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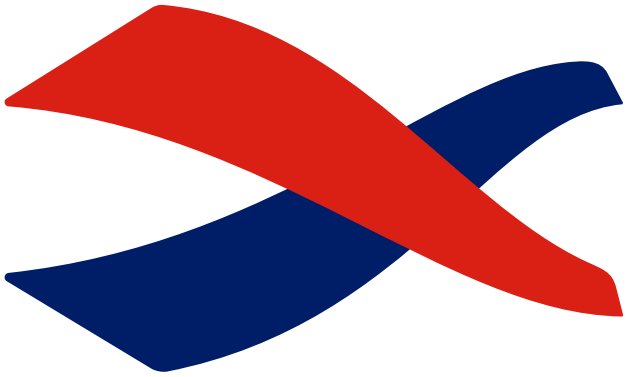
IANTD™

INTERNATIONAL ASSOCIATION OF NITROX & TECHNICAL DIVERS

Advanced Open Water Manual



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NITROX & TECHNICAL DIVERS

DISCLAIMER

Every effort has been made to ensure that this manual contains the most current, correct, and clearly expressed information possible. Nevertheless, inadvertent errors may occur. The authors, the Board of Directors, the Board of Advisors, nor any party associated with the International Association of Nitrox Divers, Inc. dba International Association of Nitrox and Technical Divers (IANTD) neither accepts any responsibility for accidents or injuries resulting from the use or misuse of the materials contained herein or from the activity of SCUBA diving, whether utilizing open, closed and/or semi-closed circuit equipment, and whether breathing compressed air or alternative breathing mixtures including combinations of Oxygen, Nitrogen and/or Helium and/or Neon.

SCUBA diving, including the use of compressed air and any gas mixture underwater, is an activity that has inherent risks. An individual may experience injury resulting in disability or death. Variations in individual physiology and medical fitness can lead to serious injury or death, even with adherence to accepted standards of performance, specified Oxygen limits and the correct use of dive tables and computers. All persons who wish to engage in SCUBA diving must receive instruction from a certified instructor and complete nationally recognized requirements in order to be certified as a SCUBA Diver. The use of alternative breathing mixtures, such as combinations of Oxygen, Nitrogen and/or Helium and/or Neon, requires additional instruction beyond that offered in traditional SCUBA courses.

Trained and certified SCUBA Divers, whether using compressed air or alternative breathing mixtures, are informed of the risks associated with SCUBA diving and with utilizing breathing mixtures as described above. As such, divers ultimately bear responsibility for their own actions. Persons must not engage in SCUBA diving and the use of compressed air or alternative breathing mixtures unless they are willing to complete a course of instruction, pass certifying examinations and evaluations, maintain their skills and knowledge through active participation in diving activities, and accept responsibility for any injury or death that may occur when participating in SCUBA diving activities.

Version 25.0.0

Printed in the United States

International Association of Nitrox & Technical Divers

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ACKNOWLEDGEMENTS

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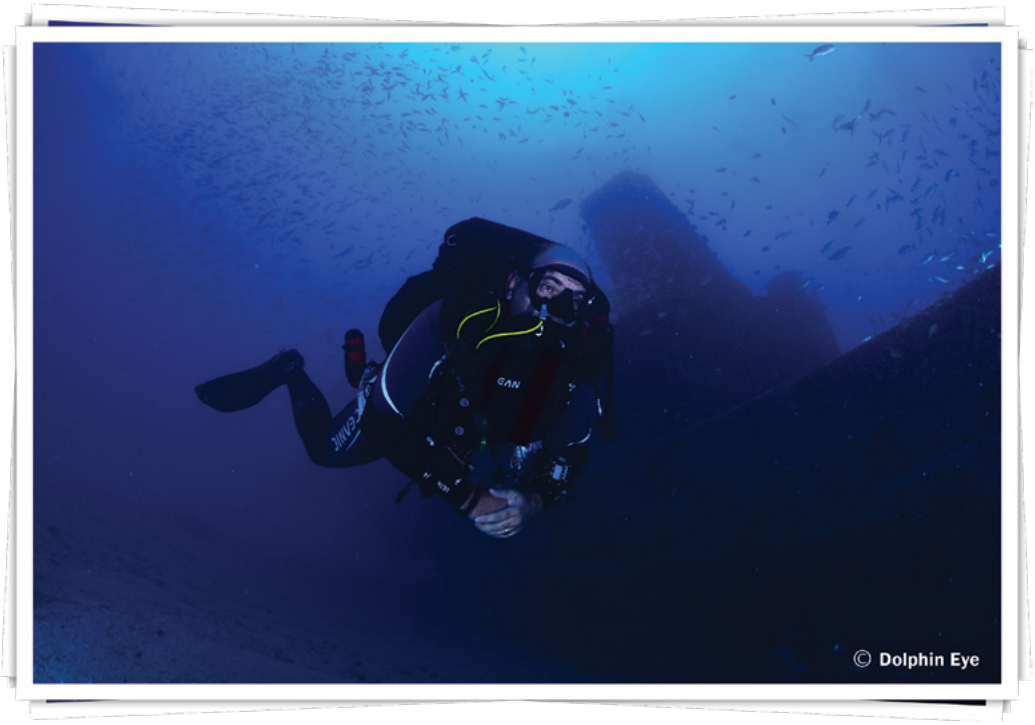
DIVE PLANNING

LEARNING OBJECTIVES

1. **Complete the major areas of dive planning which will include, but not limited to: Self-preparation; Equipment; Emergency and Contingency Planning; and the use of the IANTD Recreational Logbook.**
2. **Understand many aspects of self-preparation for Advanced Open Water Dive situations**
3. **How to select a proper dive buddy**
4. **Determine dive site conditions which are consistent with your level of training and experience**
5. **State the benefits importance of having the proper equipment to complete the dive.**

DIVE PLANNING

The planning will involve the proper use of the IANTD Recreational Dive Logbook and how it should be used in planning for Advanced Open Water Dive situations. There are a variety of new environments the advanced open water diver will be experiencing, new techniques and specific skills which will be a part of the dive, and additional accessory and specialty diving equipment that will be required. All these factors point to the fact that advanced open water situations will require far more attention to detail and be more involved than regular open water dive planning.



SELF-PREPARATION

There are many aspects to self-preparation for Advanced Open Water Dive situations. We shall examine the major areas that are critical for a safe and enjoyable dive.

TRAINING

The first part of self-preparation is proper training for the advanced open water specialty area(s) the dive involves. Each advanced open water specialty area involves training in three basic arenas as they apply to the specialty area:

1. Instruction in diving theory,
2. Water skill training in a confined open water area;
3. Open water training dives.

PHYSICAL FITNESS

Physical fitness for the dive is crucial for the safety of the diver and the dive team. Divers should have regular physical exams to make sure that there are no conditions which may arise that could potentially be a contraindication to attempting a specific type of dive or diving in general. Annual physical checkups are recommended. The diver who is over forty should seriously consider regular annual checkups. Cardiovascular conditioning is critical for safety and performance. The specialty environments the AOW diver operates in can be physically demanding in many aspects. He or she must be prepared to consider with great seriousness: current, temperature, swimming distance, extra equipment drag, longer bottom times, etc.

DIVING TO DEVELOP FITNESS

Many people over the past decade, as the “Baby Boomers” begin to gray, have increasingly become interested in health and physical fitness. Diving has many benefits that may make it much more attractive than other forms of cardiovascular fitness exercises.

These benefits include:

- **Diversions:** The person using the exercise machines at the gym can quickly become tired of the same routine. This can lead to a lack of motivation and the person becoming a “fitness dropout”. The underwater world provides a constantly changing environment where one never knows what he or she may see or experience next. Divers have so much fun they don’t even think about the fact that they are exercising. Usually all divers to need do after the dive is get something to eat and soon they are off to a peaceful sleep. The same diver is up the next day eager to get back into the water to find out what adventure awaits him or her.
- **Support and Resistance:** The natural resistance that water provides helps to prevent injuries common to numerous terra firma based forms of fitness routines. Over extension of the joints and impact injuries are prevented by the aquatic medium. The diver is able to experience a greater range of motion with minimal risk of muscle pulls. It is a small wonder that aquatic exercise is used not only by many professional athletes but also by many physical therapy and rehabilitation programs to build strength, endurance, and range of motion.

- **Coordination:** On land the person who engages in a fitness program usually operates in a two dimensional plane. Underwater the diver is exercising in a three-dimensional setting in which almost any body configuration can be assumed. This is the only earth-bound medium where such exercise to further coordination can be performed at a varied pace to fit the proficiency level of the participant.
- **Calorie Burning:** Diving is a great calorie burner. Studies have documented that calories used during a dive are comparable to the same usage per minute as someone who on land engages in such exercises as cycling, jogging, and climbing. The diver tends to burn more calories with less noticed effort due to the fact that water is great at conducting away the metabolic heat created during the exercise. Seldom does the diver (usually only those over-dressed in a dry suit) notice the hot sweaty effects that usually accompany land-based exercise.

ALTERNATIVE LAND-BASED EXERCISES FOR CARDIOVASCULAR FITNESS

There are so many great cardiovascular fitness routines that can be used to help the diver to get into shape to meet the increased challenge of advanced diving. All one needs to do is to visit a bookstore and look under subject headings such as “Health”, “Fitness”, “Exercise” or “Sports”. The key to any successful exercise program is to find something that you enjoy doing. If it is hard for you to get motivated to go exercise, then it is time to find another type of fitness routine. Many people have found that cross training not only allows them to stay motivated and interested but also allows for a better regime by which more muscle groups are strengthened and cardiovascular fitness is accelerated.

The following list (although not all inclusive) contains some suggestions for various types of exercises that advanced divers have found helpful in extending fitness levels:

Power Walking	**Climbing (various forms)**	**Formal Aerobics Class or Program**
Jogging	**Stair Master**	**Skating or Roller Blading**
Running	**Tread Mill**	**Miscellaneous Cardiovascular Fitness Machines**
Bicycling	**ExerCycle**	**Endurance Team Sports**
Mountain Biking	**Rowing Machine**	

TAKING A WISE APPROACH TO DIVING FITNESS

Before engaging in any form of exercise, it would be prudent to consult your physician. He may be best able to evaluate your present level of fitness, any potential risks or problems you may have to be aware of, and then help you to find the best place or level at which to start you exercise regimen. Periodic consultation with your physician or fitness specialist will go a long way in accelerating your progress and preventing potential injuries. Like anything else, the more you put into the proper planning and selection of your fitness program, the more you will likely benefit from it.

A gradual expansion in the difficulty of the exercises is the most common sense approach to exercise. The old adage of, "No pain – no gain!" is built around some very dangerous physiological assumptions. The risk of injury for those who engage in an overly aggressive program is extremely high. To become a highly conditioned diver takes time. A person can't get into proper shape, after long periods of inactivity, overnight. The divers who are in the best shape make regular exercise an integral part of their daily lifestyle.

PROPER DIVING NUTRITION

Exercise is only half of the equation for proper diving fitness. The other key element is proper nutrition. The IANTD publication Nitrox Diver carries a regular series of articles on "Eating for Diving Fitness" in which detailed information can be found on the various aspects of nutrition as it applies to the field of diving. In this section I will go through the simple basics and for further information you may consult the previously mentioned publication.

The Basics Of Diving Nutrition:

- **Maintain Regular Eating Patterns:** It is far too common for the diver to skip meals or have irregular eating habits while they are out diving. Many times a concerted effort must be made in order to maintain regular eating habits. The energy demands on the body are increased when diving and the fuel supply must be maintained. This is even more crucial in situations where the bottom times are longer, waters are colder, equipment drag is greater, and/or currents are swifter. These are all situations that are much more common for the Advanced Open Water Diver as they venture into the various diving specialties. The risk of hypoglycemia, decompression sickness, fatigue, poor judgement, and muscle cramping is greatly reduced with regular and proper meals during the dive day.
- **Eat Foods Which Are High In Complex Carbohydrates:** Food which are high in complex carbohydrates include those in the categories of: whole grains, fruits, and vegetables. These allow for an even output of energy during the dive and help maintain proper blood sugar levels even during periods of peak energy demand. By eating the proper amount of complex carbohydrates the diver in proper cardiovascular condition should have the energy reserves to help cope with any demanding underwater situation.

- **Eat Easily Digestible Foods:** This category will vary from one person to another. Foods that cause you heartburn or gas should be avoided. First, this prevents the possibility of acid reflux or vomiting during a dive. Second, it can prevent the discomfort and slight risk of injury from gastrointestinal squeeze.
- **Avoid Overeating:** A good light meal before the dive is what is desired. Although the old wives tale of waiting an hour before you enter the water after eating may not "hold any water," eating a light meal and waiting a bit before diving will make you feel much more comfortable during your dive. Again, the risk will probably not be so much getting cramps as the potential for vomiting, which could pose some danger.
- **Stay Well Hydrated:** One of the greatest risk factors for the development of decompression sickness is dehydration. The diver should be drinking prior to entering the water and within a short period after surfacing from the dive. For long dives the diver may even wish to consider a device to aid in staying hydrated during the dive. The beverage of choice should not be a diuretic: containing caffeine (tea, coffee, and many major soft drinks) or alcohol. It is also best to avoid highly acidic drinks. Water is a good choice. However, too much water can also dehydrate a person. A diluted isotonic beverage, such as a sports drink, is highly recommended. The breathing mixture of the diver causes dehydration to take place quickly if the diver has not taken proper precautions. Other culprits in the dehydration process include immersion dieresis, cold water, and the wetsuit or dry suit. Never decrease fluid intake to avoid soiling a suit! The potential consequences are not worth it.

WHAT YOU SHOULD STAY AWAY FROM

Alcohol: Alcohol has a multitude of potentially dangerous effects for the diver. These effects include:

Dehydration	**An increased risk of decompression sickness/illness**
Effects of narcosis may be amplified	**Hypothermia**
Inability to do multi-tasking skills	**Poor reasoning and judgement**
Slowed reaction time	**Decreased coordination and skill performance**

It is felt that in the cases of recreational range no-stop diving, alcohol consumption should be avoided at least 12 to 24 hours prior to the dive.

Caffeine: While it probably wouldn't hurt to have that morning cup of coffee or tea, excessive consumption of beverages that contain caffeine should be avoided. Be aware that caffeine is found in many soft drinks. When you add a few cups of coffee and several caffeine loaded sodas, the cumulative effects on the diver could pose problems. Caffeine is not only a diuretic which increases the risk of decompression sickness/illness and hypothermia, but also it acts as a central nervous system stimulant. It can cause a rise in blood pressure, rapid heart beat, and for some people arrhythmia.

Salt Tablets: Although the "old school of thought" would have people in warm sunny environments taking salt tablets, research has shown that the hidden salts in many of the modern processed foods we eat not only supplies all our needs but may for some be excessive. In most cases, people would be healthier decreasing their sodium intake.

Do Not Smoke: Smoking has an overall injurious effect on the cardiovascular system. It alters the circulatory system and can contribute to various forms of vascular and heart disease. A major factor is the effect smoking has on the lungs. The elasticity of lung tissue is markedly decreased in smokers. The deposits of tars and foreign materials left in the lungs, the damage to the cilia, and the increased production of mucus could lead to air entrapment or small airway closure. These factors increase the possibility of over-expansion injuries and could lead to air embolism, even during a careful normal ascent, according to The Divers Alert Network (DAN). Nicotine also has a detrimental effect on the functioning of the central nervous system, again having the potential of increasing the risk of diver injury. The best advice for the diver striving for diving fitness is, "Don't smoke!"

DIET, CALORIE INTAKE, AND NUTRITIONAL SUPPLEMENTS

Consult Your Physician: When engaging in any fitness program, it is important to consult your doctor about proper diet, calorie requirements, and vitamins/nutritional supplements. Your physician should be aware of any particular needs or special provisions that may need to be made because of your particular physiological makeup and/or condition.

Eat A Balanced Diet: Your diet should include a wide assortment of food from the basic food groups. General guidelines would include:

- **Eat Food High In Complex Carbohydrates:** Eat plenty of fruits, vegetables, and whole grains. Reduce your intake of foods high in simple sugars and refined carbohydrates.
- **Reduce Fat Intake:** Fat intake should fall in the range of no more than 10% to a maximum of 30% of calories ingested. Be especially careful to avoid foods that contain high amounts of saturated fats and transfatty acids.
- **Increase Fiber Intake:** Eat foods that are high in fiber. Soluble fiber helps to maintain the health of the circulatory system. One major benefit of soluble fiber is to reduce the blood cholesterol levels. Insoluble fiber is important in maintaining the health of the gastrointestinal system.
- **Avoid "Junk Food":** Foods which are high in calorie content and low in, or even devoid of, nutritional value are much too common in modern society. They fill the diver with "empty calories" decreasing the uptake of important nutrients and increase the risk of obesity.

Diet Sensibly**:** Radical weight loss is extremely dangerous and can permanently have a negative effect on your health. The diver must be careful, if they are on a weight loss program not to decrease calorie intake to the point where the potential for hypoglycemia during the dive becomes a risk. The best strategy for effective and safe weight loss is one that is gradual. Weight loss experts generally advocate no more than a one to two pound reduction per week. Divers need to be aware that the demand for energy caused by diving activity may actually require that the diver increase calorie intake during a dive day in order to have the energy required for a safe dive.

Follow a Proactive Vitamin and Nutritional Supplement Program: Get together with a progressive nutritional specialist/physician and plan a proactive program for vitamin and nutritional supplementation as it addresses the needs and stresses placed on the body by the hyperbaric environment of the aquatic realm. Any program of vitamin and nutritional supplementation must be well planned and researched in order to be safe and avoid potential side effects or individual contraindications.

GET PLENTY OF REST

Too many times the diver is so involved in the packing up of dive equipment, travel, and checking out the interesting and fun points at the dive destination, he or she forgets to get the proper amount of rest. Proper rest is extremely important, especially in more advanced dive situations, for safe diving. Improper rest can:

- Increase likelihood of decompression sickness/illness
- Result in poor judgement
- Slow choice reaction time
- Decrease the ability to concentrate and follow proper dive procedures
- Result in injuries from an increased potential of not being able to equalize
- Compromise the ability of the divers' immune system to fight off viruses and bacteria

The diver should strive to get at least seven to eight hours of sleep each night before diving.

PSYCHOLOGICAL FITNESS FOR DIVING

There are many psychological factors that can affect the diver and have either a positive or negative impact. Psychological fitness for diving can best divided into 1) the perceptual and 2) the attitudinal. As the diver ventures into more advanced diving environments and situations, the diver must be psychologically prepared for what may be encountered during the dive; sound pre and post dive examination, planning and evaluation are also critical.

THE PERCEPTUAL - "THE ALIEN AQUATIC ENVIRONMENT"

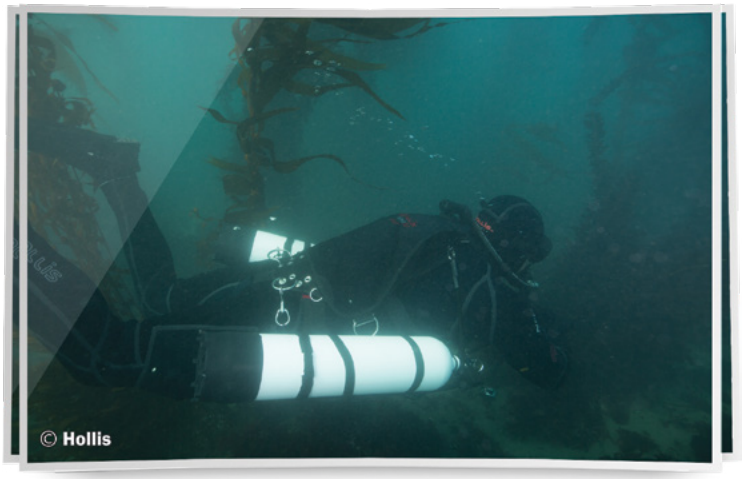
The underwater world is an alien environment to us humans who were brought up surrounded by air on terra firma. When we enter the underwater world we must deal psychologically with the altered status we find ourselves in. In this section we will examine some of the changes that take place, how they affect us psychologically, and how we can adjust to this new environment. If these perceptual factors are not adequately addressed, the diver runs the risk not being in control psychologically.

The major perceptual alterations that the underwater realm presents the diver with are:

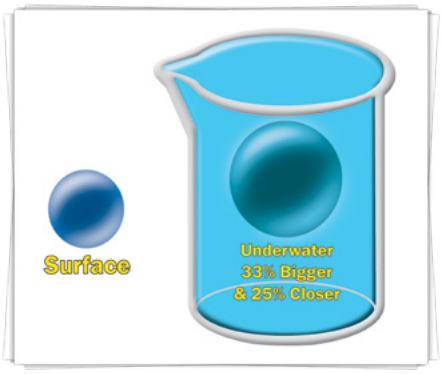
- **Weightlessness In A Three-dimensional Environment:** On land we are used to moving in a two-dimensional plane and using our weight to move about and maintain a sense of balance. When the diver enters the water all of a sudden he is essentially weightless and operating in the third dimension of the water column. Buoyancy control exercises are critical for the diver to gain some mastery of the up and down movement. Proper training and practice in the use of the correct scuba equipment and mastering relevant skills will allow the diver to retain control.

- **Altered Breathing Patterns:** The fact that the diver must use SCUBA to maintain respiration while submerged requires a drastic change in breathing patterns. A mask covers the nose. The diver must breathe via the mouth. Breathing resistance is increased. More respiratory dead air space exists. Psychologically this may cause some people to feel like they are suffocating or like they can't get enough air. The out-of-control breathing pattern may become explosive, rapid, shallow, and/or erratic. Panic could ensue. The breathing pattern must be modified. The diver must relax. The correct cycle should be a slow deep inhalation (6-8 count), pause (1-2 count), slow deep exhalation (6-8 count), pause (1-2 count). The primary step to maintain psychological control and the ability to think through a situation underwater is establishing and keeping a proper breathing pattern through out the dive.

- **Equipment:** The equipment may cause physical discomfort that in turn translates into psychological discomfort. It could be that the person is not familiar with all the extra basic equipment needed. The additional specialty equipment may result in too much task loading. A strap may be too tight. The mask seal may not be seated right and the mask is leaking. These are just a few ways in which equipment can effect the psychological outlook of the diver. Sometimes the confinement of a wetsuit or a mask on the face gives a diver the feeling of claustrophobia. Equipment failure during a dive can be a source of potential panic. Proper training, practice, and review are needed to keep emergency skills sharp. Pre-dive, dive, and post-dive planning and equipment checks are also critical. With these procedures intact the psychological assurance in being able to properly handle equipment as well as equipment problems is reinforced.
- **Visibility:** In general, visibility underwater tends to be much less than that in air. When divers experience limited visibility caused by particulates suspended in the water or diminished light, they tend to feel uncomfortable. Proper training (such as Night or Limited Visibility Diving), equipment (such as a good dive light, a positive attitude, and the ability to focus on the dive objective will usually be all that is needed to make the dive an enjoyable experience.



- **Vision:** The way the underwater world alters the visual perceptions can effect the psychological outlook of the diver. Objects appear larger and much closer than they really are. As the diver descends to depth the warm colors of the spectrum disappear (reds, oranges, yellows). This can give the perception of a cold world. Once the diver understands these processes, they can be adjusted to.



- **Hearing:** Sound travels much farther underwater and much faster. This can give a diver the perception that the source of the noise is right next to him or directly overhead. It is relatively easy for a person to judge the direction from which a sound originates in air. Underwater it is almost impossible for an inexperienced diver to judge the direction of a sound. With time the diver can learn to develop proper sound recognition underwater.

- **Touch:** The fact that the underwater world is full of many alien objects to us "land dwellers" means that there are a myriad of new touch sensations to experience. For some (especially in limited visibility situations) the unfamiliar touch sensations might cause some trepidation. In some dive environments the hands and fingers must be protected from the cold water by wetsuit/drysuit gloves or mitts. This can result in a sort of sensory deprivation. This can be especially disconcerting when a skill that calls for fine manual dexterity is needed. The diver should practice all skills in gloves or mitts (gaining confidence) in a pool or confined water area before attempting them in an environment which may be much more demanding.
- **Currents, Wave Action And Surge:** Currents, wave action, and surge can all be the cause of fear when a diver is not properly trained to deal with them. Learning how to judge the water movement and properly match the environment with personal skill levels is crucial. When a diver learns to use water movement to his/her advantage, he/she will become more relaxed and better able to safely function underwater.

- **Marine Flora:** The various types of marine vegetation may make it difficult for the diver to efficiently move through the water. This can be especially scary if the diver becomes entangled. The diver who is properly equipped with a dive knife and avoids the panic response of moving rapidly and twisting can usually free himself in a very short time. Again, familiarity with this specific environment, proper equipment and training help the diver to avoid panic, stay focused and solve the problem.

- **Exertion:** A diver may find apprehension levels climbing when they are pushed to the edge of their physical endurance. Good cardiovascular conditioning, practice, proper planning, and knowing and staying within one's physical limits will all help prevent being in a situation that is beyond one's physical capabilities.
- **Marine Fauna:** When one is unfamiliar with the marine life, it is easy to perceive a benign creature as a threatening menace. Educating yourself about the underwater fauna will arm you with the true facts and not let your imagination run wild. You will know what marine animals are potentially dangerous and how to have a sensible attitude about them. You will also find out that most marine life is very friendly and learn to appreciate it.

