Diving Safe Practices Manual

Underwater MEC Investigation/Removal Using SCUBA

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Reviewer Acknowledgment

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TITAN Dive Safety Reviewer	**Signature**	**Date**
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Acronyms and Abbreviations

ACDE	Association of Commercial Diving Educators
AED	Automatic Emergency Defibrillator
AHA	activity hazard analysis
ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
DDC	Designated Dive Coordinator
DDESB	Department of Defense Explosives Safety Board
DoD	Department of Defense
DOT	Department of Transportation
DQCR	Daily Quality Control Report
EM	Engineering Manual
EOD	Explosive Ordnance Disposal
fpm	feet per minute
fsw	feet of salt water
GPS	global positioning system
HAZWOPER	Hazardous Waste Operation and Emergency Response
MD	munitions debris
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
No.	number
OE	Ordnance and Explosives
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
QC	quality control
SCUBA	self-contained underwater breathing apparatus
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
U.S.	United States
URS	URS Group, Inc.
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer

1. INTRODUCTION

This manual establishes the Dive Operations guidelines for TITAN dive personnel engaged in munitions response diving operations. This manual combines and conforms to requirements outlined in Occupational Safety and Health Administration (OSHA) regulations, the United States (U.S.) Navy Diving Manual (Volume I) and the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual Engineering Manual (EM) 385-1-1. The requirements of OSHA, Department of Labor directive titled, 29 Code of Federal Regulations (CFR) 1910 Subpart T, Commercial Diving Operations has been integrated into this manual. OSHA and EM 385-1-1 established safety and health criteria for personnel to include medical requirements, recommended physical examination, operational procedures, equipment procedures and record keeping requirements which are incorporated herein. Where documents are conflicting in policy, the most stringent regulations take precedence. A site-specific Diving Operation Plan is established for each project.

Safety is the primary consideration in planning and executing all jobs. The underwater investigation and removal of munitions and explosives of concern (MEC) adds a degree of complexity and additional hazards, not present in land-based operations. All personnel engaged in these operations are screened carefully for the required training, experience, and physical capabilities required to perform underwater MEC work. Each individual is responsible for personal safety and for the safety of coworkers. Each individual must know their physical limits and technical capability and must immediately notify the Dive Supervisor if unable to safely complete assigned tasks. Site-specific dive plans and safety plans will be developed for each project.

This Safe Practices Manual will be available to Government representatives and all dive team members at all times at all diving locations.

2. DIVE SAFETY PROCEDURES (1910.422)

The success of any diving operation is a direct result of careful and complete planning. The procedures and checklist presented below are intended to help ensure careful planning and safe execution of dive operations. The Dive Supervisor shall comply with the following requirements during diving operations:

- A means capable of supporting the diver will be provided for water entry and exit when conducting dive operations from a boat. The means provided for exiting the water will extend below the water's surface; a means will be provided to assist an injured diver from the water to the dive boat; see Attachment A (Emergency Management Plan) for guidance.
- An operational two-way voice communication system will be used for communication between each diver and a member of the dive team at the dive location. Line-pull signals meet this requirement for SCUBA-diving mode.
- If line-pull signals are used in SCUBA mode, only Navy approved line-pull and hand signals will be used. (See Attachment B);
- Have operational two-way communications (handheld portable radios and cell phones) available at the dive location to obtain emergency assistance;
- Dive profiles will be kept at the dive location for each diver (See Attachment C).
- Explosives shall not be detonated while a diver is in the water;
- The Dive Supervisor will be on the site for all diving operations.
- The Dive Supervisor will devise a means for emergency diver recall. It must be a distinct, sure method and every diver must be made aware of the system being used.
- A standby diver will be utilized on all diving operations. Gear must be ready for immediate donning (i.e., harnesses adjusted, regulators attached, and air on etc.).
- Personnel involved in diving operations shall not hesitate to ditch, abandon, or destroy gear or equipment if, at any time, such action would, in the divers mind, be the proper course of action for his own safety or the safety of others;
- U.S. Navy Standard Air Decompression Tables will be used and available at the dive locations;
- Repetitive and no-decompression tables will be at the dive location; and
- Use a timekeeping device for recording the diving times of all SCUBA diving operations. The Dive Supervisor will ensure that a diver does not exceed the approved bottom time on any dive.
- Plan the dive, dive the plan.

2.1 PRE-DIVE PROCEDURES (1910.421)

The Dive Supervisor shall comply with the following requirements prior to each diving operation.

2.1.1 Emergency Aid

An Emergency Management Plan (Attachment A) shall be completed prior to diving operations and kept at the dive location that includes the telephone or call numbers of the following:

- Location of an operational recompression chamber;
- Location of accessible hospitals;
- Available means of emergency transportation; and
- The nearest U. S. Coast Guard Rescue Coordination Center.

2.1.2 Dive Operation Planning and Assessment

The planning of a dive operation shall include an assessment of the safety and health aspects of the following:

- Diving mode;
- Surface and underwater conditions and hazards;
- Breathing air supply (including reserves);
- Thermal protection;
- Diving equipment and systems;
- Dive team assignment, training in diving equipment/procedures and physical fitness of dive team members (including any impairment known to the employer);
- Dangerous marine life;
- Repetitive dive designation or residual air status of dive team members;
- Decompression and treatment procedures (including altitude corrections) as necessary; and
- Emergency procedures.

2.1.3 Pre-dive Brief

The Dive Supervisor shall brief the dive team members on the following prior to diving:

- Mission and location which will include drawings and/or photographs pertinent to the mission
- Safety procedures for the diving mode;
- Equipment and materials to be used or installed as part of the mission;
- Maximum working depth with estimated bottom times and water temperature;
- Names and duties of personnel on the team;
- Discussion of pertinent activity hazard analyses (AHAs) or new AHAs
- Any unusual hazards or environmental conditions likely to affect the safety of the diving operation;
- Any modifications to the Dive Plan necessitated by the specific diving activities (NOTE: If for any reason the Dive Plan is altered in the mission, depth, personnel, or equipment, the Designated Dive Supervisor (DDC) will be contacted in order to review and accept the alteration prior to actual operation. This review may be conducted electronically and confirmed in writing after completion of the dive operation); and

- Emergency procedures

Prior to making individual dive team member assignments, the Dive Supervisor will inquire into the dive team member's current state of physical fitness, and indicate to the dive team members the procedure for reporting physical problems or adverse physiological effects during and after the dive.

2.2 TERMINATION OF DIVE

The working interval of a dive shall be terminated when:

- A diver requests termination;
- A diver fails to respond correctly to communications or signals from a dive team member;
- Communications are lost and cannot be quickly re-established between the diver and a dive team member at the dive location, and between the Dive Supervisor and the boat operator; or
- A diver begins to use diver-carried reserve breathing gas;
- Emergency recall device is activated; or

2.3 POST-DIVE PROCEDURES

The Dive Supervisor shall comply with the following requirements after each diving operation.

- Check the physical condition of each diver;
- Instruct each diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness;
- Advise each diver of the location of a recompression chamber which is ready for use;
- Alert each diver to the potential hazards of flying after diving (12 hours before flying after any dive and 24 hours following multiple days of repetitive dives);
- Each diver shall remain at the dive location or in close proximity to the Dive Supervisor for at least 30 minutes after completing dive; and
- Ensure that no diver has a bottom time longer than authorized for each dive.

2.4 RECORD OF DIVE

The following information shall be recorded (use Attachment C) and maintained for each diving operation.

- Names of dive team members including Dive Supervisor;
- Date, time and location of dive (s);
- Diving mode used;
- General nature of work performed;

- Surface and underwater conditions (visibility, water temperature and current);
- Maximum depth and bottom time for each diver; and
- Attachment C will be filled out for each dive operation by Dive Supervisor and filed in the permanent project files.

For each dive in which decompression sickness/pulmonary barotraumas are suspected or symptoms are evident, the following additional information will be recorded and maintained:

- Description of decompression sickness symptoms (including depth and time of onset);
- Description and results of treatment;
- Name, address and phone number of attending physician

A decompression procedure assessment shall be conducted by the Dive Supervisor to include the following.

- 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, within 45 days of the incident of decompression sickness; and
- Written evaluations will be retained by TITAN for a period of five years and then forwarded to OSHA.

2.5 SCUBA DIVING REQUIREMENTS

2.5.1 Equipment

Each SCUBA team member will be equipped with:

- An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus;
- Buoyancy compensation device or inflatable life jacket capable of maintaining the diver at the surface in a face-up position;
- A submersible cylinder pressure gauge;
- A weight belt or assembly capable of quick release;
- A watch, pressure gauge and knife; and
- SCUBA air cylinders of seamless steel or aluminum which meet Department of Transportation (DOT) 3AA and DOT 3AL specifications with identification symbols stamped into the shoulder of

the tank. Annual inspections and hydrostatic testing will also be stamped into the cylinder as applicable;

- A safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious or hurt; and

- A time keeping device will be used by the Dive Supervisor for recording dive times at the dive location and each diver will have a time keeping device to keep track of bottom times.

- Skin suit to protect from cuts and abrasions and thermal protection as required

- Air tanks will be filled from a certified dive shop. Prior to the initial start of dive operations, a copy of the air certification from the dive shop will be obtained and provided to the DDC upon request and maintained on file in the project office.

Each dive team member will be responsible for ensuring that his equipment is inspected prior to each dive using the checklist in Attachment D and report any deficiencies to the Dive Supervisor.

2.5.2 Requirements While Engaged In SCUBA Diving Operations

SCUBA diving shall not be conducted**:**

- Against currents, exceeding one (1) knot;

- In an enclosed or physically confining spaces unless line-tended;

- In water visibility less than one (1) meter unless line tended with diver/surface two-way voice communications

- When the diver does not have direct access to the surface

2.5.3 Procedures

- Divers will not exceed designated bottom time;

- Will have a layer of skin protection to prevent injury from cuts and scratches and thermal protection if water temperatures are below 75 degrees Fahrenheit.

- A standby diver shall be available while a diver is in the water;

- A diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operation; and

- A diver-carried reserve breathing air supply shall be provided for each diver consisting of:

    - An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus.

    - The valve of the reserve breathing gas supply shall be in the closed position (lever in the up position) prior to the dive.

- All personnel will remain aware of conditions or hazards that might affect diving operations and will inform the Dive Supervisor and/or terminate the dive as necessary;

- Divers will use proper rates of descent/ascent during the dive (75 feet per minute [fpm] descent/30 fpm ascent).

- If communications are lost between a tender and diver and cannot be regained quickly, metal-on-metal audible recall signal will be sounded in the water and line pull signals will be used to recall the diver. If the diver does not surface in a reasonable amount of time after the audible re-call signal and line-pull signals have been initiated, the stand-by diver will be dispatched to the last known location of the diver. If communications are lost between the diver and the tender and cannot be regained quickly, the diver will surface immediately without waiting for the recall signal. The reason for the loss of communications will be investigated and remedied prior to continuation of the dive. The Emergency Plan in Attachment A describes emergency procedures that apply to a situation where there is a lost diver in the water.

2.6 LIVE BOATING

TITAN will operate a safety boat in the area of dive operations. The boat will be positioned to monitor the dive operation and to help maintain a safety exclusion zone around the operation. Personnel on the safety boat will assist in emergency response as requested by the Dive Supervisor. The dive boat will be anchored during dive operations.

2.7 SEARCH METHOD (CIRCLE-LINE AND STATIONARY JACKSTAY)

The purpose of a munitions response dive is to locate and identify underwater MEC. The search shall be conducted using a circle-line search method described in the following paragraph; the diver will be equipped with an all metals detector and hand tools as necessary. The area to be searched will be located using the Global Positioning System (GPS) to locate the points provided by an aero-detection mapping operation.

The circle-line search method will be used to locate underwater MEC when the search area is small. A single clump attached to a buoy line will be lowered to the bottom. A second line with knots tied every four- or five-feet apart of a specified length will be attached to the clump. The diver will then use this second line to circle around the clump at increasing or decreasing radii while searching. After one complete circle, the diver moves out or in one knot as required. This search method can be utilized to reacquire single targets previously electronically positioned (see Figure 2.1).

