

## Section 29 Marine and Diving Operations

This section establishes the requirements for marine and diving operations, oversight of contractor diving operations and Reclamation diving operations. Issues discussed include dive team requirements, diver qualifications, pre-dive planning, hazard control measures, supervision, equipment, recordkeeping, accident reporting and first aid, recompression, surface-supplied air diving, scuba diving, and communication systems.

### 29.1 Requirements for Contractor Diving Operations

**29.1.1 General Requirements.** Conventional hardhat and lightweight surface supplied and scuba diving operations must conform to the more stringent requirements of this subsection or 29 CFR 1910, Subpart T, “Commercial Diving Operations.” Use regulations contained in the U.S. Navy Diving Manual, volumes I through V, to resolve issues not covered by these or referenced standards.

**29.1.2 Hazard Control Measures.** Bring diving equipment to the worksite only after a Safe Practices Manual, diving plan, and dive hazard analysis have been developed and the Contracting Officer’s Representative (COR) or Dive Master has approved it. The dive hazard analysis and diving plan must specifically address safety procedures for each separate diving location or mode and include policies to ensure compliance with these and referenced standards. If conditions change, cease diving operations until you reevaluate conditions and implement appropriate controls.

**29.1.3 Diver Qualifications.** Divers, including those on standby, must have a certificate of training from a recognized diving school or certified record of past diving experience. Prior to commencing diving operations, submit divers’ names and qualifications to the COR or Dive Master. Divers must be at least 18 years old and be fully familiar with the equipment, diving system, and emergency procedures to be used. Divers must have undergone a medical examination within the past year that certifies them as physically fit for diving. In addition, a diver may dive to depths greater than 100 feet seawater equivalent only after being gradually introduced or reintroduced to the maximum depth of the planned dive. Divers must not take part in diving operations if they have severe colds, sinus or ear infections, alcohol intoxication or its aftereffects, drug addiction, fatigue, acute illness, or vertigo. All dive team members must be trained in cardiopulmonary resuscitation, first aid (American Red Cross standard course, or equivalent), and oxygen first aid.

**29.1.4 Supervision.** A designated, experienced, onsite Dive Master must personally supervise all diving operations, including use of personnel and decompression.

**29.1.5 Equipment.** Use a tagging or logging system to record equipment modification, repair, test, calibration, or maintenance services. Include the date and type of work performed and the name or initials of the person who did the work.

a. **Air Compressor System.** Compressors that supply air to the surface-supplied air (SSA) diver must have a volume cylinder with a check valve on the inlet side, a pressure gauge, a relief valve, a drain valve, and a carbon monoxide filter and alarm system. Compressors must have the capacity to overcome any line loss or other losses and deliver a minimum of 4.5 cubic feet per minute to each diver at the maximum working depth. Locate air compressor intakes away from areas containing exhaust or other contaminants. Respirable air supplied to a diver, or to air tanks, must not contain:

1. Carbon monoxide (CO) greater than 10 parts per million (ppm).
2. Carbon dioxide (CO<sub>2</sub>) greater than 1,000 ppm.
3. Oil mist greater than 5 milligrams per cubic meter.
4. A noxious or strong odor.

Test the air compressor system output for air purity at least every 6 months, by taking samples at the connection to the distribution system.

b. **Compressed Gas Cylinders.** Compressed gas cylinders must:

1. Be designed and maintained according to the applicable provisions of 29 CFR 1910.101(a).
2. Be stored in a ventilated area and protected from excessive heat.
3. Be secured against falling.
4. Have shutoff valves recessed into the cylinder or protected by a cap, except when in use, when manifolded, or when used for diving.

### **29.1.6 Surface-Supplied Air Diving**

a. **Auxiliary Air Supply.** Provide an auxiliary air supply during all dives. The auxiliary air supply must have a standby compressor or air flasks with a capacity of 72 cubic feet or more. Compressors that are used for diving operations must not be used for any other purpose. Auxiliary air supply must meet the requirements in the subsection, "Air Compressor System."

b. **Decompression.** A recognized decompression specialist must prepare decompression tables. Post decompression times inside and outside decompression chambers.

c. **Decompression Chamber.** The following circumstances require an onsite, dual-lock, multiplace decompression chamber (capable of recompressing the diver to a minimum of 165 feet seawater equivalent) and trained operating personnel:

- Diving operations that are outside the no-decompression limits or to depths greater than 100 feet seawater
- When surface recompressing capabilities are recommended by the decompression specialists, Dive Master, or where necessitated by onsite conditions

