

# NOAA

## Diving Manual

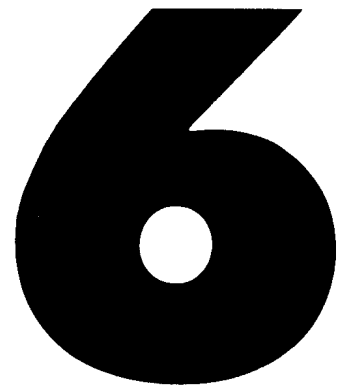


DIVING FOR SCIENCE AND TECHNOLOGY

U.S. DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration

SECOND  
EDITION

# GENERAL DIVING AND EMERGENCY PROCEDURES



## 6.0 GENERAL

Adherence to established diving procedures and recognition of any special precautions that may be needed because of local conditions will enhance the safety of diving operations. Diving personnel should have a thorough understanding of the procedures described in this section. Poor procedures result not only in unnecessary and costly delays, but also may affect the success of a project and increase the probability of accidents.

## 6.1 PLANNING THE DIVING OPERATION

### 6.1.1 Definition of Mission and Goals

A clear definition of the mission and its goals is the first step. To establish an operational plan, all parties engaged in the project should participate, including those who will be diving and those engaged in nondiving roles. Resources, including divers, diving equipment, surface or underwater support platforms, and support equipment, should be determined. The data or samples to be gathered, work to be performed, or observations to be made should be identified, and the bottom time should be estimated as closely as possible.

### 6.1.2 Selection of Diving Equipment

The selection of the proper diving equipment is dependent upon environmental conditions, qualifications of diving personnel, objectives of the operation, and diving procedures to be used.

Although most diving is at depths less than 130 fsw and uses open-circuit scuba, some missions can be accomplished using only skin diving equipment. Other more complex missions require surface-supplied or closed-circuit breathing equipment. Depth and duration of the dive, type of work to be accomplished (heavy work, light work, silent work), temperature of the water, amount of current, and visibility all influence the selection of diving equipment. Detailed descriptions of the various types of diving equipment are given in Section 4. For planning purposes, the following guidelines may be used in selecting diving equipment.

### Skin Diving Equipment

#### Generally Used For:

Scientific observation in shallow water in areas where more complex equipment is a disadvantage or is not available

Shallow water photography

Scouting for diving sites

#### Major Advantages:

Less physical work required to cover large surface areas

Simplified logistics

#### Major Disadvantages:

Extremely limited depth and duration

Requires diver to develop breath-holding techniques

Affected by sea conditions

### Open-Circuit Scuba

#### Generally Used For:

Scientific observation

Light underwater work and recovery

Sample gathering

Shallow water research

Ship inspection and light repair

#### Major Advantages:

Minimum support requirements

Mobility

Accessibility and economy of equipment and breathing medium

Portability

Reliability

#### Major Disadvantages:

Lack of efficient voice communication

Limited depth and duration

### Umbilical-Supplied Systems

#### Generally Used For:

Scientific investigation

Ship repair and inspection

Salvage

Long-duration scientific observation and data gathering

Harsh environments (low visibility, currents)

**Major Advantages:**

Heat can be supplied to suit and breathing medium

Duration of dive not limited by breathing medium

Voice communication

**Major Disadvantages:**

Limited mobility

Significant support requirements

**Closed-Circuit Scuba****Generally Used For:**

Quiet, long-duration observations

**Major Advantages:**

Mixed-gas capability

Noiseless operation

Conservation of breathing medium

Long duration

**Major Disadvantages:**

Complicated maintenance

Extensive training requirements

Lack of efficient voice communication

**6.1.3 Dive Team Organization****6.1.3.1 Dive Master**

Dive masters have total responsibility for the safe and efficient conduct of diving operations. They must be experienced divers qualified to handle the requirements of the proposed dive. No diving should be conducted when the dive master is not present. The dive master's responsibilities are many, and include but may not be limited to:

- Overall responsibility for the diving operation
- Safe execution of all diving
- Preparation of a basic plan of operation
- Liaison with other organizations
- Selection of equipment
- Proper maintenance, repair, and stowage of equipment
- Selection, evaluation, and briefing of divers and other personnel
- Monitoring the progress of the operation and updating requirements as necessary
- Maintaining the diving log
- Monitoring of decompression (when required)

The dive master is responsible for the assignment of all divers to an operation and for ensuring that their

qualifications meet the requirements of the dive. The dive master shall ensure that all divers are briefed thoroughly as to the missions and goals of the operation. Individual responsibilities will be assigned each diver by the dive master. Where special tools or techniques are to be used, the dive master shall ensure that each diver is familiar with their application.

Training and proficiency dives should be made as necessary to ensure safe and efficient operations. During operations involving a large number of divers or in very complex dives, dive masters should perform no actual diving, but should instead devote their efforts to directing the operation.

**6.1.3.2 Diving Medical Officer/Medical Technician**

Though there are obvious advantages in having a qualified diving medical officer on site, this may not always be practical. As an alternative to a diving medical officer, an Emergency Medical Technician trained in the care of diving casualties may be utilized. An individual so trained is able to respond not only to emergency medical situations, but is capable of communicating effectively with a physician located at a distance from the diving site. There are specialized courses available designed to train Emergency Medical Technicians in the care of diving casualties (see Paragraph 3.8).

In the event that neither a physician nor a trained technician is available, the dive master should obtain the names and phone numbers of at least three diving medical specialists who can be reached for advice in an emergency. Emergency consultation is available on 24-hour call at the Navy Experimental Diving Unit, Panama City, FL 32407, telephone (904) 234-4351, 4353; the National Naval Medical Center, Naval Medical Research Institute, Bethesda, MD 20014, telephone (301) 295-0283; and at Brooks Air Force Base, San Antonio, Texas 78235, telephone (512) 536-3278. Each of these services is referred to as a "Bends Watch," and is available to provide advice on the treatment of diving casualties. Diving personnel should be sure to obtain and keep the phone numbers of these facilities, especially if diving operations are to be conducted in remote areas (see Paragraph 18.5).

**6.1.3.3 Science Coordinator**

On missions where diving is performed in support of scientific programs, a science coordinator may be needed. The science coordinator is the prime point of contact for all scientific aspects of the program, including scientific equipment, its use, calibration, and

maintenance. Working with the dive master, the science coordinator briefs divers on upcoming missions and supervises the debriefing and sample or data accumulation after a dive.

#### **6.1.3.4 Divers**

Although the dive master is responsible for the overall diving operation, each diver is responsible for being in proper physical condition, for checking out personal equipment prior to the dive, and for thoroughly understanding the purpose and the procedures to be used for the dive. Divers also are responsible for using safe diving procedures and for knowing all emergency procedures.

#### **6.1.3.5 Tender for Surface-Supplied Diving**

The tender must be qualified to tend divers independently and to operate all surface-support equipment. To use manpower efficiently, the tender may be a qualified diver used in a diver-tender rotation system. Though there is no specific requirement that tenders be qualified divers, they should be trained in theory and operational procedures by the divers and diving supervisors (see Paragraph 3.3). Ideally, tenders should be trained by instructors and assigned to diving operations by the diving supervisors. A tender-assistant may assume a tender's responsibilities when he is under the direct supervision of fully qualified diving and tending personnel, and he may receive instruction in proper tending procedures during field operations. Another tender, diver, or qualified person should be assigned as communications person, console operator, timekeeper, recordkeeper, and diver's assistant.

