: 30

4.1 Objectives:

a) To familiarize the trainee with the various methods of decompression.

b) To provide the trainee experience in the practical application of decompression tables.

4.2 Outline of Instruction:

a) History of decompression

b) Decompression

1) Definition

2) Types

c) U.S. Navy Standard Air Decompression tables

d) Surface decompression tables (O_2 and Air)

e) Practical application of decompression tables in theoretical dives

f) Altitude diving tables and computation

1) Barometric

2) Tables

3) 4% Rule

5.0 ANATOMY AND PHYSIOLOGY RELATED TO DIVING
Required Hours: 18

5.1 Objectives:

a) To describe the anatomy and physiology of the circulatory and respiratory systems of the human body.

b) To educate the trainee on the effects of pressure and changes of pressure on the human body.

c) To provide the trainee a better understanding of the process and what happens when ambient pressure is increased or decreased.

5.2 Outline of Instruction:

a) Anatomy and physiology: the study of various organs and parts of the body — their functions and activities

1) Anatomy of the circulatory system

2) Physiology of the circulatory system

3) Anatomy of the respiratory system

4) Physiology of the respiratory system

5) Body cavities containing air

b) Primary effects of pressure

1) Effects of pressure applied equally to the body
2) Effects of pressure applied unequally to the body

c) Secondary effects of pressure (the disturbances in gas equilibrium, i.e., of gasses in the body)
1) Toxic effects of oxygen
2) Narcotic effect of nitrogen
3) Toxic effects of carbon dioxide and carbon monoxide
4) Nitrogen absorption and elimination
5) Effects of pressure in excess of 1 atmosphere on body tissue
6) Principles involving prevention of decompression sickness

6.0 DIVING DISEASES, INJURIES AND PSYCHOLOGICAL ASPECTS
Required Hours: 12

6.1 Objectives:
To familiarize the trainee with the various types of diseases and injuries that occur in diving.

6.2 Outline of Instruction:

a) Anoxia/hypoxia
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

b) Hypercapnia/asphyxia
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

c) Squeeze
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

d) Decompression sickness
1) Definition and types
2) Symptoms
3) Causes
4) Prevention and Treatment

e) Arterial gas embolism (AGE)
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

f) High-pressure nervous syndrome (HPNS)
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

g) Nitrogen narcosis

1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

h) Oxygen toxicity (CNS/pulmonary)
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

i) Pneumothorax
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

j) Mediastinal and subcutaneous emphysema
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

k) Carbon monoxide poisoning
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

l) Drowning (near drowning)
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

m) Lipoid pneumonia
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

n) Bone necrosis
1) Definition
2) Symptoms
3) Causes
4) Prevention and treatment

o) Psychological aspects of diving
1. Screening for phobias
2. Rationale of physics versus mental abilities of divers
3. Water skills and their psychological implications
4. Specific adaptations (breathing through the nose, use of mechanical equipment, etc.)
5. Emotional and physical stability

6. Diver stress
7. Effects of stress
8. Comparison of panic and mental controls
9. Diving philosophies
10. Dive planning
11. Breathing and diving (relate to stress stimulus)
12. Rules for reacting to all unusual feelings, control of stress, stimulus
13. Green diver syndrome

7.0 TREATMENT OF DIVER'S ILLNESS AND INJURIES
Required Hours: 30

7.1 Objectives:

a) To educate the trainee in the use of tables for treatment of arterial gas embolism, decompression sickness and omitted decompression.

b) To impress upon the trainee the importance of selection of the proper treatment table.

c) To provide the trainee practical experience in the selection and use of the treatment tables.

7.2 Outline of Instruction:

a) Treatment Table 1A
b) Treatment Table 2A
c) Treatment Table 3
d) Treatment Table 4
e) Treatment Table 5
f) Treatment Table 6
g) Treatment Table 6A
h) Treatment Table 7
i) Treatment Table 8
j) Review case histories with cases that illustrate both proper and improper selection and use of treatment tables
k) Practical use of table with hypothetical cases and various symptoms
l) Examination of injured diver
    1) Vital signs
    2) Mental condition
    3) Cranial nerves
    4) Sensory nerves
    5) Motor nerves
    6) Coordination
    7) Reflexes

8.0 FIRST AID FOR DIVERS AND CPR
Required Hours: 16

8.1 Objectives:

a) To provide the trainee with a basic understanding of the first aid measures appropriate to common diving and industrial accidents/ illnesses.

b) To meet or exceed the minimum standards as set forth by the American Red Cross or equivalent first aid and CPR training requirements.

8.2 Outline of Instruction:

a) Shock
- 1) Electric
- 2) Traumatic
- 3) Emotional

b) Artificial respiration (CPR)
- 1) Drowning
- 2) CO_2 poisoning
- 3) CO poisoning
- 4) Mouth-to-mouth method

c) Use of mechanical resuscitation

d) Hemorrhage (bleeding)
- 1) Venous
- 2) Arterial
- 3) Capillary
- 4) Internal
  - - Lungs
  - - Stomach

e) Fracture
- 1) Simple
- 2) Compound

f) Burns
- 1) Classification
- 2) Chemical
- 3) Thermal
- 4) Treatment

g) Wounds

h) Communication with medical personnel (terminology)

i) Assist in treatment of diving-related illness and accidents

j) Cardiac arrest
- 1) Definition
- 2) Symptoms
- 3) Causes
- 4) Prevention and treatment

9.0 NOXIOUS GASSES IN ENCLOSED SPACES
Required Hours: 2

9.1 Objectives:

a) To provide the trainee with knowledge of the noxious gasses encountered in diving operations.

b) To introduce the trainee to various instruments used to detect noxious gasses.

c) To familiarize the trainee with precautions necessary to avoid accidents from noxious gasses.

9.2 Outline of Instruction:

a) Noxious gasses

b) Closed spaces

c) Carbon monoxide

- 1) Origin, description and identification
- 2) Affinity toward hemoglobin; comparative attraction ratios versus oxygen
- 3) Symptoms of carbon monoxide poisoning
- 4) Treatment of carbon monoxide poisoning cases

d) Carbon dioxide

- 1) Sources and description
- 2) Effects upon respiration
- 3) Symptoms of carbon dioxide poisoning
- 4) Treatment of carbon dioxide poisoning cases

e) Explosive gasses

- 1) Types
- 2) Generation process

f) Instruments used in detecting gasses

- 1) Hydrogen sulfide detector
- 2) Carbon monoxide detector

g) Elimination and prevention of gas hazards

h) Means of avoiding accidents from gas hazards

i) Rules for mask or helmet removal

10.0 ENVIRONMENTAL HAZARDS OF DIVING
Required Hours: 12

10.1 Objectives:
To provide the trainee knowledge of the environmental hazards the diver may encounter.

10.2 Outline of Instruction:

a) Marine life

- 1) Wound-inflicting species
- 2) Animals that inject venom
- 3) Treatment of wounds
- 4) Divers' evasive action

b) Exposure/weather patterns

- 1) Climate
  - - Air temperature
  - - Water temperature
  - - Body protection (hyperthermia and hypothermia)
    - • Exposure suits
    - • Underwear

- Sunburn

c) Wave motion — seasickness
d) Surf, surge, currents and tides
e) Bottom conditions/visibility
f) Polluted water/hazards
g) Identification of underwater hazards
h) Oxygen-deficient environments
i) Underwater explosions
j) Underwater suctions and discharges

11.0 THE HYPERBARIC CHAMBER AND ASSOCIATED EQUIPMENT
Required Hours: 16

11.1 Objectives:
To provide the trainee with a knowledge of the characteristics of the chamber and the procedures for operating the chamber.

11.2 Outline of Instruction:
a) Gas supply for chambers
1) Capacity
2) Ventilation
3) Supply valves
4) Exhaust valves
5) Gauges
6) Relief and gag valve
7) Primary and secondary gas supply
8) Atmosphere sensors (O_2, CO_2, temp)
9) Life-support systems (CO_2 scrubbers, heater/chiller)
10) Plumbing
11) O_2 system
b) Precautions in chamber use
1) Lighting
2) Door
3) Seals, openings and penetrations
4) Oxygen fires
5) Testing and maintenance of chamber
6) Operational considerations
- Oxygen safety
- Personal requirements
- Chamber safety considerations
- Smoking
- General fire hazard

7) Equipment

8) Communication system

12.0 TRAINEE PARTICIPATION IN CHAMBER OPERATIONS
Required Hours: 44

12.1 Objectives:

a) To provide the trainee with practice in the operational procedures of a hyperbaric chamber and simulating the treatment of diving injuries.

b) To develop trainee's skills in proper decompression and recompression operations.

12.2 Outline of Instruction:

a) Review operating procedures for the chamber

b) Practice maintaining steady rate of ascent/descent

c) Conduct simulated treatments

d) Use of man lock and treatment lock, and the purpose of medical locks

e) Conduct simulated treatment using oxygen and/or nitrox

f) Practice maintaining required pressure while ventilating

g) Safety precautions

h) Decompression operations

1) Surface decompression using oxygen and/or nitrox

2) Surface decompression using air

i) Lock in/lock out procedures

j) Pressure test

13.0 SEAMANSHIP AND RIGGING FUNDAMENTALS
Required Hours: 25

13.1 Objectives:

a) To provide the trainee with a knowledge of the construction, use and care of fiber, synthetic and wire rope.

b) To familiarize the trainee with the purpose and use of splices in fiber and wire rope.

c) To instruct the trainee in the purpose and use of terminal fittings on wire rope.

d) To introduce the trainee to the applicable sections of the American Petroleum Institute.

13.2 Outline of Instruction:

a) Fiber rope

1) Types

2) Sizes — how measured

3) Care and maintenance

b) Wire rope

1) Types

2) Sizes — how measured

3) Care and maintenance

c) Synthetic rope

1) Nylon

2) Polyester (Dacron)

3) Polypropylene

d) Splices
   1) Types
   2) Application of various splices
   3) Strength of splices
   4) Safety factors
e) Wire rope clips
   1) Use
   2) Method of application
   3) Strength
f) Terminal fittings
   1) Types
   2) Strength
   3) Methods of application
g) Blocks and tackles and mechanical advantage
h) Come-alongs, chain hoists, shackles and grip hoist
i) Winches and air tuggers
j) Hand signals for controlling crane operations
k) Calculation of problems for safe working load and braking strain for fiber and wire rope
l) Slings
m) Performance of underwater projects for practical application of rigging

14.0 PRACTICAL APPLICATION OF SEAMANSHIP AND RIGGING
Required Hours: 60

14.1 Objectives:
To provide the trainee practice in the application of seamanship and rigging.

14.2 Outline of Instruction:
a) Splices, fiber rope
   1) Eye
   2) Short
   3) Long
b) Splices, wire rope
   1) Flemish eye (Molly Hogan)
   2) Eye splice 3-strand line
   3) Back splice 3-strand line
   4) Short splice
c) Knots and hitches
   1) Square knot
   2) Clove hitch
   3) Rolling hitch
   4) Timber hitch
   5) Telegraph hitch
   6) Two half hitches
   7) Round turn and two half-hitches
   8) Fisherman's bend
   9) Single-sheet bend

10) Double-sheet bend
11) Catspaw in center of line
12) Prussic knot
13) Single bowline
14) Running bowline
15) Stopper
16) French bowline
17) Double bowline
18) Baker bowline
19) Girth hitch
20) Double carrick

d) Practical application in knot tying and splicing
e) Reeving of block and tackles
f) Practical underwater projects requiring rigging
g) Hooks
h) Mechanical advantage
i) Chain

15.0 LIGHTWEIGHT DIVING EQUIPMENT FUNCTION AND NOMENCLATURE
Required Hours: 24

15.1 Objectives:

a) To familiarize the trainee with the nomenclature, function and operation of lightweight diving equipment, masks and helmets.
b) To instruct the trainee in the proper procedures for checking, testing and maintaining lightweight diving equipment.
c) To instill in the trainee a sense of confidence and trust in the equipment.
d) To instruct the trainee in the use of bailout systems and other safety procedures.

15.2 Outline of Instruction:

a) History and development
1) Diving equipment
2) Advantages and disadvantages — deep-sea gear versus lightweight gear

b) Use of lightweight diving equipment
c) Nomenclature and function
1) Masks and helmets
2) Dress
3) Belt (weight)
4) Air hose
5) Lifeline
6) Communications wire
7) Harness
8) Diver’s radio
8) Gas manifolds

d) Disassemble/assemble mask and helmets
1) Use of drawings/schematics and tech manuals

16.0 LIGHTWEIGHT DIVING PROCEDURES AND TECHNIQUES
Required Hours: 40

16.1 Objectives:

a) To instruct the trainee in the operational use of lightweight diving equipment, procedures and safety consideration.

b) To develop the trainee's confidence in lightweight equipment and in lightweight diving.

c) To develop the trainee's skill in the proper way of entering the water, using hose signals and other means of communication, and accomplishing different tasks, using lightweight diving equipment.

d) To instruct trainees in the proper use of procedural manuals and emergency procedures.

