INTRODUCTION

WORLD UNDERWATER FEDERATION

CMAS

CONFÉDÉRATION MONDIALE
DES ACTIVITÉS SUBAQUATIAQUES
WORLD UNDERWATER FEDERATION

We all know that today's developments require great adaptability in order to respond to the enormous changes that are taking place in everyday life.

I am however convinced that these changes should take place without having to foresake one's own cultural identity, culture being both the basis and the aim of development.

It is with this conviction in mind that CMAS presents its first test for Instructors and Students. This is the result of a project that encorporates many different forms of experience, and though it takes into account
numerous modern methods, it seeks to maintain the unaltered values that the confederation upholds throughout the world. It can be taken for granted that where there is scuba diving, there is also CMAS with its history and its human and social values.

Values that make up a culture. Our culture. The culture of universal scuba diving that respects everything that surrounds it.

This initiative wishes to offer everyone the possibility of deepening their knowledge without having to make compromises on the quality of teaching or safety.

This is an objective that has been reached thanks to the keen and disinterested support of:

Gianni Marchesini
Valerio Venturoli
Paolo Zuccheri
of the CMAS DIVING CENTRE SO.GE.SE and under the supervision of the President of the technical committee Walter Tichy.

Heartfelt thanks to all those involved

Rome 12th November 1998.

Le Président
Achille Ferrero

C.M.A.S. History

On the 28th of September 1959 delegates from the following Federations:

FEDERAL REPUBLIC OF GERMANY
BELGIUM
BRASIL
FRANCE
GREECE
ITALY
YUGOSLAVIA
MONACO
PORTUGAL
UNITED STATES OF AMERICA
SWITZERLAND

met in Brussels on the occasion of the congress of the independent International Confederation gathering all underwater disciplines.

With this aim, a meeting was held in Monaco on January 9, 10 and 11, 1959 and a decision to establish the “World Confederation of Underwater Activities” in brief C.M.A.S.. was taken.

This Confederation succeeded , specifically in regard to all functions and responsibi lities , the Comite des Sports Sous-Marins (Underwater Sports Committee) of the Intemational Confederation of Sport Fishing founded on the 22nd of February 1952.

FEDERAL REPUBLIC OF GERMANY:
Verband Deutscher Sporttancher
Delegate: Mr. Jens-Peter PAULSEN

BELGIUM:
Fédération Belge des Recherches et d'Activités Sous-Marines
Delegates: Mr. Paul BAILLY
and Mr. William XHIGNESSE

BRAZIL:
Confederacao Brasileira de Desportos
Delegate: Mr. Vittorio DE BERREDO

SPAIN:
Federacion Espanola de Pesca Sportiva
Delegates: Mr. J.J. LOZANO RODRIQUEZ and Mr. M.D. VEIRGONOS BOIX

THE UNITED STATES OF AMERICA:
National Competitive Skindivers Committee
Delegates: Mr. Serge A. BIRN
and Mr. Gustav DALLA VALLE

The following Federations or Associations, hereinafter mentioned with the Representatives of the respective Constituent Assembly, have the right to be considered as the founding members of the Confederation:

FRANCE:
Fédération Française d'Etudes et de Sports Sous-Marins
Delegates: Mr. Elie FERRAT
and Mr. Jacques DUMAS

GREAT BRITAIN:
British Sub Aqua Club
Delegate: Mr. Oscar GUGEN

Fédération Hellénique de la Peche
Sportive et des Activités Subaquatiques
Delegate: M:r. Luigi FERRARO

ITALY:
Federazione Italiana della Pesca Sportiva
Delegates: Mr. Carlo MANSTRETTA
and Mr. Luigi FERRARO

MALTA:
Malta Sub Aqua Club
Delegate: Mr. Eric PACE BONELLO

MONACO:
Club de Chasse et d'Exploration
Sous-Marines
Delegates: Mr. Camille ONDA (Yacht Club) and Commandant J.Y. COUSTEAU

HOLLAND:
Onderwater Jagers Club
Delegates: Mr. J.H. HORA ADEMA and Mr. J.P. TOENBREKER

PORTUGAL:
Centro Portugues de Actividades Submarinas
Delegates: Mr. Jorge ALBUNQUERQUE
and Mr. Antonio RAMADA CURTO

SWITZERLAND:
Fédération Suisse des Centres
de Sports Sous-Marins
Delegates: Mr. Charles KNIGGE
and Mr. Robert METRAUX

YUGOSLAVIA:
SaVez Pormorskin Ribolovaga
Delegate: Mr. J. MEDUR

GREECE:

MORE OF 100 COUNTRIES ON 5 CONTINENTS

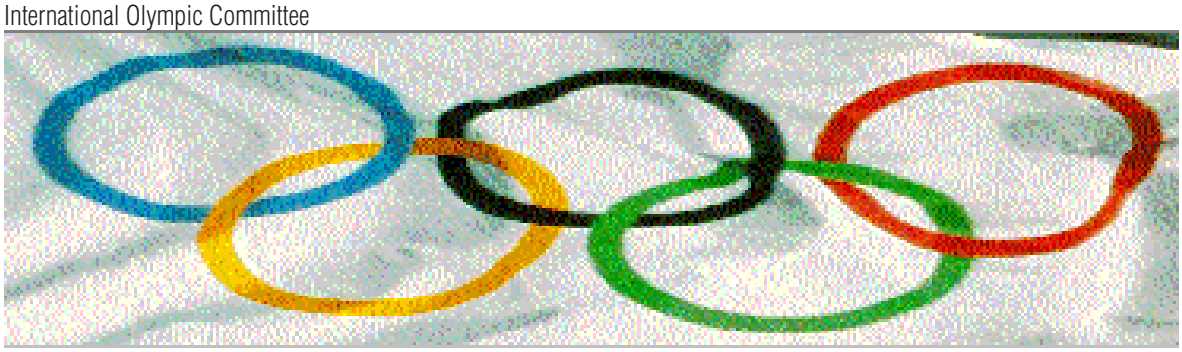
www.cmas.org

RECOGNITIONS

UNESCO

United Nations Educational, Scientific and Cultural Organization.

IOC
International Olympic Committee



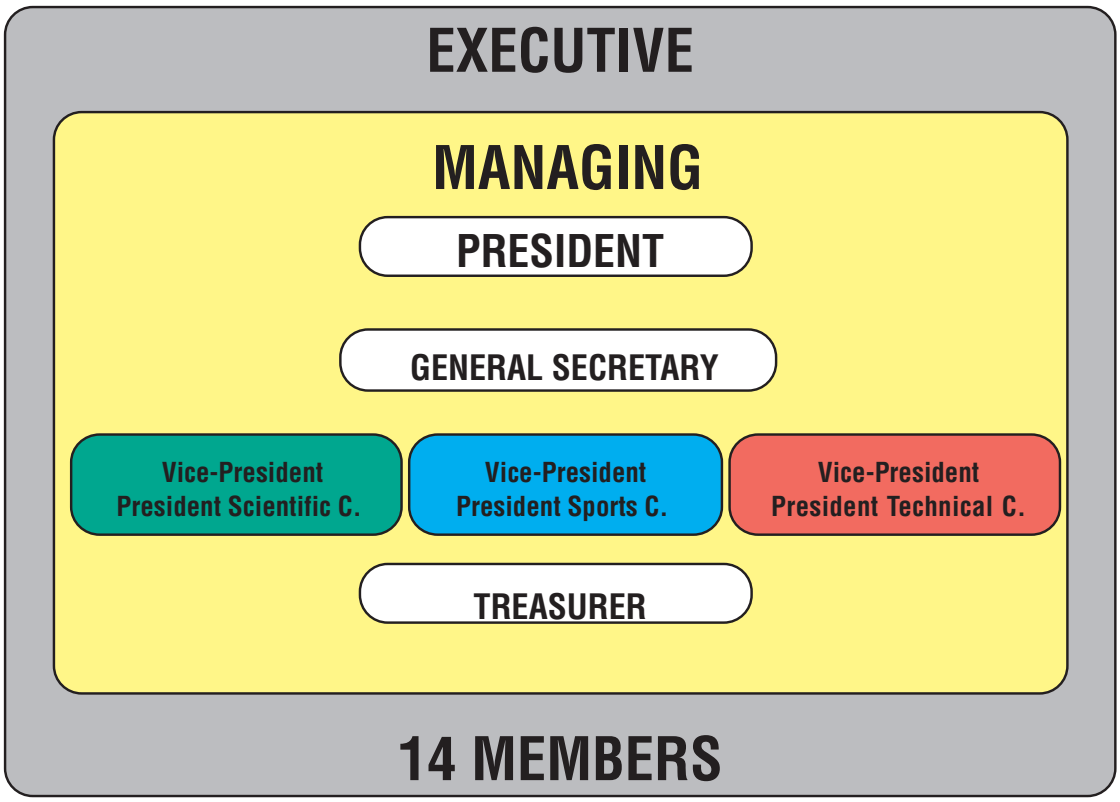
UICN
The World Conservation Union

IUCN
The World Conservation Union

GAISF
General Association of Sport Federations

IWGA
International World Games Association

IWGA international world games association



DISCIPLINARY

MEDICAL AND PREVENTION

LEGAL

PUBLIC RELATIONS

Scientific Committee

COMMISSIONS

Archaeology
Biology – Nature Preservation
Geology
Technology
Professionals – Amateurs Co-operation

Environmental Marine Protection International Award
In collaboration with UNESCO – Biannual award

Technical Committee

COMMISSIONS

O.C.C.
Certificates
Instructors
Photo-film-video
Cave Diving

International *, ** and *** certificates
Instructors and Speciality courses

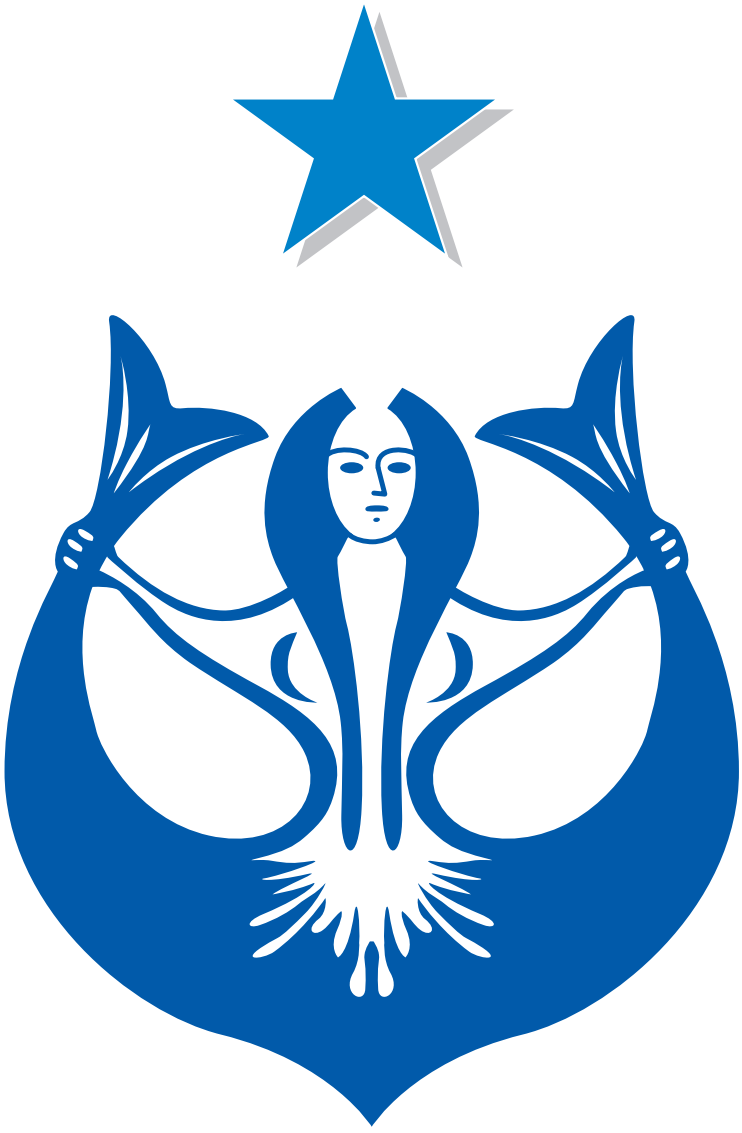
Sports Committee

COMMISSIONS

Finswimming
Spearfishing
Target shooting
Orienteering
Underwater Hockey
Underwater Rugby

World, Zones, Continental and National championships

DISCOVER DIVING



CMAS

WORLD UNDERWATER FEDERATION

Basic equipment

MASK

In order to obtain increased clarity and visibility underwater, a mask must be worn. By wearing it, an air space is placed between the diver's eyes and the water so the objects can be properly focused.
A mask consists of:
- Lens which is made of high impact, tempered, safety glass
- Skirt which is in silicone (translucent or black) or in rubber. It should ensure perfect fitting to the face in order to avoid the passage of water. It should also have a comfortable space for the nose and suppleness for compensating.
- Faceplate, which is of rigid material into which the lens is fixed and the part of the headstrap which, can be regulated.
-An adjustable rubber headstrap, of the same material as the body, which will allow you to regulate the pressure and therefore the position of the mask on the face so that it is correct.

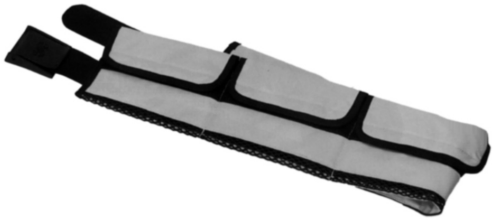
In order to choose the mask that fits your face it must be held in the correct position without the headstrap, while inhaling lightly with the nose, the suction that is created causes the mask to stick to the face. Different masks are used according to different activities. Those with a small volume are usually used for snorkelling, as they only need a small amount of air in the manoeuvre of compensation. In Scuba activity the volume is irrelevant to the compensation, therefore a mask with a bigger and a wider view can be used. The use of silicone or rubber is not important as far as the performance is concerned, but rubber doesn't last very long because of exposure to sun and to salinity. The materials employed by the firms during the stamping of the components for the masks leaves an oily film on the glass, which mists up easily. It is advisable to clean the glass of a new mask with toothpaste, as this has an abrasive effect, unless the lenses have already been treated. If the film persists it is better to wash it with a neutral soap. There are also special products on the market to use on the lens after each dive. For those with eyesight problem, suitable masks are on sale. After a mask is used it must be rinsed with fresh water and replaced with the glass downwards so that the soft part does not become deformed.

SNORKEL

It allows breathing on the surface with the head underwater thus keeping the seabed in sight. The snorkel is composed of two parts: the mouthpiece and the tube. The mouthpiece must be made of soft material and must have a form that fits well into the mouth so that it can be easily held thus avoiding any passage of water. The tube can be made of rigid or semirigid material and it must be flexible without breaking. The inside of the tube must be smooth with only slight bends so as to avoid collecting water and keeping the flow of air constant. In order to spot the diver it is advisable to colour the end part of the tube that emerges from the water. The snorkel has an attachment, which can be fixed to the mask strap. Care must be taken that it is in the correct position. Some models have a valve for emptying the end of the tube.

WEIGHT BELTS

In order to achieve neutral buoyancy the use of weights is essential. This is obtained by wearing lead weights that are fixed to the weight belt. The belt is fitted with a quick release buckle. There are also belts available, which have useful pockets to hold various numbers of weights. The proper weight to be carried depends on the thickness of the suit, on the equipment, on the type of water (sea water, fresh water) and on the type of dive.



FINS

Fins are a useful part of the equipment; they help the diver to move underwater more efficiently. Fins are available in a variety of lengths, sizes, and models. They can be made in rubber or synthetic material, closed or open, with an adjustable heel strap (in this case it is advisable to use a type with a rigid sole). Fins are chosen according to the nature of the task to perform. For snorkelling fins with a longer and narrower blade are used, whereas for Scuba diving fins of medium length and a wider blade are more suitable. Technical research of recent years has created blades, which can makes movement easier through water. It is also very important to bear in mind that a fin must not be too tight, in order to avoid problems with circulation, which could cause sensitivity to cold or cramps.

SUITS

Suits are protective clothing which help to minimise the effect of thermal exposure on the body due to the high thermal conductability of water (about 25 times higher than air). In order to obtain the necessary thermal insulation, suits must prevent the passage of water to the inside as much as possible. Wet suits are generally made of neoprene, of different thickness (from 1.5 to 8 mm), lined in the inside and outside with special cloth that make them more comfortable. Suits vary according to the uses. They are available on the market in one piece with or without hood or in two halves (a jacket and a salopette) with or without a zipper, in different thickness of neoprene, with seals at the wrists, neck, and ankles, to make them air-tight. When choosing a type and size it is important that there are no air pockets between the suit and the skin. This would interrupt thermal insulation. For use in tropical seas, where the water is warmer, light wet suits are now available in lighter synthetic materials (Lycra, Darlexx etc.) These kind of materials allow the diver ample movements as well as providing a certain thermal insulation.

GLOVES AND FOOTWEAR

It is advisable to wear gloves and footwear together with a suit because limbs are very sensitive to cold. Gloves in neoprene provide a good protection and there are different types with different levels of protection. Footwear depends on the fins used. They range from a simple type in neoprene of 2/5 mm for the closed fins to those which have a built-in shoe with a rigid sole, used for open fins.

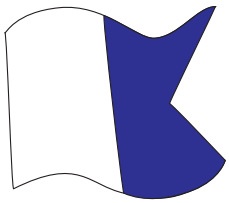
SNORKELLING EQUIPMENT

Nowadays is very common to find snorkelling jackets on the market which are lighter and less bulky, those differ from the ones used for Scuba diving. These jackets are put on over the head, fasten down the front and fasten to the body with quick release buckles. They are made for shallow waters, giving the diver the right buoyancy when he wants to observe the seabed while breathing through the snorkel. These models always have inflating tube to regulate the air inflated or deflated. In the latest models if needed the jacket can be blown up immediately with a cartridge of CO2, which can be replaced after use.

KNIFE

During a dive a knife is a must as it offers protection against any possible entanglement and can be used to accomplish different tasks, such as sound signalling. The knife must be heavy enough not to float, and must have comfortable handle as well as a sharpened blade. It should always be handy and it must be used only in case of need otherwise it could become blunt.

SURFACE MARKER BUOY



A floating buoy is a piece of safety equipment, which marks the presence of divers underwater. In some countries dive law requires flags. The buoy is topped with a flag "ALPHA" which is blue and white and is known as "A FLAG". This flag has an international definition of "I HAVE DIVERS DOWN, KEEP WELL CLEAR AT SLOW SPEED". You may also see a red flag and a white diagonal stripe on it.

BAG

Bags for every possible use are on the market. It is worth looking out for the size and the strength of material as they are never big enough and equipment is always heavy. When on a boat or in an inflatable a mesh bag is useful to keep personal belongings together and it will also dry quickly.

Put on the basic equipment

Put the equipment on in the following order:

SUITS
With a suit in two halves, put on the lower part first, if there are soft neoprene edgings, they must be rolled outwards to help the suit to slip on.

BOOTIES
In order to obtain a better fit the edge of the boot should be worn over the top of the suit trouser.

BUOYANCY COMPENSATOR (BC)
The jacket should be pulled down over the head and fastened with the belt, then slightly inflated. If the jacket is loose it could slip off.

WEIGHT BELT
The weight belt should always have a keeper on the opposite side from the buckle to avoid weights being lost.
There are two main ways to put the belt on:
-passing the belt behind the back, keeping it in with the right hand, then grabs the buckle with the left hand. Lean forward and place the belt on the back, then fasten the belt with the buckle to the left.
- with the buckle to the left take the two ends of the belt step over it and repeat the previous procedures. It is very important to make sure that the buckle opens on the right, because in an emergency it will always be clear how to release one's buckle.

FINS
The most comfortable position to put on fins is sitting. When they must be put on standing, it is advisable to ask for help from a companion. The right hand is for putting on the left fin and vice versa.

MASK
In order to obtain a proper fit the frame of the mask should be held against the face with one hand, while the other positions the strap round the head. The headstrap must not be too tight as it could deform the mask, causing water to get in. When wearing a hooded suit make sure that the hood is not interfering with the mask's seal or it will leak.

SNORKEL
Tuck the snorkel under the mask strap or attach it to the strap using the retainer provided.

GLOVES
Even those in light materials tend to hamper the use of fingers; therefore it is advisable to put them on last.

Environment adaptation

BUOYANCY CONTROL

Any object immersed in water will receive an up thrust equal to the weight of water it displaces. As a consequence of this law weight, body volume, fresh water, seawater and the thickness of the suit are all variables that effect buoyancy. When snorkelling in safety the correct weight on the belt is essential for obtaining neutral buoyancy at a foreseen depth and to keep the same buoyancy when ascending. The right weight is achieved when standing in the water and breathing out normally; one doesn't sink below the eye level.

MANOEUVRE OF COMPENSATION

As the diver sinks the surrounding pressure rises, because of the weight of the water. This rise of pressure is also felt on the human body which being basically composed of liquid and solid will only have problems where air spaces are concerned. Where the volume are reduced by the increase of impact they must be compensated. For this reason the water pressure on the eardrum must be balanced by internal pressure so that it is not damaged. This procedure is called compensation. It is necessary to compensate every time there is need, without waiting to feel the pain .The most common manoeuvre of compensation is that of "Valsalva". It consists in holding the nose with the fingers to create pressure inside and then forcing the air towards the middle ear. In order to carry out this manoeuvre successfully, avoid using earplugs that isolate an air space inside the ear, which cannot be compensated. Water should be allowed in to the hood. The use of nasal drops can cause irritation to the nasal mucus, causing difficulties in compensation. If it is impossible to compensate in a correct way it is advisable to stop and ascend. Try blowing the nose to free the air passages, and try again to descend, compensating with the head held back. In any case if the difficulties persist any further dive should be given up. Blowing air from the nose should also compensate air held in the mask.

SIGHT

We all know that when you open your eyes under water your vision is blurred, this is because air and water have a different refractive index (respectively 1 and 1.33) causing vision to be out of focus. So, in order to see clearly, is necessary to have a layer of air between the eyes and the water: thus the use of a dive mask.

SENSE OF HEARING

Because of the higher density of water, sounds reach the diver more rapidly than above the surface. Sounds made to call attention, like hitting a knife on metal can be heard at great distances. On the other hand when underwater it is difficult for a diver to distinguish where and from what distance a sound comes: for example the noise of a boat engine. The speed at which sound travels through water makes it difficult for his senses to judge the direction. Great attention must be paid on the surface and while ascending from the seabed.

SENSE OF TOUCH

Touching is another sense, which becomes modified underwater. In fact all surfaces that can come in contact with the diver are covered with a layer of water which makes everything slippery. Also because of particular changes that the skin undergoes after some time in water, the finger ends loose a certain amount of sensitivity. Gloves too, which are necessary for protection against the loss of body heat, cut down the feeling of touch. It is useful not to forget that a diver immersed in an unknown environment is timid about touching things around him. Therefore this sense is not properly employed.

SENSE OF SMELL

As far as smell is concerned, it becomes neutralised during diving because underwater it is impossible to distinguish any smell. This causes a feeling of an uneasiness, typical when moving about in an unknown environment.