It is recommended that one qualified person be designated as standby diver, ready to enter the water promptly in an emergency. The standby diver may accept tender responsibilities in routine operations; in more complicated diving operations, however, the standby diver must be free of all other duties.

#### **6.1.3.6 Support Divers and Other Support Personnel**

In most diving operations the number and types of support divers depend upon the size of the operation and the type of diving equipment used. As a general rule, those surface-support personnel working directly with the diver also should be qualified divers. Using unqualified personnel who do not understand diving techniques and terminology may cause confusion and unnecessary complications. Persons not qualified as divers can be used when the need arises only after

they have demonstrated an understanding of diving procedures to a standard acceptable to the dive master.

#### **6.1.3.7 Small-Scale Operations**

For self-contained diving operations, a minimum of two divers should be used. In a small-scale operation where the complexity of the assigned task is minimal, the dive master may dive, and no surface support is required. For an operation of increased scope, or if the tasks to be performed under water become more complex, standby divers and even tenders may be required.

### **6.1.4 Selection of Surface-Support Platform**

During the course of operations, divers will enter the water from platforms of various sizes and descriptions, ranging from small, inflatable rubber boats to large research vessels. Barges, specially outfitted for diving, also may be used.

Generally, the operational requirements, type of diving equipment, magnitude of the diving task, and prevailing and predicted environmental conditions will dictate the best surface-support platform to use. For example, near-shore diving using self-contained equipment in relatively calm water may be accomplished without much difficulty from a small boat. More extensive offshore diving operations, using self-contained or umbilical-supplied equipment, would be undertaken from a large vessel with adequate deck space. A detailed discussion of surface-support platforms is presented in Section 14.

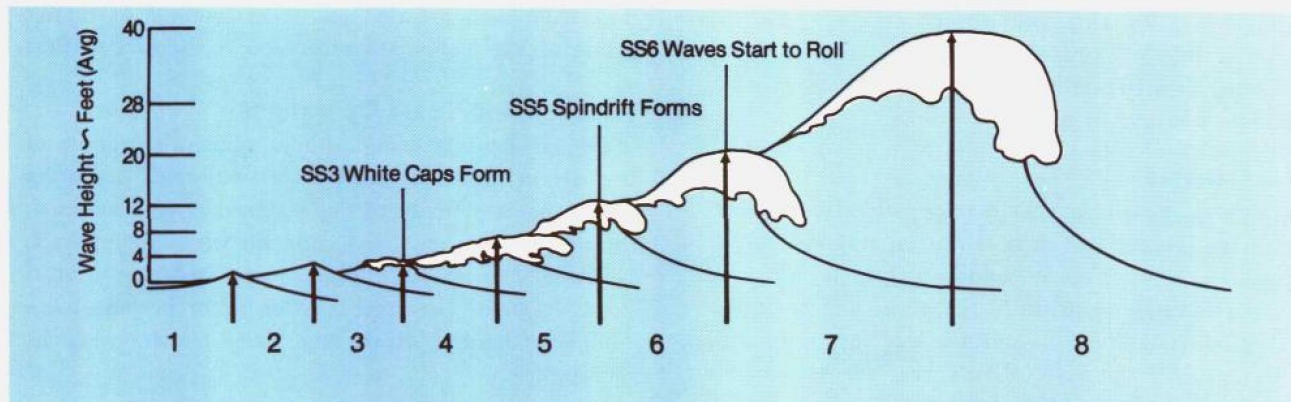
### **6.1.5 Environmental Conditions**

Environmental conditions at a dive site should be considered in planning a diving operation. Generally, environmental conditions can be divided into surface environmental conditions and underwater environmental conditions. Surface conditions include weather, sea state, and ship traffic. Underwater conditions include depth, bottom type, currents, water temperatures, and visibility. Regional and special diving conditions are discussed in Section 9.

#### **6.1.5.1 Surface Environmental Conditions**

Weather conditions are an important factor to consider in planning a dive. Whenever possible, diving operations should be cancelled or delayed during bad weather. Current and historical weather data should be reviewed to determine if proper conditions will prevail or are predicted for a sufficient amount of

**Figure 6-1**  
**Sea States**



Source: Bunker Ramo Corp.

time to complete the mission. Critical weather changes and wind shifts may jeopardize the safety of personnel and platforms. All boaters should avail themselves of the continuous marine weather broadcasts provided by NOAA on the following frequencies: 162.40 MHz, 162.475 MHz or 162.55 MHz, depending on the local area. These broadcasts can be heard in most areas of the U.S., and require only the purchase of a VHF radio receiver. VHF equipment comes in three levels of sophistication, ranging from the one- or two-band weather radios to multi-band radios and two-way sets. The weather radios are the least expensive and are designed to pick up NOAA radio broadcasts only. A boater with such a set will hear regular weather forecasts and special marine warnings any time of the day or night. Though all three receivers pick up weather signals from approximately the same distance, the two-way systems have the advantage of transmission capability.

#### NOTE

**The flag system for weather warnings is no longer in use; all weather reports are now transmitted by radio.**

Surface weather conditions may influence the selection of diving equipment in some cases. For instance, even though water temperature may permit the use of standard wet suits, cold air temperature and wind might dictate that a variable-volume dry suit (or equivalent) be worn when diving from an open or unheated platform.

#### NOTE

**Depending on Citizen Band (CB) radios for weather information is not recommended be-**

**cause they have a limited range and may be unreliable.**

Whenever possible, avoid or limit diving in moderate seas (see Table 6-1). Do not attempt scuba or surface-supplied diving in rough seas (see Figure 6-1 for a graphic representation of the various sea states). Sea state limitations depend to a large degree on the type and size of the diving platform. Diving operations may be conducted in rougher seas from properly moored larger platforms such as diving barges, ocean-going ships, or fixed structures. Divers using self-contained equipment should avoid entering the ocean in heavy surf. If bad weather sets in after a diving operation has commenced, appropriate recall signals should be employed (see Paragraph 6.2.3).

Since many diving operations are conducted in harbors, rivers, or major shipping channels, other ships often present serious problems. At times, it may be necessary to close off an area or limit the movement of other ships. Ship traffic should be taken into consideration during dive planning and, if time permits, a local "Notice to Mariners" should be issued. Any time that diving operations are to be conducted in the vicinity of other ships, the other vessels should be notified of the diving by message or signal. Signal flags, shapes, and lights are shown in Table 6-2. For information on proper lights, shapes, and flags to be displayed during diving operations, see U.S. Coast Guard (1977).

If the operation will be carried on in the middle of an active fishing ground, small boats operated by people with various levels of experience and competence must be anticipated. The diving team should assume that these operators are not acquainted with the meaning of any diving signals, and should take the necessary precautions to ensure that they remain clear of the area.

The degree of surface visibility is 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 probable delays because of low visibility. The safety of the diver and support crew are the prime consideration in determining whether surface visibility is adequate or not. For example, a surfacing scuba diver might not be able to find the support craft, or the diver (and the craft itself) might be in danger of being run down by surface traffic.

