SCUBA RESCUE MANUAL

Rescue training will expand your knowledge of diving skills, and make you more aware of what is happening around you in the diving environment. Even more importantly, rescue training can help you save lives and increase diving safety by preparing you to respond properly to diving emergencies and near-emergencies. As a part of your rescue training you must also obtain first aid and CPR training from one of the recognized agencies.

I. PREVENTION

Self Rescue

Rescue competency begins with the ability to care for yourself. The self-reliant diver does not endanger others, but, more importantly, has an advantage when assisting someone else in difficult circumstances. Self-rescue capability increases confidence – an important factor when dealing with emergencies. The person providing assistance needs to believe that he or she will be able to cope with problems that might arise when helping another diver. Self-rescue can be divided into three categories: preparation, prevention, and performance.

PREPARATION – To be self-reliant, a diver must be prepared – both physically, and mentally. It is equally important to have and maintain complete, modern equipment and maintain proficiency in diving skills. Physical preparation includes health, fitness, rest, and proper diet. Mental preparation includes confidence and a feeling of well-being about the dives to be made. Equipment preparation involves becoming familiar with the equipment, regular inspection and servicing, and the addition of emergency accessories, such as an alternate air source. Preparation of gear should include adjustment for proper fit, streamlining, and the elimination of dangling straps, hoses, and other items. Finally, the amount of weight used should be adjusted for the situation. Proper weighting can contribute greatly to self-reliance. All of these factors affect an individual's self-rescue ability, and can mean the difference between coping with a problem or requiring aid.

Personal safety is better ensured when partners are less likely to experience difficulty. Thus, preparations for self-reliant diving should be a joint effort by dive teams.

PREVENTION – The best way to handle a problem is to never allow one to occur. Self-rescue begins with the following preventative techniques:

1. Regular equipment maintenance.
2. Thorough pre-dive equipment inspections.
3. Effective use of the buddy system.
4. Thinking ahead, anticipation of possible problems. (For example: running out of air faster than usual, due to a high level of activity.)

PERFORMANCE – If, in spite of all precautions, an emergency does occur, there are fundamentals of self-rescue with which the diver should already be familiar. The diver has only seconds to respond, and must be able to decide on the correct plan of action. When in difficulty, a diver should first stop all activity for a few moments and try to reestablish a normal breathing pattern. The diver should then think of the possible actions that can be taken, the first of which will probably be the establishment of buoyancy. This depends, however, on the circumstances. Finally, the diver should select the best course of action to correct or overcome the problem – then implement it.

The following emergency plan should be committed to memory:

1. STOP
2. BREATHE
3. THINK
4. ACT

This approach to an emergency is far better than “instinctive” reaction performed without thought or control. While diving, “instinctive” responses are usually incorrect and hazardous. Practice in emergency procedures and advance mental visualization of problem situations can help divers remain in control when under stress.

SELF-RESCUE SKILLS – Self-rescue skills relate to several areas. Some fundamental skills, such as establishing buoyancy, airway control, and cramp releases, through simple, should be practices often. Additionally, Rescue Divers should be aware of other, more complex techniques, to help ensure self-reliance.

The greatest problem to be faced while under water – deprivation of air – is also one of the easiest to overcome. Without air, anxiety builds and can lead to panic; and panic is responsible for most accidents that occur under water. To be self-reliant, a diver should know procedures that can be used when no air supply is immediately available.

The best way to solve the problem of air deprivation is through the use of redundant air systems. These systems can include small compact, self-contained units with specially integrated regulator valves. The other, is the pony bottle, a small tank with a regulator attached. This entire unit is mounted on the primary tank. Both of these systems are totally independent of the primary air source, and are therefore extremely reliable during air depletion emergencies.

Vertigo is another difficulty for which self-reliance principles are helpful. Dizziness can result for a number of reasons. When dizziness is so severe that it becomes disorienting, it can be dangerous. A diver severely affected by vertigo should grasp a stationary object for reference, and wait until the vertigo passes or assistance is provided. If no object is available, the diver should hug himself or herself as this often provides some comfort.

Another problem a diver may encounter is vomiting under water. The self-reliant diver should know how to deal with this. Those feeling ill should not dive, but if sudden nausea occurs, divers should know how to respond. Throwing up through the regulator may clog it and render it inoperable, while removal of the regulator may result in the inspiration of water from involuntary gasping, The recommended procedure to offset these problems is to hold the regulator at the corner of the mouth with the purge valve depressed. In this manner, clogging will not occur and the chances of inhaling water are reduced.

DIVER STRESS

Stress is the silent factor behind most diving emergencies. Stress is often unnoticed by both the victim and rescue, yet, unless recognized early and treated properly, stress can turn a good situation into a bad one, or worse.

Stress is defined as a physical, chemical, or emotional factor that causes bodily or mental tension. For the purposes of diving, stress can be viewed as the undesirable interaction between the diver and a physical or emotional stimulus. Furthermore, divers can experience two types of stress; physiological and psychological. A physiological response to stress can be seasickness, hypothermia, or fatigue. A psychological response to stress can be fear, embarrassment, anxiety or panic.

The primary ingredients in the somewhat complex interaction we call stress, are three-fold:

- The initial cause
- The individual’s predisposition to a particular stress
- The way in which an individual deals with stress

Some people, for example, are less subject to seasickness or have a higher tolerance to cold;

others deal better with apprehension or peer pressure. From the rescuer's point of view, it is difficult to tell in advance how a person will deal with a particular type of stress. Consequently, it is important to learn how to identify the potential causes of stress, and how to recognize the ways stress manifests itself – in both personal symptoms, and visible signs.

Many factors can contribute to stress. In some situations they build gradually over a period of time. In others, stress can trigger a sudden and extreme response.

The causes of stress can be real or imaginary, and range from narcosis to peer pressure. With an understanding of the causes of stress, and by studying examples of how stress manifests itself, one can learn to recognize stressful situations, and defuse them before a more serious situation develops.

PHYSIOLOGICAL STRESS - In cases of physiological stress, the causes are often easier to recognize than the stress response itself. For example, it is easy to recognize the type of environmental conditions in which hypothermia could occur. It is not, however, as easy to tell when a diver in that environment has begun to suffer from hypothermia. One sign of hypothermia is impaired motor functions – but, these are often difficult to detect until the situation has become extreme.

Occasionally, divers will fail to recognize when they are under stress. Beginning students, in particular, can be totally unaware that they are displaying symptoms of physiological stress. When this type of stress situation is allowed to go unrecognized and untreated, the nature of the response can escalate and the situation made worse. This can result in more serious conditions such as anxiety, exhaustion, and panic.

Examples of physiological stress cover a wide and varied range. Some are largely dependent on the diver's own predisposition to factors such as seasickness, muscle cramps. Narcosis, and fatigue. Others may be caused by poor physical conditioning, illness, injury, lack of sleep, drugs, or alcohol.

Other examples are more specific. Pain from injuries such as squeezes, discomfort caused by ill-fitting equipment, the distraction of a leaky mask – these, too, are all examples of physiological stress.

PSYCHOLOGICAL STRESS – Psychological stress can result from physical stress such as cold, seasickness, or narcosis. This is because in addition to the physical reaction resulting from these conditions, an undesirable emotional reaction often results. Another reason for psychological stress is the diver's own beliefs and attitudes. In fact, in the individual's own beliefs and attitudes play a major role. Interestingly, the stimulus (factors causing stress), can be either real (such as extremely cold water) or can be totally imaginary (such as fear of making a first night dive). But whether the cause is real or imagined, the effect is the same and has been likened to falling dominoes.

When dealing with psychological stress, the stimulus (whether real or imaginary) will trigger the activation of a set of related beliefs. These in turn will trigger a reaction or stress response. The severity of these responses will depend on how deeply held the beliefs are to the individual.

Imagine, for example, three individuals about to perform their first night dive among a group of friends experienced at night diving. The group is encouraging, yet insistent, about making the dive. To the first diver, the group's encouragement and insistence is welcome. The second diver would actually prefer not to make the dive. He acknowledges the encouragement with "Thanks, but no thanks!" Now, if he or she believes that this response was really "okay" to give, and if they have no other conflicting beliefs, he or she will experience no stress response to the situation. With the third diver, the group's encouragement activates conflicting beliefs. First, the encouragement is experienced as peer pressure, thus producing a stress situation. How this

individual responds next will depend on distraction, impairment of function, and laying the groundwork for panic. It all depends upon the individual's beliefs and attitudes. If the person is insecure, they may give in to the perceived peer pressure and go on the dive even though they do not feel ready or adequate for the experience, setting them up for a panic experience, which could lead to disaster for one or more individuals.

Here is another example. It is a student's first open water dive. The individual is nervous about being evaluated in an environment never before experienced, and one, which he or she perceives to be hostile. Add to all this a small dose of task loading – requiring the student to perform more skills than he or she feels comfortable with or can yet assimilate. In this instance, an already less-than-ideal situation can become much worse. Again, beliefs and attitudes play a major role.

Among the many causes of psychological stress, it is not uncommon for divers to feel obliged to dive in situations for which they are unprepared, or about which they are apprehensive. Two common reasons for this are having traveled a great distance to go diving or peer pressure. Whenever a person feels the risk involved in doing something (such as making a dive in a new area) is greater than usual, or greater than they feel comfortable with, stress will result.

When discussing psychological stress in diving, the subject of narcosis bears special mention. Not only is narcosis physiologically stressful, it can stimulate an extremely negative psychological response in some individuals. Under these conditions, they become fearful of the loss of control as well as bothered by the euphoria natural to the condition. From the rescuer's perspective, it is also important to be alert for the individual who likes the euphoric effect of narcosis and seeks it out.

The effects of stress often go beyond feelings on anxiety and strain; they may result in diminished mental awareness and inability to think clearly. When this happens, newly acquired or little-used skills may be abandoned for random reactions. An example would be the diver who thrashed wildly about at the surface rather than inflating a BCD or dropping a weight belt.

A stressful situation left unattended can also escalate from anxiety to panic. Panic results in an almost total loss of awareness, and the ability to evaluate and completely respond to a problem. This can create a complete loss of confidence, fixation on a single idea (I gotta get out of the water!), and incorrect, repetitive behavior. The panic response can be either active and aggressive or passive and frozen. In the latter case, the victim becomes virtually unresponsive and unable to act.

THE PHYSIOLOGY OF STRESS

Physical processes can occur in the body during stress. For example, adrenaline may be released. This would in turn stimulate the heart, constrict blood vessels, and activate a system that prepares the body for an emergency situation.

Such physiological changes are rarely beneficial. An increase in breathing rate, for example, would create a tendency toward rapid, shallow breathing. This would consequently increase air consumption while actually lowering respiratory efficiency. As the level of carbon dioxide in the body continued to rise, a feeling of suffocation may follow. This can lead to increased stress and greater respiratory difficulty.

In addition, as stress continues, the individual will experience a decreasing level of awareness, or what can be termed as perceptual narrowing. Because of this effect, the diver will often fail to notice things, which would be quite obvious under normal circumstances. In its most pronounced form – panic – this perceptual narrowing can result in the victim becoming oblivious to his or her surroundings all together.

When the body prepares for an emergency situation, which does not materialize (imagine the feeling of being startled), a stress situation can continue until the body's functions return to normal. This feeling – the jitters – can compromise motor functions and control, and bring on trembling and physical discomfort.

The physical symptoms of stress need to be recognized early. From the standpoint of self-reliance, early recognition of stress symptoms can lead to the elimination or effective solving of problems.

RECOGNIZING STRESS

Learning to recognize the signs of stress will require developing the skills of observing and correctly identifying behavior. It is important to avoid the temptation to interpret behavior; most often this will result in misinterpreting or minimizing the situation.

Signs of stress can be subtle and sometimes difficult to recognize. It is a better practice to ask questions a9where possible0, or investigate what you have observed in order to verify what it means. For example, having considered proper exposure protection, checked for shivering and other body language (closed elbows and arms against chest or crossed,) the Rescue Diver's best option is still asking, "Are you cold?"

Let's discuss some easily observable signs of conditions, which tend to cause stress. Individuals suffering from seasickness tend to look tire, move slowly, and become quiet and withdrawn. Additionally, most people tend to be somewhat embarrassed about seasickness – especially when others become aware of it. Care need to be taken that the diver not be made to feel obliged to perform any dive when they are really not up to it.

Divers tend to bring pain and discomfort to one's attention unless discouraged from doing so. Beginning level students, however, bear close observation since they don't know what level of comfort to expect. Again, ask – don't assume.

Muscle cramps impair function and are occasionally so painful that rescue is necessary. But how does one tell when a person is suffering from them? Cramps typically occur suddenly and without warning, yet frequently offer no clear signs to the observer. Be alert for behavior that might be otherwise inappropriate – such as an uneven fin kick or an attempt to massage and relieve the pain.

Narcosis may impair certain physical functions, and possibly the decision-making process. The trained rescue diver should be alert to visible signs such as silly or repetitious behavior, deviation from a plan separation from buddies, and even inappropriate smiling.

In general, watch for any deviations from normal skill performance, such as poor buoyancy control, water remaining in the mask, heavy breathing, equipment complications, unnecessary and rapid fin movement (especially when the diver is on the surface), or rapid and non-specific movements. Near-panic and panic situations can also be identified by failure to return a signal; unresponsiveness to directions; sudden and aggressive behavior; a wide-eyed, frozen look; repetitive, incorrect behavior; rejection of mask or mouthpiece; treading high in the water; and attempting to "climb" objects at the surface (such as the anchor line, buoys, or the rescuer).