- **Task Loading:** Operating with new skills, using somewhat unfamiliar equipment in an alien environment can result in the mental state called “task loading”. This can be dangerous in that it may result in an inability to stay focused, critical thinking errors, perceptual problems, skill degradation, and potential panic. The best ways to avoid task loading are:

  - Proper Training For The Equipment Used And The Particular Diving Environment
  - Practice, Practice, Practice
  - Never Dive Beyond Your Experience Levels
  - Proper Dive Planning
  - Never Try To Master Too Many Tasks Or Dive Objectives At One Time
  - Gain Some Proficiency Before Attempting More Advanced Dives

ATTITUDINAL FITNESS

The IANTD Standards and procedures Manual states: “Students with unsafe attitudes, or demonstrating bad dive habits, are not to be certified.” What comprises attitudinal fitness for diving?

- **Common Sense:** The diver knows when to stay out of the water. During a dive, the diver knows when to call the dive. The diver never is in the water for any other reason than the fact that he/she wants to be there. The diver is never pressured into making a dive. If conditions become dangerous, the diver knows when to stay out or get out of the water. The diver never dives beyond the limits of his/her training, experience, skills, equipment, or abilities.
- **High Standards:** The diver seeks the best training and equipment possible for their set diving goals. In planning and performance these high standards are applied in all phases. The diver continually practices to improve skills. The diver continues his/her education gaining new knowledge, skills, and staying updated on those areas already certified in. The diver seeks buddies who also have a commitment to excellence.

- **Knowledge Of Personal Limitations:** The diver has an accurate grasp of personal capabilities and performance levels. When planning and diving the diver has no illusions of being better than he/she really is. This realistic appraisal keeps the diver within safe limits.
- **Detail Oriented:** The diver pays attention to detail in planning, during the dive, and post-dive. This requires TIME in checking and rechecking, research, and heightened mental awareness. This diver is seldom surprised by an unexpected dangerous situation. By being detail oriented, the diver not only enjoys each dive more, but also becomes a better-educated diver.
- **Ability To Accurately Judge Physical, Psychological, And Emotional Status:** The diver is able to read the day to day and moment to moment changes in their physical, psychological, and emotional states and make appropriate decisions as they may apply to the dive- either in planning or during the in-water phase.

A diver with an unsafe attitude is an accident waiting to happen. When selecting a dive buddy, stay clear of these individuals! Hold to the high ideals of the proper criteria for diving attitudinal fitness. Make a commitment to safety.

DIVE BUDDY SELECTION

Proper dive buddy selection is a critical component of dive planning which many divers simply do not give proper consideration. Too many times the diver is put in a situation where he/she allows his/herself to be paired up with a buddy simply by chance. Unwise buddy selection may compromise your safety and/or that of your partner.

The buddy team must be compatible. What are the criteria by which you can evaluate your selection of a dive partner?

- **Training:** Is the individual certified in all the areas necessary for the environment and to carry out all the dive objectives? Remember that due to the varied standards, quality of instructor, course content, etc. … certification doesn't always equal ability.
- **Experience:** What type(s) of diving experience does this individual have? How current is his/her experience? How extensive is his/her experience? Where and under what conditions was this experience gained?
- **Skill levels:** How well is the individual able to perform specific and general diving skills? Are these skills current (both in terms of recent practice as well as any skill updates or changes)?
- **Equipment:** Does the diver have the proper equipment to safely accomplish the dive objective(s) and the form(s) of specialty diving to be engaged in? Is this equipment well maintained? Has the equipment been selected with a commitment to excellence?

- **Physical Fitness Levels:** Is the diver in good cardiovascular condition? Does he/she smoke? Has he/she had alcoholic beverages within 24 hours of the dive? Is the individual free of physical illnesses and ailments?
- **Emotional/Psychological Fitness Levels:** Is the individual emotionally stable, able to concentrate and stay focused on the dive plan? Does the diver have a realistic appraisal of his/her abilities? Does the diver have a safe conservative attitude?

Even if the diver appears to be well qualified as a dive buddy it is best to proceed with caution. Whenever diving with a new dive buddy, make the first dive an easy one. It is best to rehearse critical dive skills in a shallow confined water area as a "tune-up dive". Plan air usage by adding a few hundred psig (bar) to your turn pressure on the first dives. The more frequently you dive with a particular individual serving as your buddy, the better your intuition works in alerting you to potential problems before they happen. The greater the number of dives you have with a dive buddy, the better you will be able to plan and execute your dives safely with that particular individual.

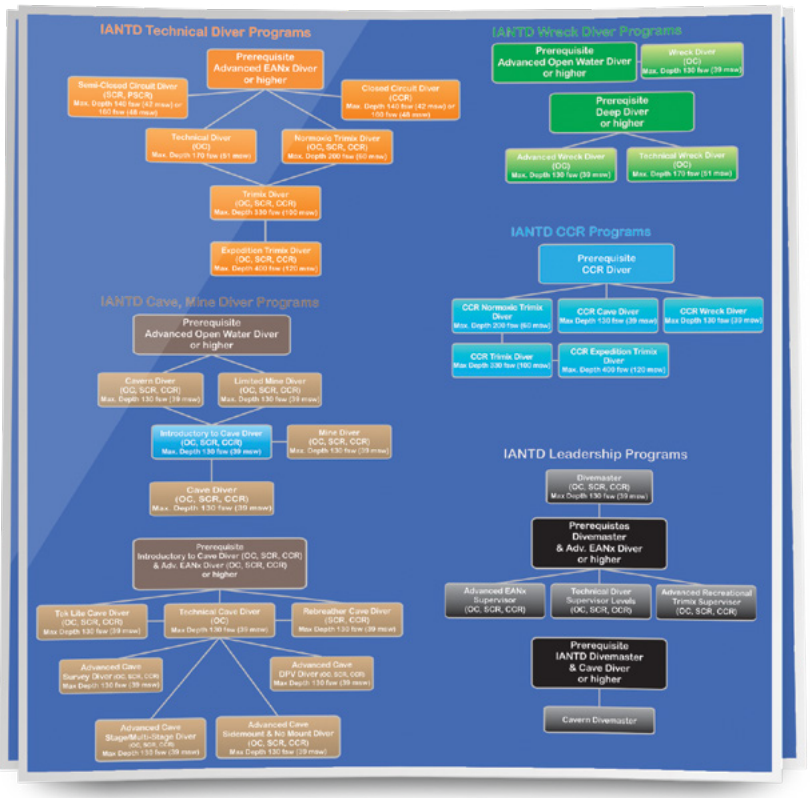
DIVE SITE SELECTION

The underwater world holds a wide diversity of dive sites. Environmental conditions can vary widely from one location to another. The diver must always use care to select a dive site where conditions are consistent with his/her level of training and experience. There are many dive environments that require special training and equipment. The prudent diver will seek out the training and get the proper experience prior to diving in unfamiliar surroundings.

IANTD has many courses which train divers to safely operate in various dive environments, with specialized equipment, particular operational procedures, and for specific dive objectives. These IANTD Specialty Courses include:

As diving continues to grow, as divers push into new areas, as equipment evolves, IANTD stands ready to offer up to date specialized training to provide the diver with a safe and enjoyable underwater experience. As the diver progresses in education and skills, IANTD provides leadership training at the Dive Master, Dive Supervisor, and Instructor Levels in all recreational and technical specialty fields.


IANTD Sport Diver Programs
START
Supervised Diver
Max. Depth 40 fsw (12 msw)
Open Water (Nitrox) Diver
Max. Depth 70 fsw (21 msw)
Advanced Open Water Diver
(OC, SCR, CCR)
Max. Depth 100 fsw (30 msw)
Diver First Aid (NDP)
Oxygen Administrator (NDP)
Cardio Pulmonary Resuscitation (NDP)
IANTD Additional Specialized Programs
Rescue Diver
(OC, SCR, CCR)
Max. Depth 100 fsw (30 msw)
Rebreather Experience Diver
Max. Depth 50 fsw (15 msw)
EANx Diver
EAN40 or Less
IANTD Additional Specialized Programs
Deep Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
IANTD Wreck Programs
IANTD Leadership Programs
IANTD Instructor Programs
Recreational SCR Diver
Max. Depth 70 fsw (21 msw)
Recreational CCR Diver
Max. Depth 70 fsw (21 msw)
Recreational Trimix Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Advanced EANx Diver
(OC, SCR, CCR)
Max. Depth 140 fsw (42 msw)
Advanced Recreational Trimix Diver
(OC, SCR, CCR)
Max. Depth 160 fsw (48 msw)
IANTD Technical Programs
IANTD Cave Programs
IANTD Additional Specialized Programs
IANTD
International Association of Nitrox and Technical Divers
The Leader in Diver Education
IANTD Additional Specialized Diver Programs (Specialty programs do not have a chronological order)
Prerequisite Non Diver Programs
First Aid
Oxygen Administrator
Automatic External Defibrillator
Cardio Pulmonary Resuscitation
Hyperbaric Chamber Operator
Diving Medical Technologists
Tek Academics
EANx or Trimix Gas Blender
Life Support Systems Service Technician
Prerequisite Open Water Diver or higher
Essentials Diver
(OC, SCR, CCR)
Underwater Photography
(OC, SCR, CCR)
Underwater Videography
(OC, SCR, CCR)
Marine Ecology
(OC, SCR, CCR)
Night Diver
(OC, SCR, CCR)
Equipment Care
(OC)
Dry Suit
(OC, SCR, CCR)
Open Water Sidemount Diver
(OC, SCR, CCR)
Prerequisite Advanced Open Water Diver or higher
Open Water DPV Diver
(OC, SCR, CCR)
Self Sufficient Diver
(OC, SCR, CCR)
Prerequisite Rescue Diver or higher
Public Safety Diver
(OC, SCR, CCR)
Prerequisites IANTD EANx IANTD Deep Diver IANTD Navigation IANTD Specialty IANTD Rescue Diver
Elite Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Prerequisite Advanced EANx Diver or higher
Decompression Specialist
In-Water Recompression
(OC, SCR, CCR)
Prerequisite Trimix Diver or higher
Trimix Gas Blender


IANTD Technical Diver Programs
Prerequisite Advanced EANx Diver or higher
Semi-Closed Circuit Diver
(SCR, PSCR)
Max. Depth 140 fsw (42 msw) or 160 fsw (48 msw)
Closed Circuit Diver
(CCR)
Max. Depth 140 fsw (42 msw) or 100 fsw (48 msw)
Technical Diver
(OC)
Max. Depth 170 fsw (51 msw)
Normoxic Trimix Diver
(OC, SCR, CCR)
Max. Depth 200 fsw (60 msw)
Trimix Diver
(OC, SCR, CCR)
Max. Depth 330 fsw (100 msw)
Expedition Trimix Diver
(OC, SCR, CCR)
Max. Depth 400 fsw (120 msw)
IANTD Cave, Mine Diver Programs
Prerequisite Advanced Open Water Diver or higher
Cavern Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Limited Mine Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Introductory to Cave Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Mine Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Cave Diver
(OC, SCR, CCR)
Max. Depth 130 fsw (39 msw)
Prerequisite Introductory to Cave Diver (OC, SCR, CCR) & Adv. EANx Diver (OC, SCR, CCR) or higher
Tek Like Cave Diver
(OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
Technical Cave Diver
(OC)
Max Depth 130 fsw (39 msw)
Rebreather Cave Diver
(SCR, CCR)
Max Depth 130 fsw (39 msw)
Advanced Cave Survey Diver (OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
Advanced Cave DPV Diver (OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
Advanced Cave Stage/Multi-Stage Diver
(OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
Advanced Cave Sidemount & No Mount Diver
(OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
IANTD Wreck Diver Programs
Prerequisite Advanced Open Water Diver or higher
Wreck Diver
(OC)
Max. Depth 130 fsw (39 msw)
Prerequisite Deep Diver or higher
Advanced Wreck Diver
(OC)
Max. Depth 130 fsw (39 msw)
Technical Wreck Diver
(OC)
Max. Depth 170 fsw (51 msw)
IANTD CCR Programs
Prerequisite CCR Diver
CCR Normoxic Trimix Diver
Max. Depth 200 fsw (60 msw)
CCR Cave Diver
Max Depth 130 fsw (39 msw)
CCR Wreck Diver
Max Depth 130 fsw (39 msw)
CCR Trimix Diver
Max Depth 330 fsw (100 msw)
CCR Expedition Trimix Diver
Max. Depth 400 fsw (120 msw)
IANTD Leadership Programs
Divemaster
(OC, SCR, CCR)
Max Depth 130 fsw (39 msw)
Prerequistes Divemaster & Adv. EANx Diver or higher
Advanced EANx Supervisor
(OC, SCR, CCR)
Technical Diver Supervisor Levels
(OC, SCR, CCR)
Advanced Recreational Trimix Supervisor
(OC, SCR, CCR)
Prerequisite IANTD Divemaster & Cave Diver or higher
Cavern Divemaster

ENVIRONMENT

The environment must be carefully considered when planning for a dive. The diver must look both at the surface and underwater conditions when taking proper measures to ensure a safe dive. Remember that the environmental status is not static and contingency courses of action must be considered when approaching a dive. One must constantly update before, during and after the dive. The safe diver is ready to handle all possible conditions. Being ready to handle all conditions includes the right of any diver to call the dive at any point for any reason! It may be difficult to abort a dive when much time, money, training, equipment, and travel has been invested in accomplishing a particular dive mission … but what value do you place on your life and the lives of those on your dive team? The dive accident history records are full of many cases where divers didn't have the common sense to know when not to dive. If the environment exceeds the scope of your training, experience, or equipment- DO NOT DIVE!

The diver should look at the following areas when evaluating the environmental status:

SURFACE CONDITIONS

- **Temperature:** The diver must dress appropriately before and after the dive with care taken to maintain proper body temperature. In the tropics, heat can be a problem. Major precautions warm environments include plenty of cool non-alcoholic fluids, light clothing, staying in a shaded area, keeping the head and possibly body wet, and not suiting up too long before the dive. In colder environments, the diver must make sure that as warm an area out of the wind can be provided for suiting up and unsuiting. Warm foods and non-diuretic fluids can also help to prevent hypothermia. A diver wearing a wetsuit must take care not to stay in the suit too long after or between dives, as surface evaporation from the suit can dangerously chill the diver. Post-dive situations are critical, because of the thermal deficit that most dives put a diver into. Even in the tropics, especially on night dives and/or windy days, a sweatshirt or light jacket may be a smart idea for after-dive wear.
- **Predicted Atmospheric Conditions:** An overcast sky may effect how much ambient light the diver may have at depth. Windy conditions may effect sea state and currents. Rain could cause runoff, which may reduce visibility down to zero. Lightning could prove a danger to the diver as well as to any surface personnel. It is best to get the latest forecast throughout the dive day in order to prevent weather related dive emergencies. Remember, weather can change quickly!
- **Surface Traffic:** The amount of boating traffic in a particular area is a dive consideration. Certain shipping lanes are off limits to diving both in the ocean as well as on inland waterways. Again, pre-dive research is needed to assure a safe dive. It is imperative to properly mark the area where diving operations are being conducted.

The U.S. divers flag (A red flag 4 units wide by five units long with a one unit white diagonal stripe from the upper right hand corner to the lower left hand corner)) is used in the territorial waters of the United States, many sites in the Caribbean and a few other areas of the world. Size of the flag varies from state to state and can also vary with the size of the vessel from which diving operations are conducted. The distance other surface traffic must maintain from where the flag is flown can very from one place to another. Keep abreast of all local and regional laws as they apply to the display of a dive flag.

The International Divers Flag or "Alpha Flag": This flag is used in most international waters. It is the single letter "A" or alpha flag (blue and white with a triangular indentation on the right hand "blue side").

WATER CONDITIONS

- **Sea State:** Sea state deals with wave height, surf conditions and currents.
- **Surf:** A diver should choose an entry and an exit point when diving from the beach that has minimal surf. If such a site can not be found the dive must be aborted.
- **Currents:** There are five major types of currents a diver should be aware of:
  - **Rip Currents:** These currents are usually found near the shore where water funnels through a deeper area back out to sea. They are usually perpendicular to the shoreline and can sometimes be identified by a trail of foam moving seaward at right angles to the waves. A slow running rip can be advantageous in helping a diver swim out to a dive site. A fast running rip current can be hazardous.
  - **Longshore Currents:** These currents run parallel to the shore. They are generally shallow currents. In areas with a moderate to strong longshore current, the diver plans the dive to have an entry point, a swim course (taking into account time, current speed and distance), and an exit point somewhere down current from where he/she entered the water.
  - **Tidal Currents:** These currents must be considered both in terms of the magnitude and direction at any particular time point in the dive. Tidal currents are caused when the tide is either moving in or out. They can be particularly strong in areas such as narrow water areas between land masses (such as under bridges), mouths of bays, rivers, jetties or other bodies of water which flow into the ocean. Tidal currents can be extremely dangerous. A diver must take time to research the characteristics of the tidal currents at a particular dive site and get the information from a reliable source. Tidal charts must be consulted. Timing is critical in areas affected by tidal currents because the diving window of opportunity can be very narrow.

- **Prevailing Ocean Currents:** All around the world there are meandering streams of currents that flow through the ocean. Some are shallow and others run deep. Their speed and varied direction is often dictated by seasons, water temperatures, weather, and a number of yet to be discovered factors. There are times when these currents make for a nice drift dive or even abate enough so that a diver can easily move around under his/her own power against or with the current. There are other times the currents are just too hazardous for even the most experienced diver to handle.
- **River Currents:** Inland divers with proper training and experience enjoy the fun which river diving has to offer. The amount of current in a river changes as the river flows along its course. The narrower and/or shallower areas can have much greater current speeds than the deeper and/or wider areas. The current against one bank of a river may be stronger than the other side, as the river winds and curves back and forth. Rainfall can also turn a usually quiet river into a torrential menace in a very short time. One should not attempt river diving where moderate to high currents may be found without proper specialty training. IANTD offers a River Diver Specialty Course for just this purpose.

For divers unfamiliar with ocean diving or wishing to dive in marine areas where water movement can be a critical factor, IANTD has an Ocean Currents, Surf, and Drift Diver Course.

- **Depths:** As an Advanced Open Water Diver, you will be certified to dive to depths no deeper than 90 fsw (27 msw). It is important to take the depth of a dive site into consideration for several reasons.
  - First, one must consider if the depth is within the realm of his/her training and experience. Should your goals take you to depths beyond the Advanced Open Water depth range, further training is a must. The next step beyond the IANTD Advanced Open Water Diver Certification to venture beyond 90 fsw (27 msw) range is the IANTD Deep Air Diver Certification which covers the requirements to dive up to 130 fsw (39 msw). Should the diving be in an area where depths exceed those of the diver's training and experience, such as a wall dive, the dive team must pay extra attention to depth throughout the dive.
  - Second, one must consider the No Decompression Limits/No Stop Limits for the depths of the dive. If the diver is qualified in the use of Enriched Air Nitrox (EANx), the "Best Gas" for the dive mission may be calculated and used, allowing maximum safety and bottom time. The IANTD EANx Diver Certification Course and the IANTD Advanced EANx Diver Certification Course provide excellent training for the use of Enriched Air Nitrox. If there is the potential or need for decompression/stop diving, the diver should take the appropriate IANTD Technical Courses which best satisfy their diving goals and objectives.
  - Third, gas consumption on dives with greater depths will require that the divers plan to have proper equipment which will allow them to carry a larger gas supply or increase the efficiency of the gas being used (i.e. a rebreather … with proper training).

- **Underwater Visibility:** For most diving operations the divers strive for optimum visibility. After all, the primary sensory input for the diver is vision. The most popular dive sites usually are those with exceptional visibility. There are areas of the country where limited visibility is expected year round. There are various dynamics which can affect visibility such as the types of bottom, time of day, season, amount of rainfall, weather conditions, or currents. Limited visibility may be caused by algae growth, plankton, silt, sediment, tannins or other substances dissolved or suspended in the water. Unless there is a specific need, the diver is highly trained and experienced, and specialized equipment is used, diving in zero visibility should be avoided. Those who choose to dive under limited visibility conditions must have good basic underwater navigation skills and in some circumstances may need to know the proper use of a wreck/cavern line and reel. Chapter 4 of this text, Night and Limited Visibility Diving, as well as Chapter 5, Basic Underwater Navigation, contain information which will be critical for safe diving where visibility is less than ideal.
- **Bottom Type And Configuration:** The type of bottom will drastically effect visibility. The worst types of bottoms are those composed of clay or silt. The diver must have excellent buoyancy control and finning techniques to avoid stirring up the sediment. Sometimes such conditions may mean that those who haven't mastered anti-silting techniques must stay out of the water, possibly opting to serve as surface support. The other alternative for the less skilled is to find a more forgiving type of bottom. On dives where survey, photography, or videography are the objectives extreme care must be taken not to stir up sediment. Sandy bottoms are more ideal. The sand will usually settle out of the water very quickly. Rock or coral bottoms are among the most ideal for maintaining good visibility. One must be careful to not touch the living coral reefs in order to prevent injury to the tiny coral polyps and organisms that live on the reef as well as injury to the diver from sharp coral edges and protrusions.

The configuration of the bottom must be a part of dive planning. The diver may need to get a hold of various types of maps from sources such as: NOAA, The Army Corp of Engineers, U.S. Geological Survey, or commercially available fishing maps. In some cases of more popular dive sites there are many dive publications which not only have site maps but other valuable resource information. Knowing what the bottom looks like and where objects are located makes the dive enjoyable and can save precious time when trying to target specific objects on the dive site. Another advantage of knowing the topography of the bottom is that it will be an aid to effective navigation. Lastly, by understanding where things are, one can avoid potential hazards- such as extreme depths.

EQUIPMENT

Every member of the dive team must be properly equipped both for the surface and to safely accomplish the dive objectives at depth. There is a fine balance to be kept between being under-equipped and having excess equipment. The under-equipped diver compromises safety by not having all the items needed to safely accomplish the dive mission with a reasonable amount of safety and redundancy. The over-equipped diver risks task loading, fatigue from excess drag, and the possible threat of entanglement.

THE BENEFITS OF OWNING YOUR EQUIPMENT

At the Advanced Open Water Level it becomes almost imperative that the diver owns his/her equipment verses renting it. In almost any sport those who engage at the advanced levels own their equipment because it has much less risk and it allows them to excel.

Some of the major reasons for owning your own equipment are:

- **Fit:** You are able to select equipment that fits you well. This adds to comfort, helps prevent potential DCS/DCI problems, and reduces the possibility of cramping. A well fitting wetsuit will keep a diver warmer. A properly fitted mask won't leak. A comfortable mouthpiece reduces jaw fatigue. The rental approach, as far as fit goes, is usually, "It's close enough!"

- **Quality:** The diver who is committed to excellence will buy quality equipment that will fit his or her diving goals well into the future. Quality runs hand in hand with safety. Scuba equipment is life-support equipment. When viewed in that light, quality is paramount! Many times with rental equipment quality is sacrificed for price. Rental equipment many times is second rate or worse in order to increase profitability.
- **Maintenance And Reliability:** The most abused dive equipment tends to be rental equipment. It is usually used by new divers who have no idea how to handle and maintain equipment. Too often rental equipment is far past due for regular scheduled maintenance as recommended by the manufacturer. Divers who own their equipment know how the equipment has been maintained. Their dive gear is better maintained at the personal level as well as having had regular scheduled maintenance completed by a dive store. An equipment owner is much more certain to fix little problems before they compromise safety.

- **Sanitary Rationale:** If you own your wetsuit or dive skin, you know that it has been properly cleaned, rinsed and disinfected. Even more personal, you know that the only person that has had the regulator or snorkel mouthpiece in their mouth is YOU! Think of it this way: Would you use some else's toothbrush?
- **Ability To Streamline, Configure, And Customize:** As a diver ventures into the world of specialty and advanced diving, the need to streamline, configure and customize dive equipment grows. Let's face it: there is only so much you can do with some else's equipment. You may come close, but seldom will you hit the nail on the head. Next time you go diving, you have to start the same process all over again if you don't own your equipment.
- **Familiarity:** You are not guaranteed each time you rent equipment that you will get the exact same equipment every time. Advanced and/or specialty diving requires that the diver is familiar with his or her equipment. You must operate "as one" with your diving system. When you own your dive gear, you are familiar with every piece: how you have it configured, how to operate it, gauge readout, center of buoyancy, proper feel, proper adjustment, limitations, and how to perform critical dive skills in that particular setup. Remember: equipment familiarity is a key element of dive safety!

- **Economics:** It doesn't take more than 10 to 15 times of renting equipment for a weekend until the cost of rental equals the cost of owning.

DIVE EQUIPMENT CHECKLISTS

Because of the wide variation of diving environments, advanced forms of diving, and uniqueness of specialty diving categories it would be impossible to list all the equipment needed for every dive situation in this text. Those listed below are based on general Advanced Open Water Diving. For greater details as they relate to equipment for advanced, specialty, and technical diving refer to the appropriate IANTD Student Manual and Workbook. When viewing the general lists below appropriate modifications must be made for every dive.

INDIVIDUAL DIVE EQUIPMENT - UNDERWATER

- Mask
- Fins
- Snorkel
- Boots
- Gloves
- Buoyancy Control Device
- Weights and Weight Belt (if BCD is not weight integrated)
- Dive Knife
- Regulator
- Alternate Second Stage
- Cylinder(s)
- Submersible Pressure Gauge
- Underwater Compass
- Dive Computer or IANTD Dive Tables and/or Dive Timer and Depth Gauge
- Environmental Protection (Appropriate for the environment and dive exposure):
  - Dive Skins
  - Wetsuit
  - Dry Suit
  - Gloves
  - Mitts
  - Hood
  - Hooded Vest
- Underwater Lights:
  - Primary
  - Backup
- Slate and Pencil
- Emergency Signaling Device (Appropriate for the dive environment):
  - Whistle
  - Dive Alert
  - Safety Sausage
  - Mirror
  - Smoke Flares
  - Strobe- Night Dive
  - Flares- Night Dive
- Dive Flag and Float- With A Tow Line
- Equipment Bag

INDIVIDUAL DIVE EQUIPMENT - SURFACE

This is a listing from which the appropriate equipment may be selected depending on the environment and weather conditions.