#### 6.1.5.2 Underwater Environmental Conditions

Dive depth is a basic consideration in the selection of personnel, equipment, and techniques. The depth should be determined as accurately as possible in the planning phases, and dive duration, air requirements, and decompression schedule (when required) should be planned accordingly.

The type of bottom affects the diver's ability to work and see. **Mud** (silt and clay) bottoms generally are the most restrictive. The slightest movement will stir sediment into suspension, restricting visibility. Divers must orient themselves so that any current will carry the suspended sediment away from the work area. Divers also should develop a mental picture of the surroundings so an ascent to the surface is possible even in conditions of zero visibility.

**Sand bottoms** present little problem for divers. Visibility restrictions caused by suspended sediment are less than in mud bottoms, and footing is firm.

**Coral reefs** are solid but contain many sharp protrusions. A diver should wear gloves and coveralls or a wet suit for protection if the mission requires much contact with the coral. Divers should learn to identify and avoid corals and other marine organisms that might inflict injury (see Paragraph 15.1.1).

**Currents** always must be taken into account when planning and executing a dive, particularly when using scuba. When a boat is anchored in a current, a buoyed safety line at least 100 feet in length should be trailed over the stern during diving operations. If, upon entering the water, a diver is swept away from the boat by the current, he can use this line to keep from being carried down current.

Descent from an anchored or fixed platform into water with currents should be made along a weighted line. Free swimming descents should be avoided in currents unless provisions are made to reach safety. A line also should be avoided unless adequate provisions are made for a pickup boat to operate down current or there is no danger in surfacing some dis-

tance from the entry point. For example, divers occasionally may drift along with a current because little or no exertion is required and long distances can be covered. Careful observation of changing tidal currents may permit divers to drift down current and return to the starting point on the return current. Expert knowledge of local conditions permits effective use of back eddies. Tide tables should be consulted when necessary, and the magnitude of tidal currents should be determined prior to diving.

To work in currents, heavily weighted divers using umbilical-supplied equipment frequently are required. Tidal currents may prevent diving at some locations except during slack tides. Tidal changes may alter the direction of the current, occasionally bringing sediment-laden water and causing low visibility within a matter of minutes. Because a slack tide may be followed by strong currents, divers should know the tides in the diving area and their effects.

Currents generally decrease in velocity and depth, and therefore divers sometimes do better by swimming close to the bottom when there are swift surface currents. However, current direction may change with depth. When there are bottom currents, the diver often swims into the current rather than with the current at the beginning of the dive. This facilitates easy return to the entry point at the end of the dive. The diver should stay close to the bottom and use rocks to pull himself along if necessary to avoid overexertion.

**Water temperature** is a major factor to consider in planning a diving operation because it has a significant effect on the type of equipment selected and, in some cases, the practical duration of the dive. A thermocline is the boundary layer of water between the surface and deep water. Below this layer, temperature decreases rapidly with depth. Although thermoclines do not pose a direct hazard to divers, their presence may affect the selection of diving dress, dive duration, or the use of certain scientific equipment (see Paragraph 1.9). Thermoclines may occur at various levels, close to the surface as well as in deep water. Temperature may vary from layer to layer, and as much as a 20°F variation has been recorded between surface and subsurface layers. Scientists taking measurements and gathering samples while diving in thermoclines should be aware of temperature differences and adjust instrumentation and techniques accordingly.

**Underwater visibility** depends on time of day, locality, water conditions, season, bottom type, weather,

**Table 6-1**  
**Sea State Chart**

Wind and Sea Scale for Fully Arisen Sea

| Sea-General |   | Wind                  |                 |               |                        | Sea                      |                                |  |                          |                         |                                |                          |
|-------------|---|-----------------------|-----------------|---------------|------------------------|--------------------------|--------------------------------|--|--------------------------|-------------------------|--------------------------------|--------------------------|
| Sea State   | Description   | (Beaufort) Wind Force | Description     | Range (Knots) | Wind Velocity (Knots)  | Wave Height Feet         |                                | Significant Range of Periods (Seconds)   | T (Average Period)       | L (Average Wave Length) | Minimum Fetch (Nautical Miles) | Minimum Duration (Hours) |
|             |   |                       |                 |               |                        | Average                  | Average $\frac{1}{10}$ Highest |  |                          |                         |                                |                          |
| 0           | Sea like a mirror.  | U                     | Calm            | Less than 1   | 0                      | 0                        | 0                              | —  | —                        | —                       | —                              | —                        |
|             | Ripples with the appearance of scales are formed, but without foam crests.  | 1                     | Light Airs      | 1-3           | 2                      | 0.05                     | 0.10                           | up to 1.2 sec.                           | 0.5                      | 10 in.                  | 5                              | 18 min.                  |
| 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                     | 0.37                           | 0.4-2.8                                  | 1.4                      | 6.7 ft.                 | 8                              | 39 min.                  |
|             | Large wavelets, crests begin to break. Foam of glassy appearance. Perhaps scattered white horses.   | 3                     | Gentle Breeze   | 7-10          | 8.5<br>10              | 0.6<br>0.88              | 1.2<br>1.8                     | 0.8-5.0<br>1.0-6.0                       | 2.4<br>2.9               | 20<br>27                | 9.8<br>10                      | 1.7<br>2.4               |
| 2           | Small waves, becoming larger; fairly frequent white horses.   | 4                     | Moderate Breeze | 11-16         | 12<br>13.5<br>14<br>16 | 1.4<br>1.8<br>2.0<br>2.9 | 2.8<br>3.7<br>4.2<br>5.8       | 1.0-7.0<br>1.4-7.6<br>1.5-7.8<br>2.0-8.8 | 3.4<br>3.9<br>4.0<br>4.6 | 40<br>52<br>59<br>71    | 18<br>24<br>28<br>40           | 3.8<br>4.8<br>5.2<br>6.6 |
| 3           | Moderate waves, taking a more pronounced long form; many white horses are formed. (Chance of some spray).                                     | 5                     | Fresh Breeze    | 17-21         | 18                     | 3.8                      | 7.8                            | 2.5-10.0                                 | 5.1                      | 90                      | 55                             | 8.3                      |
|             |   |                       |                 |               | 19                     | 4.3                      | 8.7                            | 2.8-10.6                                 | 5.4                      | 99                      | 65                             | 9.2                      |
| 4           | Moderate waves, taking a more pronounced long form; many white horses are formed. (Chance of some spray).                                     | 5                     | Fresh Breeze    | 17-21         | 20                     | 5.0                      | 10                             | 3.0-11.1                                 | 5.7                      | 111                     | 75                             | 10                       |
|             |   |                       |                 |               | 20                     | 5.0                      | 10                             | 3.0-11.1                                 | 5.7                      | 111                     | 75                             | 10                       |
| 5           | Large waves begin to form; the white foam crests are more extensive everywhere. (Probably some spray).  | 6                     | Strong Breeze   | 22-27         | 22                     | 6.4                      | 13                             | 3.4-12.2                                 | 6.3                      | 134                     | 100                            | 12                       |
|             |   |                       |                 |               | 24                     | 7.9                      | 16                             | 3.7-13.5                                 | 6.8                      | 160                     | 130                            | 14                       |
| 5           | Large waves begin to form; the white foam crests are more extensive everywhere. (Probably some spray).  | 6                     | Strong Breeze   | 22-27         | 24.5                   | 8.2                      | 17                             | 3.8-13.6                                 | 7.0                      | 164                     | 140                            | 15                       |
|             |   |                       |                 |               | 26                     | 9.6                      | 20                             | 4.0-14.5                                 | 7.4                      | 188                     | 180                            | 17                       |
| 6           | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. (Spindrift begins to be seen). | 7                     | Moderate Gale   | 28-33         | 28                     | 11                       | 23                             | 4.5-15.5                                 | 7.9                      | 212                     | 230                            | 20                       |
|             |   |                       |                 |               | 30                     | 14                       | 28                             | 4.7-16.7                                 | 8.6                      | 250                     | 280                            | 23                       |
| 6           | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. (Spindrift begins to be seen). | 7                     | Moderate Gale   | 28-33         | 30.5                   | 14                       | 29                             | 4.8-17.0                                 | 8.7                      | 258                     | 290                            | 24                       |
|             |   |                       |                 |               | 32                     | 16                       | 33                             | 5.0-17.5                                 | 9.1                      | 285                     | 340                            | 27                       |