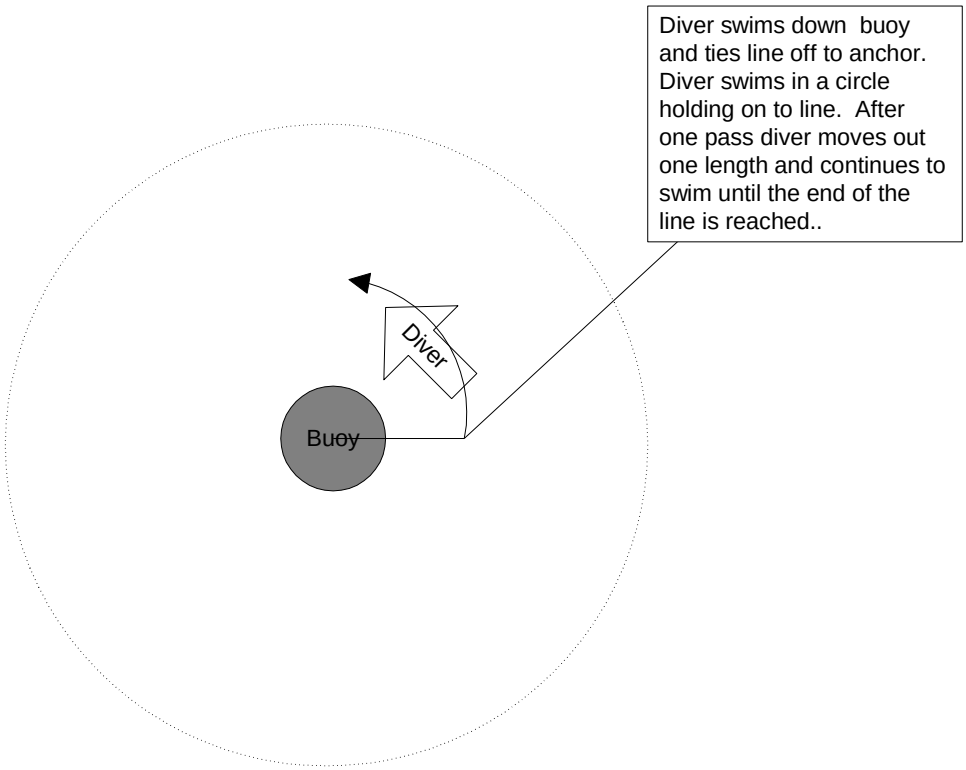


Figure 2.1 Circle Line Search Method

The Stationary Jackstay search method will be used to locate underwater MEC in the areas where specific anomaly locations are unknown. A diver will use a line as a guide as he sweeps a lane that is approximately five feet wide. At the end of the line he will turn around and swim the opposite direction, clearing a five feet wide lane on the other side of the line. The line will then be repositioned and the process is repeated until the entire area is cleared. Figure 2.2 shows how the Stationary Jackstay method is employed.

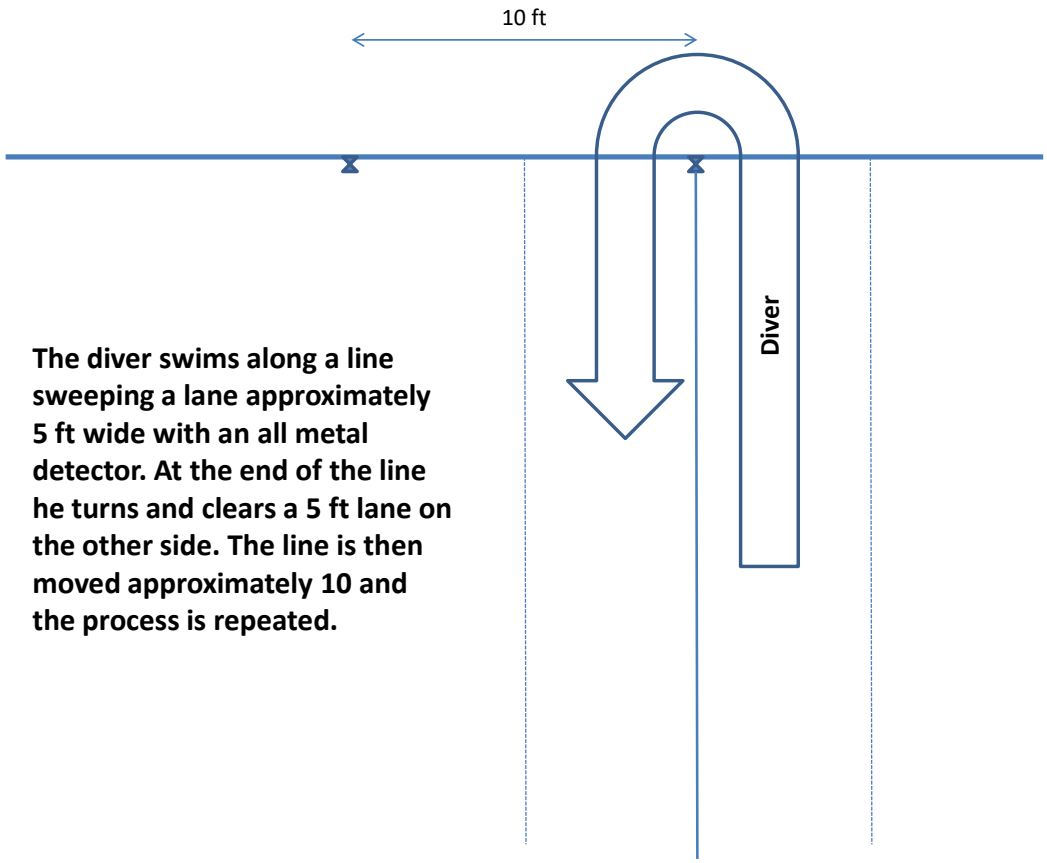


Figure 2.2 Stationary Jackstay Search Method

NOTE: If an item is identified as potential MEC, an attempt will be made to verify if the item is acceptable or unacceptable to move. If the item is acceptable to move the item will be removed to a safe location. If the item is unacceptable to move, it will be marked with a means to identify its location and left in place and the Senior Unexploded Ordnance Supervisor (SUXOS) will be notified immediately in order to coordinate with the Project Manager, Unexploded Ordnance Safety Officer (UXOSO), USACE Ordnance and Explosives (OE) Safety Specialist and/or others as appropriate to determine final disposition.

2.8 DIVE OPERATION CHECKLISTS

2.8.1 The General Planning Checklist

The *General Planning Checklist* (Attachment E) is used by the Dive Supervisor when planning dive operation and should be reviewed and updated prior to each dive.

2.8.2 The Dive Project Supervisor Checklist

The *Dive Project Supervisor Checklist* (Attachment F) is used by the Dive Supervisor to document basic data and to document pre-dive checks. It is completed prior to each dive.

2.8.3 The Project Dive Plan Checklist

The *Project Dive Plan Checklist* (Attachment G) is used by the Dive Supervisor to record basic information from the Dive Plan and to document specific team assignments and dive-specific information. It is completed prior to each dive.

2.8.4 The Dive Supervisor Pre-dive

The *Dive Supervisor Pre-dive Checklist* (Attachment H) is used by the Dive Supervisor to individual diver's readiness. It is completed prior to each dive.

2.8.5 The Dive Boat Operation

The *Dive Boat Operation Checklist* (Attachment I) is used by the Dive Supervisor or Boat Operator to inspect the dive boat. It is completed daily prior to operation of the boat.

3. TEAM MEMBERS

The Project Manager and Project UXO Dive Supervisor are responsible for ensuring all dive team members and boat support personnel, read, understand, and follow all the procedures outlined in this manual. All dive team personnel are responsible for ensuring that they read and follow the procedures outlined in this manual as it pertains to their individual work assignments. If discrepancies are found with procedural steps or any safety issues in this manual, they will immediately be brought to the attention of the Project UXO Dive Supervisor and Project Manager for clarification and or corrective action.

(Note: If for any reason the Dive Plan is altered in mission, depth, personnel, or equipment, the USACE DDC will be contacted in order to review and accept the alteration prior to continuing the operation. This review may be conducted electronically and confirmed in writing after completion of the dive operation.)

3.1 QUALIFICATIONS OF DIVERS ENGAGED IN MEC OPERATIONS

Each dive team member will be certified as appropriate for the type of diving to be conducted through formalized military training and will have the experience or training necessary to perform these assigned tasks. In addition, each dive team member shall have the experience and training in the following:

- Have documentation showing that the dive team members have successfully completed training to the appropriate level (e.g. SSA diver's certification, surface supplied mixed-gas diver certificate). Such training shall:
    - Be military school, Federal school, or an Association of Commercial Diving Educators (ACDE) accredited school, or
    - Meet the requirements contained in American National Standards Institute (ANSI)/ACDE-01.
- Have at least one (1) year commercial experience in the applicable position;
- Have completed at least four (4) working dives using the diving techniques and equipment to be used;
- Must demonstrate that at least one (1) of the four (4) qualification dives was performed in the last 6 months prior to the contract award date;
- A graduate of U.S. Naval School Explosive Ordnance Disposal, if engaged in munitions response diving operations;
- Trained in the use of tools, operation, and maintenance of equipment and systems relevant to assigned tasks;
- Trained in the techniques of the assigned diving mode;
- Trained in diving operations and emergency procedures;
- Trained in tasks to be accomplished (to include purpose and function);

- Trained in cardiopulmonary resuscitation (CPR) using emergency oxygen, Automatic Emergency Defibrillator (AED) and first aid as defined by OSHA; and

- All 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.

- 40-hour Hazardous Waste Operations (HAZWOPER) training with an 8-hour annual refresher training as required.

3.2 ASSIGNMENTS

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 a person undergoing job orientation; provided that these tasks are performed under the direct supervision of an experienced dive team member.

TITAN will 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.

The Dive Supervisor will 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 Dive Supervisor and is likely to affect adversely the safety or health of a dive team member.

The minimum manning level for dive teams shall be in accordance with Appendix O of EM 385-1-1.

3.3 RESPONSIBILITIES

3.3.1 Dive Supervisor

The Dive Supervisor will review this Safe Dive Practices Manual with the dive team prior to conducting any diving operations. This manual shall be made available at the dive location to each dive team member. The Safe Practices Manual includes:

- Safety Procedures and checklists for diving operations;

- Assignments and responsibilities of the dive team members; and

- Equipment procedures and checklists; and

- Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

The TITAN Project Manager will designate the Dive Supervisor in writing. The Dive Supervisor is responsible for ensuring complete compliance with the provisions of this manual, the Site Safety and Health Plan (SSHP), and the Project Work Plan. He is responsible for field equipment calibration, oversight of diving operations, field documentation, submittal of Daily Quality Control Reports (DQCRs), and assisting in the preparation of progress reports. The Dive Supervisor shall be at the dive location in charge of all aspects of the diving operation affecting the safety and health of the dive team members. The Dive Supervisor shall have the experience and training in the conduct of the assigned diving operation. The Dive Supervisor will be responsible for all diving operations described herein. The Dive Supervisor will:

- Ensure all dive team members possess current certification and are qualified for the type of diving operation;
- Ensure that the dive team is briefed on the appropriate ordnance safety precautions for ordnance that may potentially be present;
- Ensure safety and emergency equipment is in working order at the dive site;
- Brief the dive team prior to each dive on:
    - Dive objectives;
    - Unusual hazards or environmental conditions likely to affect the diving operation; and
    - Any modifications to the Dive Plan or Emergency Management Plan made necessary by conditions or the specific diving operation.
- Suspend diving operations if in his opinion, conditions are unsafe;
- Draft a site-specific Project Dive Plan and an Emergency Management Plan in accordance with Attachments G and A respectively prior to each diving operation;
- Determine the equipment requirements for all diving operations and ensure that adequate means are taken to make such equipment available at the scene;
- Plan the diving operation considering the job requirements, equipment and personnel available, and condition of the diving operation area utilizing the General Planning Checklist (Attachment E);
- Ensure that the Project Dive Supervisor Checklist, Project Dive Plan and Pre-Dive Checklist (Attachments F, G, H) are completed and adhered to for all diving operations including training;
- Act as timekeeper and maintain a Project Dive Log (Attachment C) at the diving location which will become part of the project official records;
- Obtain a copy of the certificate of analysis showing the breathing air meets the minimum acceptable criteria listed in section 30.F.05c of EM 385-1-1;
- Ensure that all AHA's are available and on site. The AHA will contain hazards associated with each phase of the work and includes hazards associated with flying before and after diving; and
- Maintain direct communications between the dive site, project office, and the TITAN Corporate Office.
- Implementing quality control (QC) for technical data provided by the field staff including field measurement data
- Adhering to work schedules
- Implementing and documenting corrective action procedures and provisions of communication between team and upper management

3.3.2 Diving UXO Specialist (Diver)

The Diver will be a trained and experienced diver, as well as trained in (UXO). The Diver responsibilities and experience will include:

- Required knowledge and experience to perform assigned tasks;
- Keep topside personnel informed of conditions on the bottom and progress of the task(s);
- Obey all signals from the surface and repeat all commands given from topside personnel;
- Acting as a tender for other divers;
- Notifying the Dive Supervisor of any symptoms that may be construed as diving sickness or a mechanical injury;
- Maintaining a personnel dive log which will include:
    - Inform Dive Supervisor or alternate if taking any medications;
    - Full name;
    - Date, time, and location of the dive;
    - Maximum depth and bottom time;
    - Surface interval between dives;
    - Breathing medium and type of equipment used;
    - Group classification at the beginning and the end of each interval and repetitive dive worksheet;
    - Underwater and surface conditions;
    - Depth(s) and duration(s) of any decompression stops (there will be no decompression dives and will only be required in emergency situations);and
    - Date and time of last previous dive.
    - Name of Dive Supervisor(s) during dive.
- Maintaining personal dive equipment (Attachment D);
- Identify and stop any operation that, in their opinion is unsafe

3.3.3 Standby Diver

A standby diver is a fully qualified diver and will be on station whenever a diver(s) is in the water to serve as immediate emergency assistance to the primary diver(s). A standby dive will deploy only after the dive supervisor has assessed the situation and instructed him/her to do so. The Standby Diver receives the same

briefings and instructions as the working Diver, monitors the progress of the dive, and is fully prepared to respond if called upon for assistance. The SCUBA Standby Diver shall be equipped with a second regulator, referred to as an octopus.