16.2 Outline of Instruction:

a) Safety precautions
- 1) Ascending procedures
- 2) Reasons for not removing lifeline
- 3) Last resort of ditching mask

b) Orientation dives using lightweight diving gear, helmets and weighted belt
- 1) Instruction before entering water
  - -Proper method of dressing
  - -Location of air-control valve
  - -Location of exhaust valve
  - -Proper use of weighted belt
  - -Proper method of securing lifeline to diver
  - -Location and use of EGS valve and bottle
- 2) Dress diver and commence dive
  - -Proper water entry
  - -Observe hand signals
  - -Proper ditching of weights
- 3) Water entries
- 4) Orientation dives
- 5) Use of a minimum of one demand and one free flow mask
- 6) Bailout procedures

c) Proper tending procedures

d) Proper use of communications

e) Time keeping/chart procedures

f) Use of diver's log book
- 1) Organization and content
- 2) Official documentation
- 3) Recording of dives

g) Commercial diving standards

h) Requirements for training

i) Diver classification, qualification and certification

j) Diving accident reports

17.0 MAINTENANCE OF DIVER'S UMBILICAL
Required Hours: 12

17.1 Objectives:

a) To instruct the trainee in the proper method for making, maintaining, and testing dive hose.

b) To provide practice to the trainee in making and testing dive hose.

17.2 Outline of Instruction:

a) Lifelines
- 1) Make-up
- 2) Maintenance
- 3) Minimum strength requirement
- 4) Testing
- 5) Snap shackle types/sizes

b) Airhose
- 1) Make-up
- 2) Maintenance
- 3) Testing
- 4) Marking

c) Air hose connection

d) Checking for safety

e) Communications line: care and maintenance

f) Practical application

18.0 UNDERWATER WORK USING LIGHTWEIGHT DIVING EQUIPMENT
Required Hours: 65

18.1 Objectives:

a) To provide the trainee with practical experience in diving and lightweight equipment.

b) To provide the trainee experience in some of the more difficult underwater tasks encountered in commercial diving.

c) To familiarize the trainee with safety issues surrounding using lightweight diving gear and hazards encountered (e.g. liveboating).

18.2 Outline of Instruction:

a) Safety precautions

b) Emergency procedures for loss of gas
- 1) Bailout bottle procedures
- 2) Pneumo hose procedures
- 3) Standby diver procedures

c) Bottom search project (lost object recovery)

d) Single flange ups

e) Blank flange removal

f) Multiple bolts and flange projects

g) Penetration (outfalls and intakes)

h) Overhead patches, sea chests

i) Angle descending line

j) Hogging line project

k) Excavating and dredging
- 1) Air lifts
- 2) Hand jetting

18.3 Liveboating

a) Operational considerations

1) Sunset rule
2) Visibility
3) Sea state
4) Vessel
5) Tending considerations

b) Safety considerations

1) Depth maximum
2) Standby boat
3) Propeller shutdown
4) Propeller guards
5) Standby diver
6) Bailout supply
7) Bottom time limits

19.0 OPERATIONS PLANNING
Required Hours: 12

19.1 Objectives:

a) To expose the trainee to the successful relationship of diving jobs and operational planning.

b) To demonstrate to the trainee that while the nature of each operation will determine the scope of the planning effort, certain considerations apply to every operation.

c) Trainees will be made aware of the current Association of Diving Contractors InternationalConsensus Standard, OSHA and U.S. Coast Guard diving operational regulations.

19.2 Outline of Instruction:

a) The proper sequence of the planning process is as follows:

1) Define objectives
2) Collect and analyze data (underwater surveys/inspections)
3) Establish operational tasks
4) Select diving technique
5) Select equipment and supplies
6) Select and assemble the diving team
7) Written job description
8) Equipment list
9) Make final preparations; check all safety precautions
10) Start operation
11) Maintain safety requirements/considerations

20.0 DIVING LOGS, RECORDS AND STANDARDS FOR COMMERCIAL DIVING OPERATIONS
Required Hours: 12

20.1 Objectives:

a) To compare and contrast the types and uses of dive logs, records and reports.

b) To define the differences in standards for commercial diving operations as set forth by the Association of Diving Contractors International Consensus Standards, the U.S. Coast Guard. and OSHA.

20.2 Outline of Instruction:

a) Use of log books
  1) Organization and content
  2) Official documentation
  3) Recording of dives

b) Commercial diving standards

c) Diving accident reports

21.0 UNDERWATER TOOLS
Required Hours: 24

21.1 Objectives:

a) To provide the trainee with a knowledge of the care and use of tools and equipment used underwater.

b) To familiarize the trainee with safety precautions required to safely use tools and equipment underwater.

21.2 Outline of Instruction:

a) Nomenclature and use of tools
  1) Hand tools
  2) Pneumatic and hydraulic tools
  3) Special tools
  4) Dredges and air lifts
  5) Lift bags

b) Underwater use of tools

c) Inspection/maintenance of tools

d) Safety precautions

e) Practical application in the use of tools

22.0 DRAWINGS, BLUEPRINT READING, REPORT WRITING
Required Hours: 8

22.1 Objectives:

a) To instruct the trainee in how to read and understand blueprints and properly prepare drawings for reporting purposes.

b) To familiarize the trainee with the preparation of formal reports for submittal to the employer and customer.

22.2 Outline of Instruction:

a) Introduction to blueprint reading

b) Scale drawing and schematics

c) Report-writing

23.0 HOT-WATER SYSTEMS
Required Hours: 2

23.1 Objectives:

a) To list the terms associated with diver's hot-water systems and the problems associated with the effects of cold.

b) To provide practical experience in the setup, operation, shutdown and maintenance of diver's hot-water systems.

23.2 Outline of Instruction:

a) System description

b) Operation procedures

c) Hot-water suits and umbilical

d) Maintenance and troubleshooting

e) Safety procedures

f) Practical experience in operation and maintenance of diver's hot-water system.

24.0 INTRODUCTION TO TOPSIDE WELDING
Required Hours: 26

24.1 Objectives:
To provide proper training so the trainee can understand the applications of topside welding; explain the limitations of topside welding in regard to size of project, position and condition of metals being welded. Trainees should be able to describe the techniques for topside welding in the flat, vertical and overhead positions.

24.2 Outline of Instruction:

a) Application of topside welding

b) Limitations of topside welding

c) Topside welding techniques

25.0 TOPSIDE WELDING EQUIPMENT
Required Hours: 12

25.1 Objectives:
To assist the trainee to name and describe the functions of the components of topside welding equipment and to describe the safety precautions prescribed for topside welding.

25.2 Outline of Instruction:

a) Welding machines

b) Welding cables

c) Electrode holders

d) Electrodes

e) Welding glass and faceplate

f) Safety precautions

26.0 OXYGEN-ACETYLENE CUTTING TECHNIQUES
Required Hours: 10

26.1 Objectives:
To describe the basic techniques of oxygen-acetylene cutting. At the conclusion, the trainee will be able to name and describe the function of each component of oxy-acetylene cutting equipment and the necessary safety precautions.

26.2 Outline of Instruction:

a) History of oxy-acetylene cutting

b) The torch

c) Oxygen cylinders/care in handling

d) Gauges for oxygen cylinders/care in handling

e) Safety precautions in oxy-acetylene cutting

f) Technique for oxy-acetylene cutting

27.0 PRACTICAL APPLICATION OF OXYGEN-ACETYLENE METHOD OF CUTTING
Required Hours: 12

27.1 Objectives:
To instruct the trainee on techniques for cutting various thickness of plate, pipe and structures employing the oxy-acetylene method.

27.2 Outline of Instruction:

a) Construction and nomenclature of cutting equipment

b) Setting up equipment

c) Techniques

d) Accomplish projects

e) Safety precautions

28.0 INTRODUCTION TO UNDERWATER BURNING AND WELDING
Required Hours: 24

NOTE: Because of commonalties between topside welding and underwater welding, including basic theory, equipment and techniques, many hours in the topside welding courses are applicable or supplemental to the "Introduction to Underwater Burning and Welding" course.

28.1 Objectives

a) To list and describe the basic equipment used in oxygen-arc burning. At the conclusion, the trainee will be able to name and describe the function of each component of oxy-arc underwater burning equipment and the necessary safety precautions.

b) To describe the techniques for oxy-arc underwater burning using at least two different types of electrodes (Broco, Arcair, Thermal, Arc Lance or Kerie Cable).

c) To provide a practical introduction to the techniques for burning various thicknesses of plate, pipe and structures underwater, employing the oxy-arc method using at least two different types of electrodes.

d) To list and describe the function of the components of underwater welding equipment and describe the necessary safety precautions prescribed for welding underwater.

e) To provide practical introduction to welding underwater so the trainee can understand the applications of underwater welding AND explain the limitations of underwater welding in regards to size of the project, position and condition of metals being welded. Trainees should be able to describe the techniques for underwater welding in the flat, vertical and overhead positions.

28.2 Outline of Instruction:

a) History of oxy-arc underwater cutting

b) Construction and nomenclature of underwater burning equipment

c) The torch-holder for electrodes

d) Electrodes

e) Welding generators

f) Welding cables

g) Safety switch

h) Oxygen cylinders/care in handling

i) Oxygen hose/size/care in handling

j) Gauges for oxygen cylinders/care in handling

k) Safety precautions in oxy-arc underwater cutting

I) Technique for oxy-arc underwater cutting

m) Setting up equipment

n) Accomplish projects using at least two different manufacturers of oxy-arc cutting rod (would vary on availability of materials)

o) Techniques

p) Safety precautions

q) Welding machines

r) Welding cables

s) Electrode holders
t) Electrodes
u) Welding glass and faceplate
v) Waterproofing materials
w) Application of underwater welding
x) Limitations of underwater welding
y) Underwater welding techniques
z) Safety precautions

29.0 MIXED-GAS DIVING
Required Hours: 30

29.1 Objectives
To provide the trainee with a basic understanding of mixed-gas diving techniques and procedures.

29.2 Outline of Instruction:

a) History and medical aspects of mixed-gas diving
b) Formulas
c) Decompression procedures
d) Diving and emergency procedures
e) Operator safety considerations
f) Treatments
g) Practical applications

30.0 MARINE ENGINES AND COMPRESSORS
Required Hours: 16

30.1 Objectives
To provide the trainee with fundamental knowledge of the operation, maintenance and field troubleshooting of diesel engines and low-pressure compressors.

30.2 Outline of Instruction:

a) Application of diesel engines in diving
    1) Air compressors
    2) Generators
    3) Cranes
    4) Boats
    5) Trucks
    6) Forklifts
    7) Hydraulic power units
b) Seven systems common to all diesel engines
    1) Fuel system
    2) Fuel filters
    3) Injectors
    4) Lubrication system
    5) Cooling system
    6) Intake system
    7) Exhaust system
c) Power take-offs and clutches
d) Diesel operation (practical)
e) Maintenance (practical)
f) Troubleshooting (practical)

g) Types of compressors used in diving

h) Compressor systems

1) Intake

2) Compression stage

3) Intercooler

4) Lubrication system

- Compressor oil for breathing air compressors

5) Variable differential unloader

6) Hydraulic unloader

7) Filters

8) Volume tanks

9) Supply valve/manifold

i) Compressor calculations

1) Capacity (CFM/SCFM)

2) Depth limit (over bottom pressure)

j) Set up compressors used in diving/chamber operations

k) Compressor operation (practical)

l) Compressor maintenance (practical)

m) Troubleshooting (practical)

n) Air purity testing

o) Valves and fittings

p) Air system schematic

31.0 INDUSTRIAL AND OFFSHORE SAFETY
Required Hours: 6

31.1 Objectives

a) To familiarize the trainee with federal, state and ADCI requirements for diving operations.

b) To provide the trainee with instruction in industrial and offshore safety.

c) To provide the trainee with basic crane-safety training.

31.2 Outline of Instruction:

a) U.S. Coast Guard regulations

b) OSHA regulations

c) ADCI standards

d) General industrial safety

1) Drugs and alcohol

2) Hazard identification

3) Work zone safety

4) Lock-out and tag-out

5) Personal protective equipment

6) Working in confined spaces

7) Hazardous materials

8) Fire safety

e) Offshore safety

1) H2S safety

2) Helicopter orientation

3) Personnel safety basket

4) Life jackets
5) Life rafts/boats
6) Visual location aids
7) Audio location aids

f) Basic crane safety
1) Rules and regulations
2) Slings
3) Rigging hardware
4) Proper rigging techniques
5) Signaling
6) Chain slings
7) Hoists
8) Knots

32.0 ELECTIVES

32.1 Objectives

To provide the trainee with additional skills based on individual institution needs. These needs are determined by industry needs, which are generally defined by demands of geographic location.