Decompression chambers must accommodate at least two persons.

d. **Decompression Dives.** Divers engaged in dives outside no-decompression limits or engaged in mixed-gas diving must remain awake and close to an attended decompression chamber for at least 1 hour following the dive. The diver must be able to contact a decompression chamber facility during the 4-hour period immediately following treatment or after leaving the water.

e. **Communications.** Equip divers and standby divers with communication systems that permit simultaneous, two-way conversations between the diver, his tender, other divers and tenders, and the Dive Master. Communication systems must be operable from the time the diver puts on his helmet or mask until it is removed.

f. **Minimum Crew Size.** Two divers must be available on any one diving operation. The standby diver must be available, suited up, and ready to dive in an emergency. The standby diver must not serve as a tender. The minimum crew must consist of at least four persons: the Dive Master, a diver, a standby diver, and a tender. For each diver added to the crew, one tender must also be added.

g. **Reserve Breathing Gas Supply.** Each diver using lightweight SSA must carry a reserve breathing gas tank. When heavy, deep-sea diving gear are used, when diving to depths exceeding 100 feet of seawater, or when diving outside the no-decompression limits, the standby diver must have an extra breathing gas hose for the working diver.

### 29.1.7 Scuba Diving

a. **Requirement.** Scuba diving is permitted only when sanctioned by the contract specifications and authorized in writing by the contracting officer.

b. **Maximum Depths.** Limit scuba diving to depths and times that will not require decompression staging as set forth in the U.S. Navy Standard Air Decompression Tables. Scuba dives depths must not exceed 100 feet of seawater after altitude adjustment.

- c. **Compressed Air.** Oxygen or mixed gases are prohibited, except for up to 40 percent nitrox, when used in accordance with the National Oceanic and Atmospheric Administration (NOAA) Diving Manual: *Diving for Science and Technology*, Chapter 15, "Nitrox Diving" and Appendix VII, "Nitrox Dive Tables." Use only open circuit scuba systems.
- d. **Diving Equipment.** A recognized approving agency must approve scuba diving equipment. Use and maintain scuba diving equipment in accordance with the manufacturer's recommendations.
- e. **Buddy System.** A dive may be made singly if the dive is less than 20 feet deep, there is little current, and visibility is good (at the discretion of the Dive Master). All other dives with scuba gear must use a buddy system.
- f. **Standby Diver.** Provide a standby diver for each diver or buddy pair. The standby diver must be a qualified, fully equipped scuba diver and remain on the surface, close to the diver.
- g. **Standard Equipment.** Scuba divers must wear buoyancy compensators and have a depth indicating device, timing device, cutting tool, compass, submersible pressure gauge (or integrated dive computer) to monitor cylinder/system air pressure, and an alternate second stage air source, such as an octopus or safe second.

## 29.2 Requirements for Reclamation Diving Operations

29.2.1 **Regulations and Policy.** Reclamation diving operations must comply with the requirements of 29 CFR 1910, Subpart T, "Commercial Diving Operations." The policies and guidelines for Dive Team establishment, review, training, certification, and diver qualifications are contained in Department of the Interior Manual 485 (Safety and Health Handbook), Chapter 27, "Underwater Diving Safety." Use the U.S. Navy Diving Manual, Volumes I, II, and V, to resolve issues not covered by these or referenced standards.

29.2.2 **Reclamation Oversight.** A Bureau Diving Safety Board and a Regional Diving Advisory Committee (RDAC) must oversee Reclamation diving operations. These organizations must provide guidance for the safety of all diving operations. They are responsible for:

- a. Establishing a *Bureau of Reclamation Safe Practices Manual for Underwater Inspection Program*.
- b. Reviewing diving activities.

- c. Establishing qualifications for divers.
- d. Providing periodic diver training opportunities.
- e. Approving dive teams and Dive Masters.
- f. Reviewing all diving operations and accidents.

### 29.2.3 Diving Operations.

a. **General.** Sufficiently train and equip Reclamation dive team members with resources to safely perform diving operations.

b. **Restrictions on Specialized Diving.** Reclamation teams must not undertake specialized operations, such as underwater welding, gas or electric arc cutting and burning, or explosive demolition. Permitted activities include minor maintenance (such as removing rocks and debris from stilling basins; operating small, hand-held, nonelectric power tools; inspections; and assisting surface maintenance crews with installation or cleaning operations).

c. **Recordkeeping.**

1. Each diver must maintain a dive log that contains, at a minimum, the following information:

- Names of dive team members (including Dive Master)
- Location
- Date
- Time
- Diving mode
- General nature of the work performed
- Appropriate surface and underwater conditions
- Maximum depth and bottom times
- Any accidents or unusual conditions encountered

RDAC will ensure that accurate dive logs are maintained and tabulated on an annual basis.

