ACN 2/R7 to U.S. Navy Diving Manual (SS521-AG-PRO-010), Change A

ACN 2/R7 effects changes in the following areas IAW Diving Operations Assessment Integrated Project Team recommendations:

a) Mishap and Near Mishap Reporting
b) Planning and ORM
c) Breathhold Diving
d) Calculation of SCUBA Air Supply

The following changes are attached:

1) Chapter 5
   Changes: updated paragraph 5-7
   Action: replace pages 1-ix, and 5-10 through 5-15 with attached.

2) Chapter 6
   Changes: bullets added to 6-3.1, new section 6-3.4 added, and updated paragraph 6-6.2.
   Action: replace pages 2-i through 2-iv, 2-xiii, 2-xvii, and 6-6 through 6-67 with attached.

3) Chapter 7
   Changes: section 7-4
   Action: replace page 7-14 with attached.

4) Insert a copy of this page of the ACN following the Record of Changes.

5-6 DIVER'S PERSONAL DIVE LOG

Although specific Navy Divers Personal Logbooks are no longer required, each Navy trained diver is still required to maintain a record of his dives in accordance with the OPNAVINST 3150.27 (series). The best way for each diver to accomplish this is to keep a copy of each Diving Log Form in a binder or folder. The Diving Log Form is generated by the Diver Reporting System (DRS) software. These forms, when signed by the Diving Supervisor and Diving Officer, are an acceptable record of dives that may be required to justify special payments made to you as a diver and may help substantiate claims made for diving-related illness or injury. If an individual desires a hard copy of the dives, the diver's command can generate a report using the DRS or by submitting a written request to the Naval Safety Center.

5-7 DIVING MISHAP/CASUALTY REPORTING

Mishaps shall be reported through Web Enabled Safety System (WESS) or naval message IAW OPNAVINST 5102.1 (series). Activities without reliable internet access may obtain an offline version of WESS through NAVSAFECEN for uploading via email when a connection becomes available.

Use the following guidance for dive mishap reporting on evolutions while preparing, conducting, and concluding diving operations to include divers, dive station watch standers, and support personnel: Any dive mission associated incident to include, but not limited to, restricted work, limited duty, light duty, recompression treatment or loss of consciousness on the surface shall be reported as a dive mishap. Restricted work, limited duty, light duty includes, but is not limited to thermal exposure, dehydration, altitude sickness, placing military or civilian personnel on a non-dive status regardless of the amount of time, with the exception of non-repetitive diving restrictions, shall be reported as a mishap.

Units shall investigate and submit a HAZREP on hazards and near-mishaps that do not warrant submission of a Safety Investigation Report (SIREP). Self-evaluation and self-reporting of near mishaps is a key measure of professionalism and demonstrates concern for the greater diving community. To the greatest extent possible, the reporting of safety issues or concerns shall be handled so that persons reporting or individuals involved in the reported event are not subject to punishment or censure.

Submission of HAZREPS ensures safety information is collected and disseminated throughout the fleet with the goal of preventing mishaps. Collection of hazard and near-mishap data over time allows for trend analysis and the resourcing of Fleet wide solutions to enable safe and effective diving in hazardous environments.

Specific instructions for reporting hazards, diving mishaps, near mishaps, and hyperbaric treatment are provided in OPNAVINST 5102.1 (series).

The Judge Advocate General (JAG) Manual provides instructions for investigation and reporting procedures required in instances when the mishap may have occurred as a result of procedural or personnel error. Per OPNAVINST 5202.1, a JAG investigation must remain separate from any Naval Safety Investigation, and the Safety Investigation Board (SIB) shall be granted access to all evidence collected by the JAGMAN. Further, the SIB shall be fully supported in its investigation and permitted to operate with autonomy from the oversight of operational commanders once appointed by competent appointing authority.

The following are examples (not all inclusive) of hazards and near-mishaps:

1. Execution of emergency procedure, examples include, but are not limited to:
   - Shifting to secondary air.
   - Aborted dive due to unexpected issue\event.
   - Fouling.
   - Lost diver.
2. Exceeding any prescribed limits regardless of the consequences, examples include, but are not limited to:
   - Maximum depth.
   - Bottom time.
   - Omitted Decompression.
3. Any out of specification condition discovered after equipment and systems are prepared for use, examples include, but are not limited to:
   - CO2 canister installed or filled improperly.
   - CO2 canister not installed.
   - Exhaust valves installed improperly.
   - System aligned improperly.
4. Any external systems, equipment, conditions that may adversely affect or impair diver safety, examples include, but are not limited to:
   - Ship's equipment operated or tags cleared without proper authorization before, during, or after divers enter the water.
   - Unauthorized cranes operated overhead of divers.
   - Small boat operations conducted over\in the vicinity of divers.
   - Unauthorized discharges while divers are in the water.

5-8 EQUIPMENT FAILURE OR DEFICIENCY REPORTING

The Failure Analysis Report (FAR) system provides the means for reporting, tracking and resolving material failures or deficiencies in diving life-support equipment (DLSE). The FAR was developed to provide a rapid response to DLSE failures or deficiencies. It is sent directly to the configuration manager, engineers, and technicians who are qualified to resolve the deficiency. FAR Form 10560/4 (stock number 0116-LF-105-6020) covers all DLSE not already addressed by other FARs or reporting systems. For example, the MK 21 MOD 1, MK 20 MOD 0 mask, and all open-circuit SCUBA are reportable on this FAR form; the UBAs MK 16 and MK 25 are reportable on a FAR or a Failure Analysis or Inadequacy Report (FAR) in accordance with their respective technical manuals. When an equipment failure or deficiency is discovered, the Diving Supervisor or other responsible person shall ensure that the FAR is properly prepared and distributed. Refer to paragraph 5-10 for additional reporting requirements for an equipment failure suspected as the cause of a diving accident.

An electronic version of the FAR form is also available on-line at http://www.supsalv.org. Click on Diving or 00C3 Diving. When the next screen appears, click on Failure Analysis Reporting. Follow the instructions and submit the form.

5-9 U.S. NAVY DIVE REPORTING SYSTEM (DRS)

The Dive Reporting System (DRS) is a computer-based method of recording and reporting dives required by the OPNAVINST 3150.27 (series), and replaces reporting on DD Form 2544. The computer software provides all diving commands with a computerized record of dives.

The DRS makes it easy for commands to submit diving data to the Naval Safety Center. The computer software allows users to enter dive data, transfer data to the Naval Safety Center, and to generate individual diver and command reports. The DRS was designed for all branches of the U.S. Armed Services and can be obtained through:

Commander, Naval Safety Center
Attention: Code 37
375 A Street
Norfolk, VA 23511-4399

5-10 ACCIDENT/INCIDENT EQUIPMENT INVESTIGATION REQUIREMENTS

An *accident* is an unexpected event that culminates in loss of or serious damage to equipment or loss of consciousness, injury, or death to personnel. An *incident* is an unexpected event that degrades safety and increases the probability of an accident.

The number of diving accidents/incidents involving U.S. Navy divers is small when compared to the total number of dives conducted each year. The mishaps that do occur, however, must receive a thorough review to identify the cause and determine corrective measures to prevent further diving mishaps.

This section expands on the OPNAVINST 5102.1 (series) that requires expeditious reporting and investigation of diving related mishaps. The accident/incident equipment status reporting procedures in this chapter apply, in general, to all diving mishaps when malfunction or inadequate equipment performance, or unsound equipment operating and maintenance procedures are a factor.

In many instances a Diving Life Support Equipment Failure Analysis Report (FAR) may also be required. The primary purpose of this requirement is to identify any material deficiency that may have contributed to the mishap. Any suspected malfunction or deficiency of life support equipment will be thoroughly investigated by controlled testing at the Navy Experimental Diving Unit (NEDU). NEDU has the capability to perform engineering investigations and full unmanned testing of all Navy diving equipment under all types of pressure and environmental conditions. Depth, water turbidity, and temperature can be duplicated for all conceivable U.S. Navy dive scenarios.

Contact NAVSEA/00C3 to assist diving units with investigations and data collection following a diving mishap. 00C3 will assign a representative to inspect the initial condition of equipment and to pick up or ship all pertinent records and equipment to NEDU for full unmanned testing. Upon receiving the defective equipment, NEDU will conduct unmanned tests as rapidly as possible and will then return the equipment to the appropriate activity.

NOTE **Do not tamper with equipment without first contacting NAVSEA/00C3 for guidance.**

5-11 REPORTING CRITERIA

The diving and diving related accident/incident equipment status requirements set forth in this chapter are mandatory for all U.S. Navy diving units in each of the following circumstances:

- In all cases when an accident/incident results in a fatality or serious injury.
- When an accident/incident occurs and a malfunction or inadequate performance of the equipment may have contributed to the accident/incident.

5-12 ACTIONS REQUIRED

U.S. Navy diving units shall perform the following procedure when a diving accident/incident or related mishap meets the criteria stated in paragraph 5-11.

1. Immediately secure and safeguard from tampering all diver-worn and ancillary/support equipment that may have contributed to the mishap. This equipment should also include, but is not limited to, the compressor, regulator, depth gauge, submersible pressure gauge, diver dress, buoyancy compensator/life preserver, weight belt, and gas supply (SCUBA, emergency gas supply, etc.).

2. Expeditiously report circumstances of the accident/incident via WESS. Commands without WESS access should report by message (see OPNAVINST 5102.1 (series) for format requirements) to:

- NAVSAFECEN NORFOLK VA//JJJ// with information copies to CNO WASHINGTON DC//N773// COMNAVSEASYSCOM WASHINGTON DC//00C// and NAVXDIVINGU PANAMA CITY FL//JJJ//.

- If the accident/incident is MK 16 MOD 1 related, also send information copies to PEO LMW WASHINGTON DC//PMS-EOD// and NAVEODTECHDIV INDIAN HEAD MD//70//.

- If the accident/incident is MK 16 MOD 0 related, also send information copies to PEO LMW WASHINGTON DC//PMS-NSW//.

- If the accident/incident occurs at a shore-based facility, contact NAVFAC SCA, also send information copies to NFESC EAST COAST DET WASHINGTON DC//55//.

3. Expeditiously prepare a **separate, written report** of the accident/incident. The report shall include:

- A completed Equipment Accident/Incident Information Sheet (Figure 5-2).

- A sequential narrative of the mishap including relevant details that might not be apparent in the data sheets.

4. The data sheets and the written narrative shall be mailed by traceable registered mail to:

Commanding Officer
Navy Experimental Diving Unit
321 Bullfinch Road
Panama City, Florida 32407-7015
Attn: Code 03, Test & Evaluation

5. Package a certified copy of all pertinent 3M records and deliver to NAVSEA/00C3 on-scene representative.

NOTE **Call NAVSEA/NEDU/NAVFAC with details of the mishap or incident whenever possible. Personal contact may prevent loss of evidence vital to the evaluation of the equipment.**

5-12.1 **Technical Manual Deficiency/Evaluation Report.** If the accident/incident is believed to be solely attributable to unsound operating and maintenance procedures, including publications, submit a NAVSEA (user) Technical Manual Deficiency/ Evaluation Report (TMDER) and request guidance from NEDU to ascertain if shipment of all or part of the equipment is necessary.

5-12.2 Shipment of Equipment. To expedite delivery, SCUBA, MK 16 and EGS bottles shall be shipped separately in accordance with current DOT directives and command procedures for shipment of compressed gas cylinders. Cylinders shall be forwarded in their exact condition of recovery (e.g., empty, partially filled, fully charged). If the equipment that is believed to be contributory to the accident/incident is too large to ship economically, contact NEDU to determine alternate procedures.

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ballast tanks, mud tanks, or cofferdams, which may be in either a flooded or dry condition. Access to these spaces is normally restrictive, making it difficult for the diver to enter and exit. Enclosed space diving shall be supported by a surface-supplied air system. Refer to Section 8-11.4 for more information on the hazards of enclosed space diving.

6-3 GENERAL PLANNING AND ORM PROCESS

A successful diving mission is the direct outcome of careful, thorough planning. The nature of each operation determines the scope of the planning effort, but certain general considerations apply to every operation.

- Bottom Time. Bottom time is always at a premium. Developing measures to conserve bottom time or increase diver effectiveness is critical for success. Use of a dive computer can increase available bottom time by giving credit for time spent shallower than the maximum depth of the dive.
- Preplanning. An operation that is delayed due to unanticipated problems may fail. Preplanning the use of the time available to accomplish specific objectives is a prerequisite to success.
- Equipment. Selecting the correct equipment for the job is critical to success.
- Environmental Conditions. Diving operational planners must plan for safely mitigating extreme environmental conditions. Personnel and support facility safety shall be given the highest priority.
- Diver Protection. It is critical to protect divers from all anticipated hazards. Application of the ORM process will identify hazards prior to the operation.
- Emergency Assistance. It is critical to coordinate emergency assistance from outside sources before the operation begins.
- Weather. Because diving operations are weather dependent, dive planning shall allow for worst-case scenarios.

6-3.1 Concept of ORM:

- ORM is a decision making tool used by people at all levels to increase operational effectiveness by anticipating hazards and reducing the potential for loss, thereby increasing the probability of successful mission.
- Increases our ability to make informed decisions by providing the best baseline of knowledge and experience available.
- Minimizes risks to acceptable levels, commensurate with mission accomplishment. The amount of risk we will take in war is much greater than that we should be willing to take in peace, but the process is the same. Applying the ORM process will reduce mishaps, lower costs, and provide for more efficient use of resources.
- Operational necessity is only invoked when mission success is more important to the nation than the lives and/or equipment of those undertaking it.

- Operational necessity does not apply to training.

- Manage risk by planning. Risk is best managed in the planning stage of an operation.

- Avoid unnecessary risk. Only accept risk that can be controlled and contributes to mission success.

- Accept controlled risk when its benefit outweighs its potential cost.

- Make risk decisions at the right level where the decision-maker has the proper authority to accept the risk. The greater the risk, the higher the authority required to approve taking the risk.

- Potential hazards shall be deliberately considered as a part of analysis and planning, and shall provide an estimate of hazard severity, an estimate of mishap probability and assigned Risk Assessment Code (RAC).

- Risk mitigation tactic, techniques, and procedures shall be formally reviewed and compared against ORM variables and determined if they appropriately mitigate risk by comparing RACs.

6-3.2 Risk Management Terms:

- Hazard – A condition with potential to cause personal injury or death, property damage, or mission degradation.
- Risk – An expression of possible loss in terms of severity and probability.
- Risk Assessment – The process of detecting hazards and assessing associated risks.
- Operational Risk Management (ORM) – The process of dealing with risk associated within military operations, which includes risk assessment, risk decision-making and implementation of effective risk controls.

6-3.3 Risk Management Principles and Levels.

There are four basic principles that provide the foundation for Risk Management and the framework for implementing the Operational Risk Management (ORM) Process.

Planners and supervisors shall adhere to the following four principles in ORM:

- Accept risk when benefits outweigh the cost.

- Accept no unnecessary risk.

- Anticipate and manage risk by planning.

- Make risk decisions at the right level.

The RM process is applied on three levels: in-depth, deliberate, and time critical.

6-3.3.1 **In-depth.** In-depth refers to situations when time is not a limiting factor and the right answer is required for a successful mission or task. Examples of in-depth methods include thorough research and analysis of available data, use of diagrams and analysis tools, formal testing or long term tracking of associated hazards.

6-3.3.2 **Deliberate.** Deliberate refers to situations when there is ample time to apply the ORM process to the detailed planning of a mission or task. At this level, the planning primarily uses experienced personnel and brainstorming and is more effective when done in a group.

6-3.3.3 **Time Critical.** Time critical refers to being at the point of commencing or during execution of a mission or task. At this level there is little or no time to make a plan. Since time is limited in this situation, the application of the 5-step process has proven impractical and ineffective. The Navy has adopted the A-B-C-D Model (Figure 6-5) to facilitate use of ORM at the time critical level and is further explained under paragraph 6-3.5.

The Link Between Time Critical and Deliberate

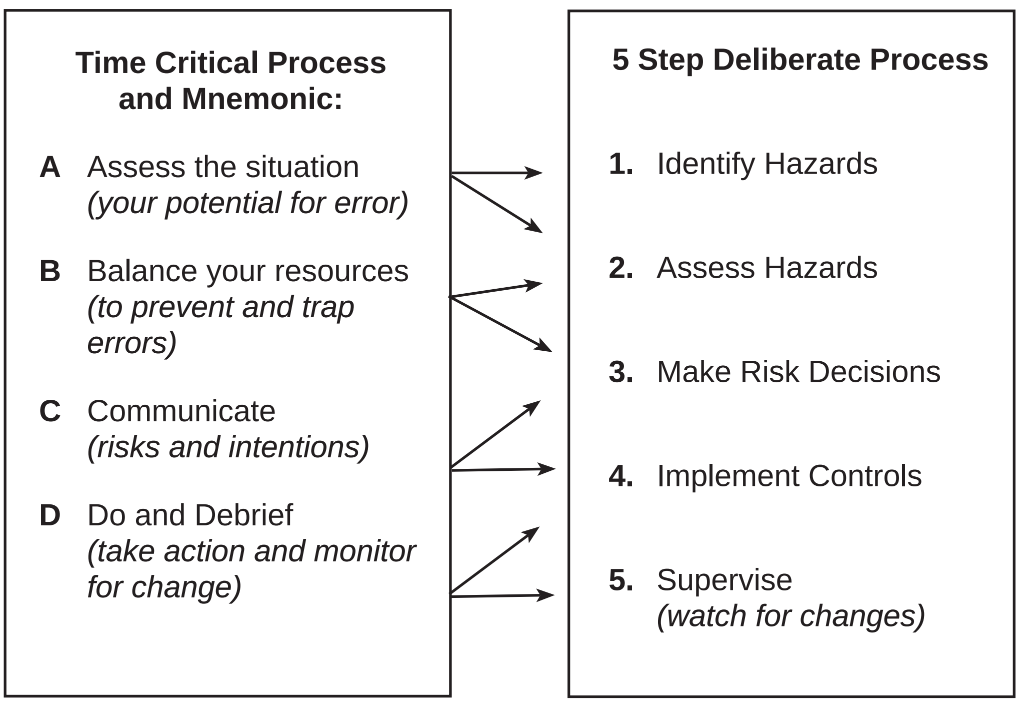


Figure 6-5. The Link Between Time Critical and Deliberate.

This requires a high degree of situational awareness. The U.S. Navy summarizes the Time Critical Risk Management (TCRM) process in a four-step A-B-C-D model:

1. **A**ssess the situation.

   The three conditions of the Assess step are task loading, human factors, and additive conditions.

   - Task loading refers to the negative effect on performance of the tasks due to increased tasking.
   - Human factors refers to the limitations of the ability of the human body and mind to adapt to the work environment (examples include, but are not limited to: stress, fatigue, impairment, lapses of attention, confusion, and willful violations of regulations).
   - Additive factors refers to the cumulative effect of variables.

