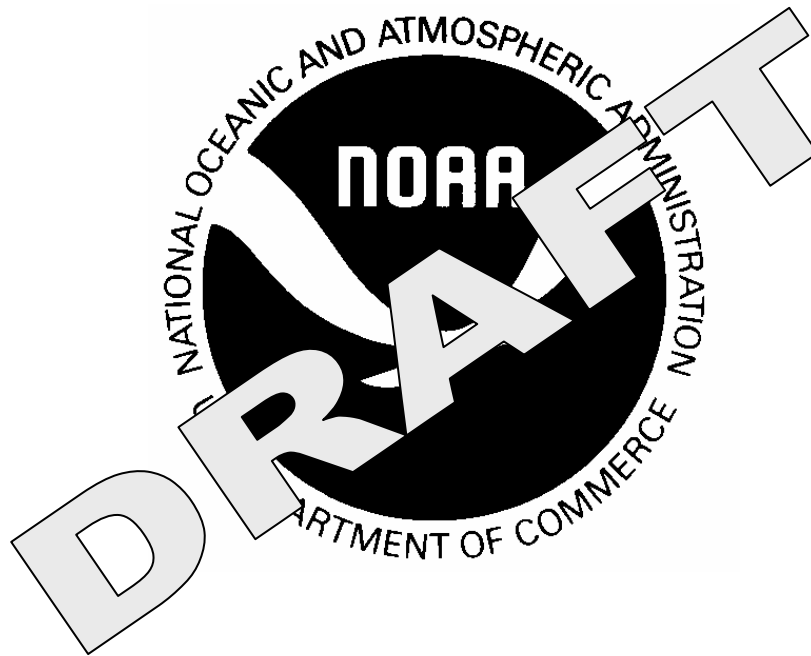


NOAA DIVING PROGRAM

MINIMUM STANDARD FOR DECOMPRESSION DIVING USING OPEN-CIRCUIT SCUBA EQUIPMENT



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FOR
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1.0 INTRODUCTION AND SCOPE

This standard specifies minimum requirements for conducting decompression diving operations using open-circuit self-contained underwater breathing apparatus (scuba) to ensure a minimum level of safety. It applies to all personnel engaged in diving activities under the auspices of the NOAA Diving Program.

The requirements outlined in this document are in addition to those listed in NOAA Administrative Order 209-123, commonly referred to as the NOAA Diving Regulations.

Exceptions to this standard will be considered by the NOAA Diving Safety Board on a case-by-case basis and may be approved if such exceptions are deemed as safe as or safer than those listed in this document.

2.0 QUALIFICATIONS

2.1 Certification and Authorization

- A. Divers must be trained and certified by the NOAA Diving Program (NDP) or another NOAA-approved certification agency (i.e., IANTD, NAUI) for the equipment, depth, and gas mixture of the proposed dive plan.
- B. Divers must be currently authorized to dive by the NDP or another NOAA-approved diving program.

2.2 Proficiency requirements

- A. In order to participate in decompression diving operations divers must have performed a minimum of 12 dives in the last 6 months.
- B. Divers must also have completed one dive within the previous 30-day period in the minimum equipment configuration to be used on the project.

3.0 EQUIPMENT

3.1 General

- A. Valve and regulator systems for primary (bottom) gas supplies shall be configured in a redundant manner that allows continuous gas delivery in the event of failure of any one component of the regulator/valve system.
- B. Minimum diver-worn equipment required:
 - 1. Mask, and fins
 - 2. Exposure suit

3. Buoyancy control devices
4. Depth gauges
5. Dive timing devices
6. Decompression tables
7. Lift bag & line reel
8. Cutting devices
9. Signaling devices

3.2 Scuba cylinders

- A. Scuba cylinders used for dives > 130 feet shall be outfitted with DIN valves.
- B. If using a single cylinder, an auxiliary gas supply with adequate volume to reach the next gas supply is required.
- C. Dual cylinders shall be connected with a dual manifold with isolation valves and be adjusted on the backpack/harness assembly so that divers can reach each cylinder and manifold valve.
- D. Scuba cylinders used for decompression shall be color-coded and labeled in accordance with the following standards:

| Gas | Cylinder Color | Labeling |
|--------|----------------|--|
| Air | Any color | None |
| Oxygen | White or Green | "Oxygen" stenciled in 3 inch high color-contrasting letters |
| Nitrox | Yellow | Four (4) inch green band with "NITROX" or "Enriched Air" stenciled in 2 inch high letters |
| | Other | Non-yellow cylinders have an additional 1 inch yellow band above and below the green label |
| Trimix | Any color | "Trimix" stenciled in 3 inch high color-contrasting letters |
| Heliox | Any color | "Heliox" stenciled in 3 inch high color-contrasting letters |

- E. The maximum operating depth (MOD), based on a maximum PO₂ of 1.6 atm, of each breathing gas/cylinder (other than air) must be displayed in three-inch high letters along the side of the cylinder, both facing inward towards the diver and outwards so other divers can identify the cylinder contents.