Prior to the dive, stress might be suggested by incessant talking; high-pitched, inappropriate laughter; an unpleasant mood; anger; equipment difficulties; and procrastination.

STRESS MANAGEMENT

On nearly every dive, there is a good change some problem will develop. Yet most minor problems experienced while diving do not result in significant level of anxiety or panic. Why?

Simply because whether aware of it or not, all divers have a relative degree of experience in dealing with stress. The problem is first recognized, a plan for coping is developed, the plan is successfully implemented and the problem corrected or minimized.

It is then easily seen that coping with a problem is likewise coping with stress. This explains why problems are routinely solved during the dive – quickly, and usually without a significant degree of anxiety. It is also important for the Rescue Diver to note that this type of solution thinking can be applied to problems experienced by others as well.

In brief, when a problem is recognized **Stop, Think,** then **Act.** Once activity is reduced, attend to proper breathing (deep, controlled breathing is suggested). Then, additional action – if necessary – can be taken.

During a rescue, the rescuer may be faced with problems that are stress producing. The same principles of stress management apply, but other techniques can be useful as well. These techniques include: advance mental visualization where the problem is imagined and solved properly; frequent practice of skills so that performance is nearly automatic; and exercising a determination to concentrate on solving the problem rather than dwelling on the consequences of it.

The preferred method of managing stress, of course, is to prevent it in the first place. By honing observation skills and developing an interview style, one can often encourage the diver into analytical thinking well before the dive takes place. The interview procedures should be non-judgmental, non-threatening, gentle, and convey genuine caring. Strong opinions expressed with the best of intentions can be assumptive and threatening.

It is often most effective and informative to ask the diver rather than to tell him or her about the problem. Characteristics of an effective interview are to ask what the nature of the suspected problem is. “Does anything concern you about this dive?” OR “You seem a little distracted or uncertain. Is something bothering you?” Next, attempt to ascertain why they are bothered fearful, or apprehensive. “What is there that concerns you?” Having ascertained their reasons for being afraid, the next step is to explore the reasons for the fear with questions or examples. Having done so, the diver might conclude that his or her reasons are valid about the dive, or that the reasons were imagined and proceed with greater confidence.

Care must always be taken that you are not exerting pressure or undue encouragement. The most important consideration is to facilitate the diver’s doing what he or she really wants, and thus, is relatively unafraid. You may need to clearly state: “If you don’t really feel comfortable making this dive then it is better not to dive.” Your tone of voice needs to convey that you really are willing to accept their decision.

Summary

To some degree, stress is present in all diving activities. The job of the Rescue Diver is to assist others in dealing with it in order to prevent stressful situations from becoming overwhelming or potentially dangerous. There is no more important skill for the Rescue Diver to develop than the astute observation of behavior and proper identification of stress in others. This skill can be mastered only after the individual has attained a high degree of awareness, self-confidence, empathy, and experience under a variety of conditions. It might also be helpful for an effective Rescue Dive to have their own ego well under control.

II. DIVING FIRST AID

In an emergency, a Rescue Diver must be able to properly administer first aid. First aid is immediate temporary assistance, provided to the victim of an injury or illness, that continues until professional assistance can be obtained. The purpose of first aid is to preserve life, prevent

further injury or worsening of a condition and promote recovery.

Proper first aid involves more than just the actual administration of aid; making the correct decision in terms of priorities is equally important. When an accident occurs, the correct response can mean the difference between life and death, temporary or permanent disability, and short-term or long-term hospitalization. Because time is of utmost importance, the prudent provider of emergency care must be ready and capable of proper action before an accident occurs.

This is to serve as an orientation to handling critical diving-related injuries and illnesses. There is no substitute for formal first-aid training. Even maladies that are not serious or life-threatening must be dealt with by using standard first aid techniques.

First Aid Equipment

Familiarity with a wide variety of emergency equipment is essential, even if such items are not part of a Rescue Diver's personal equipment. Why? It's not unusual for such equipment to be readily available at the scene of a diving accident. Knowing what to use, when to use it, and how to use it, are the most important aspects of first aid equipment.

In light of the remote locations in which diving emergencies can occur, every diver should have a well-stocked first aid kit. For the Rescue Diver, such a kit is absolutely essential.

First aid supplies can be combined with other items for emergency or personal use into either a tackle box or other container suitable for the diving environment.

Glass containers should not be included in the kit. While the exact contents may vary depending on the geographical area and the extent of one's emergency training, the following list of first aid supplies is believed to provide an adequate base of supplies for situations most frequently encountered. Items with applications not readily apparent have their uses identified.

- First Aid Manual
- Emergency Contact Information
- Coins for Phone
- Pen and Small Notebook
- Household Vinegar Solution (5% acetic acid)
- Sea Balm or Bacitracin
- Cortisone Cream
- Non-Aspirin Pain Reliever
- Cleansing Soap
- Hot Packs
- Cold Packs
- 12 oz. Bottle of Denatured Alcohol
- Plastic Wrap or Telfa Pads
- Large, Absorbent Dressings
- 6 oz. Squeeze Bottle of Water
- Triangular Bandages
- Clinging Rolled Bandage
- Sterile Cotton
- Sterile Gauze Pads
- Adhesive Tape
- Band-Aids and Butterfly Bandages
- Q-Tips
- Tongue Depressors

- Disposable Cups
- Oral Thermometer
- Single-Edged Razor Blades
- Tweezers or Forceps
- Bandage Scissors
- Lighter or Waterproof Matches
- Emergency Blanket
- Rigid Splints
- Penlight
- Seasickness Medication

The expense of assembling a first aid kit for diving is not high, compared to the value. Keep in mind, a good first aid kit can be priceless in an emergency; it will be valuable to have at all times – not just for diving.

The kit should be clearly labeled and kept where it will be readily accessible. Be sure to note any supplies used from the kit, and replace them promptly so that needed supplies will always be available for use.

THE POCKET MASK - The pocket mask, available at most medical supply houses, has gained wide-spread use by rescue diver. The pocket mask eliminates direct contact with the patient's mouth and nose and permits effective mouth-plus-nose artificial ventilation – both in and out of the water. One model has a special inlet valve that permits the mask to be used with oxygen units. The mask is transparent, which permits you to see the color of the patient's lips. Any vomitus that may be present and exhalation vapor. It is a useful rescue tool.

OXYGEN EQUIPMENT – It is widely accepted that the first aid administration of oxygen is extremely beneficial in serious diving emergencies. But what type of oxygen equipment is available, and is one type preferred over another? Since there are several different types of oxygen delivery systems on the market, each will be discussed here.

There are three main types of oxygen delivery units: (1) positive-pressure or power-resuscitation units, (2) continuous-flow units, and (3) de4mand-valve units. Power-resuscitation units require professional training and certification for use. Their use is reserved for trained emergency medical personnel.

Continuous-flow units are helpful in treating diving emergencies, however, they are not ideal. Typically these units have two drawbacks. First, most continuous-flow units cannot deliver the required 100% oxygen needed to adequately treat a victim of a lung expansion injury or decompression sickness. Continuous-flow units commonly have a flow rate of approximately ten liters per minute and this flow rate does not deliver enough volume to meet the full respiratory requirements of an adult. To overcome this problem, continuous-flow units commonly come with loose-fitting masks that have a vent on the side to allow air to be breathed in addition to the oxygen (when a vented mask is used, the vents should not be covered). This design lowers the percentage of inspired oxygen by the patient.

Continuous-flow units are also wasteful. Since oxygen is always flowing, the unused oxygen between breaths is released into the atmosphere. Even though continuous-flow units have drawbacks, their use as a treatment for suspected lung-expansion injuries and decompression sickness is certainly better than no oxygen treatment at all.

Non-resuscitator, demand valve oxygen units are highly recommended for serious diving emergencies. These units employ a demand-type regulator, much like those used for diving. Demand-type units deliver oxygen flow-rates sufficient to meet the full respiratory requirements of an adult. These units can use tight-sealing, non-vented masks to provide 100 % oxygen to the

patient. Additionally, this type of unit only delivers oxygen when the patient breathes, therefore waste is minimal.

Oxygen storage bottles may be one of two types – refillable or disposable. Refillable tank systems are more costly than disposable tank systems, but the cost of refilling them is considerably less than replacing disposable tanks. It may be difficult to obtain oxygen refills for refillable tanks. In some areas, oxygen is classified as a drug only when used by patients with chronic illnesses, but a prescription may be necessary to refill an empty cylinder. Medical supply houses will usually fill empty cylinders for emergency and rescue purposes with question. If it becomes necessary to obtain a prescription to fill an empty refillable tank, see your doctor and explain that the oxygen is for emergency treatment of diving disorders. One additional word of caution regarding refillable oxygen tanks: be certain the oxygen used for refills is intended for breathing, and not for industrial use.

Refillable tanks require periodic hydrostatic testing the same as scuba tanks. They also require special cleaning. No special maintenance is required for disposable bottles. In tropical areas disposable bottles may deteriorate over time and need to be replaced periodically, even if they have never been used. Disposable, continuous-flow oxygen units can be purchased at many dive stores, but refillable models are usually obtained through medical supply houses. Since all oxygen cylinders are high pressure tanks, they should be carefully handled.

Oxygen tanks come in a variety of sizes. The size of tank needed for diving emergencies depends primarily on the distance to secondary assistance (specifically, a recompression chamber). Authorities agree that 30 minutes of 100% oxygen may be insufficient as a treatment is secondary assistance takes that long or longer to reach. If emergency treatment is quite some distance away, a large volume of oxygen may be needed. When purchasing an oxygen unit, give this fact careful consideration.

Oxygen should only be used by Rescue Divers for diving emergencies. Do not use oxygen in non-diving emergencies unless specifically trained. Additional questions regarding the suitability of various oxygen delivery systems should be addressed to a physician knowledgeable in diving medicine.

BACKBOARDS – Research into years of diving accidents failed to locate even one serious back injury (mechanical injury to the bones and cartilage) to a skin or scuba diver. In the unlikely event, however, of a back injury in which the patient must be moved, a rigid support needs to be placed under the patient. The spine and neck must be immobilized for transport. A backboard provides such a means of immobilization for back and neck injuries. Its greatest value, however, will probably be as a litter or stretcher, or as a platform on which a victim of a diving accident can be treated.

Backboards are available commercially. They may also be made from commonly available materials without much difficulty. If none are available, makeshift items such as a door or a surfboard can sometimes be substituted.

FIRST AID PROCEDURES:

PRIORITIES - In the event of an accident or sudden illness, it is necessary to act quickly; but, it is equally important to know what to do and what the correct priority for action is. For example, both a superficial cut and respiratory failure require immediate action. However, should both problems occur simultaneously, first aid priorities (in addition to common sense) dictate that response to the respiratory failure should occur before attending to the superficial cut.

A *Primary Assessment* is the recommended, initial prioritized check for life-threatening conditions. Primary assessments are to be done in the position in which the victim is found except when the victim must be removed from a life-threatening situation. Examples of life-threatening situations

are: surfacing an unconscious, non-breathing diver or removing an incapacitated person from a burning vessel. Listed in the correct order of priority, the steps included in a primary assessment are as follows:

1. Arousal – Tap on the shoulder and shout, "Are you okay?" The tap and shout step is done to help determine the conscious level of the patient.
2. Establish an Airway – If the patient does not respond to the tap and shout, open the airway to check for breathing.
3. Check for Breathing – Once the airway is open, the patient must be checked to determine if he or she is breathing. If it is determined that the patient is not breathing, mouth-to-mouth ventilation must be initiated immediately.
4. Check for Pulse – It must be determined if the patient has a heartbeat. This is determined by checking the carotid pulse. The carotid pulse is the most reliable means of determining if the heart is beating. If the pulse is absent, artificial circulation and mouth-to-mouth ventilation must be performed together.
5. Check for Bleeding – If a patient is breathing and a pulse is present, the patient must be checked for bleeding. Serious bleeding, identified by visually scanning and feeling the patient, must be controlled.
6. Shock Management – By performing steps 1 through 5 of the primary assessment, shock management has already begun

Even after a primary assessment has been completed, these prioritized steps may be used to monitor a patient's condition over a period of time. This Circle of Care arousal, airway control, breathing, pulse, (circulation), bleeding and shock management, must be continued until medical assistance arrives.

BASIC LIFE SUPPORT

A primary assessment of a patient may indicate the need for Basic Life Support (BLS). Basic Life Support includes those emergency lifesaving procedures designed to treat failure of the respiratory or cardiovascular system. Failure of either the respiratory or cardiovascular system means that oxygen is no longer being supplied to the body. BLS techniques involve manually breathing (mouth-to-mouth ventilation/artificial respiration) and circulating (artificial circulation) for a patient. The combined techniques involved with manually breathing for and circulating the blood of a patient is called *Cardiopulmonary Resuscitation* or **CPR.**

BLS is very effective and can be performed by any trained individual without the need for complex mechanical equipment and drugs. Time is critical to the success of BLS.

Generally, if the brain is deprived of oxygen for four to six minutes, brain damage can occur. Brain damage is almost certain if deprived of oxygen for more than six minutes (a possible exception may involve a victim who is totally immersed in extremely cold water). Ideally, only seconds should elapse between the recognition of the need for BLS and the start of treatment.

Whenever BLS procedures are used, the Emergency Medical Service system (EMS) should be activated. If a patient does not respond to attempts at arousal, call out for help. When someone responds, tell that person how to contact the Emergency Medical Service system in your local area.