Task loading examples include:

- Underwater photography or videography
- Underwater search and recovery
- Underwater mapping
- Diving in environments requiring use of lights or guide reels (such as night diving, wreck diving and cave diving) or other additional equipment
- Use of thick wetsuits or dry suits
- Driving a diver propulsion vehicle (DPV)
- Diving in cold water
- Breathing a narcotic gas mixture

Task loading represents an elevated risk when a new activity is undertaken by an inexperienced diver. A diver learning how to use a dry suit, or starting underwater photography, will need to dedicate considerably more attention to the proper functioning of the new and unfamiliar piece of equipment which leads to the elevated risk of neglect of other responsibilities. Those risks will normally diminish with experience.

Common examples of routine functions that can be overlooked as a result of task loading are:

- Monitoring air supply properly
- Maintaining buddy contact
- Maintaining proper buoyancy or depth control

- Monitoring depth and time
- Monitoring oxygen partial pressure in a rebreather

Task loading is often identified as a key component in diving accidents, although statistically it is difficult to monitor because divers of differing levels of experience can cope with a more complex array of tasks and equipment. While simply getting used to using a drysuit can call for great levels of attention in an inexperienced diver, it might be a routine piece of equipment for an experienced cold water diver.

2. **B**alance your resources.

This refers to balancing resources in three different ways:

- Balancing resources and options available. This means evaluating and leveraging all the informational, labor, equipment, and material resources available.
- Balancing resources versus hazards. This means estimating how well prepared you are to safely accomplish a task and making a judgment call.
- Balancing individual versus team effort. This means observing individual risk warning signs. It also means observing how well the team is communicating, knows the roles that each member is supposed to play, and the stress level and participation level of each team member.

3. **C**ommunicate risks and intentions.

- Communicate hazards and intentions.
- Communicate to the right people.
- Use the right communication style; Asking questions is a technique to opening the lines of communication whereas a direct and forceful style of communication gets a specific result from a specific situation.

4. **D**o and debrief. (Take action and monitor for change.)

This is accomplished in three different phases:

- Execute and apply Time Critical Risk Management and continuing assessment involves managing change and risk while an event is in progress.
- Mission Completion is a point where the event can be evaluated and reviewed in full.
- Future performance improvements refers to preparing “lessons learned” for the next team that plans or executes a task.

Supervisors shall be specifically wary of “optimism bias” or unrealistic optimism. Optimism bias causes a person to believe that they are less at risk of experiencing a negative event compared to others. There are four factors that cause people to be optimistically biased: their desired end state, their cognitive mechanisms, the information they have about themselves versus others, and their overall mood. The optimistic bias is seen in a number of situations. For example: divers inherently believing they are naturally at less risk of injury in a diving incident than other divers. Avoidance of optimism bias is achieved through legitimate mission analysis, planning and ORM.

6-3.4 **ORM Process.** The five step process is:

1. Identify Hazards – Begin with an outline or chart of the major steps in the operation (operational analysis). Next, conduct a Preliminary Hazard Analysis by listing all of the hazards associated with each step in the operational analysis along with possible causes for those hazards.

2. Assess Hazards – For each hazard identified, determine the associated degree of risk in terms of probability and severity. Although not required; the use of a matrix may be helpful in assessing hazards.

3. Make Risk Decisions – First, develop risk control options. Start with the most serious risk first and select controls that will reduce the risk to a minimum consistent with mission accomplishment. With selected controls in place, decide if the benefit of the operation outweighs the risk. If risk outweighs benefit or if assistance is required to implement controls, communicate with higher authority in the chain of command.

4. Implement Controls – The following measures can be used to eliminate hazards or reduce the degree of risk. These are listed by order of preference:

   - Administrative Controls – Controls that reduce risks through specific administrative actions, such as:
   - Providing suitable warnings, markings, placards, signs, and notices.
   - Establishing written policies, programs, instructions and standard operating procedures (SOP).
   - Training personnel to recognize hazards and take appropriate precautionary measures.
   - Limiting the exposure to hazard (either by reducing the number or personnel/assets or the length of time they are exposed).
   - Engineering Controls – Controls that use engineering methods to reduce risks by design, material selection or substitution when technically or economically feasible.
   - Personal Protective Equipment – Serves as a barrier between personnel and hazard. It should be used when other controls do not reduce the hazard to an acceptable level.

5. Supervise – conduct follow-up evaluations of the controls to ensure they remain in place and have the desired effect. Monitor for changes, which may require further ORM. Take corrective action when necessary.

6-4 COLLECT AND ANALYZE DATA

Information pertinent to the mission objective shall be collected, organized, and analyzed to determine what may affect successful accomplishment of the objective. This process aids in:

- Planning for contingencies
- Developing the dive plan
- Selecting diving technique, equipment, and diver personnel
- Identifying potential hazards and the need for any special emergency procedures

6-4.1 **Information Gathering.** The size of the operation, the diving site location, and the prevailing environmental conditions influence the extent and type of information that must be gathered when planning an operation. Some operations are of a recurring nature; so much of the required information is readily available. An example of a recurring operation is removing a propeller from a particular class of ship. However, even for a standard operation, the ship may have been modified or special environmental conditions may exist, requiring a change in procedure or special tools. Potential changes in task requirements affecting work procedures should not be overlooked during planning.

6-4.2 **Planning Data.** Many operations require that detailed information be collected in advance. For example, when planning to salvage a sunken or stranded vessel, the diving team needs to know the construction of the ship, the type and location of cargo, the type and location of fuel, the cause of the sinking or stranding, and the nature and degree of damage sustained. Such information can be obtained from ship's plans, cargo manifests and loading plans, interviews with witnesses and survivors, photographs, and official reports of similar accidents.

6-4.3 **Object Recovery.** Operations involving the recovery of an object from the bottom require knowledge of the dimensions and weight of the object. Other useful information includes floodable volume, established lifting points, construction material, length of time on the bottom, probable degree of embedment in mud or silt, and the nature and extent of damage. This data helps determine the type of lift to be used (e.g., boom, floating crane, lifting bags, pontoons), indicates whether high-pressure hoses are needed to jet away mud or silt, and helps determine the disposition of the object after it is brought to the surface. Preliminary planning may find the object too heavy to be placed on the deck of the support ship, indicating the need for a barge and heavy lifting equipment.

6-4.3.1 **Searching for Objects or Underwater Sites.** When the operation involves searching for an object or underwater site, data gathered in advance helps to limit the search area. There are numerous planning data sources available to help supervisors collect data for the operation (see Figure 6-5).

PLANNING DATA SOURCES		
■ Aircraft Drawings	■ Light Lists	■ Ship's Personnel
■ Cargo Manifest	■ Local Yachtsmen/Fishermen	■ Ships Drawings (including docking plan)
■ Coastal Pilot Publications	■ LORAN Readings	■ Side-Scan Sonar Plots
■ Cognizant Command	■ Magnetometer Plots	■ SINS Records
■ Communications Logs	■ Navigation Text (Dutton's/Bowditch)	■ SITREP
■ Construction Drawings	■ Navigational Charts	■ Sonar Readings and/or Charts
■ Current Tables	■ NAVOCEANO Data	■ TACAN Readings
■ Diving Advisory Messages	■ Notices to Mariners	■ Technical Reference Books
■ DRT Tracks	■ OPORDERS	■ Test Records
■ DSV/DSRV Observations	■ Photographs	■ Tide Tables
■ Electronic Analysis	■ Radar Range and Bearings	■ Underwater Work Techniques
■ Equipment Operating Procedures (OPs)	■ RDF Bearings	■ USN Diving Manual Reference List
■ Equipment Operation and Maintenance Manuals	■ ROV Video and Pictures	■ USN Instructions
■ Eyewitnesses	■ Sailing Directions	■ USN Ship Salvage Manual
■ Flight or Ship Records	■ Salvage Computer Data	■ Visual Bearings
■ Flight Plan	■ Ship's Curves of Forms	■ Weather Reports
■ Hydrographic Publications	■ Ship's Equipment	
	■ Ship's Logs and Records	

Figure 6-6. Planning Data Sources.

For example, information useful in narrowing the search area for a lost aircraft includes the aircraft's last known heading, altitude, and speed; radar tracks plotted by ships and shore stations; tape recordings and radio transmissions; and eyewitness accounts. Once a general area is outlined, a side scan sonar system can be used to locate the debris field, and an ROV can identify target items located by the side scan sonar. Once the object of the search has been found, the site should be marked, preferably with an acoustic transponder (pinger) and/or a buoy. If time and conditions permit, preliminary dives by senior, experienced members of the team can be of great value in verifying, refining, and analyzing the data to improve the dive plan. This method saves diver effort for recovering items of interest.

6-4.4 **Data Required for All Diving Operations.** Data involving the following general categories shall be collected and analyzed for all diving operations:

- Surface conditions
- Underwater conditions
- Equipment and personnel resources
- Assistance in emergencies

6-4.4.1 **Surface Conditions.** Surface conditions in the operating area affect both the divers and the topside team members. Surface conditions are influenced by location, time of year, wind, waves, tides, current, cloud cover, temperature, visibility, and the presence of other ships. Completing the Environmental Assessment Worksheet (Figure 6-6) helps ensure that environmental factors are not overlooked during planning. For an extensive dive mission, a meteorological detachment may be requested from the local or regional meteorological support activity.

6-4.4.1.1 ***Natural Factors.*** Normal conditions for the area of operations can be determined from published tide and current tables, sailing directions, notices to mariners, and special charts that show seasonal variations in temperature, wind, and ocean currents. Weather reports and long-range weather forecasts shall be studied to determine if conditions will be acceptable for diving. Weather reports shall be continually monitored while an operation is in progress.

NOTE **Diving shall be discontinued if sudden squalls, electrical storms, heavy seas, unusual tide or any other condition exists that, in the opinion of the Diving Supervisor, jeopardizes the safety of the divers or topside personnel.**

6-4.4.1.2 ***Sea State.*** A significant factor is the sea state (Figure 6-7). Wave action can affect everything from the stability of the moor or the Dynamic Positioning of the ship to the vulnerability of the crew to seasickness or injury. Unless properly moored, a ship or boat drifts or swings around an anchor, fouling lines, and dragging divers. Because of this, any vessel being used to support surface-supplied or tended diving operations on fixed objects such as the ocean bottom, a wreck, or an underwater structure shall be secured by at least a two-point moor or use a Dynamic Positioning vessel IMO Equipment Class 2 or 3. Exceptions to diving from a two-point moor or Dynamic Positioning vessel IMO Equipment Class 2 or 3 may occur when moored alongside a pier or another vessel that is properly anchored, or when a ship is performing diving during open ocean transits and cannot moor due to depth. A Dynamic Positioning vessel or three- or four-point moor, while more difficult to set, may be preferred depending on dive site conditions.

Divers are not particularly affected by the action of surface waves unless operating in surf or shallow waters, or if the waves are exceptionally large. Surface waves may become a serious problem when the diver enters or leaves the water and during decompression stops near the surface.

6-4.4.1.3 ***Tender Safety.*** Effective dive planning shall provide for extreme temperatures that may be encountered on the surface. Normally, such conditions are a greater problem for tending personnel than for a diver. Any reduction in the effectiveness of the topside personnel may endanger the safety of a diver. Tending personnel shall guard against:

- Sunburn and windburn
- Hypothermia and frostbite
- Heat exhaustion

ENVIRONMENTAL CHECKLIST

Date: ________

Surface

Atmosphere

Visibility ________
Sunrise (set) ________
Moonrise (set) ________
Temperature (air) ________
Humidity ________
Barometer ________
Precipitation ________
Cloud Description ________
Percent Cover ________
Wind Direction ________
Wind Force (knots) ________
Other:
____
____
____

Sea Surface

Sea State ________
Wave Action:
Height ________
Length ________
Direction ________
Current:
Direction ________
Velocity ________
Type ________
Surf. Visibility ________
Surf. Water Temp. ________
Local Characteristics
____
____
____

Subsurface

Underwater & Bottom

Depth ________
Water Temperature:
________ depth ________
________ depth ________
________ depth ________
________ bottom ________
Thermoclines ________
____
Curent:
Direction ________
Source ________
Velocity ________
Pattern ________
Tides:
High Water ____/____ Time
Low Water ____/____ Time
Ebb Dir. ____ Vel. ________
Flood Dir. ____ Vel. ________

Visibility

Underwater
ft ________ at ________ depth
ft ________ at ________ depth
ft ________ at ________ depth
Bottom
ft ________ at ________ depth
Bottom Type:
____
Obstructions:
____
____
____
Marine Life:
____
____
____
Other Data:
____
____

NOTE: A meteorological detachment may be requested from the local meteorological support activity.

Figure 6-7. Environmental Assessment Worksheet. The Environmental Assessment Worksheet indicates categories of data that might be gathered for an operation. Planners may develop an assessment methodology to suit the particular situation. The data collected is vital for effective operations planning, and is also of value when filing Post Salvage Reports.

Sea State	Description	Wind Force (Beaufort)	Wind Description	Wind Range (knots)	Wind Velocity (knots)	Average Wave Height (ft)
0	Sea like a mirror. Ripples with the appearance of scales are formed, but without foam crests.	0 1	Calm Light Air	<1 5-3	0 2	0 0.05
1	Small wavelets still short but more pronounced; crests have a glassy appearance but do not break.	2	Light Breeze	4-6	5	0.18
2	Large wavelets, crests begin to break. Foam of glassy appearance, perhaps scattered whitecaps.	3	Gentle Breeze	7-10	8.5 10	0.6 0.88
3	Small waves, becoming longer; fairly frequent whitecaps.	4	Moderate Breeze	15-16	12 13.5 14 16	1.4 1.8 2.0 2.9
4	Moderate waves, taking a more pronounced long form; many whitecaps are formed. Chance of some spray.	5	Fresh Breeze	17-21	18 19 20	3.8 4.3 5.0
5	Large waves begin to form; white foam crests are more extensive everywhere. Some spray.	6	Strong Breeze	22-27	22 24 24.5 26	6.4 7.9 8.2 9.6
6	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. Spindrift begins.	7	Moderate Gale	28-33	28 30 30.5 32	11 14 14 16
7	Moderately high waves of greater length; edges of crests break into spindrift. The foam is blown in well marked streaks along the direction of the wind. Spray affects visibility.	8	Fresh Gale	34-40	34 36 37 38 40	19 21 23 25 28
8	High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll. Visibility affected.	9	Strong Gale	45-47	42 44 46	31 36 40
9	Very high waves with long overhanging crests. Foam is in great patches and is blown in dense white streaks along the direction of the wind. The surface of the sea takes on a white appearance. The rolling of the sea becomes heavy and shock-like. Visibility is affected.	10	Whole Gale	48-55	48 50 51.5 52 54	44 49 52 54 59
	Exceptionally high waves. The sea is completely covered with long white patches of foam along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility seriously affected.	11	Storm	56-63	56 59.5	64 73
	Air filled with foam and spray. Sea completely white with driving spray. Visibility seriously affected.	12	Hurricane	64-71	>64	>80

Figure 6-8. Sea State Chart.

6-4.4.1.4 ***Windchill Factor.*** In cold, windy weather, the windchill factor shall be considered. Exposure to cold winds greatly increases dangers of hypothermia and all types of cold injury. For example, if the actual temperature is 35°F and the wind velocity is 35 mph, the windchill factor is equivalent to 5°F (Figure 6-8). For information on ice and cold water diving operations, refer to Chapter 11.

6-4.4.1.5 ***Surface Visibility.*** Variations in surface visibility are important. Reduced visibility may seriously hinder or force postponement of diving operations. For operations to be conducted in a known fog belt, the diving schedule should allow for delays because of low visibility. Diver and support crew safety is the prime consideration when determining whether surface visibility is adequate. For example, a surfacing diver might not be able to find his support craft, or the diver and the craft itself might be in danger of being hit by surface traffic. A proper radar reflector for small craft should be considered.

6-4.4.2 **Depth.** Depth is a major factor in selecting both diving personnel and apparatus and influences the decompression profile for any dive. Operations in deep waters may also call for special support equipment such as underwater lights, cameras, ROV, etc.

Depth must be carefully measured and plotted over the general area of the operation to get an accurate depth profile of the dive site. Soundings by a ship-mounted fathometer are reasonably accurate but shall be verified by either a lead-line sounding, a pneumofathometer (Figure 6-9), or a high resolution sonar (bottom finder or fish finder). Depth readings taken from a chart should only be used as an indication of probable depth.

6-4.4.3 **Type of Bottom.** The type of bottom may have a significant effect upon a diver's ability to move and work efficiently and safely. Advance knowledge of bottom conditions is important in scheduling work, selecting dive technique and equipment, and anticipating possible hazards. The type of bottom is often noted on the chart for the area, but conditions can change within just a few feet.

Independent verification of the type of bottom should be obtained by sample or observation. Figure 6-10 outlines the basic types of bottoms and the characteristics of each.

6-4.4.3.1 ***Ship Husbandry Diving Considerations.*** Prior to commencing diving operations a minimum positive clearance of four feet (twenty feet for a carrier) with the pier should be established and maintained in order to provide an egress path for divers. The minimum positive clearance of the keel to the bottom at mean low water of six feet must be established when diving below bilge keel on surface ships or below the maximum beam on submarines.

6-4.4.4 **Tides and Currents.** The basic types of currents that affect diving operations are:

- River or Major Ocean Currents. The direction and velocity of normal river, ocean, and tidal currents will vary with time of the year, phase of the tide, configuration of the bottom, water depth, and weather. Tide and current tables show the conditions at the surface only and should be used with caution when planning diving operations. The direction and velocity of the current beneath the surface may be quite different than that observed on the surface.

- Ebb Tides. Current produced by the ebb and flow of the tides may add to or subtract from any existing current.
- Undertow or Rip Current. Undertow or rip currents are caused by the rush of water returning to the sea from waves breaking along a shoreline. Rip currents will vary with the weather, the state of the tide, and the slope of the bottom. These currents may run as fast as two knots and may extend as far as one-half mile from shore. Rip currents, not usually identified in published tables, can vary significantly from day to day in force and location.
- Surface Current Generated by Wind. Wind-generated surface currents are temporary and depend on the force, duration, and fetch of the wind. If the wind has been blowing steadily for some time, this current should be taken into consideration especially when planning surface swims and SCUBA dives.

6-4.4.4.1 ***Equipment Requirements for Working in Currents.*** A diver wearing a surface-supplied outfit, such as the MK 21 SSDS with heavy weights, can usually work in currents up to 1.5 knots without undue difficulty. A diver supplied with an additional weighted belt may be able to accomplish useful work in currents as strong as 2.5 knots. A SCUBA diver is severely handicapped by currents greater than 1.0 knot. If planning an operation in an area of strong current, it may be necessary to schedule work during periods of slack water to minimize the tidal effect.

6-5 IDENTIFY OPERATIONAL HAZARDS

Underwater environmental conditions have a major influence on the selection of divers, diving technique, and the equipment to be used. In addition to environmental hazards, a diver may be exposed to operational hazards that are not unique to the diving environment. This section outlines the environmental and operational hazards that may impact an operation.

6-5.1 **Underwater Visibility.** Underwater visibility varies with depth and turbidity. Horizontal visibility is usually quite good in tropical waters; a diver may be able to see more than 100 feet at a depth of 180 fsw. Horizontal visibility is almost always less than vertical visibility. Visibility is poorest in harbor areas because of river silt, sewage, and industrial wastes flowing into the harbor. Agitation of the bottom caused by strong currents and the passage of large ships can also affect visibility. The degree of underwater visibility influences selection of dive technique and can greatly increase the time required for a diver to complete a given task. For example, a diving team preparing for harbor operations should plan for extremely limited visibility, possibly resulting in an increase in bottom time, a longer period on station for the diving unit, and a need for additional divers on the team.