32.2 Outline of Instruction:

a) The standards for the courses listed as elective are maintained and monitored by the parent associations of each specific discipline.

b) The elective coursework is not limited to the list below. The list below is a result of direct industry input:
1) Non-destructive testing
2) Hazardous worker (HAZWOPER)
3) Offshore survival and safety
4) Underwater Imaging
5) Diving in contaminated environments
6) Noxious gasses in enclosed spaces
7) Dry hyperbaric welding

Total Training Hours: 625

11.9 U.S. FEDERAL REGULATIONS REGARDING COMMERCIAL DIVING OPERATIONS

U.S. FEDERAL REGULATIONS REGARDING COMMERCIAL DIVING OPERATIONS

INTRODUCTION

The following information on U.S. government regulations is provided for reference only. The Association of Diving Contractors International (ADCI) is an international organization and, therefore, each contractor will need to have knowledge of the applicable governmental regulations that apply to the diving operations in his or her specific area of operations.

Nothing herein contained is intended to replace or supplant regulations, codes or standards applied by flag state or national bodies. The ADCI recognizes the validity of codes and standards developed by other recognized international organizations, such as, but not limited to, ship classification societies, IMCA, IMO, standards institutes, etc. Member companies of this association operating outside U.S. jurisdiction may have a need to follow such codes and standards prepared by others. However, if required to also comply with other standards or codes, member companies remain pledged to comply with not less than the minimum requirements of these standards in addition to any other requirements that may apply.

DEPARTMENT OF TRANSPORTATION - USCG

46 CFR Ch. 1 (10-1-89 Edition)

SUBCHAPTER V - MARINE OCCUPATIONAL SAFETY AND HEALTH STANDARDS

PART 197 - GENERAL PROVISIONS

Subpart a – (Reserved)

Subpart b - COMMERCIAL DIVING OPERATIONS

GENERAL

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PERIODIC TESTS AND INSPECTIONS OF DIVING EQUIPMENT

197.450 - Breathing gas tests.

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197.454 - First aid and treatment equipment.

197.456 - Breathing supply hoses.

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197.460 - Diving equipment.

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197.486 - Written report of casualty.

197.488 - Retention of records after casualty.

Appendix A - Air No Decompression Limits

Authority: 33 U.S.C. 1509; 43 U.S.C. 1333; 46 U.S.C. 3306, 3703, 6101; 49 CFR 1.46.

Source: CGD 76-009, 43 FR 53683, Nov. 16, 1978, unless otherwise noted.

Subpart a - (Reserved)

Subpart b - COMMERCIAL DIVING OPERATIONS

GENERAL

§ 197.200 - Purpose of subpart.

This subpart prescribes rules for the design, construction and use of equipment, and inspection, operation, and safety and health standards for commercial diving operations taking place from vessels and facilities under Coast Guard jurisdiction.

§ 197.202 - Applicability.

(a) This subpart applies to commercial diving operations taking place at any deepwater port or the safety zone thereof as defined in 33 CFR part 150; from any artificial island, installation, or other device on the Outer Continental Shelf and the waters adjacent thereto as defined in 33 CFR part 147 or otherwise related to activities on the Outer Continental Shelf; and from all vessels required to have a certificate of inspection issued by the Coast Guard including mobile offshore drilling units regardless of their geographic location, or from any vessel connected with a deepwater port or within the deepwater port safety zone, or from any vessel engaged in activities related to the Outer Continental Shelf; except that this subpart does not apply to any diving operation (1) Performed solely for marine scientific research and development purposes by educational institutions; (2) Performed solely for research and development for the advancement of diving equipment and technology; or (3) Performed solely for search and rescue or related public safety purposes by or under the control of a governmental agency.

(b) Diving operations may deviate from the requirements of this subpart to the extent necessary to prevent or minimize a situation which is likely to cause death, injury, or major environmental damage. The circumstances leading to the situation, the deviations made, and the corrective action taken, if appropriate, to reduce the possibility of recurrence shall be recorded by the Diving Supervisor in the logbook as required by 197.482(c).

§ 197.203 - Right of appeal.

Any person directly affected by a decision or action taken under this subchapter, by or on behalf of the Coast Guard, may appeal therefore in accordance with subpart 1.03 of this chapter.

[CGD 88033, 54 FR 50382, Dec. 6, 1989]

§ 197.204 - Definitions.

As used in this subpart:

- **ACFM** means actual cubic feet per minute.
- **ANSI Code1** means the B31.1 American National Standards Institute Code for Pressure Piping, Power Piping.
- **ASME** Code means the American Society of Mechanical Engineers Boiler and Pressure Vessel Code.
- **ASME PVHO1** means the ANSI/ASME standard Safety Standard for Pressure Vessels for Human Occupancy.
- **ATA** means a measure of pressure expressed in terms of atmosphere absolute (includes barometric pressure).
- **Bell** means a compartment either at ambient pressure (open bell) or pressurized (closed bell) that allows the diver to be transported to and from the underwater work site, allows the diver access to the surrounding environment, and is capable of being used as a refuge during diving operations.
- **Bottom time** means the total elapsed time measured in minutes from the time the diver leaves the surface in descent to the time to the next whole minute that the diver begins ascent.
- **Breathing gas/breathing mixture** means the mixed-gas, oxygen, or air as appropriate supplied to the diver for breathing.
- **Bursting pressure** means the pressure at which a pressure containment device would fail structurally.
- **Commercial diver** means a diver engaged in underwater work for hire excluding sport and recreational diving and the instruction thereof.
- **Commercial diving operation** means all activities in support of a commercial diver.
- **Cylinder** means a pressure vessel for the storage of gasses under pressure.
- **Decompression chamber** means a pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system especially equipped to recompress, decompress, and treat divers.
- **Decompression sickness** means a condition caused by the formation of gas or gas bubbles in the blood or body tissue as a result of pressure reduction.
- **Decompression table** means a profile or set of profiles of ascent rates and breathing mixtures designed to reduce the pressure on a diver safely to atmospheric pressure after the diver has been exposed to a specific depth and bottom time.
- **Depth** means the maximum pressure expressed in feet of seawater attained by a diver and is used to express the depth of a dive.
- **Dive location** means that portion of a vessel or facility from which a diving operation is conducted.
- **Dive team** means the divers and diver support personnel involved in a diving operation, including the Diving Supervisor.
- **Diver** means a person working beneath the surface, exposed to hyperbaric conditions and using underwater breathing apparatus.
- **Diver-carried reserve breathing gas** means a supply of air or mixed-gas, as appropriate, carried by the diver in addition to the primary or secondary breathing gas supplied to the diver.
- **Diving installation** means all of the equipment used in support of a commercial diving operation.

- **Diving mode** means a type of diving requiring SCUBA, surface-supplied air or surface-supplied mixed-gas equipment, with related procedures and techniques.
- **Diving stage** means a suspended platform constructed to carry one or more divers and used for putting divers into the water and bringing them to the surface when in-water decompression or a heavy-weight diving outfit is used.
- **Diving Supervisor** means the person having complete responsibility for the safety of a commercial diving operation including the responsibility for the safety and health of all diving personnel in accordance with this subpart.
- **Facility** means a deepwater port, or an artificial island, installation or other device on the Outer Continental Shelf, subject to Coast Guard jurisdiction.
- **FSW** means feet of seawater (or equivalent static pressure head).
- **Gas embolism** means a condition caused by expanding gasses, which 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.
- **Heavy-weight diving outfit** means diver-worn surface-supplied deep-sea dress.
- **Hyperbaric conditions** mean pressure conditions in excess of surface atmospheric pressure.
- **Injurious corrosion** means an advanced state of corrosion which may impair the structural integrity or safe operation of the equipment.
- **Liveboating** means the support of a surfaced-supplied diver from a vessel underway.
- **Maximum working pressure** means the maximum pressure to which a pressure containment device can be exposed under operating conditions (usually the pressure setting of the pressure-relief device).
- **No-decompression limits** means the air depth and bottom time limits of appendix A.
- **Pressure vessel** means a container capable of withstanding an internal maximum working pressure over 15 psig.
- **Psig** means pounds per square inch (gauge).
- **PVHO** means pressure vessel for human occupancy but does not include pressure vessels for human occupancy that may be subjected to external pressures in excess of 15 psig but can only be subjected to maximum internal pressures of 15 psig or less (i.e., submersibles, or one atmosphere observation bells).
- **Saturation diving** means saturating a diver's tissues with the inert gas in the breathing mixture to allow an extension of bottom time without additional decompression.
- **SCUBA** diving means a diving mode in which the diver is supplied with a compressed breathing mixture from diver carried equipment.
- **Standby diver** means a diver at the dive location available to assist a diver in the water.
- **Surface-supplied air diving** means a diving mode in which the diver is supplied from the dive location or bell with compressed breathing air including oxygen or oxygen enriched air if supplied for treatment.
- **Surface-supplied mixed-gas diving** means a diving mode in which the diver is supplied from the dive location or bell with a compressed breathing mixture other than air.
- **Timekeeping device** means a device for measuring the time of a dive in minutes.
- **Treatment table** means a depth, time, and breathing gas profile designed to treat a diver for decompression sickness.
- **Umbilical** means the hose bundle between a dive location and a diver or bell, or between a diver and a bell, that supplies the diver or bell with a life line, breathing gas, communications, power, and heat as appropriate to the diving mode or conditions.
- **Vessel** means any waterborne craft including mobile offshore drilling units required to have a Certificate of Inspection issued by the Coast Guard or any waterborne craft connected with a deepwater port or within the deepwater port safety zone, or any waterborne craft engaged in activities related to the Outer Continental Shelf.
- **Volume tank** means a pressure vessel connected to the outlet of a compressor and used as an air reservoir.
- **Working pressure** means the pressure to which a pressure containment device is exposed at any particular instant during normal operating conditions.

§ 197.205 - Availability of standards.

(a) Several standards have been incorporated by reference in this subchapter. The incorporation by reference has been approved by the Director of the Federal Register under the provisions of 1 CFR part 51.

(b) The standards are available from the appropriate organizations whose addresses are listed below:

(1) American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

(2) American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.

[CGD 76009, 43 FR 53683, Nov. 16, 1978, as amended by CGD 96041, 61 FR 50735, Sept. 27, 1996]

§ 197.206 - Substitutes for required equipment, materials, apparatus, arrangements, procedures or tests.

(a) The Coast Guard may accept substitutes for equipment, materials, apparatus, arrangements, procedures or tests required in this subpart if the substitute provides an equivalent level of safety.

(b) In any case where it is shown to the satisfaction of the Commandant that the use of any particular equipment, material, apparatus, arrangement, procedure, or test is unreasonable or impracticable, the Commandant may permit the use of alternate equipment, material, apparatus, arrangement, procedure, or test to such an extent and upon such condition as will insure, to his satisfaction, a degree of safety consistent with the minimum standards set forth in this subpart.

§ 197.208 - Designation of Person in Charge.

(a) The owner or agent of a vessel or facility without a designated master shall designate, in writing, an individual to be the Person in Charge of the vessel or facility.

(b) Where a master is designated, the master is the Person in Charge.

§ 197.210 - Designation of Diving Supervisor.

The name of the Diving Supervisor for each commercial diving operation shall be (a) Designated in writing; and (b) Given to the Person in Charge prior to the commencement of any commercial diving operation.

EQUIPMENT

§ 197.300 - Applicability.

(a) Each diving installation used on each vessel or facility subject to this subpart must meet the requirements of this subpart.

(b) In addition to the requirements of this subpart, equipment which is permanently installed on vessels and is part of the diving installation must meet Subchapters F and J of this chapter.

(c) All repairs and modifications to pressure vessels used for commercial diving operations must be made in accordance with the requirements of section VIII, division 1 or division 2 of the ASME Code, ASME PVHO1, part 54 of this chapter, or 49 CFR 173.34, as applicable.

(d) All repairs and modifications to pressure piping used for commercial diving operations must be made in accordance with the requirements of the ANSI Code or part 56 of this chapter, as applicable.

§ 197.310 - Air compressor system.

A compressor used to supply breathing air to a diver must have (a) A volume tank that is (1) Built and stamped in accordance with section VIII, division 1 of the ASME Code with (i) A check valve on the inlet side; (ii) A pressure gage; (iii) A relief valve; and (iv) A drain valve; and (2) Tested after every repair, modification, or alteration to the pressure boundaries as required by 197.462; (b) Intakes that are located away from areas containing exhaust fumes of internal combustion engines or other hazardous contaminants; (c) An efficient filtration system; and (d) Slow-opening shut-off valves when the maximum allowable working pressure of the system exceeds 500 psig.

§ 197.312 - Breathing supply hoses.

(a) Each breathing supply hose must (1) Have a maximum working pressure that is equal to or exceeds (i) The maximum working pressure of the section of the breathing supply system in which used; and (ii) The pressure equivalent of the maximum depth of the dive relative to the supply source plus 100 psig; (2) Have a bursting pressure of four times its maximum working pressure; (3) Have connectors that (i) Are made of corrosion-resistant material; (ii) Are resistant to accidental disengagement; and (iii) Have a maximum working pressure that is at least equal to the maximum working pressure of the hose to which they are attached; and (4) Resist kinking by (i) Being made of kink-resistant materials; or (ii) Having exterior support.

(b) Each umbilical must (1) Meet the requirements of paragraph (a) of this section; and (2) Be marked from the diver or open bell end in 10-foot intervals to 100 feet and in 50-foot intervals thereafter.

§ 197.314 - First aid and treatment equipment.