BLS procedures (mouth-to-mouth ventilation and artificial circulation) are compo9nents of the previously outlined primary assessment.

By receiving training in CPR and First Aid and becoming certified, you will know about and be able to perform the following:

- Airway control and Mouth-to-Mouth ventilation

- Artificial circulation
- Obstructed Airway
- Control of Bleeding
- Shock

SECONDARY ASSESSMENT PROCEDURES

If a primary assessment of an injured individual has been completed and no life-threatening conditions exist or the conditions have been corrected, a thorough Secondary Assessment of the patient's condition should now be performed. A Secondary Assessment, illness and injury assessments, will help identify any additional unseen injuries that might cause harm if unattended or aggravated by mishandling. Serious damage can be caused if a patient is moved or helped improperly.

Standard first aid procedures dictate that a patient is not to be moved unless movement is necessary to protect the person from further injury, or to provide urgent first aid care. Unfortunately, diving accidents frequently involve in-water situations, and removal of the patient is essential. The correct procedures for removing a victim from the water, to administer first aid, will be presented later.

Always begin with a primary assessment. Make sure no life threatening conditions exist, provide care for respiratory or cardiac arrest, severe bleeding and shock. Continually monitor the patient's breathing and pulse throughout a secondary assessment. Maintaining verbal communication with the patient will ensure that these concerns are not being compromised.

The following general rules apply when conducting a secondary assessment:

1. Call for help if the situation warrants this action. Give bystanders the necessary information to activate the Emergency Medical Service system in your area.
2. In all severe-injury cases, the patient is to be kept in the position in which he was found. Ask the patient not to move.
3. Examine the patient from head to toe using the secondary assessment procedures outlined. Ask the patient to tell you if an area hurts when you touch it. Also look for deformity, fluid, moisture or a reaction to pain.
4. Begin first aid treatment of any injuries discovered after completion of the entire secondary assessment.
5. Any abnormalities noted should be reported to the emergency personnel responding to the accident.
6. After the secondary assessment the patient should be closely monitored. Continue treatment for shock until further examined by qualified medical personnel.

The secondary assessment procedure applies to a diver who is out of the water and in a face-up position. An exposure suit may prevent or interfere with parts of the examination. In cases of severe injury, the exposure suit may need to be carefully cut away (instead of being removed in the standard fashion) to facilitate the assessment and delivery of first aid.

Immediately before beginning a secondary assessment, ask the patient several questions. "What happened?" "Where do you hurt?" "Do you hurt anywhere else?" "Where are you?" "Do you have an allergy to a specific medication?" These questions can provide information about the patient's mental state and extent of injuries.

If the patient has identified areas of pain or discomfort, avoid these areas during the secondary assessment. If you discover a painful area during the assessment, discontinue the assessment near that area. If a neck injury is identified, discontinue the secondary assessment, monitor the patient's breathing and pulse and immobilize the head and neck (perhaps by holding the head

gently with both hands).

As a general rule, symptoms affecting only one side of the body indicate cerebral problems, while symptoms affecting only the lower or upper half of the body usually indicate a spinal injury.

Once the examination is completed, first aid should be administered according to the order of severity. Upon completion of the secondary assessment, return to the primary assessment by continually monitoring the patient's airway, breathing, circulation, bleeding and shock.

Secondary Assessment Procedures			
Area	**Procedure**	**Symptom**	**Possible Injury**
Neck	(Do not move) Carefully feel back of neck with fingertips. Discontinue assessment if patient complains of pain or discomfort. Immobilize the head and neck, and continue with the circle of care until help arrives.	Tenderness, numbness, tingling, pain, deformity	Spinal injury
Head	Lightly feel entire head with fingertips.	Pain, deformity and fluid (such as blood)	Cut(s), skull fracture, bruises
Eyes	Have patient follow finger with eyes only (do not allow patient to move his head)	Eyes not moving together	Neurological damage
Ears and nose	Look at outside of ears and nose.	Blood or clear fluid	Head injury, ruptured eardrum, damaged middle and inner ear area.
Shoulder Blades	Place a hand under each shoulder blade – first one then the other – feeling carefully with fingertips.	Dislocated or broken shoulder.	
Collar Bones	With two fingers, carefully feel the entire length of each collar bone.	Pain, deformity	Broken or bruised shoulder bones

Arms	With one hand, grasp the top of the patient's arm near the shoulder. Slide the other hand firmly but slowly down the patient's arm to the hand. Have the patient move fingers and raise arm slightly.	Pain, deformity, sensation, inability to move fingers, hands, arms	Broken, or bruised arm, spinal cord or neurological damage
Ribs	With both hands, gently push rib cage together (toward the center) and down.	Pain, deformity	Fractured or bruised ribs, lung-expansion injury, general chest injury
Abdomen	Gently push down on each side of the abdomen just below rib cage area.	Pain, tenderness, rigidity	Internal organ damage
Spine	Gently slide one hand under the patient and feel his spine with fingertips. (Do not move patient to perform this check)	Pain	Spinal Injury
Pelvis	With both hands, gently push the pelvis down and toward the center of the patient's body.	Pain	Broken or bruised pelvis
Legs	Grasp one leg at the top near the groin with one hand; slide the other hand firmly down the leg to the ankle. Repeat for the other leg. Have patient wiggle toes, move feet and lift leg at knee slightly	Pain, tenderness, deformity, sensation, numbness	Broken or bruised leg, spinal cord or neurological damage
Ankles	Have patient rotate ankle	Pain, deformity, swelling	Broken, strained or bruised ankle

Various conditions may be identified when performing a secondary assessment of an injured or ill patient. Emergency care for conditions such as nick and back injuries, heat exhaustion, heat stroke, hypothermia, and aquatic-life injuries will now be discussed in detail.

Neck and Back Injuries

Although experience has shown that neck and back injuries in diving are extremely rare, there are some special circumstances that should be noted.

Surf, rolling boats, and slippery rocks pose potential threats to diver safety. A fall or powerful wave could cause spinal injury to the neck or back. In such situations extreme care is essential since serious consequences can result unless certain precautions are heeded.

The spinal cord, which carries signals from the brain to control the body, extends down the neck and back vertebrae. The effect of a broken neck or back may be interference with the spinal cord, causing paralysis. Improper movement of a patient could damage or sever the spinal cord, causing permanent paralysis or even death. Tingling, numbness, weakness or paralysis in either the arms or the legs may indicate a spinal injury or decompression sickness.

With a neck fracture, the patient's head must not be allowed to move, especially forward. If artificial ventilation is required, head tilt for establishing the airway must be minimal. If an airway needs to be established, use the jaw-thrust technique.

To immobilize the patient's head, affix a side strip of adhesive tape or cloth across the forehead (avoiding the eyebrows) and secure it to each side of a stretcher or backboard. If such equipment is not available, the patient's head will have to be held firmly by the rescuer to prevent

movement until assistance arrives. Do not move the patient unless absolutely necessary.

A person with a broken back should be handled as little as possible. The neck or back is not to be twisted. If possible, leave the patient in the position in which he was found and send for an ambulance and trained personnel. If the patient must be turned in order to administer first aid (example: opening the airway), help should be quickly obtained so the entire body can be turned as a unit, with no part twisting or turning faster than any other part.

EXPOSURE

Many divers wear exposure suits to reduce heat loss in the water. Although wearing the suits out of the water on a hot day can lead to overheating, inadequate insulation in cold water can result in a severe loss of body heat. When illness results from exposure, a Rescue Diver should be able to recognize problems and correct them.

Heat Exhaustion - This condition occurs when the intake of water and salts are inadequate to compensate for losses due to perspiration. It is commonly characterized by cool and clammy skin and a grayish look to the face. A person may also complain of feeling dizzy, weak or faint, with accompanying nausea or headache. The body temperature of a heat exhaustion victim may be near normal and a rapid pulse may be present.

Emergency care for heat exhaustion begins with a primary assessment - arouse patient, check for open airway, breathing, circulation, bleeding and shock. Next, move the patient to a cool location and if he is wearing an exposure suit, remove it immediately. I The patient should be urged to lie down. If fully alert, the patient should be encouraged to drink up to a liter of water or a diluted commercially available balanced salt solution.

Patients will typically respond favorably to these emergency care measures within 30 minutes. If the symptoms do not clear promptly, the level of consciousness decreases, or the body temperature remains elevated, the patient should be transported to the hospital.

Heatstroke - This occurs when the body is subjected to more heat than it can handle. The normal mechanisms for getting rid of the excess heat are disrupted. When these mechanisms fail, the body temperature rises rapidly to a level that destroys tissues and may result in death. Fortunately, heatstroke is rare, but it is a life-threatening emergency requiring immediate first aid.

In advanced stages, heatstroke victims have hot, dry, flushed skin because they do not sweat. The absence of perspiration, however, may be an unreliable sign since heat exhaustion often precedes heatstroke and some moisture may remain on the skin. The skin color will be red and body temperature may rise to 103 degrees or higher. The pulse is usually rapid and strong at first, but as the victim becomes unresponsive, the pulse will fade. Sudden unconsciousness often results, and convulsions may also occur.

A heatstroke victom's body temperature must be quickly and immediately lowered. ,,First, remove the patient from the hot environment. Also, remove or cut away the patient's exposure suit. To effectively cool the patient, either cover him with wet towels or place him in cold water. When his body temperature begins to lower, continue the circle of care and seek medical attention.

Hypothermia (reduced body temperature) - Immersion is cold water reduces body temperature. Insulation can reduce the rate of heat loss, but extremely cold water or insufficient insulation can lead to serious lowering of the body's core temperature. In addition, circulatory efficiency decreases with age, therefore, older divers should exercise particular care in avoiding potential hypothermic conditions.

The mild sign of hypothermia (shivering, numbness and blueness) are well-known. Moderate to severe signs and symptoms include lack of coordination, weakness, confusion and

unconsciousness. Cardiac arrest may also occur as a result of hypothermia. Be aware, however, that a person suffering from severe hypothermia will have a very weak pulse that cannot be detected at the wrist. A carotid pulse should be taken to determine for certain that the victim's heart is not beating, before CPR is initiated.

For any individual suspected of suffering from hypothermia, begin by first performing a primary assessment: determine arousal level, assure an open airway, breathing, circulation, check for bleeding and shock. If the patient is alert and only mildly hypothermic, prevent further heat loss by removing them from the cold environment, removing their exposure suit (if applicable), and towel dry. Cover the patient's head and add heat to the neck, armpits and groin.

Patients displaying moderate to severe signs and symptoms of hypothermia must be treated in a hospital. Attempting to rewarm a patient with moderate to severe hypothermia in the field can be dangerous. Rewarming may result in serious complications that are even difficult to correct in a hospital setting. Strive to prevent further heat loss, handle the patient carefully, and transport the patient immediately to the hospital. If possible, activate the Emergency Medical Service system in the local area, allowing professionals to transport the patient.

Serious Aquatic-Life Injuries - Divers can receive venomous wounds or stings from a variety of aquatic animals. Contact with creatures such as jellyfish, stingray, spiny fish and cone shells - whether intentional or unintentional - can produce a varying degree of injuries.

An excellent source of information in this area is:

> **A Medical Guide To Hazardous Marine Life** By Paul S. Auerbach, M.D.
> Progressive Printing Co., Inc.
> 4505 Lexington Ave.
> Jacksonville, FLA 32210
> (904)388-0746

The effect of aquatic venom varies with the animal, but the injury can lead to respiratory depression, cessation of breathing, and even cardiac arrest in serious cases. CPR may be required to save the life of a diver who has received a wound or sting from certain highly venomous aquatic animals.

Thankfully, such injuries are rare.

Specific signs and symptoms also vary with the type of creature inflicting the injury, but general indications of such an injury include:

1. An open would or pieces of tentacles on the affected area.
2. Excruciating pain
3. Loss of consciousness, weakness, nausea and shock
4. Local swelling, inflammation or welts
5. Mental confusion
6. Spreading numbness
7. Paralysis
8. Convulsions
9. Respiratory depression or arrest
10. Cardiac arrest

First aid for all suspected aquatic-life injuries should begin with a primary assessment and if indicated, treat for respiratory/cardiac arrest, bleeding and shock. First aid for venomous aquatic-life wounds generally consists of removing any foreign bodies with probing instruments or with water irrigation, then soaking the afflicted are in hot water (110 to 120 degrees) for at least 30 to 90 minutes to neutralize the venom. do not delay the hot water soak while attempting to remove

foreign pieces from the wound, begin the hot water soak almost immediately. If the affected area is a limb. the patient should be kept in a position allowing the limb to remain below the level of the heart. Prompt treatment for shock must be included because loss of consciousness is a common consequence of wounds inflicted **by** venomous aquatic animals.

The patient should be closely monitored and medical assistance obtained as soon as possible. CPR may be required. The wound should be covered after the pain has subsided.

Certain jellyfish like the Portuguese man-of-war or the box jellyfish (i.e. sea wasp) are capable of inflicting very dangerous stings that require immediate first aid. Due to possible loss of consciousness, the affected individual must be removed from the water as quickly as possible.

When an individual comes in contact with a jellyfish, parts of the organism (most commonly the tentacles) often adhere to him. If this occurs, these pieces must be removed immediately in order to treat the affected area and keep the problem from spreading.

It is important to note that the jellyfish remnants adhering to the affected individual are still active and capable of stinging any-thing that touch them, even the rescuer. for this reason, the jellyfish parts must be removed carefully. Unprotected hands and wet sand should not be used.