- Towel(s)
- Swimsuit
- Dive Logbook
- C-Card
- Personal Emergency and Medical Information

Warm Environments

- Sunglasses (UV blocking)
- Hat
- Sun Protective Lotion- High SPF
- Coral Boots
- Deck Shoes
- Light Colored Light-weight Clothing

Cold Environments

- Warm Hat
- Jacket- appropriate for the temperature range
- Extra Sweatshirt or Sweater
- Gloves for very cold climates
- Wind or Rain Protecting Outer Clothing
- Wool Socks
- Insulated Boots

Tools, Spare Parts, And Field Repair Equipment

- Mask Straps
- Fin Straps
- Snorkel Clips
- “O” Rings- Various Sizes
- Appropriate Lubricant / Grease For Equipment &”O” Rings
- Defog
- Extra Regulator Port Plugs
- Extra Low Pressure and High Pressure Hoses
- Extra Inflater Hose
- Spare Regulator Mouthpiece
- Wetsuit or Dry Suit Cement
- Spare Bulbs for a Dive Light

- Spare Batteries for a Dive Light
- Extra Slate Pencils
- Allen Wrenches
- Adjustable Wrench
- Needle Nose Pliers
- Various Size and Types of Screw Drivers
- “O” Ring Pick
- Suit Shampoo
- Suit Hangers
- Duct Tape
- Zip Tie Bands
- Surgical Tubing
- Knife
- Various Clips and Buckles
- Weight Stops

Team Equipment

- First Aid Kit
- DAN Approved Oxygen Unit (with a minimum of a 30 minute supply)
- First Aid Manual(s)
- DAN Dive First Aid Manual
- Dive Manuals, Reference, Handbooks
- Dive Tables, Records and Worksheets
- Clipboards
- Extra Pencils, Pens, Markers and Paper
- Emergency Procedures and Information Sheet
- Team Spare Parts and Repair Kit
- Radio, Telephone Access, or Cellular Phone
- Appropriate Surface Signaling devices
- Appropriate Lights For Surface Use When Night Diving- and Associated Spare Parts
- Dive Timing Device
- Blanket
- Extra Fluids- Non-diuretic

The diver must look carefully for potential problems that could happen during the dive. Once the potential problems are defined, a strategy to handle the dilemma must be formed. The problem solving should be rehearsed mentally and further refined. All members of the dive team, in a safe confined water area should practice the emergency procedures.

The following is a list of common diver emergencies which advanced open water divers should know and practice proper procedure for solving. (Greater detail on individual procedures and prevention may be found in Chapter 3)

Common Diver Emergencies

- Mask Flooding
- Loss Of Mask
- Flooded Regulator Second Stage
- Regulator Free-Flow
- Loss Of Regular Mouth Piece
- Loss Of Gas Supply
- Inability To Equalize
- Loss Of Buoyancy
- Uncontrolled BCD Inflation
- Scuba Cylinder Releases From Backpack
- Multiple Equipment Problems
- Muscle Cramp
- Motion Sickness
- Fatigue Due To Overexertion
- Hypothermia
- Entanglement
- Lost / Separated Dive Buddy
- Loss Of Visibility
- Planned Depth Exceeded
- Planned Time Exceeded
- Caught In Strong Current
- Injury While On The Dive

Some environments, dive sites, advanced and/or specialty diving may have inherent risks of their own. These risks must all be planned for. All the individual divers must have the training and experience to safely handle any risks associated with a dive.

It is important for all divers to continually update their own as well as the dive team status throughout the dive. If there are changes or problems, they have been planned for and the dive plan can be modified. REMEMBER: Any diver can call a dive, at any time, for any reason!

THE IANTD LOGBOOK - YOUR TOOL TO SAFE DIVING

The IANTD Recreational Logbook has been designed to assist the diver in proper dive planning. It provides important information in the IANTD Training Record needed in documentation of training and certification levels. It has important formulas in The Quick Formula Reference Guide that might be handy for proper calculations relating to a dive. It has sections for personal information, medical information, and emergency contact information. It has Dive Log Sheets for each individual dive for: pre-planning, post dive analysis, and dive documentation. The IANTD Buddy Record contains important information on your dive buddies and provides a concise place where you have information on how to contact them. The Diving Accident Management section has CPR basics and a Dive Accident Management Flowchart.

As an IANTD Advanced Open Water Diver you should log all of your dives and make the IANTD Recreational Logbook an integral part of every dive. In order to make the best use of the IANTD Recreational Logbook.

THE IANTD TRAINING RECORD

Provides a quick glance documentation of the IANTD Certification Course that you have taken. It is one way you can quickly show others your training status. It also provides a good overview of what other training is available and will help you in planning your future dive education goals. Although all your training dives should be documented and signed off on the individual dive log pages, they do not necessarily show that you have passed the course. Your other dive by dive logbook documentation may be in a previous IANTD Recreational Logbook that you have filled up and filed. This page, when signed by your instructors and accompanied by your C-cards, provides the proper credentials you may need to show a Dive Master, Dive Supervisor, Instructor, or Dive Team Leader in order to engage in a particular diving activity.

PERSONAL, MEDICAL, AND EMERGENCY CONTACT INFORMATION

This is important information for the dive team leader, dive master, dive supervisor, dive buddy, or instructor to have on hand in case of a dive emergency. It is also handy to have the personal information section filled out completely just in case you should misplace your IANTD Recreational Logbook as it will increase your chances of recovering it. It is important to periodically update this section.

PERSONAL INFORMATION (GENERAL)

The Personal Information section at the top of the page is self-explanatory with general information like: Name, Address, Phone, Height, Weight, Phone, Sex, Birth Date, Height, Weight, Hair Color, Eye Color. Be sure to keep this information updated, especially if you have changed address or phone numbers. It may be a good idea to put both a daytime number as well as an evening number you may be reached at, if they are different. Also, some divers will include their e-mail address.

MEDICAL INFORMATION

Be sure to keep all the information in this section current. It may speak for you should you need medical treatment and are unable to speak for yourself. Appropriate spaces should be filled out as follows:

- **Medications:** Always check with a knowledgeable physician prior to diving on any type of medication. This blank should contain all current medications you are taking including prescription and over the counter brands.
- **Drug Allergies:** Be sure to list any drugs or medications to which you may be allergic. If you are unsure about what medication to which you may have an allergic reaction, ask your personal physician.
- **Medical Conditions:** Any medical conditions you may have should be listed here, no matter how insignificant they may seem. Should a new condition arise, be sure to update this section.
- **Blood Type:** Make sure this information is accurate. If unsure ask your physician. A blood type test is usually very inexpensive. Do not guess!
- **Distinguishing Marks:** List any unique marks you may have and their location. These markings may include such things as scars, tattoos, birthmarks, etc.
- **Physician:** List your personal physician who has access to your most current medical records.
- **Physician's Phone:** You may choose to list several numbers here, if there are several locations or numbers for evening and day contact.
- **Health Insurance Carrier and Policy #:** List your primary health insurance carrier and individual policy number. Some policies have a Group Number that should also be listed.
- **Dive Insurance Carrier and Policy #:** Because many health insurance carriers do not cover hyperbaric treatment, all divers should carry the appropriate form of dive insurance that matches the type(s) of diving they engage in. The Divers' Alert Network (DAN) provides a very affordable policy for divers of all types. DAN Insurance is one of the most recognized throughout the world. Keep in mind that your insurance should provide for air ambulance service in case of the possibility of DCI. Again many insurance policies do not provide this service. Air ambulance evacuation is extremely expensive. Many dive operations as well as instructors require that the diver show some form of dive insurance.

EMERGENCY CONTACT INFORMATION

It is often difficult to know whom to contact in case of emergency unless this information is readily available and current. Having this information in the dive log is prudent on your part. The categories are filled in as such:

- **Name:** The full name of which person you wish to contact in an emergency should be put in this blank. It is best not to list a person who usually dives with you.
- **Relationship To Diver:** List the relationship the person listed is to you. This relationship category may include such listings as: brother, sister, wife, husband, partner, son, daughter, cousin, aunt, uncle, parent, boss, friend, business associate, etc.

- **Address, City, State, Zip, Country, Phone:** Fill in all the contact information on the listed person accurately and be sure to update as needed. Again, the phone number may include day and evening (home or work) listings. Since diving is international, be sure to list your country and possibly country code for the telephone number.
- **Second Contact Information:** It is best to list another person to contact in the case of an emergency. The information is filled out as you would for the first contact.

DIVER ALERT NETWORK EMERGENCY NUMBER: Whenever you have a dive emergency DAN stands ready to provide assistance in one form or another. You should always have the emergency number handy. IANTD highly encourages divers to become DAN members.

QUICK FORMULA REFERENCE GUIDE

This group of pages provide the diver with formulas handy for dive planning and post-dive analysis, as well as oxygen exposure tables relating to the CNS Exposure Limits, CNS Surface Interval Credit, CNS Clock Percentage Chart, and OTU Chart. It is critical that you always double check any formulas when making calculations. Your life may depend on it.

THE INDIVIDUAL DIVE LOG PAGES

These pages are filled out for every dive that you make. They aid in pre-dive planning and post-dive analysis. They are documentation of the individual dives you have made and all pertinent data about that dive.

EMERGENCY MANAGEMENT INFORMATION

THE RISK - BENEFIT ANALYSIS PROCESS

The final decision whether or not to make the dive is not up to someone else. It is YOUR decision. Every activity has one degree or another of risk associated with it. Every dive has a degree of risk. Part of dive planning is to identify the risk and take steps to manage that risk. There is no way that all risk can be eliminated from diving. You must look at and evaluate the environment, equipment, buddy or buddies, team leadership, conditions at the site, dive objective and plan, and all other factors related to the dive. Then you must look at your training, skill levels, physical and psychological status, and experience. Then ask yourself three key questions:

- What is the personal risk level than I am willing to accept?
- What are the potential benefits I will gain from this dive?
- Is the level of risk worth the potential benefits?

Never let others talk you into making a dive decision that you are not truly comfortable with. You should only be on a dive for the reason that YOU WANT TO BE THERE!

It is best for the buddy team to work together in assembling equipment and suiting up. This allows the team to check and verify that they are both assembling and donning equipment correctly. Once the divers are suited up before entering the water, they self-check and check each other. The following is a good simple checklist to use:

PRE-DIVE CHECKLIST

- Mask In Place and Strap Correctly Positioned
- Snorkel In Place and Secured
- Air Turned On and Adequate Pressure In Cylinder
- Regulator Stages All Working
- BCD / Harness Properly Adjusted
- BCD Hose In Place and Inflator Attached
- BCD Inflation and Air Dumping Mechanisms Working Properly
- Cylinder(S) Secured and Gases Labeled
- Second Stages Properly Positioned
- Instrumentation Easily Visible:
- Dive Computer
- SPG
- Depth Gauge
- Dive Timer
- Environmental Suit Properly Zipped- If Dry Suit- Inflator Hose Attached
- Weights Secured and Quick Release Correctly Positioned
- Dive Knife Reachable
- Boot Zipped (If Zippered)
- Fins Secure

Once in the water the divers perform the self-check and check each other on the in-water check. The following is a simple In-Water Checklist:

IN WATER CHECKLIST

- Check And Record Each Others Gas Pressures
- Start Pressure
- Turn Pressure
- Bubble Check- Check Around Valves, Hoses, Regulator First and Second Stages For Leaks (Bubbles)
- Check BCD Inflation and Deflation Mechanisms
- Check Dry Suit Inflation and Deflation Mechanisms, Should You Be Wearing A Dry Suit
- Check Mask Positioning For A Good Leak-Proof Seal
- Check Dive Lights If You Carry Them:
  - Primary
  - Secondary
- Check All Regulator Second Stages, Breathing Off Each One While Slightly Submerged, For Proper Function
- Practice Sharing Air At The Surface If This Is The First Dive Of The Day Or You Are With A New Buddy
- Make Sure Your Dive Computer Is Activated Or Your Dive Timer Is Activated- If Using A Dive Watch, Record The Time You Leave The Surface

CONCLUSION

Remember the key to safe diving is proper dive planning and execution of that plan. In order to safely approach some advanced dive situations and/or environments, a diver may have to obtain further equipment, education, experience, or work to be in better cardiovascular condition. A wise diver has the maturity to know when to stay out of the water and when to call a dive when underwater. Proper planning takes time, yet what it yields in terms of safety and enjoyment makes the time spent well worth the effort. IANTD has provided you the tools to assist in advanced dive planning. By using these tools and taking advantage of the IANTD educational system you will open many new underwater vistas guaranteed to bring you endless satisfaction!

Its important that the dive team be properly to accomplish the dive objectives. In order to be properly equipped, the dive must:

QUIZ

- **A** Balance between being over or under equipped for the dive
- **B** Purchase only the top-of-the-line equipment
- **C** All have the exact same equipment when making the dive
- **D** Carry multiple dive computers that only use the VPM decompression model

The environment must be carefully considered when planning for a dive. The diver must look both the _____ when planning the dive.

QUIZ

- **A** Surface and underwater conditions that the diver may encounter during a dive
- **B** The impact of global warming on the dive and the phase of the moon
- **C** Carbon footprint of the gas fills and emissions from boat exhaust
- **D** Venomous and non-venomous marine life that may exist near the exit point of the dive

Proper dive buddy selection is a critical component of dive planning which many divers simply do not give proper consideration. Too many times the diver is put in a situation where he/she allows his/herself to be paired up with a buddy simply by chance. Unwise buddy selection may compromise your safety and/or that of your partner

QUIZ

- **A** True
- **B** False

There are many aspects of self-preparation for Advanced Open Water Dive situations; however, the first part of self-preparation is which of the following?

QUIZ

A Proper Training

B Physical fitness

C Regular medical exams

D Psychological fitness

Physical exercise is only half of the equation for proper diving fitness. The other key element is proper nutrition. Which of the following are recommended to avoid as part of proper diving nutrition?

QUIZ

A Drugs

B Complex carbohydrates

C Easily digestible foods

D Vitamin Supplements

Chapter 2

DIVING DEEPER

LEARNING OBJECTIVES

1. **Understand the various equipment requirements of diving in the 60-100 fsw/18-30 msw range.**
2. **Understanding the potential physiological risks and ways to minimize those risks while diving deeper**
3. **Be able to calculate turn pressure for a dive**
4. **State the importance of Experience in deeper diving**

DIVING DEEPER

THE 60-90 FSW (18 - 27 MSW) RANGE

INTRODUCTION

For the IANTD Advanced Open Water Diver this course opens up the first area of the deep sport diving range: The waters that lay between 60-90 fsw (18-27 msw). The maximum depth you will be certified to dive upon the successful completion of this course will be 90 fsw (27 msw). Your dives will be no-stop dives, where mandatory decompression stops are not required. You will be certified only to dive in waters where you have free access to the surface. Those who have a need to dive beyond 90 fsw (27 msw) should seek further training. The IANTD Deep Air Diver program is designed for divers who wish to advance to the depth range between 90-130 fsw (27-39 msw). The IANTD Overhead Environment Diver program is designed for divers who wish to enter the overhead environment area of wrecks and/or caverns. The IANTD Advanced Open Water Diver program is the first step toward these other specialties. As with each phase, you should take time to gain some experience before moving to the next stage of education. Know the limits to which you are trained. Respect them and you will be a wise and safe diver, prepared for the environment in which you are diving.

EQUIPMENT REQUIREMENTS

THE CYLINDER

You should have a cylinder filled to the proper pressure that will give you sufficient supply of gas for the depths and total duration of the dive. Part of your Advanced Open Water training will be computation of your individual SAC (Surface Air Consumption) and RMV (Respiratory Minute Volume). Based on your SAC, RMV and The Rule of ½ + 200 psig you will be able to calculate the gas required for your dive. This will ensure that you have enough gas to complete your dive safely. In some instances, it may mean that you will have to add extra air to a partially full cylinder for a second dive. In other cases, you may find that you will need to get a larger cylinder or combination of cylinders to allow the appropriate volume of gas.

As divers venture into deeper waters they must be certain that the cylinder(s) they are diving with have a large enough capacity to account for the increased volume of gas consumed at the greater depths. To illustrate this: Assuming the same cylinder is used, a diver who breathes 30 psig per minute (2 bar per minute) at a depth of 30 fsw (9 msw) will breathe 60 psig per minute (4 bar per minute) at a depth of 90 fsw (27 msw). This is double what the diver would consume at the shallower depth of 30 fsw (9 msw). It is imperative to make sure the diver extending his/her training and experience into the next deeper depth range, know what his/her air consumption is and carry the appropriate size cylinder filled to the correct pressure to allow a sufficient gas supply for the dive.

THE REGULATOR

The deeper a diver goes, the greater the demand placed on his/her regulator. The increased flow rate requirements of greater depths can mean increased breathing resistance. A regulator which provides adequate flow with moderate resistance in the 0–60 fsw (0-18 msw) range may have poor flow with high resistance when the diver ventures deeper than 60 fsw (18 msw). The flow rate difference between 30 fsw (9 msw) and 90 fsw (27 msw) (assuming no increase in the rate of respiration cycles) would be two times greater. Should the diver have an increased workload or other stressors, the difference could be over eight times more. Add to the heavy workload scenario one diver ending up having to share air with his/her buddy. Will the regulator's first stage be able to meet the demand of two divers who are working hard at depth? What the diver must ask is, "Will this regulator provide a sufficient amount of air at the depths I intend to dive under all circumstances?" Breathing resistance can be either on inhalation, exhalation, or both. High breathing resistance brings on carbon dioxide buildup, one of the major elements in the panic cycle. High levels of carbon dioxide in the diver's blood contribute to many diving maladies including decompression sickness, inert gas narcosis, and deep-water blackout. First, a diver must select a regulator that will meet all the potential demands of the diver at whatever depth ranges he may intend to dive. The best course of action is to ask yourself where your diving goals may take you in the future. Then, select a regulator that will meet those demands. You should also find a regulator that has a reputation for dependability. The further you are from the surface, the longer it will take to return. You want to minimize the possibility of regulator failure. The last step in having a regulator that will perform correctly, in the deeper depth range, is maintenance. Your regulator should be serviced a minimum of once per year unless the manufacturer specifies more frequent intervals. Under conditions of heavy use, water contaminants, silt, sand, mud, and frequent salt water usage, you should have it serviced two times a year or more. Servicing should be by a qualified repair technician according to the manufacturer's specifications. The regulator is a piece of life support equipment when you are underwater. You should never cut corners when you purchase a regulator. Think of it as life insurance.

THE DIVE INSTRUMENTATION

For diving in the deep sport diving range accurate instruments are a requirement. The tolerance for inaccuracy is much less at these depths when we consider the safety of the divers. The diver must have a gauge that is easy to read. It must be kept in mind that at depth the visibility may be decreased as well as the ambient light. The gauges must allow for some type of easy illumination either as part of the instrument or by a light carried with the diver. The diver must have easy access to all instrumentation and it must be easy to interpret.

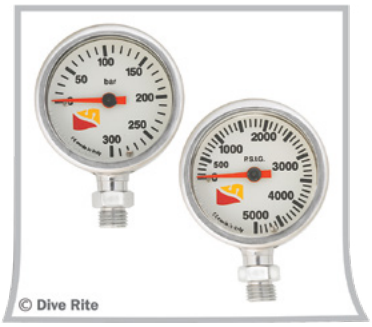
SUBMERSIBLE PRESSURE GAUGE OR SPG

Air is consumed at a faster rate the deeper the diver ventures. A pressure gauge must be accurate to allow the diver to conservatively modify the dive plan in the event that air consumption rates are higher than anticipated. The diver must be able to accurately turn the dive at the correct pressure in order to safely return to the ascent line. There also needs to be a minimum reserve kept in the cylinder for diving emergencies. An accurate submersible pressure gauge marked so the diver can easily interpret it is essential for safe diving.

DEPTH GAUGE

In the deeper range of advanced open water diving a little variation in depth can mean a big variation in the no-decompression limits or the no-decompression time remaining on a repetitive dive. It is important that the diver have an accurate depth gauge. Some older styles of mechanical analog gauges have an accuracy of + or- 5%. At 30 fsw / 9 msw this variation could result in the diver thinking from the gauge indication that he is 1.5 fsw / .45 msw shallower than he really is. With the significantly longer no-decompression limits at this depth, the chances of DCS are small.

At 90 fsw / 27 msw 5% variation could result in the diver being 4.5 fsw / 1.35 msw deeper than he really is. At these depths the variation holds considerably more potential for DCS injury. If you own a mechanical analog depth gauge, have it calibrated on an annual basis. Many divers prefer to use a digital depth gauge because they tend to be much more accurate. The variation tolerance of almost all-digital depth gauges is + 6 inches / 15 cm throughout the whole diving depth range.



BOTTOM TIMER

As the diver proceeds deeper, the time limitations of the dive become much more critical. The shortened time means that the bottom timer must be accurate. There are several types of bottom timers the diver may consider:

- Analogue watch with a bezel.
- Digital watch with countdown timer &/or stopwatch function.
- Analogue depth activated dive bottom timer.
- Digital depth activated bottom timer – may stand alone or is part of the computer function.

Many divers like the advantages that a depth activated bottom timer have to offer. Since the diver descending to depth initiates it, it eliminates the possibility of forgetting to set the bezel on a watch, writing down the time you descended on your slate, or starting your stopwatch or countdown function. Many advanced divers prefer both a depth activated bottom timer as well as a watch with a stopwatch function. This combination allows them to accurately time their safety stops or emergency decompression stops as well as providing a backup time monitor.

DIVE COMPASS

Part of advanced open water diving is learning to use an underwater compass and navigate successfully underwater. The diver operating in the 60-90 fsw / 18-27 msw depth range doesn't have the option of quickly coming up to the surface to find out his location relative to the dive boat or the shore. The compass will allow the diver to navigate on the dive site, even when visibility is less than ideal. It will also allow the divers, when properly used, to quickly find their way back to the ascent line or shore exit at the end of the dive.

TEMPERATURE GAUGE

Temperature gauges come in both analog as well as digital varieties. The digital varieties tend to be more accurate as well as easier for the diver to read. The temperature gauge will allow the diver to accurately check the temperatures of the various thermoclines encountered as he descends to depth. It will also allow the diver to make decisions about equipment for thermal protection at depth. The diver can use the temperature gauge as a guide in modifying the dive plan, in a conservative fashion, to account for unanticipated temperatures at depth.

THE DIVE COMPUTER

The dive computer has become the instrument of choice for a majority of advanced open water divers. It is actually a combination of instrument readouts, which helps the diver control the dive with a much higher degree of safety and accuracy, when properly used. The primary reason that many divers choose to use a dive computer is that it will allow the full use of a multi-level profile. Taking advantage of this in a correct manner will allow more bottom time and a better out-gassing profile. Some other features, which also can be found in dive computers (the individual features may not be available on all models of dive computers), include:

- Multi-level profiles calculated with multiple gasses in some computers including air, EANx, and with some Trimix
- Accurate digital depth readings (+ or- 6 inches / 15 cm) throughout the depth range
- Digital depth activated bottom timer
- Digital surface interval timer activated upon surfacing
- Digital readout of time remaining at any particular depth:
  - During the dive to avoid no-decompression limits
  - Before and between dives as a dive planning feature
- Emergency decompression depths and times
- Ascent rate warnings: audio, visual, or both
- Recall of previous dives

- Gas Supply Integrated Models:
  - Digital readout of cylinder gas supply
  - Digital readout of the time remaining based on the gas consumption rate
- PC interface and download with certain models is available allowing the diver to have all the information available from the previous dives. Many interfaces will graph out the dive as depth verses time and some will plot air verses time. Most offer additional input with this stored information in a dive log style format. Some dive computers will allow uploading to enhance or modify various computer functions.

If a diver uses a dive computer to control a dive, he should carry a set of backup tables appropriate for the gasses being used as well as a backup timer and depth gauge. This serves as redundancy should the computer fail during the dive. Another method of backup would be to carry two dive computers.

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THE BUOYANCY CONTROL DEVICE

The buoyancy control device, BCD, must provide the diver with adequate support throughout the entire depth range he may dive as well as on the surface of the water. Less buoyant cylinders, or extra cylinders, holding greater quantities of air for those longer and/or deeper dives may well mean the diver needs to have a BCD that provides a greater lift capacity. The advanced open water diver may well choose to wear a thicker wetsuit or a dry suit. The BCD must have adequate adjustment to accommodate the extra thickness of heavier environmental protection. Advanced open water divers are beginning to acquire accessory equipment for the various dive specialties they are training in, for example: lights for night diving, reels and lift bags for limited visibility dives, etc. If the BCD has “D” rings or other hardware to help manage, configure, and attach specialty equipment, it proves to be of greater service to the diver.

THE ENVIRONMENTAL PROTECTION

WETSUIT OR DRYSUIT

As the diver ventures deeper and or longer, the need for proper environmental protection becomes greater. Even in areas which normally do not require any type of environmental protection, longer bottom times or repetitive dives may now make wearing some form of wetsuit a necessity for diving safety. In other areas where thermoclines are present, the diver may have to wear radically different environmental protection to survive the chill found at deeper depths. In some cases, the diver may have to go from wearing a wetsuit to using a drysuit in order to prevent hypothermia from becoming a risk factor. Even where there is a mild or no thermocline, the wetsuit, which at shallow depths may have served very well at keeping the diver warm, may become woefully inadequate as the bubbles in the neoprene are crushed by the pressures of depth and the now thin suit looses it's ability to keep the diver warm.