and currents. Divers frequently are required to dive in water where visibility is minimal and sometimes at the zero level. Special precautions are appropriate when visibility is at zero or severely limited. If scuba is used, a buddy line or other reference system and float is recommended. A convenient way to attach a buddy line is to use a rubber loop that can be slipped on and off the wrist easily. This is preferable to tying a line, which would prevent rapid removal.

Heavy concentrations of plankton often accumulate at the thermocline, especially during the summer in the mid-Atlantic states. Divers may find that plankton absorb most of the light at the thermocline or that even though the water below the thermocline is clear, a light may still be required for visibility. Thermoclines in clear water diffuse light within the area of greatest temperature change, causing a significant decrease in visibility.

**Table 6-1  
(Continued)**

| Sea-General |   | Wind                  |             |               |                       | Sea              |                      |  |                    |                         |                                |                          |
|-------------|---|-----------------------|-------------|---------------|-----------------------|------------------|----------------------|--|--------------------|-------------------------|--------------------------------|--------------------------|
| Sea State   | Description   | (Beaufort) Wind Force | Description | Range (Knots) | Wind Velocity (Knots) | Wave Height Feet |                      | Significant Range of Periods (Seconds) | T (Average Period) | L (Average Wave Length) | Minimum Fetch (Nautical Miles) | Minimum Duration (Hours) |
|             |   |                       |             |               |                       | Average          | Average 1/10 Highest |  |                    |                         |                                |                          |
| 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                    | 19               | 38                   | 5.5-18.5                               | 9.7                | 322                     | 420                            | 30                       |
|             |   |                       |             |               | 36                    | 21               | 44                   | 5.8-19.7                               | 10.3               | 363                     | 500                            | 34                       |
|             |   |                       |             |               | 37                    | 23               | 46.7                 | 6-20.5                                 | 10.5               | 376                     | 530                            | 37                       |
|             |   |                       |             |               | 38                    | 25               | 50                   | 6.2-20.8                               | 10.7               | 392                     | 600                            | 38                       |
| 8           | High waves. Dense streaks of foam along the direction of the wind. Sea begins to roll. Visibility affected.   | 9                     | Strong Gale | 41-47         | 42                    | 31               | 64                   | 7-23                                   | 12.0               | 492                     | 830                            | 47                       |
|             |   |                       |             |               | 44                    | 36               | 73                   | 7-24.2                                 | 12.5               | 534                     | 960                            | 52                       |
|             |   |                       |             |               | 46                    | 40               | 81                   | 7-25                                   | 13.1               | 590                     | 1110                           | 57                       |
| 9           | Very high waves with long overhanging crests. The resulting foam is in great patches and is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes a white appearance. The rolling of the sea becomes heavy and shocklike. Visibility is affected.     | 10                    | Whole Gale  | 48-55         | 48                    | 44               | 90                   | 7.5-26                                 | 13.8               | 650                     | 1250                           | 63                       |
|             |   |                       |             |               | 50                    | 49               | 99                   | 7.5-27                                 | 14.3               | 700                     | 1420                           | 69                       |
|             |   |                       |             |               | 51.5                  | 52               | 106                  | 8-28.2                                 | 14.7               | 736                     | 1560                           | 73                       |
|             |   |                       |             |               | 52                    | 54               | 110                  | 8-28.5                                 | 14.8               | 750                     | 1610                           | 75                       |
|             |   |                       |             |               | 54                    | 59               | 121                  | 8-29.5                                 | 15.4               | 810                     | 1800                           | 81                       |
| 9           | Exceptionally high waves (Small and medium-sized ships might for a long time be lost to view behind the waves.) The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected. | 11                    | Storm       | 56-63         | 56                    | 64               | 130                  | 8.5-31                                 | 16.3               | 910                     | 2100                           | 88                       |
|             |   |                       |             |               | 59.5                  | 73               | 148                  | 10-32                                  | 17.0               | 985                     | 2500                           | 101                      |
|             | Air filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.  | 12                    | Hurricane   | 64-71         | >64                   | >80              | >164                 | 10-(35)                                | (18)               |                         |                                |                          |

U.S. Navy 1871

**WARNING**























**Divers Should Be Extremely Cautious Around Wrecks or Other Structures in Low Visibility to Avoid Swimming Inadvertently Into an Area With Overhangs**

A sense of touch is extremely important to a diver or scientist working in low or zero visibility. The

ability to use touch cues when handling tools or instruments in a strange work environment is valuable to a diver in the dark. Rehearsing work functions on the surface while blindfolded will increase proficiency in underwater tasks.

Underwater low-light-level closed-circuit television has been used successfully when light levels are reduced, because a television camera "sees" more in these conditions than does the human eye. This is

**Table 6-2**  
**Signal Flags, Shapes,**  
**and Lights**

| Signal  | Use   | Meaning  |   |   |  |   |   |  |
|---|---|--|---|---|--|---|---|--|
|  <p>Red White</p> <p>U.S. Divers Flag</p>  | <p>Displayed by civilian divers in the United States. The flag should be flown at a sufficient height above the water so as to be easily visible.</p> | <p>Divers are below. Boats should not operate within 100 feet. (Varies in accordance with individual state laws)</p> |   |   |  |   |   |  |
|  <p>White Blue</p> <p>International Code Flag<br/>"A"</p>  | <p>Displayed by all vessels and divers in international and foreign waters and by the United States Navy.</p>   | <p>"I have a diver down; keep well clear at slow speed."</p>   |   |   |  |   |   |  |
|  <p>"I"</p> <p>Yellow Black</p>  <p>"R"</p> <p>Yellow Red</p> <p>International Code Flags<br/>"I R"</p>   | <p>Displayed by all vessels in international and foreign waters.</p>  | <p>"I am engaged in submarine survey work (under water operations). Keep clear of me and go slow."</p>               |   |   |  |   |   |  |
| <p>International Day Shapes and Lights<sup>2</sup></p> <table border="0"> <tr> <td data-bbox="194 1534 398 1630"> <p>Shapes/Day</p>  Black Ball         </td> <td data-bbox="439 1534 563 1608"> <p>Lights/Night</p>  Red         </td> </tr> <tr> <td data-bbox="194 1640 398 1715">  * Black Diamond         </td> <td data-bbox="439 1640 563 1693">  White         </td> </tr> <tr> <td data-bbox="194 1725 398 1789">  Black Ball         </td> <td data-bbox="439 1725 563 1779">  Red         </td> </tr> </table> | <p>Shapes/Day</p>  Black Ball                                      | <p>Lights/Night</p>  Red          |  * Black Diamond |  White |  Black Ball |  Red | <p>Displayed by all vessels in international and foreign waters engaged in underwater operations.</p> | <p>This vessel is engaged in underwater operations and is unable to get out of the way of approaching vessels.</p> |
| <p>Shapes/Day</p>  Black Ball  | <p>Lights/Night</p>  Red   |  |   |   |  |   |   |  |
|  * Black Diamond   |  White   |  |   |   |  |   |   |  |
|  Black Ball  |  Red   |  |   |   |  |   |   |  |