To initiate emergency care, first attempt to wash the pieces off with the type of water that the jellyfish lives in. Using a dissimilar water type will cause the sting cells to "fire" creating more irritation. The stinging cells of most dangerous jellyfish are rendered inactive when they are flushed with common household vinegar. Liberal application of vinegar is highly recommended when any stinging jellyfish is suspected. When all stinging material has been removed, the wounded area should be cleansed thoroughly with soap. Pain may be relieved by immersing the area in hot water or applying an antihistamine or mild corticosteroid ointment.

Keep the patient still. In severe cases, basic life support and subsequent medical assistance may be required.

NEAR-DROWNING

Drowning is the ultimate cause of death in the majority of diving fatalities. Technically, the term drowning signifies that death from asphyxia (suffocation) by submersion has occurred and the victim cannot be revived. The term near-drowning describes the same situation, except that the victim is not dead; he can be revived if the appropriate measures are taken.

Records show that in over 80 percent of all drownings, some water enters the victim's lungs. Water in the lungs presents many problems, but primarily it interferes with the body's ability to transport oxygen to the tissues - a condition called hypoxia.

Signs and symptoms of near-drowning vary depending on the severity of the accident. Coughing, shortness of breath, rapid breathing, and cyanosis (blueness) of the lips may appear in mild cases. Convulsions, unconsciousness, cessation of breathing, cardiac arrest and frothy sputum - white, pink or red - indicate a more severe case.

Length of submersion is an unreliable guide to the physiological state of a victim. Although brain tissues can only withstand a lack of oxygen for four to five minutes on the surface, this time may be extended in cold water (70 degrees or colder) due to reduced requirements for oxygen. Age also seems to be a factor in this mechanism. Generally, the younger the victim, the less hypoxic he was at the time breathing ceased and the colder the water in which he was submerged, the better his chances are for survival. Higher partial pressures of oxygen in the body at depth also help.

A combination of factors has allowed recoveries to be made with good results after submersion

periods of up to 40 minutes. Even if the victim appears "dead," attempts at resuscitation should be made whenever immersion has been less than one hour.

The principle first aid procedure for serious near-drowning accidents is mouth-to-mouth ventilation. Don't waste time attempting to remove water from the patients lungs. an attempt to remove water from the breathing passages may be dangerous because it could eject stomach contents and cause them to be breathed into the lungs (aspiration). Begin immediately with the primary assessment. Be especially alert, however, for vomiting and prevent aspiration of any vomitus. Administer oxygen if patient is breathing sporadically and continue treatment for shock.

Once the near-drowned patient has been revived, the individual must be observed constantly and

receive prompt medical attention - no matter how well he or she may claim to be. Physiological complications can occur five to six hours following a near-drowning.

LUNG-EXPANSION INJURIES AND DECOMPRESSION SICKNESS

Lung Expansion Injuries - Lung-expansion injuries occur as a result of breath-holding during ascent while on scuba, or when air is trapped in part of the lung during ascent. In both situations, expanding air can cause the lung to expand and rupture.

Depending on where the lung rupture occurs, a variety of injuries are possible. One or several of the following conditions may be present in the victim of a lung-expansion injury. The injuries include: obstructed arteries (air embolism); collapsed lung (pneumothorax); and air under the skin of the chest or neck (mediastinal or subcutaneous emphysema). Embolism and pneumothorax are life-threatening injuries and require transport to a treatment facility as rapidly as is possible. If air travel is involved, the victim must not be exposed to the decreased pressures of altitude. Transport the patient in either a pressurized aircraft, or an unpressurized aircraft that does not exceed an altitude of 800 feet.

Air Embolism - This is the most serious of lung-expansion injuries and, unfortunately, one that frequently results from lung over-pressurization. It occurs when air is forced from the alveoli (smallest air sacs sin the lungs) into pulmonary capillaries (the smallest blood vessels in the lungs). The bubbles are then carried by the blood to the left side of the heart, and pumped out into the aorta, the main artery from the heart. The bubbles may then enter the coronary arteries supplying the heart muscle, but are usually swept up into the carotid arteries leading up the neck to the brain. As these arteries get smaller and the bubbles expand, the bubbles reach a point where they can move no further, and obstruct circulation to the brain. Thus, the onset of symptoms of the embolism usually occur within five minutes of surfacing. Symptoms for air embolism are similar to a stroke and can include blurred vision, dizziness, sudden unconsciousness, loss of motor function, bloody froth from the mouth, breathlessness and coughing

Mediastinal Emphysema -- In this injury, expanding air has been forced into the lung tissue and becomes lodged in the chest cavity between the lungs. Ascent then expands the trapped air.

This are, called the mediastinum, also contains the heart and some of its major vessels. While not as serious as an embolism, mediastinal emphysema is still a severe lung injury. symptoms and signs of this injury include pain under the breastbone, shortness of breath, difficulty in breathing or swallowing, fainting, cyanosis and shock.

Subcutaneous Emphysema - When the air escaping from a burst lung makes its way under the skin to the area of the neck and collarbone, the injury is termed subcutaneous emphysema, which means air under the skin. Its signs and symptoms include a feeling of fullness in the neck area, a change in the sound of the voice, swelling around the neck, a crackling sensation when the skin is moved and possible difficulty in breathing or swallowing.

Pneumothorax - This injury results when expanding air is forced into the space between the lung and the chest wall (pleural cavity). This can in turn result in partial or total collapse of the affected lung due to expansion of the air during ascent. In serious cases, the air may interfere with the heart. Severe chest pains, extreme difficulty in breathing, and irregular pulse are some of the signs and symptoms of a pneumothorax.

DECOMPRESSION SICKNESS - Also known as the bends, decompression sickness (DCS) is the result of inadequate decompression. It occurs when nitrogen, absorbed under pressure, cannot be released from a diver's tissues as quickly as the pressure is reduced. The nitrogen then comes out of solution, forms bubbles in the tissues and bloodstream, and obstructs circulation.

The symptoms and signs of decompression sickness are extremely variable, and in serious cases can resemble those of air embolism. The symptoms will depend on the location and extent of the bubbles, with pain in the joints being the most frequent result. More serious cases of decompression sickness affect the nervous system and may cause unusual fatigue, inability to urinate, blurred vision, vertigo, hearing and speech difficulty, paralysis, loss of sensation and unconsciousness. Nitrogen bubbles forming in the veins of the lungs can cause a condition known as the chokes, which results in shortness of breath, chest pain, and uncontrollable coughing. The chokes is a very severe form of decompression sickness.

In about one-half of bends cases, symptoms occur within 30 minutes after surfacing. Symptoms occur within three hours in about 95% of the cases.

FIRST AID FOR LUNG EXPANSION INJURIES AND DECOMPRESSION SICKNESS:

Without special medical training and equipment, it is virtually impossible to accurately diagnose the various forms of lung-expansion injuries and decompression sickness at the scene of an accident. Assessing the exact nature of the injury is far less important than timely and appropriate action. In the case of lung-expansion injuries, more than one form is typically present. The correct action is to respond to all suspected lung-expansion injuries (embolism, emphysema, or pneumothorax) and decompression sickness in the same manner, regardless of which problem is suspected. This approach will save time and greatly eliminate the possibility of giving improper first aid treatment to victims of serious diving accidents.

Time is a critical factor when dealing with lung-expansion injuries and decompression sickness. First aid treatment must begin immediately. Rapid transport to secondary assistance is very important.

The Assessment - Begin with a primary assessment when a person is suspected of having a lung expansion injury or decompression sickness; check arousal level, airway, breathing, circulation, bleeding and provide care for shock. Also encourage the patient by being calm and giving constant reassurance.

Next the secondary assessment should begin by asking the patient several questions

1 . Were you scuba diving today or breathing compressed air?

2. Was there any sort of forced, rapid ascent during any dive?

3. How deep did you dive?

4. What was your bottom time?

5. Are you fatigued?

6. Where do you hurt? Do you have pain in your joints, abdominal area/lower back?

7. Do you feel dizzy?

8. Is there a portion of your body that feels numb or tingles?
9. Are you having trouble breathing?

Emergency Care - If the answers to these questions indicate a possible lung-expansion injury or decompression sickness problem, begin the following first aid treatment immediately.

1 . Calm and reassure the patient.

2. Maintain open airway - prevent aspiration of vomitus.

3. Place a breathing patient level on the left side, head supported. To do this, place the patient on a solid, yet movable surface, for example, a surfboard, a door, a long boat hatch cover, a stretcher or a backboard. The patient's general comfort must be considered if he is to remain in this position for any length of time. a non-breathing pulse less patient should be placed level on his back for rescue breathing and

CPR. The patent should always be closely attended. Advise patients not to sit up during first aid or during transportation until advised by a physician.

4. In conscious and breathing independently, administer oxygen. Supplemental oxygen is valuable when a serious accident or injury has impaired the body's ability to transport oxygen to the tissues. oxygen administered immediately after a diving accident is important for several reasons. Breathing oxygen in high concentration will eliminate some of the nitrogen from the body by producing a pressure difference between the nitrogen in the problem bubble and the surrounding tissues. This pressure difference favor the reduction of the bubble because there will be a driving force to cause the nitrogen in the bubble to dissolve in the bloodstream and be eliminated through the lungs. Any increase in the oxygen supply to the injured area will also be beneficial, especially if brain tissue is involved. Deliver of 100% oxygen to the patient is recommended, but any additional oxygen is better than none. Oxygen should be started from the time a problem is recognized, until medical authorities order it discontinued or the oxygen supply is exhausted.

5. **If** convulsion occurs, do not forcefully restrain. Turn the patient on his side (supporting head and neck), maintain airway sweep away any vomitus. Hold the patient loosely to prevent self-injury and do not force an airway or restrain the tongue blade. Resume oxygen administration.

6. Protect the injured diver from excessive heat, cold, wetness or noxious fumes.

7. Administer nonalcoholic, non-caffeine fluids, such as fruit juices, orally.

8. Contact an emergency reference source by phone or radio for directions and instructions.

9. Arrange immediate evacuation to an appropriate medical facility. Immediate

transportation to this facility is essential, and first aid should be administered enroute. Send all diving equipment with the patient for examination.

SUMMARY

In an emergency, a Rescue Diver must be able to act quickly and correctly. to assist the Rescue Diver in doing just that, this section has outlined primary assessment, basic life support procedures, secondary assessment and emergency care for various diving related ailments. This is only meant as an outline. Rescue Divers must complete a formal training program in first aid and CPR.

III. EMERGENCY MANAGEMENT

A Rescue Diver must possess adequate knowledge and skills in three main areas: rescue - the removal of someone from a hazardous situation; first aid - the administering of temporary care and relief; and, emergency management - the organization and control of activities at the scene of an accident.

Readiness

It is difficult to manage an emergency without adequate preparation in the areas of: rescuer readiness, equipment readiness, and information readiness. During an accident, time is precious. It should not be wasted doing things that could have been taken care of through advance preparation. The Rescue Diver should be prepared to handle an emergency before one occurs.

Rescuer Readiness - Fitness, training, and periodic practice all combine to help create a prepared rescuer. Physical conditioning can be the deciding difference in rescue situations calling for strength and stamina. A well-prepared Rescue Diver maintains a high degree of fitness with a particular emphasis on diving-related, conditioning activities, such as swimming and free diving.

Training is important, though retraining or updating can be just as important. First aid and CPR skills should be kept current. Diving skills should be renewed or increased through completion of continuing education programs. Courses in emergency care, such as Emergency Medical Technician Programs, are widely available and provide information that can be used in diving emergencies. Completion of at least one training program a year is strongly recommended.

Practice is the periodic reinforcement of skills, and its value is immeasurable. Emergency procedures can be rehearsed mentally as well as physically.

Certain accidents should be anticipated at different locations and the handling of them mentally visualized. a high degree of readiness can be achieved with this mental rehearsal technique.

Physical practice is also necessary, because the skills of diver rescue are complex and vary greatly between people and circumstance. Periodic practice with other divers in different locations, and under varying conditions, enables the Rescue Diver to become aware of specific problems and develop solutions.

Whenever practice is planned, lifeguards and other authorities in the area should be notified in advance that the rescue is merely a drill. Emergency signals should not be used during practice sessions, but reserved for true emergencies. This allows onlookers to respond properly if a-real emergency situation should somehow develop during practice.

Actually, readiness begins with a proper attitude. The person who doesn't care about being

prepared will certainly not achieve readiness. A Rescue Diver who is determined not to be caught unprepared will probably be ready for any emergency.

Fitness, training, and practice, are simple tasks for the person who wants to do them. Attitude precedes and affects all aspects of readiness, and therefore needs to be correct.

Equipment Readiness - Frequently in rescue situations, special equipment is at least helpful, if not essential. The Rescue Diver needs to know what equipment is needed; where it can be found, when its use is appropriate, and how to correctly prepare it. Additionally, a good Rescue Diver should be able to improvise rescue equipment, using various, commonly available items.

It would be unreasonable to expect a diver to have everything that might be needed for an emergency on hand for every dive. Many of the items which can be useful, however, are often available especially aboard a boat. The following list of equipment is intended to familiarize the Rescue Diver with items which can be useful in a diving emergency:

Rescue Equipment

Binoculars
Clipboard, Paper, and Pen
Surf or Rescue Board
Lines (various lengths)
Circular Sweep Anchor
Underwater Compass
Bottom Markers
Marker Buoys
Blankets
First Aid Equipment:
First Aid Kit
Oxygen
Backboard/Tilt Board
Communications Equipment
Day and Night Flares
Whistle
Bullhorn
Radio (CB, VHF)
Telephone (location known)
Recall System (u/w siren, flag)

Merely having or being familiar with rescue equipment does not assure readiness for an emergency. The equipment should be clearly labeled for easy identification and kept where it can be readily located by any bystander sent to secure it. It may, however, be appropriate to keep such equipment out of the sight of entry-level students. down playing the possible need of such equipment helps reduce anxiety on the part of beginners. The equipment should be inventoried and inspected periodically, and restocked or replaced as necessary.