3.3 Scuba regulators

- A. Dual cylinders shall be outfitted with redundant scuba regulators.
- B. The primary supply regulator shall be configured with a hose of adequate length to facilitate effective emergency gas sharing in the intended environment.
- C. Regulators used with oxygen supplies shall be secured in a way (e.g., pouch or bungee) that reduces the possibility of inadvertent use at depths that would result in a hyperoxic exposure.

3.4 Buoyancy control

- A. Divers shall have the capability to achieve positive buoyancy at all depths.
- B. Acceptable means of buoyancy include:
 - 1. Dual-bladder buoyancy compensators with separate inflator hoses
 - 2. Single-bladder buoyancy compensators with a variable-volume drysuit, each with separate inflator hoses.
- C. When wearing dual cylinders, top and bottom dump valves shall be provided for the primary bladder, with a top dump valve standard for the redundant backup bladder. Each bladder must be capable of achieving positive buoyancy at all depths and be outfitted with an over pressurization relief valve.

3.5 Depth & cylinder pressure gauges

- A. Each diver shall have a redundant means of monitoring depth. At least one (1) of the devices shall be capable of recording the maximum depth obtained during dives for display once on the surface.
- B. Each gas supply will have its own dedicated submersible pressure gauge.

3.6 Dive timing devices

- A. Each diver shall have a redundant means of tracking dive time.
- B. Examples of acceptable devices include dive computers, bottom timers, and watches.

3.7 Signaling devices

- A. Each diver shall carry the following surface signaling devices:
 - 1. SMB (surface marker buoy)
 - 2. Signal mirror
 - 3. Whistles or other audible signaling devices
- B. If dives are conducted within 2-hours of sunset, each diver must also carry a flashlight and/or strobe light.

3.8 Lift bag & line reel

- A. Each diver shall carry a lift bag (minimum of 50 pounds buoyancy) and a line reel with line equal to 1.5 times the maximum depth anticipated during a dive.
- B. Redundant lift bags and line reels may be required at the discretion of the on-site Diving Supervisor.

3.9 Support boats

- A. There must be a means of extraction of an unconscious victim from the water in a timely manner at all times during decompression dive operations.
- B. In addition to any NOAA small boat requirements, each boat shall carry an oxygen resuscitator capable of ventilating an unconscious victim and a minimum of one (1) cylinder of each type of decompression gas used on the dive.

3.10 Recompression chamber

- A. A recompression chamber shall be accessible within 30 minutes from the dive site.
- B. A plan shall be prepared and verified to transport an injured diver to a recompression chamber within the required time frame.
- C. Only ASME, ABS, or equivalent certifying authority - including current PVHO - hyperbaric chambers may be used.

4.0 BREATHING GASES & GAS MANAGEMENT

4.1 General

- A. All gases used for diving must be of breathing quality.
- B. All breathing mixtures to be used for diving shall be analyzed for oxygen content using an oxygen analyzer. Gases must test within acceptable parameters as specified in the dive tables or computers used.
- C. It is the responsibility of each diver to confirm and verify in writing the oxygen content of his/her scuba cylinder(s) prior to commencing diving and acknowledge the following:
 - 1. PPO2 cut off depth (MOD) and appropriate gas mixture(s) to be used for each phase of the dive, and
 - 2. planned maximum depth and bottom time for the dive, and
 - 3. availability of adequate volumes of gas as determined by review of cylinder pressures.
- D. When physiologically appropriate, and approved by the NDP, nitrox and/or 100% oxygen may be substituted for compressed air during ascent and/or decompression stops.
- E. Each diver is responsible for calculating and carrying the required volume of breathing gases needed for each phase of the dive, plus reserves. The "rule-of-thirds" (one third to get to the dive site, one-third to reach the first decompression stop, and one-third reserve) shall be followed on all decompression dives.
- F. Divers shall carry sufficient gas to complete all phases of the dive including descent, on-the-bottom, ascent and decompression independent of surface support. Additionally, sufficient gas shall be carried to complete in-water decompression for the next deeper depth and bottom time planned.

4.2 Oxygen

- A. Breathing gases used while performing in-water decompression shall contain the same or greater oxygen content as that used during the bottom phase of the dive.
- B. All gas systems, components, and storage containers used with oxygen mixtures above 40% by volume, must be formally cleaned in accordance with the NOAA Diving Manual (4th Edition).
- C. Oxygen used for diving or nitrox preparation shall meet or exceed the purity levels for Medical (U.S.P.), or Aviator Grade oxygen.

4.3 Air

Compressed air used with oxygen concentrations greater than 40% or when used in the preparation of nitrox breathing mixtures with greater than 40% oxygen as the enriching agent, shall meet or exceed CGA Grade E standards.