The standby diver will:

- Be fully equipped to dive and readily available the entire time the diver is in the water;
- Don all specific gear (suits, harnesses, and equipment) up to mask they will wear/use and be checked by the Dive Supervisor;
- Test all gear for proper operation before the primary diver leaves the surface;
- The Standby Diver may then remove the mask and fins and have them ready to don immediately for quick deployment. For safety reasons at the discretion of the Dive Supervisor, the Standby Diver may remove the tank.
- Be dressed appropriately for the water and air temperature.

3.3.4 Tender

For each dive, a Diver will be designated as tender. The tender will:

- Assist the primary diver and the standby diver in donning, doffing, and checking gear;
- Be a diver prepared to dive each day;
- Maintain communications with the diver;
- Keep the Dive Supervisor informed of communications from and to the Diver;
- Tend the tether line for the diver;
- Monitor the diver's progress and status;
- Remain undistracted so he can monitor the surface for danger from boat traffic and any other hazards

If it becomes necessary for the standby diver to enter the water to assist the diver, the Dive Supervisor will immediately assume the role of tender for the standby diver.

3.3.5 Dive Team Support

The dive team is supported by a UXOSO/Quality Control Specialist (QCS) who is trained as a diver. When used, a safety boat will be positioned to safely observe dive operations and to direct other boat traffic away from the operation. The boat operator will be trained and proficient in the operation of the safety boat. He will position the boat as directed by the UXOSO/QCS to support the operation and will be aware of other boats operating in the area and other potential hazards or risk to the operation. The UXOSO/QCS will:

- Maintain communication with the Dive Supervisor;

- Monitor the operation with respect to worker safety and health and quality control;
- Monitor and maintain copies of certificates of training and medical surveillance;
- Verify certifications and conduct periodic audits of personnel qualifications;
- Conduct quality and safety inspection;
- Provide input to after action reviews of the operation;
- Assist in maintaining proper exclusion zones;
- Inspect munitions debris (MD) and material potentially presenting an explosive hazard (MPPEH) recovered;
- Ensure all project safety and quality requirements are met and documented and reports and potential nonconformance to the TITAN corporate quality or safety manager.

The UXOSO/QCS reports to the Corporate Quality Manager for quality related issues and to the Corporate Safety Manager for safety related issues. He also coordinates site activities with the Dive Supervisor and ensures that quality and safety requirements are met and documented.

4. EQUIPMENT

TITAN's policy on diving equipment is to use quality and state-of-the-art equipment to ensure the safety and well-being of the divers. Equipment used in diving operations, particularly those items which are classified as life-support equipment, must be properly maintained and kept in good working order.

4.1 EQUIPMENT INSPECTION

Prior to any dive, all equipment must be carefully inspected for signs of deterioration, damage, or corrosion and must be tested for proper operation. Pre-dive preparation procedures must be standardized, not altered for convenience, and must be the personal concern of each diver. All divers must always check their own equipment. An inspection of all dive gear and associated equipment will be conducted before each use, using Attachment D as a guide. Any equipment not in good working order will be removed from use.

4.2 DIVE FLAGS

In accordance with ER 385-1-86, an appropriate dive flag at least one meter in height, visible in all directions, and will be displayed at the dive location during dive operations. In accordance with 29 CFR 1910.421(h), the signal will be a rigid replica of the international code Alpha Flag.

A traditional red and white "Diver Down" flag will also be displayed in addition to the code Alpha Flag.

4.3 SCUBA EQUIPMENT

Each SCUBA team member will be equipped with:

- An independent reserve cylinder with a separate regulator or connected to the underwater breathing apparatus;
- Buoyancy compensation device or inflatable life jacket capable of maintaining the diver at the surface in a face-up position;
- A submersible cylinder pressure gauge;
- A weight belt or assembly capable of quick release;
- A watch, pressure gauge and knife; and
- SCUBA air cylinders of seamless steel or aluminum which meet DOT 3AA and DOT 3AL specifications with identification symbols stamped into the shoulder of the tank. Annual inspections and hydrostatic testing will also be stamped into the cylinder as applicable;
- A safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious or hurt; and
- A time keeping device will be used by the Dive Supervisor for recording dive times at the dive location and each diver will have a time keeping device to keep track of bottom times.

- Skin suit to protect from cuts and abrasions and thermal protection as required

- Air tanks will be filled from a certified dive shop. Prior to the initial start of dive operations, a copy of the air certification from the dive shop will be obtained and provided to the DDC upon request and maintained on file in the project office.

Each dive team member will be responsible for ensuring that his equipment is inspected prior to each dive using the checklist in Attachment D and report any deficiencies to the Dive Supervisor.

4.4 FIRST AID SUPPLIES

The following first aid supplies will be available on the dive boat:

- First aid kit appropriate for the diving operation;

- American Red Cross standard first aid handbook or equivalent;

- Emergency oxygen with transparent mask will be available at the dive location; and

- A Stokes litter or backboard.

- AED

5. EMERGENCY PROCEDURES

In every diving operation, the possibility of an accident occurring must be considered. The need for a prompt, decisive plan of action in an emergency is essential for the safety of all diving personnel. The Dive Supervisor will implement the following procedures for the respective situations described below.

5.1 FIRE

Fire extinguishers will be maintained ready at the dive site location. Only attempt to put out small fires as necessary of prevent injury or loss of life. Contact first responders immediately upon discovery. Also see Site Safety and Health Plan submitted as part of the Work Plan.

5.2 EQUIPMENT FAILURE

In the event of an equipment failure of a critical component of the dive operations, all dive operations will be discontinued until the equipment is replaced or repaired and the Dive Supervisor has given authorization for dive operations to continue.

5.3 ADVERSE WEATHER

All diving operations will be suspended if lightning is located within 10 nautical miles of the dive site. During high winds greater than 30 miles per hour, boating and platform operations will be suspended. Also see Site Safety and Health Plan submitted as part of the Work Plan.

5.4 MEDICAL ILLNESS OR INJURY

See Attachment A, *First Aid for Diving Related Injuries*, to this plan as well as the Site Safety and Health Plan submitted as part of the Work Plan. Contact first responders immediately. Render first aid as necessary until an emergency medical team arrives.

5.5 EMERGENCY PROCEDURES DURING DIVE OPERATIONS

5.5.1 Entrapped or Fouled Diver

- Diver will notify dive partner, if appropriate, otherwise will notify Dive Supervisor through line pull signals;
- If only one diver is in the water, then the standby diver will assist the fouled diver under the direction of the Dive Supervisor;
- Diver and dive boat personnel must remain calm; and
- Take additional cylinders of air to the fouled diver, if needed.

5.5.2 Loss of Vital Support Equipment

In the event of an equipment failure of a critical component of the dive operations, all dive operations will be discontinued until the equipment is replaced or repaired and the Dive Supervisor has given authorization for dive operations to continue.

5.5.3 Loss of Gas Supply

- Signal dive partner and abort dive;
- Buddy breath/activate reserve; and
- Exhale to the surface.

NOTE: No diving will proceed until the equipment is replaced/repaired (with functional checks performed) and the Dive Supervisor has given the OK to proceed with the operation.

5.5.4 Loss of Communication

If communications are lost between a tender and diver and cannot be regained quickly, an audible recall signal will be sounded. If the diver does not surface in a reasonable amount of time after the audible re-call signal has been initiated the stand-by diver will be dispatched to the last known location of the diver. If communications are lost between the diver and the tender and cannot be regained quickly, the diver will surface immediately. The reason for the loss of communications will be investigated and remedied prior to continuation of the dive.

5.5.5 Lost Diver Plan

- Initiate diver recall and wait one (1) minute for response;
- Mark the last known position of the lost diver with a buoy to establish a reference point where searches can start;
- Deploy the standby diver (Dive Supervisor direction) to swim after bubbles or to conduct a circle line search starting at the lost diver buoy;
- Notify ship/boats in the area to look out for the lost diver;
- Request emergency medical help and report situation to the Project Office and TITAN Corporate Office; and
- Ensure stricken divers recovered get immediate, effective treatment.

5.5.6 Injured Diver Plan

If a diver is injured and unable to enter the boat under his/her own power, the remaining team aboard the boat/platform (Dive Supervisor, Tender/assistant, etc.) will be used to assist or place the injured diver into/on the boat/platform or may hold onto the diver and use the boat/platform to get to the shoreline. Contact first responders immediately and render emergency first aid as necessary.

5.5.7 Actions upon Discovery of Fire

Recall the diver. Fire extinguishers will be maintained ready at the dive site location. Only attempt to put out small fires as necessary of prevent injury or loss of life. Contact first responders immediately upon discovery. Also see Site Safety and Health Plan submitted as part of the Work Plan.

5.5.8 Diver Blow-up/Over Rapid Ascent to Surface

Depths of dives typical of MEC projects performed by TITAN are unlikely to produce a requirement for decompression during ascent. If a diver is believed to have ascended too rapidly, the Dive Supervisor will evaluate the situation to confirm that no decompression stop was required. Dive tables will be consulted. The diver will be observed on the surface for one hour. If symptoms of decompression sickness are observed or suspected, the diver will be treated for decompression sickness as described above.

5.5.9 Diver Loss of Consciousness

Slowly pull the tending line to the surface to recover the diver. If the tending line is fouled deploy the standby diver. Request emergency medical help and report situation to the Project Office and TITAN Corporate Office; and ensure the stricken diver gets immediate, effective treatment.

5.5.10 Injury or Illness of Surface Crew Member

If a severe injury or illness occurs while a diver is in the water, the diver will be recalled immediately to the surface. Diver will either enter the boat/platform to help render assistance or head to the shore and provide assistance as necessary.

5.5.11 Explosive Detonation with Diver (s) in the Water

- Attempt to establish communications with the diver via tending line;
- If communications are established with the diver immediately recall diver to the surface;
- If no communications are reestablished slowly pull the tending line to the surface to recover the diver. If the tending line is fouled deploy the standby diver;
- If the tending line has parted, mark the last location of the diver and begin a surface search of the area. If no contact is made, deploy the standby diver in the last known diver location and begin a systematic search of the area.

5.5.12 Decompression Sickness ("The Bends") or Arterial Gas Embolism (air embolism)

- Recall all divers from the water;
- Arrange immediate transport of stricken diver(s) to chamber;
- Notify the Project Office and TITAN Corporate Office of circumstances;
- Perform neurological exam and record on (Attachment J); and
- Treat for shock.

6. Internal Safety Inspection

A Site Specific Accident Prevention Plan is prepared for all projects. A qualified Site Safety and Health Officer (SSHO) is assigned to each project. The SSHO reports directly to the Corporate Safety Officer and is responsible for ensuring compliance with all site safety requirements. When the project involves potential underwater MEC the SSHO will be a Navy-trained diver and UXO technician who has the qualifications of a UXOSO. The UXOSO will be on site any time work is performed. The UXOSO provides initial training to all assigned personnel and visitors to ensure that they are familiar with the hazards and controls associated with the site and specific tasks that they may perform. The UXOSO performs daily safety inspection to ensure compliance with safety requirements and to identify unsafe conditions or acts that may present a hazard to workers or visitors. The UXOSO facilitates daily tailgate safety meetings and after action reviews in order to review potential hazards and the effectiveness of controls with all site personnel. The UXOSO makes on the spot corrections as required and works with the site supervisor to address potentially unsafe conditions or actions. He reports potential nonconformance issues to the Corporate Safety Officer and conducts or supports investigation of accidents or near misses.