It is a good idea to conduct a tour of the boat or dive site, to determine the availability, type, and location of any rescue equipment or items that could be useful in the event of an emergency. This should be done well in advance of diving activities. Questions should be asked regarding procedures and operation of equipment, so the potential rescuer will know how they are to be used in advance of any situation requiring prompt action. It is especially important to have some way to summon emergency assistance, and to be sure the means to be used is operational.

Communications equipment is vital. Rescuers need to know the location of the equipment and

the operating procedures. It is also advisable to ensure that the equipment -- even a telephone -- is operating properly before it might be needed. alternate communications should also be sought. A means to recall divers - an underwater system and/or a recall flag - should be considered.

Other useful emergency equipment includes floats, lines, and search-related gear. Unless the rescuer brings all of the needed gear, it will need to be either located, or suitable substitutes found. Improvising is acceptable, but the plans to improvise need to be made before, rather than during, a crisis. For example, the rescue of a hypothermic diver from cold water will require some means to rewarm the victim. a surfboard or hatch cover can be used as a platform for placing the victim of an embolism in an inclined position. It is helpful to include equipment improvisations when rescues are practiced. The Rescue Diver should develop resourcefulness through training, practice, and anticipation.

Ensuring that sufficient equipment is available is the first step. Checking the equipment is the next. Rescuers should inspect the gear, take inventory, e.g., a first aid kit, and make sure they are familiar with the application of the equipment. This is an ongoing learning process, which can be an interesting pre-dive activity for Rescue Divers.

Finally, a diver's own equipment should be considered rescue equipment, which can be quickly put to use at any time during diving activities. This is part of readiness. A good Rescue Diver should be able to put on all needed equipment and enter the water seconds after recognizing an urgent situation. This cannot be done if the diving equipment, essential in rescue situations, is not readily available.

Information Readiness - The would-be rescuer needs to know what emergency facilities are available. Where is the nearest recompression chamber? Where is the nearest hospital? Do protocols exist between the local chamber and emergency medical system? What facilities are available for emergency evacuation? Are emergency facilities, such as a first aid station, available at the dive site?

Obtaining this information , however, is only a beginning. Phone calls, or better still, visits to the facilities are recommended to become acquainted with capabilities, procedures, requirements, personnel and recommendation. When an emergency occurs, a great deal of time can be saved when it is know whom to contact and how to make contact. The more familiar the Rescue Diver is with the local emergency facilities, the better the rescuer will be able to facilitate emergency treatment.

Up-to-date emergency contact information is also essential. Place this information in an appropriate space where it will be readily available. This allows anyone in a group to summon assistance if needed. **(911)**

The Diver's Alert Network (DAN), can be contacted at (919)684-8111. DAN is especially important to divers because it provides immediate 24-hour access to a coordinated diving emergency information center. This service is particularly useful when dealing with medical personal unfamiliar with diving accidents who are in need of consultation with medical experts knowledgeable in diving medicine. In addition to consultation, DAN can coordinate all phases of treatment for the diving casualty through its network of personnel and facilities. DAN does not provide the location of "the nearest chamber" for non-emergency use. The reason for this is simply that when a true emergency comes up, the rescuers should be concerned with getting the patient to the nearest medical facility and then call DAN to get current chamber information. In some cases, rescuers have by-passed this first step and transported to what they have written down as the nearest chamber, only to arrive and find the chamber is no longer in operation or temporarily down.

However if it is established that the local Emergency Medical Service system cannot adequately handle a diving emergency, and in areas not served by DAN, it is particularly important to have the contact information for the nearest operational recompression facility. This information should be obtained before diving activities are initiated, and it can typically be obtained from local dive operations or medical facilities.

In the U.S., the Coast Guard can arrange emergency evacuation of accident victims on navigable water. They generally respond, however, only to life-threatening situations. When at sea, the U.S. Coast Guard or similar international entities may be helpful in providing emergency assistance.

Most fire departments can quickly provide paramedics or Emergency Medical Technicians equipped with oxygen, medications and direct communication with physicians. These personnel can respond rapidly and provide excellent care. In some areas where diving is a popular activity, they often receive training in the care of diving accident victims.

Other emergency services, such as an ambulance, police and hospitals, may be useful and should be included in emergency contact information. The name and phone number of a physician knowledgeable in diving medicine may also be valuable.

In areas that do not have an organized Emergency Medical Service system established, it is important to find out the local procedure for handling diving emergencies. Often this information may have to be obtained from a local physician.

Preparedness includes readiness of self, equipment and information; each of these areas requires a periodic check to maintain the state of readiness necessary for a diving emergency.

MANAGING AN EMERGENCY

A person trained in diver rescue can function in a variety of capacities in an emergency. If other, more qualified individuals are present, the role of the Rescue Diver may only be to assist. An assistant who knows what to do, when to do it, and how to do it properly can be invaluable to someone who is trying to manage a crucial situation. When the Rescue Diver is the most qualified person present to handle

the emergency, then he or she should know how to take charge and manage the incident.

The Rescue Diver, upon recognizing the need to assume control, needs to quickly establish authority. Frantic yelling and arguing are inappropriate and ineffective. The Rescue Diver should proceed to issue instructions in a clear, firm voice. Speaking with authority does not mean speaking condescendingly. For example, "This person needs oxygen immediately please get it from my car as quickly as possible," is better than "You - go get the oxygen, and hurry."

Depending on the situation and the capabilities of others present, the person in charge of an incident can perform a variety of tasks ranging from being coordinator, to being someone who handles every aspect of the accident. The ideal situation would be having capable assistants who could be assigned various tasks. If no one is available, or those present are unqualified to assist, a Rescue Diver may very well have to perform a rescue, administer first aid, summon assistance, and single-handedly manage the entire event. Most situations fit between the two extremes, so the Rescue Diver needs to be flexible and learn to make the most of all available resources and people.

Because of the variety of roles performed by the Rescue Diver, considerations regarding emergency management should be viewed from the standpoint of both the assistant and the

individual in charge of the accident scene. This may be facilitated by thinking in terms of the "Seven A's of Emergency Management."

The Seven A's of Emergency Management:

I Anticipate
2. Assess
3. Act
4. Assign tasks
5. Attend to injuries
6. Administrate
7. Arrange for evacuation

Anticipating - If circumstances leading to accidents can be recognized, emergencies can often be prevented or handled more effectively. when the possibility and nature of an accident can be anticipated, rescue procedure scan be preplanned, thus preventing the loss of valuable time, and probably reducing the extent of injuries.

Before the start of any diving activities, talk to the people involved. Learn how they feel about the upcoming dives, their recent diving experience, any special qualifications they might have, and if they are familiar with emergency procedures for the area. This can be accomplished through friendly conversation.

The approach to be used depends on the role of the Rescue Diver in the situation. Discretion is advised. A gung-ho, self-appointed rescuer, making what seems to be unreasonable demands, can experience a lack of cooperation and even hostility.

When part of an organized dive group, and not in a position directly responsible for diver safety, the trained Rescue Diver may find that less effort in obtaining information called for. The greater the responsibility, the more information required. Often, a Rescue Diver will be assisting an instructor or other person who is in charge of the divers. In this instance, the Rescue Dive should coordinate with the leader to obtain the needed information.

Ideally, rescuers should know a great deal about everyone present at the dive sit, and about the emergency personnel who would be likely to respond to a diving emergency. This ideal is rarely achieved, but the Rescue Diver should obtain as much of the following information as is practical: What

are the qualification of those present? Are doctors, nurses, paramedics, or other professional emergency personnel part of the group;? Who are the nearest emergency personnel? Are they trained to handle diving accidents? Who could be called upon to lend assistance during an in-water rescue" who is the nearest diving doctor? Who is the emergency contact for each person in the group?

When people are preparing for a dive. it helps to be aware of details which indicate potential problems. Ineptness in handling gear, poor equipment, an abundance of rental equipment, illness, hesitation, and nervousness, can suggest unfamiliarity, stress, or both. The environmental conditions should be noted and mentally compared to the abilities of the divers. It may be possible to prevent an accident just by asking a person how he or she feels about a dive. This allows concern to be expressed, and supports a reason to put off the experience. If this is unsuccessful, at least awareness of a potential problem has been increased.

During diving operations, other signs of an impending emergency can help in anticipation. Divers down current from the boat, a sudden worsening of environmental conditions, and divers

surfacing far from the exit point are but a few of the situations which can lead to problems. In some situations, if an accident isn't anticipated, there may not be sufficient time to respond after one has occurred. Rescue Divers serving as scuba staff must be constantly alert for signs that might indicate a student is nervous, tired or simply lacks the skills or proper attitude to attempt the next set of exercises. Awareness of any of these problems should be brought to the attention of the instructor immediately.

Signs of difficulty under water include: rapid, excessive breathing; wide eyes; and unnecessary movements. Close attention is required whenever it seems that a diver may be encountering difficulties.

Familiarity with the dive site is valuable. Insight can be gained through experience, but it is unusual for divers to be acquainted with the entire underwater area at a particular location. Whether a site is known or new, there is almost always a lack of complete familiarity. Divers tend to dive the regions of interest and avoid the rest of an area; but since distress can occur anywhere, above-average knowledge of a site is helpful. When the underwater terrain, bottom composition, depth, average visibility, and prevailing currents for the entire area are known, rescuers are much more effective than when such details are only estimates.

To obtain the needed information, it is recommended that Rescue Divers first talk to local divers acquainted with the site. Preferred entry and exit point, typical conditions, area hazards, bottom topography and composition, underwater landmarks, depth, prevailing winds and currents, and site personnel and facilities can be pointed out. Notes should be kept for future reference.

Anticipation involves three steps; identification, prevention, and preparation. When a potential problem has been identified, an attempt to prevent it should be made. This can be difficult at time, especially when the person trying to prevent the problem has no authority. Diplomacy is in order.

If nothing can be done to prevent the problem then a good Rescue Diver will prepare to deal with it.

Preparation includes actions such as getting rescue equipment ready for use, keeping personal dive gear handy, becoming familiar with the equipment being used by divers present, and staying near a suspected victim. All this should be done subtly to prevent resentment or undue concern among divers. The correct action is to bring a concern to light in a quiet, friendly manner. If the concern is rejected, the Rescue Diver should then, inconspicuously prepare to deal with the problem if and when it develops. Even though no accident has occurred, anticipation is considered part of accident management because it affects what transpires when something does go wrong.

Assessing - A problem has occurred. someone is in trouble in the water and needs immediate assistance. Several divers are standing around, but no one is responding.

The steps a Rescue Diver should take in such a situation, depend on a number of factors. Assessment of the situation must occur immediately in order to formulate the correct plan of action. Assessment factors may include some or all of the following: What is the victim's condition? Is he or she conscious or unconscious? At the surface or under water? Injured? What is the distance to the victim? Is anyone available and willing to assist? What rescue and emergency equipment is available/ how can help be summoned? What are the environmental considerations? Is there any current/ Are there any hazards which would be posed to would/be rescuers?

There is never a Standard" rescue situation. all emergencies are unique in some respect, so a

different plan of action is required for each instance. The Rescue Diver needs to be able to rapidly, yet thoroughly evaluate a situation and, using the resources available, formulate a plan of action. A knowledgeable and experienced rescuer can do such an evaluation within seconds. Assessment is simply a matter of knowing what to take into consideration when an emergency develops, and taking a few moments to determine a plan of action, based on the circumstances. Prompt. correct action based on good judgment, is certainly preferable to instantaneous, thoughtless reaction.

Acting - When a distress situation has been identified, assessed, and a plan of action determined, no time should be lost in implementing the plan. The Rescue Diver should be prepared to follow one of several courses of action in an emergency. Take charge and quickly implement a plan of action unless someone with greater authority does so, or assist in the management of the emergency by doing or assigning tasks as needed. A rescue Diver can be of great value in an emergency, either by assuming command or by assisting. I

As checklists are seldom available or practical during an emergency, it is difficult to recall all the things that need to be done. Therefore, frequent practice and participation in mock emergencies can aid in the recall of the correct action, and help to maintain proficiency.

Assigning Tasks - an emergency can be handled more efficiently if the various subordinate tasks can be delegated to others. Certain tasks can be assigned before a rescue, and others afterward. There is generally very little time to coordinate assignments before initiating a rescue, so when tasks are assigned, the instructions given need to be very clear and concise. The order in which assignments are made will vary, but there are several functions which are quite helpful and generally applicable to most aquatic rescue situations.

1 . One or two qualified people to assist with rescue efforts should be asked to follow the primary rescuer as quickly as possible. rescues are far easier, and can be more effective, when more than one rescuer is available. It is important, however not to place anyone in jeopardy by asking untrained divers to assist in the actual rescue phase of an emergency.

2. Depending on circumstances, someone should be sent to summon emergency assistance, or to stand by to go for aid upon a given signal. Often it is difficult or impossible to determine the condition of a diver until contact is made.