<sup>1</sup> U.S. Navy, *International Code of Signals*, United States Edition, 1969.  
<sup>2</sup> U.S. Coast Guard, *Navigation Rules: International-Inland*, May 1, 1977.\*

true mainly when the reduced visibility is caused by the absence of light; in cases where the problem is caused by high turbidity, the TV camera does not offer a significant advantage. When the purpose of the dive is inspection or observation and a closed-circuit television system is used, the diver serves essentially as a mobile underwater platform. The monitor is watched by surface support personnel who, in turn, direct the movements of the diver. Underwater television cameras are available that are either hand-held or mounted on a helmet (see Paragraph 7.11).

## 6.2 DIVING SIGNALS

### 6.2.1 Hand Signals

The hand signals shown in Figure 6-2 and explained in Table 6-3 are used by divers to convey basic information. There are various hand signalling systems presently in use that have been developed by different organizations. Divers in different parts of the country and the world use different signals or variations of signals to transmit the same message. Prior to a dive, the dive master should review the signals shown in Figure 6-2 with all the divers. This review is particularly important when divers from different geographical areas constitute a dive team, or when divers from several organizations are cooperating in a dive.

The hand signals shown in Table 6-3 and Figure 6-2 were developed and approved by the American National Standards Institute Committee Z36, in cooperation with the Council for National Cooperation in Aquatics (American National Standards Institute 1976). The signals consist of hand instead of finger motions so that they will be usable by divers wearing mittens. Whenever possible, the signals were derived from those having similar meanings on land, to reduce learning time. Signal systems other than hand signals have not been standardized; whistle blasts, light flashes, tank taps, and hand squeezes generally are used for attracting attention and should be reserved for that purpose.

### 6.2.2 Line Signals

Line signals are used by divers with surface-supplied equipment either as a backup to voice communications to the surface or as the primary form of communication. Line signals also may be used by divers with self-contained equipment to communicate with the surface or, in restricted visibility, for diver-to-diver

communication. Tables 6-4 and 6-5 describe line signals commonly employed.

#### NOTE

**Hand or line signals may vary by geographical area or among organizations. Divers should review signals before diving with new buddies or support personnel.**

### 6.2.3 Surface-to-Diver Recall Signals

Unexpected situations often arise that require divers to be called from the water. When voice communications are not available, the following methods should be considered:

- Acoustic Detonator—a small device ignited by a flame and thrown into the water
- Hammer—rapping four times on a steel hull or metal plate
- Bell—held under water and struck four times
- Hydrophone—underwater speaker
- Strobe—used at night, flashed four times

### 6.2.4 Surface Signals

If a diver needs to attract attention upon surfacing and is beyond voice range, the following signaling devices may be used:

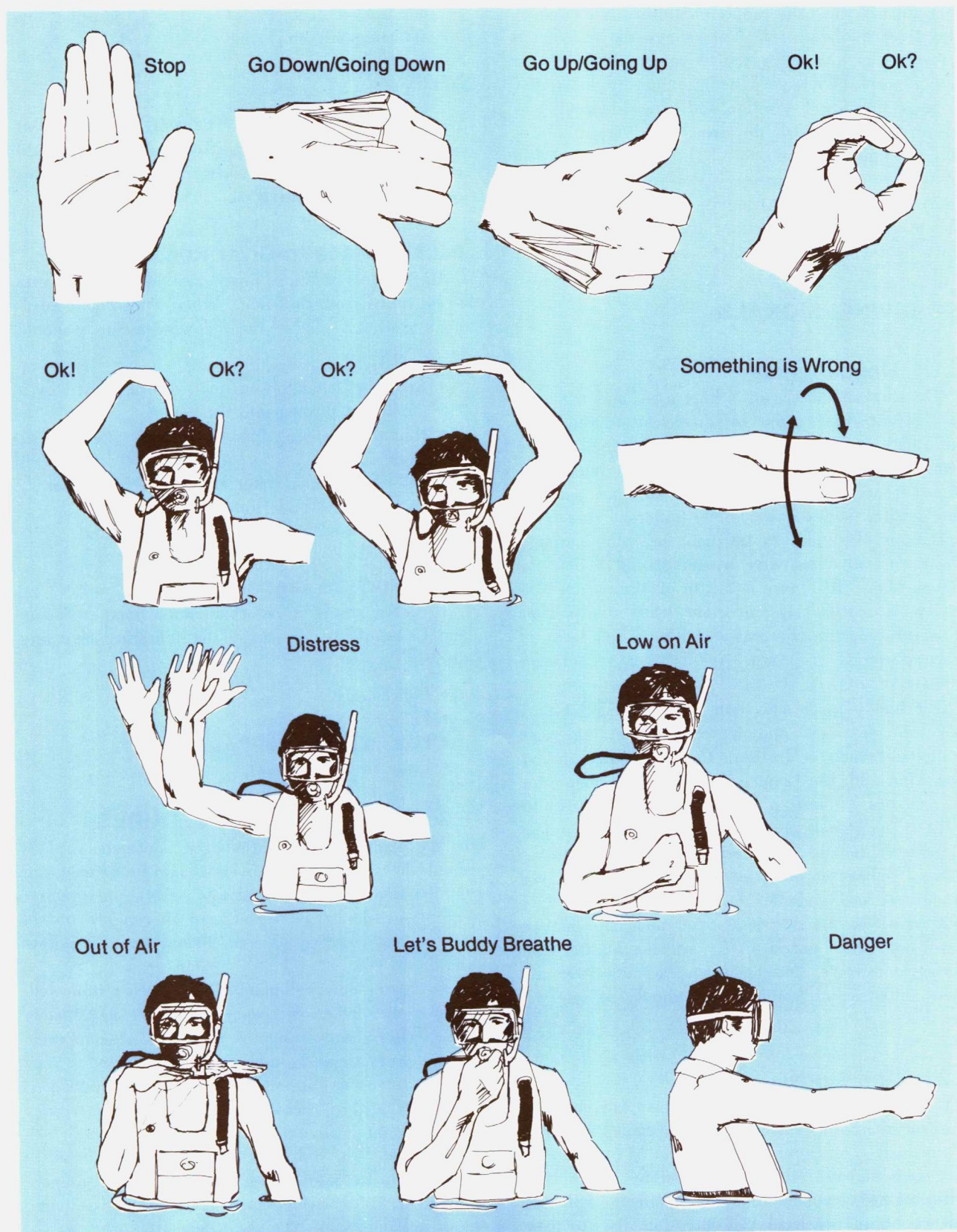
- Police whistle
- Flare
- Flashing strobe (see Paragraph 4.9.8)
- Flags (see Table 6-2)

## 6.3 EMERGENCY PROCEDURES

In the planning stages of a dive, contingency plans should be made, and all divers should be briefed and familiarized with those plans. New or unfamiliar equipment should be understood thoroughly by all divers, and practice sessions should be held before the dive.