7. Safety Compliance

TITAN dive operations are conducted in conformance with requirements outlined in OSHA regulations, the U.S. Navy Diving Manual (Volume I) and the USACE Safety and Health Requirements Manual EM 385-1-1. The requirements of OSHA, Department of Labor directive titled, 29 CFR 1910 Subpart T, Commercial Diving Operations has been integrated into this manual and a complete copy is included in Attachment K. U.S. Navy No- Decompression Dive Tables are included in Section 7. OSHA and EM 385-1-1 established safety and health criteria for personnel to include medical requirements, recommended physical examinations, operational procedures, equipment procedures and record keeping requirements which are incorporated herein. Where regulatory and guidance documents conflict, the most stringent requirement takes precedence.

It is TITAN's policy that all employees engaged in commercial dive operations, review the requirements of this safe practices manual (including 29 CFR 1910 Subpart T), as well as site specific dive and safety plans. Site-specific requirements and hazards are reviewed during the initial on-site training and throughout the project during daily safety meetings. The UXOSO ensures compliance with all safety requirements. Failure to comply is unacceptable.

8. Applicable Navy Tables

8.1 No-Decompression Limits and Repetitive Group Designation for No-Decompression Air Dives

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

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	595	20	33	47	62	78	97	117	140	166	198	236	285	354	469	595	
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	60	7	12	17	22	28	33	39	45	51	57	60					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	30	4	7	11	14	17	21	24	28	30							
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	10	2	4	6	9	10											
140	10	2	4	6	8	10											
150	5	2	3	5													
160	5		3	5													
170	5			4	5												
180	5			4	5												
190	5			3	5												

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

8.2 Residual Nitrogen Timetables for Repetitive Air Dives

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

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

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
A	:10 2:20 *															
B	:10 1:16	1:17 3:36 *														
C	:10 :55	:56 2:11	2:12 4:31 *													
D	:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *												
E	:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *											
F	:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *										
G	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *									
H	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *								
I	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *							
J	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *						
K	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *					
L	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *				
M	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *			
N	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *		
O	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *	
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
	Repetitive Group at the End of the Surface Interval															
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.

8.3 Standard Air Decompression

Air Decompression Table.

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
30 FSW														
371	1:00	AIR									0	1:00	0	Z
		AIR/O_2									**0**	1:00		
380	0:20	AIR									5	6:00	0.5	Z
		AIR/O_2									**1**	2:00		
In-Water Air/O_2 Decompression or $SurDO_2$ Recommended ----------														
420	0:20	AIR									22	23:00	0.5	Z
		AIR/O_2									**5**	6:00		
480	0:20	AIR									42	43:00	0.5	
		AIR/O_2									**9**	10:00		
540	0:20	AIR									71	72:00	1	
		AIR/O_2									**14**	15:00		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or $SurDO_2$ Required ----------														
600	0:20	AIR									92	93:00	1	
		AIR/O_2									**19**	20:00		
660	0:20	AIR									120	121:00	1	
		AIR/O_2									**22**	23:00		
720	0:20	AIR									158	159:00	1	
		AIR/O_2									**27**	28:00		
35 FSW														
232	1:10	AIR									0	1:10	0	Z
		AIR/O_2									**0**	1:10		
240	0:30	AIR									4	5:10	0.5	Z
		AIR/O_2									**2**	3:10		
In-Water Air/O_2 Decompression or $SurDO_2$ Recommended ----------														
270	0:30	AIR									28	29:10	0.5	Z
		AIR/O_2									**7**	8:10		
300	0:30	AIR									53	54:10	0.5	Z
		AIR/O_2									**13**	14:10		
330	0:30	AIR									71	72:10	1	Z
		AIR/O_2									**18**	19:10		
360	0:30	AIR									88	89:10	1	
		AIR/O_2									**22**	23:10		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or $SurDO_2$ Required ----------														
420	0:30	AIR									134	135:10	1.5	
		AIR/O_2									**29**	30:10		
480	0:30	AIR									173	174:10	1.5	
		AIR/O_2									**38**	44:10		
540	0:30	AIR									228	229:10	2	
		AIR/O_2									**45**	51:10		
600	0:30	AIR									277	278:10	2	
		AIR/O_2									**53**	59:10		
660	0:30	AIR									314	315:10	2.5	
		AIR/O_2									**63**	69:10		
720	0:30	AIR									342	343:10	3	
		AIR/O_2									**71**	82:10		

9. Repetitive Dive Worksheets

The Diving Profile Log is a chronological record of all dives conducted during a project. It contains information related to the specific dive operation conducted each day and to specific divers' specific divers involved. A sample form is included in Attachment C.

Information recorded on the log includes:

- Date of dive
- Location of the dive
- Environmental conditions affecting the dive
- Equipment used
- Purpose of the dive
- Identification of divers and standby divers
- Times left and reached surface, bottom time
- Depth
- Decompression time
- Air and water temperature
- Signatures of Diving Supervisor

10. Fitness for Duty

10.1 DIVE PHYSICAL FREQUENCY

All divers must have a certificate signed by a licensed physician, stating that they have been medically examined within the last 12 months and have been determined fit and approved to dive. The dive medical examination will be repeated every 12 months with verifications submitted to the DDC as appropriate.

10.2 PHYSICAL EXAMINATIONS

Initial and Periodic Re-examinations – All ages, require the following:

Medical History Complete

Physical Examination

Chest X-ray

Spirometry

Urinalysis

Vision

Other testing as required

10.3 DIVE PHYSICAL CONSIDERATIONS

The physician conducting the examination should consider the following disorders, which 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 yrs.
- 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.

11. Administration and Recordkeeping

11.1 DIVING RECORD KEEPING REQUIREMENTS

The Dive Supervisor will provide to the SUXOS all project diving records for the project to be incorporated into the project files; these records will be kept in the project site office. Diving Related Injury or Illness.

The Dive Supervisor and the UXOSO/QCS will record and report any diving-related occupational injury and 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 the injury or illness on applicable TITAN Incident Report Forms. All injuries and illnesses will be immediately reported to the UXOSO and Project Manager.

11.2 AVAILABILITY OF RECORDS

Records and documents required by 29 CFR 1910 Subpart T shall be provided upon request to the:

- Assistant Secretary of Labor for Occupational Safety and Health (OSH);
- Director, National Institute for OSH; and
- Employee or his designated representative.

11.3 DIVING RECORD RETENTION PERIODS

Records and documents required by 29 CFR 1910 Subpart T shall be retained by TITAN for the following periods.

- Dive team member medical records – five (5) years;
- Safe Practices Manual - current document only;
- Depth-time profile - until completion of the recording of dive, or until completion of decompression procedure assessment where there has been an incident of decompression sickness;
- Recording of dive – one (1) year, except five (5) years when there has been an incident of decompression sickness;
- Decompression procedure assessment evaluations – five (5) years;
- Equipment inspections and testing records - current entry or tag, or until equipment is withdrawn from service;
- Records of hospitalization – five (5) years;
- After the expiration of the retention period of any record required for five (5) years, TITAN will forward such records to the National Institute for Occupational Safety and Health, Department of Health and Human Services.

12. References

Department of the Army (DA). 2008. Technical Manual (TM) 60A-1-1-31, Explosive Ordnance Disposal Procedures, General Information on EOD Disposal Procedures (Revision 5). October.

Department of Defense Explosives Safety Board (DDESB). 2004. Technical Paper (TP) 18. Minimum qualifications for Unexploded Ordnance (UXO) Technicians and Personnel. 20 December.

Department of Defense (DoD) Ammunition and Explosives Safety Standards. 2012. DoD Ammunition and Explosives Safety Standards DOD Manual 6055.09-M

Department of Defense (DoD). 2008. DoD Instruction (DoDI) 4140.62, Material Potentially Presenting an Explosive Hazard. November.

DDESB. 2012. TP 16. Methodologies for Calculation Primary Fragment Characteristics.

Revision 4. August United States Army Corps of Engineers (USACE) 2006. Safety and Health Requirements Manual EM 385-1-97 (with Erratas)

United States Army Corps of Engineers (USACE) 2013. Safety and Health Requirements Manual EM 385-1-1

United States Army Corps of Engineers (USACE) 2010. USACE Dive Program.

ER 385-1-86. September. United States Navy (USN). 2008. USN Diving Manual. Revision 6. April.

Department of the Army Memorandum, Subject: Munitions Response Actions – Minimum Separation Distances (Relative to Impulse Water Pressure) from Underwater Detonations, 16 Sep 13

13. Glossary of Diving Terms

ACFM	Actual cubic feet per minute.
Alternate Project Dive Supervisor	Alternate designated, in writing, by the Project Manager to act on behalf of the Project Dive Supervisor.
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.
Bottom time	The total elapsed time measured in minutes from the time 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.
Circle line search	Descending line leading to a clump with a second line attached used by divers to rapidly search small areas.
Cylinder	A pressure vessel for the storage of gases.
Decompression sickness	A condition with a variety of symptoms which may result from gas of 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.
Dive location	A surface or vessel from which a diving operation is conducted.
Dive team	For all diving operations, the dive team will consist of a minimum of four people, including a Dive Supervisor, who are assigned to diving duty in writing by TITAN. The dive team members will be required to be graduates of an approved course of instruction.
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.
Diver	An employee working in water using underwater apparatus which supplies compressed breathing gas at the ambient pressure.
Diver Orientation	Diver orientation will be scheduled by the Project Dive Supervisor in order to familiarize or train diver personnel on new or unfamiliar technical functions to be performed by the dive team.

Diving Mode	A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air).
Dive Supervisor	The person in charge of diving operations. May be the Project UXO Dive Supervisor or an Alternate Dive Supervisor.
Diving Time/Water Time	Time spent in or underwater while engaged in a diving operation. Diving time will start at the time the diver enters the water and ends when the diver exits the water and returns to the pier, dive boat, or diving platform.
Diving Training	Training prescribed by the Project Dive Supervisor in order to maintain diver proficiency.
Diver	A graduate of U.S. Naval School Explosive Ordnance Disposal engaged in munitions response diving operations.
FSW	Feet of seawater (or equivalent static pressure head).
Hyperbaric condition	Pressure conditions in excess of (1 ATA) surface pressure.
Live boating	The practice of supporting a SCUBA, surface-supplied air, mixed-gas diver, from a vessel that is underway.
No-decompression limits	The depth-time limits of the "no-decompression limits and repetitive diving 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.
Observer/Assistant	A team member able to assist them in the water
Post-Dive preparation time	Time spent in the breakdown, cleaning, preservation, and maintenance of diving equipment upon completion of a diving operation.
Pre-Dive preparation time	Time spent by diver personnel preparing diving equipment for a diving operation.
Dive Supervisor	This person is responsible for the safe and efficient operation of all divingfunctions at the location to which he is assigned. The Dive Supervisor must be knowledgeable of diving operations in general and all specific diving assignments involved. He is assigned in writing by TITAN.
psi(g)	Pounds per square inch (as measured using a gauge).
Recompression chamber	A pressure vessel for human occupancy such as a surface recompression chamber, closed bell, or deep diving system used to decompress divers and to

	treat decompression sickness.
SCUBA	A diving mode independent of surface air 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.
Stationary Jackstay grid search	Four clumps with buoy/buoy lines and four bottom lines connecting the four clumps used by divers to systematically and thoroughly search large areas.
SSA	A diving mode in which a diver uses Surface Supplied Air.
Underwater stage	A suspended underwater work platform, which supports a diver in the water.
Volume tank	A pressure vessel connected to the outlet of a compressor and used as air reservoir.
Walking Jackstay grid search	Two clumps with descending lines and a line of a specified length connecting the clumps used by divers to systematically and thoroughly search large areas.
Working pressure	The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

Attachments

A – Emergency Management Plan

B - Line Pull and Hand Signals

C – Diving Profile Log

D – Personal Dive Equipment Checklist

E – General Planning Checklist

F – Project Dive Supervisor Checklist

G – Project Dive Plan

H – Dive Supervisor Pre-dive Checklist

I – Checklist for Dive Boat Operations

J – Neurological Examination Checklist

K – 29 CFR 1910 Subpart T

Attachment A – Emergency Management Plan

A.1. FIRST AID FOR INJURIES REQUIRING IMMEDIATE TRANSPORT TO A CHAMBER FACILITY

A.1.1 Air Embolism

Recognition - Usually occurs during or immediately after surfacing

Symptoms (one or more of the following)

Disorientation or Fatigue

Skin Itch

Chest Pain

Numbness, Tingling, Paralysis or Weakness

Dizziness, Vertigo, or Ringing in the Ears

Blurred Vision

Personality Change

Signs (one or more of the following)

Bloody froth from nose or mouth

Paralysis or Weakness

Unconsciousness

Convulsions

Shortness of Breath or Cessation of Breathing

Apparent Death

Note: Symptoms and signs usually appear within 15 minutes to 12 hours after surfacing; in severe cases, symptoms may appear immediately or even before the dive is completed. Delayed occurrence of symptoms is rare but can occur, especially if air travel follows diving. The quicker treatment begins, the better the chances of a full recovery.