Underwater accidents

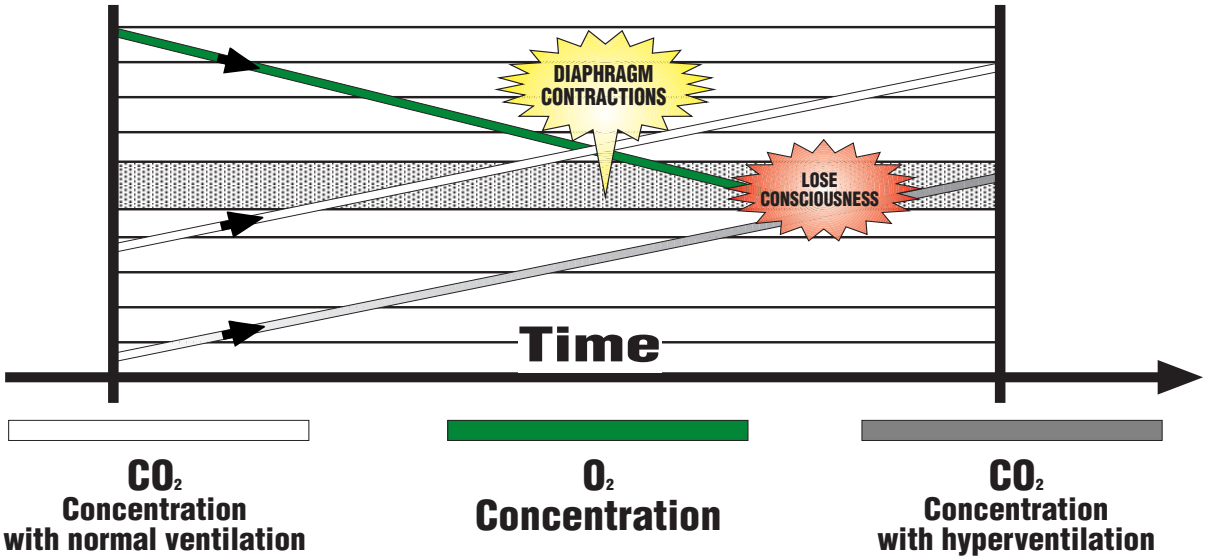
SYNCOPE

This is the most serious danger for a diver. It is a loss of consciousness; breathing stops and cardiac arrest follows. Different types of syncope can be distinguished.
The most common are:

Case 1
This happens when the concentration of oxygen drops below the level of 10% causing a metabolic block due to the fact that nerve cells stop functioning. If the oxygen supply to the brain is not restored immediately, the damage can be permanent. The seriousness of this damage depends on whether hyperventilation has occurred before snorkelling or not.

Case 2
Is not an accident that could happen only to divers. It can be caused by the differences between the body temperature and the water temperature. It is the typical accident occurring to swimmers who dive after a large meal or when tired. The heartbeat slows down causing a cardiac arrest. The blood to the brain is interrupted and a rapid hypoxia occurs.

RESCUE PROCEDURES

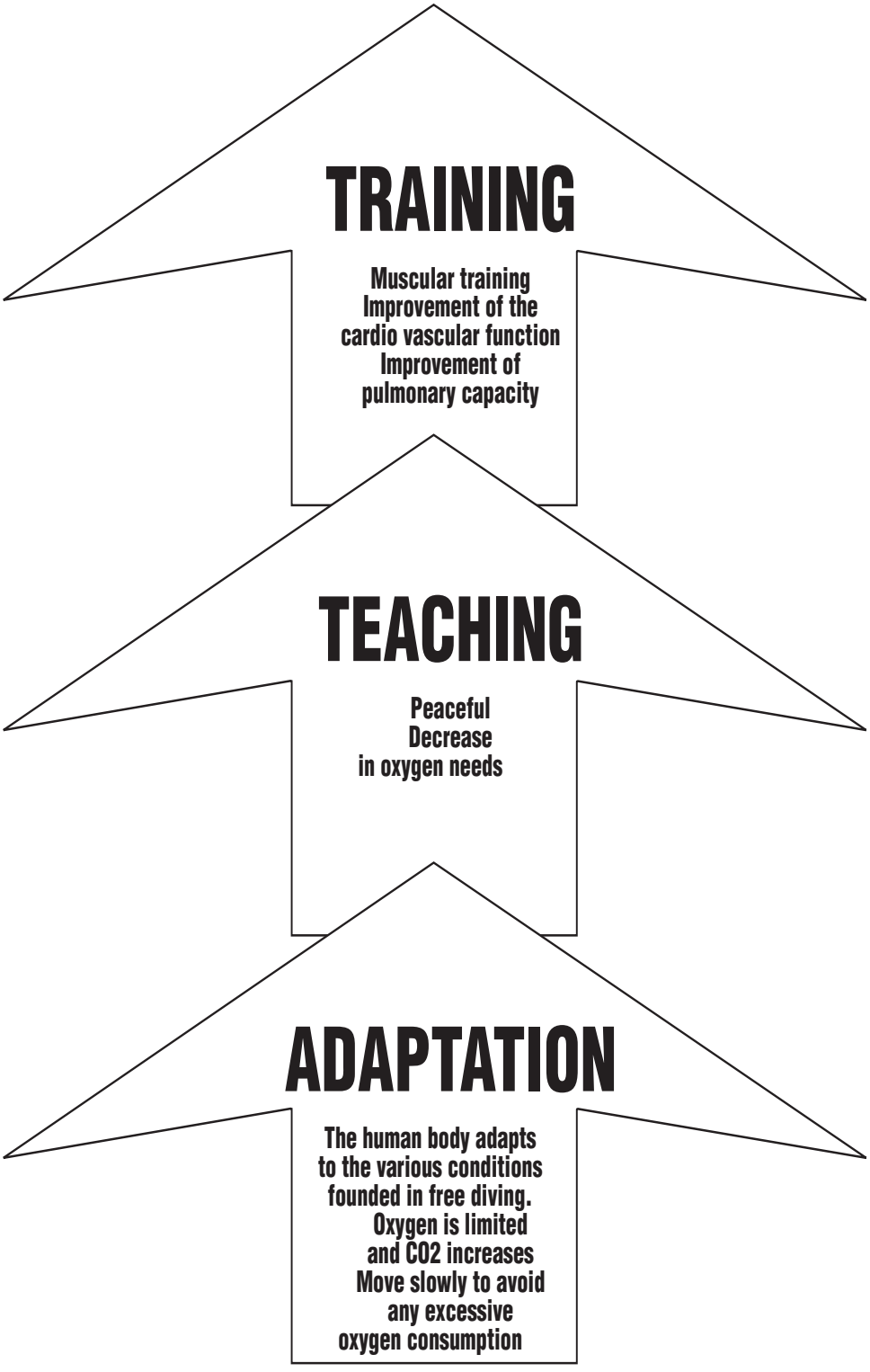


- Keep the respiratory airways clear of water
- Remove the mask and the snorkel
- Take the injured to the boat or shore
- Get medical assistance

General points to consider

Snorkelling is considered the most natural approach to diving, but despite its simplicity it must not be underestimated. The problems that the human body must face when snorkelling are much greater then those with SCUBA diving. The psychophysical aspects must always be considered.

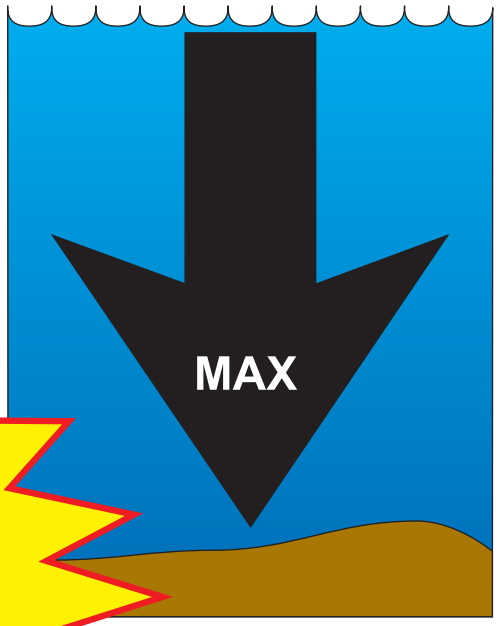
TO IMPROVE PERFORMANCE



PURPOSE

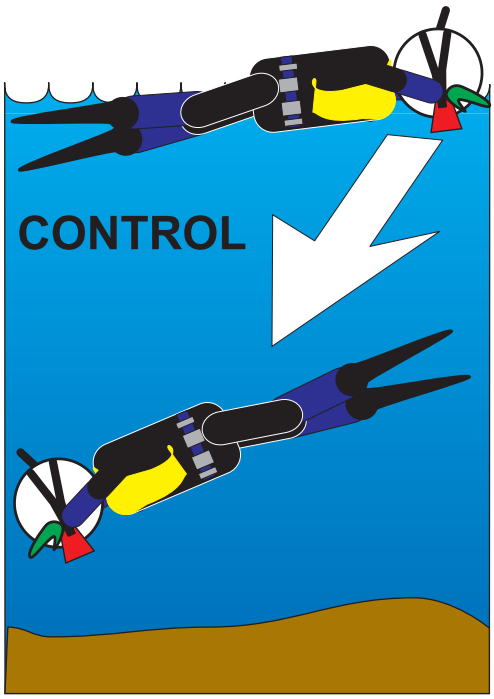
SNOKELING
PHOTO
FISHING

DEPTH



EQUIPMENT
CHOICE
AND
CHECK

BUDDY SYSTEM



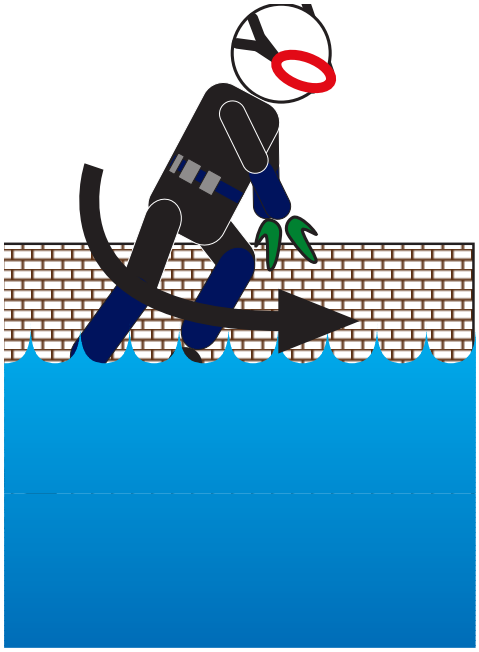
TIME
SIGNALS
SEARCH

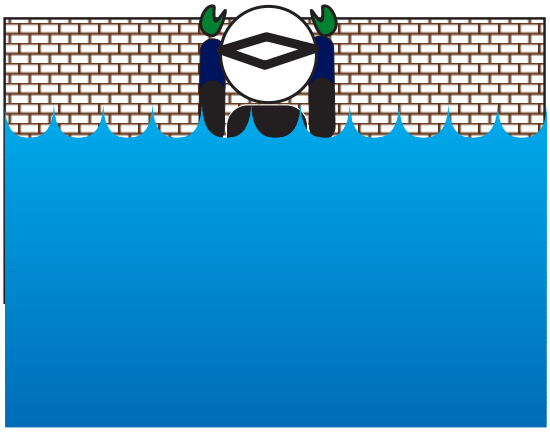
In water

ENTERING THE WATER

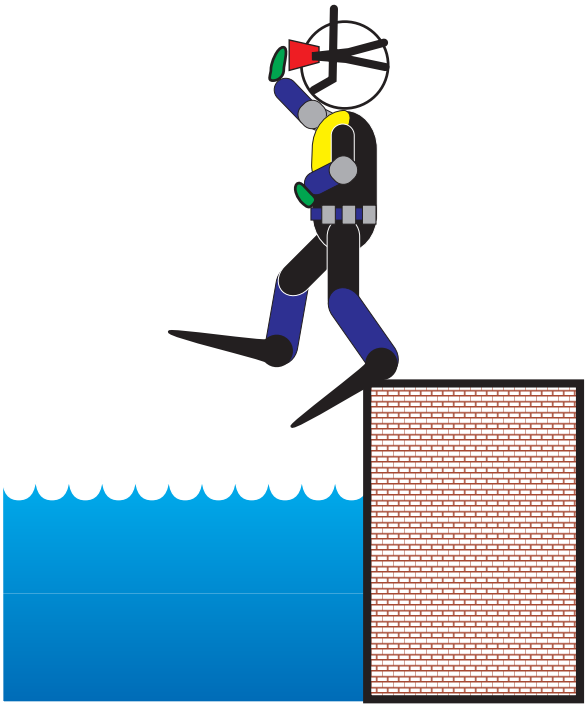
The way to enter the water depends on personal choice and so that it is less dangerous to other divers.

FROM A LOW POINT



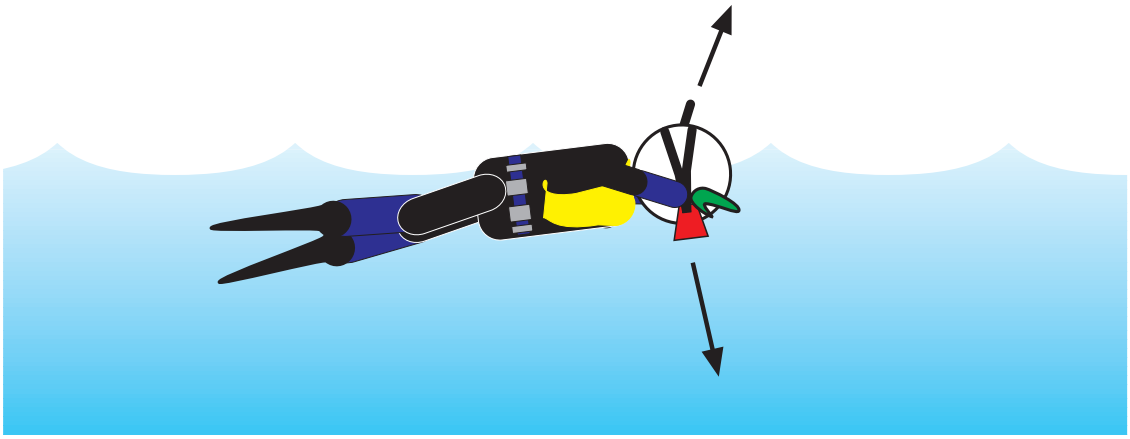


FROM A HIGH POINT



POSITION

The position to keep when a BC is worn is horizontal with the arms held straight ahead. The head will be bent towards the sea- bed at an angle of 45°. A different position would cause the diver too lose the correct buoyancy. When floating horizontally if the legs are slightly opened a greater area is covered and any sinking is avoided. This position can be held without making any sharp movements the hands. Wearing a BC, when not swimming, a vertical position is maintained, the same position is needed when moving about.

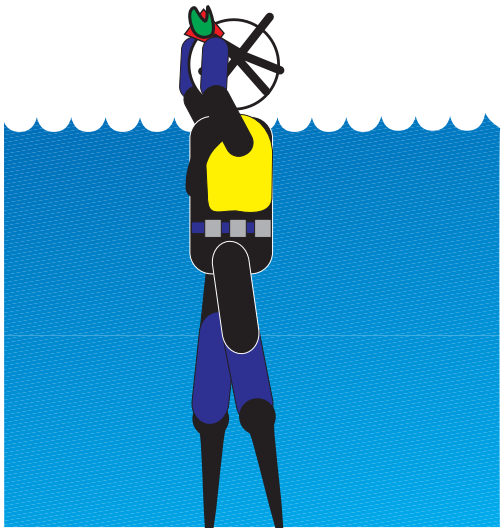


BREATHING

This is an important part when performing snorkelling. Ventilation must be very calm and slow, allowing the diver to feel completely quiet and relaxed. Regular respiration must be sustained. Training and confidence with water can be acquired after a time, helping the diver to feel more at ease. This helps him to breathe regularly.

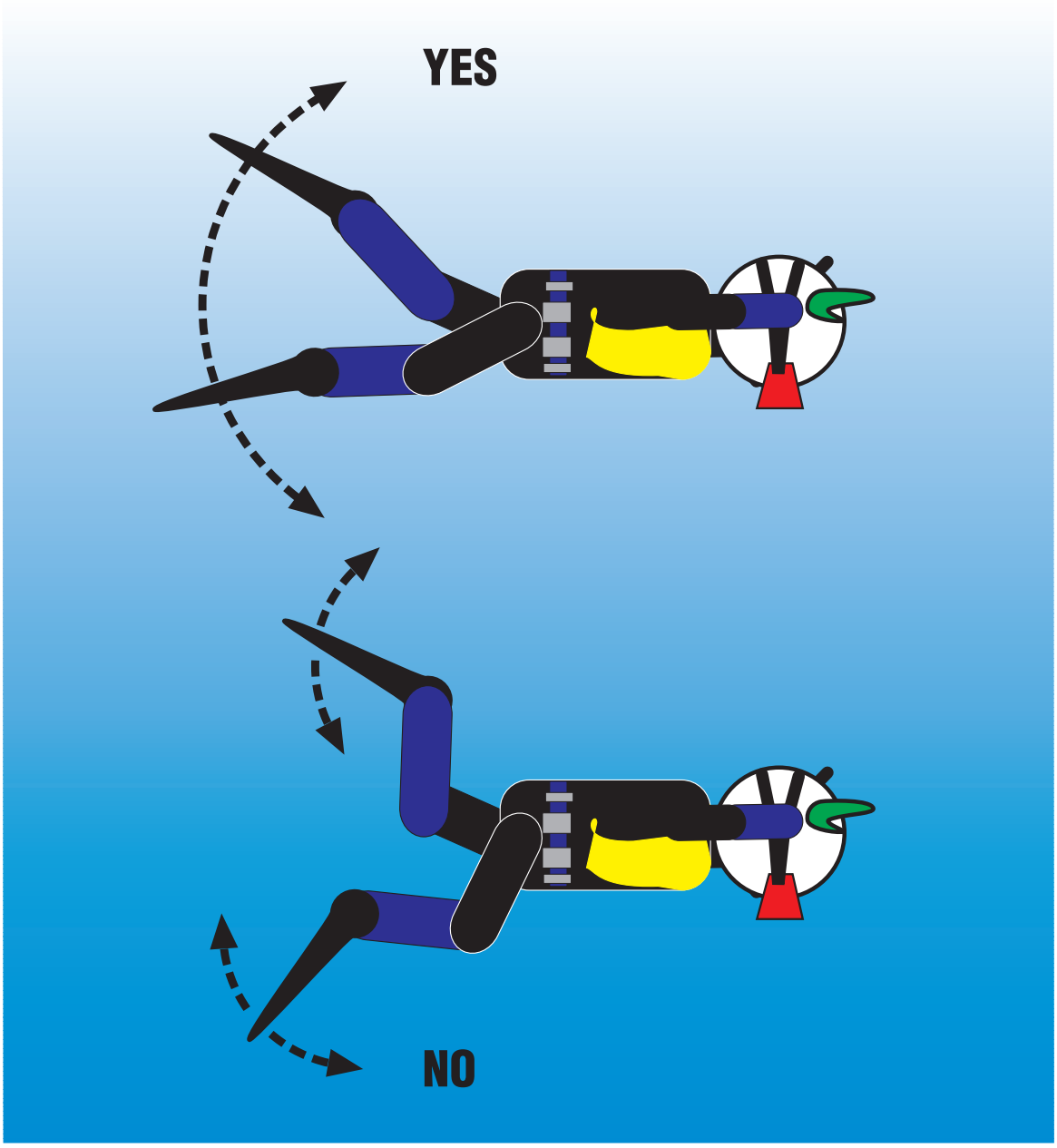
MASK AND SNORKEL

Sometimes after a dive some water may flood the mask, to get rid of it lift the lower part of the faceplate while keeping a standing position, this operation can also be carried out when the glass needs to be cleared. Occasionally this operation may be carried out during a dive; in this case the mask can be emptied by blowing air, slowly, through the nose while holding the upper edge of the mask and while keeping the head upwards. The snorkel is fixed to the mask by a special ring and must not be too vertical when on the surface of the water; this stops it from being flooded by waves and quick movements.



FINNING ON THE SURFACE

This is performed with small fast movements from the knee down. Finning correctly (the maximum movement with minimum energy) is performed with the feet and the legs extended (being careful to keep the muscles relaxed). With a slight rhythmic movement of the hips, and using the knees very slightly. The legs must stay together (avoid the fins touching each other). Finning out of the surface means keeping the fins constantly immersed. If not they can cause a breaking effect. It is important to remember that fins work in all directions and not only up and down. The movements of the fins must be steady and deliberate, otherwise thrashing about only uses up energy. During finning the diver must remain as horizontal as possible so as to facilitate speed. The head must stay in line with the body thus keeping the hips up. Above all when covering long distances it is better to keep up a slow rhythm.



DIVING ROUTE

Divers with little experience should always stay as near the coast as possible. Before entering the water find out the direction of the current, it is more difficult to swim against the current when one is tired.

Signals

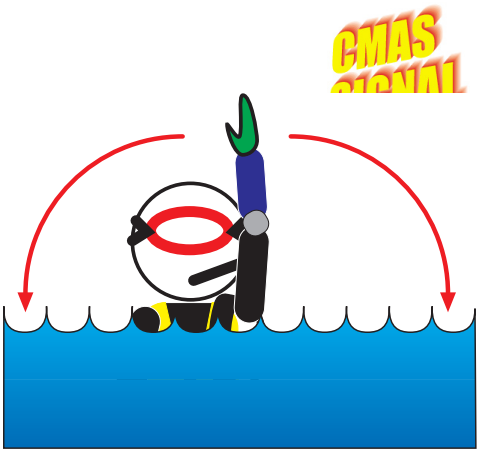
ELEMENTARY SIGNALS ON THE SURFACE

Ok - I am OK - Are you OK ?

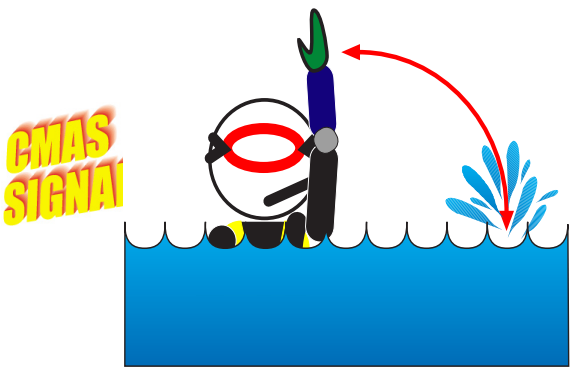
I am OK

Go down - Down!

Go up - Up!