(a) Each dive location must have (1) A medical kit approved by a physician that consists of (i) Basic first aid supplies; and (ii) Any additional supplies necessary to treat minor trauma and illnesses resulting from hyperbaric exposure; (2) A copy of an American Red Cross Standard First Aid handbook; (3) A bag-type manual resuscitator with transparent mask and tubing; and (4) A capability to remove an injured diver from the water.

(b) Each diving installation must have a two-way communications system to obtain emergency assistance except when the vessel or facility ship-to-shore, two-way communications system is readily available.

(c) Each dive location supporting mixed-gas dives, dives deeper than 130 fsw, or dives outside the no-decompression limits must meet the requirements of paragraph (a) of this section and have (1) A decompression chamber; (2) Decompression and treatment tables; (3) A supply of breathing gasses sufficient to treat for decompression sickness; (4) The medical kit required by paragraph (a)(1) of this section that is (i) Capable of being carried into the decompression chamber; and (ii) Suitable for use under hyperbaric conditions; and (5) A capability to assist an injured diver into the decompression chamber.

§ 197.318 - Gauges and timekeeping devices.

(a) A gauge indicating diver depth must be at each dive location for surface-supplied dives.

(b) A timekeeping device must be at each dive location.

§ 197.320 - Diving ladder and stage.

(a) Each diving ladder must (1) Be capable of supporting the weight of at least two divers; (2) Extend 3 feet below the water surface; (3) Be firmly in place; (4) Be available at the dive location for a diver to enter or exit the water unless a diving stage or bell is provided; and (5) Be(i) Made of corrosion-resistant material; or (ii) Protected against and maintained free from injurious corrosion.

(b) Each diving stage must (1) Be capable of supporting the weight of at least two divers; (2) Have an open-grating platform; (3) Be available for a diver to enter or exit the water from the dive location and for in-water decompression if the diver is (i) Wearing a heavy-weight diving outfit; or (ii) Diving outside the no-decompression limits, except when a bell is provided; and (4) Be(i) Made of corrosion-resistant material; or (ii) Protected against and maintained free from injurious corrosion.

§ 197.322 - Surface - supplied helmets and masks.

(a) Each surface-supplied helmet or mask must have (1) A no-return valve at the attachment point between helmet or mask and umbilical that closes readily and positively; (2) An exhaust valve; and (3) A two-way voice communication system between the diver and the dive location or bell.

(b) Each surface-supplied air helmet or mask must (1) Ventilate at least 4.5 ACFM at any depth at which it is operated; or (2) Be able to maintain the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

§ 197.324 - Diver's safety harness.

Each safety harness used in surface-supplied diving must have (a) A positive buckling device; and (b) An attachment point for the umbilical life line that (1) Distributes the pulling force of the umbilical over the diver's body; and (2) Prevents strain on the mask or helmet.

§ 197.326 - Oxygen safety.

(a) Equipment used with oxygen or oxygen mixtures greater than 40 percent by volume must be designed for such use.

(b) Oxygen systems with pressures greater than 125 psig must have slow-opening shut-off valves except pressure boundary shut-off valves may be ball valves.

§ 197.328 – PVHO General.

(a) Each PVHO contracted for or purchased after February 1, 1979, must be built and stamped in accordance with ASME PVHO1.

(b) Each PVHO, contracted for or constructed before February 1, 1979, and not Coast Guard approved, must be submitted to the Coast Guard for approval prior to February 1, 1984.

(c) To be approved under paragraph (b), a PVHO must be (1) Constructed in accordance with part 54 of this chapter; or (2) Be built in accordance with section VIII, division 1 or division 2 of the ASME Code; and (i) Have the plans approved in accordance with 54.0118 of this chapter; (ii) Pass the radiographic and other survey tests of welded joints required by section VIII, division 1 or division 2, as appropriate, of the ASME Code; and (iii) Pass(A) The hydrostatic test described in 54.1010 of this chapter; or (B) The pneumatic test described in 54.1015 of this chapter and such additional tests as the Officer-in-Charge, Marine Inspection (OCMI) may require.

(d) Each PVHO must (1) Have a shut-off valve located within 1 foot of the pressure boundary on all piping penetrating the pressure boundary; (2) Have a check valve located within 1 foot of the pressure boundary on all piping exclusively carrying fluids into the PVHO; (3) Have the pressure relief device required by ASME PVHO1; (4) Have a built-in breathing system with at least one mask per occupant stored inside each separately pressurized compartment; (5) Have a two-way voice communications system allowing communications between an occupant in one pressurized compartment of the PVHO and (i) The Diving Supervisor at the dive location; (ii) Any divers being supported from the same PVHO; and (iii) Occupants of other separately pressurized compartments of the same PVHO; (6) If designed to mechanically couple to another PVHO, have a two-way communications system allowing communications between occupants of each PVHO when mechanically coupled; (7) Have a pressure gage in the interior of each compartment that is (i) Designed for human occupancy; and (ii) Capable of having the compartment pressure controlled from inside the PVHO; (8) Have viewports that allow observation of occupants from the outside; (9) Have viewports that meet the requirements of ASME PVHO1 except those PVHO's approved under paragraph (b) of this section which have non acrylic viewports; (10) Have means of illumination sufficient to allow an occupant to (i) Read gages; and (ii) Operate the installed systems within each compartment; (11) Be designed and equipped to minimize sources of combustible materials and ignition; (12) Have a protective device on the inlet side of PVHO exhaust lines; (13) Have a means of extinguishing a fire in the interior; (14) Have a means of maintaining the oxygen content of the interior atmosphere below 25 percent surface equivalent by volume when pressurized with air as the breathing mixture; (15) Have a means of maintaining the interior atmosphere below 2 percent surface equivalent carbon dioxide by volume; (16) Have a means of overriding and controlling from the exterior all interior breathing and pressure supply controls; (17) Have a speech unscrambler when used with mixed-gas; (18) Have interior electrical systems that are designed for the environment in which they will operate to minimize the risk of fire, electrical shock to personnel, and galvanic action of the PVHO; and (19) Be tested after every repair, modification, or alteration to the pressure boundaries as required by 197.462.

§ 197.330 – PVHO Closed bells.

(a) Except as provided in paragraph (b) of this section, each closed bell must meet the requirements of 197.328 and (1) Have underwater breathing apparatus for each occupant stored inside each separately pressurized compartment; (2) Have an umbilical; (3) Have lifting equipment attached to the closed bell capable of returning the occupied closed bell when fully flooded to the dive location; (4) Be capable of recompressing on the surface to the maximum design diving depth; (5) Be constructed and equipped as required by 197.332; (6) Have an emergency locating device designed to assist personnel on the surface in acquiring and maintaining contact with the submerged PVHO if the umbilical to the surface is severed; (7) Have a capability to remove an injured diver from the water; and (8) Have a life support capability for the intact closed bell and its occupants for (i) Twelve hours after an accident severing the umbilical to the surface when the umbilical to the surface is the only installed means of retrieving the closed bell; or (ii) A period of time, at least equal to 1 hour plus twice the time required to retrieve the bell from its designed operating depth and attach an auxiliary life support system, after an accident severing the umbilical to the surface when the umbilical is one of the two independent installed means of retrieving the closed bell, each meeting the requirements of paragraph (a)(3) of this section.

(b) A closed bell that does not meet the requirements of paragraphs (a)(3), (a)(4), and (a)(5) of this section, must be capable of attachment to another PVHO that (1) Allows the transfer of personnel and diver's equipment under pressure from the closed bell to the PVHO; (2) Meets the requirements of paragraph (a)(3) of this section; (3) Is capable of attachment to a decompression chamber meeting the requirements of paragraphs (a)(4) and (a)(5) of this section; and (4) Allows the transfer of personnel and diver's equipment under pressure from the PVHO to the decompression chamber.

§ 197.332 – PVHO Decompression chambers.
Each decompression chamber must (a) Meet the requirements of 197.328; (b) Have internal dimensions sufficient to accommodate a diver lying in a horizontal position and another person tending the diver; (c) Have a capability for ingress and egress of personnel and equipment while the occupants are under pressure; (d) Have a means of operating all installed man-way locking devices, except disabled shipping dogs, from both sides of a closed hatch; (e) Have interior illumination sufficient to allow visual observation, diagnosis, and medical treatment of an occupant; (f) Have one bunk for each two occupants; (g) Have a capability that allows bunks to be seen over their entire lengths from the exterior; (h) Have a minimum pressure capability of (1) 6 ATA, when used for diving to 300 fsw; or (2) The maximum depth of the dive, when used for diving operations deeper than 300 fsw, unless a closed bell meeting the requirements of 197.330(a) (3), (4), and (5) is used; (i) Have a minimum pressurization rate of 2 ATA per minute to 60 fsw and at least 1 ATA per minute thereafter; (j) Have a decompression rate of 1 ATA per minute to 33 fsw; (k) Have an external pressure gage for each pressurized compartment; (l) Have a capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work; and (m) Have a sound-powered headset or telephone as a backup to the communications system required by 197.328(c) (5) and (6), except when that communications system is a sound-powered system.

§ 197.334 - Open diving bells.
Each open diving bell must (a) Have an upper section that provides an envelope capable of maintaining a bubble of breathing mixture available to a diver standing on the lower section of the platform with his body through the open bottom and his head in the bubble; (b) Have lifting equipment capable of returning the occupied open bell to the dive location; (c) Have an umbilical; and (d) Be(1) Made of corrosion-resisting material; or (2) Protected against and maintained free from injurious corrosion.

§ 197.336 - Pressure piping.
Piping systems that are not an integral part of the vessel or facility, carrying fluids under pressures exceeding 15 psig must (a) Meet the ANSI Code; (b) Have the point of connection to the integral piping system of the vessel or facility clearly marked; and (c) Be tested after every repair, modification, or alteration to the pressure boundaries as set forth in 197.462.

§ 197.338 - Compressed gas cylinders.
Each compressed gas cylinder must (a) Be stored in a ventilated area; (b) Be protected from excessive heat; (c) Be prevented from falling; (d) Be tested after any repair, modification, or alteration to the pressure boundaries as set forth in 197.462; and (e) Meet the requirements of (1) Part 54 of this chapter; or (2) 49 CFR 173.34 and 49 CFR part 178, subpart C.

§ 197.340 - Breathing gas supply.

(a) A primary breathing gas supply for surface-supplied diving must be sufficient to support the following for the duration of the planned dive:
  (1) The diver.
  (2) The standby diver.
  (3) The decompression chamber, when required by 197.432(e)(2) or by 197.434(a) for the duration of the dive and for one hour after completion of the planned dive.
  (4) A decompression chamber when provided but not required by this subpart.
  (5) A closed bell when provided or required by 197.434(d).
  (6) An open bell when provided or required by 197.432(e)(4) or by 197.434(c).

(b) A secondary breathing gas supply for surface-supplied diving must be sufficient to support the following:
  (1) The diver while returning to the surface.
  (2) The diver during decompression.
  (3) The standby diver.
  (4) The decompression chamber when required by 197.432(e)(2) or by 197.434(a) for the duration of the dive and one hour after the completion of the planned dive.
  (5) The closed bell while returning the diver to the surface.
  (6) The open bell while returning the diver to the surface.

(c) A diver-carried reserve breathing gas supply for surface-supplied diving must be sufficient to allow the diver to
  (1) Reach the surface.
  (2) Reach another source of breathing gas; or (3) Be reached by a standby diver equipped with another source of breathing gas for the diver.

(d) A primary breathing gas supply for SCUBA diving must be sufficient to support the diver for the duration of the planned dive through his return to the dive location or planned pick-up point.

(e) A diver-carried reserve breathing gas supply for SCUBA diving must be sufficient to allow the diver to return to the dive location or planned pick-up point from the greatest depth of the planned dive.

(f) Oxygen used for breathing mixtures must (1) Meet the requirements of Federal Specification BB-0925a; and (2) Be type 1 (gaseous) grade A or B.

(g) Nitrogen used for breathing mixtures must (1) Meet the requirements of Federal Specification BB-N411c; (2) Be type 1 (gaseous); (3) Be class 1 (oil free); and (4) Be grade A, B, or C.

(h) Helium used for breathing mixtures must be grades A, B, or C produced by the Federal Government, or equivalent.

(i) Compressed air used for breathing mixtures must (1) Be 20 to 22 percent oxygen by volume; (2) Have no objectionable odor; and (3) Have no more than (i) 1,000 parts per million of carbon dioxide; (ii) 20 parts per million carbon monoxide; (iii) 5 milligrams per cubic meter of solid and liquid particulates including oil; and (iv) 25 parts per million of hydrocarbons (includes methane and all other hydrocarbons expressed as methane).

§ 197.342 - Buoyancy - changing devices.

(a) A dry suit or other buoyancy-changing device not directly connected to the exhaust valve of the helmet or mask must have an independent exhaust valve.

(b) When used for SCUBA diving, a buoyancy-changing device must have an inflation source separate from the breathing gas supply.

§ 197.344 - Inflatable flotation devices.

An inflatable flotation device for SCUBA diving must (a) Be capable of maintaining the diver at the surface in a face-up position; (b) Have a manually activated inflation device; (c) Have an oral inflation device; (d) Have an over-pressure relief device; and (e) Have a manually operated exhaust valve.