Early Management

CPR, if required

Open airway, prevent aspiration, and incubate if trained person available

Give O^2; remove only to open airway or if convulsion ensue

If conscious, give nonalcoholic liquids

Place in horizontal, neutral position

Restrain convulsing person loosely and resume O^2 as soon as airway is open

Protect from excessive cold, heat, water, or fumes

Arrange emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally.

A.1.2 Decompression Sickness

Recognition - Symptoms usually appear 15 minutes to 12 hours after surfacing

Symptoms (one or more of the following)

Tired Feeling

Itching

Pain, arms, legs or trunk

Dizziness

Numbness, tingling or paralysis

Chest compression or shortness of breath

Anything unusual after the dive

Signs (one or more of the following)

Blotchy Rash

Paralysis or weakness anywhere in the body

Coughing Spasms

Staggering or instability

Unconsciousness

Personality change

Early Management

Stabilize patient the same way as for Air Embolism

Arrange for emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally

A.2.0 FIRST AID FOR INJURIES REQUIRING TRANSPORT TO A HOSPITAL FACILITY

A.2.1Pneumothorax

Symptoms (one or more of the following)

Pains in the chest

Shortness of breath

Signs (one or more of the following)

- Shallow Rapid Breathing
- Cyanosis (blue skin, lips, fingernails)
- Possible crackling under the skin of the neck
- Possible mediastinal shift (heart sounds not in the usual place)

Emergency Actions:

Call for help and immediate transport

A.2.2 Mediastinal Emphysema (Lung over pressure accident)

Recognition - Always associated with pneumothorax

Symptoms (one or more of the following)

Pain in the chest (beneath the breastbone)

Faintness

Shortness of breath

Signs (one or more of the following)

Obvious difficulty breathing

Brassy change in voice

Emergency Actions:

Transport to medical facility for evaluation

A.2.3 Drowning-Near Drowning

Recognition

Unconsciousness

Lack of respiration

Cyanosis (blue skin, lips, fingernails)

Management

Try to identify the time the victim was last seen breathing

Assess ABC's airway, breathing and circulation

Removal of gear

Transport to the boat or shore

Immediate call for help and transport to facility

Start CPR

A.2.4 Oxygen Toxicity (with convulsions)

Signs (one or more of the following)

Decreased or loss of consciousness; followed by

Convulsions

Symptoms (one or more of the following)

Nausea

Dizziness

Ringing in the ears

Abnormal Vision

Confusion

Prevention

Avoidance of gases with high O^2 concentrations (as in Nitrox at inappropriate depth)

Avoid CO^2 retention that can precipitate O^2 convulsions at any depth

If convulsions occur at depth, be prepared to treat near drowning and/or air embolism

TREATMENT - Call for help and immediate transport

A.2.5 Severe Trauma or Large Predator Injury (Head Injury, Limb Injury due to falls, Equipment Crush, Prop Injuries)

- call for help and immediate transport
- open airway
- treat for shock on site and stabilize before evacuation
- face up neutral position
- direct pressure over bleeding wounds
- CPR if no pulse or respiration
- keep warm
- be mindful of the possibility of neck injury
- splint limb injuries
- call for help and immediate transport

A.2.6 Suspected Heart Attack or Stroke

- Call for help and immediate transport
- Treat for shock
- CPR if no pulse or respiration
- Keep warm
- Call for help and immediate transport

A.2.7 Severe Allergic Reaction

- Remove any remnant of allergen (i.e., jellyfish tentacles, foreign material)
- Wash out wounds of injury with alcohol, vinegar, or water
- Call for help and immediate transport

- Treat for shock
- CPR if no pulse or respiration
- Keep warm
- Pain Relief, if available
- Transport to medical facility for evaluation

A.2.8 Stinging Fishes (Stingrays, Scorpion fish)

- Immobilize
- Remove spine and debride (scrub the wound)
- Irrigate wound
- Soak in hot water (thermolabile toxin) 50^{o} C, for 30-90 minutes
- Call for help and immediate transport
- Treat for shock, hydrate

A.2.9 Hypothermia

- Keep core temperature above 95^{o} F
- Keep airway open
- Immobilize
- Wrap in blankets, preferably next to another person
- Basic life support, CPR, if needed
- Warm liquids, if alert, unless very cold - then avoid due to possibility of ventricular tachycardia (rapid, useless fluttering of the heart)
- Call for help and immediate transport

A.2.10 Hyperthermia (Heat Exhaustion due to excessive fluid loss)

- Remove from source of heat
- Lower temperature (cool compresses at arterial points and head)

- Keep calm
- Keep airway open
- Call for help and immediate transport if unstable

A.2.11 Heat Stroke

- Remove all clothing
- Cover with cool wet sheet
- Place in air-conditioned area
- Cold packs to neck, scalp, groin and armpits
- If convulsions occur ensure victim does not cause further harm to themselves
- Call for help and immediate transport

A.3.0 AID FOR INJURIES THAT CAN BE TREATED ON BOARD

A.3.1 Nitrogen Narcosis

Signs (one or more of the following)

Inappropriate behavior at depth

Ignoring hand signals and instructions

Stupor or coma

Symptoms (one or more of the following)

Inflexible thinking and attitude

Decrease or loss of judgment

False sense of security

Lack of concern for safety

Inability to think through problems

Panic

Near unconsciousness or loss of consciousness at depth

Treatment

Ascend until free of symptoms

Surface with controlled ascent

Transport to medical facility for evaluation

A.3.2 Carbon Dioxide Poisoning

Symptoms (one or more of the following)

Rapid breathing

Feeling of suffocation or shortness of breath

Headache, nausea, dizziness

Rapid heartbeat

Confusion and unclear thinking

Signs (one or more of the following)

Slowed responses

Muscle irritability (twitching)

Loss of consciousness

Treatment

Remove the cause (over-exertion, equipment failure, rebreathers, etc.)

Stop and rest during early symptoms to avoid loss of consciousness

Surface; Transport to medical facility for evaluation

A.3.3 Ear Disorders

Middle Ear Barotrauma

Keep quiet and calm

Without DCS or rupture of the round or oval windows, give Benadryl 25 mg

Transport to medical facility for evaluation

Discontinue diving until cleared by EMT

Inner Ear Barotrauma

Recognize round or oval window damage (loss balance, ataxia, tinnitus, deafness)

Keep head up and affected ear elevated

Discourage straining

Transport to medical facility for evaluation

EMT evaluation, no more diving until cleared by EMT

A.3.4Sea Sickness

The best medications have been found to be Meclizine, Bonine, Dramamine and Trans-derm Scope.

Keep your eyes on the horizon

Stay on deck

Keep yourself well hydrated with non-alcoholic beverages

Try antacid tablets or lemon drops

If diving, try to be the first diver in water.

Attachment B - Line Pull and Hand Signals

LINE PULL SIGNALS - Line Pull Signals will be distinct pulls on the line which are strong enough to be felt by the diver but not strong enough to pull the diver away from the work. Acknowledgment consists of replying with the same signal. If a signal is not acknowledged, the signal will be re-sent. Continued absence of confirmation will be assumed to mean one of three things:

The line is fouled.

Too much slack in the line.

Diver in trouble.

If communication is lost, the Project Dive Supervisor will take immediate steps to identify the problem.

Line Pull Signals - From Tender to Diver:

1 Pull	"Are you All right?"
	When diver is descending, one pull means, "STOP".
2 Pulls	"Going down"
	During ascent, 2 Pulls means, "You have come up too far, go back down until we stop you"
3 Pulls	"Standby to come up"
4 Pulls	"Come up"
2-1 Pulls	"I understand" or "Answer the telephone"
3-2 Pulls	"Ventilate"
4-3 Pulls	"Circulate"

Line Pull Signals - From Diver to Tender:

1 Pull	"I am All right"
	When diver is descending, one pull means, "STOP" or "I am on the bottom"
2 Pulls	"Lower" or "Give me slack"
3 Pulls	"Take up my slack"
4 Pulls	"Haul me up"
2-1 Pulls	"I understand" or "Answer the telephone"
3-2 Pulls	"More Air"

4-3 Pulls "Less Air"

Special Line Pull Signals from the Diver:

1-2-3 Pulls "Send me a square mark"

5 Pulls "Send me a line"

2-1-2 Pulls "Send me a slate"

Line Pull Searching Signals - Without Circling Line

7 Pulls "Go on/off searching signals"

1 Pull "Stop, search where you are"

2 Pulls "Face the line and move away from the weight"

3 Pulls "Face the weight and go right"

4 Pulls "Face the weight and go left"

Emergency Line Pull Signals from the Diver:

2-2-2 Pulls "I am fouled and need the assistance of another diver"

3-3-3 Pulls "I am fouled but can clear myself"

4-4-4 Pulls "Haul me up immediately"

All Emergency Signals will be answered as given, EXCEPT 4-4-4.

Attachment C – Diving Profile Log

TITAN
DIVING PROFILING LOG

Date of Last Previous Dive: **Time of Last Previous Dive:**

Date	Geographic Location							Air Temp(°F)
Equipment Used		Dress						Wave Height (ft)
Breathing Medium		Platform						Water Temp (°F)
Breathing Medium Source								Current (kts)
Depth of Dive (fsw)		Bottom Type						Bottom Visibility (ft)

Diver	LS	RB	LB	RS	TBT	TDT	TTD	Sched Used

Purpose of Dive, Tools Used, etc.	Repet Group
	Surface Interval
	New Repet Group
	RNT

Dive Comments
Signature (Dive Supervisor)

Attachment D – Personal Dive Equipment Checklist

_____Air Cylinders	Inspect air cylinders exteriors and valves for rust, cracks, dents, and any evidence of weakness. Remove valve cover and inspect O-ring.
_____Cylinder pressure	Gauge the cylinder and record pressure reading: _____ psig.
_____ Harness straps	Check for signs of rot and excessive wear. Adjust straps and backpack for individual use, and test quick release mechanisms. Check backpack for cracks and other unsafe conditions.
_____ Hoses	Check the hose(s) for cracks and punctures. Test the connections of each hose at the regulator and mouthpiece assembly by tugging on the hose. Check the clamps for corrosion and damage, replace as necessary.
_____ Regulator	Attach regulator to the cylinder manifold and ensure it is seated correctly. Open cylinder valve slowly all the way and back off one-quarter turn. Check that there are no leaks by listening for the sound of escaping air. Check that the regulator breathes properly by breathing the regulator for thirty seconds. If any leaks are noted or regulator does not breathe properly, inform the Project Dive Supervisor and remove regulator from service.
_____Emergency air supply	Ensure that it has no damage to the mouth piece, bottle, regulator body, purge valve or regulator. Ensure that the pressure indicator is showing a filled tank or gauge is reading a full tank (3000 psi) or in the safe (green) zone.
_____Life Preserver or BC	Orally inflate preserver to check for leaks, and then squeeze out air. Inspect the carbon dioxide cartridges to ensure they have not been used and are the proper size for the vest being used and for the depth of the dive. Firing pin(s) will not show wear and will move freely. The firing lanyards and life preserver straps must be free of any signs of deterioration.
_____ Dry Suit	Inspect the exterior of dry suit for holes, rips or tears. Inspect cuffs and neck dam for dry rot, rips, and tears. Ensure zippers are in good working order and no teeth are missing. Test the air fitting connection with an air hose and ensure it locks in place. Inspect air relief valve for damage.
_____CO_2 Cartridges	Weigh carbon dioxide cartridges and record weight: _____. Weight will be within 10% of stamped weight.

	If weight is not within tolerance remove from service and notify Dive Supervisor.
_____Facemask	Check the seal of the mask and the condition of the head strap. Check for cracks in the skirt and faceplate.
_____Swim Fins	Check straps and inspect blades for signs for cracking.
_____Dive Knife	Test the edge of the knife for sharpness, and ensure the knife is fastened securely in the scabbard. Verify the knife can be removed from the scabbard.
_____Weight Belt	Check the condition of the weight belt and that the proper number of weights are secure and in place. Verify that the quick-release buckle is functioning properly.
_____Wristwatch	Ensure wristwatch is wound and set to the correct time. Inspect the pins and strap of the watch for wear.
_____Depth Gauge	Inspect pins and straps. If possible, check compass with another compass. Make comparative checks on depth gauges to ensure depth gauges read zero fsw on the surface.
_____Miscellaneous Equipment	Inspect any other equipment which will be used on the dive as well as any spare that may be needed during the dive including spare regulators, cylinders and gauges. Check all protective clothing, lines, tools, flares, and other optional gear.
_____ Dive Lights	Checked to ensure they work
_____ Metal Detector	Surface check to ensure it powers up
_____ Standby Diver	Inspect line to make sure it is proper length and no deterioration
_____ Observer/Assistant	Check line for proper length and no deterioration
_____ Observer/Assistant	Properly stowed on board Throw bag or Ring Buoy

Attachment E – General Planning Checklist

E.1.0 STEPS IN PLANNING DIVING OPERATIONS

E.1.1. Analyze the Mission for Safety

Advanced planning is the greatest single safety precaution that can be taken. The following points must be considered individually and in depth:

- Objective definition;
- Environmental conditions;
- Emergency assistance (Recompression chamber and medical assistance);
- Route familiarization for all personnel; and
- Relevant instructions.