3. When sufficient people are present, it is a good idea to post two observers some distance apart , to watch the victim constantly and to mark the location of the distressed diver. By pointing to the victim and adjusting their position to align the distressed person with a distant object, the observer can guide a rescuer precisely, and can pinpoint the location of a victim if he or she should sink from view.

4. Depending on the availability of divers, another useful assignment can be made. A pair of qualified divers can be asked to put on scuba equipment and follow the rescuers, who will probably not be wearing scuba. If the victim should submerge, the team of scuba divers can make a rapid recovery of the stricken person and increase the chance of survival.

Time must not be lost in making these or other assignments. There is no time for discussion or asking for volunteers, and it is therefore helpful to know the qualification of all those present. A rescuer needs to be able to say, "Jim, get a float and follow me. Mark and Mar, spread out, watch the victim, and pinpoint his location. Andy, stand by to radio for help, and get ready to follow us if necessary." All of these assignments can be made in less than 15 seconds while

equipment for the rescue is being donned.

Once the victim has been rescued, additional duties need to be delegated. all divers need to be recalled, and the victim's identification location, buddy accounted for, and equipment secured and held. Should the victim require medical evacuation, the equipment should not be disassembled, but simple washed and held for inspection by the proper authorities.

These are only examples of duties which can be distributed among those present at the scene of a diving emergency. The Rescue Diver needs to be aware of what must be done, and the techniques for directing assistance during an emergency.

Attending to Injuries - When a person is injured, the first-aider needs information to assist in the decision-making process. Sources of information include conducting both primary and secondary assessment, and subjective evaluations from the victim and bystanders. An example would be the
following questions:

My name is
What's wrong?
Do you hurt anywhere?
How did it happen?

and

I'm here to help you.
What is your name?
What was your depth and bottom time?
Any previous dives today?
What was your surface interval between the dives? How old are you?
Are you taking any medications?
Are you allergic to any medications? When did you first notice any symptoms?

Based on the primary and secondary assessments and what bystanders say, the first-aider will be able to select a course of action. Provide emergency care for the signs and symptoms; diagnosis can only be made **by** qualified medical personnel.

When a diving accident occurs, provide primary and secondary care if necessary, and keep the person lying down and comfortable. Prevent him from becoming chilled or overheated. Comfort him and assure him that the injury is understood, and that medical treatment is coming. A good practice is to tell the person exactly what is being done to help him. Be calm. Yelling must be avoided because of its negative effect on the patient. Emotional involvement in gruesome situation scan be overcome through total involvement in treating the victim.

Administrating - Administrate means to manage or direct, and a Rescue Diver may need to manage an emergency situation. When a person is in charge of an incident, that person needs to assume control with an air of authority - delegating duties, supervising activities, and seeing that all activities are conducted property. After a rescue has been made, a Rescue Diver may be more effective by having others who are qualified administer first aid while he or she acts as the supervisor. With so many things to be done, coordinating may be the most effective role for the Rescue Diver.

An important concern is the control of the situation. Confusion, yelling, and overzealous efforts to help are common to emergencies. This administrator needs to make organization out of the chaos and direct the activities of everyone present. Those assigned to administer first aid should tend to the needs of the victim, while someone else should be assigned to keep others who are

not involved out of. the way. One of the first assignments to be made once aid is being rendered to the victim is the recording of the events for future reference. Someone needs to write down the times, first aid, and details of the accident. When the situation is stabilized, the recorder should also obtain the names, addresses, and phone numbers of all witnesses, but avoid taking any written statements.

The administration does not end once the victim has been evacuated to a medical facility for treatment. The victim's gear needs to get into the hands of the proper authorities without disassembly or alteration. A comprehensive report of the entire event and thorough debriefing of all those taking part in the rescue should be prepared while the details are still fresh. The relatives of the injured person need to be notified. Follow-up to accidents is very important for reasons which may not be apparent at the time of the incident.

Arranging for Evacuation - The victim of any serious injury or illness must be transported to a medical facility for treatment. Divers who have suffered a lung expansion injury or decompression sickness also need medical assistance; but in addition, will require recompression (preferably in a 6 ATM, multi-lock chamber). Ideally, both of these requirements could be met at a recompression facility, but this is not always the case. Medical support such as evaluation, administering of intravenous fluids, and medication are important as well as recompression. A rescuer may face a dilemma in an emergency. Should the victim be taken to a hospital or to a recompression chamber? This problem, should be eliminated by establishing an emergency assistance plan for the area. In this way, both needs of the diving victim can be met and the dilemma can be avoided.

If the emergency assistance plan has not been established, the rescuer should try to determine if the recompression facility can provide the necessary medical support. If so, evacuation to the facility is in order. If not, it may be better to first stabilize the victim at a different emergency facility. Often emergency medical personnel arriving at the scene will determine the destination of the victim, allowing the rescuer no say in that destination. Only be establishing an emergency assistance plan in advance can a rescuer be assured the best course of action will be followed in an emergency.

When summoning assistance for an emergency, there are several rules to be observed:

1 . The opening statement of an emergency call should establish that the situation is a scuba diving emergency.
2. The exact location of the accident scene should be identified.
3. All questions should be answered, and the caller should not hang up or stop transmission until the party called ends the communication.
4. The phone number or call letters being used should be given to the emergency facility, and someone should stand by the phone or radio in case a call for additional information is made.
5. People involved in the accident should be advised that assistance is on the way.
6. Signals and markers to identify the accident scene should be set up to aid those responding in locating the area.
7. Someone should be assigned to meet or watch for emergency vehicles.

Several things should be sent with a victim who is being evacuated. Identification and a summary of what took place, from the time of the accident until evacuation, including symptoms, times, and first aid given, should be in written form, and conspicuously attached to the person. If a tourniquet has been applied, the victim should be appropriately marked for easy identification, along with the time of application. The victim's buddy should also accompany them when possible. The partner may be able to provide useful information at the treatment facility and may also need recompression himself. The victim's equipment can be forwarded with the victim, if

time and weight limitations allow.

The emergency coordinator should strive to ensure that the following rules for evacuation of an injured diver are followed:

1 Oxygen must continue to be administered even if the victim is-breathing normally and shows signs of improvement. If oxygen is discontinued, bubbles in the system can reload with nitrogen, causing a return of symptoms.

2. Ensure that medical personnel evacuating the victim understand the need to keep the victim on oxygen and in the left-side-down, head-low position.

3. The victim should be kept out of the hot sun and not allowed to become overheated. An increase in body temperature could cause bubble formation due to increased peripheral circulation.

4. Painkilling drugs should not be administered to the victim. This can reduce the effectiveness of a neurological exam at the treatment facility. Intravenous fluids to prevent dehydration are highly recommended when administered by qualified medical personnel.

If a victim is to be evacuated by air; which is typically done when the victim is aboard a boat far from a treatment facility, special procedures must be followed:

1 . Communications need to be established with the aircraft, which is usually a helicopter. If a radio or the needed frequency is not available, it may be possible to communicate indirectly through another boat or station.

2. For helicopter pickups at sea, the vessel should be underway at a speed of approximately five knots and maintaining a course into the wind of approximately 20-30 degrees on the port bow. If the boat must be anchored, as much anchor line as possible should be let out.

3. All tall objects, including the radio antenna, if necessary, must be lowered. All loose objects must be secured because of strong air movements from the blades of the helicopter.

4. The victim should be prepared in advance for the transfer. A flotation device must be put onto the victim, and critical information should be secured to the person. If tied or strapped to a tilt board, the person should be unsecured for the transfer.

5. When ready for evacuation, signal the helicopter pilot via radio, hand signals, or, at night, a flashlight. a basket stretcher will be lowered.

6. The basket must be allowed to touch the deck of the boat before it is touched. This permits the discharge of potentially dangerous static electricity.

7. The victim should be placed into the basket as quickly as possible and tied in place. If is necessary to move the basket, it should be disconnected from the lifting cable first. When ready for the patient to be lifted, the pilot should again be signaled. If a trail line is available, it should be used to steady the basket. The line must be kept clear of people and objects to avoid an entanglement.

8. When a victim is flown to a treatment facility, instruct flight crews to fly at the

lowest altitude safely possible. Reduced pressure at altitude can increase symptoms due to the further expansion of air bubbles.

Even while diving from shore, it might be appropriate to evacuate a diving accident victim via helicopter. Land-based evacuation procedures are somewhat different than those accomplished at sea. Should a helicopter evacuation from land become necessary, be certain to bear in mind the following considerations:

1. The landing area should be at least 3600 squat feet (perimeter 60 ft. per side).
2. All persons should be kept well back from the landing zone.
3. The area must be free from obstacles such as trees or power lines.
4. Any non secure items that could be blown about by wind generated from the rotor should be removed from the landing zone.
5. A guide should stand at the windward corner of the landing zone to direct the pilot to the appropriate site. During the actual landing, the guide should turn away from the aircraft to avoid injury from debris such as flying dirt or sand.
6. Never approach the aircraft unless motioned to do so by the pilot. when approaching, maintain a low, crouched position and eye contact with the pilot.
7. Be aware of the relative position of the rotor blades. As the aircraft slows, the blades will tend to drop. If the landing is on uneven ground, special care should be taken.
8. Never approach the aircraft from the rear, as the rear rotor is virtually invisible unless stopped.

To be prepared to deal with diving emergencies, a Rescue Diver needs to know and be able to recall, the "seven A's of Emergency Management" (Anticipation, Assessment, Action, Assignments, Attendance to Injuries, Administration, and arrangements for Evacuation). When these steps are followed a crisis can be resolved as quickly, efficiently, and safely as possible.

SUMMARY

Understanding the prerequisites of an emergency action plan and how this applies to the local area is essential, regardless of whether the accident is minor or life-threatening. Proper emergency management involves a thought process by which the Rescue Diver is able to efficiently organize the chaos of a diving accident in order to avoid further injury or loss. Such organization is only possible through prior planning, anticipation, familiarity, and practice.

IV. EQUIPMENT CONSIDERATIONS

Diving accidents are rarely caused by malfunctioning equipment. Problems with equipment, however, can contribute to stress and consequently, lead to an accident. A Rescue Diver familiar with common equipment problems can help prevent accidents by recognizing potential problems and correcting them before trouble develops. Awareness and familiarity with various equipment configurations is also helpful to the rescuer when gear removal is required in an emergency.

In addition to personal experience and ownership, another key source of information is the professional diving retailer. There is no better place to become familiar with the variety of equipment and its design. Establishing a rapport with the staff of such a facility can also provide the Rescue Diver with insight that normally cannot be obtained in most texts. Equipment catalogs can also be very helpful.

Common Problems - Common equipment problems include:

1. Use of unfamiliar, specialized equipment without proper instruction and controlled practice.
2. Use of ill-fitting equipment, or the wrong equipment for the environment and/or type of dive.
3. Use of makeshift, homemade items as substitutes for standard equipment
4. Diving without essential equipment items.
5. Use of severely modified equipment
6. Failure to properly inspect and/or adjust equipment

Problems of this type are usually obvious to both the user and observer. Trouble comes most often when the decision is made to dive in spite of these problems. The Rescue Diver may be able to prevent an emergency by helping a diver make the proper decision **not** to dive until an equipment problem can be corrected.

Equipment	**Problem**	**Effect**	**Prevention**
Water in Mask	Skirt dry rot; Improper fit; Leaky purge valve; Hole in skirt; Hood, air, or moustache under skirt.	Preoccupies diver and causes stress. Obstructs vision.	Visual inspection Inhale to test
Lost Mask	Broken or malpositioned; Dislodged; Dropped.	Eliminates effective underwater vision. Surface swimming difficult. Unsafe land animal in the water.	Check straps for Cracks, aging and adjustment Check before
Unable to clear snorkel	Leaky, split or broken purge; Incorrectly positioned on head or in mouth.	Breathing difficulty; Water inhalation.	Check before and after entering
Lost snorkel	Lost mask; Snorkel not attached to mask and lost; Broken snorkel keeper	Unable to snorkel at surface; High energy expenditure to swim at surface.	Check Snorkel security
Lost fins	Fins too large; Strap slippage; Broken or loose strap; Dislodged in surf.	Loss of effective propulsion and direction control.	Check straps and adjustment. Secure straps
Cramp	Fins too stiff or large; Foot pocket too small; Strap too tight; Bootie too tight.	Incapacitation Stress	Check for fit, comfort, and adjustment before dive
Chilling	Suit fits improperly	Shivering; Anxiety; Performance degradation; Air supply depletion; Cramps	Recommend proper insulation Check fit of suit
Breathing difficulty	Suit too tight or straps on BC too tight Anxiety	Air starvation	Proper maintenance

Flooded dry suit	Torn or punctured suit zipper failure Damaged seals	Cold water shock Negative Buoyancy	Check for proper fit & function
Overly buoyant	New suit; Salt water; Air in Suit; Not enough weight	Struggling to descend Overexertion; Lung injury. Runaway ascents	Check Buoyancy Obtain weight If needed
Air leak from BC	Hole in bladder; leak; Hose pulled out; Missing or defective valve.	Slow Loss of buoyancy Overexertion	Check BCD Leave inflated for storage Keep away from sharp objects
Excessive Buoyancy	Stuck or leaking inflater valve. Trapped inflater hose or valve.	Runaway ascent Possible air expansion injury or decompression sickness	Know and maintain equipment Test gear before dive
Difficult to remove weights	strap tucked or tied. Rotated weights next to buckle. Nonstandard belt. Belt under BCD harness. Release mechanism frozen.	Difficulty in establishing buoyancy in an emergency	Check weight system carefully before diving
Accidental loss or weights	Belt not buckled securely. Buckle caught. Attempted adjustment. Improper position or adjustment. Weight system release mechanism snagged and opened.	Runaway ascent. Possible lung expansion injury.	Tighten weight system at depth
Little or no air upon demand	Poor maintenance of Regulator. No pressure gauge or inaccurate gauge allowing for no air in tank. Valve only partially open. Reserve not activated.	Respiratory distress. (May force emergency procedure)	Proper maintenance and service. Monitor tank pressure Check air supply before dive Anti-freeze provision in very cold water
Air loss	Free-flowing primary or secondary second stage. Ruptured hose or burst disc.	Leaky pressure Gauge, O-ring or burst disk	Proper maintenance Call attention to air losses

Free-flowing regulator	Regulator needs service. Dented cover. Foreign matter in regulator.	Unexpected depletion of air supply	Encourage correction before dive Keep second stages clear of sand and dirt
Aspiration of water	Loose or defective mouthpiece. Stuck exhaust valve. Hole in regulator diaphragm	Respiratory distress, coughing chocking. (May cause emergency procedure)	Adequate pre-dive check Proper routine maintenance and service
Tank out of backpack	Backpack improperly adjusted. Incorrect tank band. Releasing of tank band.	Awkward situation. may cause loss of tank and air supply	Proper and secure attachment

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Note: It is important to make a distinction between an air leak and a free flow. If air is flowing through the second stage in a steady stream but coming out of the mouth piece, this is a free flow. If air is coming out of any other location where you would not expect air to be coming it is a leak. They signify two very different problems.