2. Maintain a log of all equipment modifications, repairs, tests, calibrations, and maintenance.

3. Maintain the underwater diving safety records identified above and other dive team records in accordance with table 29-1.

Table 29-1.—Dive team recordkeeping

| Record   | Instructions   | Retention period <sup>1</sup>                            | Responsibility |
|--|--|--|----------------|
| Injury or illness requiring hospitalization of ≥24 hours     | Notify RDAC, report using SMIS system within 6 days; CA-1 within 2 days                | 5 years (SMIS)<br>Permanent (CA-1)                       | Team leader    |
| Minor diving injuries  | Report using SMIS system within 6 days; (CA-1) within 2 days                           | 5 years (SMIS)<br>Permanent (CA-1)                       | Team leader    |
| Safe practices manual  | Retain copy at dive site   | Current document   | Dive Master    |
| Depth-time profiles  | Individual records   | Until transferred to the dive log                        | Diver          |
| Recording of dives (dive log)                                | Individual records (tabulated annually)  | 1 year, unless an accident; in case of accident, 5 years | Dive Master    |
| Dive hazard analysis and briefing notes                      | Review and discuss dive hazard analysis prior to each dive.                            | 1 year   | Dive Master    |
| Dive team medical records and medical clearance              | Keep with medical records. Retain copy of medical clearance at dive site.              | 5 years; most recent clearance (1 year)                  | Team leader    |
| Equipment inspections, repairs, maintenance, and calibration | Keep current record until equipment is withdrawn from service.                         | Most current tag or entry                                | Team leader    |
| Dive training and dive training summary                      | Individual diver must maintain it as a continuous record; annual summary at dive site. | Continuous running record; summaries every 5 years       | Team leader    |
| Compressor air quality                                       | Check every 180 days.  | Most current record                                      | Team leader    |

<sup>1</sup> Records required to be retained 5 years (with the exception of minor injuries report) must be forwarded by Reclamation to the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

**d. Dive Plan and Hazard Analysis.** Prepare a dive plan and hazard analysis before each diving activity. All personnel involved must review the dive plan and hazard analysis before suiting up. As a minimum, the plan must contain the following:

1. Names and duties of dive team members, including diving supervisor.
2. Date, time, and location of the dive operation.
3. Diving mode to be used (scuba, surface-supplied air, etc.), including a description of the backup air supply.
4. A description of the work divers will perform, and inspection requirements.
5. Surface and underwater conditions, including visibility, temperature, thermal protection, and currents.
6. Activity hazard analysis for each phase of work, including the hazards of flying after diving.
7. Maximum depth and bottom time (make altitude adjustments to dive tables for dives at altitudes of 1000 feet or more above sea level).
8. Emergency management plan, including emergency procedures, means of notification, telephone numbers (for ambulance, doctors, and Divers Alert Network), locations of evacuation route, and emergency assistance.
9. Lockout/tagout procedures, including how to deal with differential water pressures due to unequal water elevations.
10. Equipment servicing records, procedures, and checklists and requirements for special tools and equipment.

**29.2.4 Accident and Incidents.** Report all accidents that occur in connection with a diving activity, following standard accident reporting procedures (see table 29-1). In addition, the team leader must submit to the RDAC a comprehensive analysis of each accident or incident involving a diver. The purpose of the accident and incident analyses is to identify hazardous situations and constructively prevent their recurrence.

**29.2.5 Diving Supervision.** The Dive Master must attend each diving operation. The Dive Master is responsible for pre-dive planning, the dive hazard analysis, and the conduct and safety of the dive. The Dive Master's decisions are final. However, a diver who considers a diving operation unsafe is not required to participate in the dive.

**29.2.6 Required Divers.** At least three divers must be present during all Reclamation dives. In addition to the diver, there must be a standby safety diver and the Dive Master. Top side personnel are responsible for tending the diver, recordkeeping, and controlling any surface-supplied breathing air equipment. This requirement may be varied only with the approval of the Dive Master and RDAC.

**29.2.7 Pre-dive Briefing.** Before beginning work on a dive operation, the dive team, facility representatives, and/or others involved in, or affected by, the operation must meet to review the dive plan and dive hazard analysis and to coordinate the diving operation. Maintain a record of the briefing notes.