I am Here

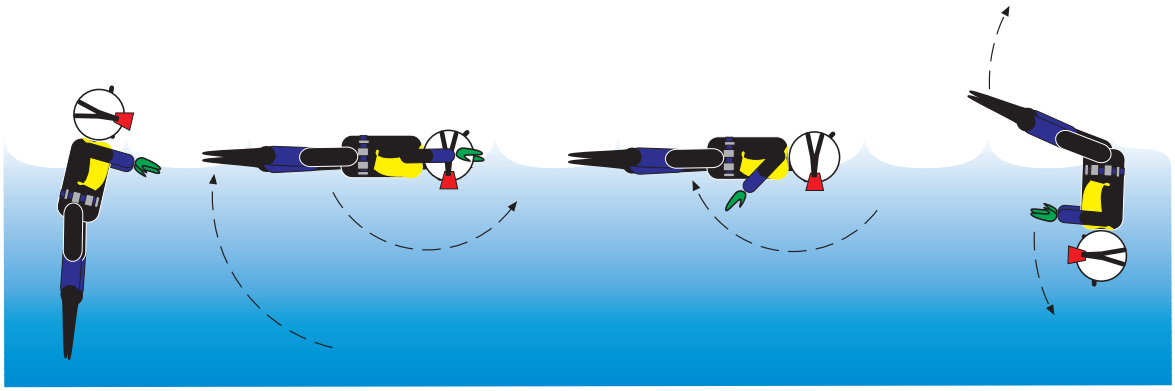


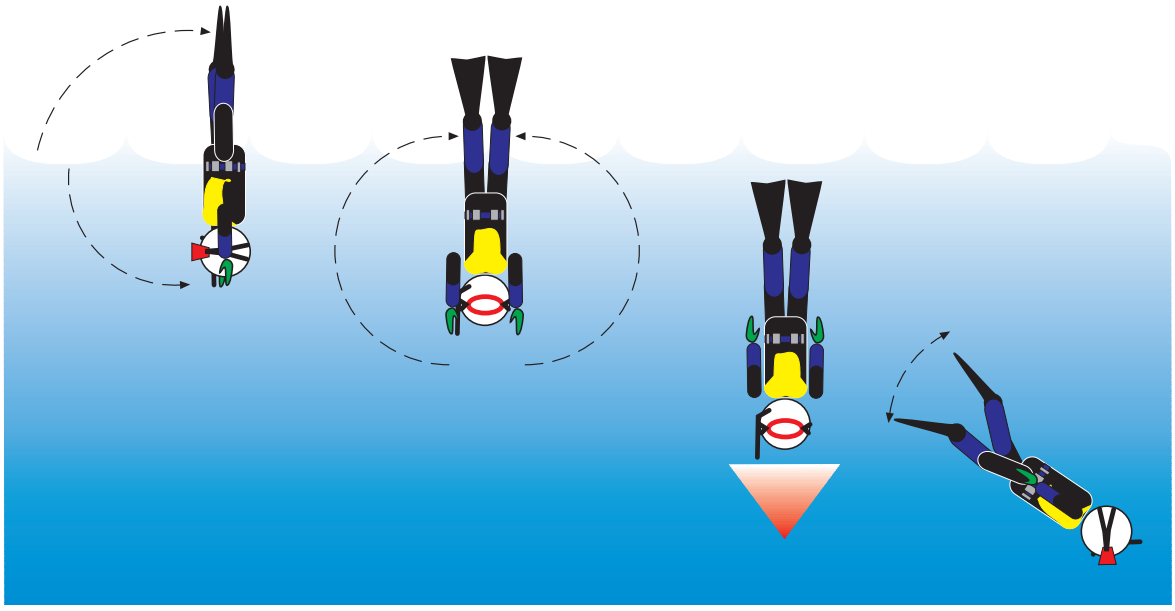
Come here, I have a problem

THE ROLL OVER

A rollover carries out the passage from swimming on the surface to diving. Performing these movements correctly avoids any waste of energy. A correct roll over is noiseless thus allowing the diver to get underwater without frightening underwater life.
Finning should begin only after complete immersion, moving the fins too early often compromises a good roll over. At this stage for safety it is better to take out the mouthpiece. It must also be remembered that while wearing a B.C. this must be deflated completely before the roll over.

DURING DIVING





A good roll over results in carrying out the first phases of diving without any effort. At the end of this operation it is essential to get into the most hydrodynamic position possible. Once at the set depth, horizontal position can be sustained and finning steadily can save energy. Any change in direction can be carried out using the hands.

ASCENDING

This operation is carried out by finning steadily towards the surface to avoid useless waste of oxygen. Near to the surface the arms must be held up for protection against possible obstacles. It is important never breathe out during ascent.

SAFETY PROCEDURES

When snorkelling it is a good rule that a diving companion stays on the surface while the other dives. This means that the two divers are in control of the situation and in an emergency one is there to help the other.

Once on the bottom it is better to keep the mask on and to replace the mouthpiece while looking around and breathing. It is a good idea to wait some minutes between one dive and another, for this reason the BC is useful and safe.

EMERGING FROM THE WATER

The operations to get out must always be carried out in the safest and easiest way. The weight belt and fins are taken off while taking into account the actual environment and its conditions. The undressing order is the opposite of that used for dressing.

EQUIPMENT MAINTENANCE

On return the equipment must be washed in fresh water, dried if possible out of the sun and kept in a dry place. It is a good idea to check the equipment in case it needs any small repairs.

LESSON 1

CMAS

WORLD UNDERWATER FEDERATION

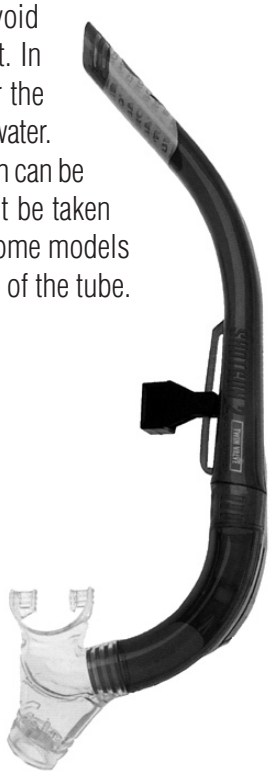
Basic equipment

MASK

In order to obtain increased clarity and visibility underwater, a mask must be worn. By wearing it, an air space is placed between the diver's eyes and the water so the objects can be properly focused.
A mask consists of:
- Lens, which is made of high impact, tempered safety glass
- Skirt which is in silicone (translucent or black) or in rubber. It should ensure perfect fitting to the face in order to avoid the passage of water. It should also have a comfortable space for the nose and suppleness for compensating.
- Faceplate, which is of rigid material into which the lens is fixed and the part of the headstrap which, can be regulated.
- An adjustable rubber headstrap, of the same material as the body, which will allow you to regulate the pressure and therefore the position of the mask on the face so that it is correct. In order to choose the mask that fits our face it must be held in the correct position without the headstrap, while inhaling lightly with the nose, the suction that is created causes the mask to stick well to the face. Different masks are used according to different activities. Those with a small volume are usually used for snorkelling, as they only need a small amount of air in the manoeuvre of compensation. In Scuba activity the volume is irrelevant to the compensation, therefore a mask with a bigger and a wider view can be used. The use of silicone or rubber is not important as far as the performance is concerned, but rubber doesn't last very long because of exposure to sun and to salinity. The materials employed by the firms during the stamping of the components for the masks leaves an oily film on the mask, which mists up easily. It is advisable to clean the glass of a new mask with toothpaste, as this has an abrasive effect, unless the lenses have already been treated. If the film persists it is better to wash it with a neutral soap. On the market you can find special products to use on the lens after each dive. For those with eyesight problem, suitable masks are on sale. After the use the mask must be rinsed with fresh water and replaced with the glass downwards so that the soft part does not become deformed.

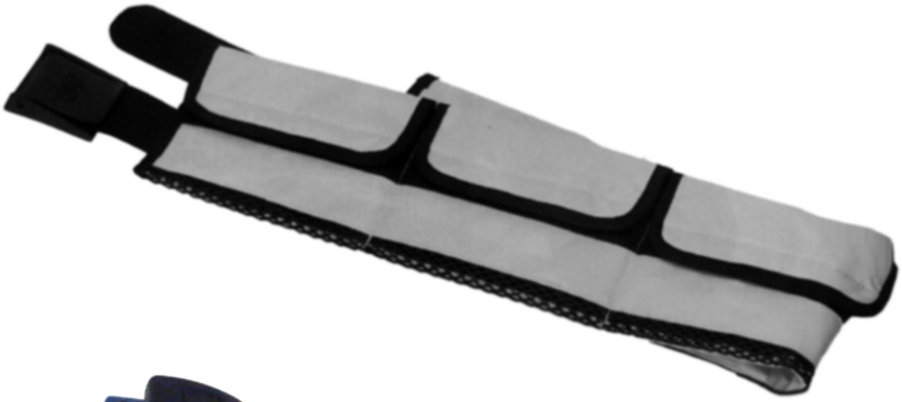
SNORKEL

It allows breathing on the surface with the head underwater thus keeping the seabed in sight. The snorkel is composed of two parts: the mouthpiece and the tube. The mouthpiece must be made of soft material and must have a form that fits well into the mouth so that it can be easily held thus avoiding any passage of water. The tube can be made of rigid or semirigid material and it must be flexible without breaking. The inside of the tube must be smooth with only slight bends so as to avoid collecting water and keeping the flow of air constant. In order to spot the diver it is advisable to colour the end part of the tube that emerges from the water. The snorkel has an attachment, which can be fixed to the mask strap. Care must be taken that it is in the correct position. Some models have a valve for emptying the end of the tube.



WEIGHT BELTS

In order to achieve neutral buoyancy the use of weights is essential. This is obtained by wearing lead weights, which are fixed to the weight belt; the belt should also have a quick release buckle. There are also belts on the market which have useful pockets to hold various numbers of weights. The proper weight to be carried depends on the thickness of the suit, on the equipment, on the type of water (sea water, fresh water) and on the type of dive.



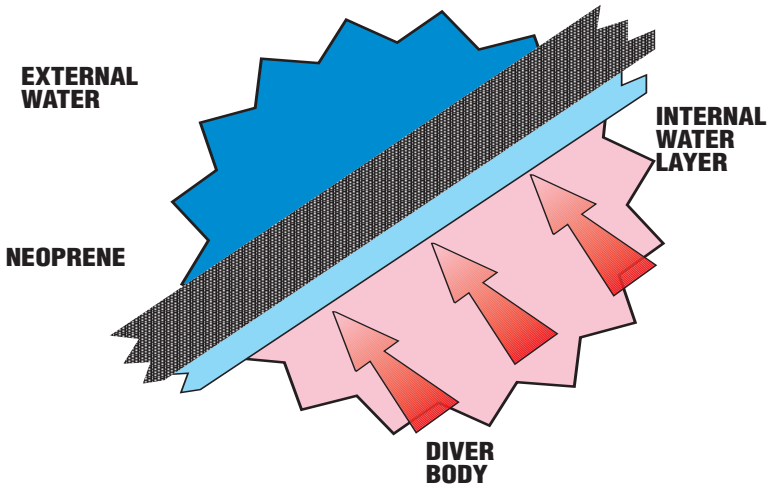
FINS

Fins are a useful part of the equipment, which helps the diver to move underwater more efficiently. They are available in a variety of lengths, sizes, and models. They can be made in rubber or synthetic material, closed or open, with an adjustable heel strap (in this case it is advisable to use a type with a rigid sole). Fins are chosen according to the nature of the task to perform. For snorkelling fins with a longer and narrower blade are used, whereas for Scuba diving fins of medium length and a wider blade are more suitable. Technical research of recent years has created blades, which can make movements easier through water. It is also very important to bear in mind that a fin must not be too tight, in order to avoid problems with circulation, which could cause sensitivity to cold or cramps.

SUITS

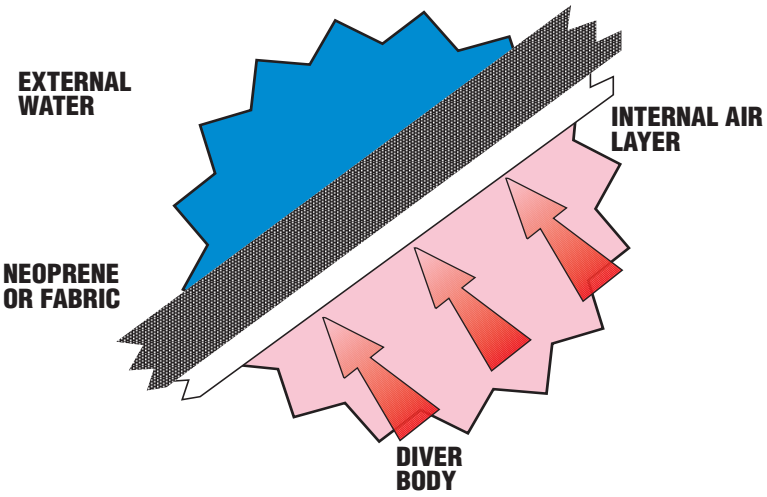
Suits are protective clothing, which help to minimise thermal exposure effects on the body; this is due to the high thermal conductability of water (about 25 times higher than air). In order to obtain the necessary thermal insulation, suits must prevent the passage of water to the inside as much as possible. Wet suits are generally made of neoprene, of different thickness (from 1.5 to 8 mm), lined on the inside and outside with special cloth that make them more comfortable. Suits vary according to the use. They are available on the market in one piece with or without hood or in two halves (a jacket and a salopette) with or without a zipper, in different thickness of neoprene, with seals at the wrists, neck, and ankles, to make them air-tight. When choosing a type and size it is important that no air pockets are found between the suit and the skin.

WET SUIT



This would interrupt thermal insulation. For use in tropical seas, where the water is warmer, light wet suits are now available in lighter synthetic materials (Lycra, Darlexx etc.) These kind of materials allow the diver ample movements as well as providing a certain thermal insulation.

DRY SUIT



GLOVES AND FOOTWEAR

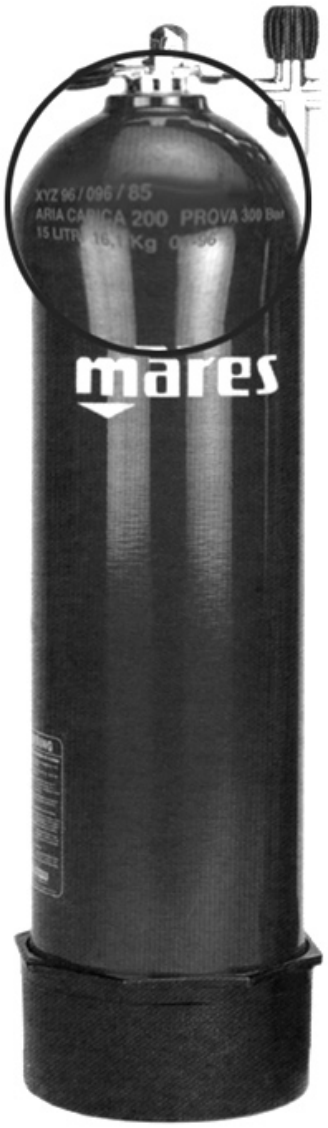
Gloves and footwear should be worn together with a suit because limbs are very sensitive to cold. Gloves in neoprene provide a good protection and there are different types with different levels of protection. Footwear depends on the fins used. From a simple type in neoprene of 2/5 mm for the closed fins to those which have a built-in shoe with a rigid sole, used for open fins.

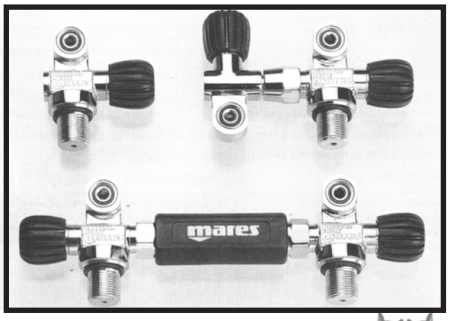
Scuba equipment

CYLINDER

The cylinder is the container that allows the diver to carry a reserve of breathable air underwater. The tank is made up of a bottle in steel or aluminium and a mechanism to regulate the airflow. The bottle is a cylindrical container, which has one closed end. The other end of the cylinder has a neck on it, which has a threaded hole, which allows a valve to be fitted for regulating the airflow. Generally it has a filling pressure of 232 atm.

At the shoulder of the bottle all the details about the cylinder are printed, the volume, weight of the bottle, its number, the maximum pressure, test pressure, date of manufacture and the name of the manufacturer. Because of the material used the pressure to which they are exposed and environment in which they are used the cylinders are tested in authorised centers with a variable expiring date according to the rules of the different countries where they are used. The test consists of checking inside and outside for corrosion and pressure resistance test using pressure of 50% higher than in normal use. In the UK the first test is carried out 4 years after the date of construction and then after every two years. The date of testing is generally stamped under the manufacturing date, the cylinder, if made of steel is equipped with plastic support, which keep it upright. If it is in aluminium the bottom is already flat. An o-ring secures the sealing of the valves that is screwed to the bottle. For the assembly of regulator there are two types of fitting: DIN with five or seven thread female and INT with a yoke (A clamp). After diving the cylinder must be washed and stored in a dry place.





REGULATOR

This is what enables the diver to breathe underwater. This part the equipment allows air supply at ambient pressure. At present most of the regulators available on the market are two—stage whereas the earliest ones were single-stage. Single stage regulators have single valve assemblies that reduces cylinder pressure to ambient pressure. Two stage regulators have a first stage that reduces cylinder pressure to ambient pressure plus a pre-set intermediate pressure and a second stage which reduces ambient plus intermediate pressure to simply ambient pressure. The first stages of the regulators can work with a piston or a diaphragm to reduce the cylinder pressure, and are normally with a balanced configuration, which allows better performance of the second stage.

ALTERNATIVE AIR SOURCE (AAS)

Together with the main regulator it is advisable to have an alternative source of air in order to have a safer diving. This is an extra safety measure in case the main regulator stops functioning or if a buddy breathing needs to be carried out.
The A.A.S. is:

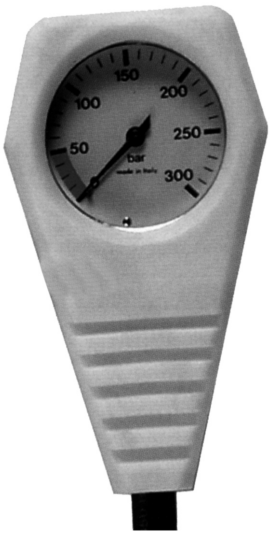
A second stage or "Octopus"
It is fixed to a low-pressure port of the first stage through a hose longer than the normal one. Its colour is different, generally yellow, so as it can be easily spotted.

Spare regulator
It consists of a complete regulator fixed to a second outlet valve of the tank. Even in this case the A.A.S. has an easily spotted colour.

Alternative air source inflators
It consists of a B.C.D. inflator functioning as an octopus second stage by means of inflating low-pressure hose. (E.g. auto-air)

Independent source
It is possible to find on the market extra small cylinders of 0.5 or 1 lt., known as "Pony bottles"; these are equipped with an outlet valve that allows you to fix an extra regulator.

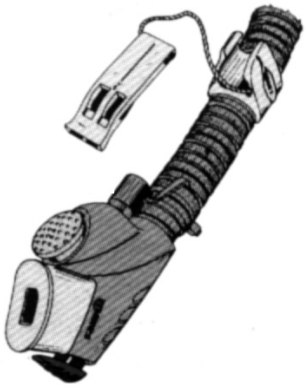
PRESSURE GAUGE



The pressure gauge is linked through a hose to the High Pressure (HP) of the first stage and shows the level of pressure in the cylinder, so that it can give a continual readout of the amount of air during diving. The pressure gauge must have a safety valve that will blow before the glass does, so that the glass will not explode into the face of a diver if there is a fault with the gauge.

BUOYANCY CONTROL DEVICE (B.C.D.)

The BCD is used to keep the buoyancy constant regardless of the changes in depths that occurs during diving. By inflating and deflating with the right amounts of air, changes in volume are compensated; this is due to the increase and decrease of pressure. It is fixed through one or two harness to the cylinder and has a soft or hard backpack. The connection with the first stage of the regulator through a low-pressure hose allows the operation of inflating. Deflation can be carried out through a quick released valve or dump. The BCD is also equipped with one or more valves to avoid the risks of over inflating it. The use of BCD on surface allows the diver to move and float freely.



Device

DEPTH GAUGE

Depth gauge is an instrument that measures the depth during a dive. The instrument must always have a pointer that indicates the maximum depth reached during immersion as this data is fundamental when planning a dive with the dive tables. Digital depth gauges are available which beside the usual function of indicating the depth and the maximum depth can also indicate to the diver when the speeds of ascend exceed 10m/min. It can also indicate the temperature and the time of immersion. It can also calculate the surface interval and hold previous dives in its memory; this instrument is very useful because several functions are incorporated in one.

WATCH

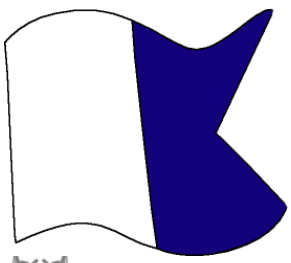
Watch must be pressure and waterproof, it can be digital or analog. An external counter-clockwise rotating self-locking bezel is a must for registering elapsed time.

KNIFE

It is one of the most indispensable devices when diving because it gives some added safety in situations which could become critical, for example if one is caught in a net, especially when snorkelling. It can also be used for signalling by hitting the blade on the tank. It must be strong with a comfortable handle and well sharpened. It must always be worn in handy position, knifes are generally worn on the inside of the calf, or on the upper arm. Knifes must be used only in case of real need, otherwise they could become blunt. After use should be rinsed with fresh water dried and coated with oil.

SURFACE MARKER BUOY

A floating buoy is a piece of safety equipment that marks the presence of divers underwater. In some countries dive law requires flags. The buoy is topped with a blue and white flag known as an “A FLAG”. This flag “ALPHA” has an international definition of ”I HAVE DIVERS DOWN, KEEP WELL CLEAR AT SLOW SPEED”. You may also see a red flag and a white diagonal stripe on it.



DIVING TORCH

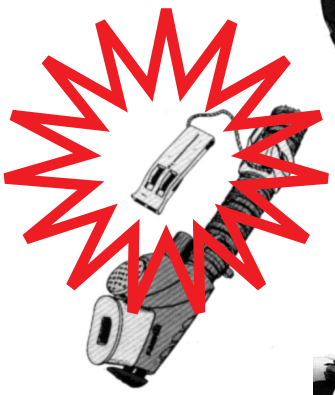
A torch can compensate the change in colours caused by the surrounding water. There are different types from the smallest, which takes up a minimum space and fits into a B.C.D. pocket, to those much larger and much more powerful. In Scuba diving torches with bigger and more powerful beams are used, which last a longer time. Some models can be equipped with rechargeable batteries that are very useful but may not last as long.

COMPASS

When diving without reference points and in reduced visibility, the compass supplies the diver with information of the route and helps with the return to the starting point. The most common compass has a window on one side to make it easy to read. It is normally worn on the wrist but can also be kept together with other instruments.

WHISTLE

A whistle is important because in an emergency it can signal the divers position over a great distance; it is advisable to be carried in a handy position.



BAG

Bags for every possible use are available on the market; it is worth looking at the size and strength of material, as they are never big enough. When on a boat or on a dinghy a fishnet bag is useful to keep personal belonging together and allow them to dry quicker.

KIT BOX

Parts of diving equipment consist of rubber or plastic material that in contact with a saline environment or when affected by the sun's rays easily deteriorates. Therefore it is a good idea to keep a box handy with spare parts.

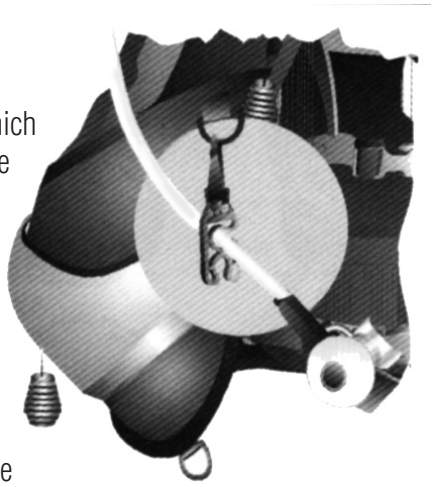
The followings are an example of what it should contain:

- a pair of straps for the fins
- a mask strap
- Snorkel fitting
- several o-rings
- a screwdriver
- a screw-spanner or multifunction tool
- a liquid neoprene tube
- a rope

Preparation and assembly of scuba diving

CYLINDER
Keep the cylinder vertical, with the air outlet opposite the diver. When the diver is not holding a cylinder it must always be left lying down.

BCD
Fix the BCD onto the cylinder checking the position so as to avoids the valves hitting the back of the divers head when in the water.



REGULATOR
Before assembly a regulator check the condition of the O-ring, which should exhibit no cuts. At this point connect the regulator first stage closing gently the fitting system, while checking the exact position of the hoses. The second stages must be on the right. Connect the inflating hose of the BCD; put the pressure gauge and the second regulator in their supports in the BCD. Slowly open the valve while keeping the purge button pushed on one of the second stages and leave it when the air begins to get out. This operation is useful to extend the life of the regulator, because the pressure that reached the first stage is not released too strongly, now it is possible open the valve completely. Breathe a couple of time from both the regulators so as to check them. It is important to look at the pressure gauge when breathing, because if the pressure falls drastically this means that the valve is not completely open or something is obstructing the flow of air at the first stage. Inflate and deflate the BCD a couple of times in order to check the functioning of the valve. Once the equipment is assembled lie the cylinder down in a safe position.