SPECIALTY EQUIPMENT

For the advanced open water core courses you will be required to have certain pieces of specialty equipment. They are:

- Night Diving:
  - A primary dive light
  - A secondary dive light
  - A diver marker light

- Limited Visibility Diving:
  - Lights as described above
  - A cavern or wreck reel with a minimum of 150 feet (45 meters) of line
  - A lift bag with a minimum lift capacity of 50 pounds (22.5 kg)

- Basic Underwater Navigation:
  - An underwater compass
  - A medium sized dive slate

- General (as needed to correctly configure and streamline your equipment):
  - Clips
  - Tie bands
  - Surgical tubing
  - Rings – split and standard
  - Quick release buckles
  - “D” rings
  - “D” ring holders
  - Stage bands

Because of the specific environment you may be conducting the open water portion of you course in, your instructor may require additional equipment.

CONFIGURING YOUR EQUIPMENT

Proper equipment configuration for diving deeper is important for the safety and comfort of the diver. All equipment must meet or exceed the standards set forth in this text. For the most part, equipment for diving deeper AOW range is very similar to that used by the Open Water Diver. It has, however, been refined and modified for the tasks and dive objectives, which come along with the challenges of Advanced Open Water Diving.

Proper equipment configuration means the equipment meets these criteria:

- **Streamlined:** There is nothing dangling- This helps eliminate the possibility of entanglement or coral reef damage
- **Low Drag:** The equipment presents a low profile with minimal resistance as it moves through the water
- **Reliable:** The equipment is in itself reliable, as well as being an assembled unit that functions in a consistent, dependable fashion
- **User Friendly:** The equipment is put together in a fashion which allows the diver easy use, readability, functionality, and movement
- **Easy Access:** The diver can get to each component with minimal effort
- **Logical:** There should be a rationale for the way the equipment is configured which will increase both diver safety and enjoyment
- **Self Rescue and Recovery Capable:** The diver should have the equipment put together in such a manner that self rescue and recovery are able to be performed in a quick efficient manner without the help of a buddy
- **Simple:** The way in which the equipment is assembled is straightforward without being unduly complicated
- **Balanced:** The diving system will be balanced so as not to pull the diver to one side or another- The head to toe trim will also be correct for the diving environment.

KEY QUESTIONS TO ASK ABOUT YOUR DIVING CONFIGURATION

- Are the buoyancy control device's inflate/deflate controls properly secured and in an easy to reach position to allow quick inflation and deflation of the BCD?
- Are all the diver's instrumentation positioned where the diver can easily read each individual monitor during the dive and not dangling freely where they might be an entanglement hazard?
- Is the diver correctly weighted to allow effortless buoyancy control? Is there a quick release on these weights, which is easy to get to, yet will not accidentally release the diver's ballast?
- Is the alternate second stage positioned where it is within quick reach and can be deployed in an instant, yet not placed where it can easily be dislodged accidentally during the dive?
- Are all the components of the diver properly clipped, wrapped, stowed, and placed so that they do not dangle thus providing a streamlined and low drag configuration?
- Are the hoses coming off the first stage of the regulator arranged in a logical and streamlined fashion?
- Are slates and tables stored securely in a fashion so they can be easily accessed yet do not dangle or present an entrapment hazard?

MANAGING POTENTIAL PHYSIOLOGICAL RISKS OF DIVING DEEPER

As we venture deeper into the underwater realm, the risk factors increase. In order to make this a safer venture, we must educate ourselves as to what these various risk factors are and how we can manage them. Those Factors listed in this section are not all the potential physiological hazards that can be associated with diving deeper. They are, however, some of the most common ones.

DECOMPRESSION SICKNESS - DCS

As the diver ventures deeper underwater, the risk of decompression sickness increases. There are many models that have been used to develop various dive tables. Some models are considered more conservative than others. The bottom line is that there is no particular decompression model or dive table that will completely eliminate the incidence of DCS. The diver who ventures into deeper water must be educated as to what might predispose a diver to DCS, how to recognize the symptoms, and how to deal with the bends should the diver get decompression sickness.

There are many factors that could cause a diver to become more susceptible for the development of decompression sickness. Looking at the DCS incidence reports collected by DAN and other agencies, it becomes apparent, in most cases of DCS that multiple factors, rather than a single reason, are most likely to cause DCS. If one knows the potential causes, then steps can be proactively taken to decrease the risk factors. The list below is not all-inclusive. It does record those dynamics which have been found to be commonly associated with decompression sickness.

RISK FACTORS FOR DECOMPRESSION SICKNESS

- Dehydration – One Of The Greatest Risks
- Obesity
- Smoking
- Alcoholic Beverage Consumption – Pre & Post-Dive
- Flying After Diving
- Physiological Aging
- High Air Consumption Rates
- Physical Exertion
    - Pre-Dive
    - During The Dive
    - Post-Dive
- Carbon Dioxide Buildup
- Fatigue
- Improper Diet
- Hypothermia

- Hyperthermia
- Altitude
  - Pre-Dive Altitudes
  - Dive Site Altitude
  - Post Dive Altitudes
- Lack Of Sleep
- Injuries Which Have Resulted In Poor Circulation To The Surrounding Tissues
- Forceful Movement Of The Muscles And Joints At Depth
- Quick Ascents – Faster Than The Table Prescribed Rates
- Equipment Which Might Impair Circulation
- Ascents Without A Safety Stop [3-5 Minutes @ 15 fsw (4.5 msw)]
- Inaccurate Gauges Or Gauge Failure:
  - Depth Gauge
  - Bottom Timer
  - Submersible Pressure Gauge
  - Dive Computer
- Poor Cardiovascular Conditioning
- Not Accurately Following The Dive Plan (Wrong Depths, Times, Ascent/Descent Rates, Etc.)
- Bad State Of Health
- Decompression Diving – Without Proper Training and/or On Air
- Certain Drugs

Although there is no proven method, other than not diving, which can guarantee zero bends incidence, there are certain steps that may be taken to manage or decrease the risk. Below are steps the diver can take to be proactive in lowering the chances of a DCS incident.

WAYS TO DECREASE THE RISK OF DECOMPRESSION SICKNESS

- Hydrate Well Prior To and After The Dive Using A Non-Diuretic Fluid- Isotonic Beverages Are Recommended
- Ascend Slowly- Always Within The Parameters Of The Table Or Dive Computer You Are Using To Control The Dive
- Always Conduct A Safety Stop Of 3- 5 Minutes Minimum At 15 fsw (4.5 msw)
- Stay Away From No-Decompression Limits (NDL) Or No-Decompression Times (NDT) By 5 Minutes
- Don’t Smoke
- Keep In Good Cardiovascular Condition
- Get Plenty Of Rest Prior To Making Your Dives

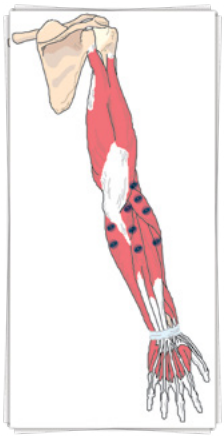
- Allow Plenty Of Time Before Flying (At Least 12 To 24 Hours From Your Last Dive)
- Maintain A Healthy Weight- Fit Body Fat Ratio
- When Diving Keep A Proper Breathing Pattern:
  - Slow Deep Inhalation Of A 6 To 8 Count
  - Slow Deep Exhalation Of A 6 To 8 Count
- Practice Your Skills Taught In Your Dive Courses And Maintain Your Proficiency- Over-Learn These Skills So They Can Be Performed Quickly And Efficiently Without Much Thought
- Make Sure Your State Of Health Is Excellent Before Engaging In A Dive
- Make The Deepest Portion Of The Dive At The Beginning Of The Bottom Time and Gradually Get Shallower During The Dive- No Reverse Profiles
- Avoid Hot Baths After A Dive
- Check With DAN About Any Medication You May Be On While Engaging In Diving
- Always Figure Altitudes Into Your Dive Plan (Must Be Properly Trained and Certified In Altitude Diving), The Altitude Of The Dive Site, As Well As Pre and Post-Dive Altitudes
- Have Gauges Checked Annually For Accuracy:
  - Depth Gauge
  - Bottom Timer
  - Submersible Pressure Gauge
  - Dive Computer
- Have Your Buoyancy Control Device (BCD) Serviced Annually
- Have Your Regulator Serviced Annually Or More Often If Specified By Manufacturer In Situations Of Heavy Use, Or Frequent Use In Muddy, Silty, Salt And Contaminated Waters
- Avoid Heavy Exercise Prior To, During, And After Diving
- Do Not Consume Alcoholic Beverages At Least 12 Hours Before Or After Diving
- Gradually Warm Up After A Dive- Avoid Hot Baths And Showers
- Conduct A Surface Safety Stop (If Surface Conditions Allow) Of At Least 3 Minutes Before Exiting The Water
- Make Sure You Conduct Your Deepest Dive First and Make Each Repetitive Dive Shallower Than The One Preceding It
- Engage In Continuing Diving Education
- Stay Abreast Of New Information Concerning DCS and Managing DCS Risk- The IANTD Nitrox Diver Is A Perfect Medium For This
- As You Get Older, Become Wiser And Dive In A More Conservative Manner
- Make Your Surface Intervals Longer Between Repetitive Dives
- Get Certified In And Use Enriched Air Nitrox – EANx

- Eat A Balanced Low-Fat Diet
- Make Sure Your Environmental Protection (Wet Suit Or Dry Suit & Accessories Like Hood, Mitts, Boots, Gloves) Provides Appropriate Warmth For The Environment You Are Diving, Your Depths and Bottom Times- Stay Warm At Depth
- Make Sure Your Dive Equipment Fits Properly And Does Not Impair Circulation
- Check With Your Physician As Well As DAN If You Are On Any Medication While You Are Diving

CLASSIFICATIONS OF TYPES OF DCS BY SYMPTOMS

Decompression sickness is usually divided in to two major categories with several sub-categories under each. The first of the major categories is Type I Decompression Sickness. This category is defined by symptoms as "pain only". The sub-categories of Type I DCS are: muscular skeletal bends, skin bends, and lymphatic bends. Type II Decompression Sickness is the second major category. It is defined by serious symptoms that involve the cerebral, spinal and pulmonary systems. The sub-categories of Type II are neurological (sometimes divided into cerebral and CNS categories) and cardiovascular. In about 30% of the cases of DCS symptoms progressed from minor to serious over a period of time. There is no way to tell how symptoms will progress, therefore it is important to treat all potential indications of DCS, no matter how slight they may appear, as serious. Symptoms will normally manifest themselves between 20 minutes to 2 hours after the diver surfaces from a dive. There are cases where DCS was indicated as late as 36 hours after diving or more. Most of the later cases involved flying shortly after diving. What should you look for as indicators of DCS?

TYPE I DECOMPRESSION SICKNESS BY CATEGORY AND SYMPTOMS



MUSCULAR/SKELETAL DCS

- Pain In The Joints
- Limb Pain
- Irritation
- Soreness
- Swelling
- Flu-Like Malaise
- Unusual Fatigue
- Lesions In The Bone Tissues (Especially The Long Bones Of The Body) Only Detected By X-Ray

SKIN DCS

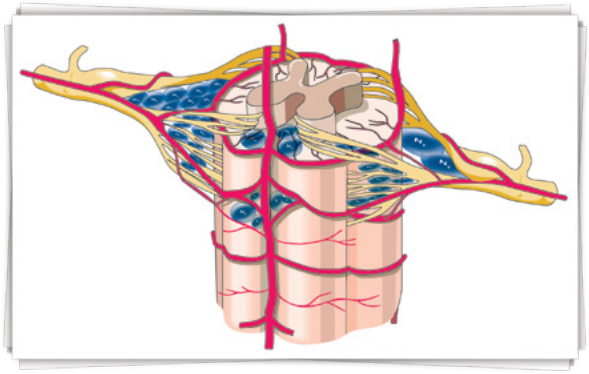
- Rash
- Discoloration – Blue Or Red Marbling Effect
- Itching

LYMPHATIC DCS

- Edema (Puffiness and Swelling) Of:
  - Limbs
  - Face
  - Hands
  - Feet
  - Joint – As A Secondary Indicator After Pain At The Joint
  - Areas Of Lymph Node Concentration: Underarms Neck, Groin

TYPE II DECOMPRESSION SICKNESS BY CATEGORY AND SYMPTOMS

NEUROLOGICAL DCS - CEREBRAL AND CNS



- Loss Of Strength
- Lack Of Sensation
- Paralysis
- Unusual Fatigue
- Tunnel Or Blurred Vision
- Dizziness
- Disorientation
- Headache
- Auditory Abnormalities
- Loss Of Bladder Control
- Loss Of Bowel Control
- Encircling Girdle Pain
- Loss Of Consciousness
- Convulsions

CARDIOVASCULAR/PULMONARY DCS

- Dry Unproductive Cough
- Rapid Shallow Breathing
- Substernal Pain – Acute On Inhalation
- Shock
- Cardiovascular Collapse And Death

DECOMPRESSION SICKNESS FIRST AID

Prompt treatment is critical in cases where decompression sickness symptoms are suspected. The quicker the treatment, the better the final prognosis. The treatment for decompression sickness is hyperbaric oxygen treatment also called “HBO Therapy”. One organization which helps divers get to the nearest operating chamber and can set up air ambulance evacuation is the Divers Alert Network, DAN based at Duke University Medical Center. IANTD supports the Divers Alert Network and highly encourages divers to become DAN members. DAN also offers low cost insurance to divers that will cover hyperbaric treatment as well as air ambulance evacuation. It should be noted that either HBO treatment and air ambulance evacuation is not usually covered in the majority of health insurance policies. The following are the steps of first aid you should follow if decompression sickness is suspected:

1. Check:
    - Airway
    - Breathing
    - Circulation

2. Be Trained In and Ready To Administer CPR If Needed

3. Activate The Emergency Medical System (EMS) Or Transport To The Nearest Hospital If Necessary
    - Have Emergency Phone Numbers Handy Prior To The Dive
    - Have Emergency Radio Frequencies Recorded Where Applicable
    - It Is Always Useful To Have A Cellular Phone At The Dive Site For Such An Emergency
4. Administer 100% Oxygen – Make Sure You Get Certified In An IANTD/DAN Oxygen Provider Course- Do Not Take Them Off The Oxygen

5. Administer Non-Diuretic Fluids- Stop Only If There Is An Indication Of Fluid Retention
6. Call The Divers Alert Network (DAN) (919) 684-8111

A Final Note On Decompression Sickness:
Do Not Dive After An Incident Of DCS Until You Have Received Medical Clearance To Do So

NITROGEN NARCOSIS

As the diver goes to deeper depths the nitrogen in the breathing mixture has an increasing narcotic effect. This effect is known as nitrogen narcosis. For the Advanced Open Water deep range of 60 – 90 fsw (18 – 27 msw), the degree of narcosis under most circumstances will be very slight. Many divers will not even notice it unless a combination of factors lead to moderate and sometimes severe narcosis. You see, depth is not the sole factor that comes into play concerning the onset of narcosis. A critical look at contributing factors will help you be aware of what to watch out for and avoid.

CONTRIBUTING FACTORS TO NITROGEN NARCOSIS

- High Gas Consumption Rates
- Depths Below 60 fsw (18 msw)
- Cold
- Limited Visibility
- Darkness

- Exertion At Depth
- Anxiety
- Loss Of Orientation
- Carbon Dioxide Buildup
- Fatigue
- Task Loading
- Rapid Descent
- Predisposing Psychological Outlook – "I'm Really Going To Experience Narcosis On This Dive!"
- Lack Of Sleep
- Certain Medications And Drugs
- Lack Of Deep Diving Experience

NITROGEN NARCOSIS - THE SYMPTOMS

The symptoms of narcosis will vary from dive to dive and from one individual to another. It would be imprudent to give a list stating, "At a particular depth you should expect to observe these particular symptoms." In some cases certain divers would exhibit none of the stated symptoms and other divers might exhibit more severe symptoms than what was stated to be "average". Be aware of the symptoms no matter how slight they may seem. Remember that the symptoms don't usually get better as you spend time at depth; you just become "numbed" up to them. The biggest danger of narcosis is its insidious onset.

SYMPTOMS OF NITROGEN NARCOSIS:

Feeling Of Relaxation	Feeling Of Well-Being	Overconfidence
Euphoria	Light-Headedness	Slowing Of The Reflexes
Loss Of Fine Discrimination	Judgment Errors	Giddiness
Deterioration Of Handwriting	Distortion Of Time Perception	Inability To Perform Multiple Tasks
Numbness	Tingling	Impaired Reaction Time
Decreased Conceptual Reasoning	Confusion	Memory Lapses
Memory Distortion	Dreamlike State	Inability To Solve Problems
Feeling Of Wanting To Fall Asleep	Auditory Or Visual Hallucinations	Feeling Of Impending Blackout

NITROGEN NARCOSIS - MANAGEMENT STEPS

If a diver is diving deep on air [60 fsw (18 msw) or greater] he should be aware that narcosis will effect his performance on the dive. The diver who thinks that under no circumstances will he/she get nitrogen narcosis is at just as great a danger as the diver who expects to get narcosis as soon as he/she hits a particular "magic depth". Some suggested techniques to help lessen the degree of narcosis and/or cope with it are listed below.

TECHNIQUES TO HELP MANAGE NARCOSIS:

- Get Proper Training For The Depths At Which You Intend To Dive
- Never Exceed The Maximum Depth To Which You Are Certified And Feel Comfortable At
- Get Training For Specialized Environments (Cave, Wreck, Ice, Cavern, Etc.)
- Get Training In The Use Of Special Gasses For Deep Diving (I.E. Trimix)
- Descend Slowly, 30 Feet Per Minute (9 Meters Per Minute)
- Get Plenty Of Rest Before The Dive
- Keep The Pre-Dive As Well As The Dive As Stress Free As Possible
- Visualize The Dive
- Keep Dive Objectives A Simple As Possible Until You Gain Plenty Of Experience At Depth
- Avoid Diving If You Feel Apprehensive
- Over-Learn Your Dive Skills
- Maintain Visual Orientation During The Dive
- Wear Appropriate Protection To Keep Warm During The Dive
- Keep Multiple Tasking To A Minimum
- Don't Consume Alcohol With 12 Hours Either Side Of A Dive
- Check With DAN On Their Information Number (919-684-2948) Before Diving On Any Type Of Medication – Even Over-The-Counter Medicines
- Listen To Your Intuition
- Stay In Good Cardiovascular Condition
- If You Haven't Been Diving For A While, Work Up To Deeper Depths Gradually
- Abort Any Dive You Feel Apprehensive About
- Make Sure You Have A Regulator Which Will Provide Low Breathing Resistance
- Dive With A Buddy Who You Feel Comfortable With and That Has The Proper Training, Equipment and Experience To Dive To The Depths Of Your Dive Plan

HYPOTHERMIA

Hypothermia is a major concern for most divers venturing below 60 fsw (18 msw). Most inland as well as many ocean diving sites will have thermoclines. In some areas during the summer months the difference between surface temperature and temperatures at depth can be quite severe. As the diver goes to depth any insulating neoprene components of his environmental protection will become thinner and loose much of their insulating properties when they are needed the most. The gas a diver breathes as he descends deeper becomes denser. The cooler ambient waters then cool this denser gas. Denser and cooler gas now picks up heat from the core of the diver's body as it is breathed.

Hypothermia is a definite risk factor for the diver venturing to greater depths. Loss of dexterity, impaired mental functions, and inability to perform critical tasks are all problems that are associated with hypothermia. Narcosis is enhanced when a diver gets cold. The amount of energy the diver has, both mental and physical, can be quickly depleted once he/she starts to chill. It is important when venturing deeper to understand hypothermia and how to avoid it.

DEGREES FAHRENHEIT	DEGREES CENTIGRADE	SYMPTOMS
98.6	37.0	Average Body Temperature
95.0	35.0	Shivering Actually Begins
93.0	33.9	Confusion And Disorientation
92.0	33.4	Amnesia
91.5	33.1	Shivering Stops, Muscle Rigidity, Irregular Heart Beat
86.0	30.0	Unconsciousness, Loss Of Reflex Responses
77.0	25.0	Death

DRESSING TO AVOID HYPOTHERMIA

It is important for the diver to evaluate the particular environment in terms of temperature, depth, and exposure time in order to select the environmental protection that would be most appropriate for the dive. There are currently many options the diver has to keep warm while underwater.

WETSUITS AND NEOPRENE INSULATION COMPONENTS

One of the most common forms of environmental protection used by divers is the wetsuit. The neoprene rubber is filled with thousands of tiny gas bubbles that increase the insulation the diver has. The efficiency of the wetsuit and neoprene components decreases the deeper the diver goes in the water column. To offset this effect, a diver can opt to wear a thicker neoprene suit.

The most critical are of the body to keep warm is the head. The hood is used to prevent loss from this area. One way to make a hood warmer is to wear one made out of thicker neoprene. There are several differing designs of hoods: warm water (short bib), cold water (long bib), attached hood, and hooded vest. There are a variety of gloves and mitts designed for all water temperatures: thin gloves for warm waters, thicker gloves with long gauntlets for cold warm, and mitts for very cold waters. There are a variety of skins that may be worn under wetsuits to increase insulation. Some provide more insulation than the warm water nylon or Lycra. Certain wetsuits have a reflective lining made out of various metallic threads such as titanium. Wearing several layers of the appropriate types of wetsuit & skin materials can help when dealing with reducing the risk of hypothermia. Wetsuit options including kidney pads as well as spine pads can help increase the warmth.

DRY SUITS AND ASSOCIATED COMPONENTS

Air is a much better insulator than trapped water. The dry suit further extends the diving exposure to cold water. You must have a dry suit with quality dependable seals in order to stay dry and warm. Some divers will further increase the insulation factor by filling the suit with argon rather than air (argon being a slightly better insulator than air). The type of undergarment worn in a dry suit will vary according to the water temperature and the duration of exposure. Many high tech materials have been developed for these undergarments that provide both thinner materials than those of the past and greater insulation even if damp or wet. Sometimes a diver may use a neoprene component with a dry suit in waters that aren't extremely cold, such as neoprene boots gloves, hoods. For those that prefer a greater degree of cold protection there are suits that have dry boots, dry gloves, and dry hoods. NOTE: Do not use a dry suit unless you have been educated in its proper use. Safe dry suit diving requires special training and techniques.

OTHER METHODS TO BEAT THE COLD

ACTIVE HEATING SYSTEMS

There have been perfected in recent years active heating systems for both dry suits and wetsuits. The electric wetsuit/dry suit heater is one of the most recent. It is an affordable option for almost any diver. Some will offer the option of turning up the heat during the dive. In this manner the diver can actually get warmer during the dive. This option has made some dives that were once considered dangerous or impossible, due to the risk of hypothermia, within the realm of safe possibilities.

A DIET FOR KEEPING WARM

Keeping the metabolic heater tuned up will help in protecting the diver from hypothermia. The first step in keeping warm would be to stay well hydrated with non-diuretic fluids. This hydration should start the day before the dive and on repetitive dives should continue during the surface interval(s). Warm, not hot fluids will help to keep the diver warm and bring up the core temperature. A diet high in complex carbohydrates will help in ensuring a steady supply of energy for the metabolism. A diet high in proteins will also help in raising the metabolism as long as it is started two to three days prior to the dive and maintained throughout the diving schedule. You should avoid consuming a lot of sugar, which can spike blood insulin levels and then put you in a hypoglycemic state resulting in a higher potential for hypothermia. You should also be sure to maintain food intake at regular intervals – no skipping meals. A slight increase in calorie intake will help maintain heat production when diving in cold waters.

DRESSING PROPERLY ON THE SURFACE

A diver who gets chilled on the surface is only going to be closer to hypothermia once he enters the water. Make sure that you have proper clothing to stay warm while you are out of the water. Again, the head is a very critical area to keep insulated. Wear your hat. Between dives it may be handy to have an extra sweatshirt or jacket to put on. Even though the air temperatures may be mild, you come out wet and a little wind can really chill you. It is a smart idea to remove the top of the wetsuit and put on a dry top between dives. A little forethought and preparation can go a long way for safety and comfort while diving.

FIRST AID FOR HYPOTHERMIA

Hypothermia is a dangerous enemy and should never be underestimated. The progression of hypothermia is much faster underwater than it is in air. The minute you start to shiver underwater is the point at which you should terminate the dive. One tip that will help you detect that your buddy is getting cold will be an increase in breathing rate. Remember that hypothermia can be deadly. Plan to minimize the risk, and if you start shiver, act quickly to terminate the dive.

The first aid for hypothermia is:

1. Get The Diver Out Of The Water
7. Place Him/Her In A Sheltered, Warm Environment Out Of The Wind
8. Have Them Dress In Dry Warm Clothing
9. Give Warm (Not Hot) Fluids
10. Re-Warm Gradually – Too Rapid Of A Re-Warming Process Can Be Extremely Dangerous
11. Activate The Emergency Medical System (EMS)- Get Medical Help
12. Monitor Vital Signs
13. If CPR Is Needed And/Or Drowning Is Involved, Don't Give Up Because There Have Been Cases Of Revival Even After Hours Of Submersion

HAND SIGNS FOR ADVANCED OPEN WATER DIVES

Advanced Open Water diving requires that the divers have a superior ability to communicate. Below are some of the general phrases which you should have hand signs to review with your dive buddy for increased ability for swift, concise communication needed for safe diving in special situations, environments and deeper depths. See Appendix for the hand signs.