E.1.2 Pinpoint potential hazards

Atmospheric

_____ Extreme exposure of personnel to elements

_____ Adverse exposure of equipment and supplies to elements

_____ Delays or disruption caused by weather

Surface

_____ Sea sickness

_____ Water entry and exit

_____ Handling of heavy equipment in rough water

_____ Maintaining location in winds and currents

_____ Flotsam, kelp, petroleum disrupting operations

_____ Delays or disruption caused by water state

Underwater and Bottom

_____ Depth exceeds diving limits or limits of available equipment

_____ Exposure to cold temperatures

_____ Bottom obstructions

_____ Dangerous bottom conditions (mud, drop-offs, sewer outfalls, etc.)

_____ Visibility reduced or obstructed by suspension of bottom sediment

"On-site" Hazards

_____ Unusual site conditions

_____ High powered, active sonar

_____ Other conflicting water or shore operations

_____ Radiation contamination

_____ Pollution

Mission Hazards

_____ Decompression sickness/Pulmonary Barotraumas

_____ Communications problems

_____ Drowning

_____ Other trauma (injuries)

_____ Equipment malfunctions

Other Hazards

_____ Entrapment

_____ Entanglement

_____ Pollution, toxic

_____ Explosives or other ordnance

_____ Shifting or "working" of object

_____ Handing branches or limbs

E.1.3 Minimize Hazards and Plan for Emergencies.

E.1.3.1 Diving Personnel

_____ Assemble a complete and properly qualified Diving Team

_____ Assign each task to the most trained and experienced personnel

_____ Verify that each member of the Diving Team is properly trained and qualified for the equipment and depths involved

_____ Determine that each diver is physically fit to dive, paying attention to:

- _____ General condition
- _____ Last record of medical exam
- _____ Ears and sinuses
- _____ Severe cold or flu
- _____ Use of stimulants or intoxicants
- _____ Fatigue
- _____ Last Repetitive Dive
- _____ Time since last air travel
- _____ Determine each person's emotional fitness to dive (as far as possible):
- _____ Motivation (willingness)
- _____ Stability

E.1.3.2 Diving Equipment

_____ Verify that the type of diving gear chosen (and diving technique) is adequate for the mission and particular task meeting OSHA and USACE requirements

_____ Verify that the type of equipment and diving technique is appropriate for the depth involved

_____ Verify that all equipment has been tested and approved

_____ Determine that all necessary support equipment and tools are readily available and are the best for accomplishing the job efficiently and safely

_____ Determine that all related support equipment such as winches, boats, cranes, floats, etc., are operable, safe, and under the control of trained personnel

_____ Check that all diving equipment has been properly maintained with appropriate records, and is in full operating condition

E.1.3.3 Provide for Emergency Equipment

_____ Obtain suitable communications equipment with sufficient capability to reach "outside help". Check all communications for proper functioning

_____ Verify that a recompression chamber is ready for use, or notify the nearest location having one that its use may be required within a given time frame

_____ Verify that a First Aid Kit is near at hand, and is completely stocked.

_____ If a resuscitator will be used, check the apparatus for function

_____ If conducting boat operations, check that all fire-fighting equipment is readily available and in full operating condition

_____ Verify that Emergency transportation is either standing by, or on immediate call

_____ Verify AED is on Site and personnel are trained in its use

E.1.3.4 Establish Emergency Procedures

_____ Know how to obtain medical assistance immediately

_____ Assign specific tasks to the Diving Team and support personnel for different emergencies

_____ Develop and post the emergency assistance checklist and ensure that all personnel are familiar with its location and use

_____ Verify that a copy of the latest U. S. Navy Standard Air Decompression, repetitive and no-decompression tables are available at the dive location

_____ Be sure that all divers, boat crews, and other support personnel understand all diver hand signals

_____ Verify that all personnel are familiar with emergency recall signals and procedures

_____ Pre-determine distress signals and call-signs with all members of the diving team, boat crews, and other activities

_____ Be sure that all divers have removed anything from their mouths which might choke them during a dive (gum, dentures, tobacco)

_____ Thoroughly drill and train all personnel in Emergency Procedures, with particular attention to cross training. Drills will include:

- Fire, for boat operations
- First Aid
- Decompression Sickness
- Embolism
- Restoration of Breathing
- Drowning
- Entrapment
- Lost Diver
- Unconscious Diver Recovery

E.1.4 Establish Safe Diving Operational Procedures

_____ Determine that all other means of accomplishing the mission have been considered before deciding to use divers.

_____ Be sure that contingency planning has been conducted.

_____ Carefully state the goals of each mission, and develop a flexible plan of operations.

_____ Completely brief the Diving Team and support personnel.

_____ Designate a properly qualified Dive Supervisor to be in charge of the mission.

_____ Designate a timekeeper and verify that he understands his duties and responsibilities.

_____ Determine the exact depth at the job-site through the use of an electronic depth finder, lead line or fathometer.

_____ Verify the existence of an adequate supply of compressed air available for all planned diving operations plus an adequate reserve for emergencies.

_____ Be sure that operations or action on the part of the Diving Team, support personnel, boat crews, technicians, winch/crane operators, etc., do not start without the knowledge and direct command of the Project Dive Supervisor.

_____ All efforts must be made through proper planning, briefings, training, organization and other preparations to minimize "bottom-time". Remember in all cases, water depth and the condition of the diver (especially fatigue) rather than amount of work to be done will govern the diver's bottom time.

_____ Decompression tables will be on hand, be up-to-date, and be used in all planning and scheduling of diving operations.

_____ Instruct all divers and support personnel not to cut any lines until that action is approved by the Dive Supervisor.

_____ Be sure that the ship, boat, or diving craft is properly manned and in position to permit the safest and most efficient operation (except in the case of emergency).

_____ Ensure that, when conducting SCUBA operations, the boat can be quickly cast off and moved to a diver in distress.

_____ Ensure that each diver checks his own equipment in addition to checks made by tenders, technicians, or other support personnel.

_____ Designate a standby diver for all SCUBA operations, and check that the standby diver is equipped and ready to enter the water if needed.

_____ All efforts will be made to prevent divers from being fouled on the bottom. If work is to be conducted inside a wreck or similar underwater structure, designate a team of divers to accomplish the task. One diver will enter the water; the other will tend his lines from the point of entry.

_____ When using explosives, take appropriate measures to ensure that no charge will be fired while divers are in the water.

_____ Brief all divers on the planned decompression schedules for each particular dive. Check provisions made for decompressing diver.

_____ Verify that the ship, boat, or diving craft is displaying the proper signals, flags, or lights to indicate diving operations are in progress.

_____ Ensure that proper protection against harmful marine life has been provided.

_____ When using the air compressor to fill air cylinders check that the intake hose is not near the exhaust of the compressor.

_____ Thoroughly brief the boat crew using the Diving Boat Operations Checklist.

_____ Verify that proper safety and operational equipment is aboard small diving boats or craft.

E.1.5 Notify Proper Parties that Dive Operations are Ready to Commence

_____ Local officials, military or civilian

_____ Cognizant Navy Organizations

_____ U. S. Coast Guard (if present).

If deemed necessary by the Dive Supervisor, notify emergency facilities having recompression chambers, as well as sources of emergency transportation that Diving Operations are under way and their assistance may be needed.

Attachment F – Project Dive Supervisor Checklist

F.1. Dive Supervisor: _____

F.2. Dive Location: _____

F.3. Dive Operation Scheduled: _____

F.4. Time Scheduled for Dive: _____

F.5. Chamber Location:

Primary: _____

Secondary: _____

Phone Number: _____

F.6. Route to Chamber/Hospital: _____

_____

F.7. U. S. Coast Guard Rescue Coordination Center: _____

F.8. Pre Operational Checks:

_____ All equipment Pre-Dive maintenance accomplished

_____ Boat set-up

_____ Recompression Chamber notified

_____ Weather conditions checked

_____ Scuba bottles with gauge signifying pressure reading is no less than 90% of the capacity

_____ Personal dive gear inventoried

_____ Required equipment loaded

_____ Radio check with command center

_____ Standby Diver Line loaded

F.9. Dive Supervisor checks:

_____ Dive flag posted

_____Verify water depth

_____ Conduct dive brief

_____ Divers properly dressed

_____ Fill in rough dive log

_____ Emergency Equipment is checked, loaded and/or readily available

Attachment G – Project Dive Plan

(Note: If for any reason the Dive Plan is altered in mission, depth, personnel, or equipment, the DDC will be contacted in order to review and accept the alteration prior to continuing the operation. This review may be conducted electronically and confirmed in writing after completion of the dive operation)

Name of Dive Supervisor: _____ Date/Time: _____

Locations of Operation:_____ Durations of Operation: _____

G.1. Dive team Assignments: ----------

A. Dive team # _____ Dive Mission # _____

Name of Primary	Physical condition
Name of Secondary	Physical condition
Name of Standby	Physical condition
Observer/Assistant:	Remarks:

B. Support Personnel:

Communications:	First Aid/CPR certified person on site
Boat Operator:	Tender

G.2. Emergency Data: (See Emergency Management Plan in Appendix F)

A. DUTY CHAMBER:_____ PHONE:_____

B. AIR TRANSPORT:_____ PHONE:_____

C. ROUTE TO CHAMBER:_____

_____

G.3. Diver Physical Fitness (Aches/Pains/Numbness/Medications):

_____

G.4. TASK:

A. PURPOSE OF THE DIVE: _____

B. NATURE OF THE WORK TO BE PERFORMED: _____

C. DIVING MODE (ie. SSA, SCUBA,) _____

D. MAXIMUM DEPTH PER DIVE: No dive will be no more than 100 feet

E. BOTTOM TYPE :_____(no dive will exceed 45 minutes in length)

F. TABLE & SCHEDULE (All dive will be no-decompression dives):_____

G. WEATHER/RIVER STATE (visibility, water temperature, etc.):
_____
_____

H.TYPE OF PLATFORM TO BE USED (boat, platform, shore): _____

I. TOOLS AND MATERIALS INVOLVED: _____

Note:

1. All dives will be no-decompression dives and the following rates of ascent and descent will be observed: 30 FPM Ascent/75-FPM Descent.

2. Direct communications will be made available at all times between the dive site and the URS project office, the TITAN corporate office, the contracting officer, and the USACE project manager via hand-held two-way communication and or cell phone.

Attachment H – Dive Supervisor Pre-dive Checklist

_____ DIVERS (AND STAND-BY) ARE PHYSICALLY/MENTALLY FIT TO ENTER THE WATER?

_____ ANY DIVES WITHIN THE LAST 12 HOURS?

_____ ALL DIVERS HAVE MINIMUM EQUIPMENT (FINS, MASK, LIFE PRESERVER, WEIGHT BELT, KNIFE, SCUBA CYLINDER, DEPTH GAUGE, WATCH, REGULATOR, DIVE LIGHT)

_____ CYLINDERS HAVE BEEN GAUGED.

DV1: _____PSI **DV2:** _____PSI **STBY:** _____PSI

_____ ALL QUICK-RELEASE BUCKLES AND FASTENINGS CAN BE REACHED BY BOTH HANDS AND ARE RIGGED FOR PROPER RELEASE.

_____ WEIGHT BELT IS OUTSIDE OF ALL OTHER EQUIPMENT, BELTS, AND STRAPS?

_____ LIFE PRESERVER IS NOT CONSTRAINED, FREE TO EXPAND. CO2 CARTRIDGES ARE PROPERLY INSTALLED AND ALL AIR HAS BEEN REMOVED FROM VEST.

_____ KNIFE POSITIONED SO IT CANNOT BE JETTISONED.

_____ CYLINDER VALVE IS FULLY OPENED AND THEN BACKED OFF ¼ TURN. (DIVER PERFORM)

_____ CYCLE RESERVE MECHANISM AND ENSURE LEVER IS IN THE UP POSITION. (DIVER PERFORM)

_____ DIVER BREATHES FOR 30 SECONDS. ANY IMPURITIES?

_____ CONDUCT FINAL BRIEF.

_____ PROPER DIVING SIGNALS ARE BEING DISPLAYED.

_____ DIVER ENTER THE WATER WHEN READY AND CONDUCTS SURFACE CHECKS.

Attachment I – Checklist for Dive Boat Operations

All personnel involved in the operation of dive boats, launches, barges, floats, and other types of secondary small craft will be briefed and must understand the following safety precautions.