§ 197.346 - Diver's equipment.

(a) Each diver using SCUBA must have (1) Self-contained underwater breathing equipment including (i) A primary breathing gas supply with a cylinder pressure gage readable by the diver during the dive; and (ii) A diver-carried reserve breathing gas supply provided by (A) A manual reserve (J valve); or (B) An independent reserve cylinder connected and ready for use; (2) A face mask; (3) An inflatable floatation device; (4) A weight belt capable of quick release; (5) A knife; (6) Swim fins or shoes; (7) A diving wristwatch; and (8) A depth gage.

(b) Each diver using a heavyweight diving outfit must (1) Have a helmet group consisting of helmet, breastplate, and associated valves and connections; (2) Have a diving dress group consisting of a basic dress that encloses the body (except for head and hands) in a tough, waterproof cover, gloves, shoes, weight assembly, and knife; (3) Have a hose group consisting of the breathing gas hose and fittings, the control valve, the lifeline, communications cable, and a pneumofathometer; and (4) Be provided with a helmet cushion and weighted shoes.

(c) Each surface-supplied dive operation using a heavyweight diving outfit must have an extra breathing gas hose with attaching tools available to the standby diver.

(d) Each diver using a lightweight diving outfit must have (1) A safety harness; (2) A weight assembly capable of quick release; (3) A mask group consisting of a lightweight mask and associated valves and connections; (4) A diving dress group consisting of wet or dry diving dress, gloves, shoes or fins, and knife; and (5) A hose group consisting of the breathing gas hose and fittings, the control valve, the lifeline, communications cable, and a pneumofathometer (if the breaking strength of the communications cable is at least equal to that required for the lifeline, the communications cable can serve as the lifeline).

(e) Each surface-supplied air dive operation within the no-decompression limits and to depths of 130 fsw or less must have a primary breathing gas supply at the dive location.

(f) Each surface-supplied dive operation outside the no-compression limits, deeper than 130 fsw, or using mixed-gas as a breathing mixture must have at the dive location (1) A primary breathing gas supply; and (2) A secondary breathing gas supply.

(g) Each diver diving outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas must have a diver-carried reserve breathing gas supply except when using a heavy-weight diving outfit or when diving in a physically confining area.

OPERATIONS

§ 197.400 - Applicability.
Diving operations may only be conducted from a vessel or facility subject to the subpart if the regulations in this subpart are met.

§ 197.402 - Responsibilities of the Person in Charge.

(a) The Person in Charge shall (1) Be fully cognizant of the provisions of this subpart; (2) Prior to permitting any commercial diving operation to commence, have (i) The designation of the Diving Supervisor for each diving operation as required by 197.210; (ii) A report on (A) The nature and planned times of the planned diving operation; and (B) The planned involvement of the vessel or facility, its equipment, and its personnel in the diving operation.

(b) Prior to permitting any commercial diving operation involving liveboating to commence, the Person in Charge shall insure that (1) A means of rapid communications with the Diving Supervisor while the diver is entering, in, or leaving the water is established; and (2) A boat and crew for diver pickup in the event of an emergency is provided.

(c) The Person in Charge shall insure that a boat and crew for SCUBA diver pickup is provided when SCUBA divers are not line-tended from the dive location.

(d) The Person in Charge shall coordinate the activities on and of the vessel or facility with the Diving Supervisor.

(e) The Person in Charge shall insure that the vessel or facility equipment and personnel are kept clear of the dive location except after coordinating with the Diving Supervisor.

§ 197.404 - Responsibilities of the Diving Supervisor.

(a) The Diving Supervisor shall (1) Be fully cognizant of the provisions of this subpart; (2) Be fully cognizant of the provisions of the operations manual required by 197.420; (3) Insure that diving operations conducted from a vessel or facility subject to this subpart meet the regulations in this subpart; (4) Prior to the commencement of any commercial diving operation, provide the report required by 197.402 to the Person in Charge; (5) Coordinate with the Person in Charge any changes that are made to the report required by 197.402; and (6) Promptly notify the Person in Charge of any diving related casualty, accident, or injury.

(b) The Diving Supervisor is in charge of the planning and execution of the diving operation including the responsibility for the safety and health of the dive team.

§ 197.410 - Dive procedures.

(a) The Diving Supervisor shall insure that (1) Before commencing diving operations, dive team members are briefed on (i) The tasks to be undertaken; (ii) Any unusual hazards or environmental conditions likely to affect the safety of the diving operation; and (iii) Any modifications to the operations manual or procedures including safety procedures necessitated by the specific diving operation; (2) The breathing gas supply systems, masks, helmets, thermal protection, when provided, and bell lifting equipment, when a bell is provided or required, are inspected prior to each diving operation; (3) Each diver is instructed to report any physical problems or physiological effects including aches, pains, current illnesses, or symptoms of decompression sickness prior to each dive; (4) A depth, bottom time profile, including any breathing mixture changes, is maintained at the dive location for each diver during the dive, except that SCUBA divers shall maintain their own profiles; (5) A two-way voice communication system is used between (i) Each surface-supplied diver and a dive team member at the dive location or bell (when provided); and (ii) The bell (when provided) and the dive location; (6) A two-way communication system is available at the dive location to obtain emergency assistance; (7) After the completion of each dive (i) The physical condition of the diver is checked by (A) Visual observation; and (B) Questioning the diver about his physical well-being; (ii) The diver is instructed to report any physical problems or adverse physiological effects including aches, pains, current illnesses, or symptoms of decompression sickness or gas embolism; (iii) The diver is advised of the location of an operational decompression chamber; and (iv) The diver is alerted to the potential hazards of flying after diving; (8) For any dive outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas as a breathing mixture (i) A depth, time, decompression profile including breathing mixture changes is maintained for each diver at the dive location; (ii) The diver is instructed to remain awake and in the vicinity of the dive location decompression chamber for at least one hour after the completion of a dive, decompression, or treatment; and (iii) A dive team member, other than the diver, is trained and available to operate the decompression chamber; and (9) When decompression sickness or gas embolism is suspected or symptoms are evident, a report is completed containing (i) The investigation for each incident including (A) The dive and decompression profiles; (B) The composition, depth, and time of breathing mixture changes; (C) A description of the symptoms including depth and time of onset; and (D) A description and results of the treatment; (ii) The evaluation for each incident based on (A) The investigation; (B) Consideration of the past performance of the decompression table used; and (C) Individual susceptibility; and (iii) The corrective action taken, if necessary, to reduce the probability of recurrence.

(b) The Diving Supervisor shall ensure that the working interval of a dive is terminated when he so directs or when (1) A diver requests termination; (2) A diver fails to respond correctly to communications or signals from a dive team member; (3) Communications are lost and can not be quickly reestablished between (i) The diver and a dive team member at the dive location; or (ii) The Person in Charge and the Diving Supervisor during liveboating operations; or (4) A diver begins to use his diver-carried reserve breathing gas supply.

§ 197.420 - Operations manual.

(a) The Diving Supervisor shall (1) Provide an operations manual to the person-in-charge prior to commencement of any diving operation; and (2) Make an operations manual available at the dive location to all members of the dive team.

(b) The operations manual must be modified in writing when adaptation is required because of (1) The configuration or operation of the vessel or facility; or (2) The specific diving operation as planned.

(c) The operations manual must provide for the safety and health of the divers.

(d) The operations manual must contain the following:

(1) Safety procedures and checklists for each diving mode used.

(2) Assignments and responsibilities of each dive team member for each diving mode used.

(3) Equipment procedures and checklists for each diving mode used.

(4) Emergency procedures for (i) Fire; (ii) Equipment failure; (iii) Adverse environmental conditions including, but not limited to, weather and sea state; (iv) Medical illness; and (v) Treatment of injury.

(5) Procedures dealing with the use of (i) Hand-held power tools; (ii) Welding and burning equipment; and (iii) Explosives.

SPECIFIC DIVING MODE PROCEDURES

§ 197.430 - SCUBA diving.

The Diving Supervisor shall insure that (a) SCUBA diving is not conducted (1) Outside the no-decompression limits; (2) At depths greater than 130 fsw; (3) Against currents greater than one (1) knot unless line-tended; and (4) If a diver cannot directly ascend to the surface unless line-tended; (b) The SCUBA diver has the equipment required by 197.346(a); (c) A standby diver is available while a diver is in the water; (d) A diver is line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operation; (e) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver; and (f) A boat is available for diver pickup when the divers are not line-tended from the dive location.

§ 197.432 - Surface - supplied air diving.

The Diving Supervisor shall insure that (a) Surface-supplied air diving is conducted at depths less than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw; (b) Each diving operation has a primary breathing gas supply; (c) Each diver is continuously tended while in the water; (d) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver; (e) For dives deeper than 130 fsw or outside the no-decompression limits (1) Each diving operation has a secondary breathing gas supply; (2) A decompression chamber is ready for use at the dive location; (3) A diving stage is used except when a bell is provided; (4) A bell is used for dives with an in-water decompression time greater than 120 minutes, except when the diver is using a heavy-weight diving outfit or is diving in a physically confining space; (5) A separate dive team member tends each diver in the water; (6) A standby diver is available while a diver is in the water; and (7) Each diver has a diver-carried reserve breathing gas supply except when using a heavy-weight diving outfit or when diving in a physically confining space; and (f) The surface-supplied air diver has the equipment required by 197.346 (b) or (d).

§ 197.434 - Surface - supplied mixed - gas diving.

The Diving Supervisor shall insure that (a) When mixed-gas diving is conducted, a decompression chamber or a closed bell meeting the requirements of 197.332 is ready for use at the dive location; (b) A diving stage is used except when a bell is provided; (c) A bell is used for dives deeper than 220 fsw or when the dive involves in-water decompression times greater than 120 minutes, except when the diver is using a heavy-weight diving outfit or is diving in a physically confining space; (d) A closed bell is used for dives at depths greater than 300 fsw, except when diving is conducted in a physically confining space; (e) A separate dive team member tends each diver in the water; (f) A standby diver is available during all non saturation dives; (g) When saturation diving is conducted (1) A standby diver is available when the closed bell leaves the dive location until the divers are in saturation; and (2) A member of the dive team at the dive location is a diver able to assist in the recovery of the closed bell or its occupants, if required; (h) When closed bell operations are conducted, a diver is available in the closed bell to assist a diver in the water; (i) When a diver is in a physically confining space, another diver is stationed at the underwater point of entry and is line-tending the diver; (j) Each diving operation has a primary and secondary breathing gas supply meeting the requirements of 197.340; and (k) The surface-supplied mixed-gas diver has the equipment required by 197.346 (b) or (d).

§ 197.436 - Liveboating.

(a) During liveboating operations, the Person in Charge shall insure that (1) Diving is not conducted in seas that impede station-keeping ability of the vessel; (2) Liveboating operations are not conducted (i) From 1 hour after sunset to 1 hour before sunrise; or (ii) During periods of restricted visibility; (3) The propellers of the vessel are stopped before the diver enters or exits the water; and (4) A boat is ready to be launched with crew in the event of an emergency.

(b) As used in paragraph (a)(2)(ii) of this section, restricted visibility means any condition in which vessel navigational visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.

(c) During liveboating operations, the Diving Supervisor shall insure that (1) Diving is not conducted at depths greater than 220 fsw; (2) Diving is not conducted in seas that impede diver mobility or work function; (3) A means is used to prevent the diver's hose from entangling in the propellers of the vessel; (4) Each diver carries a reserve breathing gas supply; (5) A standby diver is available while a diver is in the water; (6) Diving is not conducted with in-water decompression times greater than 120 minutes; and (7) The person-in-charge is notified before a diver enters or exits the water.

PERIODIC TESTS AND INSPECTIONS OF DIVING EQUIPMENT

§ 197.450 - Breathing gas tests.

The Diving Supervisor shall insure that (a) The output of each air compressor is tested and meets the requirements of 197.340 for quality and quantity by means of samples taken at the connection point to the distribution system (1) Every 6 months; and (2) After every repair or modification; (b) Purchased supplies of breathing mixtures supplied to a diver are checked before being placed on line for (1) Certification that the supply meets the requirements of 197.340; and (2) Noxious or offensive odor and oxygen percentage; (c) Each breathing supply system is checked, prior to commencement of diving operations, at the umbilical or underwater breathing apparatus connection point for the diver, for noxious or offensive odor and presence of oil mist; and (d) Each breathing supply system, supplying mixed-gas to a diver, is checked, prior to commencement of diving operations, at the umbilical or underwater breathing apparatus connection point for the diver, for percentage of oxygen.

§ 197.452 - Oxygen cleaning.

The Diving Supervisor shall ensure that equipment used with oxygen or oxygen mixtures greater than 40 percent by volume is cleaned of flammable materials (a) Before being placed into service; and (b) After any repair, alteration, modification, or suspected contamination.

§ 197.454 - First aid and treatment equipment.

The Diving Supervisor shall ensure that medical kits are checked monthly to insure that all required supplies are present.