There is a constant need to inspect equipment prior to diving, as well as to observe the proper position and function of equipment on divers once they enter the water. Obviously, it is not the responsibility of those trained in rescue techniques to conduct a complete gear inspection on everyone present prior to each dive, but a knowledgeable individual who observes possible problems should bring them to the attention of the user. The responsibility might be described as careful observation combined with diplomacy. Rescue Divers service as staff during the open water experience with students should help those students for whom he is responsible to learn to do appropriate and effective equipment checks before beginning each dive.

It is always possible some divers may choose to dive with equipment problems even when the potential consequences have been explained. In this case, a Rescue Diver can only advise against the decision, hope that no difficulty results, and be alert for a potential rescue situation.

Some equipment problems are subtle, and it is only through knowledge and experience that recognition is possible. an example is the drag created by certain configurations. A bulky BCD, a large game bag, stacked weights, and other protrusions all require an increased expenditure of energy for the diver to move through the water. Observe the overall equipment configuration and assess whether unnecessary; otherwise, risk of entanglement could be created while swimming. Anticipating problems and taking action to correct them can prevent emergencies from occurring, and contribute to the diver's safety in the future.

Divers can learn from their mistakes. A good Rescue Diver can help the learning process take place without allowing the lesson to be too severe.

EQUIPMENT FAMIUARIZATION:

It is extremely important for the Rescue Diver to become familiar with the widest range of

equipment possible. Familiarity with diving equipment will save valuable time and help avoid costly mistakes. The ability to notice subtle equipment problems and understand what they mean can prevent trouble or help in understanding why it occurred.

Let's begin be getting acquainted with the operation of a typical scuba unit; then, examine some common problems that can affect the normal performance of this equipment.

A scuba tank is usually filled to a pressure of 2250 (2475 if a + mark exists) or 3000 psi, with extremely. dry, well-filtered, compressed air. No other substance should be used to fill the tank.

Air from the tank passes through the valve, which either allows air to flow or shuts it off. With a K-valve the operation is a simple on-off function. The J-valve contains a spring-loaded valve to maintain a reserve supply of air at low tank pressure. I All U.S.-made tank valves have a pressure relief port, which contains a blow-out disc that will rupture it tank pressure is excessive.

When the air leaves the valve, it passes into the first stage of the regulator through a filter. The point at which the regulator attaches to the tank valve uses an 0-ring for the high-pressure seal. The first stage of a scuba regulator reduces the pressure to an intermediate pressure of 120-160 psi above the ambient (surrounding) pressure.

Intermediate pressure air is available to the second stages through low pressure hoses. The intermediate pressure is also provided through another hose to the low-pressure inflator attachment on the BC. High-pressure air from the tank passes through the bank valve regulator first stage, and directly into a high-pressure hose to the submersible pressure gauge. High a6d low pressure hoses must never be mixed. On newer regulators this is impossible since they have different size ports on the first stage. On older models however, the ports are the same size and it is possible to put the low pressure BC inflator hose on the high-pressure port with disastrous results.

There are several available internal regulator configurations. An important feature of regulators is the "fail-safe" design. Regulators are designed with the valves open; and pressure is required to close them. This means that a malfunction will result in the continuous flow of air, rather than the cutting off of the flow. Second stages are designed with downstream valves. This means that the valves open with the flow of air from the first stage and will allow excess pressure to escape through the second stage. This condition is known as free flow.

A major important feature of scuba regulators is the submersible pressure gauge. The gauge indicates the pressure in the tank. Safety features include a restricted orifice from the main supply, a low-volume bourdon tube to minimize damage in the event of a rupture, and a relief plug in the casing to prevent excessive pressure from causing damage to the gauge casing or glass.

Scuba regulators are extremely dependable, reliable, and safe when properly serviced and maintained. It would be rare to encounter a difficulty with a scuba system.

Tank Problems - A serious problem results from foreign matter inside a cylinder. Water is particularly undesirable, producing corrosion which can weaken steel tanks and damages valves and regulators as well. any tank with material inside that can be heard or felt when the cylinder, is moved should be suspect. The tank should be visually examined at a service center before further use.

Although rare, a tank could contain contaminated air. If this is suspected, an inquiry as to the source of the air should be made. The air can be smelled and can also be blown through a clean handkerchief. If the air has an offensive odor, and/or the handkerchief is discolored by the air,

the air should not be used. Arrangements should be made to alert the air station of possible contamination problems.

A much more common problem with scuba tanks is slippage from the backpack. A good test to ensure a snug fit in the pack is to grasp the bottom of the tank after a diver has secured it in place and to lift up on the tank and wiggle it from side to side. If the cylinder moves within the strap securing it, it will

probably slip out of the pack. Occasionally, the tank may also be observed as positioned too high in the pack, creating the potential for the diver to strike his or her head on the valve.

Valve Problems - Here are three problems divers commonly experience with tank valves. Sometimes a diver will open a valve only slightly in order to check tank pressure and forget to open the valve completely before diving. A partially open valve restricts airflow. This may not be a problem at or near the surface, but it can make a regulator difficult to breathe through at depth. One early indicator of this problem is a substantial drop in the pressure reading on the submersible pressure gauge when a breath is taken. Checking the valve to make certain it is opened property should be a part of a pre-dive equipment inspection.

Reserve valves can cause several difficulties affecting the air supply. The lever can be bumped into the non-reserve position during a dive. Some divers even reverse the lever position of the valve so that it functions opposite from normal. Other divers elect not to use the reserve mechanism, leaving the lever' down at all times. The best policy is to discuss, prior to a dive, just how a diver intends to use the reserve device - it at all.

Worn or blown 0-rings are a common valve problem. Minute leakage is not serious though should be tended to as soon as possible. Significant leaks require immediate attention. If an 0-ring is forced out of its seat, failing to maintain its seal, the diver with the leak should ascend normally, shut off the air supply, and correct the problem. to help avoid this problem, 0-rings should be replaced regularly even if there is no apparent sign of wear. A Rescue Diver should be aware that air leaks under water tend to overly excite many inexperienced divers. In these situations, a calming influence is important. Air leaks should be dealt with, but at the same time it should be made clear that air leaks are not dangerous. They simply use up air more quickly than we would like.

Hose Problems - Air leakage can also stem from the hoses attached to the regulator. Any hoses showing signs of stress and aging are suspect, and prompt replacement should be recommended. Weak hoses can and do rupture. Above water, a broken low-pressure hose will thrash wildly. Surprisingly enough this does not occur with a high-pressure hose, due to the restricted orifice which limits flow to the gauge. Caution should be used near a thrashing hose at the surface when turning off the air.

If a hose ruptures under water, the same procedure used for a severe 0-ring leak should be followed. The use of hose protectors can greatly extend the life of hoses and reduce significantly the likelihood of this problem.

At times, hose problems can arise, not necessarily due to conditions created by wear, but due to their arrangement or configuration. For example, the diver may have too many hoses dangling freely, or the hose of the primary second stage may be too short to reach the mouth properly. common sense will indicate when a hose configuration is unreasonable. Potential problems should be brought to the attention of the user.

Regulator Problems - Regulator problems are almost always the result of inadequate care and maintenance. A regulator that is hard to breathe through will almost certainly cause stress under

water.

One quick way to test regulator performance is to lower the second stage, mouthpiece upward, into the water. Most regulators should begin free-flowing by the time the mouthpiece is submerged. If this does not happen, the regulator may require servicing. Advice from a professional diving retailer or service center should be sought regarding specific regulator performance characteristics.

Second stage exhaust valves can also be a source of problems. These valves may not seal properly, or they may stick shut. Valves that do not seal properly indicate a need for professional servicing.

The same is true of valves that stick shut; although for temporary use, the valves can sometimes be freed by soaking the second stage in water for a couple of minutes, then sealing the mouth-piece opening while depressing the purge button. This is still no substitute for professional servicing as soon as possible.

A worn mouthpiece is the most common cause of water entering the second stage. This can either be because the mouthpiece is not securely fastened to the second stage, or because there is a break or tear in the mouthpiece collar. Mouthpieces should always be replaced whenever the regulator is serviced.

Problems with the second stage diaphragm occasionally result in water leakage. These usually occur when the regulator has not been serviced properly. The use of silicone spray on internal regulator parts is generally not recommended and can result in the dislodging of the diaphragm during inhalation. Old, stiff diaphragms will tend to increase breathing resistance. Although a hole in the diaphragm would certainly cause water leakage, this problem is actually very rare; nearly all second stage leaks can be traced to the exhaust valves or mouthpiece. Any problem involving water leakage or excessive inhalation or exhalation effort indicates the need for professionals servicing.

Several points need to be addressed regarding regulator first stages:

While all first stages are designed to provide sufficient air for one diver over a wide range of pressure, some first stages -- particularly those with are unbalanced -- may not be capable of providing adequate air for two divers at low tank pressures. This means an octopus attachment will not perform adequately with these regulators. A review of performance characteristics and a discussion with someone knowledgeable can help you recognize which types of regulators may not meet expected demands.

Most modern regulators have balanced first stages. These offer easy breathing that is relatively unaffected by tank pressure or depth. This type of regulator is an obvious "first choice" for the Rescue Diver.

Alternate Air Source - Another important equipment consideration involves the use of alternate air sources. The alternate air source is considered a standard piece of equipment. For Rescue Divers in particular, its use is mandatory.

There are to basic types of alternate air source systems: those that are connected to a redundant air tank, and those that are connected to the primary air tank. Redundant air supplies are small, compact air tanks. These tanks may either have built-in regulators or use standard regulator configurations with one or more second stages.

Alternate air source systems that are connected to the primary tank include: (1) octopus regulator

configurations, and (2) second stages built into low-pressure BCD inflator. The octopus configuration is an alternate second stage connected to the first stage of the primary regulator. The alternate second stage typically has a longer hose than the primary second stage.

Use of alternate air source devices often differs among divers due to varying equipment configurations and training techniques. Differences include:

- Positioning of the alternate air source.
- Which second stage to make available to out-of-air divers.
- How to keep the additional second stage fastened when not in use.

There are valid arguments for handling alternate air sources different ways. When using the octopus regulator configuration, which side should the additional second stage be mounted on? The primary argument for mounting a usually right-handed second stage on the diver's left-hand side is that when it is used by an out-of-air diver, the second stage will be in a right-side-up position - providing both divers are face-to-face. The arguments for mounting the alternate second stage on the right-hand side are; (1) this generally keeps the number of hoses on each side of the diver balanced, allowing better control and less confusion, and (2) if the out-of-air diver takes the donor's primary second stage (the one in the donor's mouth), w\either accidentally or be design, the remaining second stage will still be on the correct side for use by the donor.

In terms of which breathing device to offer the out-of-air diver (primary or secondary), proponents of giving the alternate second stage to the out-of-air diver highlight three points. First, if this is done, the donor should not have to remove the second stage from his mouth at any time. This is, in fact, a very desirable situation for less-experience divers trying to help someone else. The second point is that this arrangement gives the out-of-air diver the option of securing the extra second stage first, then gaining the donor's attention - after the out-of-air diver has resumed breathing. The third point focuses on the fact that most octopus regulator configurations incorporate a longer hose. When this configuration is used, proponents say that for comfort, this is the second stage that should be given to the out-of-air diver.

Advocates of handing the donor's primary second stage to the out-of-air diver point to four supporting arguments. First, if a second stage needs to be handed to an out-of-air diver, the one in the donor's mouth can typically be located faster than one positioned elsewhere. The out-of-air diver needs air immediately, while the donor is typically calm and has time to locate the alternate air source. Second, this procedure is highly similar to buddy breathing and may be the response some out-of-air divers are most likely to expect and feel comfortable with. Third, the diver may instinctively attempt to gain access to a regulator he sees functioning and ignore the extra unit. Finally, the technique of handing the donor's primary second stage to the out-of-air diver has merit when the donor is equipped with an alternate air source that is built into the BCD low-pressure inflator. In this situation the donor should offer his or her primary second stage and breathe from the alternate air source.