Actual Air Temp °F (°C)	Wind MPH 5	10	15	20	25	30	35	40
	Equivalent Chill Temperature °F (°C)							
40 (4)	35 (2)	30 (-1)	25 (-4)	20 (-7)	15 (-9)	10 (-12)	10 (-12)	10 (-12)
35 (2)	30 (-1)	20 (-7)	15 (-9)	10 (-12)	10 (-12)	5 (-15)	5 (-15)	0 (-17)
30 (-1)	25 (-4)	15 (-9)	10 (-12)	5 (-15)	0 (-17)	0 (-17)	0 (-17)	-5 (-21)
25 (-4)	20 (-7)	10 (-12)	0 (-17)	0 (-17)	-5 (-21)	-10 (-23)	-10 (-23)	-15 (-26)
20 (-7)	15 (-9)	5 (-15)	-5 (-21)	-10 (-23)	-15 (-26)	-20 (-29)	-20 (-29)	-20 (-29)
15 (-9)	10 (-12)	0 (-17)	-10 (-23)	-15 (-26)	-20 (-29)	-25 (-32)	-25 (-32)	-30 (-34)
10 (-12)	5 (-15)	-10 (-23)	-20 (-29)	-25 (-32)	-30 (-34)	-30 (-34)	-30 (-34)	-35 (-37)
5 (-15)	0 (-17)	-15 (-26)	-25 (-32)	-30 (-34)	-35 (-37)	-40 (-40)	-40 (-40)	-45 (-43)
0 (-17)	-5 (-15)	-20 (-24)	-30 (-34)	-35 (-37)	-45 (-43)	-55 (-46)	-50 (-46)	-55 (-48)
-5 (-21)	-10 (-23)	-25 (-32)	-40 (-40)	-45 (-43)	-50 (-46)	-65 (-54)	-60 (-51)	-60 (-51)
-10 (-23)	-15 (-26)	-35 (-37)	-45 (-43)	-50 (-46)	-60 (-54)	-70 (-57)	-65 (-54)	-70 (-57)
-15 (-26)	-20 (-29)	-40 (-40)	-50 (-46)	-60 (-51)	-65 (-54)	-70 (-57)	-75 (-60)	-75 (-60)
-20 (-29)	-25 (-32)	-45 (-43)	-60 (-51)	-65 (-54)	-75 (-60)	-80 (-62)	-85 (-65)	-90 (-68)
-25 (-32)	-30 (-34)	-50 (-46)	-65 (-45)	-75 (-60)	-80 (-62)	-85 (-65)	-90 (-68)	-95 (-71)
-30 (-34)	-35 (-37)	-60 (-51)	-70 (-57)	-80 (-62)	-90 (-68)	-95 (-71)	-100 (-73)	-100 (-73)
-35 (-37)	-40 (-40)	-65 (-54)	-80 (-62)	-85 (-65)	-95 (-71)	-100 (-73)	-105 (-76)	-110 (-79)
-40 (-40)	-45 (-43)	-70 (-57)	-85 (-65)	-95 (-71)	-105 (-76)	-110 (-79)	-115 (-82)	-115 (-82)
-45 (-43)	-50 (-46)	-75 (-60)	-90 (-68)	-100 (-73)	-110 (-79)	-115 (-82)	-120 (-85)	-125 (-87)
-50 (-46)	-55 (-48)	-80 (-62)	-100 (-73)	-110 (-79)	-120 (-85)	-125 (-87)	-130 (-90)	-130 (-90)
-55 (-48)	-60 (-51)	-90 (-68)	-105 (-76)	-115 (-82)	-125 (-87)	-130 (-90)	-135 (-93)	-140 (-96)
-60 (-51)	-70 (-57)	-95 (-71)	-110 (-79)	-120 (-85)	-135 (-93)	-140 (-96)	-145 (-98)	-150(-101)

LITTLE DANGER

INCREASING DANGER (flesh may freeze within one minute)

GREAT DANGER (flesh may freeze within 20 seconds)

Figure 6-9. Equivalent Wind Chill Temperature Chart.

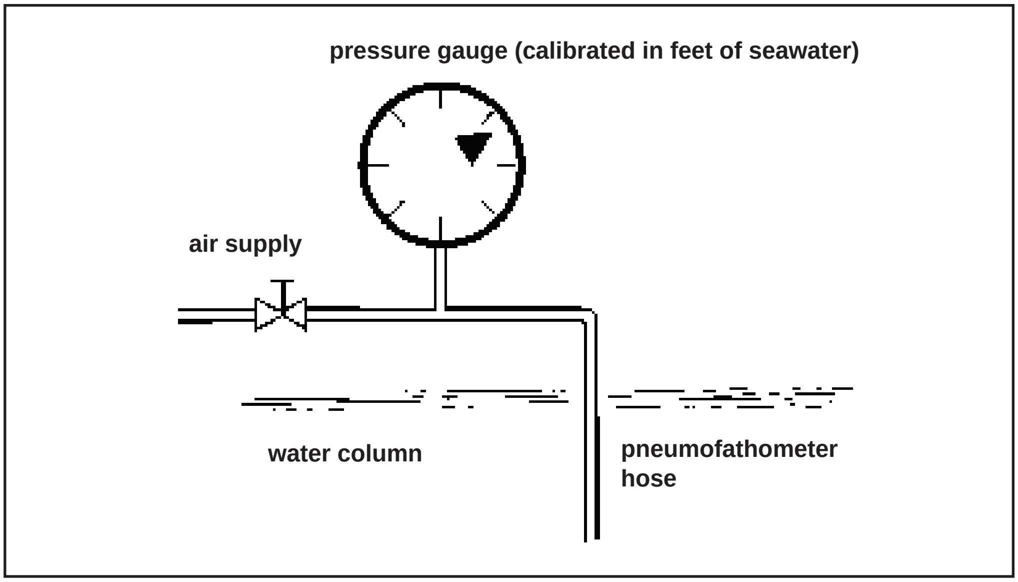


Figure 6-10. Pneumofathometer. The pneumofathometer hose is attached to a diver or weighted object and lowered to the depth to be measured. Water is forced out of the hose by pressurized air until a generally constant reading is noted on the pressure gauge. The air supply is secured, and the actual depth (equal to the height of the water column displaced by the air) is read on the gauge.

6-5.2 **Temperature.** Figure 6-11 illustrates how water temperature can affect a diver's performance, and is intended as a planning guide. A diver's physical condition, amount of body fat, and thermal protection equipment determine how long exposure to extreme temperatures can be endured safely. In cold water, ability to concentrate and work efficiently will decrease rapidly. Even in water of moderate temperature (60–70°F, 15.5–21.5°C), the loss of body heat to the water can quickly bring on diver exhaustion.

6-5.3 **Warm Water Diving.** Warm water diving is defined as those diving operations that occur in water temperatures exceeding 88° F. During recent studies at the Navy Experimental Diving Unit, physiological limits have been developed for diving operations in water temperatures up to 99°F. Diving in water temperatures above 99°F should not be attempted without first contacting NAVSEA 00C.

6-5.3.1 **Operational Guidelines and Safety Precautions.** These guidelines are based on data collected from heat acclimated divers dressed in UDT swim trunks and t-shirts who were well rested, calorically replete, well hydrated, and had no immediate heat exposure prior to starting exercise. Exercise rate for the divers replicated a moderate swimming effort. Conditions that contribute to thermal loading such as heavy work rates, significant pre/post dive activities, and various diver dress (dive skins/wetsuits/dry suits) can reduce exposure limits appreciably. Guidelines for exposure limits are based on diver dress and water temperatures. The following precautions apply to all warm water diving operations above 88°F:

- Weight losses up to 15 lbs (or 6-8% of body weight) due to fluid loss may occur and mental and physical performance can be affected. Divers should hydrate fully (approximately 500 ml or 17 oz) two hours before diving. Fluid loading in excess of the recommended 500 ml may cause life-threatening pulmonary edema and should not be attempted.

- Hydrating with water or a glucose/electrolyte beverage should occur as soon as possible after diving. Approximately 500 ml should be replaced for each hour of diving.

- Exposure limits represent maximum cumulative exposure over a 12 hour period. Divers should be hydrated and calorically replete to baseline weight, rested, and kept in a cool environment for at least 12 hours before a repeat exposure to warm water is deemed safe.

NOTE **The following are the general guidelines for warm water diving. Specific UBAs may have restrictions greater than the ones listed below; refer to the appropriate UBA Operations and Maintenance manual. The maximum warm water dive time exposure limit shall be the lesser of the approved UBA operational limits, canister duration limits, oxygen bottle duration or the diver physiological exposure limit.**

- A diver working at a moderate rate e.g. swimming at 0.8 kts or less:

  88°–94°F - limited to canister/O2 bottle duration or diver aerobic endurance

  94°–97°F - limited to three hours based on physiological limits.

  97°–99°F - limited to one hour based on physiological limits.

NOTE **In cases of SDV and DDS operations, thermal loading may change during the course of the mission. Exposure times should be reduced and fluids replaced during the dive when possible.**

- A resting diver e.g. during decompression:

  88°–94°F - limited to canister duration.

  94°–97°F - limited to canister duration.

  97°–99°F - limited to two hours based on physiological limits.

6-5.3.2 **Mission Planning Factors.** The following mission planning factors may mitigate thermal loading and allow greatest utilization of the exposure limits:

1. Conduct diving operations at night, dusk, or dawn to reduce heat stress incurred from sun exposure and high air temperatures.

2. Avoid wearing a hood with a dive skin to allow evaporative cooling.

3. When possible avoid wearing dive skin or anti-chafing dress. Although the effect of various diver dress is not known, it is expected that safe exposure durations at temperatures above 96°F will be less.

4. Follow the guidelines in paragraph 3-10.4 regarding acclimatization. Reduce the intensity of the diving for five days immediately prior to the diving operation.

5. Ensure divers maintain physical conditioning during periods of warm water diving.

6. Methods of cooling the diver should be employed whenever possible. These include using hot water suits to supply cold water to the diver and the use of ice vests.

Mission planning should also include recognition and management of heat stress injuries as part of pre-dive training and briefing. The diver and topside personnel shall be particularly alert for the symptoms of heat stress. Further guidance is contained in paragraph 3-10.4.4 (Excessive Heat - Hyperthermia), paragraph 3-12.1 (Dehydration), and Figure 3-6 (Oxygen Consumption and RMV at Different Work Rates).

TYPE	CHARACTERISTICS	VISIBILITY	DIVER MOBILITY ON BOTTOM
Rock	Smooth or jagged, minimum sediment	Generally unrestricted by dive movement	Good, exercise care to prevent line snagging and falls from ledges
Coral	Solid, sharp and jagged, found in tropical waters only	Generally unrestricted by diver movement	Good, exercise care to prevent line snagging and falls from ledges
Gravel	Relatively smooth, granular base	Generally unrestricted by diver movement	Good, occasional sloping bottoms of loose gravel impair walking and cause instability
Shell	Composed principally of broken shells mixed with sand or mud	Shell-sand mix does not impair visibility when moving over bottom. Shell-mud mix does impair visibility. With higher mud concentrations, visibility is increasingly impaired.	Shell-sand mix provides good stability. High mud content can cause sinking and impaired movement
Sand	Common type of bottom, packs hard	Generally unrestricted by diver movement	Good
Mud and Silt	Common type of bottom, composed of varying amounts of silt and clay, commonly encountered in river and harbor areas	Poor to zero. Work into the current to carry silt away from job site, minimize bottom disturbance. Increased hazard presented by unseen wreckage, pilings, and other obstacles.	Poor, can readily cause diver entrapment. Crawling may be required to prevent excessive penetration, fatiguing to diver.

Figure 6-11. Bottom Conditions and Effects Chart.

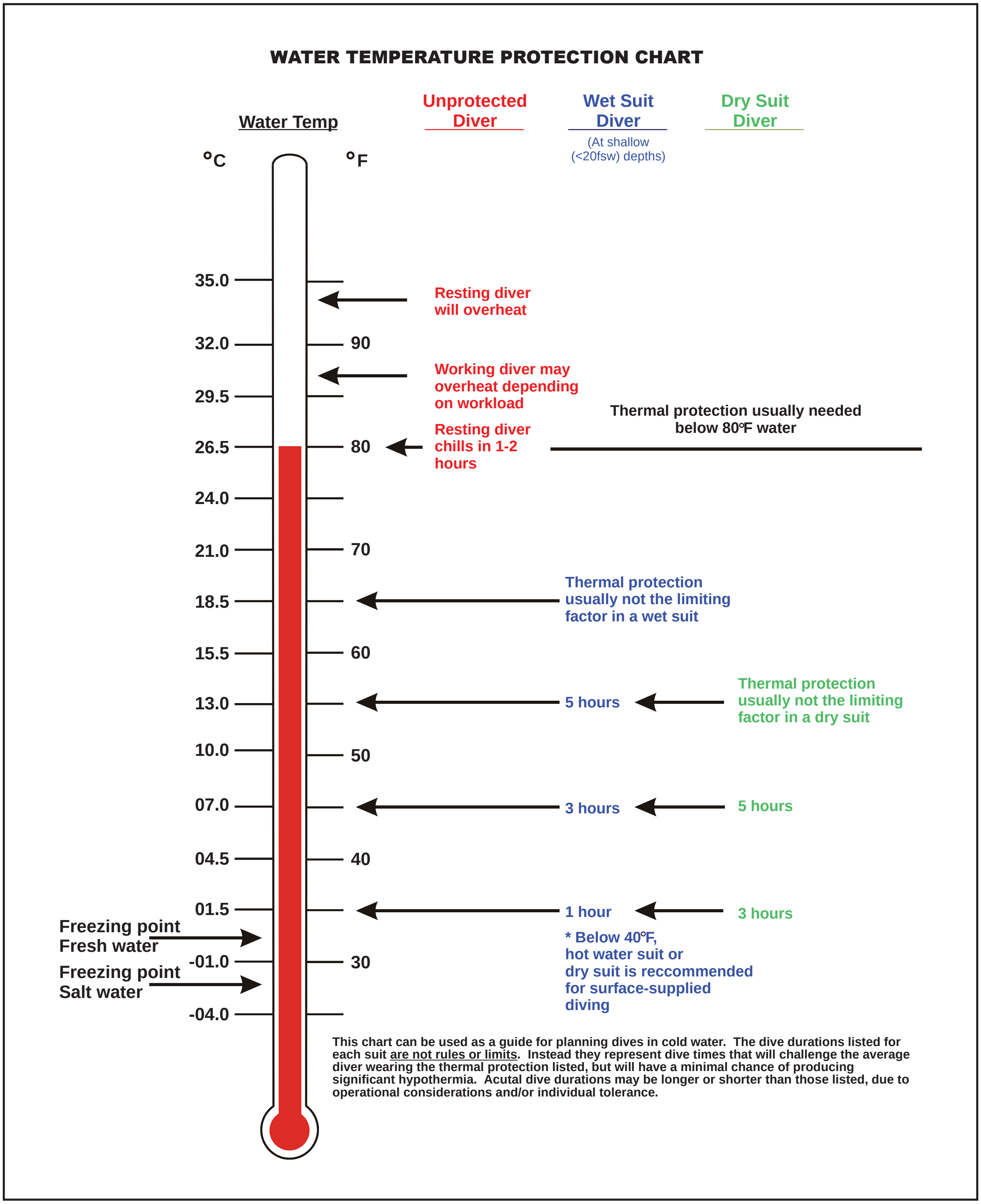


Figure 6-12. Water Temperature Protection Chart.

6-5.4 **Contaminated Water.** When planning for contaminated water diving, medical personnel should be consulted to ensure proper pre-dive precautions are taken and post-dive monitoring of divers is conducted. In planning for operations in polluted waters, protective clothing and appropriate preventative medical procedures shall be taken. Diving equipment shall be selected that gives the diver maximum protection consistent with the threat. Resources outside the scope of this manual may be required to deal with nuclear, biological, or chemical contaminants. Resources and technical advice for dealing with contaminated water diving conditions are available in the *Guidance for Diving in Contaminated Waters,* SS521-AJ-PRO-010, or contact NAVSEA 00C3.

6-5.5 **Altitude Diving.** Divers may be required to dive in bodies of water at higher altitudes. Planning shall address the effects of the atmospheric pressures that may be much lower than those at sea level. Air Decompression Tables and Surface-Supplied Helium-Oxygen Tables are authorized for use at altitudes up to 300 feet above sea level without corrections (see paragraphs 9-13 and 14-6). Transporting divers out of the diving area, which may include movement into even higher elevations either overland or by plane, requires special consideration and planning. The Diving Supervisor shall be alert for symptoms of hypoxia and decompression sickness after the dive due to the lower oxygen partial pressure and atmospheric pressure.

6-5.6 **Underwater Obstacles.** Various underwater obstacles, such as wrecks or discarded munitions, offer serious hazards to diving. Wrecks and dumping grounds are often noted on charts, but the actual presence of obstacles might not be discovered until an operation begins. This is a good reason for scheduling a preliminary inspection dive before a final work schedule and detailed dive plan is prepared.

6-5.7 **Electrical Shock Hazards.** Electrical shock may occur when using electric welding or power equipment. All electrical equipment shall be in good repair and be inspected before diving. Although equipped with test buttons, electrical Grounds Fault Interrupters (GFI) often do not provide any indication when the unit has experienced an internal component failure in the fault circuitry. Therefore, GFI component failure during operation (subsequent to testing the unit) may go unnoticed. Although this failure alone will not put the diver at risk, the GFI will not protect the diver if he is placed in contact with a sufficiently high fault current. The following is some general information concerning GFIs:

- GFIs are required when line voltage is above 7.5 VAC or 30 VDC.
- GFIs shall be capable of tripping within 20 milliseconds (ms) after detecting a maximum leakage current of 30 milliamps (ma).

CAUTION **GFIs require an established reference ground in order to function properly. Cascading GFIs could result in loss of reference ground; therefore, GFIs or equipment containing built-in GFIs should not be plugged into an existing GFI circuit.**

In general, three independent actions must occur simultaneously to electrically shock a diver:

- The GFI must fail.
- The electrical equipment which the diver is operating must experience a ground fault.
- The diver must place himself in the path between the fault and earth ground.

6-5.7.1 **Reducing Electrical Shock Hazards.** The only effective means of reducing electrical shock hazards are to ensure:

- Electrical equipment is properly maintained.
- All electrical devices and umbilicals are inspected carefully before all operations.
- Electrical umbilicals are adequately protected to reduce the risk of being abraded or cut when pulled over rough or sharp objects.
- Personnel are offered additional protection through the use of rubber suits (wet, dry, or hot-water) and rubber gloves.
- GFI circuits are tested at regular intervals throughout the operation using built-in test circuits.

Divers operating with remotely operated vehicles (ROVs) should take similar precautions to ensure the ROV electrical system offers the required protection. Many new ROVs use extremely high voltages which make these protective actions even more critical to diver safety.