The dive slate should always be carried to facilitate specific communication, but well learned hand signals can convey critical information easily and quickly. The learning of finger spelling can also be advantageous. The IANTD Underwater Signing Specialty Course is designed specifically for divers who wish to take their communication skills through signing even further.

GAS MANAGEMENT

As a diver ventures deeper, the gas supply that he is breathing is depleted at a faster rate. Gas supply management becomes even more critical to monitor. The first step in gas supply management is setting up your turn pressure. Turn pressure is defined as the point at which you reach a predetermined gas pressure as indicated on your SPG and "turn the dive", returning to the anchor line, the ascent line, or exit point and ascend.

THE ½ + 200 PSIG (1/2 + 14 BAR) RULE

This rule is employed in open water environments where there are no obstructions above the diver such as cavern, wreck or ice. It is used only on dives where no decompression stops are required or "non-stop dives". It is used only on dives shallower than 130 fsw (40 msw). On most cases the Advanced Open Water Diver will use the ½ + 200 Rule as their turn pressure.

Imperial Example: 3500 psig starting pressure:

- 3500/2 = 1750 + 200 = 1950 psig
- Rounded up = 200 psig turn pressure

Metric Example: 240 Bar starting tank pressure:

- 240/2 = 120 + 14 = 134 Bar turn pressure

Formula For Determining Surface Air Consumption Rate Or SAC

- SAC = Surface Air Consumption: either as psig / minute or Bar / minute
- AC = Air Consumed in psig
- T = Time at depth in minutes
- ATA = Average depth of the dive expressed in Atmospheres Absolute
- FORMULA: SAC = AC / (ATA x Time)

Formula For Determining Respiratory Minute Volume Or RMV

- RMV = Respiratory Minute Volume in cubic feet / minute or free liters / minute
- SAC = Surface Air Consumption: either expressed as psig / minute or Bar / Minute
- CWP = Cylinder's Rated Working Pressure in Psig or Bar
- CV = Cylinder Volume At Working pressure (amount of total gas when released at 1 ATA)
- FORMULA: RMV = (SAC x CV) / CWP

Further information as well as comprehensive planning charts on advanced gas management may be found in the IANTD Deep Air Student Manual and Workbook.

LIFT BAG - EMERGENCY PROCEDURES

There are two primary reasons for the use of a lift bag for emergency ascents in deep diving. The equipment the diver needs for these procedures, and are required safety equipment when diving below in most diving open water environments when diving below 60 fsw (18 msw), includes a lift bag of 50 pound (22.5 kilogram) lift capacity and a cavern/wreck reel with at least 150 feet (45 meters) of line.

DISORIENTATION, NARCOSIS, OR VERTIGO

The deployment of the lift bag on a line attached to a cavern/wreck reel provides the diver with instantaneous vertical reference. When a diver is overcome with severe narcosis or vertigo there may not be the luxury of time to find or swim to the ascent line. The lift bag, properly deployed, provides the diver with a direct ascent line in under a minute. The 50 pound (22.5 kilogram) lift capacity makes available a stable platform for the buddy team to conduct a slow controlled ascent and safety or emergency stop.

LOST ASCENT LINE AND/OR ANCHOR LINE

There is a chance that divers may not be able to find their way back to the anchor and/or ascent line in the allotted bottom time. There can be multiple reason for such an instance: extremely limited visibility, currents, navigational errors, and narcosis. The divers who carry a lift bag can deploy it and start their ascent in a controlled fashion. This minimizes the possibility of running low on gas supply, having to perform an emergency decompression, or an out of control ascent. It also provides the surface support crew, dive master, dive supervisor and/or boat captain a reference to find a team and be ready for them once they come to the surface. It could be critical in areas where there are currents in that the lift bag many be the one factor that alerts people at the surface divers have been swept away from the ascent line. It is much easier to spot a bright lift bag than the divers bubbles, especially if there is any surface chop. A lift bag and reel could make all the difference between a safe ascent or an emergency situation.

THE ROLE OF EXPERIENCE IN DEEPER DIVING

Once you are trained and have the proper equipment, there is still something you have to work on: building experience. Your instructor may have taken you to 90 fsw (27 msw). You must remember that this was done under the instructors' supervision. Once you are out on your own, the instructor will not be there to help you out. It is a prudent approach to pull back your depths to make the first dives around the 60 fsw (18 msw) to 70 fsw (21 msw) range. After enough dives to allow you to know this range well, gain confidence and comfort then proceed to then add another 10 fsw (3 msw) to your operating range. Continue the process over a series of many dives until you reach the maximum depth to which you are trained in the IANTD Advanced Open Water Course of 90 fsw or 27 msw. Should you not dive for an extended period of time, you should gradually work up to your maximum certified depth over a series of dives rather than pushing it to the maximum right away. If you have need and/or you goals are taking you beyond the 90 fsw (27 msw) depth range, then the IANTD Deep Air Diver Certification Course is your next step in the educational process.

Once you complete the IANTD Advanced Openwater Course, you are experienced enough to conduct any number of dives to any recreational diving depth

QUIZ

A True

B False

You start the dive with a tank that is filled to 240 bar/ 3500 psig. Based upon the IANTD gas management rule for Advanced Openwater dives, you should turn your dive when your SPG reads? starting pressure:

QUIZ

A 134 bar/ 1950 psig

B 120 bar/1750 psig

C 160 bar/2300 psig

D There is not enough information to calculate an answer

As we venture deeper into the underwater realm, the risk factors increase. In order to make this a safer venture, we must educate ourselves as to what these various risk factors are and how we can manage them.

QUIZ

- **A** True
- **B** False

As the diver ventures deeper and or longer, the need for proper equipment becomes greater. Dives requiring longer bottom times, deeper depths and/or repetitive dives may now require which of the following piece of equipment to be upgraded?

QUIZ

- **A** Thicker wetsuit or drysuit
- **B** Mask with corrective lenses
- **C** A side mount bottle
- **D** A rebreather

@ Huish Outdoors

Chapter 3

LIMITED VISIBILITY AND NIGHT DIVING

LEARNING OBJECTIVES

1. **State 2 or more causes of limited visibility during a dive**
2. **Name 2 or more pieces of equipment that are important to a diver while diving in limited visibility conditions or night diving.**
3. **State 2 or more key questions you should ask during the dive planning process for limited visibility or night diving.**
4. **State 2 or more criteria for selecting a night diving location.**

LIMITED VISIBILITY AND NIGHT DIVING

LIMITED VISIBILITY DIVING

INTRODUCTION

Although most divers strive to dive under conditions where visibility exceeds 25 feet, it just isn't always possible. Crystal clear cobalt blue water isn't at every ocean dive site. In certain areas of the world the seas always have poor visibility. In other places the visibility can vary drastically on a day to day basis (sometimes hour to hour). Inland divers tend to be even more restricted in their choices of sites that offer pristine conditions. The need to learn how to dive in limited visibility from the standpoint of safety and enjoyment cannot be argued. The diver who will only dive sites where visibility is considered good, has a very narrow perspective on the underwater world and will miss some potentially unique experiences. In some areas where a fin kick or two can drastically change how far you can see, proper training in Limited Visibility Diving can reduce stress levels and make the dive much safer.

THE NEED FOR PROPER NAVIGATION SKILLS

Disorientation is common when the visual clues are limited or nonexistent. Diving where limited visibility is a factor means the diver must have proper navigation skills. In Chapter 5 you will become familiar with the basic navigation skills needed for Advanced Open Water Diving and Limited Visibility Diving. What is covered in this section is simply a general overview of what will be covered in much greater detail in the next chapter. Therefore the material here will be kept brief.

NATURAL NAVIGATION

Where the underwater terrain allows for it, navigation by natural features can be a helpful means of finding your way around the dive site. This requires that either you are personally very familiar with the bottom layout or you have a good map showing how various natural (and sometimes man made) features are configured at the site. You may be able to follow a particular reef formation or ledge, but do you know where it will take you? Can you get back to where you must exit? Next chapter will state exactly what these natural navigation features are and how to use them.

COMPASS NAVIGATION

Many times the primary form of underwater navigation, when visibility is less than ideal, will be the compass. When selecting a compass, one should consider just how easy it will be to read under low visibility/low light conditions. You need a compass that has the appropriate features to make it functional under a wide variety of environmental conditions. Some of the primary considerations should be the azimuth markings, lubber line, and north needle. Can you see them well enough to use them in murky waters? How will the compass be carried? If it is a wrist mounted unit, you want to be sure that you can properly navigate as well as use a dive light. If you have a console mounted unit, you want to make sure you can manage the tasks of holding the console and your dive light as well as performing navigation.

COMPASS BOARDS

Many divers who consistently operate under limited visibility conditions prefer the use of compass boards. The compass board allows for many alternate forms of lighting the compass, such as on board mounted mini dive lights or the use of chemical light sticks. The lubber line can be extended on such a board making it much easier to see. The compass on the board can be larger than would be found on a wrist or console allowing for larger compass markings. Since survey is such an important part of many limited visibility dives, the board may actually be a necessity. You may wish to consider taking the IANTD Underwater Survey Diver Course.

BASIC NAVIGATION TECHNIQUES

- Compass management is critical for operating in poor visibility. You must be able to properly read the compass and handle a light or any other special equipment appropriate for the environment and/or dive objectives. A crucial skill is the ability to hold the compass level so that the north-seeking needle swings freely. This can be difficult to achieve under conditions where visual clues on where the horizontal horizon are few. It is easy to think, “This isn’t right. I feel like I am going in the wrong direction.” You should make sure that the compass needle is freely swinging. If it is, trust your instrumentation.
- Point to point swimming is another skill that should be perfected under good visibility conditions before engaging in limited visibility diving. It is a fact that you will be focused in on a much narrower area under these conditions. It is important that you reach your specified site(s) quickly and accurately.
- Using a kick count or time to measure distance traveled is another skill to master. It is easy to swim right by your target if you aren’t aware you are in the general area. Divers have been known to swim right by rather large wrecks just a few yards off to their side in murky waters, simply because they lacked the ability to know when they should stop swimming out on their set azimuth and start running a search pattern.

CAUSES OF LIMITED VISIBILITY

SUSPENDED SEDIMENT AND BIOLOGICAL ACTIVITY

SEDIMENT

Sediment is a major factor in most dive areas where limited visibility is encountered. Typically areas with rocky bottoms tend to have the best water clarity. Many diveable areas get that way because they are filled with runoff water. Along with runoff water generally comes sediment. This sediment can be classified in three major groups:

- Sand – Normally, sand is the least serious of the sediments. Under most circumstances, it settles out quick and visibility returns quickly in a matter of minutes. In areas effected by rapid water movement, sand can remain continuously suspended thus keeping visibility low.
- Fine inorganic matter – This class of sediment is in the common vernacular referred to as “mud”. Much more serious than sand, fine inorganic matter will remain suspended far longer than sand. It is also easier for a careless diver to stir up the mud compared to sand. Fine inorganic is probably the most common cause of limited visibility, especially in freshwater areas.
- Clay – Although clay is a type of fine inorganic matter, it is usually categorized by itself due to the severe long term potential it can have in causing poor visibility. Two major factors make clay such a powerful agent in clouding the water: 1) Clay is composed of such fine particles, it can stay suspended for extremely long periods of time once stirred up. Sometimes turbidity may last for over a day. 2) A little clay goes a long way! If a diver’s fin tip or console touches down into a clay bottom, the diver will be throwing off a “smoke screen” as his/her movement through the water washes the clay off.

BIOLOGICAL ACTIVITY

Practically every underwater environment on earth is a type of ecosystem. The biological activity taking place in the water can either be responsible for clear water or the cause of murky water. This organic matter will fall into one of two categories – living or dead. These can decrease visibility as follows:

- Decaying And Decomposed Organic Matter. As plant and animal material washes into water basins it decomposes. As it breaks down smaller and smaller particles form. Not only can this decaying matter cause reduced visibility, it usually smells very noxious.
- Certain Plants Contain High Concentrations Of Tannic Acid. As water flows across the leaves of the tannin-laden plants it becomes darkened. The water takes on the appearance like that of dark clear tea or coffee. Many rivers in the Southern U.S. have tannic water – usually referred to as “blackwater”. The surface light in these bodies of water quickly disappears. Light from the diver’s underwater source is usually absorbed in a few feet.

- Animal Life: Small and microscopic animals living in the water can become key elements affecting visibility. This is evident when they are present in great number. Many divers are familiar with ocean sites where the annual plankton bloom turns the water into a virtual underwater fog.
- Plant Life: This is usually prominent in areas rich in nutrients that can promote algae growth. Inland this has become very common at dive sites whose source is runoff form farm areas. Agricultural runoff is high in nitrates and thus promotes. This can be a seasonal event in fresh as well as saltwater areas. Other factors that can result in increased suspended plant growth and reduced visibility are: warmer water and increased sunlight.

WATER MOVEMENT

Water movement may cause limited visibility. Just how water movement can reduce visibility includes but is not limited to one or more of the following:

- Tidal Influence: As the tide moves in and out, the wave action, tidal currents, and surge may reduce visibility as sediment is kicked up.
- Currents: Currents in any body of water: lakes, oceans, jetties, rivers may be a source of not only danger but can make it difficult to see, stirring up sediment along their path.
- Aeration: Flowing water may cause tiny bubbles of air to become suspended temporarily in instances such as swiftly flowing over and around objects such as rocks. Common areas effected include sites in or near rivers, below waterfalls, and in the surf zone.
- Seasonal Turnover: As water cools it becomes denser and sinks until it reaches a temperature near 38ºF or 2ºC. At this point the water molecules start to move farther apart and become less dense and rise. This causes seasonal turnover each spring and fall in many bodies of water. This turnover can either enhance or reduce underwater visibility.

DIVER ACTIVITY

Any seasoned diver is well aware that the greater the number of divers operating in a specific area, the less the chance good visibility exists. The chances that someone or several parties in a large group of divers have poor finning techniques, a lack of buoyancy control, and/or bad equipment configuration is high. This tends to compound if the divers are poorly educated, inadequately trained, and/or have little experience.

ADDED RISKS OF LIMITED VISIBILITY WATERS

BUDDY SEPARATION

It is very easy for dive buddies to become separated when diving under conditions where visibility is poor. The usual mistake that most team members make is to allow spacing between each other to become too great. In clear waters distances between buddies can be measured in yards and a few extra feet farther away makes little difference. In murky water a foot or even a few inches may make the difference between knowing where your buddy is or being separated. A lapse of just a few seconds, a couple of kicks and you could find yourself alone.

ENTANGLEMENT

When you can see what you are heading into, it is easy to avoid objects that might entangle you. It may be difficult to see monofilament line under the best conditions. When visibility is poor, it is impossible. Lake divers are familiar with the fact that trees and brush can pose dangers. Experienced river divers have probably had the experience of barbed wire fence grabbing hold of them or their equipment. Wreck divers know that outside the wreck such things as fishing line, rigging, cables, and netting can be a problem. Inside the wreck they may have to deal with such things as loose and hanging wiring. Add to all the above the element of limited visibility and there is an exponential increase in the probability of entanglement.

PSYCHOLOGICAL STRESS FOR SOME

Perhaps the greatest fear that most humans have to deal with at sometime in their life is the fear of the unknown. When you can't see farther than a few inches it is easy for the imagination to run wild about what creatures are waiting out their ready to threaten your existence. Darkness often goes hand in hand with limited visibility. The inexperienced or insufficiently prepared (no or inadequate light) may experience anxiety form being in the dark. For others it is just the primal fear of the dark. Certain people experience claustrophobia when diving in murky waters. Finally, stress may originate from disorientation. This may start in the psychological realm as the fear of being lost and may progress into the physical realm as vertigo and nausea.

Most individuals with proper education, dive skills, experience, and equipment can manage these risks. Proper planning and execution of the dive are critical for a safe dive. There may be circumstances where the risk levels are too high for the diver to accept and the no-dive decision must be made.

EQUIPMENT FOR LIMITED VISIBILITY DIVING

If you don't have the right tool for the job, limited visibility diving could become extremely dangerous. It is important that you select and maintain your equipment with care. It all starts with a good basic set of dive equipment for the environment in which you intend to dive. You then add the following specialty equipment to allow you to operate more efficiently under limited visibility conditions:

LIGHTS

Depending on the factors causing the poor visibility, a light may help you see farther or just illuminate a small area in front of you. It can be critical in reading your instrumentation. In some types of murky waters the light will reflect back much light as fog does a car's headlights. The light is important in all cases because it can be a critical factor in keeping you and your buddy together. Some divers will use a strobe to aid in making them more visible to their buddy under such conditions.

COMPASS

It is just too easy to get lost when you can't see. Your visual clues as to your location on the dive site are limited or non-existent. Unless you have a compass that you can read and you know how to use it, you will probably end up lost.

CUTTING DEVICE - DIVE KNIFE OR SHEARS

With the increased risk of entanglement that accompanies limited visibility, it is imperative the diver has the appropriate cutting devices for the dive site. This must be mounted on the upper body within easy reach. A spare or backup cutting device should also be carried. Shears are usually quicker and easier to use in limited visibility because they can cut fishing line, rope, etc. with one hand.

REEL

A cave or cavern reel often is more than just a handy device in cases of low visibility. It can be a lifeline. It will allow you to find your way back to your ascent line and/or a safe exit point. The diver needs to know proper line protocol to avoid getting tangled in his own line. Diving in murky waters, it is easy to swim into or under something without being aware of entering an overhead situation. The guideline you have properly laid may be your only clue as to how you get back out.

BUDDY LINE

A buddy line is a short piece or rope that the divers each hold on opposite ends. The rope is no longer than three to four feet to avoid self-entanglement or snagging on an object in the water. The buddy line is never clipped, tied or attached in any manner, as this could be extremely dangerous. In cases of extremely limited visibility, this may be the only way the divers can maintain contact. If you aren't invading your buddy's personal space too much, holding hands may work as well as a buddy line.

LIFTBAG AND UP REEL

A lift bag of at least 50 pound (22.5 kg) lift capacity should be carried with the diver along with an up reel with enough line to be deployed from the maximum intended depth [at least 130ft (40m)]. This will provide an instant ascent line should the divers have an emergency or not be able to return to their preplanned ascent line. It will also signal the surface support personnel where the divers will ascend if they cannot use the preplanned ascent point.

ULTRASONIC LOCATOR

These devices have become more common on the dive market. Their prices have fallen making them an affordable consideration. Although not absolutely required for limited visibility diving, they can make the finding of the anchor line, exit point, or ascent/descent line much easier in limited visibility situations.

CONFIGURATION

Properly equipped, the diver should make sure that his/her equipment is configured correctly. Regulators should be on a neckband to prevent their loss, entanglement, or potential malfunction. Gauges and consoles must be clipped or positioned so they will not hang away from the diver or catch on possible snags. Knives should be located on the upper body within easy reach. Reels, lights, liftbags, and other equipment carried on the dive system must be easy to reach yet not dangle, encouraging entanglement. Swinging gate clips ("suicide clips") should not be used in order to avoid hooking into stray lines. The key word for proper configuration is "streamlined".

PLANNING LOW VISIBILITY DIVES

STANDARD DIVE PLAN

A properly planned low visibility dive begins with the "standard dive plan" – see Chapter One. All elements of Advanced Open Water Dive Planning must be strictly adhered to. Then the environmental specifics of Limited Visibility Diving are also put into the dive plan.

ENVIRONMENTAL ASSESSMENT

In reduced visibility situations extra caution must be taken when conducting an environment assessment. The limited visibility can greatly increase the dangers from other environmental factors. One must carefully consider the following aspects of the dive:

- Are There Depths Beyond The Levels Of Training Of The Team At Or Near The Dive Site?
- Can Entries And Exits Be Made Safely Under Such Conditions?
- What Are The Causes Of The Limited Visibility? Can These Factors Pose Additional Dangers To The Diver – Such As Strong Current, Surge, Environmental Contaminants?

- Are There Objects On The Bottom, Which Under These Conditions Could Entangle Or Entrap The Dive Team?
- Could The Possibility Of Not Surfacing On The Ascent Line Pose An Additional Risk To The Diver? (I.E. Surface Traffic, Rocks, Strong Surface Currents, Etc.)

DIVE OBJECTIVES AND RISK ASSESSMENT

When entering water with less than ideal visibility you must carefully consider the purpose of your dive. You should evaluate the objectives and do a risk assessment. Key questions you should ask during this process would be:

- Are the dive objectives reasonable given the reduced visibility and other environmental conditions?
- Can the risks associated with the dive be brought into "manageable" parameters?
- Are all team members and you comfortable, properly trained, adequately experienced, and have the proper equipment for the dive?
- Are all team members and you clear on all points of the dive plan as well as emergency procedures and contingency plans?
- Are the risks of the dive worth the benefits derived from it?
- Are you doing the dive because you wish to be there?

If you can't answer "yes" to the above, then abort the dive!

DIVE ABORT AGREEMENT

As on every dive, the dive abort agreement must be strictly adhered to. This agreement states:

1. Any diver can call the dive, at any time, for any reason.
2. The thumbs up signal means, "We are terminating this dive."
3. When a diver gives the abort signal it is never debated, questioned, delayed, or ignored. The dive is over – period!
4. Once at the surface the diver who gave the abort signal should never be ridiculed for the decision. An explanation as simple as, "I just didn't feel comfortable" should suffice.

MAINTAINING THE BUDDY SYSTEM

One of the most difficult tasks when diving in murky waters is maintaining the buddy system. The following should be well covered as part of the dive planning process and strictly adhered to on the dive in order not to loose your buddy.

COMMITMENT AND SLOW MOVEMENT

The dive team must have a strong commitment to stay together during the dive. The role of each diver is clearly defined in terms of maintaining the buddy system. Slow movement during the dive is extremely important as a few feet or even inches can mean the difference between being able to find your buddy or being lost. The team leader must pace him/herself so as not to get too far ahead of the secondary team member. The secondary team member must be continually vigilant at all times to stay with the team leader.

PHYSICAL CONTACT

Physical contact is highly recommended in cases where extremely poor visibility exists. It provides immediate assurance at all times as to where your buddy is located. It also allows for touch communication, which may be under some circumstances the only possible way to convey a message to your buddy. Physical contact can also be psychologically reassuring helping to prevent stress.

BUDDY LINE

The buddy line has both advantages and drawbacks. The major advantage is that it allows the divers to operate just outside the range of each other's vision, yet know where their buddy is at all times. This could be a benefit for search and recovery operations where visibility is limited. The major disadvantage is the buddy line can get snagged by objects on the bottom, plant growth, or caught in lines. It important to remember that the buddy line is never attached, clipped or tied to the diver. It is held on the end by the diver's hand. To reduce the possible catching of the buddy line on objects, it should be only 3 – 4 feet (1 meter) in length.

EMERGENCY PROCEDURE - BUDDY SEPARATION

Even with all the best intentions, training, equipment, experience, and planning, there is still a remote possibility of buddy separation when you are in murky waters. The emergency procedure for buddy separation is:

1. **Remain Calm –** Maintain the proper breathing pattern: Slow deep exhalation followed by a slow deep inhalation. Stay focused.
2. **Look and Listen For Your Buddy, His Light Or Bubbles.** During the short pause between inhalation and exhalation be especially alert for any sound which might indicate where your buddy might be. Do a 360-degree turn looking for his light. First flash your light out into the darkness. Then put it up against your chest scanning for any sign of your buddy's light. While you are looking for your buddy's light also look and listen for any bubbles that would tip you off as to where he could be.

3. **Surface and Reunite.** You and your buddy should agree that if separated, you will spend no more than one minute at the bottom looking for each other. Then you both should start your ascent to the surface at the end of the minute and reunite there.
4. **Mark Location If Buddy Doesn't Surface:** If your buddy doesn't surface, you should mark the location and seek immediate help. This will increase the chances that a speedy and successful rescue can be conducted.

THE DESCENT AND BOTTOM PHASE

During the descent and bottom phase of the dive the diver runs the risk of disorientation, vertigo, anxiety, and possible panic. It is important that the diver takes advantage of all the visual cues that remain plus use equipment and instrumentation to maintain orientation. Proper descent and bottom procedures are the same as more ideal diving situations with the addition of the following for low visibility:

- **Use A Descent/Ascent Line:** This may be a buoyed line or a boat anchor line. The line allows you to maintain stability, vertical orientation, and buddy contact.
- **Descend Feet First And Head Up:** It is easier to maintain your sense of up and down in a head-up position. This position is also the easiest from a physiological standpoint to equalize from. It is also a dangerous proposition to go headfirst into something you can't see.
- **Break Your Descent:** Stop your descent using your BCD so you come to rest neutrally buoyant a few feet off the bottom. Plowing into the bottom or kicking to stop your descent will only further decrease you visibility.
- **Get Organized Before Leaving The Line:** Is all equipment working and in place? Are you maintaining a proper breathing pattern? Is your buddy okay? Allow a few seconds for your eyes to adjust to the lower light conditions. Recheck environmental conditions at the bottom. At this point you and your buddy will make the final decision if the dive is a "go" or "no-go".
- **Check Your Buoyancy:** Get neutrally buoyant before leaving the line. Do any last minute fine-tuning.
- **Employ Proper Navigation:** At this phase you will be either navigating by natural features, using your compass, or running a line. Sometimes you may be using a combination of techniques.
- **Use Anti-silting Techniques:** You don't want the downward thrust of your fins creating a vortex, which will leave a cloud of silt trailing behind you. As part of your pool/confined water and open water training for this course you will be working on finning techniques which will help prevent a further reduction of visibility in areas with a silty bottom. These kicks include the modified flutter, modified whip kick, modified dolphin and the shuffle kick.
- **Hold Your Light Out From Your Body:** Let your light shine at a 30 to 45 degree angle from the long axis of your body. This should result in much less back-scatter from the particles that may be suspended in the water.