Putting on the scuba equipment

SUIT
With a two piece suit put on the trousers first then the jacket, if edgings in soft neoprene are present roll them outwards to help the suit to slip on.

FOOTWEAR
Put the edge of the boot over the suit trousers. This ensures a better seal.

WEIGHT BELT
Always have a keeper on the opposite side of the weightbelt from the buckle to avoid to loosing the weights. The two main methods for wearing the belt are:
- passing the belt behind the back holding it with the right hand then grab the buckle with the left hand, lean forward and place the belt on the back, then fasten the buckle
- with the buckle to the left, take the two ends of the belt, step over it and repeat the previous procedures
It is very important to check that the buckle is on the right, because in an emergency it will always be clear how to release one's buckle.

FINS
The best position to put fins on is when one is sitting. If it is necessary to put them on while standing, do it with the help of a companion. It is important to remember that the left hand put on the right fin and vice versa.

MASK

To position the mask hold the skirt in position against the face with one hand, while the other positions the strap round the head. The headstrap must not be too tight as it could deform the mask, causing water to get in. With a hooded suit make sure that the edge of the mask is in contact with the face by passing a finger around the edge of the hood.

SNORKEL

The snorkel must be put on the left side so as not to obstruct a regulator.

GLOVES

In order to have a better control of dressing it is advisable to put the gloves on last.

PUTTING ON EQUIPMENT WHILE STANDING

To put on equipment while standing get a friend to take the weight of the cylinder thus making it easier to put on the BC and to hold it until the harness straps have been fixed.

PUTTING ON EQUIPMENT WHILE SITTING

This is a more practical and comfortable way of putting on the equipment but it is not always possible. It is generally possible when we dive from a large boat.

PUTTING ON THE EQUIPMENT IN WATER

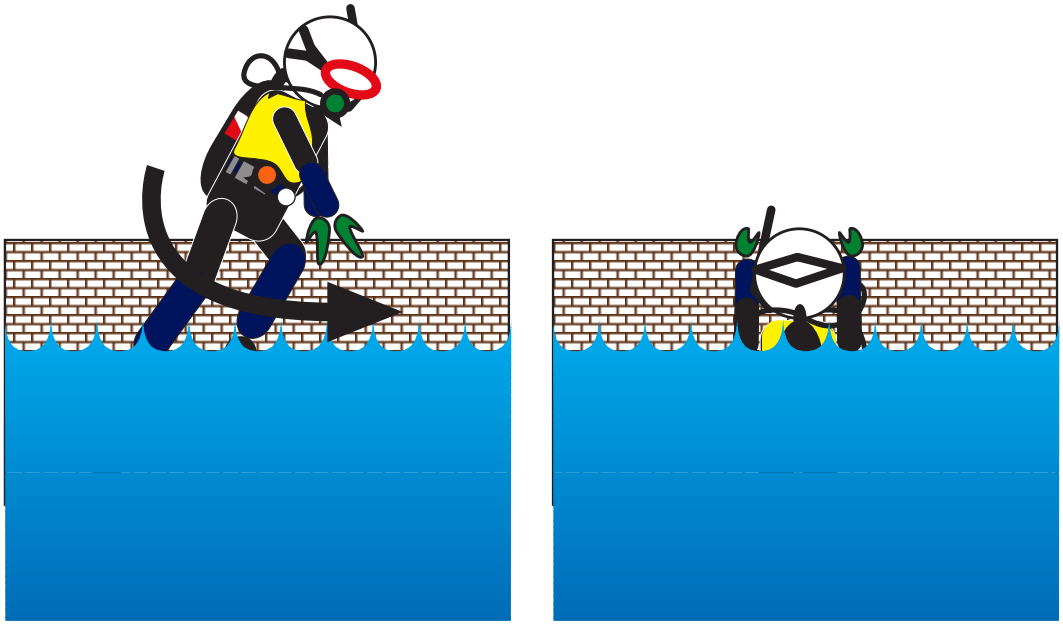
Putting on the equipment in water is not too difficult but not advisable in rough water. In any case the use of a line is advisable. To speed up the fitting of equipment it is better to place the back against the inside support of the BC, the arms can be put through the jacket one at time and then it can be fastened. At this point a normal position can be taken and the line can be abandoned. This operation should be carried out as quickly as possible so as to leave space at the entry point for other divers.

Enter the water

The way of entering the water must always be chosen by considering its easiness and safety for the diver and the companions. In order to achieve positive buoyancy it is advisable to slightly inflate the jacket before entering the water.

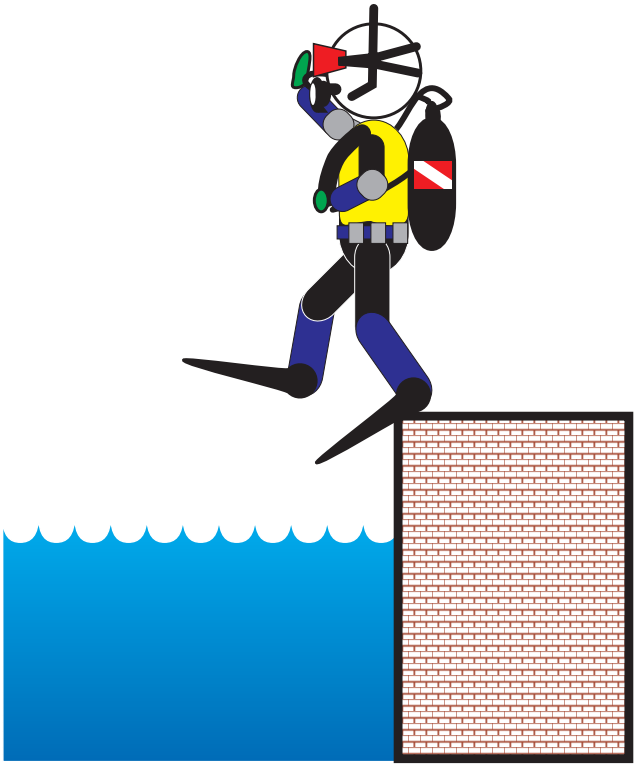
FROM A LOW POINT

The simplest way is to put the hands down by the side of the body, then allow the body to roll into the water, ending up with the face turned back to the point of entrance, so that there is always something to steady oneself with.



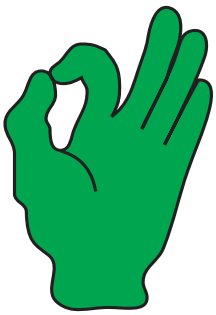
FROM A HIGH POINT

Entering water from a boat is normally done by taking a step forward while keeping a vertical position until impact with the water, this means that the body does not sink fast. Before doing this always check for the presence of other divers or obstacle of some sort. When entering is very important to avoid slipping out of the equipment, to do so it is advisable to keep one hand on the mask and regulator and the other on the weight belt.



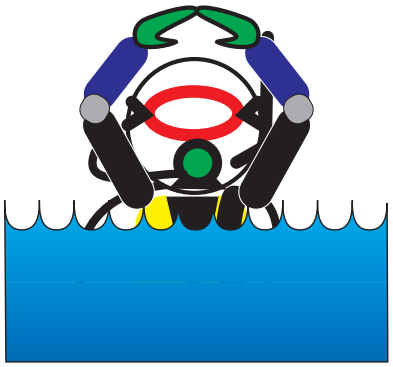
Signals

BASIC SIGNALS TO DO WHEN ON SURFACE



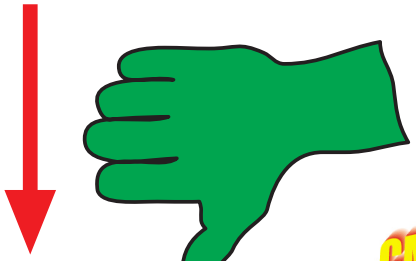
CMAS SIGNAL

Ok - I am OK - Are you OK ?



CMAS SIGNAL

I am OK

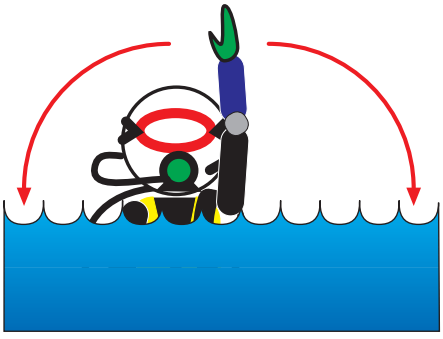


CMAS SIGNAL

Go down - Down!

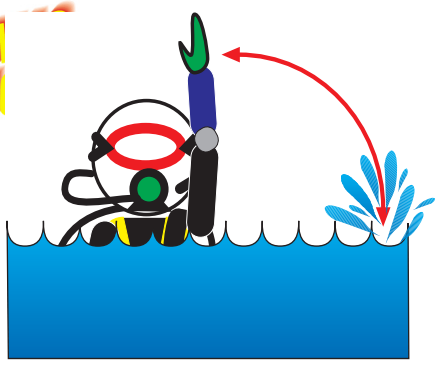
CMAS SIGNAL

Go up - Up!



I am Here!

CMAS SIGNAL



Come here, I have a problem

Adjustment

MANOEUVRE OF COMPENSATION

As the diver sinks the ambient pressure rises, because of the weight of the water. This rise of pressure is also felt on the human body that is basically composed of liquid and solid but will only have problems where air spaces are concerned. Where the volumes are reduced by the increase of pressure they must be compensated. For this reason the water pressure on the eardrum must be balanced by internal pressure so that it is not damaged. This procedure is called compensation. It is necessary to compensate every time there is a need, without waiting to feel the pain .The most common manoeuvre of compensation is that of "Valsalva". Which consists in holding the nose with the finger to create pressure inside and then forcing the air towards the middle ear. In order to carry out this manoeuvre successfully, avoid using earplugs that isolate an air space inside the ear, as this cannot be compensated. Water should be allowed into the hood. The use of nasal drops can cause irritation to the nasal mucus, causing difficulties in compensation. If it is impossible to compensate in a correct way it is advisable to stop and ascend. Blow the nose to free the air passages, and try again to descend, compensating with the head held back. In any case if the difficulties persist any further dive should be given up. Blowing air from the nose should also compensate air held in the mask.

SOUNDS UNDERWATER

Because of the higher density of water, sounds reach the diver more rapidly than above the surface. Sounds made to call attention, like hitting a knife on metal can be heard at great distances. On the other hand when underwater it is difficult for a diver to distinguish where and from what distance a sound comes: for example the noise of a boat engine. The speed at which sound travels through water makes it difficult for his senses to judge the direction. Therefore great attention must be shown while ascending from the seabed.

SIGHT UNDERWATER

We all know that if we keep the eyes open underwater the resulting vision is very confused. This is because air and water have a different index of refraction; therefore the vision is unfocused. In order to have clear vision underwater it is necessary to have a layer of air between the eye and the water. This is the reason why a mask is used.

CONTROL OF THE BUOYANCY

A body immersed in water will receive an up thrust equal to the weight of water it displaces. As consequence the weight and volume of a body are very important as well as density of water and thickness of the suit we have on. The weight belt gives the possibility to keep neutral buoyancy. This is the condition, which allows you to float without sinking nor ascending. The right weight is achieved when standing in water and breathing out normally, one does not sink below the eye level.

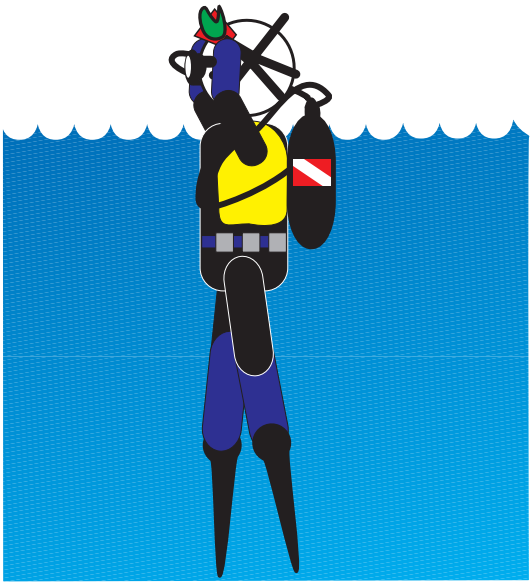
BREATHING WITH THE REGULATOR

Breathing with the regulator does not require any particular ability; the only thing to remember is to have a regular breathing with no pause. If the regulator gets out of the mouth it must be emptied before starting breathing again. The emptying of the second stage can be done after having replacing it in the mouth and blow a firm breathe through, or by the help of the button on the front part. (Purge button)

EMPTYING THE MASK

It is possible that water will leak into the mask during a dive. To get rid of the water, lift away the bottom part of the mask while standing up if on the surface. This can also be carried out when the glass needs cleaning. The differences between the air temperature and the water often cause the mask to mist up.

During a dive breathing slightly through the nose can empty the mask if at the same time you hold the upper edge of the mask and keep the head facing upwards.



STARTING THE DIVE

If we want to dive, keeping a vertical position, the B.C.D. must be deflated by using the exhaust valve. During descent, in order to slow down the speed, small amount of air must be inflated in the B.C.D. through the inflate valve.

FINNING UNDERWATER

The right finning is performed with feet and legs extended, with a slight rhythmic movement of the hips. Generally the fins for SCUBA diving move in both directions with a strong effect. The finning must be ample otherwise the effort will be useless. In order to be more hydrodynamic during finning the best position is horizontal with the arms at the side.

REGULATOR RECOVER

During diving it is possible to lose contact with the regulator, to recover it a round movement of the arm must be carried out, beginning from the bottom and passing it close to the body, which must be slightly bent on the same side. Therefore when the arm is brought back to the front the hose will be caught by the arm. As the body of the second stage will be flooded it will be necessary to empty it. The recovery procedure is made easier if the equipment has been put together properly.

ASCENDING

The ascent starts finning towards the surface, in order to control the speed; the B.C.D. must be deflated. It is important to check the way back and as the surface is approached it is advisable to extend the arm for protection in case any obstacles are present. Breathing must always be regular and with no stops.

GETTING OUT OF WATER

The procedure to get out of the water must always be safe and easy to be carried out. It is important to take in consideration the method of entry and the general condition of the environment.

MAINTENANCE OF THE EQUIPMENT

After a dive all the equipment must be washed in fresh water, let dry out of the sun and stored in a dry place. The importance of small repairs mustn't be underestimate. Scuba diving equipment needs to be inspected regularly and at least once a year it must be tested in a specialised center. The regulator must be washed in fresh water after each immersion putting the protection plug of the filter back on the first stage. It is important not to push the button of the second stage so that water will not get into the hose and the first stage where it could cause damage to the piston.

LESSON 2

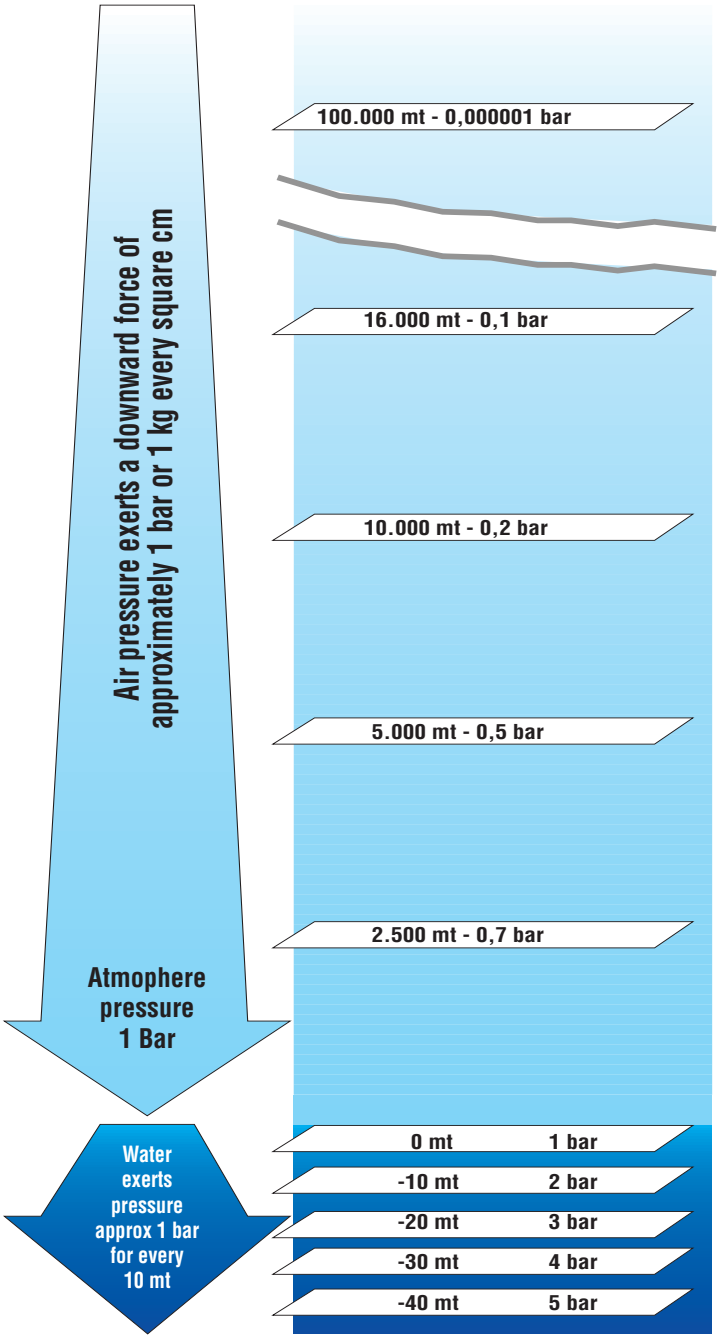
CMAS

WORLD UNDERWATER FEDERATION

Basic physics

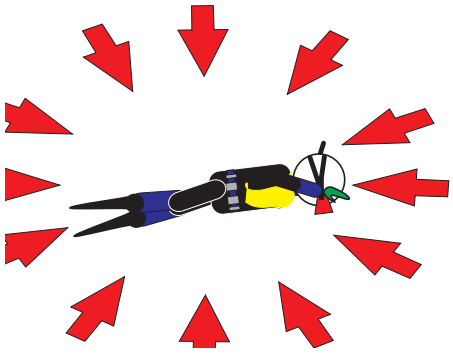
TORRICELLI 'S LAW

A gas layer known as atmosphere surrounds the earth, which can reach width of over 20,000 metres. Given that all gases have a weight, this layer of air exerts a pressure on the earth's surface. This is known as barometric or atmospheric pressure, and its unit of measurement is the atmosphere (1 atm = 1 kg/ cm^2). This pressure varies according to the height of the gas layer and is at its highest at sea level. Since air can be compressed it is most dense in its lowest layer where it is weighed upon by the total height of the atmosphere. Variations in pressure in the atmosphere are not consistent in that as the height of the air varies so does its density, and therefore its weight. Descending underwater, which is not compressible, the increase in pressure is constant at 1 Atmosphere (1 kg per cm^2) every 10 metres because there will be no change in density. For the purposes of diving, therefore, atmospheric pressure is considered separate from hydrostatic pressure, and when making calculations it is the sum of the two, known as absolute pressure, that needs to be taken into account.

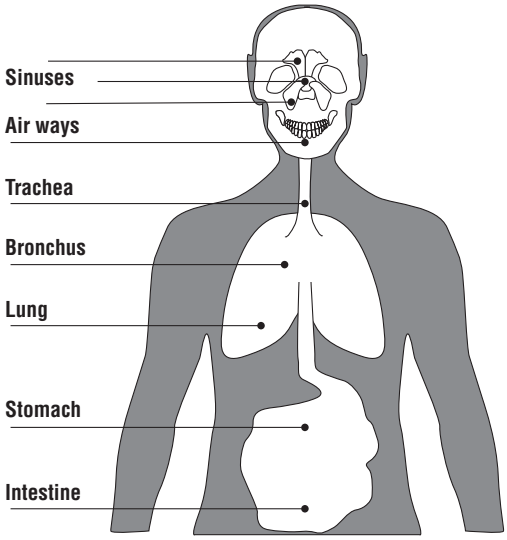


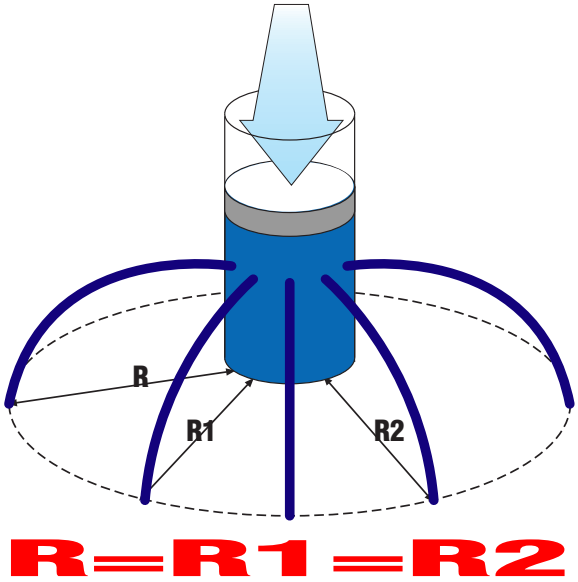
PASCAL'S LAW

" If pressure is applied to a non-flowing fluid in a container, then that pressure is transmitted equally in all directions within the container". If we transfer this principle to diving we can see the same situation in the human body as the pressure of the air breathed from a cylinder is transmitted in all directions and to all cavities with the same intensity. A body immersed in a fluid is not crushed by the column fluid above it: instead pressure tends to envelop it exerting the same force on its whole surface. For this reason it is possible to bear this degree of pressure, which otherwise would be unbearable. Given that the human body is subject to a pressure of 1 kg per cm^2 on the surface of his body.



If it were a solid substance exerting an equivalent pressure on the divers body it would be crushed by a weight of several hundred kilograms. When a diver descends the water presses evenly over the body, allowing him to survive to pressures of several kg per cm^{2}..