§ 197.456 - Breathing supply hoses.

(a) The Diving Supervisor shall insure that (1) Each breathing supply hose is pressure tested prior to being placed into initial service and every 24 months thereafter to 1.5 times its maximum working pressure; (2) Each breathing supply hose assembly, prior to being placed into initial service and after any repair, modification, or alteration, is tensile tested by (i) Subjecting each hose-to-fitting connection to a 200 pound axial load; and (ii) Passing a visual examination for evidence of separation, slippage, or other damage to the assembly; (3) Each breathing supply hose is periodically checked for (i) Damage which is likely to affect pressure integrity; and (ii) Contamination which is likely to affect the purity of the breathing mixture delivered to the diver; and (4) The open ends of each breathing supply hose are taped, capped, or plugged when not in use.

(b) To meet the requirements of paragraph (a)(3) of this section, each breathing supply hose must be (1) Carefully inspected before being shipped to the dive location; (2) Visually checked during daily operation; and (3) Checked for noxious or offensive odor before each diving operation.

§ 197.458 - Gages and timekeeping devices.

The Diving Supervisor shall insure that (a) Each depth gage and timekeeping device is tested or calibrated against a master reference gage or timekeeping device every 6 months; (b) A depth gage is tested when a discrepancy exists in a depth gage reading greater than 2 percent of full scale between any two gages of similar range and calibration; (c) A timekeeping device is tested when a discrepancy exists in a timekeeping device reading greater than one-quarter of a minute in a 4-hour period between any two timekeeping devices; and (d) Each depth gage and timekeeping device is inspected before diving operations are begun.

§ 197.460 - Diving equipment.
The Diving Supervisor shall insure that the diving equipment designated for use in a dive under 197.346 is inspected before each dive.

§ 197.462 - Pressure vessels and pressure piping.

(a) The Diving Supervisor shall ensure that each pressure vessel, including each volume tank, cylinder and PVHO, and each pressure piping system is examined and tested as required by this section and after any repair, modification or alteration to determine that they are in satisfactory condition and fit for the service intended.

(b) Pressure vessels and pressure piping shall be examined annually for mechanical damage or deterioration. Any defect that may impair the safety of the pressure vessel or piping shall be repaired and pressure tested to the satisfaction of the Officer in Charge, Marine Inspection.

(c) The following tests shall be conducted at least every three years:

(1) All piping permanently installed on a PVHO shall be pressure tested.

(2) PVHOs subject to internal pressure shall be leak tested at the maximum allowable working pressure using the breathing mixture normally used in service.

(3) Equivalent nondestructive testing may be conducted in lieu of pressure testing. Proposals to use nondestructive testing in lieu of pressure testing shall be submitted to the Officer in Charge, Marine Inspection.

(d) Unless otherwise noted, pressure tests conducted in accordance with this section shall be either hydrostatic tests or pneumatic tests.

(1) When a hydrostatic test is conducted on a pressure vessel, the test pressure shall be no less than 1.25 times the maximum allowable working pressure.

(2) When a pneumatic test is conducted on a pressure vessel, the test pressure shall be the maximum allowable working pressure stamped on the nameplate.

(3) When a pneumatic test is conducted on piping, the test pressure shall be no less than 90 percent of the setting of the relief device.

(4) Pressure tests shall be conducted only after suitable precautions are taken to protect personnel and equipment.

(5) When pressure tests are conducted on pressure vessels or pressure piping, the test pressure shall be maintained for a period of time sufficient to allow examination of all joints, connections and high stress areas.

[CGD 95028, 62 FR 51220, Sept. 30, 1997]

RECORDS

§ 197.480 - Logbooks.

(a) The Person in Charge of a vessel or facility that is required by 46 U.S.C. 11301 to have an official logbook shall maintain the logbook on form CG706.

(b) The Person in Charge of a vessel or facility not required by 46 U.S.C. 11301 to have an official logbook, shall maintain, on board, a logbook for making the entries required by this subpart.

(c) The Diving Supervisor conducting commercial diving operations from a vessel or facility subject to this subpart shall maintain a logbook for making the entries required by this subpart.

[CGD 76009, 43 FR 53683, Nov. 16, 1978, as amended by CGD 95028, 62 FR 51220, Sept. 30, 1997]

§ 197.482 - Logbook entries.

(a) The Person in Charge shall insure that the following information is recorded in the logbook for each commercial diving operation:

(1) Date, time, and location at the start and completion of dive operations.

(2) Approximate underwater and surface conditions (weather, visibility, temperatures, and currents).

(3) Name of the Diving Supervisor.

(4) General nature of work performed.

(b) The Diving Supervisor shall insure that the following information is recorded in the logbook for each commercial diving operation:

(1) Date, time, and location at the start and completion of each dive operation.

(2) Approximate underwater and surface conditions (weather, visibility, temperatures, and currents).

(3) Names of dive team members including Diving Supervisor.

(4) General nature of work performed.

(5) Repetitive dive designation or elapsed time since last hyperbaric exposure if less than 24 hours for each diver.

(6) Diving modes used.

(7) Maximum depth and bottom time for each diver.

(8) Name of Person in Charge.

(9) For each dive outside the no-decompression limits, deeper than 130 fsw, or using mixed-gas, the breathing gasses and decompression table designations used.

(10) When decompression sickness or gas embolism is suspected or symptoms are evident (i) The name of the diver; and (ii) A description and results of treatment.

(11) For each fatality or any diving related injury or illness that results in incapacitation of more than 72 hours or requires any dive team member to be hospitalized for more than 24 hours (i) The date; (ii) Time; (iii) Circumstances; and (iv) Extent of any injury or illness.

(c) The Diving Supervisor shall insure that the following is recorded in the logbook for each diving operation deviating from the requirements of this subpart:

(1) A description of the circumstances leading to the situation.

(2) The deviations made.

(3) The corrective action taken, if appropriate, to reduce the possibility of recurrence.

(d) The Diving Supervisor shall insure that a record of the following is maintained:

(1) The date and results of each check of the medical kits.

(2) The date and results of each test of the air compressor.

(3) The date and results of each check of breathing mixtures.

(4) The date and results of each check of each breathing supply system.

(5) The date, equipment cleaned, general cleaning procedure, and names of persons cleaning the diving equipment for oxygen service.

(6) The date and results of each test of the breathing supply hoses and system.

(7) The date and results of each inspection of the breathing gas supply system.

(8) The date and results of each test of depth gages and timekeeping devices.

(9) The date and results of each test and inspection of each PVHO.

(10) The date and results of each inspection of the diving equipment.

(11) The date and results of each test and inspection of pressure piping.

(12) The date and results of each test and inspection of volume tanks and cylinders.

(e) The Diving Supervisor shall insure that a notation concerning the location of the information required under paragraph (d) is made in the logbook.

Note: 46 U.S.C. 11301 requires that certain entries be made in an official logbook in addition to the entries required by this section; and 46 U.S.C. 11302 prescribes the manner of making those entries.

[CGD 76009, 43 FR 53683, Nov. 16, 1978, as amended by USCG19996216, 64 FR 53229, Oct. 1, 1999]

§ 197.484 - Notice of casualty.

(a) In addition to the requirements of subpart 4.05 of this chapter and 33 CFR 146.30, Person in Charge shall notify the Officer in Charge, Marine Inspection, as soon as possible after a diving casualty occurs, if the casualty involves any of the following:

(1) Loss of life.

(2) Diving-related injury to any person causing incapacitation for more than 72 hours.

(3) Diving-related injury to any person requiring hospitalization for more than 24 hours.

(b) The notice required by this section must contain the following:

(1) Name and official number (if applicable) of the vessel or facility.

(2) Name of the owner or agent of the vessel or facility.

(3) Name of the Person in Charge.

(4) Name of the Diving Supervisor.

(5) Description of the casualty including presumed cause.

(6) Nature and extent of the injury to persons.

(c) The notice required by this section is not required if the written report required by 197.486 is submitted within 5 days of the casualty.

[CGD 76009, 43 FR 53683, Nov. 16, 1978, as amended by CGD 95072, 60 FR 50469, Sept. 29, 1995]

§ 197.486 - Written report of casualty.

The person-in-charge of a vessel or facility for which a notice of casualty was made under 197.484 shall submit a report to the Officer-in-Charge, Marine Inspection, as soon as possible after the casualty occurs, as follows:

(a) On Form CG2692, when the diving installation is on a vessel.

(b) Using a written report, in narrative form, when the diving installation is on a facility. The written report must contain the information required by 197.484.

(c) The report required by this section must be accompanied by a copy of the report required by 197.410(a)(9) when decompression sickness is involved.

(d) The report required by this section must include information relating to alcohol or drug involvement as required by 4.0512 of this chapter. (The reporting requirement in paragraph (a) was approved by OMB under control number 2115 0003)

[CGD 76009, 43 FR 53683, Nov. 16, 1978, as amended by CGD 82023, 47 FR 35748, Aug. 16, 1982; 48 FR 43328, Sept. 23, 1983; CGD 84099, 52 FR 47536, Dec. 14, 1987]

§ 197.488 - Retention of records after casualty.

(a) The owner, agent, or Person in Charge of a vessel or facility for which a report of casualty is made under 197.484 shall retain all records onboard that are maintained on the vessel or facility and those records required by this subpart for 6 months after the report of a casualty is made or until advised by the Officer in Charge, Marine Inspection, that records need not be retained onboard.

(b) The records required by paragraph (a) of this section to be retained on board include, but are not limited to, the following:

(1) All logbooks required by 197.480.

(2) All reports required by 197.402(a)(2)(ii), 197.404(a)(4), 197.410(a)(9).

(c) The owner, agent, Person in Charge, or Diving Supervisor shall, upon request, make the records described in this section available for examination by any Coast Guard official authorized to investigate the casualty.

DEPARTMENT OF LABOR OSHA

TEXT OF THE REGULATION-OSHA

PART 1910 - OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Subpart T - Commercial Diving Operations

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APPENDIX A

Examples of conditions that may restrict or limit exposure to Hyperbaric conditions.

APPENDIX B

Guidelines for scientific diving.

In addition to this Standard, the 2006 OSHA Directive is available for reference.

Subpart T - Commercial Diving Operations

Authority: Sections 4, 6, and 8, of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); sec. 107, Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333); sec. 41, Long shore and Harbor Workers' Compensation Act (33 U.S.C. 941); Secretary of Labor's Order No. 8-76 (41 FR 25059), 9-83 (48 FR 35736), or 1-90 (55 FR 9033), as applicable; 29 CFR part 1911.

General

§ 1910.401 Scope and application.

(a) Scope.

(1) This subpart (standard) applies to every place of employment within the waters of the United States, or within any State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, Guam, the Trust Territory of the Pacific Islands, Wake Island, Johnston Island, the Canal Zone, or within the Outer Continental Shelf lands as defined in the Outer Continental Shelf Lands Act (67 Stat. 462, 43 U.S.C. 1331), where diving and related support operations are performed.

(2) This standard applies to diving and related support operations conducted in connection with all types of work and employments, including general industry, construction, ship repairing, shipbuilding, ship breaking and longshoring. However, this standard does not apply to any diving operation:

(i) Performed solely for instructional purposes, using open-circuit, compressed-air SCUBA and conducted within the no-decompression limits;

(ii) Performed solely for search, rescue, or related public safety purposes by or under the control of a governmental agency; or

(iii) Governed by 45 CFR part 46 (Protection of Human Subjects, U.S. Department of Health and Human Services) or equivalent rules or regulations established by another federal agency, which regulate research, development, or related purposes involving human subjects.

(iv) Defined as scientific diving and which is under the direction and control of a diving program containing at least the following elements:

(A) Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.

(B) Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices; and assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.

(3) Alternative requirements for recreational diving instructors and diving guides. Employers of recreational diving instructors and diving guides are not required to comply with the decompression-chamber requirements specified by paragraphs (b)(2) and (c)(3)(iii) of §1910.423 and paragraph (b)(1) of §1910.426 when they meet all of the following conditions:

(i) The instructor or guide is engaging solely in recreational diving instruction or dive-guiding operations;

(ii) The instructor or guide is diving within the no-decompression limits in these operations;

(iii) The instructor or guide is using a nitrox breathing-gas mixture consisting of a high percentage of oxygen (more than 22% by volume) mixed with nitrogen;

(iv) The instructor or guide is using an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus (SCUBA); and

(v) The employer of the instructor or guide is complying with all requirements of Appendix C of this subpart.

(b) Application in emergencies.

An employer may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation which is likely to cause death, serious physical harm, or major environmental damage, provided that the employer:

(1) Notifies the Area Director, Occupational Safety and Health Administration within 48 hours of the onset of the emergency situation indicating the nature of the emergency and extent of the deviation from the prescribed regulations; and

(2) Upon request from the Area Director, submits such information in writing.

(c) Employer obligation. The employer shall be responsible for compliance with:

(1) All provisions of this standard of general applicability; and

(2) All requirements pertaining to specific diving modes to the extent diving operations in such modes are conducted.

[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982; 58 FR 35310, June 30, 1993; 69 FR 7363, Feb. 17, 2004]

§ 1910.402 Definitions.