- **Stop When Surrounded By Swirling Silt:** If the bottom gets stirred up, hang neutrally buoyant off the bottom and wait for the silt to settle. In extreme low visibility situations hanging up off the bottom can be disorienting. Under these circumstances it is better to do a toe touchdown and sit motionless to allow the waters to gain some visibility.
- **Maintain Your Orientation:** This is critical for a safe dive in murky waters. Key elements which will help you maintain orientation include:

1. **Watch Your Bubbles:** Bubbles, unless there is an extremely strong current always rise. In this way you can maintain vertical orientation.
2. **Use A Little Water In The Mask As A Level:** Let a little water in your mask. Focus on the water line, which will help you maintain your horizontal horizon.
3. **Trust Your Compass:** As long as the north-seeking needle swings freely, trust the heading on your compass. This is the way you can maintain your proper direction in the horizontal plane. Learn to ignore those gremlins in your head that would tell you that the compass couldn't be right.
4. **Check Your Depth Gauge:** With fewer visual clues it becomes easier to accidentally float to the surface or exceed the maximum planned depth of the dive. Be careful and check often as to where you are in the vertical plane underwater.

THE ASCENT

The divers need to keep in mind that proper ascent is as critical to safety as any other portion of the dive. It is important that the ascent be done in a controlled fashion. The following are guidelines for safe ascents in limited visibility waters:

- **Use Proper Air Management:** In cases where the limited visibility is slight or moderate, ½ + 200 psig should be the minimum for turning your dive. In cases where you are unfamiliar with the site and/or the limited visibility is severe, the Rule of Thirds should be the minimum applied to the turn point. The Rule of Thirds is: one third for the trip out from the decent line, one third to return to the decent line and the last third for emergency (reserve). In cases where returning to the ascent line is absolutely critical, always use the Rule of Thirds for a minimum turn point. Murky water may cause time delays and the possibility of having to deal with entanglement is high, so always be very conservative when planning your air management.
- **Use An Ascent Line:** It is important to use an ascent line in limited visibility situations. It helps you maintain your vertical reference. The ascent line keeps you and your buddy together preventing the possibility of a lost diver. It helps you maintain a safe ascent rate and provides a stable platform for your safety stop [3-5 minutes @ 15 fsw (4.5 msw)].

- **If You Can't Find The Ascent Line, Use Your Reel And Liftbag:** Simply deploy your liftbag attached to your reel (you will be shown how by your instructor as part of your waterskill training) if you should fail to find the ascent line. You should never take the risk of exceeding your planned bottom time or let your gas supply get to critical levels when trying to locate your ascent line. Each diver in the group should have a reel and liftbag combination. One diver in the team will deploy the reel and liftbag. The team will then ascend on the line. Should there be a failure, such as a reel jam, the second team member has a backup.
- **Beware Of Overhead Objects:** In limited visibility situations you should always ascend slowly with one hand up over your head. You should also be looking up to make sure you don't ascend under an object. Better to catch the object with your hand than a hard bump on the head. Many an unaware diver has had the misfortune of hitting his/her head on such objects as tree limbs, overhangs, or dive boats. Be careful and watch what you are ascending into.
- **Clean Up:** Limited visibility water is usually full of all sorts of organisms. Many times these are not harmful, but why take that chance? Clean yourself as well as your equipment with a good anti-bacterial soap. At the very least both you and your equipment will look better and smell better.

NIGHT DIVING

INTRODUCTION TO NIGHT DIVING

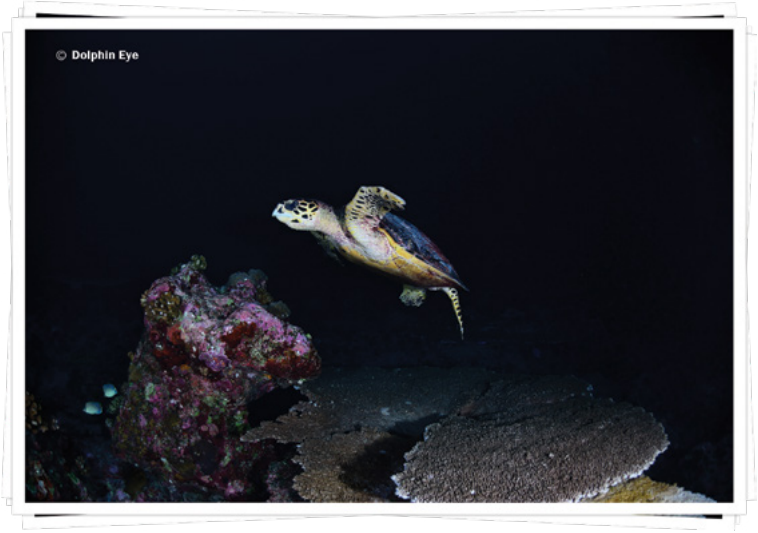
Why include night diving in the same chapter as limited visibility diving? Night diving is in essence a form of limited visibility diving, even in the clearest of waters. Once the sun sets, the distance you can see in the water is drastically decreased. Your visibility is limited by how far your light can penetrate the darkness. Therefore it is important to keep in mind everything you have learned in the previous half of this chapter when planning and conducting a night dive.

CHALLENGING THE UNKNOWN (ADVENTURE)

For the new diver who has only been familiar with day diving, the next step in the adventure is to go on a night dive. The underwater world is so different at night. The experience is so exhilarating. The initial fears that some divers have about night diving are quickly dismissed when they enter the water after sunset. The mysteries of the night are not just limited to those who dwell on land. They are even more powerful for those who choose to venture underwater at dark. Your light seems as if it holds a mystical power in the way it transforms a dark world into a wonderland full of interesting objects with bright colors. Your brilliant white light replaces the reflected ambient blue light, associated with day diving. Colors are much more intense.

NIGHT TIME MARINE LIFE

Few divers who have never engaged in night diving can foresee the magical transformation that happens after the sun goes down. A whole new array of fish life becomes active, while others become very tranquil and approachable in a sleep state. Many hard corals, which appeared as dead rock in the daylight, now take on a soft feathery look as the coral polyps come out to feed. The stage and the actors are so completely different at night that many times, should you dive the same spot at night that you did during the day, you would swear it couldn't be the same dive site. Many creatures that were hidden or extremely timid during the day are found out in the open at night. lobster, crab, shrimp, moray eels and the very illusive octopus often make a nighttime appearance. Words fail to adequately describe what Cousteau termed "The Fireflies of the Deep".



NAVIGATION TECHNIQUES

All of the remarks about navigation and use of the compass mentioned under the section on Limited Visibility Diving apply here. There may be one difference which can be advantageous to the night diver that the diver in an area where constant limited visibility is the rule may never have. The night diver can (and should) conduct a day dive at the same site to gather important information which will help determine how to navigate around the area at night and conduct the dive safely. Reconnaissance information you should obtain is:

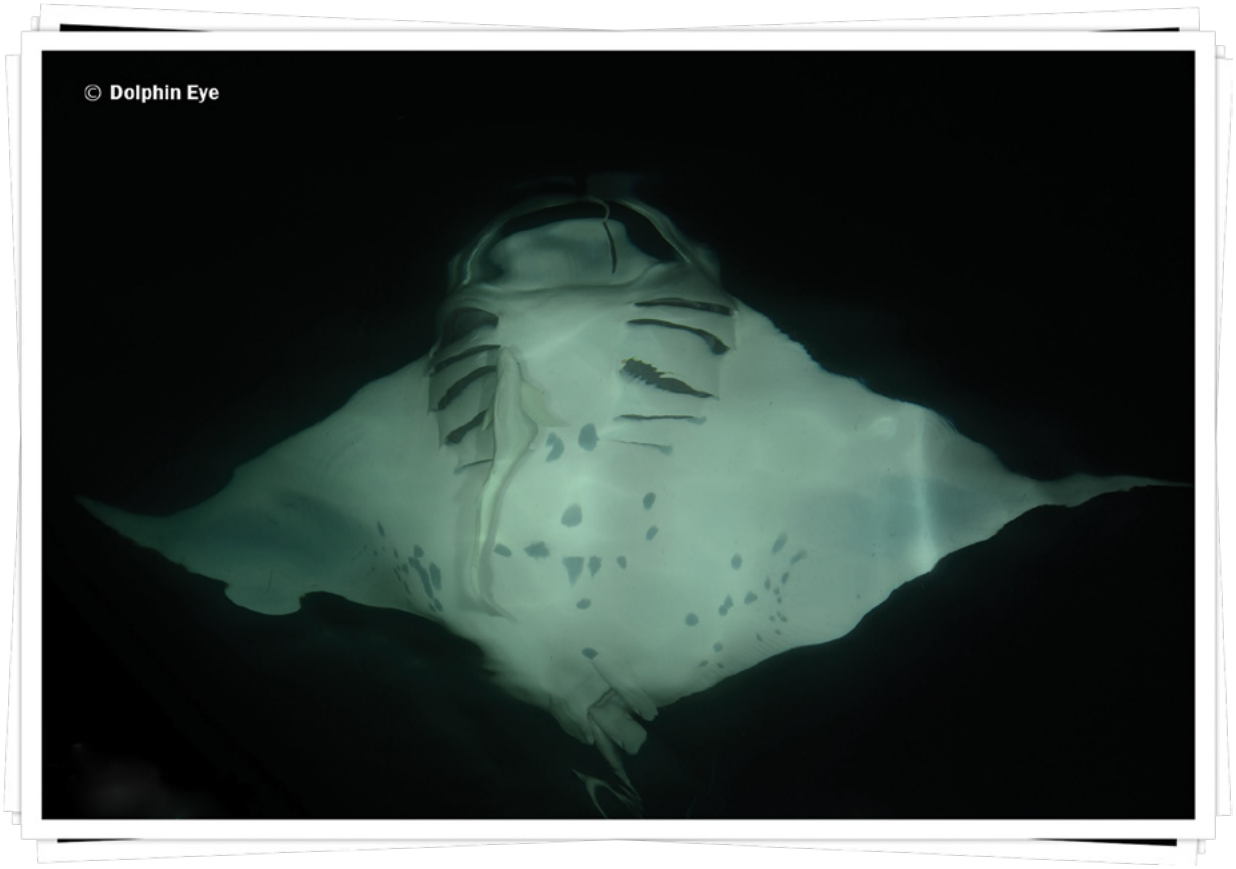
- Compass headings and distance from the point of entry to the site
- Compass headings and distance from the site to your point of exit
- Distinctive landmarks that may be of help for surface swims at night- Pay special attention to those that might be illuminated
- Natural features and how they are configured on the site in relation to each other- A drawing with compass headings would be helpful- This information could be carried back to the site at night with the diver on the dive slate or in laminated form

- Depths at the dive site. Be especially aware of any excessive depths that exceed your dive plan or are beyond 90 fsw (27 msw)- If such depths exist, note any terrain features that would help you identify that you were in close proximity to this area
- When in areas affected by tides, try to dive the site in the daytime under the same tidal conditions- This will help you gather information on correct depths as well as tidal currents
- Make note of the marine life- This will heighten your sensations as to the great difference that exists between the creatures of the day and those of the night- You will also be surprised by how certain species will exhibit far different behavior once the sun sets
- Investigate any potential hazards on or near the dive site- Look for such things as ledges, walls, drop-offs, currents, surge, difficult entries and exits, and/or potentially dangerous marine life

A little bit of extra work during the day will go a long way to increase safety, comfort and enjoyment of your night dive.

EQUIPMENT - THE DIVE LIGHT

The greater the intensity of your dive lights the more intense the night diving experience. Get a quality primary light with plenty of candlepower and burn time. It will be an investment that will pay you back every time you go diving with it.



THE PRIMARY LIGHT

This light is the brightest light carried by the diver. Those serious about night diving or specialty areas of diving that require dive lights will often have a primary light with at least a 20-watt bulb. The smartest choice of power for the primary light is that of rechargeable batteries. Rechargeable batteries are both cost effective and will allow for a more consistent beam of light throughout the dive. The upper end primary dive lights will allow the diver to change the wattage of bulb as well as the width of the beam. Differences in water clarity and dive objectives often dictate if a wide angle or spot light work best. You want the light configured in a fashion that would allow it to be clipped off or otherwise stowed away in the event you should have to switch to your secondary light source.

THE SECONDARY LIGHT

The secondary light is not a luxury. It is a mandatory safety requirement. The minimum number of backups light for most open water dive environments is one. There may be circumstances where either the diver may elect to take more or the environment demands a greater minimum number. Should the primary light fail, the secondary light provides the needed illumination to safely terminate the dive and ascend. Just like the primary light, you want a quality secondary that is dependable. To have a cheap, poorly designed and/or undependable secondary light is to compromise your safety. The secondary light must provide sufficient candlepower to allow the dive to perform all functions necessary to terminate the diver in the event of a primary light failure. An underwater penlight is not considered a secondary light. Most divers use alkaline powered secondary lights. This requires the diver to check the batteries prior to the dive to ensure that they have adequate power in case of primary light failure. The secondary light is usually a smaller light than the primary. This allows for easy stowing of the secondary light(s) as well as streamlining the configuration.

DIVER MARKER LIGHTS

The purpose of the diver marker lights is to allow a dive buddy, dive team, and/or dive master to easily see each person who is underwater from all directions via a light which is usually positioned high on the diver either on the upper cylinder or valve or the upper arm. It should be mounted so that anyone around the diver, especially those following behind this diver, can without difficulty see the light. There are three major categories of these diver marker lights:

- **Chemical Light Sticks:** These sticks run a wide variety of colors making dive identification easier should the dive plan assign a specific color to each team member. They are inexpensive. Chemical light sticks come with different intensity levels. The brightest sticks usually have the shortest burn time. The light sticks, if stored for a long time, can fail when activated. It is important to check the expiration date stamped on the outside of the foil wrapping around the tube. The advantage of this type of light is there are no bulbs or batteries to fail.
- **"Standard" Lights:** These lights are small and usually made to be attached to the cylinder valve. Most have a conical attachment which fits on the top of the light lens allowing it to be seen from all directions (much like a traffic controllers light). Since these smaller lights use very small batteries, it is imperative that the diver makes sure they are fresh prior to making the dive. The advantage of this type of light is that it is reusable.
- **Dive Strobe:** This type of light must only be used underwater, unless there is an emergency. The strobe offers the ability for other divers to see it from a great distance and in limited visibility situations. Most personal dive strobe markers are configured so they can be attached to the diver's upper arm or somewhere on the diver's upper body or cylinder valve. The strobe not only offers extremely good diver visibility from great distances; it also will operate for very long periods of times on a fresh battery. The last advantage of a strobe is emergency use on the surface.

DIVE CONTROL MARKER LIGHTS

The three major types of lights mentioned in the above section are usually used for dive control marker lights. It should be noted that the strobe should not be used as a surface dive control marker light with the exception of its' use in an emergency. There are two general categories of dive control marker lights:

- **Surface Dive Control Marker Lights:** These lights are attached to a float or floats on the surface. They aid the diver in locating the dive site or specific objects of interest on the dive site. A descending line is attached to the buoy allowing the diver to quickly descend to the site without.
- **Underwater Dive Control Marker Lights:** These lights help control the dive at depth. The underwater marker light may be used to mark the ascent/descent line or mark the anchor line of the boat.

These lights should be of high quality and visible from all directions. It is important to make sure that the burn time of the light exceeds that of the planned bottom time.

- **Boat Lights:** Boat lights are used for four reasons as they relate to night diving activities:
  - To provide adequate light for the divers to properly assemble their equipment and put it on, as well as, disassemble and take off equipment
  - To provide sufficient light for a safe entry into the water from the boat
  - To provide sufficient light for a safe exit onto the boat from the water
  - To allow divers to locate the boat if they should surface at some distance away from it
- **Shore Lights:** When the beach is used as a point of entry and exit, shore lights become part of the standard operating procedure. Shore lights should be visible from all directions and of sufficient brightness that they can be seen whatever the distance the diver is operating offshore, even if rain, fog, or snow should come up during the dive. Purposes for shore lights are:
  - They are used to mark the entry and exit points
  - They allow plenty of light for pre and post-dive operations
  - They provide light for safe entry and exit from the water
  - They may aid in navigation. These lights can help divers on the surface find where their exit point may be- Sometimes two shore marker lights are used; one above and behind the other, in order to navigate through a narrow channel or reef cut, by aligning the two lights

DIVE LIGHT FEATURES

BULBS FOR UNDERWATER LIGHTS

There are many varieties of bulbs used in underwater lighting systems. Although the list here is not all inclusive, it deals with the most common bulbs on the market used in dive lights.

- **Standard Vacuum Bulbs:** This type of bulb was the first to be used in underwater lights. As technology has advanced newer more efficient bulb types have almost made this type of bulb obsolete for underwater use. Generally, it is found only in the low quality light systems. Some mid-range quality lights still use a seal beam standard vacuum bulb. It is not very energy efficient for the amount of candlepower it produces. The common methodology used to get this bulb to provide brighter output for diving purposes is to use a bulb of a lower current rating on a higher voltage. (A 4.5-volt bulb might be used on a 6-volt system.) This does result in a brighter light. It also has its' drawbacks: 1. The bulb life is shortened. 2. The bulb is more sensitive to failing if bumped while it is turned on. These drawbacks must be considered seriously by the diver because both could result in light failure during the dive. Perhaps the only advantage the standard vacuum bulb has over the newer versions is price. They tend to be far less expensive than rare gas filled bulbs. One must ask, does the possibility of light failure on a dive justify the few dollars extra one might have to pay?

- **Rare / Inert Gas Filled Bulbs:** The rare / inert gas bulbs allow the filament to operate at a higher temperature with the rare gasses acting as a heat sink. This makes these bulbs extremely efficient in that they give more candlepower for the energy consumed when compared to vacuum bulbs. The common rare gasses used in these bulbs are krypton, argon, or xenon. Another modification that may be made is to add a trace amount of halogen to these inert gasses. Those bulbs that contain the halogen are termed "halogen bulbs". Rare gas bulbs operate at very high temperatures. Some of the underwater lights use the water as a heat sink to carry away the heat and should not be operated outside the water. You should check the manufacturer's specs as to how the light should be used. Higher temperatures also mean that care must be taken during transport of these lights. It is a good idea to either remove or disconnect the batteries. When changing or replacing one of these bulbs, care must be taken not to leave any fingerprints or oils on the bulb. Never directly touch the bulb. Oils left on it can burn and cause the bulb to fail. If you should accidentally touch a rare gas bulb with your fingers, clean it with an alcohol solution and allow it to dry before replacing.
- **Experimental And New Technology Bulbs For Underwater Lights:** There are some new types of bulbs that have been modified from land applications, which hold some potential for underwater applications. Manufacturers are currently experimenting by making modifications to bulbs such as mercury and sodium vapor bulbs as well as arc lights to provide exceptional candle power for underwater lighting products. The future holds much promise in this area.

BATTERIES FOR UNDERWATER LIGHTS

The power source for your underwater light is an important consideration. You must have a source that will give you the burn time and meet all the demands of the type of light you have. In some cases the manufacturer will allow several choices of types batteries to used in their lighting systems. You must choose the one which fits your dive objectives the closest. Some of the most common battery types for underwater lights are:

DISPOSABLE

- **Carbon-Zinc:** Although some divers use carbon-zinc batteries in their dive lights, they are not recommended. Their only advantage is that they are inexpensive. Their burn time tends to be shorter than other battery types. Because of the lower quality of this battery, it is more prone to leakage. Carbon-zinc batteries don't perform well in a sealed environment, especially in the presence of moisture. They tend to release fumes which can corrode the contacts inside the light as well as de-silver the bulb reflector.
- **Alkaline:** For many divers, alkaline batteries are the batteries of choice for their secondary lights. They are moderately priced for the disposable type of battery. These batteries are able to sustain a greater current draw compared to carbon-zinc varieties, which means longer burn times for the light. The alkaline battery is usually a quality type of battery, making it much less likely to leak in a sealed environment. They tend to have a long shelf life. Many actually are dated for freshness. One way to extend this battery's shelf life is to store it in a cool place or in a sealed container in your refrigerator.

- **Disposable Lithium Battery:** The disposable lithium battery is the most expensive of the non-rechargeable dive light batteries. It has several advantages that make it worth the expense for some diving environments. It is the least of this category affected by extremely low water temperatures. The lithium battery also has little power variation throughout its life cycle, which translates into consistent candlepower from your bulb.

RECHARGEABLE

- **Lithium-ion:** The lithium-ion rechargeable battery is found in only a few expensive dive lights. The reason this battery, with some major advantages, is not as popular as other varieties, is primarily its high cost. The lithium-ion battery has the ability to deliver more burn time than comparable nicad batteries (30% – 50% more). Extremely cold temperatures have little effect on this battery's power output. The lithium-ion battery is not prone to picking up a charging memory compared to the nicad. As price on this battery technology begins to drop, there will be more manufacturers that will seriously consider the lithium-ion battery for their dive lights.

BEAM ANGLE

Be aware that beam angle will play an important role in selecting a dive light. There are certain waters where a floodlight is advantageous. There are other situations where there is a need for a spotlight. Dive lights fall into four major groupings when it comes to choice of beam angle:

1. Fixed Beam Angle: This style of light offers only one beam angle. The type of reflector and bulb are preset by the manufacturer and allow for no variation. This type of light is not normally the light of choice for the primary light. It is the most common choice for a secondary light.
2. Dual Beam Bulb: The dual beam bulb light can give the diver a choice of a spot or flood light by allowing the ability to switch between two filaments in a sealed beam reflector bulb that are positioned at different distances from the reflector. One must take care on dual filament bulbs to make sure beam angle is the function of the dual beam (others have dual beams for a backup filament or a brighter beam with little or no change in beam angle).
3. Changeable Beam Angle: This allows the diver to change the light and/or reflector in the light head prior to diving. This way the diver can not only change the wattage of the bulb but can also change the beam angle. It should be noted that once on the dive, the diver couldn't make any further changes in beam angle. This is one type of light that is a popular primary light.
4. Adjustable Beam Angle: For a diver who may have a need or desire to change the angle of the beam during the dive, the adjustable beam light is mandatory. This type of light allows the diver to move the reflector nearer or farther away from the light bulb, thus focusing the beam of light at the desired angle. Divers who plan on going on to a variety of advanced sport and technical specialty areas, which demand the use of a dive light, tend to prefer this style of light.

OTHER FEATURES OF UNDERWATER LIGHTS

There are also some other considerations divers must take into account when selecting their dive light. These features would be:

- **Buoyancy:** Where the bottom is far below the diver's planned operating depth, such as a wall dive, a positively buoyant light may be preferred- For a fixed bottom, such as wreck diving, a negatively buoyant light is preferable
- **Battery Pack:** Will the pack be separate from the light head (as is the case for most high-powered primary lights with long burn times) or will the light head and battery housing be one piece?
- **Burn-Time:** You must select a primary light that has enough burn-time to allow you to safely accomplish all your dive objectives- If you don't carry extra battery packs, will it allow for extra dives during the day before recharging?
- **Candlepower:** How bright a light will you need?
- **Depth Rating:** You must consider on all of your lights, primary and secondary, how deep you might be operating with them- This becomes especially important should you intend at some point in your diving education to venture into the technical realm
- **Grip Type:** How will you hold the light? There are many types of grips and handles on the market; which is most appropriate and comfortable for your diving needs?
- **Size:** You want a light that can be easily mounted, handled, and stored when not in use- Secondary lights should be small, streamlined and have low drag when it comes to shape and size.
- **Warranty:** How well does its manufacturer guarantee the light? You want to keep your light in top shape- The greater investment you make in a light, the better the warranty should be

CARING FOR YOUR LIGHT

Proper care will help in making sure you have a dependable source of underwater illumination and that your light continues working properly for many years to come. Always follow your manufacturer's guidelines for light care. The following are some general light maintenance procedures.