6-5.7.2 **Securing Electrical Equipment.** The Ship Repair Safety Checklist for Diving requires underwater electrical equipment to be secured while divers are working over the side. While divers are in the water:

- Ship impressed current cathodic protection (ICCP) systems must be secured, tagged out, and confirmed secured before divers may work on an ICCP device such as an anode, dielectric shield, or reference cell.
- When divers are required to work close to an active ICCP anode and there is a risk of contact with the anode, the system must also be secured.
- In situations other than those described above, the ICCP should remain active.
- Divers working within 15 feet of active systems must wear a full dry suit, unisuit, or wet suit with hood and gloves.
- All other underwater electrical equipment shall be secured while divers are working over the side.

6-5.8 **Explosions.** Explosions may be set off in demolition tasks intentionally, accidentally, or as the result of enemy action. When working with or near explosives, the procedures outlined in SWO 60-AA-MMA-010 shall be followed. Divers should stay clear of old or damaged munitions. Divers should get out of the water when an explosion is imminent.

WARNING **Welding or cutting torches may cause an explosion on penetration of gas-filled compartments, resulting in serious injury or death.**

6-5.9 **Sonar.** Appendix 1A provides guidance regarding safe diving distances and exposure times for divers operating in the vicinity of ships transmitting with sonar.

6-5.10 **Nuclear Radiation.** Radiation may be encountered as the result of an accident, proximity to weapons or propulsion systems, weapons testing, or occasionally natural conditions. Radiation exposure can cause serious injury and illness. Safe tolerance levels have been set and shall not be exceeded. These levels may be found in the *Radiological Control Manual for Ships*, NAVSEA S9123-33-MMA-000-V, or *Shipyard Radiological Control Manual*, 389-0288. Local instructions may be more stringent and in such case shall be followed. Prior to diving all divers shall be knowledgeable of local command radiological control requirements. When required divers shall wear a Thermal Luminescence Dosimeter (TLD) or similar device and be apprised of the locations of items such as the reactor compartment, discharges, etc.

6-5.11 **Marine Life.** Certain marine life, because of its aggressive or venomous nature, may be hazardous to man. Some species of marine life are extremely dangerous, while some are merely an uncomfortable annoyance. Most hazards from marine life are largely overrated because most underwater animals leave man alone. All divers should be able to identify the hazardous species that are likely to be found in the area of operation and should know how to deal with each. Refer to Appendix 5C for specific information about hazardous marine life, including identification factors, hazardous characteristics, injury prevention, and treatment methods.

6-5.12 **Vessels and Small Boat Traffic.** The presence of other ships is often a serious problem. It may be necessary to close off an area or limit the movement of other ships. A local Notice to Mariners should be issued. At any time that diving operations are to be conducted in the vicinity of other ships, they shall be properly notified by International Code signal flags (Figure 6-12). An operation may have to be conducted in an area with many small boats operated by people with varied levels of seamanship and knowledge of Nautical Rules of the Road. The diving team should assume that these operators are not acquainted with diving signals and take the precautions required to ensure that these vessels remain clear of the diving area. Hazards associated with vessel traffic are intensified under conditions of reduced visibility.

NOTE: **When small civilian boats are in the area, use the civilian Sport Diver flag (red with white diagonal stripe) as well as "Code Alpha."**

6-5.13 **Territorial Waters.** Diving operations conducted in the territorial waters of other nations shall be properly coordinated prior to diving. Diving units must be alert to the presence of foreign intelligence-collection ships and the potential for hostile action when diving in disputed territorial waters or combat zones.

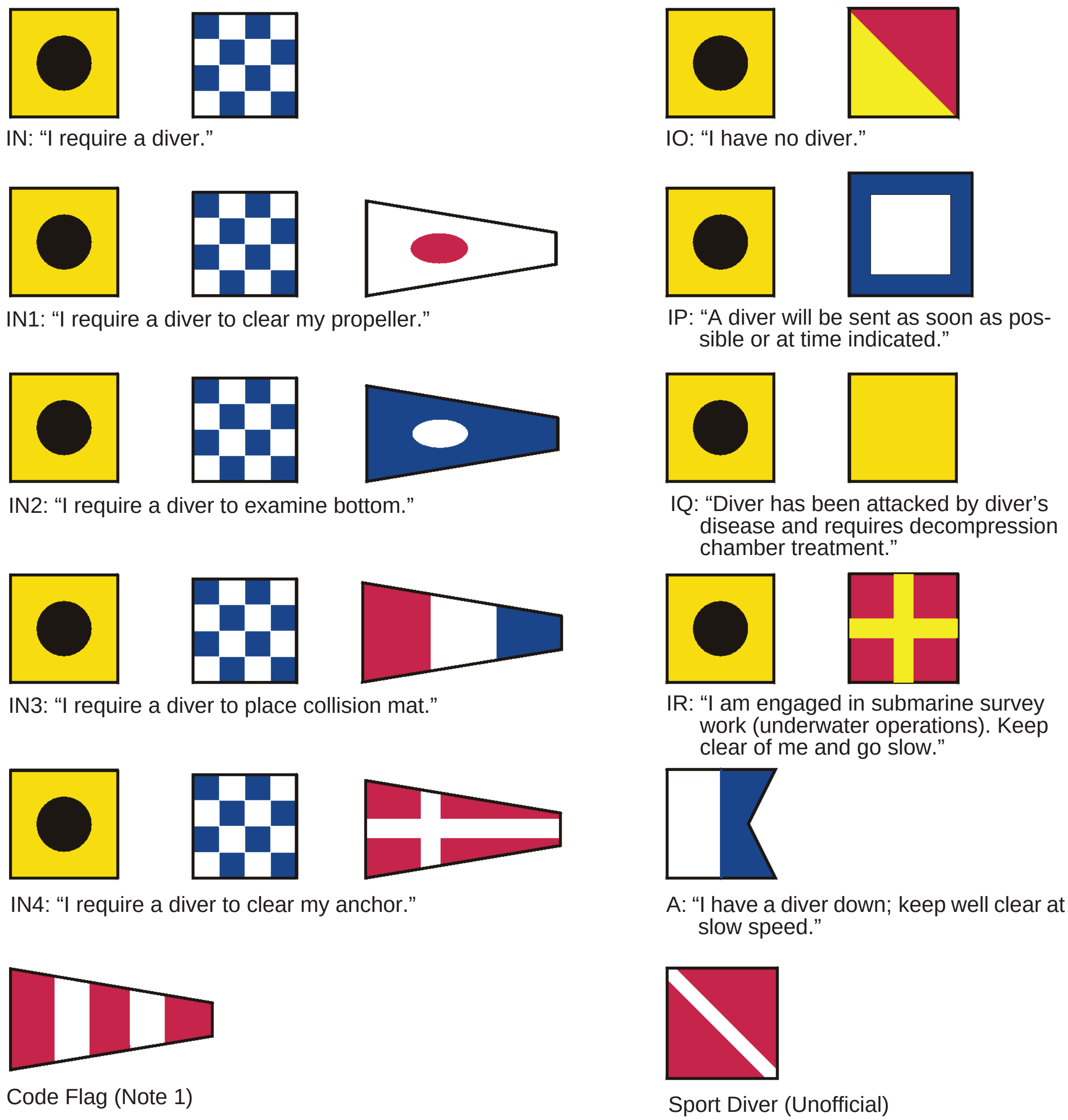
6-5.14 **Emergency Equipment.** The Diving Safety and Planning Checklist (see Figure 6-19) lists operational steps and equipment required to safely conduct diving operations. The following minimum emergency equipment shall be available on the dive station for every diving operation:

- Communications equipment capable of reaching help in the event of an emergency
- A completely stocked first aid kit
- Automated External Defibrillator (AED)
- Portable oxygen supply with sufficient capacity to reach either the recompression chamber or the planned evacuation location listed in the Emergency Assistance Checklist (Figure 6-22)
- Resuscitator or Bag-mask (to provide rescue breathing)
- A means of extracting and transporting an unconscious diver (e.g., litter, stretcher, mesh stretcher, backboard)

If unable to comply due to operational restrictions (limited space, DDS operations, saturation diving), this equipment will be as close as practical to the diving operations and ready for immediate use.

6-5.15 **Recompression Chamber Requirements.** Any dive, no matter how routine can result in arterial gas embolism or decompression sickness. For decompression dives, circumstances may occur that force the diving supervisor to plan omitted decompression or force the divers themselves to omit decompression. For these reasons, the closest available recompression chamber must always be identified during dive planning phase. Locating a back-up recompression chamber during the planning phase is desirable in the event that the primary chamber becomes inoperable or is otherwise occupied.

The Navy categorizes the level of recompression chamber support required for a given dive into one of three categories: Level I, Level II, and Level III. This paragraph deals with the recompression chamber requirements for air diving. Chapters 10, 14, 18, and Appendix 4A give specific requirements for their respective types of diving. Table 6-1 shows which level of chamber is required based on the depth and bottom time of the dive. For repetitive dives, use the depth and bottom time of the decompression schedule rather than the actual depth and bottom time used to enter the table.



General Note: Rule 27 of Navigation Rules-International-Inland of March 1999 states the lights and shapes that must be displayed when engaged in diving operations.

Note 1: International Signal Code – All signals must be preceded by the code flag to signify that they are international signals. (Do not use code flag in inland waters.)

Figure 6-13. International Code Signal Flags.

Table 6-1. *Air Diving Recompression Chamber Requirements (Bottom Time in MInutes)*

Depth (fsw)	Level I Chamber Required	Level II Chamber Required	Level III Chamber Required
20			0 - unlimited
25		372 - 720	0 - 371
30		270 - 720	0 - 269
35		207 - 720	0 - 206
40	>540	191 - 540	0 - 190
45	>360	171 - 360	0 - 170
50	>300	161 - 300	0 - 160
55	>240	141 - 240	0 - 140
60	>220	131 - 220	0 - 130
70	>160	111 - 160	0 - 110
80	>120	91 - 120	0 - 90
90	>90	61 - 90	0 - 60
100	>70	56 - 70	0 - 55
110	>70	51 - 70	0 - 50
120	>55	46 - 55	0 - 45
130	>50	41 - 50	0 - 40
140	>45	31 - 45	0 - 30
150	>40	31 - 40	0 - 30
160	>40	26 - 40	0 - 25
170	>35	26 - 35	0 - 25
180	>35	21 - 35	0 - 20
190	>30	21 - 30	0 - 20

Table 6-2 defines the three Navy recompression chamber support levels. These levels are arranged according to the required proximity of the recompression chamber to the dive site.

Table 6-2. *Navy Recompression Chamber Support Levels*

RCC Support Level	Definition
Level I	A U.S. Navy certified recompression chamber close enough to the dive site to support surface decompression with a surface interval of 5 minutes. (Notes 1, 2)
Level II	A U.S. Navy certified recompression chamber accessible within one hour of the casualty. (Note 2)
Level III	A U.S. Navy certified recompression chamber accessible within six hours of the casualty. (Note 3, 4)
Note 1. Based on space constraints at the site, the Commanding Officer may authorize extension of the surface interval to a maximum of 7 minutes in accordance with Paragraphs 9-12.6 and 14-4.14. Note 2. A non-Navy chamber may be used to satisfy this requirement if approved in writing by the CNO. Note 3. A non-Navy chamber may be used to satisfy this requirement if approved in writing by the Commanding Officer. Note 4. During extreme circumstances when a chamber cannot be reached within 6 hours the Commanding Officer can give authorization to use the nearest approved recompression facility.	

A U.S. Navy certified chamber is required at all three levels. This guarantees that the chamber is capable delivering the full range of treatments and is engineered to provide the maximum degree of safety and reliability. In certain circumstances, a non-Navy chamber can be used to meet the requirement provided it has been inspected by a qualified chamber supervisor and deemed to offer comparable treatment capability, safety, and accessibility. Paragraphs 21-2.4 through 21-2.8.6 and Figure 21-13 provide criteria for evaluating a recompression chamber. For Levels I and II, CNO approval is required to use a non-Navy chamber. Commands submitting a CNO waiver request are encouraged to contact NAVSEA 00C for guidance.

The accessibility times cited in Table 6-2 are the maximum allowed times to transport the casualty to the chamber. If a suitable chamber cannot be identified within the maximum time allowed for a given level, a chamber must be deployed to the dive site. This should not be interpreted to mean that if a chamber is available within the maximum time, the unit is not obligated to deploy a chamber to the dive site. ORM should be used to determine when deployment of the chamber to the dive site is necessary. For any large scale or sustained diving operation, deployment of the chamber to the dive site should be strongly considered regardless of chamber level.

In rare instances, the urgency or severity of the casualty may dictate bypassing the designated chamber in favor of a closer and/or more capable facility. Examples include, but are not limited to: rapid onset of paralysis with inability to breathe, near-drowning superimposed upon arterial gas embolism or decompression sickness, and the co-existence of major trauma. The Commanding Officer may authorize treatment in the closest military or civilian hyperbaric/medical facility capable of providing the immediate and needed level of care.

6-6 SELECT DIVING TECHNIQUE

The four main types of air diving equipment used in U.S. Navy diving operations are (Figure 6-13):

1. Open-circuit SCUBA
2. MK 20 MOD 0 Full Face Mask surface-supplied or open-circuit SCUBA
3. MK 21 MOD 1, KM-37 NS surface-supplied gear
4. EXO BR MS Full Face Mask surface-supplied or open-circuit SCUBA

6-6.1 **Factors to Consider when Selecting the Diving Technique.** When selecting the technique to be used for a dive, the following factors must be considered:

- Duration and depth of the dive

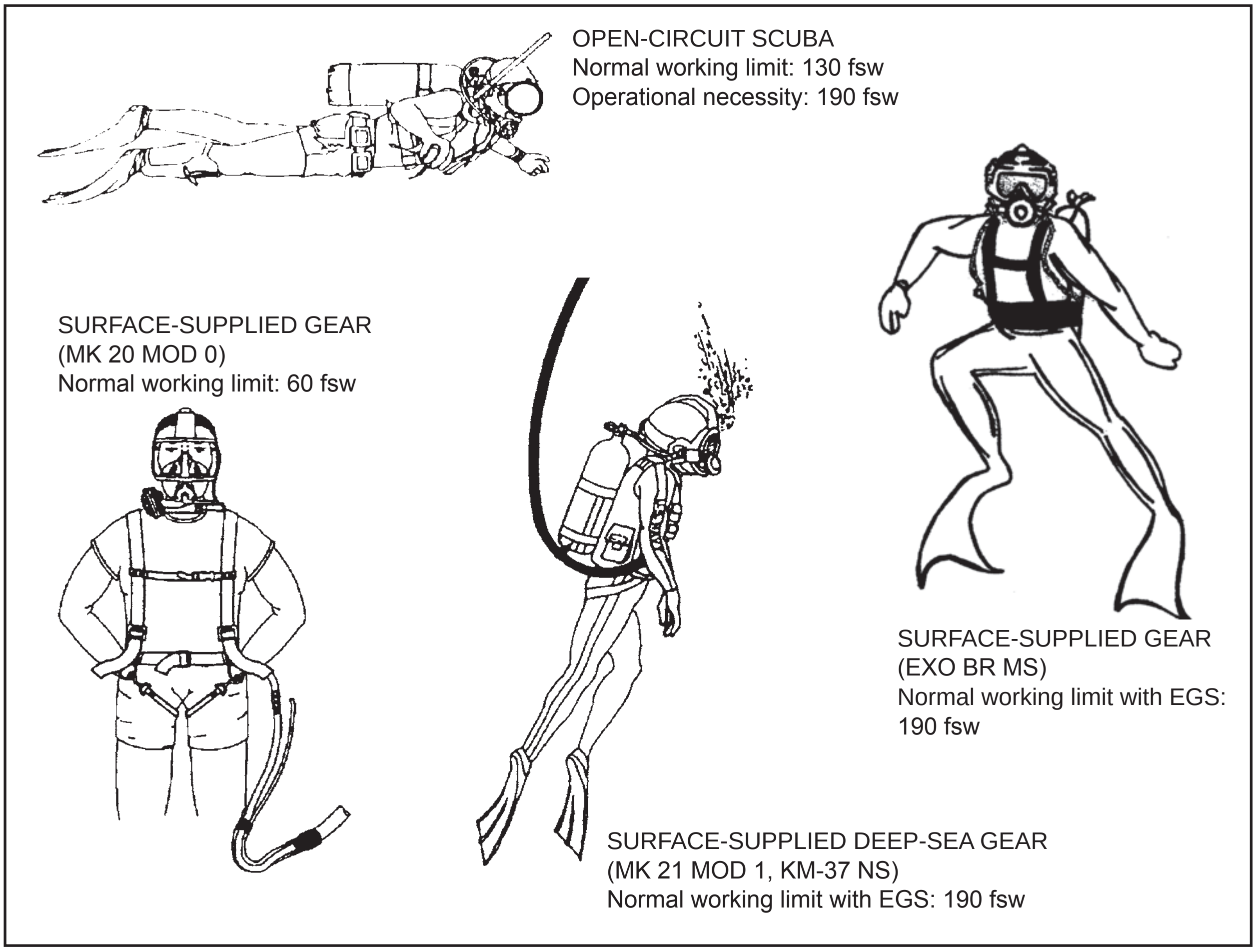


Figure 6-14. Air Diving Techniques. A choice of four air diving techniques are available: open circuit SCUBA, surface-supplied gear (MK 20 MOD 0), surface-supplied deep-sea gear (MK 21 MOD 1 and KM-37 NS), and surface-supplied deep sea gear (EXO BR MS).

- Type of work to be performed
- Environmental conditions
- Time constraints

A dive of extended length, even in shallow water, may require an air supply exceeding that which could be provided by SCUBA. Specific depth limits have been established for each type of diving gear and shall not be exceeded without specific approval of the Chief of Naval Operations in accordance with the OPNAVINST 3150.27 series (see Figure 6-14).

The increase of air consumption with depth limits open-circuit SCUBA to 130 fsw for reasonable working dives. The hazards of nitrogen narcosis and decompression further limit open-circuit SCUBA to 190 fsw even for short duration dives. Surface-supplied equipment is generally preferred between 130 and 190 fsw, although open-circuit SCUBA may be used under some circumstances. Decompression SCUBA dives and SCUBA dives deeper than 130 fsw may be conducted when dictated by operational necessity and with the specific approval of the Commanding Officer or the Officer-in-Charge. All open-circuit SCUBA dives deeper than 100 fsw shall employ cylinders having a capacity of at least 100 cubic feet.

In some operations there may be no clear-cut choice of which diving technique to use. Selecting a diving technique may depend upon availability of equipment or trained personnel. The following comparison of SCUBA and surface-supplied techniques highlights the significant differences between the methods and outlines the effect these differences will have on planning.

6-6.2 **Breathhold Diving Restrictions.** Breathhold diving is a dangerous practice that may lead to unconsciousness and death. Breathhold diving shall be limited to operations and training that cannot be effectively accomplished with a UBA such as, free ascent and escape training, SCUBA confidence training, shallow water object recovery and obstacle\ordnance clearance.