5.0 MANNING REQUIREMENTS

5.1 Minimum diving positions & capabilities

A. Bottom divers

1. Minimum of two (2) divers functioning as a buddy team
2. Divers shall remain in such proximity to each other to render immediate assistance if necessary at all times during the dive. If separated during the dive, divers shall initiate the standard separated buddy procedure.

B. Support divers

1. Minimum of two divers, one of which is capable and outfitted to reach the bottom.
2. Divers that may be required to dive to the bottom must be appropriately trained and outfitted to perform such dives.

5.2 Minimum topside support

A. Diving Supervisor

1. Must remain at the surface during diving operations
2. Must be approved by the NDP

B. Vessel/boat captain

1. Must remain on the vessel/boat during diving operations
2. Must concur with the Diving Supervisor on the commencement of diving operations and can terminate diving due to weather, operational problems, or any other factors that may jeopardize the safety of the operation

6.0 MINIMUM OPERATIONAL REQUIREMENTS

6.1 Dive Planning

A. Dive condition limits

1. The Diving Supervisor and the Vessel Captain shall assess current and predicted weather conditions, sea state and current speed and direction and decide whether or not diving can be safely initiated.

B. Diver Communications

1. Bottom divers must be able to signal topside personnel at all times during the dive.
2. Signaling protocols must be established that allow the differentiation between routine and emergency situations.

6.2 Decompression Calculation

A. All decompression tables must be approved by the NDP.

B. The use of dive computers and/or computer-based decompression generating software program must be approved by the NDP.

- C. Each diver must carry a set of decompression dive tables. Additionally, one over and one under contingency time schedule will be carried by each bottom diver.

6.3 Maximum Depth & Bottom Time

- A. Maximum depth for decompression diving using open-circuit scuba equipment and breathing air is 170 feet.
- B. The maximum operating depth for a given breathing mixture shall be based on the oxygen partial pressure of the gas and shall not exceed 1.6 atmospheres of pressure.
- C. Bottom times will not exceed the maximum allowable exposure time for a given partial pressure of oxygen as listed in Table 15.2, Appendix D, NOAA Diving Manual (4th Edition).
- D. Repetitive dives may be approved by the diving supervisor if appropriate and approved diving tables and procedures are available.

6.4 Diving Procedures

- A. Deployment
 - 1. The procedures involved with descending to the bottom, i.e., use of down-line versus “free dropping,” will be determined by the Diving Supervisor.
 - 2. If the members of the bottom team get separated during descent and cannot locate each other within five (5) minutes of reaching the bottom, both divers will terminate the dive and begin ascent/decompression.
 - 3. No additional dives will be made until all members of the dive team have completed their in-water decompression and have been on the surface for a minimum of 30-minutes.
- B. On-bottom

The decision to remove and stage decompression cylinders once on the bottom must be approved by the Diving Supervisor.
- C. Ascent

The procedures involved with ascending to the surface, i.e., use of ascent-line versus “drift decompression,” will be determined by the Diving Supervisor.

6.5 Contingency Protocols

- A. The following contingency protocols must be established and practiced and/or reviewed by all participants prior to commencement of diving.
 - 1. Out of Gas
 - Bottom mix failure
 - Decompression staged gases
 - 2. Aborted dive procedures
 - 3. Omitted decompression
 - 4. Lost bottom divers
 - Separation during deployment
 - Unable to reach down-line
 - Unable to locate ascent-line
 - Separated on dive site

- Separated or swept off dive site
 - Entanglement on bottom
 - Buoy/down-line breakaway
5. CNS Oxygen Toxicity
 6. Change in environmental condition during dive
 - Increase in current
 - Increase in surface waves and/or swells
 - Change in water temperature

B. Post-dive incident review

1. Following the actual occurrence of any of the above scenarios, a post-dive “stand down” will be initiated to thoroughly review the incident.
2. If deemed a “near-miss” an incident report will be written and submitted in accordance with NAO 209-123, Section 5.02b.1 (b).

7.0 DIVE PLAN

7.1 Submission and Review Requirements

- A. In accordance with NAO 209-123, Section 5.01a, proposed diving projects involving non-standard open-circuit scuba diving equipment and techniques must be approved by the NDP before diving activities begin.
- B. In order to evaluate the proposed diving activities, a detailed dive plan must be submitted to the NDP for review a minimum of 45 days prior to the commencement of diving operations.
- C. The dive plan shall include, but not be limited to, the following elements:
 1. Overview of the operations
 2. Goals, objectives, and tasks to be accomplished
 3. Description and location of dive site
 4. Names, affiliations, roles/responsibilities, and qualifications of all participants
 5. Schedule of operations
 6. Description of equipment and facilities
 7. Logistical arrangements and considerations
 8. Normal and emergency diving procedures
 9. Dive accident management plan
 10. Supporting documents, permits, and forms