I.1. Inspect the specified boat or craft and determine its suitability for the intended mission and operating environment; ensure that:

_____ Boat (craft) is sound, and seaworthy.

_____ Engine is running well and fully tested.

_____ Required safety and running equipment is onboard and in workable condition.

_____ Proper gear for diving operation is onboard and operational.

_____ The assigned boat crew is fully qualified to operate that particular craft.

I.2. Know the details of the Emergency Assistance Checklist. Make sure it is completely filled out for small craft operations, with a legible copy placed onboard.

I.3. Inspect all communications gear, radios, underwater communications, power sources, walkie-talkies, cell phones, and ensure that they have been fully tested and are operational.

I.4. Determine that all non-powered communication equipment (flags, sounds signals, flares, air horn, etc.) are onboard, are complete and are operational.

I.5. Know all pre-determined signals, proper call signs, etc.

I.6. Know routine and emergency signals (for divers).

I.7. Determine that adequate and safe mooring equipment is onboard and personnel are familiar with proper mooring techniques.

I.8. Know who is in charge of the boat and responsible for giving orders to “Stop” and “Start”. Orders to commence boat operations that affect divers are given only by the Dive Supervisor.

I.9. Before getting underway, check with the Dive Supervisor for:

_____ An “all aboard” head count

_____ Approval that all diving equipment lines, safety equipment, etc. are onboard.

I.10. Plans for various Boat Handling Procedures during Dive Operations include:

_____ Dropping off of divers (On small boat drop off both sides)

_____ Picking up divers s

_____ Towing divers, if applicable

_____ Getting underway in an emergency have anchors lines attached to buoys

_____ Handling of divers lines during descent, ascent, hanging-off, raising or lowering tools and gear drop-off/pick-up.

_____ Setting/retrieving of buoy markers.

_____ Moving or towing of platforms, rafts, rubber boats, search sleds, etc.

I.11. Ensure that stowage of diving supplies and gear does not block access to:

_____ Fire Extinguishers

_____ Life Preservers

_____ Ground tackle

_____ Engine spaces

_____ Communication gear

_____ Bilge pump or switch

_____ Boat hook

_____ Heaving line

_____ Emergency Lights

_____ Flares

_____ First Aid Kit

_____ Diving platform

I.12. Know these general safety precautions that apply to Boat Operations:

_____ Place all intakes for the diving air compressor upwind of engine or auxiliary power plant exhausts

_____ Ensure safety of the boat

_____ Handling gasoline, or other dangerous material

_____ Shoring and handling of heavy equipment

_____ Securing gear for heavy weather

_____ Cutting or other operations involving fire

When divers are in the water:

(1) Do not change moor if attached to divers

(2) Do not set anchors

(3) Do not drop heavy items overboard

(4) NEVER START ENGINES WHEN DIVERS OR SNORKLERS ARE ALONGSIDE OR DIRECTLY UNDER BOAT

I.13. The Dive Supervisor will ensure that the below listed equipment is ready and available for each Diving Operation:

_____ Boat Tool Box (if required)
_____ Binoculars
_____ SCUBA Bottles
_____ Standby Bottle
_____ Water Jug
_____ First Aid Kit
_____ Communications Line
_____ Tools required for job
_____ Paddles
_____ Marker Buoys & Lines
_____ Stand By Diver Tending Line
____ Diver Tending Line
____ Lost Diver Buoy, Line and Clump
____ Observer/Assistant Throw Bag or Ring Buoy

_____ Descent Line & Clumps
_____ Cell Phones/Radio Frequency
_____ Litter (Stokes)
_____ U/W Dive Lights (as required)
_____ Ladder
_____ Outboard Motor Oil (if required)
_____ Underwater Metal Detector
_____ Gas Cans (if required)
_____ Circle Line/with Snap hooks
_____ Anchors & lines
_____ Observer/Assistant Throw Line
_____ Search Buoys

I.14. The Dive Supervisor will ensure that the information contained below is recorded in the Diving Log:

Time Departed Shore/Pier (if applicable)_____

Time Commenced Dive _____

Time Completed Dive _____

Time Returned Shore/Pier (if applicable)_____

Notify URS Field Office upon completion of daily operation.

Attachment J – Neurological Examination Checklist

NEUROLOGICAL EXAMINATION CHECKLIST

(Sheet 1 of 2)

Patient's Name: _____ Date/Time: _____

Describe pain/numbness: _____

_____

HISTORY

Type of dive last performed: _____ Depth: _____ How long: _____

Number of dives in last 24 hours: _____

Was symptom noticed before, during or after the dive? _____

If during, was it while descending, on the bottom or ascending? _____

Has symptom increased or decreased since it was first noticed? _____

Have any other symptoms occurred since the first one was noticed? _____

Describe: _____

Has patient ever had a similar symptom before? _____ When: _____

Has patient ever had decompression sickness or an air embolism before? ____ When: _____

MENTAL STATUS/STATE OF CONSCIOUSNESS

COORDINATION

Walk: _____
Heel-to-Toe: _____
Romberg: _____
Finger-to-Nose: _____
Heel Shin Slide: _____
Rapid Movement: _____

CRANIAL NERVES

Sense of Smell (I): _____
Vision/Visual Fld (II): _____
Eye Movements, Pupils (III, IV, VI): _____
Facial Sensation, Chewing (V): _____
Facial Expression Muscles (VII): _____
Hearing (VIII): _____
Upper Mouth, Throat Sensation (IX): _____
Gag & Voice (X): _____
Shoulder Shrug (XI): _____
Tongue (XII): _____

STRENGTH (Grade 0 to 5)

Upper Body

Deltoids	L _____	R _____
Latissimus	L _____	R _____
Biceps	L _____	R _____
Triceps	L _____	R _____
Forearms	L _____	R _____
Hands	L _____	R _____

Lower Body

Hips

Flexion	L _____	R _____
Extension	L _____	R _____
Abduction	L _____	R _____
Adduction	L _____	R _____

Knees

Flexion	L _____	R _____
Extension	L _____	R _____

NEUROLOGICAL EXAMINATION CHECKLIST

(Sheet 2 of 2)

REFLEXES

(Grade: Normal, Hyopactive, Hyperactive, Absent)

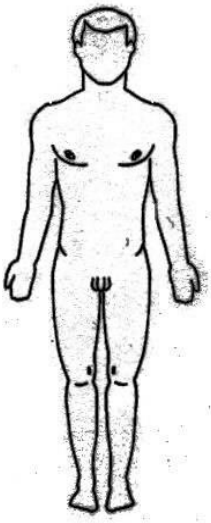
Biceps	L_____	R_____
Triceps	L_____	R_____
Knees	L_____	R_____
Ankles	L_____	R_____

Ankles		
Dorsiflexion	L_____	R_____
Plantarflexion	L_____	R_____
Toes	L_____	R_____

Sensory Examination for Skin Sensation

(Use diagram to record location off sensory abnormalities — numbness, tingling, etc.

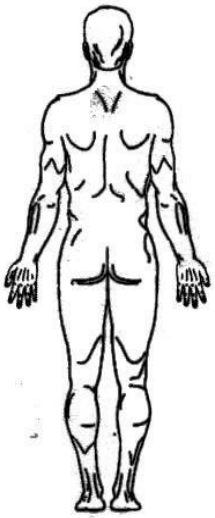
LOCATION



Indicate results as follows:

|||| Painful Area

=== Decreased Sensation



COMMENTS

Examination Performed by:_____

Attachment K – 29 CFR 1910 Subpart T

NFPA 70E–2000 *Standard for Electrical Safety Requirements for Employee Workplaces. (See also NFPA 70E–2004.)*

NFPA 77–2000 *Recommended Practice on Static Electricity.*

NFPA 80–1999 *Standard for Fire Doors and Fire Windows.*

NFPA 88A–2002 *Standard for Parking Structures.*

NFPA 91–2004 *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.*

NFPA 101–2006 *Life Safety Code.*

NFPA 496–2003 *Standard for Purged and Pressurized Enclosures for Electrical Equipment.*

NFPA 497–2004 *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.*

NFPA 505–2006 *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation.*

NFPA 820–2003 *Standard for Fire Protection in Wastewater Treatment and Collection Facilities.*

NMAB 353–1–1979 *Matrix of Combustion-Relevant Properties and Classification of Gases, Vapors, and Selected Solids.*

NMAB 353–2–1979 *Test Equipment for Use in Determining Classifications of Combustible Dusts.*

NMAB 353–3–1980 *Classification of Combustible Dust in Accordance with the National Electrical Code.*

[72 FR 7221, Feb., 14, 2007]

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, Longshore 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), 1–90 (55 FR 9033), 3–2000 (65 FR 50017), or 5–2002 (67 FR 65008) as applicable; 29 CFR part 1911.

SOURCE: 42 FR 37668, July 22, 1977, unless otherwise noted.

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, shipbreaking 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 elasped 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 gases.

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.

Inwater 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.

Psi(g): Pounds per square inch (gauge).

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 gases 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 inwater 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 inwater 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 inwater 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 inwater stage shall be provided to divers in the water.

(7) An inwater 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 inwater 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 inpede 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]

APPENDIX A TO SUBPART T TO PART 1910—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 yrs.

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, moodaltering 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 TO SUBPART T TO PART 1910—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 trouble-shooting 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]

APPENDIX C TO SUBPART T TO PART 1910—ALTERNATIVE CONDITIONS UNDER §1910.401(a)(3) FOR RECREATIONAL DIVING INSTRUCTORS AND DIVING GUIDES (MANDATORY)

Paragraph (a)(3) of §1910.401 specifies that an employer of recreational diving instructors and diving guides (hereafter, "divers" or "employees") who complies with all of the conditions of this appendix need not provide a decompression chamber for these divers as required under §§1910.423(b)(2) or (c)(3) or 1910.426(b)(1).

1. EQUIPMENT REQUIREMENTS FOR REBREATHERS

(a) The employer must ensure that each employee operates the rebreather (*i.e.*, semi-closed-circuit and closed-circuit self-contained underwater breathing apparatuses (hereafter, "SCUBAs")) according to the rebreather manufacturer's instructions.

(b) The employer must ensure that each rebreather has a counterlung that supplies a sufficient volume of breathing gas to their divers to sustain the divers' respiration rates, and contains a baffle system and/or other moisture separating system that keeps moisture from entering the scrubber.

(c) The employer must place a moisture trap in the breathing loop of the rebreather, and ensure that:

(i) The rebreather manufacturer approves both the moisture trap and its location in the breathing loop; and

(ii) Each employee uses the moisture trap according to the rebreather manufacturer's instructions.

(d) The employer must ensure that each rebreather has a continuously functioning moisture sensor, and that:

(i) The moisture sensor connects to a visual (*e.g.*, digital, graphic, analog) or auditory (*e.g.*, voice, pure tone) alarm that is readily detectable by the diver under the diving conditions in which the diver operates, and warns the diver of moisture in the breathing loop in sufficient time to terminate the dive and return safely to the surface; and

(ii) Each diver uses the moisture sensor according to the rebreather manufacturer's instructions.

(e) The employer must ensure that each rebreather contains a continuously functioning CO_2 sensor in the breathing loop, and that:

(i) The rebreather manufacturer approves the location of the CO_2 sensor in the breathing loop;

(ii) The CO_2 sensor is integrated with an alarm that operates in a visual (*e.g.*, digital, graphic, analog) or auditory (*e.g.*, voice, pure tone) mode that is readily detectable by each diver under the diving conditions in which the diver operates; and

(iii) The CO_2 alarm remains continuously activated when the inhaled CO_2 level reaches and exceeds 0.005 atmospheres absolute (ATA).

(f) Before each day's diving operations, and more often when necessary, the employer must calibrate the CO_2 sensor according to the sensor manufacturer's instructions, and ensure that:

(i) The equipment and procedures used to perform this calibration are accurate to within 10% of a CO_2 concentration of 0.005 ATA or less;

(ii) The equipment and procedures maintain this accuracy as required by the sensor manufacturer's instructions; and

(iii) The calibration of the CO_2 sensor is accurate to within 10% of a CO_2 concentration of 0.005 ATA or less.

(g) The employer must replace the CO_2 sensor when it fails to meet the accuracy requirements specified in paragraph 1(f)(iii) of this appendix, and ensure that the replacement CO_2 sensor meets the accuracy requirements specified in paragraph 1(f)(iii) of this appendix before placing the rebreather in operation.