WARNING **The practice of hyperventilating (for the purpose of "blowing-off" carbon dioxide, as differentiated from taking two or three deep breaths) prior to a breathhold dive is a primary cause of unconsciousness and may lead to death. Breathhold divers shall terminate the dive and surface at the first sign of the urge to breathe. See paragraph 3-3.5 for more information about hyperventilation and unconsciousness from breathhold diving.**

Breathold diving shall be supervised by a qualified Diving Supervisor and the breathhold diver shall be tended where practical. ORM, dive briefs, emergency action plans, and notifications relevant to Navy dives apply to breathhold diving. Operations requiring breathhold diving as a tactic, technique, and procedure shall develop an in-depth ORM assessment process that shall be utilized as part of the deliberate planning for the evolution. Standard Operating Procedures (SOP) shall also be developed, and associated ORM and SOPs shall be retained until completion of all breathhold evolutions. Breathhold mishaps and near-misses, involving personnel qualified as Navy Divers in any capability, are deemed diving incidents and shall be reported as such.

NORMAL AND MAXIMUM LIMITS FOR AIR DIVING		
Depth fsw (meters)	**Limit for Equipment**	**Notes**
60 (18)	MK 21 MOD 1, KM-37 NS diving equipment, maximum working limit without Emergency Gas Supply (EGS)	a
60 (18)	MK 20 MOD 0 equipment surface-supplied	a
60 (18)	Maximum depth for standby SCUBA/DP-1 diver using a single cylinder with less than 100 SCF capacity	
100 (30)	Open-circuit SCUBA/DP-1 with less than 100 SCF cylinder capacity	b
130 (40)	Open-circuit SCUBA/DP-1, normal working limit	b
190 (58)	Open-circuit SCUBA, maximum working limit with Commanding Officer's or Officer-in-Charge's permission	b
190 (58)	MK 21 MOD 1, KM-37 NS and EXO BR MS (air) diving equipment with EGS, normal working limit	c, d
285 (87)	MK 21 MOD 1, KM-37 NS and EXO BR MS (air) diving equipment with EGS, maximum working limit, exceptional exposure with authorization from the Chief of Naval Operations (N873)	c, d

General Operating Notes (Apply to all):

1. These limits are based on a practical consideration of working time versus decompression time and oxygen-tolerance limits. These limits shall not be exceeded except by specific authorization from the Chief of Naval Operations (N873).
2. Do not exceed the limits for exceptional exposures for the Air Decompression Table.
3. The requirements for a recompression chamber are contained in Tables 6-1 and 6-2.
4. In an emergency, any operable recompression chamber may be used for treatment if deemed safe to use by a qualified Chamber Supervisor.

Specific Notes:

a. When diving in an enclosed space, EGS must be used by each diver.

b. Under normal circumstances, do not exceed the limits of the No-Decompression Table. Dives requiring decompression may be made if considered necessary with approval by the Commanding Officer or Officer-in-Charge of the diving command. The total time of a SCUBA dive (including decompression) shall not exceed the duration of the apparatus in use, disregarding any reserves.

c. A Diving Medical Officer is required on the dive station for all air dives deeper than 190 fsw and for exceptional exposure dives.

d. Exceptional exposure dives have a significantly higher probability of DCS and CNS oxygen toxicity.

Figure 6-15. Normal and Maximum Limits for Air Diving.

6-6.3 **Operational Characteristics of SCUBA.** The term SCUBA refers to open-circuit air SCUBA unless otherwise noted. The main advantages of SCUBA are mobility, depth flexibility and control, portability, and reduced requirement for surface support. The main disadvantages are limited depth, limited duration, lack of voice communications (unless equipped with a through-water communications system), limited environmental protection, remoteness from surface assistance, and the negative psychological and physiological problems associated with isolation and direct exposure to the underwater environment.

6-6.3.1 **Mobility.** The SCUBA diver is not hindered by bulky or heavy equipment and can cover a considerable distance, with an even greater range through the use of diver propulsion vehicles (DPVs), moving freely in any direction. However, the SCUBA diver shall be able to ascend directly to the surface in case of emergency.

WARNING SCUBA equipment is not authorized for use in enclosed space diving.

6-6.3.2 **Buoyancy.** SCUBA equipment is designed to have nearly neutral buoyancy when in use, permitting the diver to change or maintain depth with ease. This allows the SCUBA diver to work at any level in the water column.

6-6.3.3 **Portability.** The portability and ease with which SCUBA can be employed are distinct advantages. SCUBA equipment can be transported easily and put into operation with minimum delay. SCUBA offers a flexible and economical method for accomplishing a range of tasks.

6-6.3.4 **Operational Limitations.** Divers shall adhere to the operational limitations contained in Figure 6-14. Bottom time is limited by the SCUBA's fixed air supply, which is depleted more rapidly when diving deep or working hard.

6-6.3.5 **Environmental Protection.** The SCUBA diver is not as well protected from cold or from contact with marine plants and animals as a diver in surface-supplied gear, and is more easily swept along by current.

6-6.4 **Operational Characteristics of SSDS.** Surface-supplied diving systems can be divided into two major categories: lightweight full face mask (MK 20 and EXO 26-BR), and deep-sea (MK 21 and KM-37 NS) gear.

6-6.4.1 **Mobility.** Surface-supplied gear allows the diver almost as much mobility as SCUBA. The primary use for deep-sea gear is bottom work in depths up to 190 fsw.

6-6.4.2 **Buoyancy.** The buoyancy associated with SSDS varies with the diving dress selected. Variable Volume Dry Suit (VVDS) provides the greatest buoyancy control (see paragraph 7-3.1.2), making it a desirable technique for working on muddy bottoms, conducting jetting or tunneling, or working where the reaction forces of tools are high.

6-6.4.3 **Operational Limitations.** Divers using surface-supplied gear are restricted to the operational limitations described in Figure 6-14. Additional limitations of using surface-supplied gear include additional topside support personnel and lengthy predive and postdive procedures.

6-6.4.4 **Environmental Protection.** Surface-supplied diving systems can offer the diver increased thermal protection when used with a Hot Water or VVDS. The MK 21 helmet can increase protection of the diver's head. Deep sea gear (MK 21 MOD 1, KM-37 NS) should be used for jobs involving underwater rigging, heavy work, use of certain underwater tools, and any situation where more physical protection is desired. Because the diver's negative buoyancy is easily controlled, an SSDS allows diving in areas with strong currents.

6-7 SELECT EQUIPMENT AND SUPPLIES

6-7.1 **Equipment Authorized for Navy Use.** Equipment procured for use in the U.S. Navy has been tested under laboratory and field conditions to ensure that it will perform according to design specifications. A vast array of equipment and tools is available for use in diving operations. The NAVSEA/00C Authorization for Military Use (AMU) list identifies much of this equipment and categorizes diving equipment authorized for U.S. Navy use.

6-7.2 **Air Supply.** The quality of diver's breathing air is vitally important. Air supplies provided to the diver in tanks or through a compressor shall meet five basic criteria.

1. Air shall conform to standards for diving air purity found in paragraph 4-3 and paragraph 4-4.
2. Flow to the diver must be sufficient. Refer to the appropriate equipment operations and maintenance manual for flow requirements.
3. Adequate overbottom pressure shall be maintained at the dive station.
4. Adequate air supply shall be available to support the duration and depth of the dive (see paragraph 7-4.1 for SCUBA; paragraph 8-2.2 for MK 21).
5. A secondary air supply shall be available for surface-supplied diving.

6-7.3 **Diving Craft and Platforms.** Regardless of the technique being supported, craft used for diving operations shall:

- Be seaworthy
- Include required lifesaving and other safety gear
- Have a reliable engine (unless it is a moored platform or barge)
- Provide ample room for the divers to dress
- Provide adequate shelter and working area for the support crew
- Be able to carry safely all equipment required for the operation
- Have a well-trained crew

Other support equipment—including barges, tugs, floating cranes, or vessels and aircraft for area search—may be needed, depending on the type of operation. The need for additional equipment should be anticipated as far in advance as possible.

6-7.4 **Deep-Sea Salvage/Rescue Diving Platforms.**

- **Auxiliary Rescue/Salvage Ship (T-ARS) (Safeguard Class).** The mission of the T-ARS ship is to assist disabled ships, debeach stranded vessels, fight fires alongside other ships, lift heavy objects, recover submerged objects, tow other vessels, and perform manned diving operations. The T-ARS class ships carry a complement of divers to perform underwater ship husbandry tasks and salvage operations as well as underwater search and recovery. This class of vessel is equipped for all air diving techniques. Onboard equipment allows diving with air to a depth of 190 fsw.

- **Submarine Tender (AS).** U.S. submarine tenders are designed specifically for servicing nuclear-powered submarines. Submarine tenders are fitted with a recompression chamber used for hyperbaric treatments. Submarine tenders support underwater ship husbandry and maintenance and security swims.

- **Fleet Ocean Tug (T-ATF).** T-ATFs are operated by the Military Sealift Command. Civilian crews are augmented with military communications and diving detachments. In addition to towing, these large ocean-going tugs serve as salvage and diving platforms.

- **Diving Tender (YDT).** These vessels are used to support shallow-water diving operations. Additionally, a wide variety of Standard Navy Dive Boats (SNDB), LCM-8, LCM-6, 50-foot work boats, and other yard craft have been fitted with surface-supplied dive systems.

- **Dynamic Positioning Vessel.** A Dynamic Positioning (DP) Vessel is defined as a vessel actively using its propulsion system to maintain position and heading. Ship's propulsion systems include thrusters, main propellers, rudders, and the machinery and controls required to provide power to them. Main propellers and rudders are included only if they are controlled by the DP system. DP vessels used for U.S. Navy diving operations shall meet International Maritime Organization (IMO) Equipment Class 2 or 3. IMO Equipment Class 2 or 3 will maintain automatic or manual position and heading control under specified maximum environmental conditions, during and following any single-point failure of the DP system. There are limited exceptions to this rule, such as certification, training, or qualification dives where the diver does not interact with the bottom or a fixed DP systems meeting IMO Equipment Class 1 are, by definition, subject to single point failure and are not suitable for diving operations and require mission specific waiver. For further guidance relating to DP vessels contact NAVSEA 00C3.

6-7.5 Small Craft. SCUBA operations are normally conducted from small craft. These can range in size and style from an inflatable rubber raft with an outboard engine to a small landing craft. If divers are operating from a large ship or diving float, a small boat must be ready as a rescue craft in the event a surfacing diver is in trouble some distance from the support site. A small boat used by SCUBA divers must be able to slip its moorings quickly and move to a diver needing assistance.

6-8 SELECT AND ASSEMBLE THE DIVING TEAM

When planning diving assignments and matching the qualifications and experience of diving personnel to specific requirements of the operation, a thorough knowledge of the duties, responsibilities, and relationships of the various members of the diving team is essential. The diving team may include the Diving Officer, Master Diver, Diving Supervisor, Diving Medical Officer, divers qualified in various techniques and equipment, support personnel (tenders—qualified divers if possible), recorder, and medical personnel, as indicated by the type of operation (Figure 6-15). Other members of the ship's company, when properly instructed, provide support in varying degrees in such roles as boat crew, winch operators, and line handlers.

6-8.1 **Manning Levels.** The size of the diving team may vary with the operation, depending upon the type of equipment being used, the number of divers needed to complete the mission, and the depth. Other factors, such as weather, planned length of the mission, the nature of the objective, and the availability of various resources will also influence the size of the team. The minimum number of personnel required on station for each particular type of diving equipment is provided in Figure 6-16. Minimum levels as determined by ORM shall be maintained; levels must be increased as necessary to meet anticipated operational conditions and situations.

6-8.2 **Commanding Officer.** The ultimate responsibility for the safe and successful conduct of all diving operations rests with the Commanding Officer. The Commanding Officer's responsibilities for diving operations are defined and the provisions of U.S. Navy Regulations and other fleet, force, or command regulations confirm specific authority. To ensure diving operations are efficiently conducted, the Commanding Officer delegates appropriate authority to selected members of the command who, with subordinate personnel, make up the diving team.

6-8.3 **Command Diving Officer.** The Command Diving Officer's primary responsibility is the safe conduct of all diving operations within the command. The Command Diving Officer will become thoroughly familiar with all command diving techniques and have a detailed knowledge of all applicable regulations and is responsible for all operational and administrative duties associated with the command diving program. The Command Diving Officer is designated in writing by the Commanding Officer and must be a qualified diver. In the absence of a commissioned officer or a Master Diver, a senior enlisted diving supervisor may be assigned as the Command Diving Officer. On submarines the senior qualified diver may be assigned Command Diving Officer.

6-8.4 **Watchstation Diving Officer.** The Watchstation Diving Officer must be a qualified diver and is responsible to the Commanding Officer for the safe and successful conduct of the diving operation. The Watchstation Diving Officer provides overall supervision of diving operations, ensuring strict adherence to procedures and precautions. A qualified Diving Officer or Master Diver may be assigned this watchstation. The Watchstation Diving Officer must be designated in writing by the Commanding Officer.

6-8.5 Master Diver

6-8.5.1 **Master Diver Responsibilities.** The Master Diver is the most qualified person to supervise air and mixed-gas dives (using SCUBA and surface-supplied diving equipment) and recompression treatments (Figure 6-17). He is responsible to the Commanding Officer, via the Diving Officer, for the safe conduct of all phases of diving operations. The Master Diver manages preventive and corrective maintenance on diving equipment, support systems, salvage machinery, handling systems, and submarine rescue equipment. The Master Diver, who also ensures that divers are trained in emergency procedures, conducts training and requalification of divers attached to the command. The Master Diver recommends to the Commanding Officer, via the Diving Officer, which enlisted divers are qualified to serve as Diving Supervisors. The Master Diver oversees the efforts of the Diving Supervisor and provides advice and technical expertise. If circumstances warrant, the Master Diver shall relieve the Diving Supervisor and assume control of the dive station. In the absence of a Diving Officer, the Master Diver can assume the duties and responsibilities of the Diving Officer.

6-8.5.2 **Master Diver Qualifications.** The Master Diver has completed Master Diver evaluation course (CIN A-433-0019) successfully and is proficient in the operation of Navy-approved underwater breathing equipment, support systems, and recompression chambers. He is also trained in diagnosing and treating diving injuries and illnesses. The Master Diver is thoroughly familiar with operating and emergency procedures for diving systems, and possesses a working knowledge of gas mixing and analysis, computations, salvage theory and methods, submarine rescue procedures, towing, and underwater ship husbandry. The Master Diver shall possess a comprehensive knowledge of the scope and application of all Naval instructions and publications pertaining to diving, and shall ensure that logs and reports are maintained and submitted as required.

6-8.6 **Diving Supervisor.** While the Master Diver is in charge of the overall diving operation, the Diving Supervisor is in charge of the actual diving operation for a

Figure 6-16. MK 21 Dive Requiring Two Divers. The team consists of one Diving Supervisor, two divers, a standby diver, one tender per diver, comms and logs, console operator, and extra personnel (as required).

particular dive or series of dives. Diving operations shall not be conducted without the presence of the Diving Supervisor. The Diving Supervisor has the authority and responsibility to discontinue diving operations in the event of unsafe diving conditions.

6-8.6.1 **Pre-dive Responsibilities.** The Diving Supervisor shall be included in preparing the operational plans. The Diving Supervisor shall consider contingencies, determine equipment requirements, recommend diving assignments, and establish back-up requirements for the operation. The Diving Supervisor shall be familiar with all divers on the team and shall evaluate the qualifications and physical fitness of the divers selected for each particular job. The Diving Supervisor inspects all equipment and conducts pre-dive briefings of personnel.

6-8.6.2 **Responsibilities While Operation is Underway.** While the operation is underway, the Diving Supervisor monitors progress; debriefs divers; updates instructions to subsequent divers; and ensures that the Master Diver, Diving Officer, Commanding Officer, and other personnel as necessary are advised of progress and of any changes to the original plan. The Diving Supervisor should not hesitate to call upon the technical advice and expertise of the Master Diver during the conduct of the dive operation.

6-8.6.3 **Post-dive Responsibilities.** When the mission has been completed, the Diving Supervisor gathers appropriate data, analyzes the results of the mission, prepares reports to be submitted to higher authority, and ensures that required records are

MINIMUM MANNING LEVELS FOR AIR DIVING

	Open circuit SCUBA Operations		Surface-Supplied Operations
	Single Diver	Buddy Pair	
Diving Supervisor	1	1	1
Comms and Logs	(a)	(a)	(a)
Console Operator			(a)
Diver	1	2	1
Standby Diver	1	1	1
Diver Tender (b, c)	1(b)		1(b)
Standby Diver Tender	(c)	(c)	1
Total	4(d)	4	5(e)

WARNING

These are the minimum personnel levels required. ORM may require these personnel levels be increased so the diving operations can be conducted safely. See Paragraph 6-1.1 and 6-9.1

NOTES:

(a) Diving Supervisor may perform/assign Comms/Logs or Console Operator positions as necessary or required by the system/operations/mission.

(b) See paragraph 6-8.8.5.2 for Tender Qualifications.

(c) If the standby diver is deployed, the Diving Supervisor shall tend the standby diver.

(d) The diver will be tended or have a witness float attached, see paragraph 7-3.1.7. A tender is required when the diver does not have free access to the surface, see paragraph 7-8.2 for further guidance. During mission essential open circuit SCUBA operations, minimum-manning level may be reduced to three qualified divers at the Diving Supervisor's discretion.

(e) Although five is the minimum number of personnel for the MK III and Extreme Lightweight Dive System (XLDS) operations, six or more is highly recommended based on mission requirements and ORM.

Figure 6-17. Minimum Personnel Levels for Air Diving Stations.

completed. These records may range from equipment logs to individual diving records.

6-8.6.4 **Diving Supervisor Qualifications.** The Diving Supervisor may be commissioned or enlisted depending on the size of the operation and the availability of qualified personnel. When qualifying a Diving Supervisor, selection is based on knowledge of diving technique, experience, level of training, and the competence of the available personnel. Regardless of rank, the Diving Supervisor shall be a qualified diver of demonstrated ability and experience. The Diving Supervisor shall be designated in writing by the Commanding Officer. Diving Supervisors under instruction shall stand their watches under the supervision of a qualified Diving Supervisor.

Figure 6-18. Master Diver Supervising Recompression Treatment.

6-8.7 Diving Medical Officer.

The Diving Medical Officer recommends the proper course of medical action during medical emergencies. The Diving Medical Officer provides on-site medical care for divers as conditions arise and ensures that diving personnel receive proper attention before, during, and after dives. The Diving Medical Officer may modify recompression treatment tables, with the specific concurrence of the Commanding Officer. A Diving Medical Officer is required on the dive station for all air dives deeper than 190 fsw, or for planned exceptional exposure dives. A DMO must be consulted at some point during an actual recompression chamber treatment prior to the release of the patient.

6-8.8 Diving Personnel

6-8.8.1 **Diving Personnel Responsibilities.** While working, the diver shall keep topside personnel informed of conditions on the bottom, progress of the task, and of any developing problems that may indicate the need for changes to the plan or a call for assistance from other divers. To ensure safe conduct of the dive, the diver shall always obey a signal from the surface and repeat all commands when using voice communications. The diver is responsible for the diving gear worn and shall ensure that it is complete and in good repair.