As used in this standard, the listed terms are defined as follows:

ACFM: Actual cubic feet per minute.

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

ATA: Atmosphere absolute.

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

Bottom time: The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver begins ascent.

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

Cylinder: A pressure vessel for the storage of gasses.

Decompression chamber: A pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system used to decompress divers and to treat decompression sickness.

Decompression sickness: A condition with a variety of symptoms which may result from gas or bubbles in the tissues of divers after pressure reduction.

Decompression table: A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.

Dive-guiding operations means leading groups of sports divers, who use an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, to local undersea diving locations for recreational purposes.

Dive location: A surface or vessel from which a diving operation is conducted.

Dive-location reserve breathing gas: A supply system of air or mixed-gas (as appropriate) at the dive location which is independent of the primary supply system and sufficient to support divers during the planned decompression.

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

Diver: An employee working in water using underwater apparatus which supplies compressed breathing gas at the ambient pressure.

Diver-carried reserve breathing gas: A diver-carried supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by a standby diver.

Diving mode: A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).

FSW: Feet of seawater (or equivalent static pressure head).

Heavy gear: Diver-worn deep-sea dress including helmet, breastplate, dry suit, and weighted shoes.

Hyperbaric conditions: Pressure conditions in excess of surface pressure.

In water stage: A suspended underwater platform which supports a diver in the water.

Liveboating: The practice of supporting a surfaced-supplied air or mixed gas diver from a vessel which is underway.

Mixed-gas diving: A diving mode in which the diver is supplied in the water with a breathing gas other than air.

No-decompression limits: The depth-time limits of the "no-decompression limits and repetitive dive group designation table for no-decompression air dives", U.S. Navy Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.

Psig: Pounds per square inch (gage).

Recreational diving instruction means training diving students in the use of recreational diving procedures and the safe operation of diving equipment, including an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, during dives.

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

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

Standby diver: A diver at the dive location available to assist a diver in the water.

Surface-supplied air diving: A diving mode in which the diver in the water is supplied from the dive location with compressed air for breathing.

Treatment table: A depth-time and breathing gas profile designed to treat decompression sickness.

Umbilical: The composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions, and includes a safety line between the diver and the dive location.

Volume tank: A pressure vessel connected to the outlet of a compressor and used as an air reservoir.

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

[42 FR 37668, July 22, 1977, as amended at 47 FR 53365, Nov. 26, 1982; 69 FR 7363, Feb. 17, 2004]

Personnel Requirements

§ 1910.410 Qualifications of dive team.

(a) *General.*

(1) Each dive team member shall have the experience or training necessary to perform assigned tasks in a safe and healthful manner.

(2) Each dive team member shall have experience or training in the following:

(i) The use of tools, equipment and systems relevant to assigned tasks;

(ii) Techniques of the assigned diving mode: and

(iii) Diving operations and emergency procedures.

(3) All dive team members shall be trained in cardiopulmonary resuscitation and first aid (American Red Cross standard course or equivalent).

(4) Dive team members who are exposed to or control the exposure of others to hyperbaric conditions shall be trained in diving-related physics and physiology.

(b) *Assignments.*

(1) Each dive team member shall be assigned tasks in accordance with the employee's experience or training, except that limited additional tasks may be assigned to an employee undergoing training provided that these tasks are performed under the direct supervision of an experienced dive team member.

(2) The employer shall not require a dive team member to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.

(3) The employer shall not permit a dive team member to dive or be otherwise exposed to hyperbaric conditions for the duration of any temporary physical impairment or condition which is known to the employer and is likely to affect adversely the safety or health of a dive team member.

(c) *Designated person-in-charge.*

(1) The employer or an employee designated by the employer shall be at the dive location in charge of all aspects of the diving operation affecting the safety and health of dive team members.

(2) The designated person-in-charge shall have experience and training in the conduct of the assigned diving operation.

General Operations Procedures

§ 1910.420 Safe practices manual.

(a) *General.*

The employer shall develop and maintain a safe practices manual which shall be made available at the dive location to each dive team member.

(b) *Contents.*

(1) The safe practices manual shall contain a copy of this standard and the employer's policies for implementing the requirements of this standard.

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

(i) Safety procedures and checklists for diving operations;

(ii) Assignments and responsibilities of the dive team members;

(iii) Equipment procedures and checklists; and

(iv) Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984]

§ 1910.421 Pre-dive procedures.

(a) *General.*

The employer shall comply with the following requirements prior to each diving operation, unless otherwise specified.

(b) *Emergency aid.*

A list shall be kept at the dive location of the telephone or call numbers of the following:

(1) An operational decompression chamber (if not at the dive location);

(2) Accessible hospitals;

(3) Available physicians;

(4) Available means of transportation; and

(5) The nearest U.S. Coast Guard Rescue Coordination Center.

(c) *First aid supplies.*

(1) A first aid kit appropriate for the diving operation and approved by a physician shall be available at the dive location.

(2) When used in a decompression chamber or bell, the first aid kit shall be suitable for use under hyperbaric conditions.

(3) In addition to any other first aid supplies, an American Red Cross standard first aid handbook or equivalent, and a bag-type manual resuscitator with transparent mask and tubing shall be available at the dive location.

(d) *Planning and assessment.*

Planning of a diving operation shall include an assessment of the safety and health aspects of the following:

(1) Diving mode;

(2) Surface and underwater conditions and hazards;

(3) Breathing gas supply (including reserves);

(4) Thermal protection;

(5) Diving equipment and systems;

(6) Dive team assignments and physical fitness of dive team members (including any impairment known to the employer);

(7) Repetitive dive designation or residual inert gas status of dive team members;

(8) Decompression and treatment procedures (including altitude corrections); and

(9) Emergency procedures.

(e) *Hazardous activities*.

To minimize hazards to the dive team, diving operations shall be coordinated with other activities in the vicinity which are likely to interfere with the diving operation.

(f) *Employee briefing.*

(1) Dive team members shall be briefed on:

(i) The tasks to be undertaken;

(ii) Safety procedures for the diving mode;

(iii) Any unusual hazards or environmental conditions likely to affect the safety of the diving operation; and

(iv) Any modifications to operating procedures necessitated by the specific diving operation.

(2) Prior to making individual dive team member assignments, the employer shall inquire into the dive team member's current state of physical fitness, and indicate to the dive team member the procedure for reporting physical problems or adverse physiological effects during and after the dive.

(g) *Equipment inspection.*

The breathing gas supply system including reserve breathing gas supplies, masks, helmets, thermal protection, and bell handling mechanism (when appropriate) shall be inspected prior to each dive.

(h) *Warning signal.*

When diving from surfaces other than vessels in areas capable of supporting marine traffic, a rigid replica of the international code flag "A" at least one meter in height shall be displayed at the dive location in a manner which allows all-round visibility, and shall be illuminated during night diving operations.

[42 FR 37668, July 22, 1977, as amended at 47 FR 14706, Apr. 6, 1982; 54 FR 24334, June 7, 1989]

§ 1910.422 Procedures during dive.

(a) *General.*

The employer shall comply with the following requirements which are applicable to each diving operation unless otherwise specified.

(b) *Water entry and exit.*

(1) A means capable of supporting the diver shall be provided for entering and exiting the water.

(2) The means provided for exiting the water shall extend below the water surface.

(3) A means shall be provided to assist an injured diver from the water or into a bell.

(c) *Communications.*

(1) An operational two-way voice communication system shall be used between:

(i) Each surface-supplied air or mixed-gas diver and a dive team member at the dive location or bell (when provided or required); and

(ii) The bell and the dive location.

(2) An operational, two-way communication system shall be available at the dive location to obtain emergency assistance.

(d) *Decompression tables.*

Decompression, repetitive, and no-decompression tables (as appropriate) shall be at the dive location.

(e) *Dive profiles.*

A depth-time profile, including when appropriate any breathing gas changes, shall be maintained for each diver during the dive including decompression.

(f) *Hand-held power tools and equipment.*

(1) Hand-held electrical tools and equipment shall be de-energized before being placed into or retrieved from the water.

(2) Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.

(g) *Welding and burning.*

(1) A current supply switch to interrupt the current flow to the welding or burning electrode shall be:

(i) Tended by a dive team member in voice communication with the diver performing the welding or burning; and

(ii) Kept in the open position except when the diver is welding or burning.

(2) The welding machine frame shall be grounded.

(3) Welding and burning cables, electrode holders, and connections shall be capable of carrying the maximum current required by the work, and shall be properly insulated.

(4) Insulated gloves shall be provided to divers performing welding and burning operations.

(5) Prior to welding or burning on closed compartments, structures or pipes, which contain a flammable vapor or in which a flammable vapor may be generated by the work, they shall be vented, flooded, or purged with a mixture of gasses which will not support combustion.

(h) *Explosives.*

(1) Employers shall transport, store, and use explosives in accordance with this section and the applicable provisions of §1910.109 and §1926.912 of Title 29 of the Code of Federal Regulations.

(2) Electrical continuity of explosive circuits shall not be tested until the diver is out of the water.

(3) Explosives shall not be detonated while the diver is in the water.

(i) Termination of dive.

The working interval of a dive shall be terminated when:

(1) A diver requests termination;

(2) A diver fails to respond correctly to communications or signals from a dive team member;

(3) Communications are lost and can not be quickly re-established between the diver and a dive team member at the dive location, and between the designated Person in Charge and the person controlling the vessel in liveboating operations; or

(4) A diver begins to use diver-carried reserve breathing gas or the dive-location reserve breathing gas.

§ 1910.423 Post-dive procedures.

(a) *General.*

The employer shall comply with the following requirements which are applicable after each diving operation, unless otherwise specified.

(b) *Precautions.*

(1) After the completion of any dive, the employer shall:

(i) Check the physical condition of the diver;

(ii) Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness;

(iii) Advise the diver of the location of a decompression chamber which is ready for use; and

(iv) Alert the diver to the potential hazards of flying after diving.

(2) For any dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas as a breathing mixture, the employer shall instruct the diver to remain awake and in the vicinity of the decompression chamber which is at the dive location for at least one hour after the dive (including decompression or treatment as appropriate).

(c) *Recompression capability.*

(1) A decompression chamber capable of recompressing the diver at the surface to a minimum of 165 fsw (6 ATA) shall be available at the dive location for:

(i) Surface-supplied air diving to depths deeper than 100 fsw and shallower than 220 fsw;

(ii) Mixed gas diving shallower than 300 fsw; or

(iii) Diving outside the no-decompression limits shallower than 300 fsw.

(2) A decompression chamber capable of recompressing the diver at the surface to the maximum depth of the dive shall be available at the dive location for dives deeper than 300 fsw.

(3) The decompression chamber shall be:

(i) Dual-lock;

(ii) Multiplace; and

(iii) Located within 5 minutes of the dive location.

(4) The decompression chamber shall be equipped with:

(i) A pressure gauge for each pressurized compartment designed for human occupancy;

(ii) A built-in-breathing-system with a minimum of one mask per occupant;

(iii) A two-way voice communication system between occupants and a dive team member at the dive location;

(iv) A viewport; and

(v) Illumination capability to light the interior.

(5) Treatment tables, treatment gas appropriate to the diving mode, and sufficient gas to conduct treatment shall be available at the dive location.

(6) A dive team member shall be available at the dive location during and for at least one hour after the dive to operate the decompression chamber (when required or provided).

(d) *Record of dive.*

(1) The following information shall be recorded and maintained for each diving operation:

(i) Names of dive team members including designated person-in-charge;

(ii) Date, time, and location;

(iii) Diving modes used;

(iv) General nature of work performed;

(v) Approximate underwater and surface conditions (visibility, water temperature and current); and

(vi) Maximum depth and bottom time for each diver.

(2) For each dive outside the no-decompression limits, deeper than 100 fsw or using mixed gas, the following additional information shall be recorded and maintained:

(i) Depth-time and breathing gas profiles;

(ii) Decompression table designation (including modification); and

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

(3) For each dive in which decompression sickness is suspected or symptoms are evident, the following additional information shall be recorded and maintained:

(i) Description of decompression sickness symptoms (including depth and time of onset); and

(ii) Description and results of treatment.

(e) *Decompression procedure assessment.*

The employer shall:

(1) Investigate and evaluate each incident of decompression sickness based on the recorded information, consideration of the past performance of 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, within 45 days of the incident of decompression sickness.

[42 FR 37668, July 22, 1977, as amended at 49 FR 18295, Apr. 30, 1984]

Specific Operations Procedures

§ 1910.424 SCUBA diving.

(a) *General.*

Employers engaged in SCUBA diving shall comply with the following requirements, unless otherwise specified.

(b) *Limits.*

SCUBA diving shall not be conducted:

(1) At depths deeper than 130 fsw;

(2) At depths deeper than 100 fsw or outside the no-decompression limits unless a decompression chamber is ready for use;

(3) Against currents exceeding one (1) knot unless line-tended; or

(4) In enclosed or physically confining spaces unless line-tended.

(c) *Procedures.*

(1) A standby diver shall be available while a diver is in the water.

(2) A diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations.