**29.2.8 Safe Practices Manual.** Make the *Safe Practices Manual* available at each dive location.

**29.2.9 Maximum Depth.** Limit diving operations to depths and times that will not require decompression staging, in accordance with the U.S. Navy standard air decompression tables and the altitude conversion tables developed by R.L. Bell and R.E. Borgwardt (1975). When diving, do not exceed 100 feet of seawater (after altitude conversion).

**29.2.10 Clearance and Lockout Procedures in Areas of Hazardous Energy Sources.** Use clearance and lockout procedures where hazardous energy sources exist. When diving near dams, powerplants, pumping plants, or diversion structures with mechanical or electrical features that could pose a hazard to divers, a technical representative from the project at which the dive is being made must be present or in direct communication to assist the divers. All divers must review the clearance before beginning diving operations. Clearance procedures and lockouts must conform with the section, "Control of Hazardous Energy (Lockout/Tagout)" of this standard.

**29.2.11 Pressure Differentials.** Review diving operations for potential hazards to divers before beginning to dive on the upstream or high-pressure side of open or badly leaking gates, valves, diversion structures, or other features where a combination of flow and pressure differential could immobilize a diver.

**29.2.12 Equipment.** Equip each diver to ensure personal safety. No diver is required to dive with a type or brand of equipment they consider unsafe. Divers must not dive with equipment known to be damaged or improperly maintained.

a. **Basic Auxiliary Requirement.** The basic auxiliary requirement for each scuba diver includes, but is not limited to:

1. Buoyancy compensating device.



2. Depth indicating device.
3. Timing device.
4. Cutting tool.
5. Compass.
6. Submersible pressure gauge (or integrated dive computer) to monitor cylinder/system air pressure.
7. Alternate second stage air source, such as an octopus or safe second.

b. **Equipment Inspection.** Before diving operations begin, and every day during dive operations, dive team personnel must inspect the equipment to make sure it is in proper operating condition. Record inspection results in a dive log or as required by the Safe Practices Manual.

c. **Air Cylinders.** Every year, have all air cylinders visually inspected by a certified cylinder inspector, attach an inspection sticker to the cylinder and issue a certificate. Hydrostatically test the cylinders every 5 years in accordance with U.S. Department of Transportation regulations. Permanently mark the cylinder with the most recent test date.

d. **Regulators.** A diver's first and second stage regulators must be professionally inspected at least once a year, or more frequently if recommended by the manufacturer. Retain the inspection certificate until the next inspection or maintenance.

29.2.13 **Diving Flag.** Fly a red flag with white diagonal stripe (see figure 29-1) at all times when divers are working near motor boats or other dangerous watercraft, or where mandated by State or national Coast Guard regulations.

29.2.14 **Surfacing.** Divers must surface when the cylinder pressure reaches 500 pounds per square inch or at the first signs of equipment malfunction.

29.2.15 **Recompression Chamber Location.** Include in the dive hazard analysis all emergency telephone numbers, including the Divers Alert Network (DAN) and the local hospital. DAN maintains a listing of the closest recompression chambers for each day. The dive hazard



Figure 29-1.—Diving flag.

analysis must also specify the most effective mode of transportation to the hospital, as determined by the Dive Master.

**29.2.16 Repetitive Dive Tables.** Keep repetitive dive tables at the dive site as part of the dive plan and dive hazard analysis.

**29.2.17 Emergency First Aid Equipment.** Make emergency first aid equipment immediately available to the dive team. Include in the dive plan and dive hazard analysis the location and telephone number of an ambulance service and hospital near the dive area. Emergency first aid equipment must include a first aid kit, spine board, and a demand-type oxygen unit able to deliver at least 15 liters of oxygen per minute. When traveling to remote sites where professional medical assistance is more than 1-1/2 hours away, have Remote Emergency Medical Oxygen available at all times.

**29.2.18 Post-Dive Restrictions**

a. **Commercial Flying.** Wait a minimum of 12 hours after completing a single no-compression dive, or 24 hours after multiple days of diving or decompression dives.

b. **Driving to Altitude.** Divers shall correct for altitude prior to diving by assuming the highest point to be reached after the dive is the altitude of the dive. Refer to the Travel Delay Table and Altitude Modifications discussion in *Bureau of Reclamation Safe Practices Manual for Underwater Inspection Program*.

**29.2.19 Individual Safety.** Divers are ultimately responsible for their own safety. It is the diver's responsibility and privilege to refuse to dive if, in the diver's judgment, conditions are unsafe, unfavorable, or the dive would violate the dictates of their training, judgment, or these regulations.