6-8.8.2 **Diving Personnel Qualifications.** Military divers shall be qualified and designated in accordance with instructions issued by the Naval Personnel Command (NPC) or as appropriate by USMC, U.S. Army, or U.S. Air Force orders. Civilian divers under military cognizance must be qualified in accordance with OPNAV 3150.27

(Series). The diving team selected for an operation shall be qualified for the positions manned, diving technique used, the equipment involved, and for diving to the depth required. The DSWS NAVEDTRA 43910 Series Personnel Qualification Standard (PQS) is required for Navy Diver, and equivalent Navy civilian divers. All other Military Divers qualifying to operate or supervise diving systems and equipment contained in the NAVEDTRA 43910 Series PQS, should use the current NAVEDTRA 43910 Series PQS Watch Stations as a guide for qualification, in an effort to standardize DOD qualifications and ensure safe conduct of diving operations. Diving personnel assigned to Navy Experimental Diving Unit (NEDU) and Naval Submarine Medical Research Laboratory (NSMRL) are exempt from such requirements as they are assigned as experimental test subjects and may be employed in experimental dive profiles as required within approved test protocols.

Formal training is required for all designated U.S. Military and DOD civilian employee divers. The Center for EOD and Diving (CENEODDIVE) is authorized to designate fleet units to train personnel in specific critical diving skill sets (HEO_2, Saturation, MK-16 Mod 0 and Mod 1, and MK 25). Commands performing these local qualifications must be designated in writing. Qualifications will be conducted using curricula and materials provided and controlled by CENEODDIVE. Commands conducting local qualifications must have a Master Diver qualified in the equipment being trained and who holds NEC 9502 or an equivalent instructor qualification as determined by CENEODDIVE.

6-8.8.3 **Standby Diver.** A standby diver with a tender is required for all diving operations. The standby diver need not be equipped with the same equipment as the primary diver (except as otherwise specified), but shall have equivalent depth and operational capabilities. SCUBA shall not be used for the standby diver for surface-supplied dive systems.

6-8.8.3.1 ***Standby Diver Qualifications.*** The standby diver is a fully qualified diver, assigned for back-up or to provide emergency assistance, and is ready to enter the water immediately. For surface-supplied operations, the standby diver shall be dressed to the following points, MK 20 or MK 21 MOD 1, KM-37 NS, with strain relief connected to the harness. Under certain conditions, the Diving Supervisor may require that the helmet be worn. A standby SCUBA diver shall don all equipment and be checked by the Diving Supervisor. 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 Diving Supervisor, the standby diver may remove the tank. 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 an octopus rig.

6-8.8.3.2 ***Deploying the Standby Diver as a Working Diver.*** The standby diver may be deployed as a working diver provided all of the following conditions are met:

1. Surface-supplied no-decompression dive of 60 fsw or less.

2. Same job/location, e.g., working on port and starboard propellers on the vessel:

- Prior to deploying the standby diver, the work area shall be determined to be free of hazards (i.e., suctions, discharges) by the first diver on the job site.

- When working in ballast tanks or confined spaces, the standby diver may deploy as a working diver, but both divers shall be tended by a third diver who is outside the confined space.

NOTE **The standby diver shall remain on deck ready for deployment when salvage operations diving is being done.**

6-8.8.4 **Buddy Diver.** A buddy diver is the diver's partner for a SCUBA operation. The buddy divers are jointly responsible for the assigned mission. Each diver keeps track of depth and time during the dive. Each diver shall watch out for the safety and well-being of his buddy and shall be alert for symptoms of nitrogen narcosis, decompression sickness, and carbon dioxide build-up. A diver shall keep his buddy within sight and not leave his buddy alone except to obtain additional assistance in an emergency. If visibility is limited, a buddy line shall be used to maintain contact and communication. If SCUBA divers get separated and cannot locate each other, both divers shall surface immediately.

6-8.8.5 **Diver Tender**

6-8.8.5.1 ***Diver Tender Responsibilities.*** The tender is the surface member of the diving team who works closely with the diver on the bottom. At the start of a dive, the tender checks the diver's equipment and topside air supply for proper operation and dresses the diver. Once the diver is in the water, the tender constantly tends the lines to eliminate excess slack or tension (certain UWSH tasking may preclude this requirement, e.g., working in submarine ballast tanks, shaft lamination, dry habitat welding, etc.). The tender exchanges line-pull signals with the diver, keeps the Diving Supervisor informed of the line-pull signals and amount of diving hose/tending line over the side, and remains alert for any signs of an emergency.

Figure 6-19. Standby Diver.

6-8.8.5.2 ***Diver Tender Qualifications.*** The tender should be a qualified diver. When circumstances require the use of a non-diver as a tender, the Diving Supervisor shall ensure that the tender has been thoroughly instructed in the required duties. If a substitute tender shall be employed during an operation, the Diving Supervisor must make certain that the substitute is adequately briefed before assuming duties.

6-8.8.6 **Recorder.** The recorder shall be a qualified diver. The recorder maintains worksheets, fills out the diving log for the operation, and records the diver's descent time, depth of dive, and bottom time. The recorder reports to the Diving Supervisor the ascent time, first stop, and time required at the decompression stop. In SCUBA operations, the Diving Supervisor may assume the duties of the recorder. The recorder is required to have on hand a copy of the U.S. Navy Decompression Table being used. When decompression begins, the schedule selected by the Diving Supervisor is recorded on the chart and log. The recorder keeps all members of the team advised of the decompression requirements of the divers.

6-8.8.7 **Medical Personnel.** Diving Medical Officers and Diving Medical Technicians are given special training in hyperbaric medicine and in diving. They provide medical advice and treatment to diving personnel. They also instruct members of the diving team in first aid procedures and participate in diving operations when the presence of diving medical personnel is indicated, as when particularly hazardous operations are being conducted.

Diving medical personnel evaluate the fitness of divers before operations begin and are prepared to handle any emergencies which might arise. They also observe the condition of other support personnel and are alert for signs of fatigue, overexposure, and heat exhaustion.

There are no hard and fast rules for deciding when a medication would preclude a diver from diving. In general, topical medications, antibiotics, birth control medication, and decongestants that do not cause drowsiness would not restrict diving. Diving Medical Personnel should be consulted to determine if any other drugs would preclude diving.

6-8.8.8 **Other Support Personnel.** Other support personnel may include almost any member of the command when assigned to duties that support diving operations. Some personnel need specific indoctrination. Small-Boat operators shall understand general diving procedures, know the meanings of signals, and be aware of the mission objectives. Other personnel, such as winch operators or deck crew, might interact with the operation directly, but only when under the control of the Diving Supervisor. Engineering personnel may be directed to secure overboard discharges and lock the shafts; a sonar operator might be required to secure equipment and put a Do Not Energize tag on the power switch (see Figure 6-20 for a detailed Ship Repair Safety Checklist).

The Officer of the Deck (OOD) or Command Duty Officer (CDO) is responsible to the Commanding Officer for the operation and safety of the ship and crew during the watch. The OOD/CDO shall stay informed of the progress of the operation, of any changes to the original plan, and shall be notified as far in advance as possible of any special requirements. He shall inform the Diving Officer and Diving Supervisor of any changes in these conditions.

6-8.8.9 **Cross-Training and Substitution.** Each member of the diving team should be qualified to act in any position on the team. Because it is probable that substitutions will be made at some point during a lengthy mission, dive plans and diving schedules should organize personnel and work objectives so that experienced personnel will always be available on site. All personnel who participate in the operation should be included in initial briefings.

6-8.8.10 **Physical Condition.** Diving candidates shall meet the specific physical requirements for divers set forth by the Commander Naval Medical Command and pass a physical screening test as outlined in MILPERSMAN Article 1220.100. Once qualified, the diver is responsible for maintaining good health and top physical condition.

Reference NAVMEDCOMINST 6200.15 (series) to provide guidance on suspension of diving duty of pregnant servicewomen.

Medical personnel assigned to a diving unit shall evaluate the day-to-day condition of each diver and the Diving Supervisor shall verify the fitness of each diver immediately before a dive. Any symptom such as cough, nasal congestion, apparent fatigue, emotional stress, skin or ear infection is reason for placing the diver on the binnacle list until the problem is corrected.

Physical condition is often best judged by the diver who is obligated to report to the Diving Supervisor when not feeling fit to dive. A diver who, for any reason, does not want to make a dive should not be forced. A diver who regularly declines diving assignments shall be disqualified as a diver.

6-8.8.11 **Underwater Salvage or Construction Demolition Personnel.** Underwater salvage demolition training is provided at the Naval Diving and Salvage Training Center in both the Second class and First class Diver curriculum. Demolition diving personnel shall be qualified in accordance with the requirements of OPNAVINST 8023.2 (series).

6-8.8.12 **Blasting Plan.** The Master Diver or senior qualified diver is responsible for providing the Commanding Officer with a comprehensive and written blasting plan. At a minimum, the blasting plan contains:

- Demolition team organization
- Work description with alternatives
- Range standard operating procedures
- Prefiring procedures
- Postfiring procedures
- Area security plan
- Misfire procedures
- Personnel and equipment casualty procedures
- Blasting sequence of events

All demolition operations shall be conducted using approved operating and safety procedures. Qualified demolition personnel shall ensure the operation does not proceed until receiving specific approval from the diving supervisor and shall take charge of all misfires, ensuring they are handled in accordance with the approved plan.

6-8.8.13 **Explosive Handlers.** All divers who handle explosives shall be trained and certified in accordance with the OPNAVINST 8023.2 (series).

6-8.9 OSHA Requirements for U.S. Navy Civilian Diving. U.S. Navy Civilian Divers are governed by the provisions of the U.S. Navy Diving Program, yet they must also comply with U.S. Government Occupational Safety and Health Administration (OSHA) diving standards, delineated in 29 CFR Part 1910 Subpart T; Subj: Commercial Diving Operations. U.S. Navy Civilian Divers are identified as all permanent Navy employees who have formally trained at an approved U.S. Navy diving school as either a SCUBA diver, Second Class diver, or First Class diver. Commercial divers contracted by the Navy who are not permanent government employees are not subject to these provisions.

Most directives of the U.S. Navy Diving Program provide parallel requirements, or are similar enough not to be considered of substantive difference. Several requirements of OSHA do, however, exceed those delineated for U.S. Navy divers and must be identified to ensure compliance by USN civilian divers to both standards. Therefore, the following restrictions, in addition to all other requirements addressed in this manual, apply to USN civilian divers:

6-8.9.1 **SCUBA Diving (Air) Restrictions.**

1. SCUBA diving shall not be conducted:

- To depths deeper than 130 fsw.
- To depths deeper than 100 fsw or outside no-decompression limits unless a recompression chamber is available within 5 minutes of the dive location.

2. All SCUBA cylinder manifolds shall be equipped with a manual reserve (J valve), or an independent reserve cylinder gas supply with a separate regulator.
3. A SCUBA cylinder submersible pressure gauge shall be worn by each diver.

6-8.9.2 **Surface-Supplied Air Diving Restrictions.**

1. Surface-supplied air diving shall not be conducted:

- To depths deeper than 190 fsw if bottom time is 30 minutes or greater.
- To depths deeper than 220 fsw regardless of bottom time.
- To depths deeper than 100 fsw or outside no-decompression limits unless a recompression chamber is available within 5 minutes of the dive location.

2. The diver shall be equipped with an emergency gas supply (come-home bottle) for all planned decompression dives regardless of depth.

6-8.9.3 **Mixed Gas Diving Restrictions.**

1. Mixed gas diving shall not be conducted:

- To depths deeper than 220 fsw, unless a bell diving system is used.
- With a total in-water decompression time greater than 120 minutes.

2. A recompression chamber shall be available within 5 minutes of the dive location for all mixed gas dives.

6-8.9.4 **Post-Dive Surveillance.**

1. Civilian divers shall remain at the location of the recompression chamber for 1 hour after surfacing for all dives that require a recompression chamber to be available within 5 minutes of the dive location.

6-9 ORGANIZE AND SCHEDULE OPERATIONS

6-9.1 Task Planning and Scheduling. All phases of an operation are important. A common failure when planning an operation is to place excessive emphasis on the actual dive phases, while not fully considering pre-dive and post-dive activities. Another failure is to treat operations of a recurring nature with an indifference to safety that comes with over-familiarity. In developing a detailed task-by-task schedule for an operation, the following points shall be considered.

- The schedule shall allocate sufficient time for preparation, transit to the site, rendezvous with other vessels or units, setting up and testing the Dynamic Positioning system on site or establishing a secure mooring.
- Bottom time is always at a premium, and all factors that shall affect bottom time shall be carefully considered. These include depth, decompression, number of divers available, support craft size, and surface and underwater environmental conditions.
- The number and profile of repetitive dives in a given time period are limited. This subject is discussed in Chapter 9.
- Plans may include the option to work night and day; however, there is an increased risk of a diving mishap from fatigue.
- The level of personnel support depends on the diving techniques selected (see Minimum Manning Levels, Figure 6-16).
- In planning tasks, non-diving topside support personnel shall be selected carefully, especially those who are not members of the diving team.
- Any schedule must be flexible to accommodate unexpected complications, delays, and changing conditions.

- The Diving Supervisor shall anticipate difficulties and be prepared to either overcome them or find alternative methods to circumvent them.
- If divers have been inactive and operating conditions permit, work-up dives should be conducted in-water or in the recompression chamber.

6-9.2 **Post-dive Tasks.** A diving operation is completed when the objective has been met, the diving team demobilized, and records and reports are filed. Time shall be allocated for:

- Recovering, cleaning, inspecting, maintaining, repairing, and stowing all equipment
- Disposing materials brought up during the operation
- Debriefing divers and other team members
- Analyzing the operation, as planned and as actually carried out
- Restocking expended materials
- Ensuring the readiness of the team to respond to the next assignment

6-10 BRIEF THE DIVING TEAM

6-10.1 **Establish Mission Objective.** The Master Diver or the Diving Supervisor shall brief the team on the overall mission and the aspects of the operation necessary to safely achieve the objective. Major points of discussion include:

1. Clear, brief statement of the mission objective
2. Dominant factors that may determine mission outcome (i.e., environment, enemy/friendly actions, and hazards)
3. All tasks required to accomplish the mission
4. Time factors that may prevail
5. Any changes or augmentations of the dive plan

Prior to starting a dive mission or dive day, coordination with other commands and/or shipboard departments shall be accomplished.

6-10.2 **Identify Tasks and Procedures.** A briefing may be elaborate or simple. For complex operations, briefing with charts, slides, and diagrams may be required. For most operations, the briefing need not be complex and may be an informal meeting. The briefing shall present a breakdown of the dive objective, primary tasks, diving procedures, and related work procedures for the mission or dive day. Prompt debriefing of divers returning to the surface provides the Diving Supervisor with information that may influence or alter the next phase of the operation. Divers should be questioned about the progress of the work, bottom conditions and anticipated problems. They should also be asked for suggestions for immediate changes.

6-10.3 **Review Diving Procedures.** Diving and work procedures to be used for the task at hand shall be reviewed during the briefing. The Diving Safety and Planning Checklist (Figure 6-19), Ship Repair Safety Checklist for Diving (Figure 6-20) and the Surface-Supplied Diving Operations Pre-dive Checklist (Figure 6-21) support control of diving operations. These checklists may be tailored to specific missions and environmental circumstances.

6-10.4 **Assignment of Personnel.** All personnel assignments shall be reviewed and verified to ensure properly trained personnel are assigned to operations.

6-10.5 **Assistance and Emergencies.** In any diving operation, three types of assistance may be required:

1. Additional equipment, personnel, supplies, or services
2. Clarification, authorization, or decisions from higher command
3. Emergency assistance in the event of an accident or serious illness

Unexpected developments or emergency situations may be accompanied by confusion. The source and availability of any needed assistance and the method for obtaining it as quickly as possible, shall be determined in advance. The location of the nearest recompression chamber shall be identified and the chamber operators notified before the operation begins. The sources of emergency transportation, military or civilian, shall be established and alerted and the nearest Diving Medical Officer should be located and notified. Arrangements must be made to ensure a 24-hour availability for emergency assistance.

If emergency transportation is required by civilian Emergency Medical Services (EMS) sources, a Memorandum of Agreement or Diving Protocol should be established in advance and those casualty response agreements incorporated into the Command Diving Bill.

When a recompression chamber is required, as outlined in Table 6-1, it shall be a U.S. Navy certified chamber. In certain circumstances, a non-Navy chamber can be used to meet the requirement provided it has been inspected by a qualified chamber supervisor and deemed to offer comparable treatment capability, safety, and accessibility. For Levels I and II, CNO approval is required to use a non-Navy chamber.

Figure 6-22 is a suggested format for the Emergency Assistance Checklist that shall be completed and posted at the diving station to provide necessary information so that any member of the team could take prompt action.

6-10.6 **Notification of Ship's Personnel.** In the event of a diving casualty or mishap on dive station, calm must be maintained. Maintain silence on the side and take orders from the Diving Officer, Master Diver, and/or Diving Supervisor.

6-10.7 **Fouling and Entrapment.** Fouling and entrapment are more common with surface-supplied gear than SCUBA because of the ease with which the umbilicals can become entangled. Divers shall be particularly careful and watch their own umbilicals and those of their partners as well.

The surface-supplied diver may become fouled more easily, but will usually have an ample air supply while working to get free. The SCUBA diver may have no other recourse but to remove the gear and make a free ascent. If trapped, the SCUBA diver must face the possibility of running out of air before being able to work free.

The first and most important action that a trapped diver can take is to stop and think. The diver shall remain calm, analyze the situation, and carefully try to work free. Panic and overexertion are the greatest dangers to the trapped diver. If the situation cannot be resolved readily, help should be obtained. A new umbilical can be provided to the surface-supplied diver; the SCUBA diver can be given a new apparatus or may be furnished air by the dive partner.

Once the diver has been freed and returns to the surface, the diver shall be examined and treated, bearing in mind the following considerations:

- The diver will probably be overtired and emotionally exhausted.
- The diver may be suffering from or approaching hypothermia.
- The diver may have a physical injury.
- A SCUBA diver may be suffering from asphyxia. If a free ascent has been made, gas embolism may have developed.
- Significant decompression time may have been missed.

6-10.8 **Equipment Failure.** With well-maintained equipment that is thoroughly inspected and tested before each dive, operational failure is rarely a problem. When a failure does occur, the correct procedures will depend upon the type of equipment and dive. As with most emergencies, the training and experience of the diver and the diving team will be the most important factor in resolving the situation safely.

6-10.8.1 **Loss of Gas Supply.** Usually, when a diver loses breathing gas it should be obvious almost immediately. Some diving apparatus configurations may have an emergency gas supply (EGS). When breathing gas is interrupted, the dive shall be aborted and the diver surfaced as soon as possible. Surfacing divers may be suffering from hypoxia, hypercapnia, missed decompression, or a combination of the three, and should be treated accordingly.

6-10.8.2 **Loss of Communications.** If audio communications are lost with surface-supplied gear, the system may have failed or the diver could be in trouble. If communications are lost:

1. Use line-pull signals at once. Depth, current, bottom or work site conditions may interfere.
2. Check the rising bubbles of air. A cessation or marked decrease of bubbles could be a sign of trouble.
3. Listen for sounds from the diving helmet. If no sound is heard, the circuit is probably out of order. If the flow of bubbles seems normal, the diver may be all right.
4. If sounds are heard and the diver does not respond to signals, assume the diver is in trouble.
5. Have divers already on the bottom investigate, or send down the standby diver to do so.