(3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(4) A diver-carried reserve breathing gas supply shall be provided for each diver consisting of:

(i) A manual reserve (J valve); or

(ii) An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus.

(5) The valve of the reserve breathing gas supply shall be in the closed position prior to the dive.

§ 1910.425 Surface-supplied air diving.

(a) *General.*

Employers engaged in surface-supplied air diving shall comply with the following requirements, unless otherwise specified.

(b) *Limits.*

(1) Surface-supplied air diving shall not be conducted at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw.

(2) A decompression chamber shall be ready for use at the dive location for any dive outside the no-decompression limits or deeper than 100 fsw.

(3) A bell shall be used for dives with an in-water decompression time greater than 120 minutes, except when heavy gear is worn or diving is conducted in physically confining spaces.

(c) *Procedures.*

(1) Each diver shall be continuously tended while in the water.

(2) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(3) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.

(4) For dives deeper than 100 fsw or outside the no-decompression limits:

(i) A separate dive team member shall tend each diver in the water;

(ii) A standby diver shall be available while a diver is in the water;

(iii) A diver-carried reserve breathing gas supply shall be provided for each diver except when heavy gear is worn; and

(iv) A dive-location reserve breathing gas supply shall be provided.

(5) For heavy-gear diving deeper than 100 fsw or outside the no-decompression limits:

(i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the standby diver.

(ii) An in water stage shall be provided to divers in the water.

(6) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided whenever the diver is prevented by the configuration of the dive area from ascending directly to the surface.

§ 1910.426 Mixed-gas diving.

(a) *General.*

Employers engaged in mixed-gas diving shall comply with the following requirements, unless otherwise specified.

(b) *Limits.*

Mixed-gas diving shall be conducted only when:

(1) A decompression chamber is ready for use at the dive location; and

(i) A bell is used at depths greater than 220 fsw or when the dive involves in water decompression time of greater than 120 minutes, except when heavy gear is worn or when diving in physically confining spaces; or

(ii) A closed bell is used at depths greater than 300 fsw, except when diving is conducted in physically confining spaces.

(c) *Procedures.*

(1) A separate dive team member shall tend each diver in the water.

(2) A standby diver shall be available while a diver is in the water.

(3) A diver shall be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.

(4) Each diving operation shall have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.

(5) Each diving operation shall have a dive-location reserve breathing gas supply.

(6) When heavy gear is worn:

(i) An extra breathing gas hose capable of supplying breathing gas to the diver in the water shall be available to the standby diver; and

(ii) An in water stage shall be provided to divers in the water.

(7) An in water stage shall be provided for divers without access to a bell for dives deeper than 100 fsw or outside the no-decompression limits.

(8) When a closed bell is used, one dive team member in the bell shall be available and tend the diver in the water.

(9) Except when heavy gear is worn or where physical space does not permit, a diver-carried reserve breathing gas supply shall be provided for each diver:

(i) Diving deeper than 100 fsw or outside the no-decompression limits; or

(ii) Prevented by the configuration of the dive area from directly ascending to the surface.

§ 1910.427 Liveboating.

(a) *General.*

Employers engaged in diving operations involving liveboating shall comply with the following requirements.

(b) *Limits.*

Diving operations involving liveboating shall not be conducted:

(1) With an in-water decompression time of greater than 120 minutes;

(2) Using surface-supplied air at depths deeper than 190 fsw, except that dives with bottom times of 30 minutes or less may be conducted to depths of 220 fsw;

(3) Using mixed gas at depths greater than 220 fsw;

(4) In rough seas which significantly impede diver mobility or work function; or

(5) In other than daylight hours.

(c) Procedures.

(1) The propeller of the vessel shall be stopped before the diver enters or exits the water.

(2) A device shall be used which minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.

(3) Two-way voice communication between the designated person-in-charge and the person controlling the vessel shall be available while the diver is in the water.

(4) A standby diver shall be available while a diver is in the water.

(5) A diver-carried reserve breathing gas supply shall be carried by each diver engaged in liveboating operations.

Equipment Procedures and Requirements

§ 1910.430 Equipment

(a) *General.*

(1) All employers shall comply with the following requirements, unless otherwise specified.

(2) Each equipment modification, repair, test, calibration or maintenance service shall be recorded by means of a tagging or logging system, and include the date and nature of work performed, and the name or initials of the person performing the work.

(b) *Air compressor system.*

(1) Compressors used to supply air to the diver shall be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

(2) Air compressor intakes shall be located away from areas containing exhaust or other contaminants.

(3) Respirable air supplied to a diver shall not contain:

(i) A level of carbon monoxide (CO) greater than 20 p/m;

(ii) A level of carbon dioxide (CO_2) greater than 1,000 p/m;

(iii) A level of oil mist greater than 5 milligrams per cubic meter; or

(iv) A noxious or pronounced odor.

(4) The output of air compressor systems shall be tested for air purity every 6 months by means of samples taken at the connection to the distribution system, except that non-oil lubricated compressors need not be tested for oil mist.

(c) *Breathing gas supply hoses.*

(1) Breathing gas supply hoses shall:

(i) Have a working pressure at least equal to the working pressure of the total breathing gas system;

(ii) Have a rated bursting pressure at least equal to 4 times the working pressure;

(iii) Be tested at least annually to 1.5 times their working pressure; and

(iv) Have their open ends taped, capped or plugged when not in use.

(2) Breathing gas supply hose connectors shall:

(i) Be made of corrosion-resistant materials;

(ii) Have a working pressure at least equal to the working pressure of the hose to which they are attached; and

(iii) Be resistant to accidental disengagement.

(3) Umbilicals shall:

(i) Be marked in 10-ft. increments to 100 feet beginning at the diver's end, and in 50 ft. increments thereafter;

(ii) Be made of kink-resistant materials; and

(iii) Have a working pressure greater than the pressure equivalent to the maximum depth of the dive (relative to the supply source) plus 100 psi.

(d) *Buoyancy control.*

(1) Helmets or masks connected directly to the dry suit or other buoyancy-changing equipment shall be equipped with an exhaust valve.

(2) A dry suit or other buoyancy-changing equipment not directly connected to the helmet or mask shall be equipped with an exhaust valve.

(3) When used for SCUBA diving, a buoyancy compensator shall have an inflation source separate from the breathing gas supply.

(4) An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manually activated inflation source independent of the breathing supply, an oral inflation device, and an exhaust valve shall be used for SCUBA diving.

(e) *Compressed gas cylinders.*

Compressed gas cylinders shall:

(1) Be designed, constructed and maintained in accordance with the applicable provisions of 29 CFR 1910.101 and 1910.169 through 1910.171.

(2) Be stored in a ventilated area and protected from excessive heat;

(3) Be secured from falling; and

(4) Have shut-off valves recessed into the cylinder or protected by a cap, except when in use or manifolded, or when used for SCUBA diving.

(f) *Decompression chambers.*

(1) Each decompression chamber manufactured after the effective date of this standard, shall be built and maintained in accordance with the ASME Code or equivalent.

(2) Each decompression chamber manufactured prior to the effective date of this standard shall be maintained in conformity with the code requirements to which it was built, or equivalent.

(3) Each decompression chamber shall be equipped with:

(i) Means to maintain the atmosphere below a level of 25 percent oxygen by volume;

(ii) Mufflers on intake and exhaust lines, which shall be regularly inspected and maintained;

(iii) Suction guards on exhaust line openings; and

(iv) A means for extinguishing fire, and shall be maintained to minimize sources of ignition and combustible material.

(g) *Gauges and timekeeping devices.*

(1) Gauges indicating diver depth which can be read at the dive location shall be used for all dives except SCUBA.

(2) Each depth gauge shall be deadweight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than two percent (2 percent) of full scale between any two equivalent gauges.

(3) A cylinder pressure gauge capable of being monitored by the diver during the dive shall be worn by each SCUBA diver.

(4) A timekeeping device shall be available at each dive location.

(h) *Masks and helmets.*

(1) Surface-supplied air and mixed-gas masks and helmets shall have:

(i) A non-return valve at the attachment point between helmet or mask and hose which shall close readily and positively; and

(ii) An exhaust valve.

(2) Surface-supplied air masks and helmets shall have a minimum ventilation rate capability of 4.5 acfm at any depth at which they are operated or the capability of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 ATA when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

(i) *Oxygen safety*.

(1) Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed for oxygen service.

(2) Components (except umbilicals) exposed to oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be cleaned of flammable materials before use.

(3) Oxygen systems over 125 psig and compressed air systems over 500 psig shall have slow-opening shut-off valves.

(j) *Weights and harnesses.*

(1) Except when heavy gear is worn, divers shall be equipped with a weight belt or assembly capable of quick release.

(2) Except when heavy gear is worn or in SCUBA diving, each diver shall wear a safety harness with:

(i) A positive buckling device;

(ii) An attachment point for the umbilical to prevent strain on the mask or helmet; and

(iii) A lifting point to distribute the pull force of the line over the diver's body.

[39 FR 23502, June 27, 1974, as amended at 49 FR 18295, Apr. 30, 1984; 51 FR 33033, Sept. 18, 1986]

Recordkeeping

§ 1910.440 Recordkeeping requirements.

(a)

(1) [Reserved]

(2) The employer shall record the occurrence of any diving-related injury or illness which requires any dive team member to be hospitalized for 24 hours or more, specifying the circumstances of the incident and the extent of any injuries or illnesses.

(b) *Availability of records.*

(1) Upon the request of the Assistant Secretary of Labor for Occupational Safety and Health, or the Director, National Institute for Occupational Safety and Health, Department of Health and Human Services of their designees, the employer shall make available for inspection and copying any record or document required by this standard.

(2) Records and documents required by this standard shall be provided upon request to employees, designated representatives, and the Assistant Secretary in accordance with 29 CFR 1910.1020 (a)–(e) and (g)–(i). Safe practices manuals (§1910.420), depth-time profiles (§1910.422), recordings of dives (§1910.423), decompression procedure assessment evaluations (§1910.423), and records of hospitalizations (§1910.440) shall be provided in the same manner as employee exposure records or analyses using exposure or medical records. Equipment inspections and testing records which pertain to employees (§1910.430) shall also be provided upon request to employees and their designated representatives.

(3) Records and documents required by this standard shall be retained by the employer for the following period:

(i) Dive team member medical records (physician's reports) (§1910.411)—5 years;

(ii) Safe practices manual (§1910.420)—current document only;

(iii) Depth-time profile (§1910.422)—until completion of the recording of dive, or until completion of decompression procedure assessment where there has been an incident of decompression sickness;

(iv) Recording of dive (§1910.423)—1 year, except 5 years where there has been an incident of decompression sickness;

(v) Decompression procedure assessment evaluations (§1910.423)—5 years;

(vi) Equipment inspections and testing records (§1910.430)—current entry or tag, or until equipment is withdrawn from service;

(vii) Records of hospitalizations (§1910.440)—5 years.

(4) After the expiration of the retention period of any record required to be kept for five (5) years, the employer shall forward such records to the National Institute for Occupational Safety and Health, Department of Health and Human Services. The employer shall also comply with any additional requirements set forth at 29 CFR 1910.20(h).

(5) In the event the employer ceases to do business:

(i) The successor employer shall receive and retain all dive and employee medical records required by this standard; or

(ii) If there is no successor employer, dive and employee medical records shall be forwarded to the National Institute for Occupational Safety and Health, Department of Health and Human Services.

[42 FR 37668, July 22, 1977, as amended at 45 FR 35281, May 23, 1980; 47 FR 14706, Apr. 6, 1982; 51 FR 34562, Sept. 29, 1986; 61 FR 9242, Mar. 7, 1996; 71 FR 16672, Apr. 3, 2006]

§ 1910.441 Effective date.

This standard shall be effective on October 20, 1977, except that for provisions where decompression chambers or bells are required and such equipment is not yet available, employers shall comply as soon as possible thereafter but in no case later than 6 months after the effective date of the standard.

Appendix A — Examples of Conditions Which May Restrict or Limit Exposure to Hyperbaric Conditions

The following disorders may restrict or limit occupational exposure to hyperbaric conditions depending on severity, presence of residual effects, response to therapy, number of occurrences, diving mode or degree and duration of isolation:

- History of seizure disorder other than early febrile convulsions.
- Malignancies (active) unless treated and without recurrence for 5 years.
- Chronic inability to equalize sinus and/or middle ear pressure.
- Cystic or cavitary disease of the lungs.
- Impaired organ function caused by alcohol or drug use.
- Conditions requiring continuous medication for control (e.g., antihistamines, steroids, barbiturates, mood-altering drugs or insulin).
- Meniere's disease.
- Hemoglobinopathies.
- Obstructive or restrictive lung disease.
- Vestibular end organ destruction.
- Pneumothorax.
- Cardiac abnormalities (e.g., pathological heart block, valvular disease, intraventricular conduction defects other than isolated right bundle branch block, angina pectoris, arrhythmia, coronary artery disease).
- Juxta-articular osteonecrosis.

Appendix B - Guidelines for Scientific Diving

This appendix contains guidelines that will be used in conjunction with §1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

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

[50 FR 1050, Jan. 9, 1985]

Notes

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