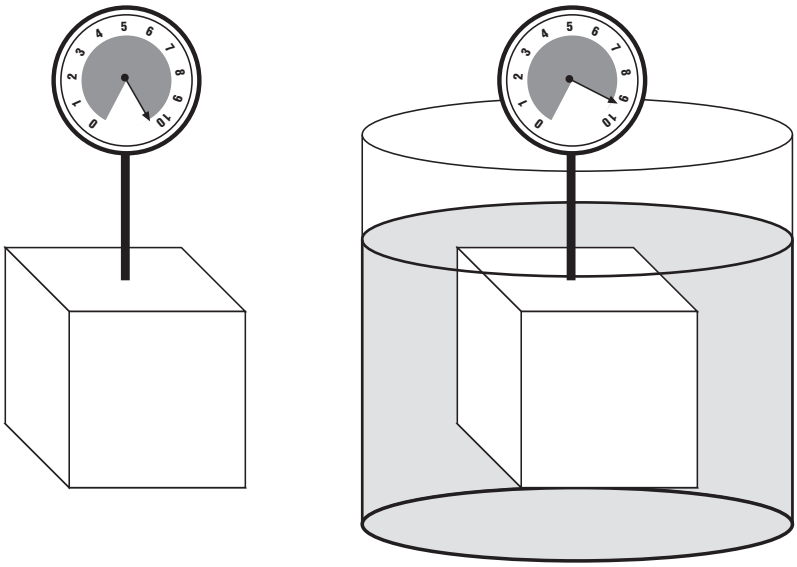
ARCHIMEDE 'S PRINCIPLE

Archimede' s law states that " a body immersed in water will receive an up thrust equal to the weight of water it displaces". This law is at the base of one of the most important procedures that must become automatic for a diver: the assessment of the hydrostatic equilibrium between the body, the equipment and the weight. Doing this, is important for getting as near neutral balance as possible and therefore more safety and comfort. In order to evaluate this balance is important to consider the relation between volume and weight of

a) the human body

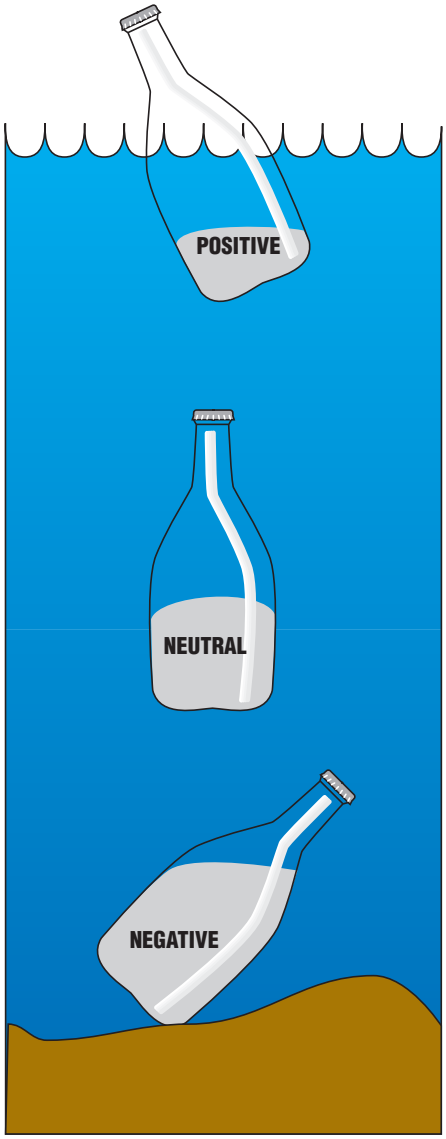
b) the density of the liquid (fresh water, sea- water)

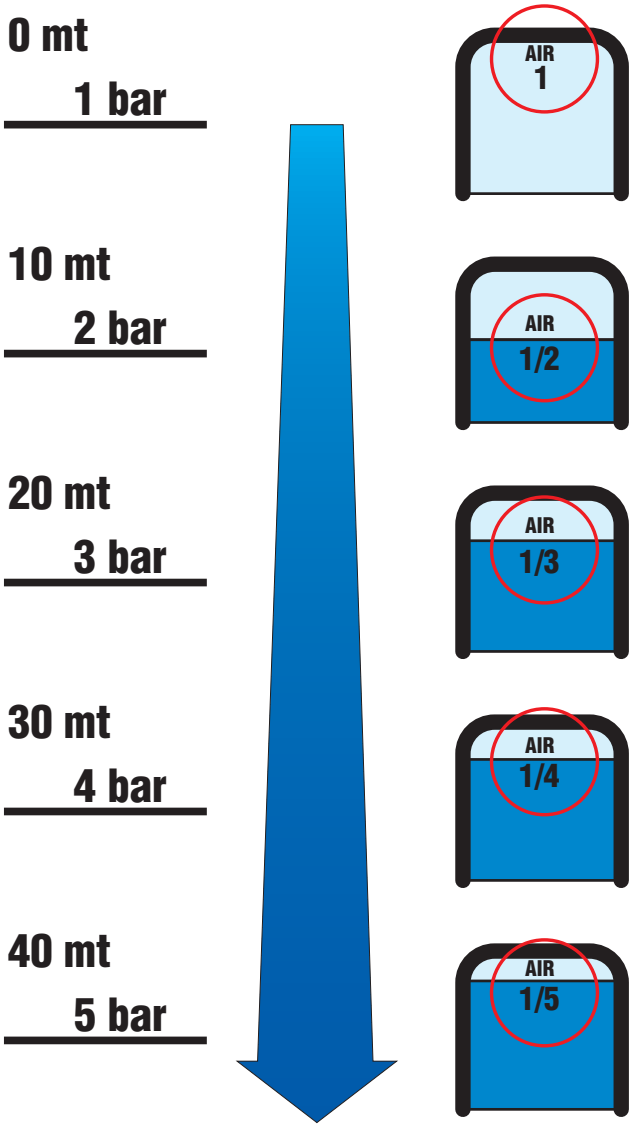
c) the neoprene suit (specific weight lower than normal body weight)



BUOYANCY IN WATER

Buoyancy in diving refers to the tendency for the body to float caused by the push described in Archimede's law.
Some common terms to describe it are:
Positive Buoyancy: the tendency of the body to float
Neutral Buoyancy: the body neither float nor sink
Negative Buoyancy: the tendency of the body to sink
The diver may change his buoyancy in different ways. By adding weights to the weight belt, the specific weight is increased causing him to sink. Breathing in and out changes the lung capacity, which in turn changes the volume of the water displaced resulting in an increased likelihood of either floating or sinking. Even small changes of volume can result in considerable change from one type of buoyancy to another. If we apply Archimede 's law we can see that an increase in the volume of the lungs of about 3 litres (the equivalent of a deep inhalation) can cause an up thrust of about 3 kg. Generally the divers try to obtain neutral buoyancy by regulating the amount of air in the BCD so that they can swim or dive deeper more easily, or in order to float without too much effort.

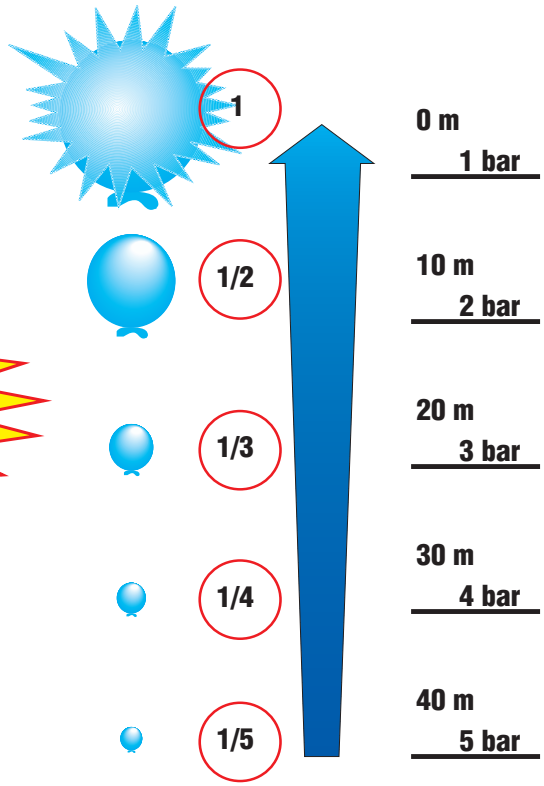


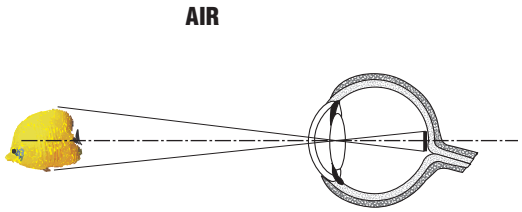


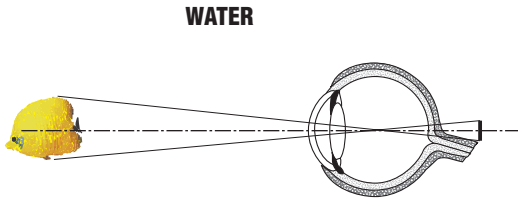
BOYLE'S LAW

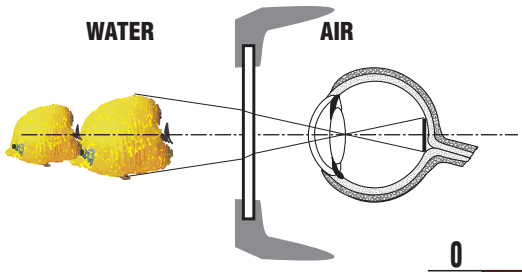
The Boyle's law states: "At a constant temperature the volume of a gas varies inversely with absolute pressure while the density of a gas varies directly with absolute pressure".
One way to demonstrate this law would be to put an inverted glass filled with air and take it to a depth of 10 metres. The total pressure is 2 bar absolute and the glass will appear half full of air, as water enters the glass filling it halfway thus reducing proportionally the quantity of air. Given that, when diving each 10 metres adds 1 atm to external pressure, the variation in pressure will be very high at low depth, progressively reducing towards the surface. Variations in the volume are inversely proportional to the increase in pressure. Therefore the diver must be careful when approaching the surface because of the even greater increase in the volume of

gas inside his body. For this reason the diver must continue to breathe regularly during ascent and never hold the breath. In the case of loss of regulator it is necessary to continue to exhale to keep the respiratory airways open.





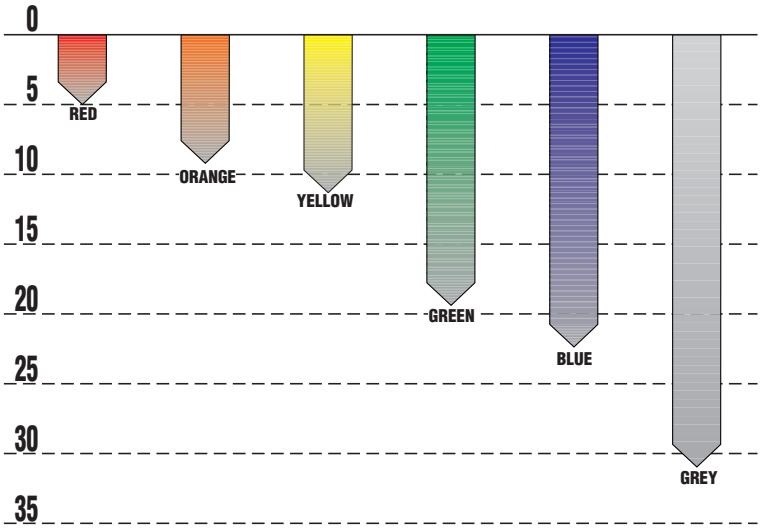




SIGHT UNDERWATER

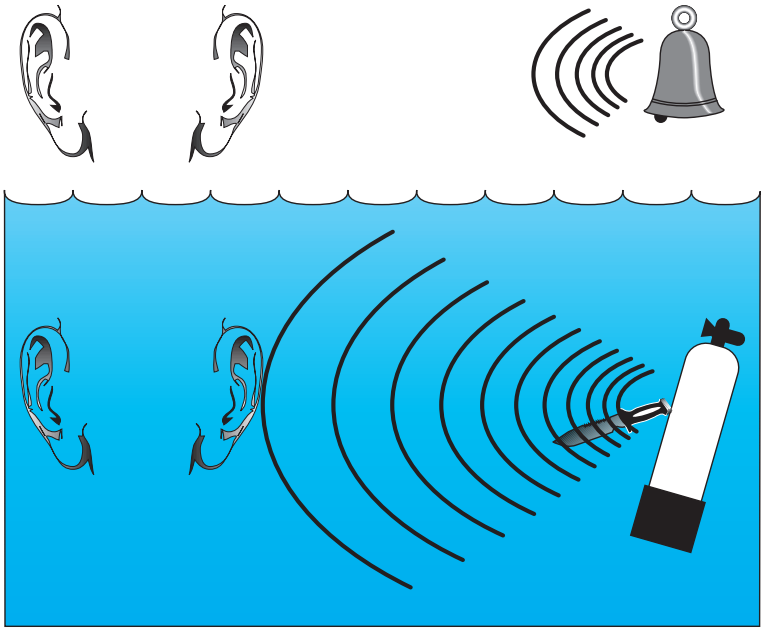
Sight doesn't present particularly problems in diving. However when the eyes are in direct contact with water the vision is unfocused, everything appear blurred and indistinct because the rays of light coming from the viewed objects undergo a index of refraction different to that of the air, the images is no longer being formed on the retina. To be able to see clearly underwater it is therefore necessary for the eyeballs to be in contact with air. The clear vision thus obtained can however suffer from slight alteration which is caused by different density in the materials that light rays have to go through to reach the eye: water, lens of the mask, and air.

Objects appear closer and bigger by about 1/3; water also absorbs light, an effect that increases with water depth. For example the colour red at 5 metres loses its brightness at 15 metres it appears very dark. The next colour to be affected is orange, then yellow, green, and blue. Therefore in order to be able to see the true colours underwater a diving torch must be used.



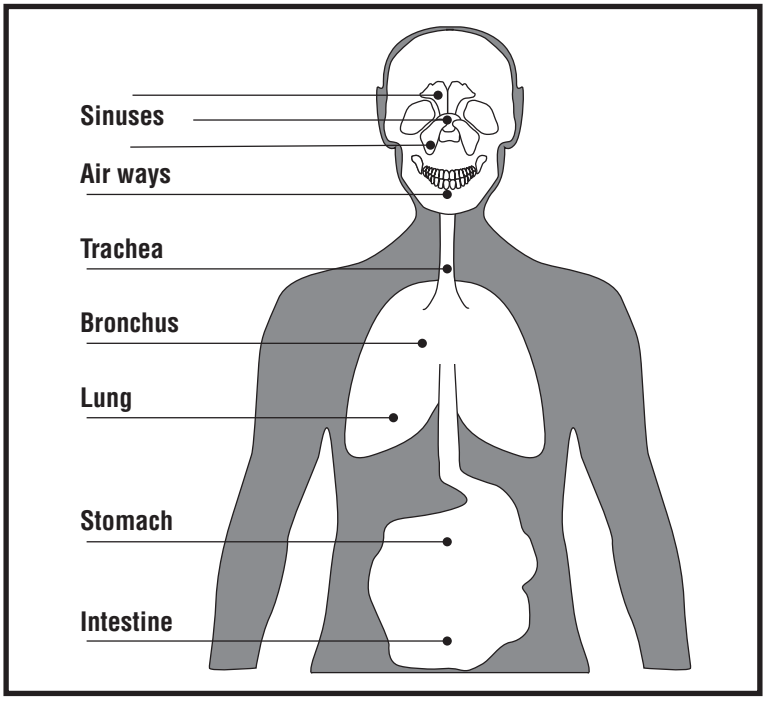
SOUND UNDERWATER

Underwater sounds are transmitted much more quickly because water has a greater density than air. While the speed of sound in air is 330/ mt per second underwater is 1500 m/s. The diver will therefore be able to perceive sounds much more clearly and from a greater distance than through air, but it is difficult for him to identify the direction and the distance of the source. This is caused by the considerable difference in time that it takes for the sound to reach the ear. This result in a sensation of being completely surrounded by sound and we are therefore unable to establish the origin.



COMPENSATION

If we subject a non ridged container filled with gas to a higher external pressure in order to keep the volume unchanged, it is necessary to increase the internal pressure so that an equilibrium with the former can be achieved. This is called compensation. Our body contains cavities filled with gas that subjected with pressure are compensated for in two ways. Both of them follow Boyle and Mariotte's law.

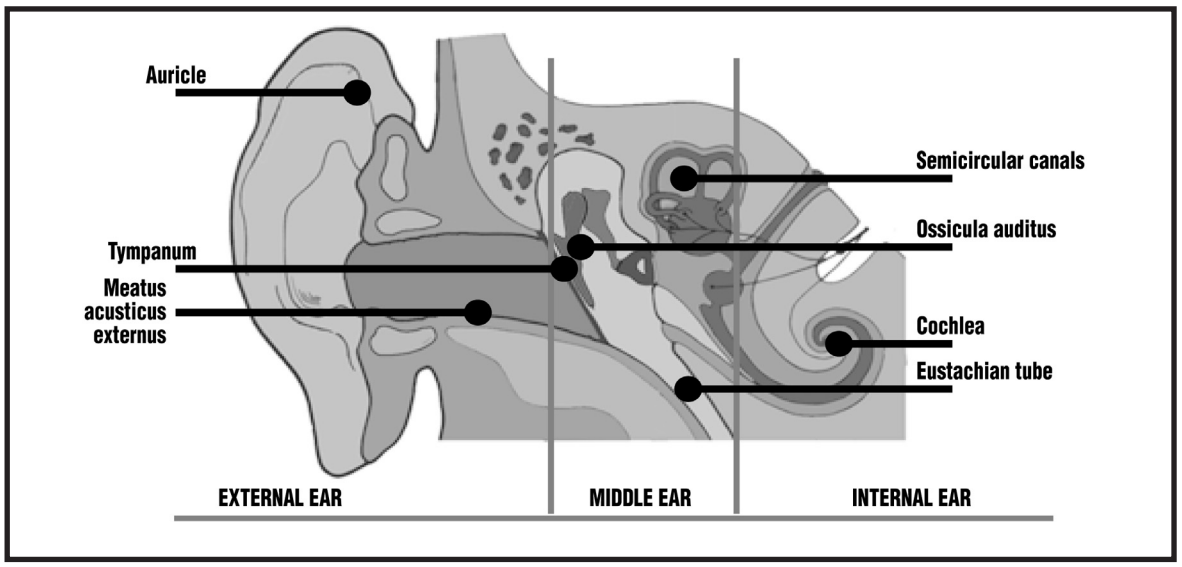


INCREASE IN PRESSURE

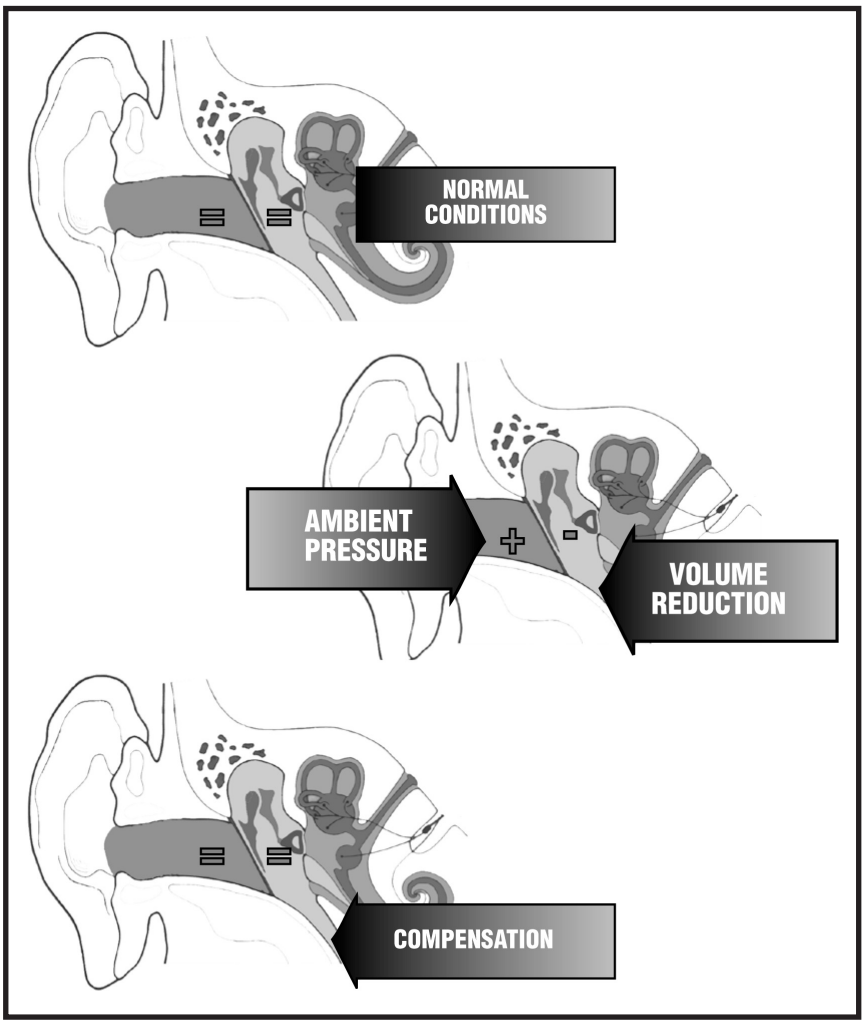
If the external pressure progressively increases and gas at ambient pressure is introduced into the organ, to compensate, the volume of the organ doesn't change. When the pressure is reduced this greater quantity of gas must be able to be easily released, in order to avoid an increase of volume. The respiratory airways are compensated automatically as they are in contact to air at ambient pressure through the air supplied by the regulator.

REDUCTION OF VOLUME

When the rising external pressure crushes an empty organ such as stomach, intestine, and the middle ear it causes a reduction in their volume. The gases they contain proportionally increase their pressure and the external and internal pressure are always in equilibrium. In the stomach and intestine this variation in volume doesn't normally entail any problems but in the ear it causes the crash of the Eustachian tube; the connection with the airways is severed causing the inward bending of the ear drum and consequent pain.



Making it necessary to introduce air to bring back the volume of the middle ear to its original dimension and the eardrum to its natural position.
The most common and effective methods for achieving compensation are VALSALVA (forced exhalation with intermittent and simultaneous closure of both nose and mouth) and Freznel manoeuvre (compression of air at the back of the pharynx).
The Valsalva manoeuvre is easy to learn but can be difficult in that it requires a contraction of the thorax which use all the muscles employed for exhalation.
Closing the nose and moving the tongue upwards does the Freznel manoeuvre and backwards; it is a very effective manoeuvre that causes a movement of the pharyngeal walls, which facilitates the open of the Eustachian tube. This is achieved with the use of few major muscles, with minimum effort and without interfering with the circulation. The only drawback is that it is not an easy manoeuvre and it requires some practice.
Whichever technique is chosen, compensation must be carried out before the ear start to hurt: too long a wait can result in reduction in the volume of the air inside the middle ear and that can make the manoeuvre difficult. In addition, it can cause introflexion of the eardrum that may result in damage to the ear.



COMPENSATING THE EQUIPMENT

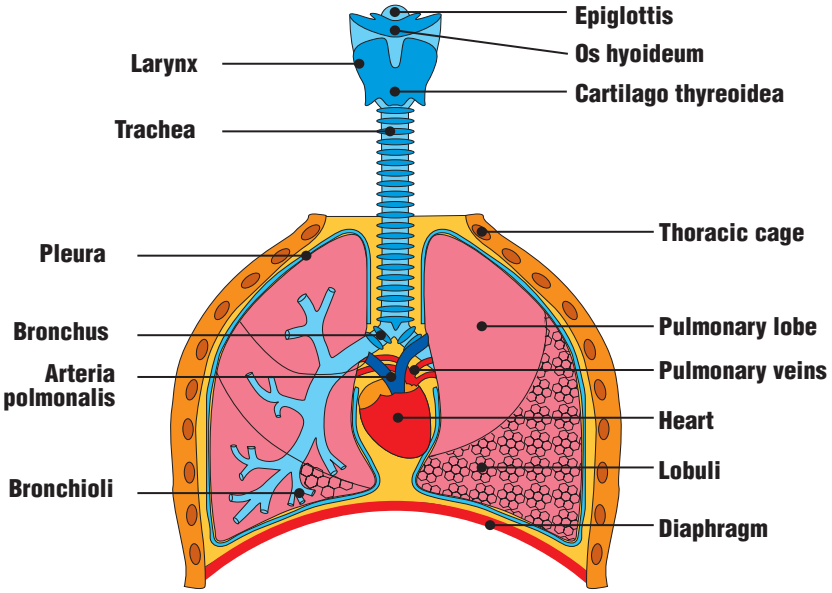
It is always necessary to compensate the mask, as you go deeper underwater the volume of the air inside the mask is reduced and it is pressed into the soft tissues of the face. This can be avoided by blowing air through the nose into the mask to maintain a constant internal volume. The volume of air in the BCD is also reduced through the increase of pressure and must be continually readjusted in order to maintain neutral buoyancy.

The human body

The human body is made up of a number of cells with different forms and functions that all need to be continuously supplied with oxygen in order to produce energy. Oxygen, which is one of the basic elements of the atmospheric air, enters our body through the respiratory organs, feeding all the cells via the bloodstream.