**29.2.20 Transporting Cylinders.** Transport all dive cylinders in racks designed for this purpose or secure them safely. Shade dive cylinders and maintain the temperature at less than 100 °F if possible. If the temperature, elevation, or other conditions cannot be controlled, reduce the pressure to avoid exceeding the cylinder's working pressure.

**29.2.21 Scuba Diving**

a. **Compressed Air.** Use only open-circuit type scuba equipment using compressed air. Obtain compressed air from a reliable source, meeting the specifications of Compressed Gas Association (CGA) Standard G7.1, *Commodity Specification for Air*.

b. **Penetration Drive.** You must not dive with scuba, under overhead obstructions, or when vertical access to the surface is restricted if you can become disoriented as to the egress direction. Limit penetration to less than 50 feet.

c. **Standby Diver.** Provide a standby diver for each working unit or pair of divers. The standby diver must be suited up and have all diving gear available for immediate use. Position the standby diver to respond quickly to the needs of the divers.

d. **Buddy System.** Conduct all scuba diving activities using a buddy system, unless the Dive Master determines that two divers working in close proximity will increase the hazards. A single diver may work alone, subject to the following conditions:

1. The working depth does not exceed 20 feet, or 30 feet with approval by the Dive Master and Safety Manager.
2. A standby diver is provided for the single diver.
3. The Dive Master, standby diver, and diver clearly understand that the diver will be working alone.
4. The Dive Master, standby diver, and diver agree, in advance, on the exact operation. The diver must not alter the agreed-upon operation or stray from the prescribed locality.

29.2.22 **Surface-Supplied Air Diving.** SSA diving is permitted only if divers, standby divers, and console operators have successfully completed SSA training by an RDAC-approved instructor from an accredited or nationally recognized organization.

a. **Air Supply.** Each diving operation must have a primary breathing air supply sufficient to support divers for the duration of the planned dive. Air supply to SSA must be a manifold control system of scuba cylinders that meet the criteria of this section or a volume tank specifically designed for use in a breathing air system. A manifold system must be at least a two-cylinder system and allow cylinders to be changed without shutting down the air supply.

b. **Air Quality.** Respirable air that will be supplied to divers through cylinders must be obtained from suppliers whose air is tested every 6 months by an independent tester. Respirable air must not contain:

1. Carbon monoxide greater than 10 ppm.
2. Carbon dioxide greater than 1,000 ppm.
3. Oil mist greater than 5 milligrams per cubic meter.
4. A noxious or pronounced odor.

- c. **Reserve Breathing Air.** Equip each diver with a reserve breathing supply that the diver can immediately turn on if the primary air source is lost.
  
- d. **Umbilicals.** Mark umbilicals in 10-foot increments to 100 feet, beginning at the diver's end, and in 50-foot increments thereafter. Umbilicals must be made of kink-resistant materials. Include a safety line as an integral part of each umbilical. Umbilicals must have a nominal breaking strength of at least 1,000 pounds.
  
- e. **Helmets.** SSA helmets and masks must have a check valve at the attachment between the helmet or mask and hose. They must also have an exhaust valve. Helmets and masks must have a minimum ventilation rate capacity of 4.5 cubic feet per minute at the depth in which they are operated.
  
- f. **Weight System.** Equip divers with a weight belt that can release quickly.
  
- g. **Safety Harness.** Divers must wear a safety harness. The safety harness must have a positive buckling device and an attachment point for the umbilical and safety line.
  
- h. **Equipment Records.** Record each equipment modification, repair, test, calibration, or maintenance service in the equipment log.
  
- i. **Minimum Crew Size.** At least two divers must be available on any one diving operation. The standby diver must be suited up and ready to dive in an emergency. The standby diver must not serve as a tender. The crew must consist of at least four persons: the Dive Master, a diver, a standby diver, and a tender. For each diver added to the crew, one tender must also be added.
  
- j. **Dive Tender.** While in the water, each diver must be continuously tended by one tender.
  
- k. **Penetration Dive.** Station an SSA diver at the underwater point of entry when diving takes place in enclosed or physically confining area. Limit penetration to 300 feet total distance.
  
- l. **Standby Diver.** While a diver is in the water, the SSA standby diver must be suited up and ready to dive in an emergency.
  
- m. **Communication System.** All SSA diving operations require electronic communication systems. The communication system must provide diver-to-diver and diver-to-surface communication. If voice communications are lost, terminate all diving.