Where to attach the extra second stage of an alternate air source when not in sue tends to be an issue involving different equipment configurations. a procedure that works well with one particular diver's equipment may not work as well for a diver using different equipment.

From the Rescue Diver's standpoint, the validity of any one of these arguments is secondary to the fact that a variety of methods and techniques exist. The combination of methods and techniques an individual diver selects is likely to be a matter of personal preference. Whether an individual is comfortable with his preference may be more important than anything else. The duty of the Rescue Diver, then, is to find out from other divers how their air sources -- primary and alternate - will be used and to explain in return how his, the Rescue Diver's is utilized.

Regardless of the methods selected, there is general agreement on at least three points regarding alternate air sources:

1 . The second stage intended for use by the out-of-air diver should be clearly identified. Colored hose protectors, exhaust tees, mouthpieces, and tape are among several means commonly used to accomplish this.

2. For octopus regulator configurations, the donated second stage (either primary or alternate) should be attached to a low-pressure hose that is at least six inches longer than is usual. This allows divers to maintain a more comfortable distance from one another and lessens the likelihood of a second stage being accidentally pulled out from the out-of-air diver's mouth.

3. The additional second stage should not be allowed to dangle when not in use. Doing so increases the likelihood it will catch on something, fill with sand or mud, or be otherwise damaged prior to the time it is needed.

Regulator Freezing - When regulators are used in subfreezing air or near-freezing water, freezing of the first or second stage may occur unless certain precautions are taken.

Fort example, when high-pressure air passes through a small opening - such as that in a regulator first stage - a drop in temperature results. In near-freezing water, this can be sufficient to lower first stage temperature to below freezing, When this occurs, and there is moisture present in the tank air, ice can form at the first stage high-pressure seat. Ice crystals will then prevent the valve from seating properly, and the regulator will free-flow.

Since tanks are usually filled with moisture-free air, this is seldom a problem. However, since water is allowed to enter the first stage bias-spring chamber on most piston regulators, a different type of icing problem can occur. The temperature drop in the first stage may cause water in this bias chamber to freeze. This freezing can prevent the piston from returning to its extended position, thereby causing free-flow. Diaphragm regulators may suffer from a similar problem, but are less prone to first stage freezing than piston regulators.

To prevent freezing of the first stage in cold water, several regulators have the bias-spring chamber or diaphragm area filled with a fluid which will not freeze. This fluid is sealed into the first stage with a flexible cap or ports, which allow water pressure to be transmitted directly through the antifreeze solution to the piston or diaphragm. This arrangement leaves regulator performance virtually unaffected - by either the cold or the antifreeze modification.

Another regulator freezing problem can occur in the second stage. When the air temperature is below freezing, and water or moisture from exhaled breath is allowed to enter the second stage while it is out of the water, this water or moisture can freeze. This too, can create regulator free-flow, it if causes the valve to lock in the open position. While rare, the freezing can also cause the second stage valve to lock in the closed position -- cutting off the airflow completely. A similar problem can result when the first stage has been submerged, then exposed to freezing air.

To prevent problems caused by subfreezing air temperatures, the regulator first and second stage must be kept dry when out of the water and completely submerged when the diver is in the water. This requires special procedures learned in the Ice Diver specialty course.

Submersible Pressure Gauge Problems - The submersible pressure gauge is a sensitive instrument. It may be combined with other delicate instruments into a console, and can be damaged by rough treatment. The weight of the gauge or console can break down the stainless

steel mesh of the high-pressure hose at the first stage connection. This area should be inspected when the air supply is checked, because a deteriorated high-pressure hose could rupture.

It is common for gauges to be allowed to dangle freely, although it is better to have them secured close to the diver. Dangling gauges can become entangled and difficult to locate quickly. This can be hazardous and can also damage the instruments. As a gauge ages and receives abuse, it may begin to leak at the point where the hose is attached. It may be possible to slow or stop the leak temporarily by rotating the gauge on the hose. A leak in the hose or gauge is a problem, but is not an emergency unless the diver panics. A normal ascent is in order, as more than sufficient air will be available to reach the surface.

If the bourdon tube inside a gauge should rupture, the situation will be alarming, but is not necessarily dangerous. Modern gauges are quipped with a blowout plug, which will relieve the pressure and prevent injury due to bursting of the gauge casing. To avoid injury from an unsuspected blowout, one should never look at the gauge while turning the tank on. A good habit to develop in order to minimize this problem is to turn the valve slowly so as to allow the air to gradually fill the regulator and hoses.

Rupture of the bourdon tube is very unlikely to occur under water, but since divers may be frightened by the noise and not realize what is occurring, the Rescue Diver should be familiar with this possible, though highly uncommon problem.

The most frequent problem experienced with submersible pressure gauges is the failure to monitor them under water. Rescue Divers can prevent distress simply by reminding dives to check their air supply frequently.

Water is the enemy of submersible pressure gauges if it is able to enter into the inside of the gauge. This can happen several ways. First, if the first stage is allowed to be submersed without being firmly connected to the tank valve or without the dust cap securely fastened and second if the blowout plug in the gauge case is missing. Being alert to make sure that water is not allowed to enter the first stage and checking for the presence of the blowout plug will lengthen the life of the submersible pressure gauge.

BCD Operation - Inflation and deflation of the BCD is normally a simple process. However, given the varied means by which the systems can be inflated, and the variety of styles and models, difficulties can arise.

Inflation can be accomplished in many ways. The easiest and least problem-ridden is the use of a low pressure inflator which uses air from the first stage of the regulator. Some devices are equipped to allow mechanical inflation through the operation of a small compressed-air bottle attached to the vest and others may be inflated by detonating a C02 cartridge. Finally the BCD may be inflated orally. This, however, should be considered the least favorable means, due to the potential problems of removing the regulator mouthpiece in order to exhale into the vest.

BCD Operation Problems - Difficulties in inflating a buoyancy control device are varied. The diver may be unable to locate the inflator hose or mechanism or cold water may render lips and fingers incapable of manual inflation. The BCD may also be damaged. Inflator hoses have come loose, as have inflator mechanisms and mouthpieces. Bladders can leak. Poor or improper service is usually the source of these malfunctions.

Deflation problems are not as complex, but can be serious due to runaway ascents. The inability to locate the deflation mechanism is the most common problem. Some divers also have difficulty orienting themselves in such a way that the BCD can be vented, trying in vain to expel air with the exhaust valve positioned at a point lower than other parts of the BCD. A low-pressure inflation

mechanism stuck in a position which feeds air into the BCD continuously is an uncommon, but possible, problem. To assist with the smooth operation of the BCD and to help avoid runaway ascent problems, a vest equipped with a large diameter, quick-deflate valve is recommended. This valve is designed to vent air more quickly and is often positioned in a more convenient location than the inflator hose. Look for this feature when selecting a buoyancy control device.

A Rescue Diver can help prevent buoyancy problems by inspecting the BCDs of divers carefully before dives. The Rescue Diver should also be alert for other potential problems, such as a drain plug not in place, an inadequate skin diving vest or life vest being used as a BCD, an improperly-fitted or adjusted BCD, or - worst of all - absence of a BCD on a diver.

EQUIPMENT RELEASES

An awareness and familiarity with equipment is critical to the Rescue Diver, and of particular importance are the release devices used. During a rescue, equipment may have to be removed quickly; and therefore familiarity with different types of releases and their operation is essential.

There are many different types of releases used for tank harnesses, weight systems, and BCDS. In addition to the releases provided by manufacturers, a few makeshift or non-diving releases may even be encountered.

The release used most frequently is one with which all divers are probably acquainted. When used correctly, the standard web belt release holds securely and functions well. There are a few problems associated with it, with which a rescuer should be familiar. One problem is that the webbing passes through the device. This means the webbing must clear the buckle before release can occur. Excess webbing can impede release, and, if the bill of the buckle is not opened completely, the webbing passing beneath the bill may partially close it and arrest the release process. A related problem also exists. If the buckle is used on webbing of a different thickness than that for which it was designed, operation of the release will be affected, being either too tight or too loose. This can allow the webbing to slip or can make the buckle extremely difficult to open. If the webbing is not aligned properly when the buckle is closed, the fastener does not lock completely, and a\inadvertent opening can result. To prevent this problem from occurring, the sides of the bill have been tapered on some standard releases.

Because the standard release is commonly used for both the backpack waistband and the weight belt, this often leads to releasing of the wrong belt during an emergency. It is also possible for a diver trying to adjust the tank harness under water to release the weight belt by mistake; or a diver boarding a boat may release the weight belt instead of the tank harness, dropping the weight belt on another diver below.

Wire-loop releases are not used as commonly as the standard type because adjustments are difficult to make. A wire-loop release can also open if accidentally caught on something. Webbing does not pass -through the device during release, however, so wire loops form a very positive release mechanism.

Insert-type releases are found primarily on BCDs and are becoming more the rule than the exception. With this type of fastener, a part or parts are depressed or squeezed to initiate the release. When wearing gloves, however, or when hand strength is reduced by cold, some insert-type releases can be difficult or impossible to operate.

Velcro is sometimes used for securing of straps. When the two straps with the mating portions of the Velcro are pressed together, the closure has a very low profile, and the fastening point has flexibility not found with rigid fasteners. This is also a disadvantage because it can be difficult to

feel the release, to get a good hold on it, and to separate the mated parts. Gloves contribute to the difficulty in working with Velcro releases.

Velcro material is also commonly used on BCDs to secure regulator hoses, both primary and extra second stages. With some configurations, it is necessary to release these fasteners whenever the scuba tank is removed.

Snaps are sometimes used as fasteners on tank-harness shoulder straps. When functioning properly, snaps are good fasteners. They have, however, a tendency to corrode and lose their ability to mate or hold securely. They can also be crushed and damaged. When a release isn't working, divers are tempted to improvise or to dive without securing equipment properly. This obviously is unwise, unsafe, and should be avoided.

There is one additional equipment connection which may not be regarded as a release, but which may need to be disconnected during equipment removal. This is the low-pressure inflator connector, which may need to be released when the scuba tank is removed. This usually requires the use of both hands, which is unfortunate in rescue situations. It should be kept in mind that the low-pressure inflator may be connected to either a BCD or to a dry suit, and that the hose must be disconnected before the tank is removed unless the BCD is attached to the scuba unit.

Tank-band releases can create difficulties if not secure. Some soft bands require threading through buckle through a buckle in order to function properly. Insecure attachment can result. Metal band releases can corrode and become difficult to operate if not maintained properly. Become acquainted with various tank-band releases in order to be able to detect errors in their use.

If weights are not placed properly on a belt, operation of the release can be affected. Loose weights not evenly distributed on a non-compensating belt can lead to rotation of the belt at depth and to blockage of the buckle by a weight, which has slipped against it. It is not uncommon to see excess webbing tucked or tied around the secured portion of the belt. A small person wearing a long BCD may buckle the weight belt beneath the BCD or the crotch strap of a BCD may be outside the weight belt. All of these situations increase the difficulty of releasing the belt and need to be quickly identified and corrected by observant Rescue Divers.

Preventing and Solving Release Problems - The first step to preventing and solving problems with equipment releases is becoming familiar with them. The ability to recognize a potential problem, call it to the diver's attention, and have it corrected before a dive does a great deal to prevent problems before they occur.

For example, the proper order to don the weight belt and tank is not always constant. Currently, most jacket-style BCDs - by far the most popular configuration -- are not equipped with crotch straps. Therefore, should the need arise to jettison the weight belt; it is impossible for them to get in the way. As a result, an easier and more convenient practice of donning the weight belt first and then the tank/BCD second, may be advised. An effective pre-dive buddy check will further assure that the weight belt is not hindered by the tank assembly. In instances where divers are using front-mounted buoyancy control devices or jacket-style devices equipped with crotch straps, the practice of donning the weight belt last is still advised.

Being prepared to deal with release problems is an excellent idea. It is helpful to have at least one spare buckle in a spare parts kit. This can prevent someone from trying to dive when a release is broken or lost. An extra weight - minus weights -- is an even better backup. It can replace a missing strap on a backpack or BCD, or be used to lengthen a strap that is too short.

Before diving operations begin, note what types of releases are being used. As divers arrive at a site or board a boat, it is wise to observe the releases on tanks, weight belts, and BCDs to determine if their operation is understood. If not, ask about the release and obtain an orientation.

Perhaps the best means to prevent difficulties with releases is to pay attention to divers as they suit up. Many problems can be corrected at this time. As usual, tact and diplomacy are appropriate. Equipment inspections - with attention called to releases - should be encouraged or required by supervisory personnel before each dive.

Divers are anxious to get into the water when suited up, and delays to make more than essential corrections may not be appreciated. At times, a problem such as identical tank and weight belt buckles can be identified, and a suggestion can be made that a correction is in order when it is convenient to do SO.

There are, by the way, some simple solutions for this problem. The tank harness buckle can be attached to the opposite strap so the buckle operates in a direction opposite that of the weight belt. The bill of the weight belt buckle can be notched or marked in some way that makes it identifiable by feel. And, of course, the use of a different type of buckle on one or the other of the belts **is** a possibility.

One other way to prevent problems which can be caused by releases is with underwater observation.

Watching divers to ensure that their equipment is secure should be part of the dive routine for a Rescue.

Unfortunately, learning rescue skills is not like learning to ride a bicycle. The skills are lost with the passing of time, and the knowledge can be forgotten. To prevent the certain deterioration of what has been learned, it is recommended that rescue skills be applied in practice sessions frequently.