- Rinse your light in clean fresh water after each dive- Dry the exterior surfaces
- Open the light and check for moisture- If moisture is present allow to dry- If the moisture source is salt water, the light should be rinsed first with fresh water prior to drying- Drying, in most cases, is best accomplished by gently blowing the inside dry with compressed air
- Remove the batteries and care for them in the appropriate manner- Never leave batteries in a light when storing it
- Clean any sand, silt, or debris from the casing and screw-down threads with a soft brush- Old toothbrushes work great for this task

- Check all electrical connections and clean if needed- Emory cloth, fine grit sand paper, fine steel wool, or a pen eraser will help with this task- Contacts free of oxidation and corrosion will mean a dependable light
- Check all o-rings- Clean them by wiping lightly with a no lint soft cotton cloth- Coat with a very light coat of silicone lubricant
- If your light has a hydrogen absorbing catalyst inside, make sure it is dry- If it gets wet, replace it- The function of this device is to absorb hydrogen released as the battery discharges- Should the unit fail there is a chance of explosion

SELECTING A SITE FOR NIGHT DIVING

- **All The Criteria For Selecting A Day Dive Site Apply:** First evaluate the site based on the standards you would use when making a day dive- See Chapter One of this text- Then apply the following principles
- **This Should Be A Site You Have Become Familiar With By Diving It During Daylight:** The information gathered during the day will ensure that you are in control of the dive and know the features and potential hazards of the area
- **If Swimming From Shore:** Make The Surface Swim No More Than Moderate
- **The Site Should Have Limited Wave And Current Activity:** Darkness can only add to the hazards of current and wave action
- **Easy And Safe Access:** Make sure that the divers can enter and exit the water in a safe manner
- **Free Of Surface Traffic:** Surface traffic is always hazardous- It becomes more so after sunset- Should the divers surface away from their marker buoy, the beach, or at the dive boat, it could be very difficult for them to be spotted by traffic on the surface
- **Good Surface And Underwater Visibility:** You can't enjoy a night dive if there is no visibility- Poor visibility makes the possibility of entanglement and loss of buddy greater- It is not worth the risk to night dive in poor viz
- **Good Navigational Features:** The site should have features that make it easy to find your way around underwater- This way you can concentrate on your objectives rather than spending most of your time trying to navigate and figure out where you are
- **Good Anchorage Or Staging Area:** It is imperative that the anchorage or staging areas provide an easy safe place to go through pre-dive and post-dive operations both in terms of enjoyment as well as safety
- **Interesting Features And/Or Marine Life:** The dive should be worthwhile- A night dive with plenty of underwater life to enjoy or interesting features to explore will definitely be worth the effort

NIGHT DIVING - THE PRE-DIVE

All the same pre-dive planning that would be followed on a day dive should be executed during the pre-dive phase of a night dive- Other night diving pre-planning includes:

- **Site Selection:** Selecting a site that you have become familiar with during the day- You must integrate the information you have gathered on your day dive at the site into your night dive pre-plan such as site layout, control features, and compass headings
- **Arrival And Setup:** Arrive at the site and anchor / or get setup at the beach entry point before dark- This allows plenty of natural daylight to assemble and check equipment, visualize and discuss the dive pre-plan, as well as fill out preplanning information in your logbook.
- **Your Dive Buddy:** Know your buddy- Make sure that your buddy has the proper equipment, experience, training and skills for the night dive you intend to do- It is best to have previously done some daylight diving with the same buddy so you are familiar with the way he/she operates in the water
- **Special Light Signals:** Go over any special light signals that will be used during the dive- Never use a light signal that calls for turning on and off the light as this is can increase the possibility that a light will fail- Common light signals for diving in the dark are:
  - "**OK"** The beam of light is moved in a slow circular motion in the shape of an "O"- The first diver to do so is asking the question, "are you okay?" If the next diver signals back with the same signal, he is saying, "I am OK"
  - **"Help"**, "Attention", "Emergency" The beam of light is moved back and forth in a rapid manner- After gaining the buddy's attention, this is followed by pointing the light at the source requiring attention or by an illuminated hand signal
- **Swim Area:** Limit the swim area- Specific limits should be placed on the area that will be covered on a night dive- To decrease the chances of getting lost is the first reason to cover less area than would normally be covered during the daylight- The second reason is that the focus will be on a much smaller zone – that area illuminated by the beam of light from your dive lights- Focusing in on a smaller area at night will lead to many interesting discoveries and increase the overall enjoyment of the dive
- **Emergency Plan:** Emergency procedures are more complicated- Be sure to have all personnel briefed on emergency procedure – divers as well as surface support- Cover emergency signals that will be used- Make sure that all emergency phone numbers and/or radio frequencies are recorded and handy including those for the local EMS, DAN, nearest chamber, and Coast Guard if applicable
- **Time Schedule:** Cover the time schedule for the dive including projected time of descent, bottom time, and arrival back at the surface
- **Marker Lights:** All marker lights should be checked prior to the dive, both those used on the surface as well as those for underwater
- **Refined Navigation Techniques:** Navigation is best accomplished on a night dive if you can use natural features to find your way around the site- If this is applicable to your site, go over the features in detail- Make sure the team fully understands the route that will be taken during the dive

- **Air Management:** Always add an extra margin of safety to your dive plan by increasing your RMV by at least-1 cubic feet per minute for your first 20 night dives- If diving with a new buddy it is wise to follow this practice also
- **Surface Float Option:** On some dives it is convenient to add the control feature of having each dive team use a line and illuminated float so they can be tracked by personnel on the surface - Each buddy team is usually given a distinctive colored light for their float, so the surface support can tell teams apart
- **Diver Marker Lights:** Make sure that all individual diver marker lights are activated and attached to the cylinder valves or other appropriate location before entering the water

DESCENT PHASE

Apply what we covered in the previous section on limited visibility diving for maintaining orientation when you night dive also. Key points of the descent phase are:

- **Use A Descent Line:** The line will serve to:
  - Help you maintain your vertical and horizontal orientation
  - Serve as a control feature for a slow controlled descent, allowing you to stop at any point and equalize
  - Keep you and your buddy together on the descent- You should always descend eyeball to eyeball
- **Check Descent Marker Light:** The marker light may need to be attached by you and activated if you are the first down the line- This will help you relocate the line at the end of the dive
- **Stop Descent Above The Bottom:** Once you get close to your preplanned depth range, stop a few feet shy and do the following checks:
  - **Check Buoyancy:** Make sure that you are neutrally buoyancy- Fine-tune your buoyancy
  - **Check Your Breathing:** Make sure your breathing pattern is a deep slow inhalation of 6 to 8 counts followed by a deep slow exhalation of 6 to 8 counts- Make sure the breathing pattern is relaxed
  - **Check Your Air Supply:** Make sure that you have plenty of air for the projected bottom time and have not used excessive amounts on the descent- If the air usage is greater than planned, modify your bottom time in a conservative fashion (shorten it)
  - **Check Your Buddy:** Make sure that your buddy is okay and ready to proceed
  - **Get Horizontal:** Prior to leaving your descent line obtain a horizontal body position- This will help keep from stirring up the bottom and maintain good visibility

THE BOTTOM PHASE

This phase of the dive is where all the fun should begin. Proper functioning at depth will make the dive not only safer but also more enjoyable by all involved. Important aspects of functioning at depth on a night dive are:

- **Maintain Neutral Buoyancy:** Be aware of depth changes that may exist on the site- As you change depths, make the necessary changes to maintain neutral buoyancy
- **Operate In A Small Radius Around the Descent Line:** Be sure to keep the marker light you have on the descent line in sight
- **Use Natural Navigation Features:** Use the natural features for navigation which you discussed during preplanning to stay within the dive area and maintain your awareness as to your exact location on the dive site
- **Check Instrumentation:** On a night dive it is important to check your air supply and depth often- Keep a close eye on depth gauges, bottom timers, submersible pressure gauges, and compass headings and/or your dive computer- At night you will check these instruments a little more often than you would on a day dive
- **Check Your Buddy:** Make sure at periodic intervals that your buddy is okay- Never allow yourself to get beyond sight of your buddy's dive light- The operating rule is: "Close & Careful" - Swim together slowly
- **Keep Initial Night Dives Easy:** On initial night dives everything should be planned in an extremely conservative manner- Dive Objectives should be simple- The bottom depths should be shallow- The water conditions should be ideal- The dive times should be limited- As you gain experience and confidence, then you can expand your dive parameters
- **Watch Your Turn Pressure:** Be sure to start your return to the descent line at or before your turn pressure

THE ASCENT PHASE

Once you have returned to the ascent line, you will begin the ascent phase of the dive. The ascent phase is as follows:

- **Return To The Ascent Line:** You should always ascend on a line- It is important to keep you from becoming separated from your buddy, to maintain a correct ascent rate, to keep vertical orientation, and to provide a stable platform for a 3 – 5 minute safety stop at 15 fsw (4.5 msw)
- **Signal Your Buddy You are Ready to Ascend:** Give your buddy the thumbs up signal- Wait for a returned signal, then start your ascent together
- **Stay Together:** It is important that you and your buddy stay together on the line as you ascend incase one of you needs assistance
- **Perform A Safety Stop:** Conduct a safety stop of at least 3 to 5 minutes at 15 fsw (4.5 msw)
- **Signal Surface Support:** Once at the surface, signal the surface support leader, dive master, or dive supervisor as to your status- If you are in need of help, don't hesitate to ask
- **Exit The Water:** Be careful upon your exit from the water- It is all too easy to accidentally trip or fall without the benefit of daylight

TWILIGHT DIVING

Twilight diving is a prudent approach to approaching a site where you will be night diving. On this type of dive you arrive at the dive site before dark. If getting to the site involves a swim, you plan on arriving at the descent line just before the sun goes down. The dive teams make sure that all planning and preparation for the dive is completed well before dark. Just as the sun starts to set the divers begin their descent to depth. This will allow the divers to conduct the first part of the dive in the low ambient light of twilight. By entering the water at this time they have some time to become familiar with the area. They also get to observe the magical Transformation that takes place underwater after dark. The last portion of the dive will take place in the darkness where the only light provided is by the lights carried by the divers. The divers plan their ascent just as they would on any night dive, at an ascent line denoted by an underwater marker light. The twilight dive can truly be a moving experience for any diver.

NIGHT DIVING SUMMARY

Night diving holds an element of adventure like few others. There are all sorts of interesting creatures in many areas to observe that normally would not be seen during a daylight dive.

Perhaps the most popular spots for night diving are in the tropics. It is here where the magic of the night is most striking with the transformation of the corals and all the tropical marine actors which come onto the stage at night. One must be sure that they are familiar with the dive site prior to diving it in the dark. A day dive at the designated night dive location will allow the diver to gather all the critical information for setting up a safe and enjoyable night dive. The diver must be familiar with the use of natural navigation (covered in detail in Chapter 4) on the dive site, which makes it easier to remain oriented and within a safe dive area. The easiest way for new divers to enter into the night diving experience is to conduct a twilight dive. As you gain experience your objective can become more complicated and the night dives can be more challenging. Just because it is dark outside, there will be no excuse for staying out of the water once you know how to properly night dive. The world underwater is mysterious, fascinating, adventurous and almost magical at night. Don’t miss out on the adventure of diving after dark!

When selecting a Night diving location, which of the following criteria should be used in selecting a good dive site?

QUIZ

A Be familiar with the dive site

B Only night dive from a boat in areas with a lot of boat traffic.

C Begin and end night dives at boat ramps

D Make sure that the dive site is a barren area free of any features underwater

The dive planning process for limited visibility or night diving begins with a standard dive plan and then the environmental specifics of the dive are also put into the plan.

QUIZ

A True

B False

Which of the following piece of equipment is the most important to a diver to increase visibility underwater while diving in limited visibility conditions or night diving?

QUIZ

A Light(s)

B Dive computertraffic

C Tri-view mask

D Handheld sonar device

Which of the following is not a typical cause of limited visibility conditions during a dive?

QUIZ

A Bubbles from regulator exhaust

B Sediment

C Biological activity

D Water movement

@ Huish Outdoors

Chapter 4

BASIC UNDERWATER NAVIGATION

LEARNING OBJECTIVES

1. **State 2 or more reasons for the importance of being able to navigate underwater**
2. **State 2 or more items that can be used to assist a diver to naturally navigate a dive site**
3. **State 2 or more components of an underwater compass**
4. **Name 2 or more simple compass patterns used by divers to compass navigate a dive site**
5. **Name 2 or more safety guidelines to practice while navigating underwater**

BASIC UNDERWATER NAVIGATION

INTRODUCTION

Underwater there are no street signs to tell you what direction to head. You are moving in a three-dimensional medium that can make orientation more difficult than moving in the two-dimensional world you normally have to navigate on dry land. Visibility is normally less underwater than it is in air. Many times it is not possible to look out in the distance to get a frame of reference to maintain your orientation. Yet, there are ways a diver can find his way with a great degree of accuracy once the basic principles of underwater navigation are learned. In this chapter you will learn about the two major categories of underwater navigation:

1. Natural Navigation
2. Compass Navigation.

With these two skills well-mastered, divers should be able to plot their course and follow it in almost any underwater situation they encounter in the open water.

Unfortunately many divers have not taken time to learn and perfect their skills at underwater navigation. The question could be asked, “What is the value of learning to navigate underwater?” Here are some of the primary reasons to know your underwater navigation and how to use the tools:

- **Finding Your Dive Site:** If you have a swim from the boat anchor line or from a beach to a specific spot where you will find a reef or wreck, you must head in the correct direction and know when you are in the vicinity. Time and time again you see divers who failed to find the specific spot underwater they had their hearts set on seeing. They either didn’t know how to read an underwater compass and/or didn’t know their swim speed so they could look around once they were close to the object. The skilled navigator seldom misses his target.
- **Safer Dive Profiles:** The diver who is constantly coming up from 60 fsw (18 msw) because he is lost and needs to reference his position at the surface, is a physiological disaster waiting for a case of DCS. In a majority of cases the diver who has obtained his surface bearings gets turned around and/or disoriented every time he returns to the bottom. An additional way that safer dive profiles are obtained with navigational skills is the diver who doesn’t have to surface avoids the risk every time he surfaces, not knowing where he is at, of getting struck by surface traffic.

- **Avoiding Hazards:** Once you learn to successfully navigate underwater, you will be able to plan your dive so you can steer free of any potential or real hazards that might exist going to and from or at the dive site.
- **Lower Stress Levels:** Imagine yourself underwater. You and your buddy have finished your descent. Bottom time and air supply is limited. Visibility is not exactly 100%. All of a sudden you don't know which way you are swimming. You have no idea where the boat or water exit point is. Most divers under these circumstances would feel a great degree of anxiety. With proper navigational skills learned, stress levels are reduced because the diver knows which way to head and/or his location underwater.
- **Allows The Diver To Take The Most Direct Route:** The diver who knows how to navigate can shoot a direct azimuth to the area he wishes to explore in most cases will be able to take the shortest route possible. Little time has to be wasted swimming around in the hope that the diver might stumble upon the target area.

NAVIGATION BY NATURAL FEATURES

Many dive sites have natural features that allow the diver to find his way around the site without necessarily having to use a compass. Some of these features are very general giving the diver an approximate idea of the direction of travel. Other features are very specific signposts allowing the diver to ascertain his exact location underwater. In general, the more familiar the diver is with the specific dive site, the better he will be able to use natural features for navigation.

WATER MOVEMENT

Water movement may be used at some dive sites to give an indication of general direction of underwater travel.

PREVAILING CURRENTS

Many divers, to navigate their way to and from an underwater site as well as around the site area itself, use prevailing currents. The diver must make sure during the course of the dive that the current direction does not change if they are using this methodology. Currents are normally used to run line and reciprocal courses. For the most part a diver would use one of the following procedures to navigate by using currents:

1. Swim directly into the current to start the dive and directly with the current at the end of the dive. (Sometimes this procedure can be reversed in very slow running currents. It is normally not the recommended procedure to swim against the current at the end of a dive, when your gas supply is lowest and you are more likely to be tired.)

2. Swimming at right angles to the current and reversing the side the current hits on the return leg. Example: If the current is hitting the diver's right side as he swims to the site, he will swim with the current on his left side on the return leg. (This method is a bit more advanced because it requires that the diver compensate for distance "downstream" the current will carry him during the time it takes to swim out and back.)

SURGE

Surge is the back and forth movement of water noted in the ocean and large bodies of water in areas of shallow depths. Most commonly, surge movement is perpendicular to the shore. The diver can combine the direction of surge movement with two other factors to assist in navigation to and from the beach. These other factors are depth and surge strength. Normally depth tends to decrease the further from shore a diver travels and as depth increases surge strength weakens. A check of navigational charts of the area should give any indications of potential exceptions to the above. When navigating in surge, the diver should remember that, in the absence of other currents, the overall effect of surge is neutral. It may appear you are losing ground when the surge is against you. When the surge moves again with you, you will find that you will actually have gained the approximate distance as if there were no current. It is best not to fight the surge, as this will needlessly exhaust you.

BOTTOM STRIATIONS

In areas of shallow water wave action has formed ridges in the sand that run parallel to shore known as bottom striations. The diver may judge his direction (either towards or away from the beach) by moving at right angles to these striations. The deeper the diver ventures, the further apart the bottom striations become and the less distinct they are.

UNDERWATER VEGETATION

Aquatic vegetation can provide valuable information as to where a diver may be on an underwater site and the direction the diver may be heading. Some vegetation is very depth specific, growing in set depth parameters. Thus the vegetation may provide clues as to depth. The vegetation can also provide information as to bottom composition. Certain types of aquatic vegetation will only grow on rocky terrain, while some plants will only grow on sandy bottoms, and certain vegetation will prefer a bottom consisting of mud or decomposed organic matter. At some underwater sites the plants form "islands" of life surrounded by sand or rock. These unique shaped oases can serve as "signposts" allowing a diver familiar with the location to know exactly where he/she might be underwater.

AQUATIC ANIMAL LIFE

As you become familiar with the characteristics inherent to specific forms of marine animals, you will realize that certain creatures may prefer to live within a specified depth range while others may live in a broader range of depths. Some marine life will prefer specific surroundings and underwater habitats. There are certain aquatic animals which commonly are found in the company of each other. Others with a greater symbiotic relationship may always be found together. Certain species of marine animals are extremely territorial and may not move too far from their home. Others will be seen defending their territory from outsiders. Once you construct a "bio-map" (being familiar where specific groups of animals may be found on a dive site) you may be able to find your way around the site by the creatures which inhabit the area.

REEF STRUCTURES

If the area you are diving has coral reefs, the shape of the reef or reefs can be helpful in aiding your underwater navigation. Good navigation charts may help you out initially. As you dive the site, you will become familiar as to specific reef formations and begin to know your way around the dive site by these structures alone. It can be handy to sketch the dive site with the various reef structures graphed out by location. This will provide a handy map for quick location of precise areas on future dives. Many divers even give names to distinctive reef structures. This can help in remembering where these structures are positioned on the dive site.

SUNLIGHT

The sun can provide valuable navigational clues for the diver to use underwater. In shallower waters the sun may cast shadows at specific angles off of underwater structures such as reefs or rocks. The diver may take note of the angle the rays enter the water under conditions which allow him to see individual shafts of light penetrating the water column. While not always totally reliable, these clues can be used with other natural features to help the diver find his way underwater.

CALCULATING TRAVEL DISTANCE AND SWIM SPEED UNDERWATER

THE KICK CYCLE METHOD

One method, which is commonly used to measure the distance a diver travels underwater, is the Kick Cycle Method. The objective is to find the average distance each kick cycle will carry the diver. To use this method the diver employs the most common underwater kick – the flutter kick. Each time the diver kicks both the left leg and the right leg it counts as one cycle. Most divers get their count from each drop of the right foot.

To determine the cycle travel distance, an underwater swim course of a specified distance must be set up. Running a pre-measured line from a cave or wreck reel of 100 yards if done in standard U.S. measurements or 100 meters for metric measurements is the most efficient way to set up this course.

The diver swims the course at a normal relaxed swim pace counting the number of kick cycles it takes to complete. The number of yards or meters (100 in this case) is divided by the number of kick cycles it takes to complete the course to yield the distance per kick cycle (yards/cycle or meters/cycle).

Once the diver knows the distance he travels with each kick cycle, he may divide any particular distance that must be traveled underwater by his kick cycle rate in order to know how many kick cycles it will take to travel a specified distance.

EXAMPLE (U.S. - IMPERIAL)

A diver with a swim rate of 1.2 yards per kick cycle wishes to swim 150 yards from shore out to a wreck. Assuming there is no current, what will be the required number of kick cycles needed to accomplish this task?

150 yards / 1.2 yards per kick cycle = 125 kick cycles

EXAMPLE (METRIC)

A diver with the swim rate of .95 meters per kick cycle wishes to swim 150 meters from shore to a reef. Assuming there is no current, what will be the number of kick cycles required to accomplish this task?

150 meters / .95 meters per kick cycle = 158 kick cycles

TIMED SWIM SPEED METHOD

The Timed Swim Speed Method uses the diver's swim speed in either yards per minute or meters per minute to compute how far a diver will travel underwater in a given time. The advantage the Timed Swim Speed Method holds over the Kick Cycle Method is primarily that of not forgetting or loosing track of the correct number of kick cycles. It is far less task loading to monitor a timing device in order to determine distance than to count kick cycles.

To determine the cycle travel distance, an underwater swim course of a specified distance must be set up. Running a pre-measured line from a cave or wreck reel of 100 yards if done in standard U.S. measurements or 100 meters for metric measurements is the most efficient way to set up this course. The diver swims the course at a normal relaxed swim pace timing the number of minutes it takes to complete. The number of yards or meters (100 in this case) is divided by the number of minutes it takes to complete the course to yield the distance per minute (yards/minute or meters/minute).

EXAMPLE: (U.S. - IMPERIAL)

It takes a diver 4 minutes 15 seconds to complete a 100-yard course. What is the diver's swim speed?

100 yards / 4.25 minutes = 23.5 yards per minute

EXAMPLE (METRIC)

It takes a diver 6 minutes 30 seconds to complete a 100-meter course. What is the diver's swim speed?

100 meters / 6.5 minutes = 15.4 meters per minute

THE TIME, DISTANCE, RATE FORMULA

The variables for this formula are:

D = Distance R = Rate T = Time

This formula is usually expressed as:

D = R x T

EXAMPLE: (U.S. - IMPERIAL)

A diver with a swim rate of 15 yards per minute swims a direct course out from the beach for 10 minutes. Assuming there is no current, how far did the diver swim?

D = 15 yards per minute x 10 minutes

D = 150 yards

EXAMPLE: (METRIC)

A diver with a swim rate of 16.5 meters per minute swims a direct course out from the beach for 17 minutes. Assuming there is no current, how far did the diver swim?

D = 16.5 meters per minute x 17 minutes

D = 280.5 meters

It may also be rearranged to find the other variables:

R = D/T

EXAMPLE: (U.S. - IMPERIAL)

A diver swam a 150-yard course in 8 minutes. What was the diver's swim rate?

R = 150 yards / 8 minutes

R = 18.75 yards per minute

EXAMPLE: (METRIC)

A diver swam a 120-meter course in 11 minutes. What was the diver's swim rate?

R= 120 meters / 11 minutes

R = 10.9 meters per minute

T = D/R

EXAMPLE: (U.S. - IMPERIAL)

A diver wishes to swim north on a reef for 200 yards. His/her swim rate is 14 yards per minute. Assuming there is no current, how long will it take him to make this swim?

T = 200 yards / 14 yards per minute

T = 14.3 minutes

EXAMPLE: (METRIC)

A diver wishes to swim out from the beach 175 meters. His/her swim rate is 15 meters per minute. Assuming there is no current, how long will it take him to make this swim?

T = 175 meters / 15 meters per minute

T = 11.67 minutes (11 minutes 40 seconds)

THE DIVE COMPASS

The dive compass is an essential component of underwater navigation. A diver who is proficient in the use of an underwater compass can navigate to, from, and around a dive site with a high degree of accuracy. Sometimes a bottom can be flat sand or mud devoid of natural features. Under these conditions a compass can mean the difference between locating a particular spot underwater or being lost. Many times visibility in the water can be much less than ideal making compass reading skills mandatory for a safe and enjoyable dive.

ELEMENTS OF AN UNDERWATER COMPASS

MAGNETIC NEEDLE

The magnetic needle is the freely swinging needle when the compass is held in a level horizontal fashion. Under most conditions it will point towards magnetic north. This needle provides a reference point around which other angles of direction (azimuths) may be charted. For the navigation performed in this course, magnetic north will be used. You should be aware that there are other terms that refer to north such as "Grid North" and "True North". These other terms are covered in detail as part of the IANTD Advanced Underwater Navigation Course.

The magnetic needle may be attracted to ferrous metals such as iron or steel. The amount of error introduced by a diver wearing steel cylinders is considered negligible. There can be appreciable error when a diver wears gauges, watches, dive knives, dive computers, and other electronic instruments in too close a proximity to an underwater compass. This is usually when these components contain ferrous metals or the electronics produce a magnetic field. It may also be difficult or even impossible to navigate near, in, or around large ferrous objects such as metal shipwrecks.

COMPASS SCALE

The compass scale is a circular measurement that represents the 360 degrees of a circle. On a majority of underwater compasses the scale is marked every 5 degrees and numbered every 30 degrees. The four points of the compass correspond to these degrees in the following manner: 0 or 360 degrees equals North, 90 degrees equals East, 180 degrees equals South, 270 degrees equals West.

On Type I compasses the scale is numbered increasing in degrees clockwise. On Type II compasses the scale is numbered increasing in degrees counterclockwise. Since each type of compass uses a different methodology on sighting and setting up an azimuth there is no difference in the direction of travel for a given azimuth, even though the scales are numbered in an opposite direction.

THE LUBBER LINE

The lubber line is usually an arrow in the center of the compass body. This arrow indicates the direction of intended travel. The diver must align his body (head to toe) with this arrow and maintain this alignment in order to stay on course. When sighting a compass course, the lubber line is pointed at the object in order to correctly read the azimuth from the compass scale.

THE BEZEL

The bezel allows the diver to rotate the compass scale and/or the witness marks. This is done in reference to the magnetic needle, the witness marks and the compass scale. On the Type I compass the clockwise numbered scale is on the bezel. The bezel, scale and witness marks all rotate on this type of compass. On the Type II compass the counterclockwise numbered scale is marked on the compass body. The bezel on a Type II compass only moves the witness marks.

THE WITNESS MARKS

The witness marks are on the bezel on both Type I and Type II compasses. The magnetic needle must stay aligned with the witness marks in order to follow or sight on any particular azimuth. On a Type I compass the witness marks are placed at 0 degrees on the clockwise numbered scale which is a part of the bezel. On a Type II compass the witness marks are two closely placed parallel lines on the bezel.

SIGHTING ON AN OBJECT AND FINDING THE AZIMUTH

To find the azimuth to a sighted object form where you are located, you first point the lubber line at the object. If the object is large in size, you should pick a particular point on the object or a specific side to point the lubber line at. The compass must be held level in order to allow the magnetic needle to swing freely. Without moving the compass in respect to where the lubber line is pointing, you follow the next steps, specific to your compass type, in order to read the correct azimuth to the object.

TYPE I COMPASS

Once you have sighted on the desired object, you rotate the bezel so that the witness marks (0 degrees) align with the tip of the magnetic needle. You would then read the azimuth from the point at which the compass scale intersects the top end of the lubber line.