6-10.9 **Lost Diver.** In planning for an operation using SCUBA, lost diver procedures shall be included in the dive plan and dive brief. Losing contact with a SCUBA diver can be the first sign of a serious problem. If contact between divers is lost, each diver shall surface. If the diver is not located quickly, or not found at the surface, the Diving Supervisor shall initiate search procedures immediately. At the same time, medical personnel should be notified and the recompression chamber team alerted.

A lost diver is often disoriented and confused and may have left the operating area. Nitrogen narcosis or other complications involving the breathing mixture, which can result in confusion, dizziness, anxiety, or panic, are common in recovered lost divers. The diver may harm the rescuers unknowingly. When the diver is located, the rescuer should approach with caution to prevent being harmed and briefly analyze the stricken diver's condition.

If the diver is found unconscious, attempts should be made to resupply breathing gas and restore consciousness. If this cannot be accomplished, the diver shall be brought to the surface immediately. Gas Embolism may occur during ascent and significant decompression may be missed and immediate recompression may be required. If it is possible to provide the diver with an air supply such as a single-hose demand SCUBA, the rescuer should do so during the ascent.

6-10.10 **Debriefing the Diving Team.** After the day's diving has been completed (or after a shift has finished work if the operation is being carried on around the clock), all members of the diving team should be brought together for a short debriefing of the day's activities. This offers all personnel a chance to provide feedback to the Diving Supervisor and other members of the team. This group interaction can help clarify any confusion that may have arisen because of faulty communications, lack of dive site information, or misunderstandings from the initial briefing.

6-11 AIR DIVING EQUIPMENT REFERENCE DATA

There are several diving methods which are characterized by the diving equipment used. The following descriptions outline capabilities and logistical requirements for various air diving systems.

DIVING SAFETY AND PLANNING CHECKLIST

(Sheet 1 of 4)

STEPS IN PLANNING OF DIVING OPERATIONS

Detailed, advanced planning is the foundation of diving safety.

A. ANALYZE THE MISSION FOR SAFETY.

__ Ensure mission objective is defined.

__ Determine that non-diving means of mission accomplishment have been considered and eliminated as inappropriate.

__ Coordinate emergency assistance.

__ Review relevant Naval Warfare Publications (NWP) and OPNAV instructions.

B. IDENTIFY AND ANALYZE POTENTIAL HAZARDS.

__ **Natural Hazards:**

1. Atmospheric:
   - __ Exposure of personnel to extreme conditions
   - __ Adverse exposure of equipment and supplies to elements
   - __ Delays or disruption caused by weather
2. Surface:
   - __ Sea sickness
   - __ Water entry and exit
   - __ Handling of heavy equipment in rough seas
   - __ Maintaining location in tides and currents
   - __ Ice, flotsam, kelp, and petroleum in the water
   - __ Delays or disruption caused by sea state
3. Underwater and Bottom:
   - __ Depth which exceeds diving limits or limits of available equipment
   - __ Exposure to cold temperatures
   - __ Dangerous marine life
   - __ Tides and currents
   - __ Limited visibility
   - __ Bottom obstructions
   - __ Ice (underwater pressure ridges, loss of entry hole, loss of orientation, etc.)
   - __ Dangerous bottom conditions (mud, drop-offs, etc.)

__ **On-Site Hazards:**

- __ Local marine traffic or other conflicting naval operations
- __ Other conflicting commercial operations
- __ High-powered, active sonar
- __ Radiation contamination and other pollution (chemical, sewer outfalls, etc.)

__ **Mission Hazards:**

- __ Decompression sickness
- __ Communications problems
- __ Drowning
- __ Other trauma (injuries)
- __ Hostile action

__ **Object Hazards:**

- __ Entrapment and entanglement
- __ Shifting or working of object
- __ Explosives or other ordnance

Figure 6-20. Diving Safety and Planning Checklist (sheet 1 of 4).

DIVING SAFETY AND PLANNING CHECKLIST

(Sheet 2 of 4)

C. SELECT EQUIPMENT, PERSONNEL and EMERGENCY PROCEDURES.

__ **Diving Personnel:**

- __ 1. Assign a complete and properly qualified Diving Team.
- __ 2. Assign the right man to the right task.
- __ 3. Verify that each member of the Diving Team is properly trained and qualified for the equipment and depths involved.
- __ 4. Determine that each man is physically fit to dive, paying attention to:
  - __ general condition and any evidence of fatigue
  - __ record of last medical exam
  - __ ears and sinuses
  - __ severe cold or flu
  - __ use of stimulants or intoxicants
- __ 5. Observe divers for emotional readiness to dive:
  - __ motivation and professional attitude
  - __ stability (no noticeably unusual or erratic behavior)

__ **Diving Equipment:**

- __ 1. Verify that diving gear chosen and diving techniques are adequate and authorized for mission and particular task.
- __ 2. Verify that equipment and diving technique are proper for depth involved.
- __ 3. Verify that life support equipment has been tested & approved for U.S. Navy use.
- __ 4. Determine that all necessary support equipment and tools are readily available and are best for accomplishing job efficiently and safely.
- __ 5. Determine that all related support equipment such as winches, boats, cranes, floats, etc. are operable, safe and under control of trained personnel.
- __ 6. Check that all diving equipment has been properly maintained (with appropriate records) and is in full operating condition.

__ **Provide for Emergency Equipment:**

- __ 1. Obtain and verify communication equipment with sufficient capability to reach help.
- __ 2. Verify that a recompression chamber is ready for use, or notify the nearest command with one that its use may be required within a given timeframe.
- __ 3. Verify that a completely stocked first aid kit is at hand.
- __ 4. Automated External Defibrillator (AED)
- __ 5. If oxygen will be used, verify that the tank is full and properly pressurized, and that masks, valves, and other accessories are fully operable.
- __ 6. Check resuscitator for proper functioning.
- __ 7. Check that fire-fighting equipment is readily available and in full operating condition.
- __ 8. Verify that emergency transportation is either standing by or on immediate call.

__ **Establish Emergency Procedures:**

- __ 1. Know how to obtain medical assistance immediately.
- __ 2. Assign specific tasks for each potential emergency situation to dive and support team.
- __ 3. Complete and post Emergency Assistance Checklist; ensure that all personnel are familiar with it.
- __ 4. Verify that an up-to-date copy of U.S. Navy Decompression Tables is available.
- __ 5. Ensure that all divers, boat crews and other support personnel understand all diver hand signals.
- __ 6. Predetermine distress signals and call-signs.

Figure 6-20. Diving Safety and Planning Checklist (sheet 2 of 4).

DIVING SAFETY AND PLANNING CHECKLIST

(Sheet 3 of 4)

__ 7. Ensure that all divers have removed anything from their mouths on which they might choke during a dive (gum, dentures, tobacco).

__ 8. Thoroughly drill all personnel in Emergency Procedures, with particular attention to cross-training; drills should include:

Emergency recompression	Rapid undressing	Fire
First aid	Rapid dressing	Embolism
Restoration of breathing	Near-drowning	Electric shock
Blowup	Entrapment	Lost diver

D. ESTABLISH SAFE DIVING OPERATIONAL PROCEDURES

__ **Complete Planning, Organization, and Coordination Activities:**

__ 1. Ensure that other means of accomplishing mission have been considered before deciding to use divers.

__ 2. Ensure that contingency planning has been conducted.

__ 3. Carefully state goals and tasks of each mission and develop a flexible plan of operations (Dive Plan).

__ 4. Completely brief the diving team and support personnel (paragraph 6-7).

__ 5. Designate a Master Diver or properly qualified Diving Supervisor to be in charge of the mission.

__ 6. Designate a recorder/timekeeper and verify that he understands his duties and responsibilities.

__ 7. Determine the exact depth at the job-site through the use of a lead line, pneumofathometer, or commercial depth sounder.

__ 8. Verify existence of an adequate supply of compressed air available for all planned diving operations **plus an adequate reserve for emergencies.**

__ 9. Ensure that no operations or actions on part of diving team, support personnel, technicians, boat crew, winch operators, etc., take place without the knowledge of and by the direct command of the Diving Supervisor.

__ 10. All efforts must be made through planning, briefing, training, organization, and other preparations to minimize bottom time. Water depth and the condition of the diver (especially fatigue), rather than the amount of work to be done, shall govern diver's bottom time.

__ 11. Current decompression tables shall be on hand and shall be used in all planning and scheduling of diving operations.

__ 12. Instruct all divers and support personnel not to cut any lines until approved by the Diving Supervisor.

__ 13. Ensure that ship, boat, or diving craft is set up on site using a Dynamic Positioning mode or securely moored and in position to permit safest and most efficient operations.

__ 14. Verify that, when using surface-supplied techniques, the ship, boat, or diving craft has at least a two-point moor or is in position using a Dynamic Positioning vessel IMO Equipment Class 2 or 3.

__ 15. Ensure that, when conducting SCUBA operations in hazardous conditions, a boat can be quickly cast off and moved to a diver in distress.

__ **Perform Diving Safety Procedures, Establish Safety Measures:**

__ 1. Ensure that each diver checks his own equipment in addition to checks made by tenders, technicians or other support personnel.

__ 2. Designate a standby diver for all diving operations; standby diver shall be dressed to the necessary level and ready to enter the water if needed.

__ 3. Assign buddy divers, when required, for all SCUBA operations.

Figure 6-20. Diving Safety and Planning Checklist (sheet 3 of 4).

DIVING SAFETY AND PLANNING CHECKLIST

(Sheet 4 of 4)

__ 4. Take precautions to prevent divers from being fouled on bottom. If work is conducted inside a wreck or other structure, assign a team of divers to accomplish task. One diver enters wreck, the other tends his lines from point of entry.

__ 5. When using explosives, take measures to ensure that no charge shall be fired while divers are in water.

__ 6. Use safety procedures as outlined in relevant Naval publications for all U/W cutting and welding operations.

__ 7. Brief all divers and deck personnel on the planned decompression schedules for each particular dive. Check provisions for decompressing the diver.

__ 8. Verify that ship, boat, or diving craft is displaying proper signals, flags, day shapes, or lights to indicate diving operations are in progress. (Consult publications governing International or Inland Rules, International/Inland local signals, and Navy communications instructions.)

__ 9. Ensure that protection against harmful marine life has been provided. (See Appendix 5C.)

__ 10. Check that the quality of diver's air supply is periodically and thoroughly tested to ensure purity.

__ 11. Thoroughly brief boat crew.

__ 12. Verify that proper safety and operational equipment is aboard small diving boats or craft.

__ **Notify Proper Parties that Dive Operations Are Ready to Commence:**

__ 1. Diving Officer

__ 2. Commanding Officer

__ 3. Area Commander

__ 4. Officer of the Deck/Day

__ 5. Command Duty Officer or Commanding Officer of ships alongside

__ 6. Bridge, to ensure that ship's personnel shall not: turn the propeller or thrusters unless using a Dynamic Positioning Vessel and the Diving Supervisor has been notified and agrees to ship's configuration.

- __ get underway
- __ activate active sonar or other electronics
- __ drop heavy items overboard
- __ shift the moor or change position using Dynamic Positioning mode without prior approval from the Diving Supervisor
- __ change any agreed upon Dynamic Positioning setting without first getting approval from the Diving Supervisor

__ 7. Ship Duty Officer, to ensure that ship's personnel shall not:

- __ activate sea discharges or suctions
- __ operate bow or stern-planes or rudder
- __ operate vents or torpedo shutters
- __ turn propellers

__ 8. Other Interested Parties and Commands:

- __ Harbor Master/Port Services Officer
- __ Command Duty Officers
- __ Officers in tactical command
- __ Cognizant Navy organizations
- __ U.S. Coast Guard (if broadcast warning to civilians is required)

__ 9. Notify facilities having recompression chambers and sources of emergency transportation that diving operations are underway and their assistance may be needed.

Figure 6-20. Diving Safety and Planning Checklist (sheet 4 of 4).

SHIP REPAIR SAFETY CHECKLIST FOR DIVING

(Sheet 1 of 2)

When diving operations will involve underwater ship repairs, the following procedures and safety measures are required in addition to the Diving Safety Checklist.

SAFETY OVERVIEW

A. The Diving Supervisor shall advise key personnel of the ship undergoing repair:

1. OOD	4. OODs of ships alongside
2. Engineering Officer	5. Squadron Operations (when required)
3. CDO	6. Combat Systems Officer (when required)

B. The Diving Supervisor shall request that OOD/Duty Officer of ship being repaired ensure that appropriate equipment is secured and tagged out.

C. The Diving Supervisor shall request that OOD/Duty Officer advise him when action has been completed and when diving operations may commence.

D. When ready, the diving Supervisor shall request that the ship display appropriate diving signals and pass a diving activity advisory over the 1MC every 30 minutes. For example, “There are divers working over the side. Do not operate any equipment, rotate screws, cycle rudder, planes or torpedo shutters, take suction from or discharge to sea, blow or vent any tanks, activate sonar or underwater electrical equipment, open or close any valves, or cycle trash disposal unit before checking with the Diving Supervisor.”

E. The Diving Supervisor shall advise the OOD/Duty Officer when diving operations commence and when they are concluded. At conclusion, the ship will be requested to pass the word on the 1MC, “Diving operations are complete. Carry out normal work routine.”

F. Diving within 50 feet of an active sea suction (located on the same side of the keel) that is maintaining a suction of 50 gpm or more, is not authorized unless considered as an emergency repair and is authorized by the Commanding Officers of both the repair activity and tended vessel. When it is determined that the sea suction is maintaining a suction of less than 50 gpm and is less than 50 feet, or maintaining a suction of more than 50 gpm and is less than 50 feet but on the opposite side of the keel, the Diving Supervisor shall determine if the sea suction is a safety hazard to the divers prior to conducting any diving operation. In all cases the Diving Supervisor shall be aware of the tend of the diver’s umbilical to ensure that it will not cross over or become entrapped by an active sea suction. Diving on SSN 688, SSN 774, SSN 21 (SEAWOLF), SSBN, and SSGN class submarines does not present a hazard to divers when ASW and MSW pumps are operating in slow or super slow modes. Diver tag-out procedures must be completed in accordance with the TUMS and SORM to ensure ASW and MSW pumps are not operated in fast mode. Divers must be properly briefed on location of suctions and current status of equipment.

NOTIFY KEY PERSONNEL.

1. OOD ______________________________ (signature)
2. Engineering Officer ______________________________ (signature)
3. CDO USS ____________________________ (signature)
4. OOD USS ____________________________
   OOD USS ____________________________
   OOD USS ____________________________
   OOD USS ____________________________
5. Squadron Operations ____________________________
6. Port Services Officer ____________________________

(Diving Supervisor (Signature))

Figure 6-21. Ship Repair Safety Checklist for Diving (sheet 1 of 2).

SHIP REPAIR SAFETY CHECKLIST FOR DIVING

(Sheet 2 of 2)

TAG OUT EQUIPMENT

TAG OUT	SIGNATURE AND RATE
Rudder	______________________
Anchors	______________________
Planes	______________________
Torpedo tube shutters	______________________
Trash disposal unit	______________________
Tank blows	______________________
Tank vents	______________________
Shaft(s) locked	______________________
Sea suctions	______________________
Sea discharges	______________________
U/W electrical equipment	______________________
Sonars	______________________
Other U/W equipment	______________________

USS ______________________

(name of ship)

CDO______________________

(signature of CDO)

Figure 6-21. Ship Repair Safety Checklist for Diving (sheet 2 of 2).

SURFACE-SUPPLIED DIVING OPERATIONS PREDIVE CHECKLIST

(Sheet 1 of 3)

CAUTION

This checklist is an overview intended for use with the detailed Operating Procedures (OPs) from the appropriate equipment O&M technical manual.

A. Basic Preparation:

___1. Verify that a Level I recompression chamber is operational for all decompression dives deeper than 130 fsw.

___2. Verify that proper signals indicating underwater operations being conducted are displayed correctly.

___3. Ensure that all personnel concerned, or in the vicinity, are informed of diving operations.

___4. Determine that all valves, switches, controls, and equipment components affecting diving operation are tagged-out to prevent accidental shut-down or activation.

___5. Verify that diving system and recompression chamber are currently certified or granted a Chief of Naval Operations (CNO) waiver to operate.

B. Equipment Protection:

___1. Assemble all members of the diving team and support personnel (winch operators, boat crew, watchstanders, etc.) for a predive briefing.

___2. Assemble and lay out all dive equipment, both primary equipment and standby spares for diver (or standby diver), including all accessory equipment and tools.

___3. Check all equipment for superficial wear, tears, dents, distortion, or other discrepancies.

___4. Check all masks, helmets, view ports, faceplates, seals, and visors for damage.

___5. Check all harnesses, laces, strain reliefs, and lanyards for wear; renew as needed.

C. MK 21 MOD1/KM-37 NS:

___ Ensure that all Operating Procedures (OPs) have been completed in accordance with *UBA MK 21 MOD 1,* NAVSEA S6560-AG-OMP-010, or *KM-37 NS Technical Manual.*

D. MK 20 MOD 0:

___ Ensure that all Operating Procedures (OPs) have been completed in accordance with *UBA MK 20 MOD 0 Technical Manual*, NAVSEA SS600-AK-MMO-010.

E. General Equipment:

___1. Check that all accessory equipment – tools, lights, special systems, spares, etc., – are on site and in working order. In testing lights, tests should be conducted with lights submerged in water and extinguished before removal, to prevent overheating and failure.

___2. Erect diving stage or attach diving ladder. In the case of the stage, ensure that the screw pin shackle connecting the stage line is securely fastened with the shackle pin seized with wire or a safety shackle is used to help prevent opening.

F. Preparing the Diving System:

___1. Check that a primary and suitable back-up air supply is available with a capacity in terms of purity, volume, and supply pressure to completely service all divers including decompression, recompressions and accessory equipment throughout all phases of the planned operation.

___2. Verify that all diving system operating procedures have been conducted to properly align the dive system.

___3. Ensure that qualified personnel are available to operate and stand watch on the dive system.

Figure 6-22. Surface-Supplied Diving Operations Predive Checklist (sheet 1 of 3).