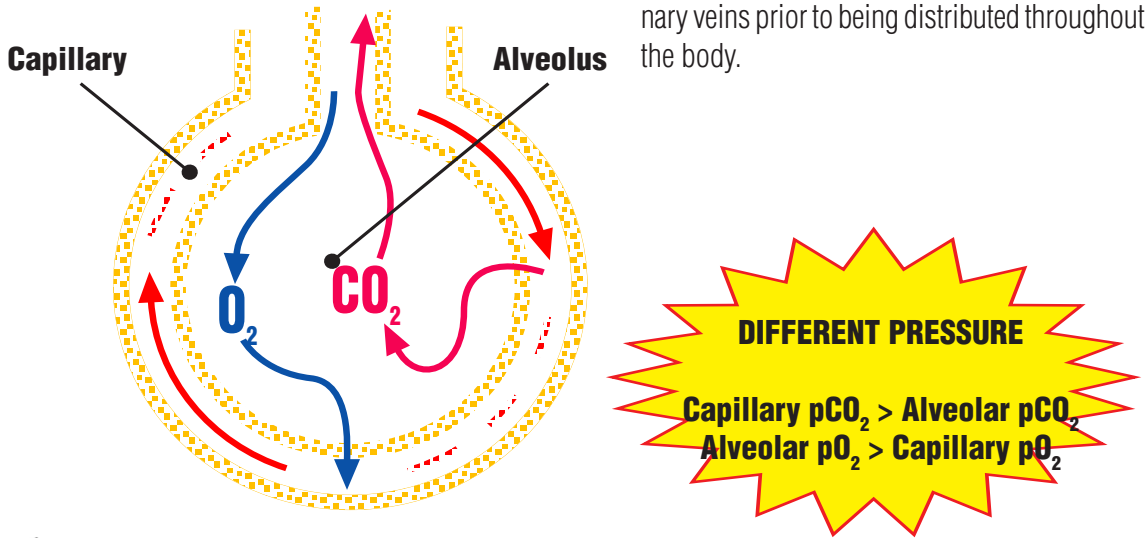
THE RESPIRATORY SYSTEM

The function of the respiratory organs is to supply the body with the gasses surrounding it; this is done by its absorption into the blood through the following organs:
The respiratory airways: which connect the lungs with the outside.
The alveoli, the place where gas enters the bloodstream. The capillaries, which link the alveoli with the heart.
The respiratory airways are divided in two sections: upper and lower. The upper airways are nose, mouth, sinuses, pharynx and larynx: their function is to carry air to the lungs while purifying and adding moisture to it. The lower airways are trachea, bronchi, bronchioli and alveoli. The bronchioli and alveoli make up the pulmonary mass inside which the respiratory exchange takes place.



THE ALVEOLI AND THE CAPILIARIES

These are the organs used for the gas exchange and have a vast surface area (between 40 and 100 square metres in adults). Oxygen and carbon dioxide are transferred from the breathed air into the blood, because of the difference in partial pressure, through the membrane of the pulmonary alveolus. Once oxidised the blood carries to the left atrium via the pulmonary veins prior to being distributed throughout the body.

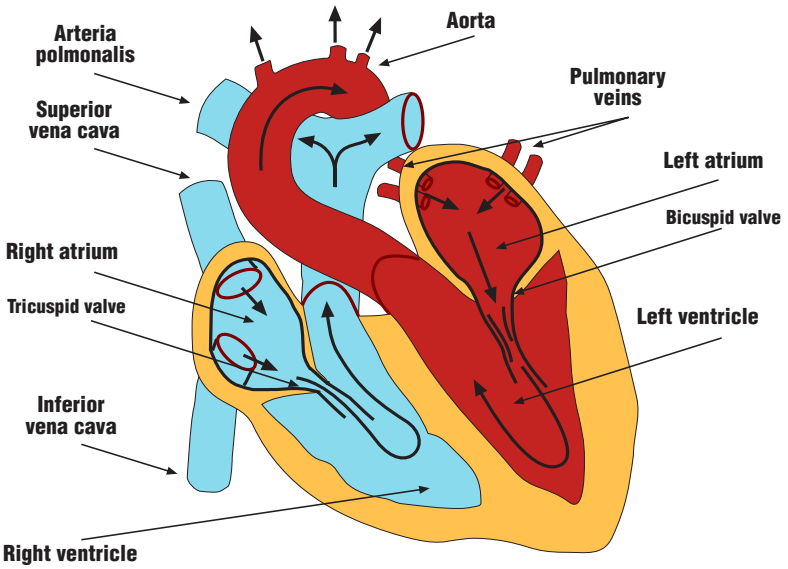


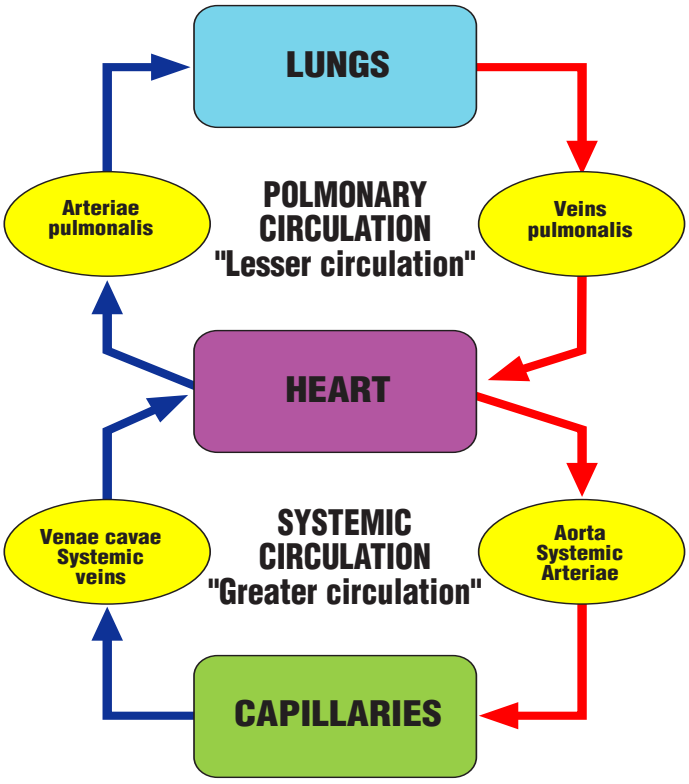
THE CARDIO - CIRCULATORY SYSTEM

The function of the cardio-circolatory system is to transport and distribute oxygen and to remove residues and carbon dioxide. The main element of the system is the heart, which is divided vertically in two sections:
- the left side of the heart is responsible for the transportation of the blood enriched in oxygen
- the right side of the heart is responsible for the transportation of the blood charged with carbon dioxide and poor in oxygen.

It is in turn divided horizontally into two parts:
- the atria, in the upper part, which receive the blood.
- the ventricles, in the lower part, which pump the blood.

The right ventricle pushes the blood towards the lung via the pulmonary arteries, and returns, oxidised blood, through the pulmonary veins, which go to the left atrium. From here the blood passes into the left ventricles where is then pumped throughout the body via the arteries after which it returns through the veins to the right atrium. Cardiac movement is divided into two phases: “systolic” and “diastolic”. The systole is a contraction and enables the release of the blood; the diastole is dilatation that allows the heart to be filled with blood.





Cardiac movement in adults is approximately 60 to 80 beats to the minute while in children and old people this tends to increase.

Blood is carried by:
- the main arteries: these are thick and wide, and are resistant to high blood pressure
-the arteriole: these are small in width and regulate the flow of blood according to the requirements of the various organs
- the capillaries: here the blood slows down considerably to allow tissue exchange. From the capillary the blood goes into the venule, then into the larger veins and finally to the vene cavae that return to the heart.

Human metabolism

Every time we make a movement we use energy which asks more of our body, requiring a change in the metabolism in order to satisfy this new demand. For example, if we draw on a muscular structure to make a movement we set off a chain of events:
- The need for oxygen, vital for the production of muscular energy, increases, as a result, the breathing rate increases in order to oxidise the blood, and to increase the CO2 wash out.
- The heart rate also increases in order to pump blood more quickly through the body.
- There will also be an increase in the body temperature.

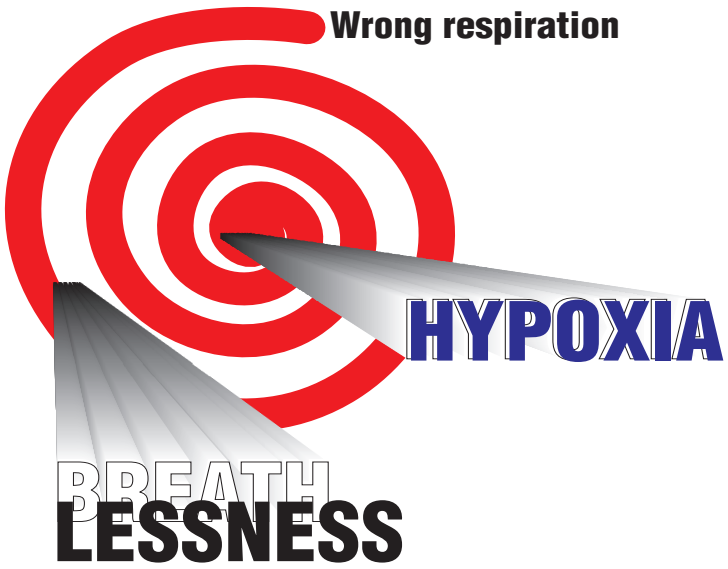
If any of these delicate balancing mechanisms are altered an emergency situation will arise.
These emergency situations can, in a context of diving, be grouped into the following categories:
--accidents due to excess of carbon dioxide (shortness of breath)
-accidents due to lack of oxygen (hypoxia)
-accidents due to water temperature (hypothermia or hyperthermia)
-accidents due to the breathing of compressed air (embolism)

SHORTNESS OF BREATH

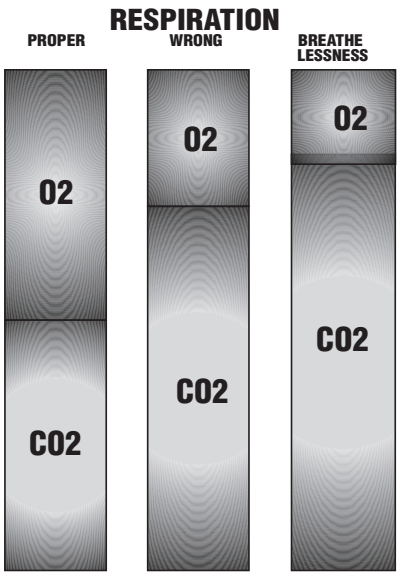
A particularly strenuous action or heightened emotional tension can bring on shortness of breath, which is characterised by the difficulty in satisfying an increased need for oxygen with one's breathing. It can take more effort to breathe underwater, because of the different ambient pressure, the resistance due to the equipment and the low temperature. At its worst, this can lead to shortness of breath.
Normally, shortness of breath is preceded by an increase in the breathing rate. If the cause is not dealt with breathing becomes faster and faster without, however, adequate oxidisation having taken place.
A feeling of anxiety and a suffocating sensation arises which can lead to panic and therefore more serious risks. To prevent shortness of breath a regular breathing pattern (10/ 12 breaths a minute) with equal inhalation and exhalation times must be maintained.
The diver who feels the first symptoms of shortness of breath must immediately stop all activity, remain still and try to re-establish his regular breathing pattern, which can be achieved with the use of respiratory stop. The diver's companion must be alerted to his condition as soon as possible: the two should then slowly re-ascend to the surface together.

HYPOXIA

Hypoxia refers to the situation whereby the amount of oxygen required by the cells exceeds that which is available to the body. When scuba diving, hypoxia can occur after a sudden interruption of the air supply or can develop gradually.
In the former case the cause can be a malfunction in the equipment or exhaustion of the air reserves, something which should never happen if the dive has been well planned. In the latter case, incorrect breathing or excessive physical exertion causes the lack of oxygen. The symptoms of hypoxia include inability to concentrate and impaired movement. The diver suffering from hypoxia

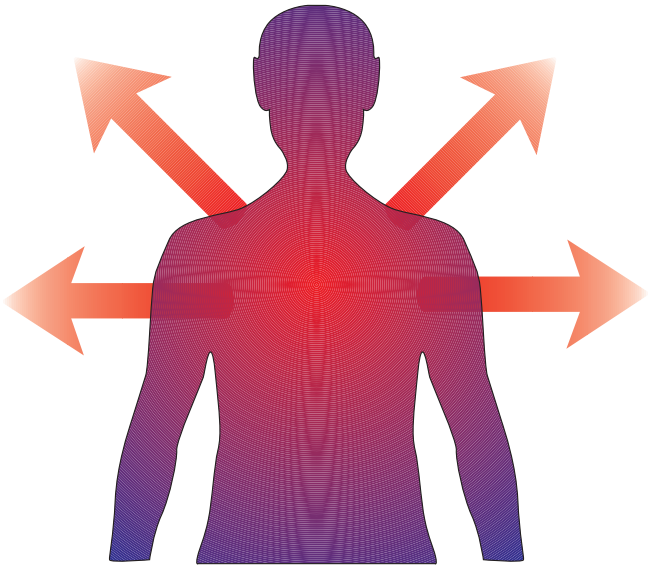


should be taken to the surface as soon as possible, treated with oxygen and, if necessary, given artificial respiration. If the oxygen supply proves to be insufficient there will also be an increase in carbon dioxide and therefore the problem of hypercapnia, or asphyxia.



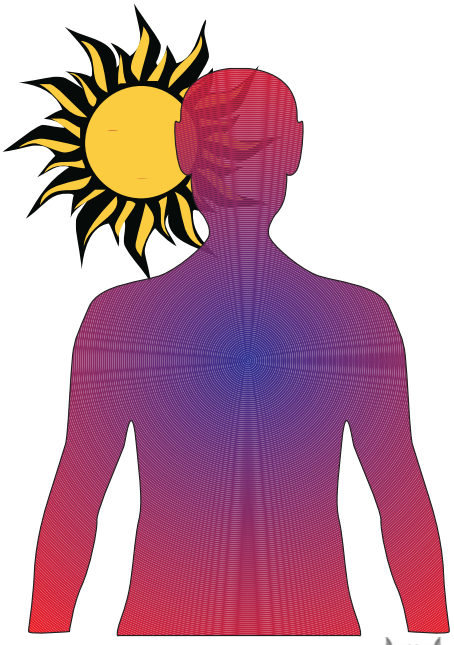
HYPOTHERMIA

Every time that our body undergoes a loss of heat it responds by trying to maintain a constant temperature in the central zone. In a prolonged stay in cold water, for example, the body automatically protects this central zone (which includes all the vital organs) as a result of which hypothermia may occur. Hypothermia is caused by a lowering of the body temperature to about 30 degrees C and can lead to serious clinical problems. At first an increase in the heartbeat occurs, to try to deal with the negative situation, but when the temperature drops to below 34 degrees C, the heart beat starts to slow down. Below 30 degrees potentially very serious heart problems can occur. Hypothermia affects the respiratory functions, causing reduction of breathing. It also reduces the brain activity causing anxiety, disorientation and coma. It is therefore very important to be properly equipped, but above all to have a sensible attitude. Treatment of hypothermia consists of preventing a further decrease of body temperature: it is therefore necessary to remove the diver 's wet clothing and to dry him, cover him with blankets, and keep him warm all over. It must be remembered that it is very dangerous to give alcoholic drinks to someone suffering from hypothermia, because the resulting dilatation of the blood vessels would allow the colder blood at the extremes of the body to reach the vitals organ more quickly.



HYPERTHERMIA

This occurs after excessive exposure to external heat. When the diving suit is left on under the sun for considerable time. The body can no longer compensate for the increase in his own temperature. Symptoms such as light-headless, headache, excessive sweating, respiratory difficulties, and even loss of consciousness may occur. It is recommended that the diver be undressed, taken to a cooler environment and given plenty of water to drink.



Diving accidents

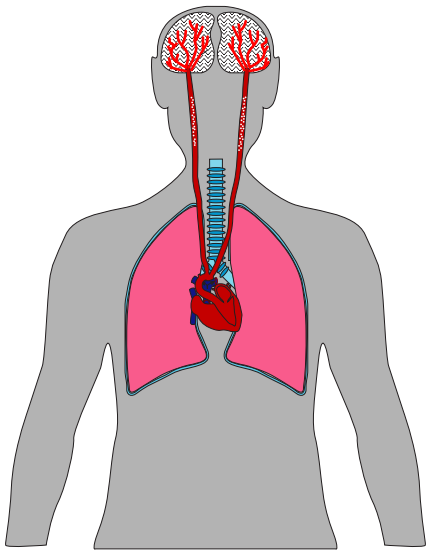
EMBOLISM

During ascent the air in the lungs tend to expand. If for any reason the breath is held during ascent in a Scuba diving this expansion of the air after having enlarged the lungs to their maximum causes a progressive distension of the pulmonary alveoli, if the diver continues to ascend without breathing out the overdistension of the lung can results in a pulmonary barotrauma (a wounding of the lungs caused by pressure) in this case the alveoli membrane is stretched to a such a degree that tiny air bubbles are able to pass into the blood stream, or can tear and cause the release of larger bubbles. Regular and continuous breathing is, however, sufficient to eliminate excess air and maintain normal lung volume. A risk of pulmonary overdistension occurs in the last ten metres below the surface where the variation in the pressure volume ratio is at his greatest. The reduction in pressure in the last ten metres of ascent towards the surface is 50% (from 2 to 1 atm), while the same distance, but from 20 to 10 metres, sees the 33% drop in pressure (from 3 to 2 atm). This considered, it is important remembering to never hold one's breath during ascent, even in the pool. The seriousness of a pulmonary distension depends on the effect that pressure has exerted on the walls of the pulmonary alveoli: distension or laceration of tissue.
The most serious consequence of pulmonary overdistension is the passing of air bubbles from the alveoli into the blood stream and is commonly known as air embolism syndrome. The air bubbles that pass from the lacerated alveoli to the adjacent tissues can, on the other hand, causes pneumothorax, mediastinal emphysema, subcutaneous emphysema.

AIR EMBOLISM SYNDROME

The bubbles escaping from the laceration of the pulmonary alveolus, once they have reached and been pushed along the aorta, can reach any part of the body and may stop in the small vessels. This can block circulation of the blood, and therefore of oxygen in the areas below the embolus.

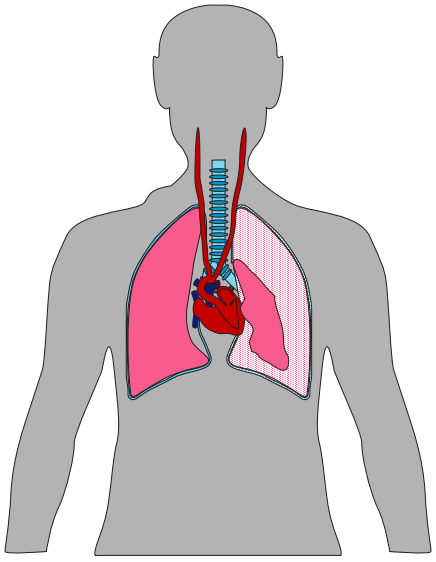
Symptoms and effects
Air embolism syndrome is generally traumatic and usually occurs in the first moments of surfacing or even before reaching the surface. The symptoms include dizziness, vertigo, impaired vision, breathing problems, heart disturbances, and paralysis.



PNEUMOTHORAX

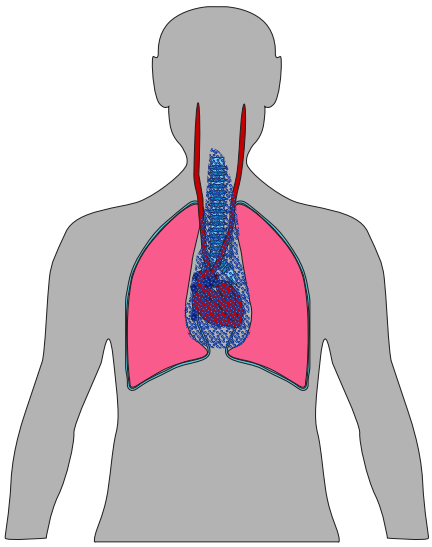
It occurs when considerable quantity of air that escaped from the alveolus remains trapped between pleura. The lung, then stop to function due to the lack of vacuum between the pleurae.

Symptoms and effects
The symptoms of pneumothorax consist of intense chest pain along with coughing of blood and considerable difficulty in breathing.



MEDIASTINAL EMPHYSEMA

When the air that leaves the exits from the alveoli head towards the inside of the rib cage, so remaining trapped between the tissues around the heart and the major large blood vessels and causing an irregular return of venous blood as well as abnormal pressure on the respiratory airways pulmonary sac, the result is mediastinal emphysema.

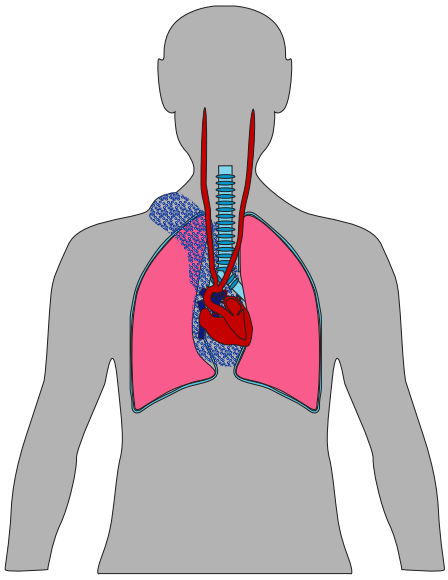


Symptoms and effects

The first symptom is a pain in the inside of the rib cage. In addition, the trapped air that presses against the lungs, the heart, and the large blood vessels, inhibiting breathing and circulation, causes breathing difficulties and possible loss of consciousness.

SUBCUTANEOUS EMPHYSEMA

Subcutaneous emphysema occurs when air bubbles that have escaped from a laceration of lung tissue are forced toward the neck causing it to swell at the front.



Symptoms and effects

The symptoms are a “sense of swelling” at the neck and a change in the sound of the voice.

Subcutaneous emphysema is often associated with mediastinal emphysema.

TREATMENT OF PULMONARY OVERDISTENSION

The only effective treatment for air embolism syndrome is immediate recompression in a hyperbaric chamber and the administration of large quantity of water to make the blood more fluid and so reduce the risks of obstruction by the bubbles. The administration of oxygen or artificial respiration is of use only as first aid on the way to the hospital.

In Water

ENTERING AND COMING OUT OF THE WATER

Several techniques exist for entering into the water. The use of these can depend on point to departure (from the bank or from the boat), and on the condition of sea, waves, or current. In general these techniques have always been developed with the safety of the diver as a primary consideration.

FROM THE SHORE

In many parts of the world the best diving excursions have either a rocky or coral bank as their starting point. Unfortunately in these situations is not unusual to encounter waves and currents that can create problems because of the backwash, entering and coming out of the water in this way must therefore be done very carefully.

Method of entry

If conditions are not favourable choose an area free of obstructions, rocks, etc. Photographic equipment should not be taken since it can be lost or damaged if a fall occurs. In tropical water it is advisable to wear gloves and footwear to protect oneself from the coral. Using the help of a companion put the fins on, with the mask in place, the regulator in your mouth and the jacket inflated slightly to achieve positive buoyancy, walk backward with your companion until you reach a sufficient depth to make a full paddling movement on the surface, making use if possible of the backwash. In better conditions entry into the water can be done wearing the same equipment as described before, but without need for fins. Once the water has reached waist level these can be put them on with the help of your companion and the dive can then commence.

Method of exit

Before approaching the waters' edge the best starting point for the exit should be determined. Approach quickly allowing yourself if possible to be carried by the waves. When the depth of the water is such that you can stand up, walk backward while in turns helping and being helped by your companion. Removing the fins, taking care not to turn your back to the waves, as this may lead to being knocked over. It is important to keep the mask on in order to be able to see clearly in all conditions.