No matter how well-planned the dive or how well-trained the diver, emergency situations occasionally arise, usually as a result of failure to observe some safety precaution. In most instances, taking a few seconds to assess the situation accurately and determine the actions necessary can keep the emergency from becoming an accident. Instinctive reactions seldom are correct, and may prove to be blind impulses brought on by panic. Adequate training will prepare the diver for most emergencies, provided that panic does not intervene.

Figure 6-2  
Hand Signals



**Table 6-3**  
**Hand Signals**

| No. | Signal  | Meaning               | Comment   |
|-----|---|-----------------------|---|
| 1.  | Hand raised, fingers pointed up, palm to receiver   | STOP                  | Transmitted in the same way as a Traffic Policeman's STOP   |
| 2.  | Thumb extended downward from clenched fist  | GO DOWN or GOING DOWN |   |
| 3.  | Thumb extended upward from clenched fist  | GO UP or GOING UP     |   |
| 4.  | Thumb and forefinger making a circle with 3 remaining fingers extended (if possible)                            | OKI or OK?            | Divers wearing mittens may not be able to extend 3 remaining fingers distinctly (see both drawings of signal)   |
| 5.  | Two arms extended overhead with fingertips touching above head to make a large O shape                          | OKI or OK?            | A diver with only one free arm may make this signal by extending that arm overhead with fingertips touching top of head to make the O shape. Signal is for long-range use |
| 6.  | Hand flat, fingers together, palm down, thumb sticking out, then hand rocking back and forth on axis of forearm | SOMETHING IS WRONG    | This is the opposite of OKI. The signal does not indicate an emergency  |
| 7.  | Hand waving over head (may also thrash hand on water)   | DISTRESS              | Indicates immediate aid required  |
| 8.  | Fist pounding on chest  | LOW ON AIR            | Indicates signaller's air supply is reduced to the quantity agreed upon in pre-dive planning or air pressure is low and has activated reserve valve                       |
| 9.  | Hand slashing or chopping throat  | OUT OF AIR            | Indicates that signaller cannot breathe   |
| 10. | Fingers pointing to mouth   | LET'S BUDDY BREATHE   | The regulator may be either in or out of the mouth  |
| 11. | Clenched fist on arm extended in direction of danger  | DANGER                |   |

All signals are to be answered by the receiver's repeating the signal as sent. When answering signals 7, 9, and 10, the receiver should approach and offer aid to the signaller.

### 6.3.1 Loss of Air Supply and Buddy Breathing

#### 6.3.1.1 Scuba

If the loss of air is gradual and the diver is using self-contained equipment with a reserve supply, simply opening the air reserve mechanism and ascending to the surface may alleviate the situation. If the loss of air is sudden and unexpected, "buddy breathing" may be used. The most efficient method of buddy breathing is for the two divers to face each other, each alternately breathing from the same mouthpiece while ascending (Figure 6-3). During the exchange of the mouthpiece, the exhaust valve on single hose regulators must be below the mouthpiece or water may not be eliminated from the second stage; this position can be achieved conveniently if the divers are side by side, with the diver in distress on the left. The donor controls the air, and both divers must exhale between exchanges. Contact should be main-

tained by having each diver hold the straps or belt of the other diver.

If it is necessary to cover a horizontal distance while buddy breathing, a number of different methods can be used. The two most common are for the divers to swim side by side (about halfway on their sides), facing each other, or to swim one above the other, the diver with the good air supply on the bottom. In this manner, the mouthpiece can be passed easily back and forth between divers. With one diver above the other, however, the donor has no visual contact with the buddy diver, which may interfere with the smooth operation of the technique.

#### WARNING

**When One Diver Runs Out of Air, the Buddy Usually is Very Low. With Double Consumption, Available Air can be Depleted in Seconds. Buddy Breathing Ascent Should Therefore be Prompt**

**Table 6-4**  
**Line Pull, Audio, and Visual Signals**  
**for Diver-to-Diver Communication**

| Signal Title and Meaning          | Hand Squeeze/<br>Line Pull/<br>Light Flash/<br>Tank Tap | Answer                        |
|-----------------------------------|---|-------------------------------|
| OK? or OK                         | One   | Same                          |
| Go                                | Two   | Same                          |
| Stop                              | Three   | Same                          |
| Surface                           | Four  | Same                          |
| Emergency or<br>Come Here Quickly | Five or More  | Go<br>Quickly to<br>Signaller |

All signals, except the emergency signal, should be answered, by repeating signal, when received.

Scuba tanks can be equipped with two second-stage hoses with regulators (octopus) for emergency buddy breathing or in case of failure of the primary regulator. This is a valuable safety item that should be considered when new equipment is purchased.

Unless the breathing apparatus is entangled, a diver should not abandon it. The reduction of ambient pressure as the diver rises to the surface increases the pressure differential, providing additional air for breathing from the scuba and allowing the diver to make a controlled ascent. For additional information on ascents, see Paragraph 6.3.5.

The buddy breathing technique requires overlearning (17-21 trials) and should be practiced while swimming, not while sitting on a pool bottom (Egstrom 1978). It should be practiced periodically when diving with a familiar partner and equipment, and always before diving with an unfamiliar diving partner or equipment.

#### WARNING

Discarding Self-Contained Equipment and Making a Free Ascent Should be Considered a Last Resort. When This Procedure Must Be Used, Exhale All the Way to the Surface (see Paragraph 2.2.2)

#### 6.3.1.2 Surface-Supplied Equipment

A diver using umbilical-supplied equipment who experiences a loss of air supply usually has a limited amount of usable air left in the helmet or constant-

**Table 6-5**  
**Line Pull Signals for**  
**Surface-to-Diver Communication**

#### Emergency Signals

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

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

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

All signals will be answered as given except for emergency signal 4-4-4

#### From tender to diver

1 Pull "Are you all right?"

When diver is descending, one pull means "stop"

2 Pulls "Going down"

During ascent, 2 pulls mean "You have come up too far, go back down until we stop you"

3 Pulls "Stand by to come up"

4 Pulls "Come up"

2-1 Pulls "I understand," or "Answer the telephone"

#### From diver to tender

1 Pull "I am all right" or "I am on the bottom"

2 Pulls "Lower" or "Give me slack"

3 Pulls "Take up my slack"

4 Pulls "Haul me up"

2-1 Pulls "I understand" or "Answer the telephone"

3-2 Pulls "More air"