(h) As an alternative to using a continuously functioning CO_2 sensor, the employer may use a schedule for replacing CO_2-sorbent material provided by the rebreather manufacturer. The employer may use such a schedule only when the rebreather manufacturer has developed it according to the canister-testing protocol specified below in Condition 11, and must use the canister within the temperature range for which the manufacturer conducted its scrubber canister tests following that protocol. Variations above or below the range are acceptable only after the manufacturer adds that lower or higher temperature to the protocol.

(i) When using CO_2-sorbent replacement schedules, the employer must ensure that each rebreather uses a manufactured (*i.e.*, commercially pre-packed), disposable scrubber cartridge containing a CO_2-sorbent material that:

(i) Is approved by the rebreather manufacturer;

(ii) Removes CO_2 from the diver's exhaled gas; and

(iii) Maintains the CO_2 level in the breathable gas (*i.e.*, the gas that a diver inhales directly from the regulator) below a partial pressure of 0.01 ATA.

(j) As an alternative to manufactured, disposable scrubber cartridges, the employer may fill CO_2 scrubber cartridges manually with CO_2-sorbent material when:

(i) The rebreather manufacturer permits manual filling of scrubber cartridges;

(ii) The employer fills the scrubber cartridges according to the rebreather manufacturer's instructions;

(iii) The employer replaces the CO_2-sorbent material using a replacement schedule developed under paragraph 1(h) of this appendix; and

(iv) The employer demonstrates that manual filling meets the requirements specified in paragraph 1(i) of this appendix.

(k) The employer must ensure that each rebreather has an information module that provides:

(i) A visual (*e.g.*, digital, graphic, analog) or auditory (*e.g.*, voice, pure tone) display that effectively warns the diver of solenoid failure (when the rebreather uses solenoids) and other electrical weaknesses or failures (*e.g.*, low battery voltage);

(ii) For a semi-closed circuit rebreather, a visual display for the partial pressure of CO_2, or deviations above and below a preset CO_2 partial pressure of 0.005 ATA; and

(iii) For a closed-circuit rebreather, a visual display for: partial pressures of O_2 and CO_2, or deviations above and below a preset CO_2 partial pressure of 0.005 ATA and a preset O_2 partial pressure of 1.40 ATA or lower; gas temperature in the breathing loop; and water temperature.

(l) Before each day's diving operations, and more often when necessary, the employer must ensure that the electrical power supply and electrical and electronic circuits in each rebreather are operating as required by the rebreather manufacturer's instructions.

2. Special Requirements for Closed-Circuit Rebreathers

(a) The employer must ensure that each closed-circuit rebreather uses supply-pressure sensors for the O_2 and diluent (*i.e.*, air or nitrogen) gases and continuously functioning sensors for detecting temperature in the inhalation side of the gas-loop and the ambient water.

(b) The employer must ensure that:

(i) At least two O_2 sensors are located in the inhalation side of the breathing loop; and

(ii) The O_2 sensors are: functioning continuously; temperature compensated; and approved by the rebreather manufacturer.

(c) Before each day's diving operations, and more often when necessary, the employer must calibrate O_2 sensors as required by the sensor manufacturer's instructions. In doing so, the employer must:

(i) Ensure that the equipment and procedures used to perform the calibration are accurate to within 1% of the O_2 fraction by volume;

(ii) Maintain this accuracy as required by the manufacturer of the calibration equipment;

(iii) Ensure that the sensors are accurate to within 1% of the O_2 fraction by volume;

(iv) Replace O_2 sensors when they fail to meet the accuracy requirements specified in paragraph 2(c)(iii) of this appendix; and

(v) Ensure that the replacement O_2 sensors meet the accuracy requirements specified in paragraph 2(c)(iii) of this appendix before placing a rebreather in operation.

(d) The employer must ensure that each closed-circuit rebreather has:

(i) A gas-controller package with electrically operated solenoid O_2-supply valves;

(ii) A pressure-activated regulator with a second-stage diluent-gas addition valve;

(iii) A manually operated gas-supply bypass valve to add O_2 or diluent gas to the breathing loop; and

(iv) Separate O_2 and diluent-gas cylinders to supply the breathing-gas mixture.

3. O_2 Concentration in the Breathing Gas

The employer must ensure that the fraction of O_2 in the nitrox breathing-gas mixture:

(a) Is greater than the fraction of O_2 in compressed air (*i.e.*, exceeds 22% by volume);

(b) For open-circuit SCUBA, never exceeds a maximum fraction of breathable O_2 of 40% by volume or a maximum O_2 partial pressure of 1.40 ATA, whichever exposes divers to less O_2; and

(c) For a rebreather, never exceeds a maximum O_2 partial pressure of 1.40 ATA.

4. Regulating O_2 Exposures and Diving Depth

(a) Regarding O_2 exposure, the employer must:

(i) Ensure that the exposure of each diver to partial pressures of O_2 between 0.60 and 1.40 ATA does not exceed the 24-hour single-exposure time limits specified either by the 2001 National Oceanic and Atmospheric Administration Diving Manual (the ''2001 NOAA Diving Manual''), or by the report entitled ''Enriched Air Operations and Resource Guide'' published in 1995 by the Professional Association of Diving Instructors (known commonly as the ''1995 DSAT Oxygen Exposure Table''); and

(ii) Determine a diver's O_2-exposure duration using the diver's maximum O_2 exposure (partial pressure of O_2) during the dive and the total dive time (*i.e.*, from the time the diver leaves the surface until the diver returns to the surface).

(b) Regardless of the diving equipment used, the employer must ensure that no

a separate supply of emergency breathing gas, and the emergency breathing gas consists of air or the same nitrox breathing-gas mixture used during the dive.

(b) As an alternative to the ''bail-out'' system specified in paragraph 7(a) of this appendix, the employer may use:

(i) For open-circuit SCUBA, an emergency-egress system as specified in §1910.424(c)(4); or

(ii) For a semi-closed-circuit and closed-circuit rebreather, a system configured so that the second stage of the regulator connects to a reserve supply of emergency breathing gas.

(c) The employer must obtain from the rebreather manufacturer sufficient information to ensure that the bail-out system performs reliably and has sufficient capacity to enable the diver to terminate the dive and return safely to the surface.

8. Treating Diving-Related Medical Emergencies

(a) Before each day's diving operations, the employer must:

(i) Verify that a hospital, qualified health-care professionals, and the nearest Coast Guard Coordination Center (or an equivalent rescue service operated by a state, county, or municipal agency) are available to treat diving-related medical emergencies;

(ii) Ensure that each dive site has a means to alert these treatment resources in a timely manner when a diving-related medical emergency occurs; and

(iii) Ensure that transportation to a suitable decompression chamber is readily available when no decompression chamber is at the dive site, and that this transportation can deliver the injured diver to the decompression chamber within four (4) hours travel time from the dive site.

(b) The employer must ensure that portable O_2 equipment is available at the dive site to treat injured divers. In doing so, the employer must ensure that:

(i) The equipment delivers medical-grade O_2 that meets the requirements for medical USP oxygen (Type I, Quality Verification Level A) of CGA G–4.3–2000 (''Commodity Specification for Oxygen'');

(ii) The equipment delivers this O_2 to a transparent mask that covers the injured diver's nose and mouth; and

(iii) Sufficient O_2 is available for administration to the injured diver from the time the employer recognizes the symptoms of a diving-related medical emergency until the injured diver reaches a decompression chamber for treatment.

(c) Before each day's diving operations, the employer must:

(i) Ensure that at least two attendants, either employees or non-employees, qualified in first-aid and administering O_2 treatment, are available at the dive site to treat diving-related medical emergencies; and

(ii) Verify their qualifications for this task.

9. Diving Logs and No-Decompression Tables

(a) Before starting each day's diving operations, the employer must:

(i) Designate an employee or a non-employee to make entries in a diving log; and

(ii) Verify that this designee understands the diving and medical terminology, and proper procedures, for making correct entries in the diving log.

(b) The employer must:

(i) Ensure that the diving log conforms to the requirements specified by paragraph (d) (''Record of dive'') of §1910.423; and

(ii) Maintain a record of the dive according to §1910.440 (''Recordkeeping requirements'').

(c) The employer must ensure that a hard-copy of the no-decompression tables used for the dives (as specified in paragraph 6(a) of this appendix) is readily available at the dive site, whether or not the divers use dive-decompression computers.

10. Diver Training

The employer must ensure that each diver receives training that enables the diver to perform work safely and effectively while using open-circuit SCUBAs or rebreathers supplied with nitrox breathing-gas mixtures. Accordingly, each diver must be able to demonstrate the ability to perform critical tasks safely and effectively, including, but not limited to: recognizing the effects of breathing excessive CO_2 and O_2; taking appropriate action after detecting excessive levels of CO_2 and O_2; and properly evaluating, operating, and maintaining their diving equipment under the diving conditions they encounter.

11. Testing Protocol for Determining the CO_2 Limits of Rebreather Canisters

(a) The employer must ensure that the rebreather manufacturer has used the following procedures for determining that the CO_2-sorbent material meets the specifications of the sorbent material's manufacturer:

(i) The North Atlantic Treating Organization CO_2 absorbent-activity test;

(ii) The RoTap shaker and nested-sieves test;

(iii) The Navy Experimental Diving Unit (''NEDU'')-derived Schlegel test; and

(iv) The NEDU MeshFit software.

(b) The employer must ensure that the rebreather manufacturer has applied the following canister-testing materials, methods, procedures, and statistical analyses:

(i) Use of a nitrox breathing-gas mixture that has an O_2 fraction maintained at 0.28 (equivalent to 1.4 ATA of O_2 at 130 fsw, the

maximum O_2 concentration permitted at this depth);

(ii) While operating the rebreather at a maximum depth of 130 fsw, use of a breathing machine to continuously ventilate the rebreather with breathing gas that is at 100% humidity and warmed to a temperature of 98.6 degrees F (37 degrees C) in the heating-humidification chamber;

(iii) Measurement of the O_2 concentration of the inhalation breathing gas delivered to the mouthpiece;

(iv) Testing of the canisters using the three ventilation rates listed in Table I below (with the required breathing-machine tidal volumes and frequencies, and CO_2-injection rates, provided for each ventilation rate):

TABLE I—CANISTER TESTING PARAMETERS

Ventilation rates (Lpm, ATPS [1])	Breathing machine tidal volumes (L)	Breathing machine frequencies (breaths per min.)	CO_2 injection rates (Lpm, STPD [2])
22.5	1.5	15	0.90
40.0	2.0	20	1.35
62.5	2.5	25	2.25

[1] ATPS means ambient temperature and pressure, saturated with water.
[2] STPD means standard temperature and pressure, dry; the standard temperature is 32 degrees F (0 degrees C).

(v) When using a work rate (*i.e.*, breathing-machine tidal volume and frequency) other than the work rates listed in the table above, addition of the appropriate combinations of ventilation rates and CO_2-injection rates;

(vi) Performance of the CO_2 injection at a constant (steady) and continuous rate during each testing trial;

(vii) Determination of canister duration using a minimum of four (4) water temperatures, including 40, 50, 70, and 90 degrees F (4.4, 10.0, 21.1, and 32.2 degrees C, respectively);

(viii) Monitoring of the breathing-gas temperature at the rebreather mouthpiece (at the "chrome T" connector), and ensuring that this temperature conforms to the temperature of a diver's exhaled breath at the water temperature and ventilation rate used during the testing trial; [1]

(ix) Implementation of at least eight (8) testing trials for each combination of temperature and ventilation-CO_2-injection rates (for example, eight testing trials at 40 degrees F using a ventilation rate of 22.5 Lpm at a CO_2-injection rate of 0.90 Lpm);

(x) Allowing the water temperature to vary no more than ± 2.0 degrees F (± 1.0 degree C) *between* each of the eight testing trials, and no more than ± 1.0 degree F (± 0.5 degree C) *within* each testing trial;

(xi) Use of the average temperature for each set of eight testing trials in the statistical analysis of the testing-trial results, with the testing-trial results being the time taken for the inhaled breathing gas to reach 0.005 ATA of CO_2 (*i.e.*, the canister-duration results);

(xii) Analysis of the canister-duration results using the repeated-measures statistics described in NEDU Report 2–99;

(xiii) Specification of the replacement schedule for the CO_2-sorbent materials in terms of the lower prediction line (or limit) of the 95% confidence interval; and

(xiv) Derivation of replacement schedules only by interpolating among, but not by extrapolating beyond, the depth, water temperatures, and exercise levels used during canister testing.

[69 FR 7363, Feb. 17, 2004]

[1] NEDU can provide the manufacturer with information on the temperature of a diver's exhaled breath at various water temperatures and ventilation rates, as well as techniques and procedures used to maintain these temperatures during the testing trials.

Subparts U–Y [Reserved]

§§ 1910.901–1910.999 [Reserved]