FROM A ROCKY SHORE

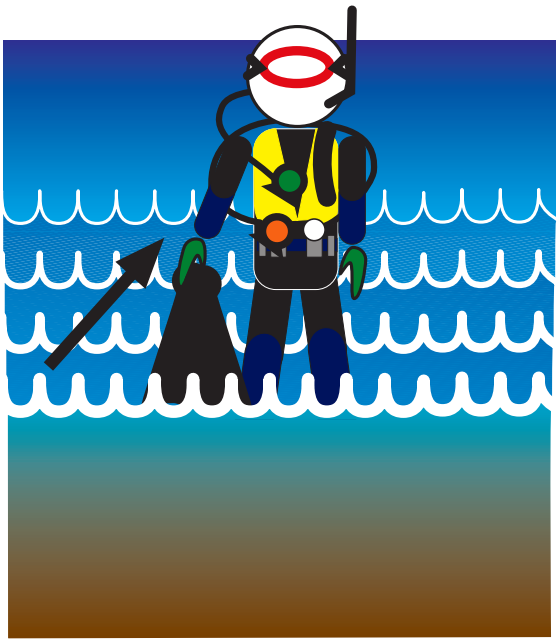
Diving from a rocky shore presents some interesting aspects, unlike sandy shores there is better visibility, allowing clearer observation of the marine life. Walking on the rocks with diving equipment on can, however, be dangerous and much attention needs to be paid to this method of entry. When planning this type of dive it is important to note any change of direction and intensity that the movement of the waves against the rocks may have and to look for the best point for entering and exiting.

Method of entry
In order to walk on the rocks with the equipment on, it is advisable to wear footwear with soles, which have a good grip. Come as close as possible to the point of entry, keeping your hands free at all times: it is better to make additional trips for the rest of the equipment. Choose a solid rock on which to sit and to place the fins and mask on. It is not advisable to enter with a dive, even if the cleanness and depth of the water appears to allow it. It is much better to sit and move forward until your legs, with the fins on, are in the water. After having put the mask and snorkel on, hold onto them with one hand and push yourself into the water. Start to swim quickly on your back finning vigorously so as to move away as quickly as possible from any backwash. In the case of rough seas it is better to perform this manoeuvre when the waves are at their highest point as the backwash helps to carry you away from the shore.

Method of exit
Exit onto a rocky shore should not be made from the canals that can sometimes be found between the rocks, since the waves and the backwash are stronger here. The best moment to carry out this manoeuvre is when the sea or the waves are at there highest. Attention must be paid to areas where there is a lot of foam, as buoyancy may be very limited.

FROM THE BEACH

Wearing all equipment except for mask and fins, walk into the water until it is at the knee level and then with help of your companion, put the fins on using your right hand to put on the left one and viceversa. Then begin walking backwards watching for rocks and other potential obstacles, until the water is deep enough for you to start finning to the dive site.



Method of exit
Fin until you reach water that is shallow enough for you to stand up in and then take off your fins with the help of your companion, in turn helping him with his. If the sea is rough let yourself be carried by the waves as close as possible to the shore being careful to avoid any rocks or other obstacles.

FROM AN INFLATABLE

Since it is not always possible begin a dive from a larger boat, an inflatable must sometimes be used. These have limited space but are very useful for entries.

Method of entry
Entering the water from a inflatable or small boat is generally done by sitting on the edge and tipping oneself backwards head first, either with or without the Scuba equipment on. In the first instant one hand must hold onto the mask and snorkel so as to avoid losing it on impact with the water, while the other hold the hoses and the buckle of the weight belt. In the second instance, the equipment must be secured by a rope to the boat and placed in the water to put on after entry.Once again the hands should be used to hold the mask and the weight belt in place.

Method of exit
After having obtained positive buoyancy, the first thing to do is to remove the weight belt and put it inside the inflatable. Remove the rest of the equipment and if the help of a companion is available put it on board. If no help is available tie it to a seamless rope, then using your fins and arms, climb on board and recover the equipment.

FROM A BOAT

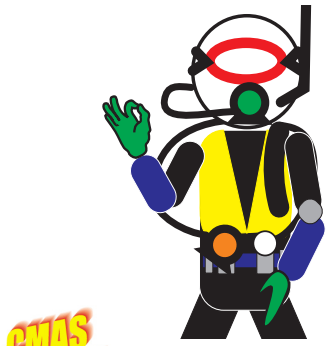
Diving from a larger boat can be much easier but particular attention must be paid to the personal safety of you and others when making the necessary movements for reaching the entry point with the equipment on. Rocking of the boat caused by the waves can easily cause loss of balance.

Method of entry
Entry into the water is generally a simple step forward from the edge of the boat or the board plank sometimes at the stern. This technique known as " the giant step" consists of a step forward while maintaining the body in a vertical position until impact is made with the water. If the distance between the point from which the jump is made and the water is greater than one metre, it is advisable to bring the legs together on contact with the water in order to minimise descent below the surface. In both cases keep one hand on the mask and regulator to prevent them from slipping off on impact with the water and the other hand on the straps of the B.C.D., and on the weight belts to stop the cylinder from hitting the back of the head.

Method of exit
To get back on board a center spine ladder is generally used. If possible it is best to first remove the weight belt and hand it into the boat. Then remove fins and climb the ladder with the rest of the equipment still on.

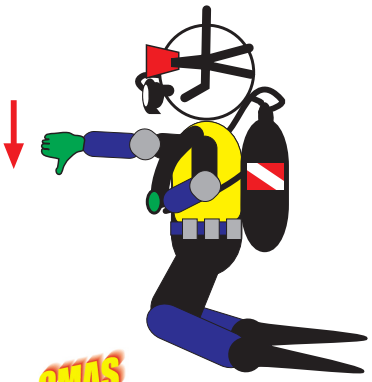
Signals

DIVING SIGNALS



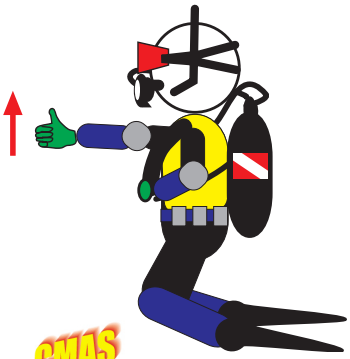
CMAS SIGNAL

OK -Did you understand ?



CMAS SIGNAL

Down

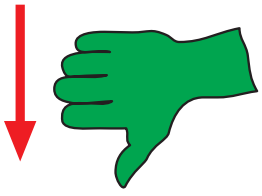


CMAS SIGNAL

Up

CMAS SIGNAL

CMAS SIGNAL



Go down - Down!

CMAS SIGNAL

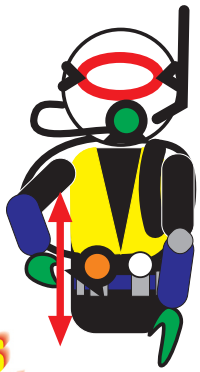
Go up - Up!

CMAS SIGNAL

Out of air

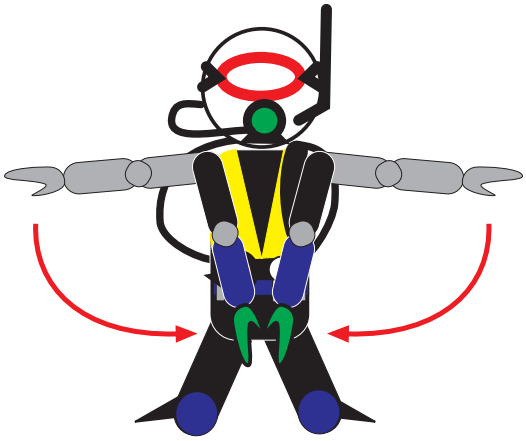
CMAS SIGNAL

Tie



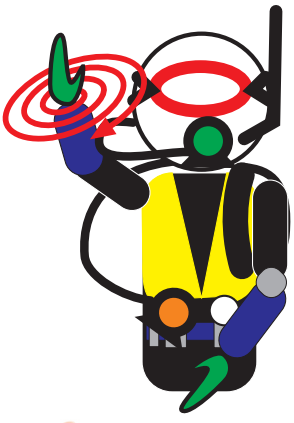
CMAS SIGNAL

(can't) open my reserve



CMAS SIGNAL

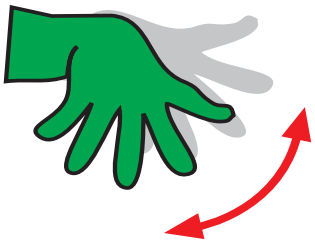
Everybody here



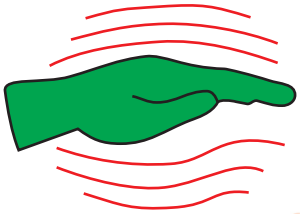
CMAS SIGNAL

Dizziness

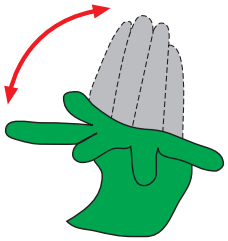
DIVING SIGNALS



Wrong



Calm - Buoyancy



I don't understand

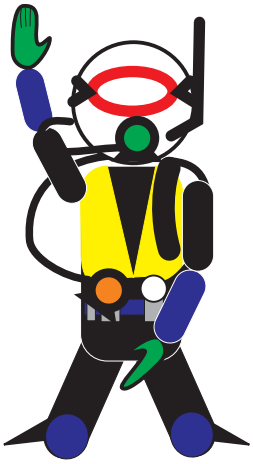
50 Atm

Inflate

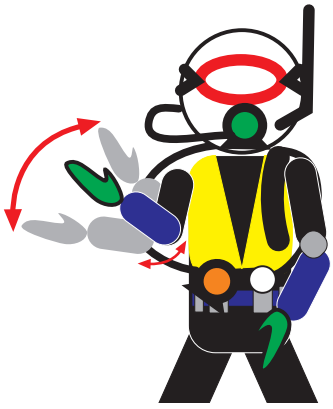
You

Me

Direction



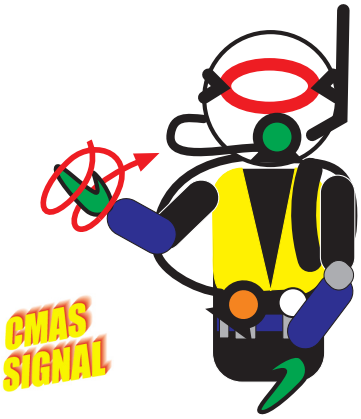
Pay attention - Stop



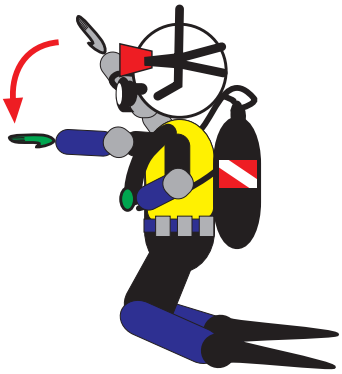
Slow down

DIVING SIGNAL

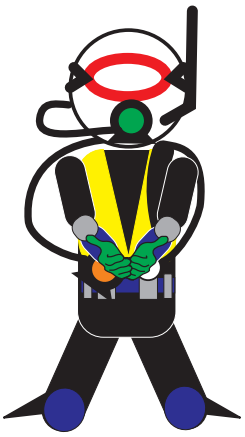
No



Acceleration



Look (There..., Here...)



Boat

Cramps

Tank pressure

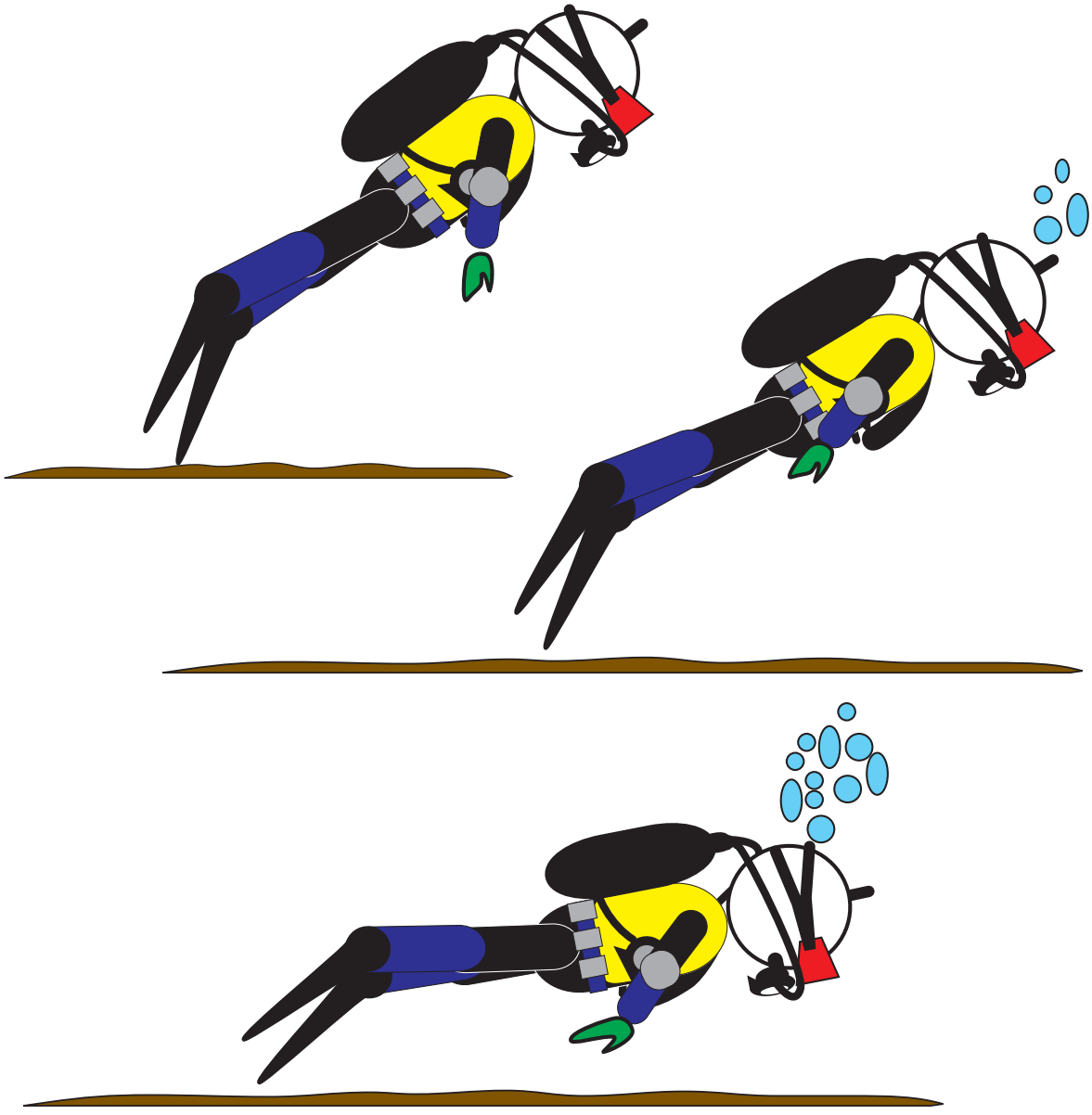
Half pressure

Shared respiration

Buoyancy

CONTROLLING BUOYANCY IN DIVING

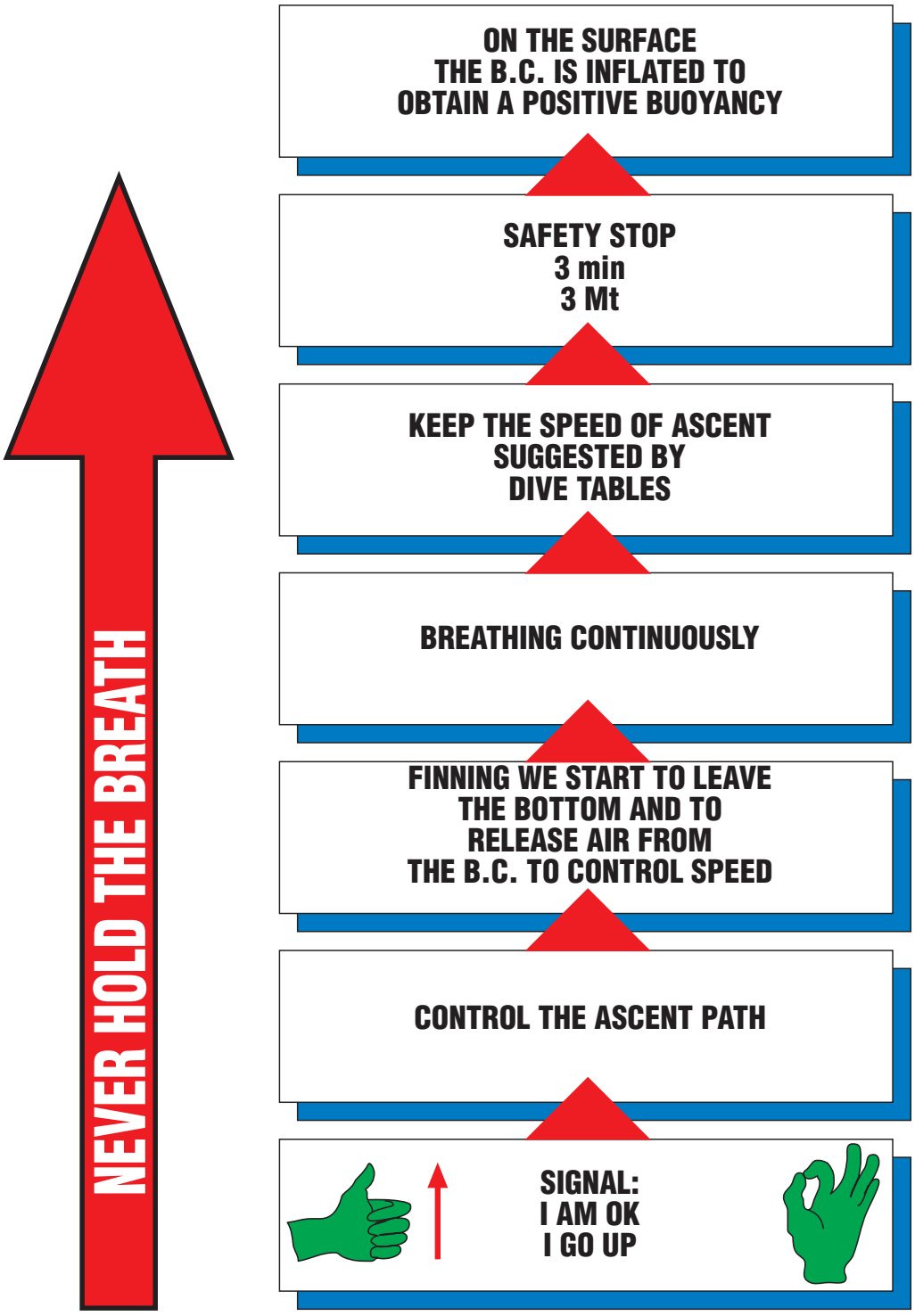
During a dive careful attention needs to be paid to controlling the buoyancy, which should be neutral. A good exercise, which can also be done in a pool, is to adopt an horizontal position near the bottom with a slightly negative buoyancy; at this point slowly inflating the B.C.D., you will achieve a buoyancy that will be positive when breathing in and negative when breathing out. The aim of this exercise is to acquire the necessary sensitivity to be able to carry out a dive and control the variation in one's depth. It is important to bear in mind when trying for the desired buoyancy that breathing must never be interrupted.

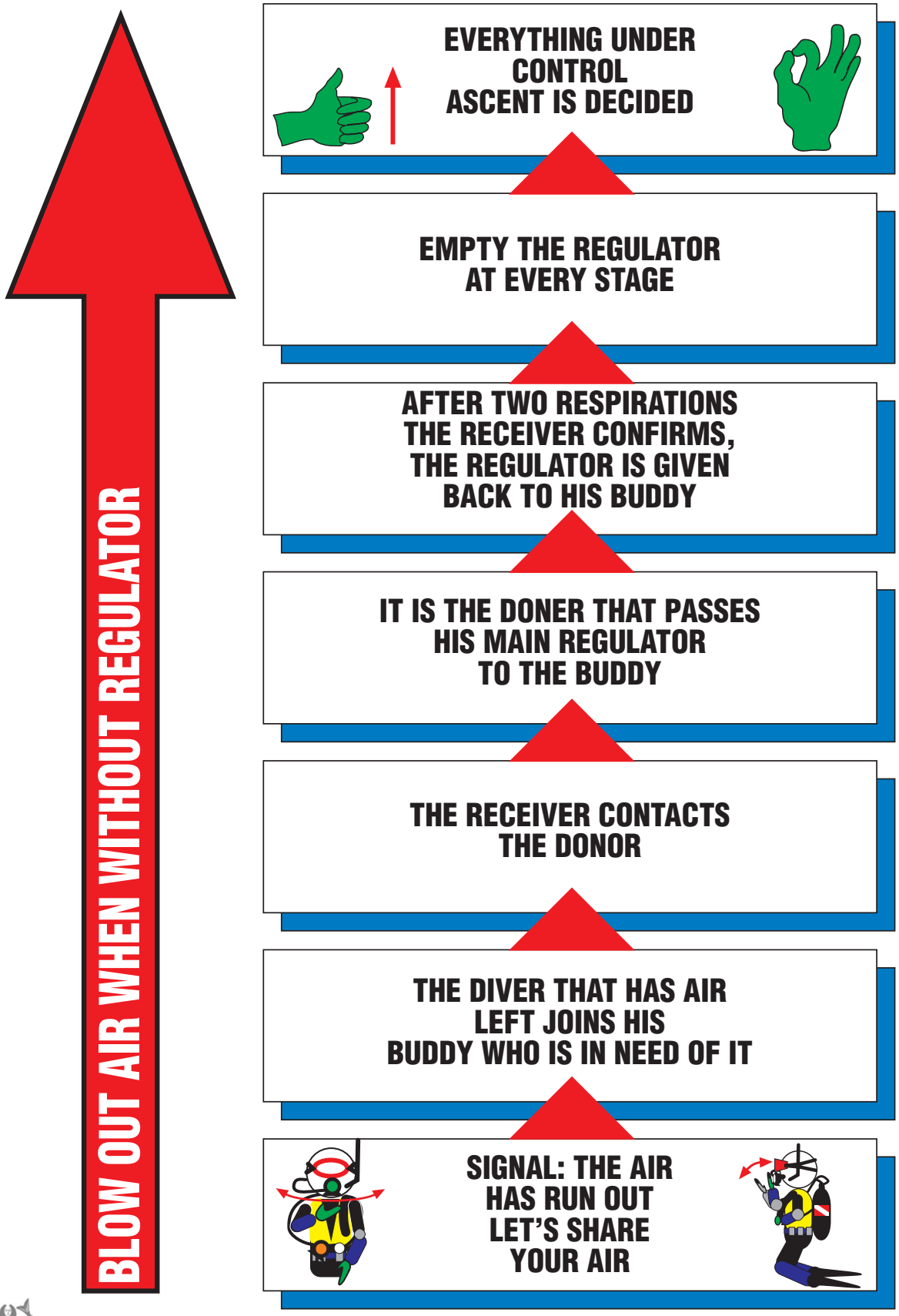


Safety procedures

At the end of the dive when the ascent begins it is important to be attentive to the vertical speed. The BC must be slowly deflated during ascent, because the air inside it expands and creates an increasingly positive buoyancy and subsequent loss of control of speed. It is extremely important to never stop regular breathing by holding the breath. On approaching the surface it must be checked that it is free from obstacles. These procedures must be clearly set down as rules so as to avoid difficulties and misunderstanding with diving companions and should anyhow be agreed upon with the diving companion and the group leader during the pre-dive briefing.