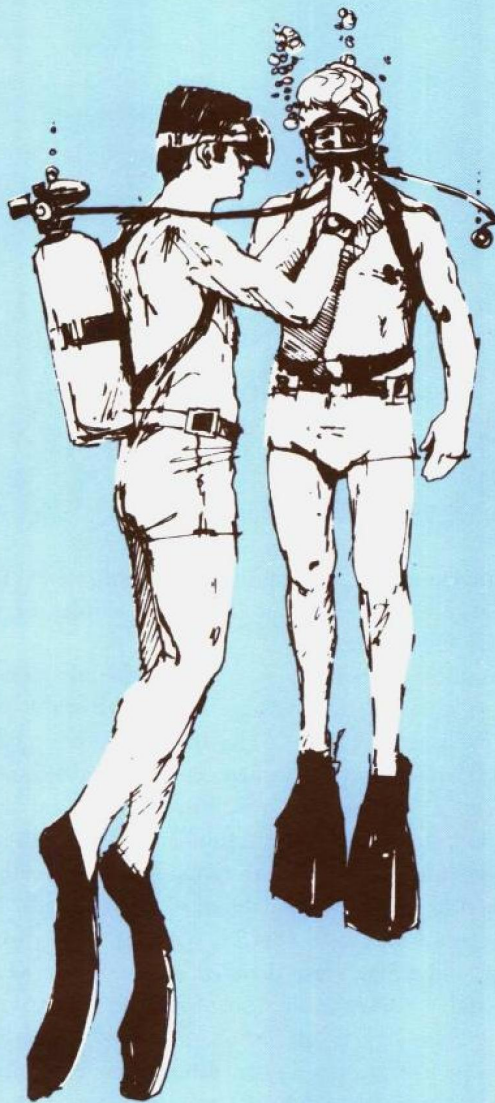
4-3 Pulls "Less air"

Special signals from the diver to the tender should be devised as required by the situation

| Searching Signals | Without circling line   | With circling line             |
|-------------------|---|--------------------------------|
| 7 Pulls           | "Go on (or off) searching signals"  | Same                           |
| 1 Pull            | "Stop and search where you are"   | Same                           |
| 2 Pulls           | "Move directly away from the tender if given slack, move toward the tender if strain is taken on the life-line" | "Move away from the weight"    |
| 3 Pulls           | "Go to your right"  | "Face the weight and go right" |
| 4 Pulls           | "Go to your left"   | "Face the weight and go left"  |

volume suit. If the supply of air to the mask does not resume again quickly, the diver should signal the tenders, requesting to be brought to the surface, or should make a controlled ascent. The diver should not discard the diving equipment unless it is hopelessly fouled.

**Figure 6-3**  
**Buddy Breathing**



A self-contained emergency air supply system (come-home or bailout cylinder) may be used in conjunction with surface-supplied diving equipment. Such a system consists of a scuba cylinder assembly, a reduction regulator (first stage of a standard single hose regulator), and a backpack/harness assembly. Although the capacity of the scuba cylinder may vary from 10 to 140 cubic feet, many divers prefer to use a 40 to 50 ft<sup>3</sup> cylinder, rather than a large 72 ft<sup>3</sup> cylinder, for an emergency supply.

The first-stage regulator used with the emergency air supply is fitted with a relief valve in the auxiliary low-pressure port to prevent overpressure of the regulator to the mask hose in the event of regulator

malfunction. Self-contained emergency air may be fed directly into the mask through a special attachment on the side valve or directly into the diver's air hose assembly. In the latter case, the check valve should be located between the intersection of the emergency gas supply hose and the primary surface supply hose.

For total redundancy, a completely separate scuba unit also may be used as a backup system. In this case the diver would ditch the helmet or mask in an emergency and insert the scuba regulator mouthpiece. This procedure is useful if the surface-supplied hose is badly tangled or the helmet or mask is not adapted for self-contained emergency air systems.

Another method commonly used by commercial divers is to have a standby diver with a spare hose available.

### 6.3.2 Loss or Flooding of Equipment

Flooding of a face mask may be caused by another diver inadvertently kicking the mask loose with a fin, by high currents, or by turning the head into a rock web or other obstruction. The mask can be cleared by tilting the head back, pressing the top of the mask against the forehead, and blowing into the mask through the nose (Figure 6-4). The air will displace the water, forcing it out the bottom of the mask. When the mask is equipped with a purge valve, the diver should position his head so the purge valve is in the lowest position relative to the mask, hold the mask against his face and then exhale through his nose. If the mask is lost, divers should fix their position, wave one hand over their heads, and have their partner come to them. This procedure should ensure that the mask is close by and if the buddy fails to respond, the diver knows the surrounding area and can ascend safely alone.

When a single hose regulator mouthpiece is lost, the hose is generally lying over the right shoulder. If it is not, it can be located by reaching back with the right hand over the right shoulder, grasping the first stage of the regulator at the tank's neck and locating the hose where it joins the first stage, and then following the hose out to the mouthpiece. The mouthpiece probably will be flooded, but it can be cleared by pushing the purge button.

With a double hose regulator, the mouthpiece and hose will float. One method of recovery is for the diver to roll onto his back. The hose and mouthpiece will then be floating over the diver's face. When the mouthpiece of a double hose regulator is above the level of the tank neck, it will free flow. The hose and

**Figure 6-4**  
**Clearing a Face Mask**



mouthpiece can be cleared of water by holding the mouthpiece above the head. If the exhaust hose is flooded, it can be cleared after the mouthpiece is back in the mouth by exhaling or rolling over longitudinally to the left, which allows the water to flow the length of the exhaust hose and be forced out the air exhaust valve.

### 6.3.3 Fouling and Entanglement

When a diver becomes trapped, entangled, or fouled, it is important that the first step be a calm assessment of the situation. Struggling probably will result in even deeper entanglement and damage to, or loss of, diving equipment. The scuba diver is more concerned about entanglement than other types of divers, because the air supply is limited and communication with the surface usually is not available. The combination of a cool head, common sense, a nearby diver, and a diving knife usually suffices to gain freedom from entanglement. Emergency free ascent should be used only as a last resort. When surface-supplied equipment is used, the surface should be notified as soon as the diver becomes entangled. If the diver cannot become unentangled promptly, the assistance of a standby diver should be requested.

### 6.3.4 Drowning

The most common antecedent to drowning is panic, induced when divers find themselves in a position for which they are not prepared mentally or physically. The majority of drownings can be avoided if the diver is trained properly, is in good physical condition, and

is using reliable, well-maintained equipment. Divers must stay with their buddy and dive within the limits of their experience.

The most important step in the immediate treatment of a near-drowning victim is to restore breathing (see Paragraph 17.1.5). The most effective means of artificial resuscitation (when used by trained personnel) is a mechanical resuscitator. If one is not available, artificial resuscitation is required, the most effective form being mouth-to-mouth. This method is simple and can be administered to a victim still in the water (see Paragraph 18.4.1). Victims of near-drowning in cold water (less than 70°F) may appear to be dead and yet have a significant chance for survival if cardiopulmonary resuscitation is started immediately. Recovery has occurred even after submersion in cold water for periods up to 40 minutes (see Paragraph 17.1.5).

### 6.3.5 Ascents

In emergency situations in which running out of air or loss of consciousness is imminent, it may be necessary to make an emergency buoyant ascent. In such cases, it may be necessary to buddy breathe or make a free ascent long before the air supply actually is depleted. Often, the distressed diver is coughing or choking. Until the diver's condition has stabilized, both the diver and buddy should maintain their depth while continuing to buddy breathe. Air donors should allow the victim to use their air supply as much as is possible without jeopardizing their own supply. When the distressed diver's condition has stabilized, a safer ascent can be made.