SURFACE-SUPPLIED DIVING OPERATIONS PREDIVE CHECKLIST

(Sheet 2 of 3)

___4. Compressors:

- ___ a. Determine that sufficient fuel, coolant, lubricants, and antifreeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated, and serviced (with all spillage cleaned up completely).
- ___ b. Verify that all diving system operating procedures have been conducted properly to align the dive system.
- ___ c. Check maintenance and repair logs to ensure the suitability of the compressor (both primary and back-up) to support the operation.
- ___ d. Verify that all compressor controls are properly marked and any remote valving is tagged with "Divers Air Supply - Do Not Touch" signs.
- ___ e. Ensure that compressor is secure in diving craft and shall not be subject to operating angles, caused by roll or pitch, that will exceed 15 degrees from the horizontal.
- ___ f. Verify that oil in the compressor is an approved type. Check that the compressor oil does not overflow Fill mark; contamination of air supply could result from fumes or oil mist.
- ___ g. Check that compressor exhaust is vented away from work areas and, specifically, does not foul the compressor intake.
- ___ h. Check that compressor intake is obtaining a free and pure suction without contamination. Use pipe to lead intake to a clear suction if necessary.
- ___ i. Check all filters, cleaners and oil separators for cleanliness IAW PMS.
- ___ j. Bleed off all condensed moisture from filters and from the bottom of volume tanks. Check all manifold drain plugs, and that all petcocks are closed.
- ___ k. Check that all belt-guards are properly in place on drive units.
- ___ l. Check all pressure-release valves, check valves and automatic unloaders.
- ___ m. Verify that all supply hoses running to and from compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed on deck in such a way that they could be rolled over, damaged, or severed by machinery or other means.
- ___ n. Verify that all pressure supply hoses have safety lines and strain reliefs properly attached.

H. Activate the Air Supply in accordance with approved OPs.

___1. Compressors:

- ___ a. Ensure that all warm-up procedures are completely followed.
- ___ b. Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain plugs for leakage or malfunction of any kind.
- ___ c. Verify that there is a properly functioning pressure gauge on the air receiver and that the compressor is meeting its delivery requirements.

___2. Cylinders:

- ___ a. Gauge all cylinders for proper pressure.
- ___ b. Verify availability and suitability of reserve cylinders.
- ___ c. Check all manifolds and valves for operation.
- ___ d. Activate and check delivery.

___3. For all supply systems, double check "Do Not Touch" tags (tags outs).

Figure 6-22. Surface-Supplied Diving Operations Predive Checklist (sheet 2 of 3).

SURFACE-SUPPLIED DIVING OPERATIONS PREDIVE CHECKLIST

(Sheet 3 of 3)

I. Diving Hoses:

___1. Ensure all hoses have a clear lead and are protected from excessive heating and damage.

___2. Check hose in accordance with PMS.

___3. Ensure that the hose (or any length) has not been used in a burst test program. No hose length involved in such a program shall be part of an operational diving hose.

___4. Check that hoses are free of moisture, packing material, or chalk.

___5. Soap test hose connections after connection to air supply and pressurization.

___6. Ensure umbilical boots are in good condition.

J. Test Equipment with Activated Air Supply in accordance with approved OPs.

___1. Hook up all air hoses to helmets, masks and chamber; make connections between back-up supply and primary supply manifold.

___2. Verify flow to helmets and masks.

___3. Check all exhaust and non-return valves.

___4. Hook up and test all communications.

___5. Check air flow from both primary and back-up supplies to chamber.

K. Recompression Chamber Checkout (Predive only):

___1. Check that chamber is completely free and clear of all combustible materials.

___2. Check primary and back-up air supply to chamber and all pressure gauges.

___3. Check that chamber is free of all odors or other "contaminants."

___4. Hook up and test all communications.

___5. Check air flow from both primary and back-up supplies to chamber.

Final Preparations:

___1. Verify that all necessary records, logs, and timesheets are on the diving station.

___2. Check that appropriate decompression tables are readily at hand.

___3. Place the dressing bench in position, reasonably close to the diving ladder or stage, to minimize diver travel.

Figure 6-22. Surface-Supplied Diving Operations Predive Checklist (sheet 3 of 3).

EMERGENCY ASSISTANCE CHECKLIST

Location

Name/Phone Number

Response Time

AIR TRANSPORTATION

Location

Name/Phone Number

Response Time

SEA TRANSPORTATION

Location

Name/Phone Number

Response Time

HOSPITAL

Location

Name/Phone Number

Response Time

DIVING MEDICAL OFFICER

Location

Name/Phone Number

Response Time

Location

Name/Phone Number

Response Time

COMMUNICATIONS

Location

Name/Phone Number

Response Time

DIVING UNITS

Location

Name/Phone Number

Response Time

COMMAND

Location

Name/Phone Number

Response Time

EMERGENCY CONSULTATION
Duty Phone Numbers 24 Hours a Day
Navy Experimental Dive Unit (NEDU)

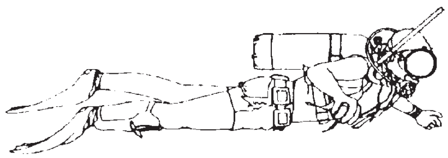
Commercial	(850)	234-4351
	(850)	230-3100
DSN		436-4351

Navy Diving Salvage and Training Center (NDSTC)

Commercial	(850) 234-4651
DSN	436-4651

Figure 6-23. Emergency Assistance Checklist.

SCUBA General Characteristics



Principle of Operation:

Self contained, open-circuit demand system

Minimum Equipment:

1. Open-circuit SCUBA with J-valve or submersible pressure gauge
2. Life preserver/buoyancy compensator
3. Weight belt (if required)
4. Dive knife
5. Face mask
6. Swim fins
7. Submersible wrist watch
8. Depth gauge

Principal Applications:

1. Shallow water search
2. Inspection
3. Light repair and recovery

Advantages:

1. Rapid deployment
2. Portability
3. Minimum support requirements
4. Excellent horizontal and vertical mobility
5. Minimum bottom disturbances

Disadvantages:

1. Limited endurance (depth and duration)
2. Limited physical protection
3. Influenced by current
4. Lack of voice communication (unless equipped with a through-water communications system or full face mask)

Restrictions:

Work limits:

1. Normal 130 fsw
2. Maximum 190 fsw with Commanding Officer or Officer-in-Charge's permission
3. 100 fsw using SCUBA cylinder(s) with less than 100 SCF
4. Standby diver with at least 100 SCF cylinder capacity for dives deeper than 60 fsw
5. Within no-decompression limits
6. Current - 1 knot maximum. Current greater than 1 knot, requires ORM analysis. As a minimum the divers(s) must be tended or have a witness float.

Operational Considerations:

1. Standby diver required
2. Small craft is mandatory for diver recovery during open-ocean diving, when diving off of a large platform or when the diver is untended and may be displaced from dive site, e.g., during a bottom search in a strong current or a long duration swim.
3. Moderate to good visibility preferred
4. Ability to free ascend to surface required (see paragraph 7-8.2)

Figure 6-24. SCUBA General Characteristics.

MK 20 MOD 0 General Characteristics

Principle of Operation:

Surface-supplied, open-circuit lightweight system

Minimum Equipment:

1. MK 20 MOD 0 mask
2. Harness
3. Weight belt (as required)
4. Dive knife
5. Swim fins or boots
6. Surface umbilical

Principal Applications:

Diving in mud tanks and enclosed spaces

Advantages:

1. Unlimited by air supply
2. Good horizontal mobility
3. Voice and/or line-pull signal capabilities

Disadvantages:

1. Limited physical protection

Restrictions:

1. Depth limits: 60 fsw
2. Current - Above 1.5 knots requires extra weights
3. Enclosed space diving requires an Emergency Gas Supply (EGS) with 50 to 150 foot whip and second-stage regulator.

Operational Considerations:

1. Adequate air supply system required
2. Standby diver required

MK 20 MOD 0 Helmet

Figure 6-25. MK 20 MOD 0 General Characteristics.

MK 21 MOD 1, KM-37 NS General Characteristics

Principle of Operation:

Surface-supplied, open-circuit system

Minimum Equipment:

1. MK 21 MOD 1, KM-37 NS Helmet
2. Harness
3. Weight belt (if required)
4. Dive knife
5. Swim fins or boots
6. Surface umbilical
7. EGS bottle deeper than 60 fsw

Principal Applications:

1. Search
2. Salvage
3. Inspection
4. Underwater Ships Husbandry and enclosed space diving

Advantages:

1. Unlimited by air supply
2. Head protection
3. Good horizontal mobility
4. Voice and/or line pull signal capabilities
5. Fast deployment

Disadvantages:

1. Limited mobility

Restrictions:

1. Depth limits: 190 fsw
2. Emergency air supply (EGS) required deeper than 60 fsw or diving inside a wreck or enclosed space
3. Current - Above 1.5 knots requires extra weights
4. Enclosed space diving requires an Emergency Gas Supply (EGS).

Operational Considerations:

1. Adequate air supply system required
2. Standby diver required

MK 21 MOD 1, KM-37 NS Helmet.

Figure 6-26. MK 21 MOD 1, KM-37 NS General Characteristics.

EXO BR MS Characteristics

Principle of Operation:

Surface-supplied, open-circuit system
Self contained, open-circuit demand system

Minimum Equipment:

1. EXO BR MS Full Face Mask
2. Manifold Block (except for SCUBA and ship husbandry enclosed spaces)
3. Harness
4. Weight belt (if required)
5. Dive knife
6. Swim fins or boots
7. Surface umbilical
8. EGS bottle deeper than 60 fsw

Principal Applications:

1. Search
2. Salvage
3. Inspection
4. Underwater Ships Husbandry and enclosed space diving

Advantages:

1. Unlimited by air supply
2. Good horizontal mobility
3. Voice and/or line pull signal capabilities
4. Fast deployment

Disadvantages:

1. Limited physical protection

Restrictions:

1. Depth limits: 190 fsw
2. Emergency air supply (EGS) required deeper than 60 fsw or diving inside a wreck or enclosed space
3. Current - Above 1.5 knots requires extra weights
4. Enclosed space diving requires an Emergency Gas Supply (EGS) with 50 to 150 foot whip and second stage regulator.

Operational Considerations:

1. Adequate air supply system required
2. Standby diver required

EXO BR MS Full Face Mask.

Figure 6-27. EXO BR MS Characteristics.

Interspiro Divator MK II DP 1/2 Surface Supply Apparatus

Principle of Operation:

Surface augmented dive apparatus

Minimum Equipment:

1. Divator DP 1 surface box with adequate cylinders per dive plan
2. Divator MK-II open-circuit SCUBA with octopus regulator and MK 20 Full Face Mask
3. Life Preserver
4. Weights (if required)
5. Dive knife
6. Swim fins
7. Submersible wrist watch
8. Depth Gauge

Principal Applications:

1. Shallow water search
2. Inspection
3. Light repair and recovery

Advantages:

1. Rapid deployment
2. Portability
3. Minimum support requirements
4. Excellent horizontal and vertical mobility
5. Minimum bottom disturbances
6. Greater endurance, air supply not limited to man carried cylinders

Disadvantages:

1. Limited physical protection
2. Influenced by current

Restrictions:

1. Work limits:
2. Maximum 130 fsw
3. Standby diver with minimum of 100 scf cylinder for all DP 1 diving
4. Within no-decompression limits
5. Current – 1 knot maximum
6. Diving team – minimum 4 persons

Open Water Operational Considerations:

1. Standby diver required. Standby diver may be supplied from the DP 1 surface box or a stand-alone SCUBA diver. Standby must be tended. In either case the designated Standby diver must wear minimum of 100 scf capacity cylinder(s).
2. Small craft mandatory for diver recovery during open-ocean diving
3. Moderate to good visibility preferred

CAUTION
In the DP 2 configuration with two divers, if one diver experiences an umbilical casualty (cut) the primary air supply for both divers will be lost. Both divers must shift to EGS and abort the dive. If two DP 1 systems are being utilized for diving and one diver's umbilical is cut only that diver's air supply will be affected.

NOTE: Addition of an authorized T-piece to attach the secondary umbilical allows two divers to use the same topside panel (DP 2).

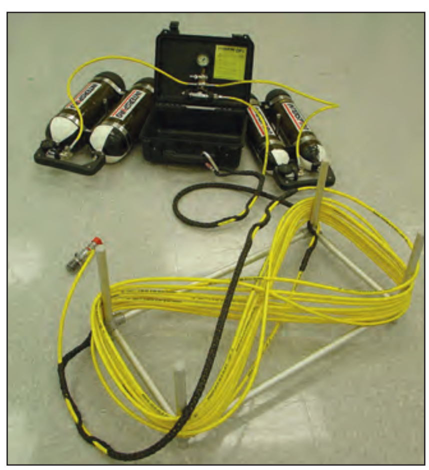


Figure 6-28. Interspiro Divator MK II, DP 1/2 Surface Supply Apparatus General Characteristics. (Sheet 1 of 2)

Interspiro Divator MK II DP 1/2 Surface Supply Apparatus

Operating guidelines for enclosed or confined space diving utilizing Interspiro Divator MK II, DP 1/2 surface supply diving apparatus in reserve mode with AMU approved flasks or cylinders as a primary air source and an emergency gas supply (EGS), provided applicable guidance listed below is followed:

Air source will meet analysis guidelines in accordance with Chapter 4 paragraph 4-3.

The DP UWSH and Enclosed Space Diving Supervisor Pre-Dive Checklists are located on the SECURE SUPSALV website on the 00C3 publications page in the Interspiro Divator SCUBA and Divator DP 1 section. The applicable checklist must be completed prior to diving.

Underwater Ship Husbandry (UWSH) Enclosed Space Diving:

- All current enclosed space safety precautions must be followed as outlined in Chapter 8.
- An individual depth gauge or approved dive computer will be used for each diver.
- For submarine ballast tanks, cofferdams, and mud tanks only, the diver may wear a harness with the “EGRESS” Divator Regulator Assembly attached (Interspiro drawings 99644 A and 99645 A). EGS will be provided as outlined in Chapter 8.
- NEC 5345 divers are not authorized to conduct enclosed space diving.
- UWSH standby diver guidance provided for in Chapter 6 must be followed.
- Standby diver will be supplied air from DP 2 or a separate DP 1 but cannot be a SCUBA diver.

Salvage Operation Enclosed Space Diving:

- An individual depth gauge or approved dive computer will be used for each diver.
- As the primary diving rig it will only be used for short duration operations, for example, examining item(s) of interest, quick recovery, etc.
- As a support or secondary rig, it may be used for ancillary purposes, for example, underwater photographer, shuttling underwater tools, etc.
- DP 2 is not authorized for one primary diver and standby. In this case, it must be DP 1 for the primary diver and a separate DP 1 for standby.
- DP 2 is authorized for two primary divers with standby diver in DP 1, provided both divers are outfitted with EGS.

Figure 6-28. Interspiro Divator MK II, DP 1/2 Surface Supply Apparatus General Characteristics. (Sheet 2 of 2)

7-3.1.10 **Submersible Cylinder Pressure Gauge.** The submersible cylinder pressure gauge provides the diver with a continual read-out of the air remaining in the cylinder(s). Various submersible pressure gauges suitable for Navy use are commercially available. Most are equipped with a 2- to 3-foot length of high-pressure rubber hose with standard fittings, and are secured directly into the first stage of the regulator. When turning on the cylinder air, the diver should turn the face of the gauge away in the event of a blowout. When worn, the gauge and hose should be tucked under a shoulder strap or otherwise secured to avoid its entanglement with bottom debris or other equipment. The gauge must be calibrated in accordance with the equipment planned maintenance system.

7-3.1.11 **Dive Computers.** Introduced by the civilian SCUBA dive sector, dive computers have proven useful in the optimization and management of dive time and decompression. These tools may be used for both SCUBA and surface supplied dives. Only AMU approved dive computers may be used in lieu of decompression tables. Proper training and strict adherence to specific guidelines regarding the various dive computers must be followed. Dive computers are not a substitute for ORM. Proper planning of the dive remains the responsibility of the diver and the dive supervisor.

7-4 AIR SUPPLY

During the planning phase, the required air supply is computed to determine dive and logistics considerations based on an RMV of 1.4. During the execution phase, the Dive Supervisor must know how long an air supply may last for a particular diver. Therefore, the Dive Supervisor shall compute the air supply duration before conducting a SCUBA dive using a conservative estimation of RMV based on the individual diver with the highest expected RMV.

7-4.1 **Duration of Air Supply.** The duration of the air supply of any given cylinder or combination of cylinders depends upon:

- The diver's consumption rate, which varies with the diver's work rate,
- The depth of the dive, and
- The capacity and minimum pressure of the cylinder(s).

Work rate may be influenced by water temperature, thickness of thermal protection, currents, the nature of the tasks to be performed, the diver's physical fitness, the diver's actual experience with the dive rig, diving environment and task, and how current the diver's experience actually is.

There are three steps in calculating how long a diver's air supply will last:

1. Calculate the diver's consumption rate by using this formula:

$$C = \frac{D + 33}{33} \times RMV$$

Where:

C = Diver's consumption rate, standard cubic feet per minute (scfm)

D = Depth, fsw

minimize potential diver disorientation caused by multiple keel crossings or fore and aft confusion.

When notified of a lost diver, a search shall be conducted by a tended diver in the area where the lost diver was last seen.

Predive briefs must include careful instruction on life preserver use when working under a hull to prevent panic blowup against the hull. Life preservers should not be fully inflated until after the diver passes the turn of the bilge.

7-8.3 **Decompression.** Open-circuit SCUBA dives are normally planned as no-decompression dives. Open-circuit SCUBA dives requiring decompression may be made only when considered absolutely necessary and authorized by the Commanding Officer or Officer in Charge (OIC). Under this unique situation, the following provides guidance for SCUBA decompression diving.

The Diving Supervisor shall determine the required bottom time for each dive. Based upon the time and depth of the dive, the required decompression profile from the tables presented in Chapter 9 shall be computed. The breathing supply required to support the total time in the water must then be calculated. If the air supply is not sufficient, a backup SCUBA will have to be made available to the divers. The backup unit can be strapped to a stage or tied off on a descent line which also has been marked to indicate the various decompression stops to be used.

When the divers have completed the assigned task, or have reached the maximum allowable bottom time prescribed in the dive plan, they must ascend to the stage or the marked line and signal the surface to begin decompression. With the stage being handled from the surface, the divers will be taken through the appropriate stops while the timekeeper controls the progress. Before each move of the stage, the tender will signal the divers to prepare for the lift and the divers will signal back when prepared. When using a marked line, the tender will signal when each stop has been completed, at which point the divers will swim up, signaling their arrival at the next stop. Stop times will always be regulated by the Dive Supervisor.

In determining the levels for the decompression stops, the sea state on the surface must be taken into consideration. If large swells are running, the stage or marker line will be constantly rising and falling with the movements of the surface-support craft. The depth of each decompression stop should be calculated so that the divers' chests will never be brought above the depths prescribed for the stops in the decompression tables.

In the event of an accidental surfacing or an emergency, the Diving Supervisor will have to determine if decompression should be resumed in the water or if the services of a recompression chamber are required. The possibility of having to make such a choice should be anticipated during the planning stages of the operation.

RECORD OF CHANGES

CHANGE NO.	DATE OF CHANGE	TITLE AND/OR BRIEF DESCRIPTION	ENTERED BY
A	10-15-11	Changes throughout the manual to provide new procedures for use of KM 37 (NS) in contaminated water diving, use of MK 16 in non-EOD diving operations, and revised requirements for use of recompression chambers.	JGJ
ACN 1/R7	02-04-13	ACN 1/R7 provides the operating guidelines for enclosed or confined space diving utilizing Interspiro MKII, DP 1/2 Surface Supply Diving Apparatus.	JGJ
ACN 2/R7	10-23-14	ACN 2/R7 effects changes in the following areas IAW diving operations assessment integrated project team recommendations: mishap and near mishap reporting, planning and ORM, breathhold diving, and calculation of SCUBA air supply.	KDL