TYPE II COMPASS

Once you have sighted the object, you rotate the bezel so that the tip of the magnetic needle falls between the witness marks. You would the read the azimuth from where the tip of the magnetic needle (between the witness marks) intersects the compass scale.

FOLLOWING A GIVEN AZIMUTH

For the sake of clarity, we shall use an azimuth of 120 degrees to illustrate how to follow a given azimuth for both types of compasses.

TYPE I COMPASS

Rotate the bezel so that the given azimuth on the compass scale (in this case 120 degrees) intersects the top of the lubber line. Rotate your body in a horizontal plane so the tip of the magnetic needle aligns with the witness marks (0 degrees). Align your body with the lubber line, while keeping the magnetic needle on the witness marks, and move in the direction the lubber line points.

TYPE II COMPASS

Rotate the bezel so that the given azimuth (in this case 120 degrees) falls between the witness marks. Rotate your body in a horizontal plane so that the tip of the magnetic needle aligns with the witness marks. Align your body with the lubber line, while keeping the magnetic needle between the witness marks, and move in the direction the lubber line points.

METHODS OF PROPERLY MOUNTING AND HOLDING AN UNDERWATER COMPASS

WRIST MOUNT

The typical method of using a wrist compass is to point the arm without the compass straight in alignment with the body. The arm with the compass grasps the elbow of the opposite arm to form a right angle. Sometimes it may be necessary to grasp the opposing arm just above the elbow. This places the compass directly in front of the diver in an easy to read fashion. The extended arm also serves as an extension of the lubber line.

CONSOLE MOUNTED

The dive compass that is mounted in an instrument console is usually read by holding it an extended manner with both hands. This places the compass out in front of the diver for easy reading. The console acts as an extended lubber line. It has been noted that occasionally the instrumentation in certain console configurations can cause significant deviation of the magnetic needle and adversely effect navigational accuracy.

CARD MOUNTED

The card-mounted compass is held on either side by both hands with arms extended midline in front of the diver. There are various schools of thought as to how far the arms should be extended, ranging from 45 degrees at the elbows to holding both arms straight. The bottom line is whatever methodology will work best for you under the environmental conditions and preferences you may have. Card mounted compasses allow the lubber line to be extended on the card itself making body alignment more precise should the card be large enough. Some cards also have space for the notation of azimuths and distances to be covered. Many divers involved in underwater survey use the card-mounted compass.

OTHER TIPS TO ENSURE NAVIGATIONAL ACCURACY

Make Sure The Magnetic Needle Swings Freely. If you are not holding the compass flat the magnetic needle will get hung up and not move. This will result in some grievous navigational error. During the running of the course it is a wise idea to periodically check, by a quick back and forth motion of the wrist in the horizontal plane, to make sure that the magnetic needle is moving freely. Good buoyancy control and underwater swimming experience will also help a diver to maintain his body in a horizontal position.

Keep A Constant Watch To Make Sure That The Magnetic Needle Stays Aligned With The Lubber Lines. It will do you no good if your body is aligned with the lubber line when the north-seeking needle is not between the lubber lines.

Check Your Body Alignment. Throughout the dive keep checking to make sure that the lubber line is in line with the center axis of your body.

Make Sure You View The Compass From The Same Angle Throughout The Dive. If you view the compass from a variety of angles, you will come up with different readings. This inconsistency in the reading of the compass will result in navigational errors. The difference in readings is commonly referred to as parallax. You want to avoid parallax by consistently holding and viewing the compass in a consistent manner.

Practice Courses On Land Before Attempting To Navigate Underwater. This will alert you to any potential problems you may have with technique or course calculations. It is a good way to see if you can make it back to the same spot when doing reciprocal and closed courses. If practiced on a flat piece of ground, you can avoid “cheating” by keeping your eyes on the compass without looking up until your course is finished. Distances can be approximated through counting paces. Remember, if you can’t accomplish a navigational walk-through on land, you will probably never succeed underwater.

Write Down All Compass Headings (Azimuths) Before Entering The Water. All your calculations for your navigation should be done prior to entering the water. They should be recorded along with swim times or kick cycles before you get into the water. They should be easily accessible for easy reading by the dive team. Underwater is not the place to do navigational computations. The recording of compass azimuths and times/distances must be a part of dive pre-planning.

UNDERWATER NAVIGATION - RECIPROCAL COURSES

THE BASICS

Reciprocal courses are the easiest to perform underwater and should be perfected before moving on to closed compass courses. The reciprocal course is defined as a course where a diver will start the dive heading out on an initial azimuth (or several initial azimuths in the case of courses like "doglegs" or "T's") and return to his/her point of origin by reversing the direction over the same compass legs via a reciprocal azimuth(s). You end up retracing your steps in a reverse manner to end up where you started. When operating in waters where there is a current, your initial azimuths have you heading into the current and your reciprocal azimuths have you swimming with the current. This will help to ensure a higher margin of safety allowing you to work against the current when you are the most rested and have the greatest air supply. Returning to your point of origin swimming with the current allows you the least exertion when your air supply is the lowest and you are the most fatigued.

To calculate a reciprocal course is relatively easy.

- If your initial compass heading is between 0 and 180 degrees, you will add 180 degrees to get your "return" or reciprocal azimuth. For example: Your initial azimuth is 30 degrees. Your return azimuth would be 30 degrees + 180 degrees, or 210 degrees.
- If your initial azimuth is between 180 and 360 degrees, you will subtract 180 degrees to get your return azimuth. For example: Your initial azimuth is 290 degrees. Your reciprocal azimuth would be 290 degrees – 180 degrees, or 110 degrees.

THE LINE AND RECIPROCAL COURSE

This course is the simplest of all the reciprocal courses and yet is the most commonly used. The line and reciprocal involves swimming out from your start point in a straight line for a prescribed time or distance. You then return to your point of origin by swimming the same line back (180 degrees opposite your initial compass heading). It can be used to swim out to a dive site from a beach or boat and return to the exit point at the end of the dive.

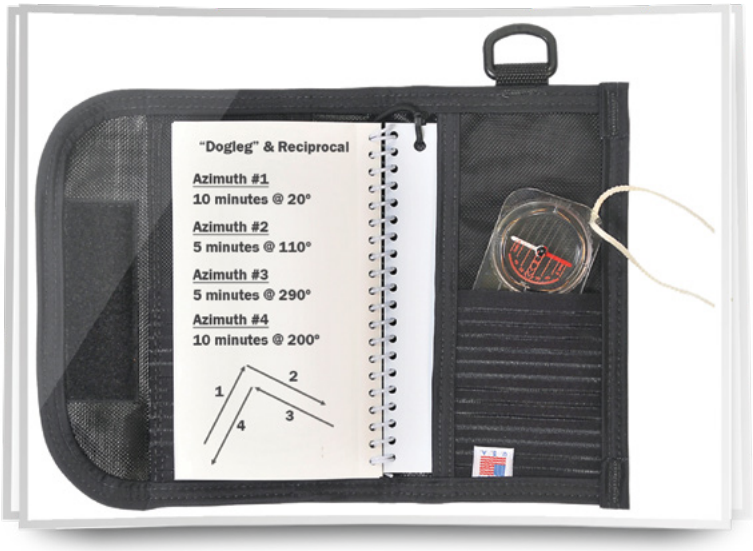
In the illustration below we see that the diver swims out from the boat anchor line for 25 minutes on an initial heading of 120 degrees. To return to the anchor line the diver must swim 25 minutes on a reciprocal azimuth of 300 degrees (120 + 180 = 300).

THE "DOGLEG" AND RECIPROCAL COURSE

The next reciprocal course to master would be the "dogleg" and reciprocal. This course is in the shape of an "L". To keep the calculations simple, the second leg of this course is usually kept at a right angle to the first leg. When calculating this course you must add 90 degrees to your previous heading whenever you make a right-hand turn to the next leg or subtract 90 degrees from your previous heading whenever you make a left hand turn. If this calculation exceeds 360 degrees when making a right hand turn, subtract 360 from the sum to get your next azimuth. If the heading becomes a negative number when making a left-hand turn, subtract the absolute value from 360 degrees to get your next azimuth. This course involves two initial azimuths and two reciprocal azimuths.

In the following illustration the diver swims out on Leg # 1 at an initial azimuth of 20 degrees swimming for 10 minutes. He then turns right for Leg # 2, giving him a heading of 110 degrees (20º + 90º = 110º). He swims 5 minutes on this second heading. His first reciprocal azimuth will be 290 degrees for 5 minutes. The final reciprocal azimuth will be 200 degrees for 10 minutes.

SLATE DATA



THE "T" AND RECIPROCAL COURSE

The "T" and Reciprocal Course is a slight bit more complicated than the dogleg course because the complete course has one more leg. The typical "T" and reciprocal course (like we shall use in this Advanced Open Water Program) has the base of the "T" at a right angle to the top. The top does not necessarily have to be the same size on either side of the base. A situation where this particular course could come in handy would be, if a boat captain were to anchor off the middle of a reef and the diver wanted to swim from the anchor line out to the reef. Then the diver would explore the right side, then the left side of the reef, and swim back to the anchor line.

The same rules apply for the calculation of azimuths for right and left-hand 90 degree turns as were applied in the "Dogleg" and Reciprocal course.

In the illustration below the diver swims out on his first azimuth of a "T" course at a heading of 200 degrees for 10 minutes. He then turns left for the second leg at a heading of 110 degrees (200º – 90º = 110º) for 5 minutes. The third leg's azimuth is the reciprocal of the second heading. For the third leg the diver swims at an azimuth of 290 degrees (110º + 180º = 290º) for 15 minutes. The fourth leg will be at the same heading as the second leg, 110 degrees, for the time/distance of the third leg minus the time/distance of the second leg or 10 minutes (15 minutes – 5 minutes = 10 minutes). The fifth and final leg would be the reciprocal of the first leg for the same time/distance For this example the azimuth would be 20 degrees (200º – 180º = 20º) for 10 minutes.

USING NATURAL FEATURES TO AID IN RECIPROCAL NAVIGATION

Since the diver is covering the same territory on the return portions of reciprocal courses noticing natural features and underwater landmarks may aid in the accuracy of his underwater navigation. Should you notice objects on the "out" azimuths you should again come across the same objects on the return azimuths. If the object was to your right on the way out, it should be the same distance away on your left on the return. If you swam directly over an object, you should swim directly over it when you return. If you notice that you are not in the proper respective position to these "landmarks" on your return, you should make the proper correction (stop timing or counting kick cycle while doing so) and then continue your swim at the proper azimuth. It is a wise idea to see if there are any objects at the right angle turns that you can "landmark" in either the "Dogleg" or "T" course. That way you can improve accuracy by making the proper correction relative to the expected proper position they should be located at when you make the same turn upon your return.

BASIC CLOSED COMPASS COURSES

Closed compass courses differ from reciprocal courses in that the diver never covers the same territory on his return to the point of origin. The three basic types of closed compass courses for IANTD Advanced Open Water Divers are the equilateral triangular course, the square course, and the rectangular course. The calculations for setting up these courses are simple and require no knowledge of trigonometry to calculate the azimuths and/or distances/times.

THE SQUARE AND RECTANGULAR COMPASS COURSES

To successfully calculate either the square or rectangular compass course the following five characteristics should be kept in mind:

- On a square compass course all sides are equal in time/distance.
- On a rectangular course the opposite or parallel sides are always equal.
- All interior angles are always equal.
- All interior angles equal 90º.
- All exterior angles equal the interior angles.

On these two compass courses you add 90º, when running them in a clockwise direction, to your previous azimuth to get your next heading. When running them in a counter-clockwise direction, you subtract 90º from your previous azimuth to get your next heading. If your calculated heading is greater than 360º, you should subtract 360º from the heading to get the correct azimuth. If your calculated heading is a negative number, you should subtract the absolute value of this number from 360º to get the correct azimuth.

THE CLOCK-WISE SQUARE COMPASS COURSE ILLUSTRATED

Two divers wish to run a square compass course with 5-minute legs. Their initial azimuth is 110º. They calculate their second azimuth by adding 90º to their initial heading. The second azimuth is 200º (110º + 90º = 200º). They then calculate their third azimuth. The third azimuth is 290º (200º + 90º = 290º). Finally they calculate their last azimuth. The calculation yields 380º (290º + 90º = 380º), which is greater than 360º, and must be corrected. They subtract 360º from 380º and find that their final heading is 20º.

SLATE DATA

THE COUNTER-CLOCKWISE RECTANGULAR COURSE ILLUSTRATED

Two divers wish to run a rectangular compass course. The short legs will be 4 minutes and the long legs will be 8 minutes. Their initial azimuth is 220º for 4 minutes. They then calculate their second leg. They find that their azimuth will be 130º (220º- 90º = 130º) for 8 minutes. They calculate their third azimuth and find the heading to be 40º (130º- 90º = 40º) for 4 minutes. Finally they calculate their last heading and find that it turns out to be a negative number:- 50º (40º- 90º =-50º). They must correct for the negative reading by subtracting its' absolute value from 360º. They find that this gives them a final azimuth of 310º (360º- 50º = 310º)

SLATE DATA

SAFETY GUIDELINES FOR PRACTICING BASIC UNDERWATER NAVIGATION

Practice in areas with little or no current. The scope of this course does not pertain to making corrections for current. If you are interested in how this is performed, take the IANTD Advanced Navigation Course.

- Keep your depths reasonably shallow.
- Check your total running time at the particular depth you intend to practice and make sure that you will have enough air using the ½ + 200 Rule.
- Check your total running time at the particular depth you intend to practice at and make sure that you do not exceed the no-decompression limits for your dive.
- Walk through the course on land prior to running it underwater.
- Draw out the course on your underwater slate and check it for accuracy.
- Record the azimuths and the times and distances on your underwater slate as part of your pre-dive planning. Never enter the water without this information.
- Maintain the dive team integrity. Stay with your buddy. It is far more important to keep the buddy team together than to be accurate in your navigation.
- Many times it is easy to get caught up in the challenge of navigation and forget to monitor critical dive information. Be sure to check you depth, air and bottom time frequently.
- Know your abilities and limits. Dive within them.

Which of the following is a good guideline to follow when performing basic underwater navigation?

QUIZ

A. Record the azimuths and the times and distances on your underwater slate

B. Use the rule of thirds for all your diving

C. Dive alone

D. Dive no deeper than 30 fsw/10msw.

Which of the following is NOT a basic Navigation pattern that you consider using at a dive site?

QUIZ

A. Circle pattern.

B. Triangle pattern.

C. Reciprocal pattern.

D. Square pattern.

What feature of a compass is usually an arrow in the center of the compass body and indicates the direction of intended travel.

QUIZ

A. Lubber line.

B. Compass scale.

C. North arrow.

D. Witness marks.

Which of the following is NOT a good choice for use as a natural navigation aid?

QUIZ

A Underwater sound.

B Currents.

C Reef structures.

D Bottom Striations

Its important for an IANTD Advanced Openwater diver to process basic underwater navigation skills because:

QUIZ

A It is important for the safety of a diver to find their way and remain orientated while underwater.

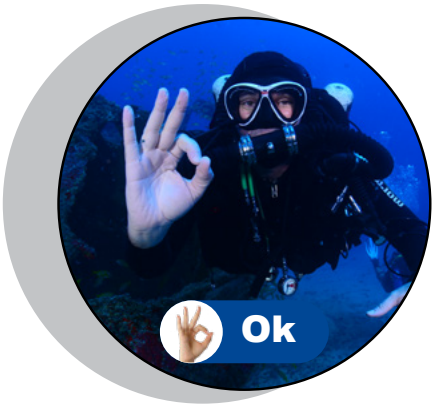
B It is how you locate treasure.

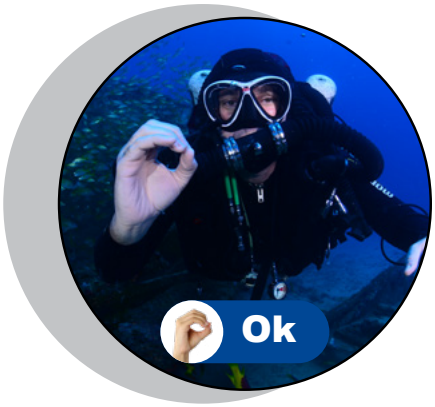
C It will prevent decompression sickness.

D You are responsible to making sure your buddy doesn't get lost during the dive.

HAND SIGNALS

IANTD





ALWAYS PIONEER


Low on gas


Out of gas


Share gas


Turn


Bubbles


Deco


Cold


Together


you lead

HAND SIGNALS

GENERAL FORMULAS:

ABSOLUTE PRESSURE:

$$P_{ata} = \left[\frac{D_{fsw}}{33_{fsw}}\right] + 1 \quad OR \quad P_{ata} = \left[\frac{D_{msw}}{10_{msw}}\right] + 1$$

OXYGEN PARTIAL PRESSURE:

$$PO_2 = FO_2 \times P_{ata}$$

BEST EANX MIX:

$$FO_2 = \frac{\text{Desired Oxygen Level } (PO_2)}{\text{Depth in Atmospheres Absolute } (P_{ata})}$$

EQUIVALENT AIR DEPTH:

$$EAD_{fsw} = \left[\frac{(\text{Fraction of Nitrogen on Mixture } FN_2) \times (D_{fsw} + 33_{fsw})}{\text{Fraction of Nitrogen on Air } 0.79}\right] - 33_{fsw}$$

OR

$$EAD_{msw} = \left[\frac{(\text{Fraction of Nitrogen on Mixture } FN_2) \times (D_{msw} + 10_{msw})}{\text{Fraction of Nitrogen on Air } 0.79}\right] - 10_{msw}$$

MAXIMUM OPERATION DEPTH:

$$MOD_{fsw} = \left[\left(\frac{\text{Maximum Oxygen Exposure } PO_{2\,(ata)}}{\text{Oxygen Fraction } FO_2}\right) - 1_{ata}\right] \times 33_{fsw}$$

OR

$$MOD_{msw} = \left[\left(\frac{\text{Maximum Oxygen Exposure } PO_{2\,(ata)}}{\text{Oxygen Fraction } FO_2}\right) - 1_{ata}\right] \times 10_{msw}$$

TARGET OPERATION DEPTH:

$$TOD_{fsw} = \left[\left(\frac{\text{Target Oxygen Exposure } PO_{2\,(ata)}}{\text{Oxygen Fraction } FO_2}\right) - 1_{ata}\right] \times 33_{fsw}$$

$$TOD_{msw} = \left[\left(\frac{\text{Target Oxygen Exposure } PO_{2\,(ata)}}{\text{Oxygen Fraction } FO_2}\right) - 1_{ata}\right] \times 10_{msw}$$

GAS SUPPLY FORMULAS:

SURFACE AIR CONSUMPTION:

$$SAC = \frac{\text{Total Gas Consumed}}{D_{ata} \times T_{(min.)}}$$

CONSUMPTION RATE AT DEPTH:

$$RMV \times ATA$$

TOXICITY FORMULAS:

CENTRAL NERVOUS SYSTEM:

$$\%CNS = \frac{\text{Dive Time at } PO_2}{\text{NOAA Single Exposure Limit}}$$

WHOLE BODY TOXICITY:

$$OTU = T \times \left[\frac{(PO_2 - 0.5)}{0.5}\right]^{0.83}$$

IANTD OPEN WATER AIR DIVING & DECOMPRESSION TABLES

(A)	40	50	60	70	80	90	100	110	120	130	140	Depth (Feet)	Repetitive Group
	12	15	18	21	24	27	30	33	36	39	42	Depth (Meters)	
	125	75	51	35	25	20	17	14	12	10	9	No Decompression Limits (Minutes)	

(B) BOTTOM TIMES	A	B	C	D	E	F	G	H	K	L
19	16	14	12	11	10	9	8	7	7	6							
25	20	17	15	13	12	11	10	9	8	7							
37	29	25	22	20	18	16	11	10	9	8							
57	41	33	28	24	19	17	14	12	10	9							
82	59	44	35	25	20												
111	65	51															
125	75																

SURFACE INTERVALS (C)	A	B	C	D	E	F	G	H	K	L
	00:00 01:59	02:00								
	00:00 00:19	00:20 01:59	02:00							
	00:00 00:09	00:10 00:24	00:25 02:59	03:00						
	00:00 00:09	00:10 00:14	00:15 00:29	00:30 02:59	03:00					
	00:00 00:09	00:10 00:14	00:15 00:24	00:25 00:44	00:45 03:59	04:00				
	00:00 00:19	00:20 00:29	00:30 00:44	00:45 01:14	01:15 01:29	01:30 07:59	08:00			
	00:00 00:24	00:25 00:44	00:45 00:59	01:00 01:14	01:15 01:39	01:40 02:09	02:10 11:59	12:00		
	00:50 01:04	01:05 01:34	01:35 02:09	02:10 02:59	03:00 03:59	04:00 05:39	05:40 23:59	24:00		
	03:00 03:59	04:00 04:59	05:00 05:59	06:00 06:59	07:00 07:59	08:00 09:19	09:20 38:59	39:00		
	06:00 06:59	07:00 08:29	08:30 09:59	10:00 11:59	12:00 13:59	14:00 16:29	16:30 47:59	48:00		

(D) REPETITIVE GROUP AT END OF S.I.

(E) REPETITIVE DIVE TABLES	G	F	E	D	C	B	A		DEPTH (ft)	DEPTH (m)
	137	111	82	57	37	25	19	RNT	40	12
	115	88	59	41	29	20	16	RNT	50	15
	91	68	44	33	25	17	14	RNT	60	18
	72	53	37	28	22	15	12	RNT	70	21
	57	42	30	24	20	13	11	RNT	80	24
	47	35	26	21	18	12	10	RNT	90	27
	40	30	23	19	16	11	9	RNT	100	30
	35	27	21	17	14	10	8	RNT	110	33
	31	24	19	15	12	9	7	RNT	120	36
	27	21	17	14	11	8	7	RNT	130	39
	25	19	16	13	10	7	6	RNT	140	42
	23	17	14	11	9	7	6	RNT	150	45

RESIDUAL NITROGEN TIME

Warning: DO NOT attempt to use these tables unless you are fully trained & certified in the use of Compressed Air, or are under the supervision of a Scuba Instructor. Proper use of these tables will reduce the risk of decompression sickness & oxygen toxicity, but no table or computer can eliminate those risks.

These Tables Are For Air With Air As Deco Gas. The 15 Foot (4.5 m) Stops MUST Be Taken At 15 Feet (4.5 m). These Tables Are Based On Bühlmann's ZHL-16 Algorithm For 0-1000 Feet (0-300 m) Above Sea Level. They Were Produced Using Cybortronix DPA Software. The Repetitive Dive Groups Are Not Transferable To ANY Other Tables. A Three Minute Safety Stop Is Required For All Dives. These Tables Do Not Account For Physical Condition Of Diver, Difficulty Of Dive, Water Temperature, Etc.

(A) Planned Depth
(B) Bottom Time In Depth Column
(C) Read Across To Find Surface Interval
(D) Locate RNT After S. I.
(E) Read Down To Planned Repetitive Dive Depth. Read RNT

C-3800

QUIZ ANSWER KEY

CHAPTER 01 - ANSWER KEY

1. Its important that the dive team be properly to accomplish the dive objectives. In order to be properly equipped, the dive must:

a. Balance between being over or under equipped for the dive

2. The environment must be carefully considered when planning for a dive. The diver must look both the _____ when planning the dive

a. Surface and underwater conditions that the diver may encounter during a dive.

3. Proper dive buddy selection is a critical component of dive planning which many divers simply do not

give proper consideration. Too many times the diver is put in a situation where he/she allows his/herself to be paired up with a buddy simply by chance. Unwise buddy selection may compromise your safety and/or that of your partner.

a. True.

4. There are many aspects of self-preparation for Advanced Open Water Dive situations; however, the first part of self-preparation is which of the following?

a. Proper Training.

5. Physical exercise is only half of the equation for proper diving fitness. The other key element is proper nutrition. Which of the following are recommended to avoid as part of proper diving nutrition?

a. Drugs.

CHAPTER 02 - ANSWER KEY

1. Once you complete the IANTD Advanced Openwater Course, you are experienced enough to conduct any number of dives to any recreational diving depth

b. False.

2. You start the dive with a tank that is filled to 240 bar/ 3500 psig. Based upon the IANTD gas management rule for Advanced Openwater dives, you should turn your dive when your SPG reads? starting pressure:

a. 134 bar/ 1950 psig.

3. As we venture deeper into the underwater realm, the risk factors increase. In order to make this a safer venture, we must educate ourselves as to what these various risk factors are and how we can manage them

a. True.

4. As the diver ventures deeper and or longer, the need for proper equipment becomes greater. Dives requiring longer bottom times, deeper depths and/or repetitive dives may now require which of the following piece of equipment to be upgraded?

a. Thicker wetsuit or drysuit.

CHAPTER 03 - ANSWER KEY

1. Which of the following is a good guideline to follow when performing basic underwater navigation?

a. Record the azimuths and the times and distances on your underwater slate.

2. Which of the following is NOT a basic Navigation pattern that you consider using at a dive site.

a. Circle pattern.

3. What feature of a compass is usually an arrow in the center of the compass body and indicates the direction of intended travel.

a. Lubber line.

4. Which of the following is NOT a good choice for use as a natural navigation aid?

a. Underwater sound.

5. Its important for an IANTD Advanced Openwater diver to process basic underwater navigation skills because.

a. It is important for the safety of a diver to find their way and remain orientated while underwater.

INTERNATIONAL ASSOCIATION OF NITROX & TECHNICAL DIVERS

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