When three or more divers are in the water, the air donor should buddy breathe with a third diver, because this may speed up the stabilization of the victim. If practical, depth always should be maintained until the distressed diver has resumed normal breathing. If it is necessary to remove the diver's equipment, the ascent should be stopped while the equipment is removed. Equipment removal will distract the diver and interrupt the breathing pattern, increasing the possibility of gas embolism. Every effort should be made to maintain an ascent rate no greater than 60 feet per minute.

When using constant-volume dry suits or large buoyancy compensators, extra precautions should be taken to prevent uncontrolled ascent caused by air expansion of the suit as the diver rises in the water column. For example, the normal procedure of dropping the weight belt should not be followed when a constant-volume dry suit is used unless the suit is flooded. During ascent, the amount of air in the dry suit or partially inflated buoyancy compensator should be controlled by the exhaust valves or other venting methods, such as opening a cuff.

Methods by which divers can ascend safely are: octopus buddy breathing ascent, buddy breathing ascent with one regulator, and controlled buoyant ascent.

#### **6.3.5.1 Buddy Breathing Ascent with Octopus System**

Many divers use an extra second stage, known as an octopus rig, on the regulator. If such equipment is being used, the distressed diver should notify the buddy that air is needed and should then proceed to breathe from the extra regulator. Since the air supply of the buddy also is likely to be low, ascent should begin immediately after a brief stabilization period. Two persons breathing from a tank with a low air volume through a single first stage can quickly cause an insufficiency of air. Also, in cold water, the extra flow may cause the regulator to freeze. Physical contact between the divers should be maintained by holding onto each other's straps. This procedure is one of the safer methods of making an emergency ascent.

#### **6.3.5.2 Buddy Breathing Ascent with One Regulator**

If an octopus system is not available, a two-person ascent with a single regulator may be used as an alternative method. After initially supplying the distressed diver with a regulator, the donor should

attempt to establish a steady breathing pattern while simultaneously initiating the ascent. If the donor has plenty of air, the steady breathing pattern should be established before beginning the ascent. The divers should ascend face to face and maintain physical contact. Practicing this procedure with a partner is essential for it to be used safely under emergency conditions.

#### **WARNING**

**While One Diver is Breathing From the Regulator, the Other Diver Should be Exhaling During Buddy Breathing Ascent**

#### **6.3.5.3 Controlled Buoyant Ascent**

If buddy breathing is not possible, the diver can make an ascent to the surface while venting air continuously. As the diver rises in the water column, a small amount of additional air may become available from the scuba as ambient pressure decreases. Trying to breathe by sucking on the regulator or swallowing may decrease the urge to breathe during ascent.

#### **WARNING**

**An Emergency Buoyant Ascent Should Be Used Only as a Last Resort to Resolve an Emergency Situation. It is Hazardous and Difficult to Accomplish Safely in Stress Situations**

When using constant-volume dry suits or large buoyancy compensators, extra caution should be taken to prevent uncontrolled ascent. Spreading the arms and legs increases drag and stability, thus slowing the rate of ascent.

The diver must continue to exhale throughout the ascent. The head should be extended back, allowing maximal opening of the throat and a good overhead view. The diver should swim to the surface, staying constantly aware of possible entanglements or obstructions and the consequences of breath-holding. The mouthpiece should be left in place.

#### **WARNING**

**The Weight Belt Should Be Released Immediately If the Diver Is Having Difficulty Ascending. Make Sure No Divers Are Below Before Dropping The Belt**

At night or when visibility is low, the hand should be held over the head during ascent to prevent the head hitting a boat or some other object on the way up.

Upon reaching the surface after an emergency ascent, or when in trouble at the surface after normal ascent (rough water, exhaustion, etc.), the diver should inflate the buoyancy compensator and signal for pickup. When the diver is a long distance from assistance, it may be necessary to use a signal flare to attract attention. When not in difficulty, the diver should swim for the diving platform or shore. If the breathing apparatus interferes with swimming, it may have to be discarded if the diver is faced with a long swim to safety.

#### 6.4 FLYING AFTER DIVING AT SEA LEVEL

The elimination of inert gas from body tissues after an exposure to pressure continues for a period of 24 hours or more after the dive before equilibration with the ambient partial pressure of nitrogen in the air at the surface is completed. During this period, reducing the ambient pressure further will create a condition identical to that which occurs during decompression after a dive. After diving, divers should exercise caution when travelling in mountainous terrain as well as when flying. The cabin atmosphere in modern pressurized aircraft usually is maintained at an altitude of 8,000 feet (0.74 atmosphere) (Edel et al. 1969), and this reduction in pressure may be sufficient to cause inert gas dissolved in a diver's tissues to come out in the form of bubbles, causing decompression sickness. This has occurred, with severe symptoms, in divers who fly after diving. Flying after diving is a recognized hazard that should be avoided. Termination of the flight, which increases the ambient pressure to 1 atmosphere, does not necessarily cause the gas bubbles to decrease sufficiently in size to stop causing symptoms. Recompression treatment may be required to relieve symptoms. Since a diver may have left the vicinity of a recompression chamber, it may be difficult to find a chamber in which treatment can be instituted. The delay that results may cause permanent tissue damage and extend treatment time.

If it is necessary to fly immediately after a decompression dive, a series of repetitive dives, or recompression treatment (as with an injury that requires medical capability beyond that available at the dive site), the diver should be transported at low altitude by helicopter or aircraft, or in a pressurized aircraft

at a cabin atmosphere of not more than 800 feet of altitude. If it is necessary to transport a diver suffering from decompression sickness by air, the flight should be conducted at the lowest safe altitude possible or in a pressurized aircraft in which the cabin atmosphere does not exceed 800 feet of altitude. In addition, the victim should breathe pure oxygen until arrival at a recompression chamber (R. D. Workman, M.D., personal communication).

#### WARNING

**The Following Procedures Do Not Apply to Flying After Saturation Diving (see Paragraph 12.6.4)**

Before flying in an aircraft in which the cabin atmosphere is less than 8000 feet (usually the case in most flights), a diver who has completed any number of dives on air and been decompressed according to the U.S. Navy Standard Air Decompression Tables should wait at sea level, breathing air, for the computed surface interval that allows him to be classified as a Group D diver in the U.S. Navy Repetitive Diving Table.

This procedure is illustrated by the following example:

- 0800 Dive to 50 feet on air for 60 minutes.
- 0900 Surface. (The U.S. Navy Residual Nitrogen Timetable for Repetitive Air Dives indicates diver is in repetitive Group H.) Remain at sea level for 5 hours.
- 1400 U.S. Navy Residual Nitrogen Timetable for Repetitive Air Dives indicates the diver has moved to Group B (dive to 60 feet on air for maximum no-decompression time of 49 minutes). This is found by subtracting the residual nitrogen time of 11 minutes for Group B at 60 feet (U.S. Navy Residual Nitrogen Timetable for Repetitive Air Dives) from the maximum no-decompression time of 60 minutes at 60 feet (U.S. Navy No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives).
- 1449 Surface. (U.S. Navy No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives indicates the diver is in Group J.) Diver must wait 185 minutes to move into Group D.
- 1754 Diver can now fly at a maximum cabin altitude of 8000 feet.