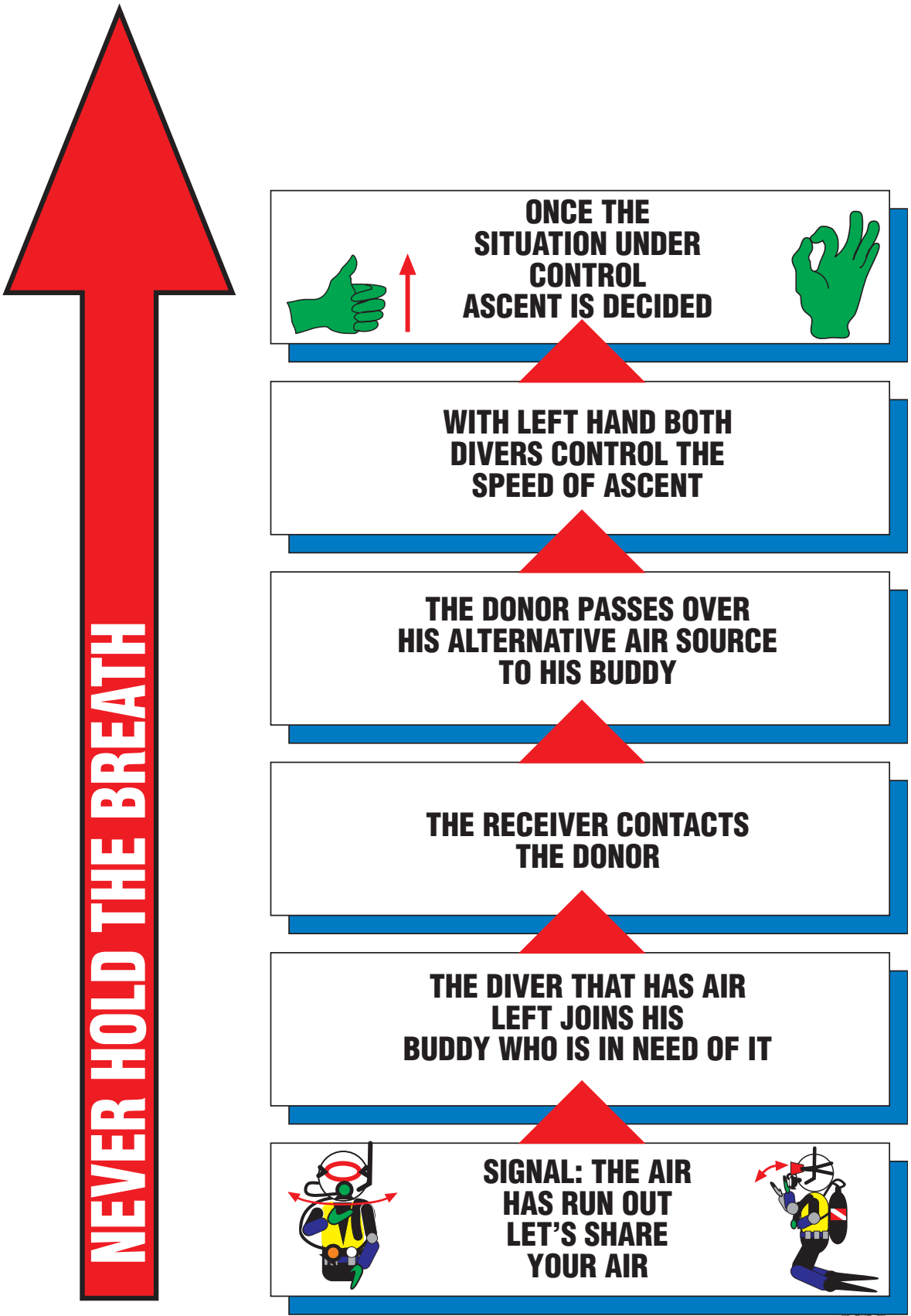
ASCENDING



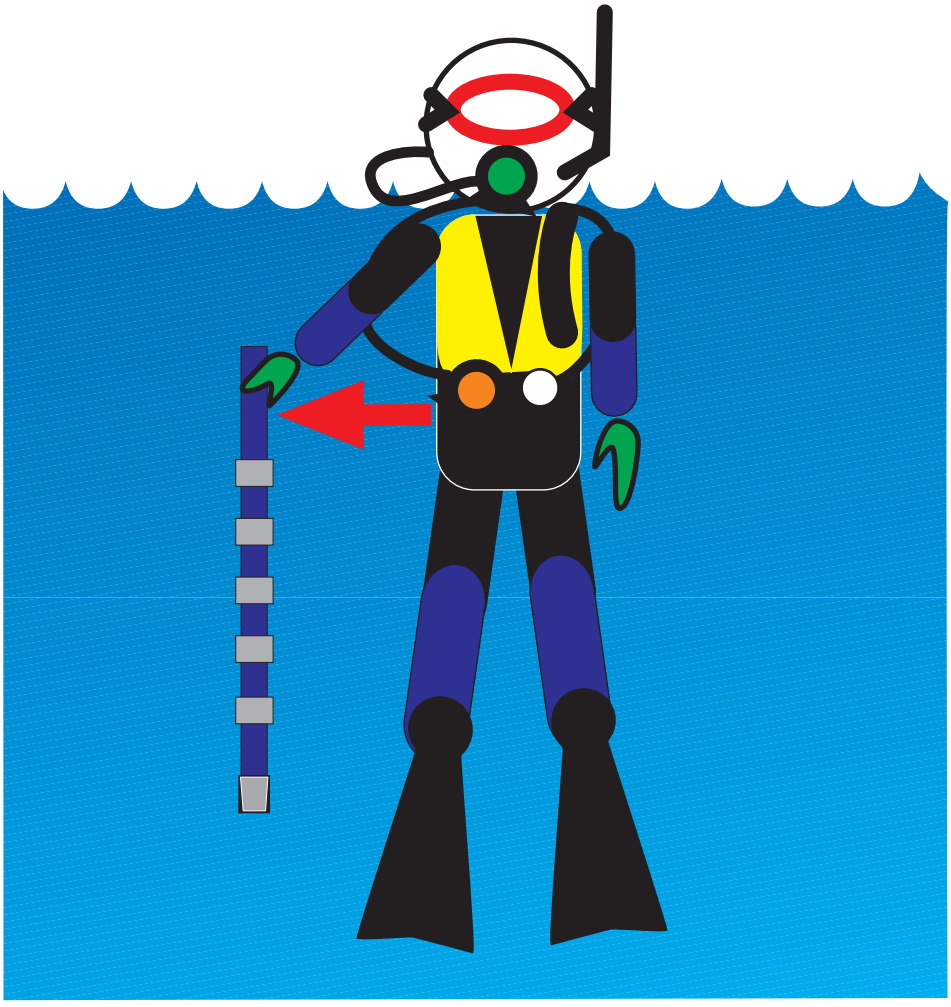

BLOW OUT AIR WHEN WITHOUT REGULATOR
EVERYTHING UNDER CONTROL ASCENT IS DECIDED
EMPTY THE REGULATOR AT EVERY STAGE
AFTER TWO RESPIRATIONS THE RECEIVER CONFIRMS, THE REGULATOR IS GIVEN BACK TO HIS BUDDY
IT IS THE DONER THAT PASSES HIS MAIN REGULATOR TO THE BUDDY
THE RECEIVER CONTACTS THE DONOR
THE DIVER THAT HAS AIR LEFT JOINS HIS BUDDY WHO IS IN NEED OF IT
SIGNAL: THE AIR HAS RUN OUT LET'S SHARE YOUR AIR

ALTERNATIVE AIR SOURCE RESPIRATION

RELEASE OF THE WEIGHT BELT



On resurfacing it may be necessary to quickly remove the weight belt to obtain positive buoyancy or to be able to come out of the water more easily. Having determined the position of the belt and the buckle, release the latter with your right hand while holding on to the belt so as not to let it slip away. If the belt must be abandoned, the operation should be carried out with the arm far from the body.



LESSON 3

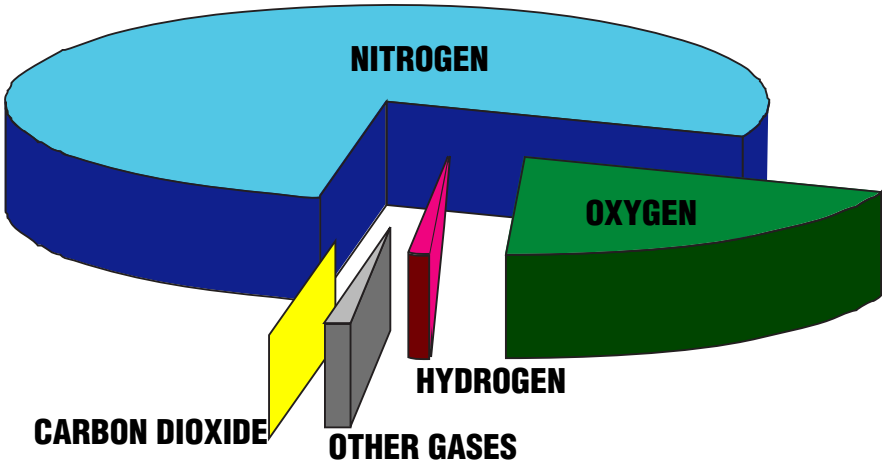
CMAS

WORLD UNDERWATER FEDERATION

Absorption of gas in the human body

COMPOSITION OF THE AIR AT SURFACE LEVEL

The air that we breathe is composed of a mixture of gases, for simplicity let's say that is made up mainly of 20% of oxygen and 80% of nitrogen. Dalton's Law States " The total pressure exerted by a mixture of gases is equal to the sum of the pressures that would be exerted by each of the gases if it alone were present and occupied the total volume" At sea level with a pressure of 1bar, the partial pressure of the oxygen will be 0.2 bar, & the nitrogen will have a partial pressure of 0.8 bar. IT is the oxygen that is metabolised by the human body for energy, transformed into carbon dioxide or expelled; while the nitrogen is inert and circulates as a dissolved gas in the blood stream. It has a partial pressure of 0.8 Bar.

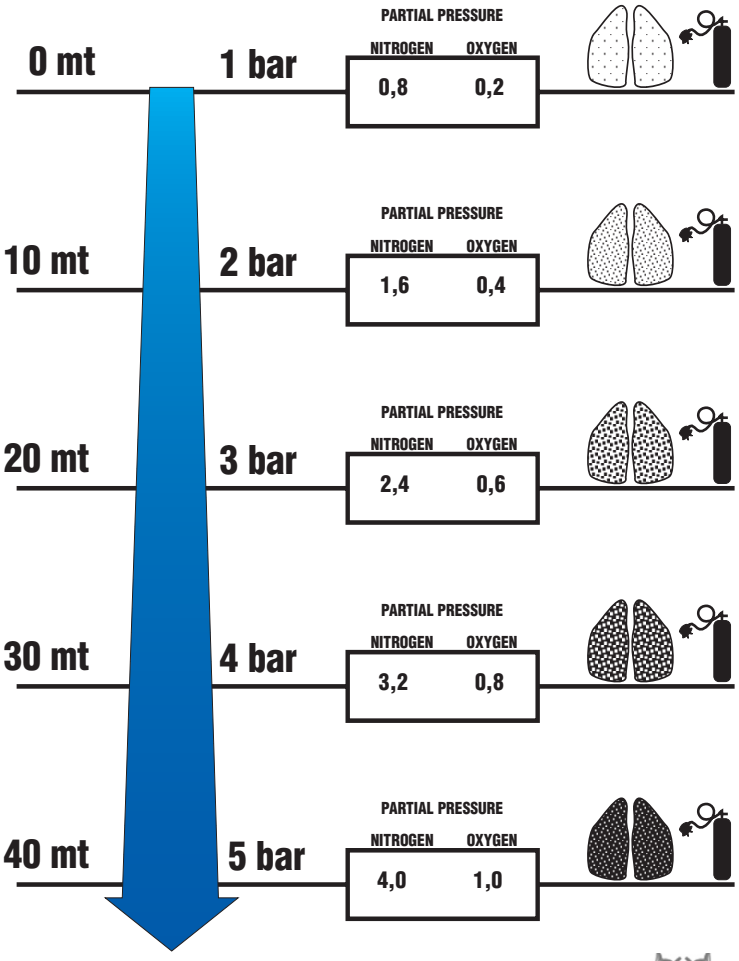


COMPOSITION OF THE AIR DURING DIVING

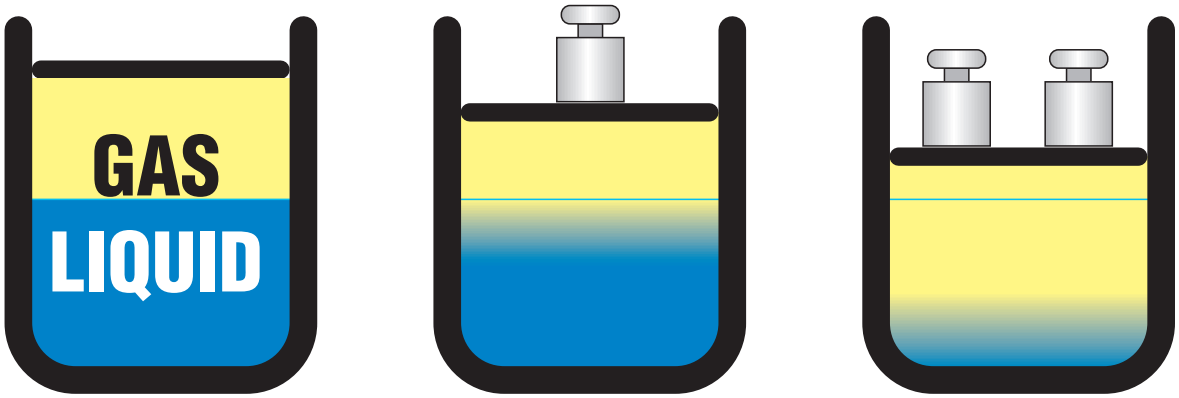
Whilst underwater a diver breathes compressed air or, more precisely, air that is supplied at ambient pressure. At a depth of 10 metres, the pressure inside the lungs will be the equivalent of the ambient pressure, 2 bar. In these conditions as the maximum volume of the lungs cannot change the density of the air varies according to the ambient pressure. We have therefore, at this depth, doubled the quantity of air supplied. Likewise the partial pressures of each of the gases shall increase.

At this point another law of physics comes into play. Henry's Law. This states, "The amount of any given gas that will dissolve in a liquid at a given temperature is a function of the partial pressure of the gas that is in contact with the liquid and the solubility coefficient of the gas in the particular liquid".

This means that the deeper the diver descends the greater the quantity of oxygen and nitrogen passes into the

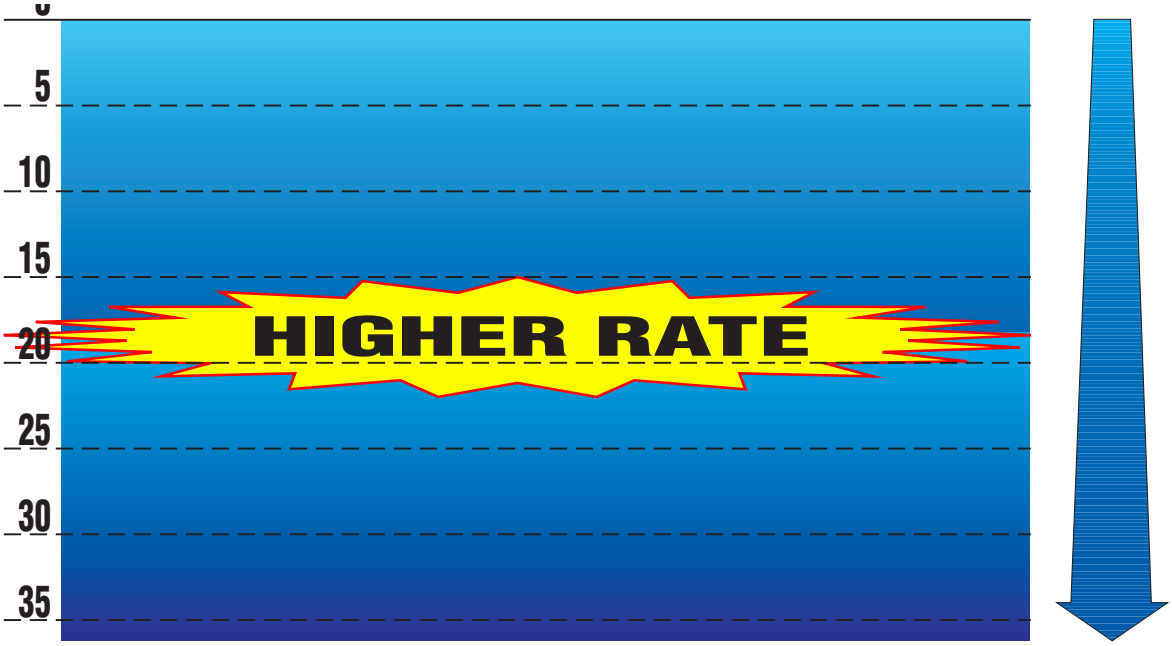


blood stream and the tissues. The increase in the partial pressure of the oxygen causes no problems at the recommended depths for recreational diving. However, the quantity of nitrogen absorbed (which is 4 times greater) can cause nitrogen narcosis during the dive or decompression sickness after the dive.



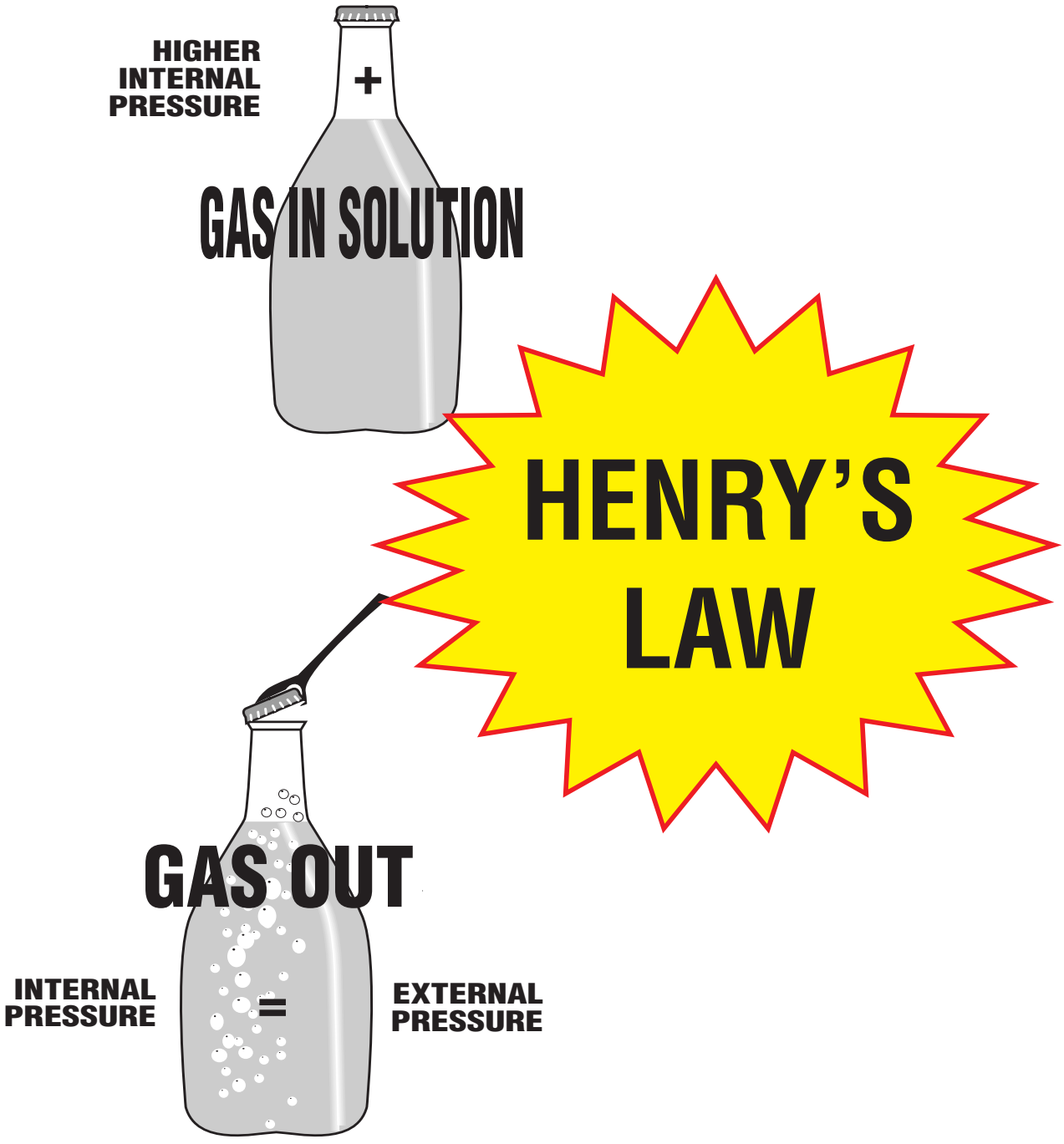
NITROGEN NARCOSIS

From the middle of last century, it was observed that men exposed to hyperbaric air, which is higher pressure than normal, behaved as if they were drunk. For this reason these symptoms were called nitrogen narcosis. As soon as a diver leaves the surface and descends he is exposed to an increase in the partial pressure of nitrogen. At the same time the first symptoms of narcosis become apparent. Near the surface the symptoms are mild and the effects increase as the diver descends, affecting his awareness and behaviour. The danger is that as the Nitrogen Narcosis affects reason, a diver may not realise that that he is affected. Nitrogen narcosis adversely affects the thought processes causing difficulties in carrying out normal activities such as reading instruments, communicating with diving buddies, recognising the right direction to the surface, any of which can be potentially dangerous. Nitrogen narcosis effects different divers differently depending on the physical conditions and the ambient. It is difficult to establish a depth at which these symptoms appear. It can be said that from studies carried out at random, that dives carried out above 18 metres depth have fewer accidents. If effected by Nitrogen Narcosis the treatment to reduce or to eliminate the symptoms completely is simply to ascend a few metres and breath normally.

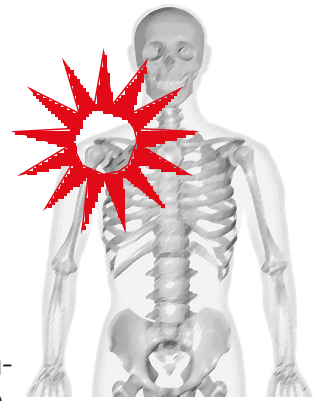


DECOMPRESSION SICKNESS

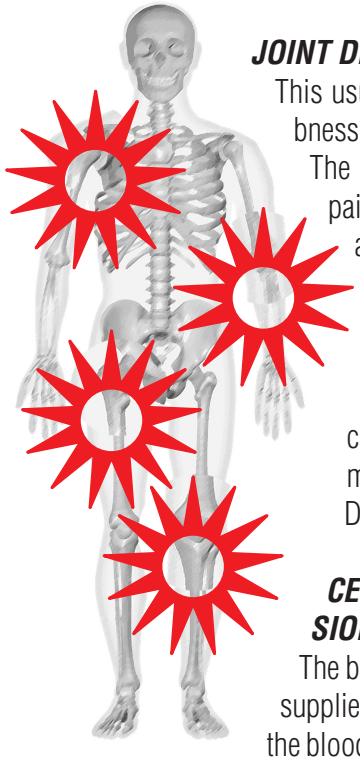
As we have seen the increase in pressure during descent, corresponds to a rise in the partial pressure of the gas breathed. According to Henry's Law the pressure in the tissues increases at the same rate. With increasing the depth these percentages vary in the same proportion, the longer spent at a given depth, and therefore pressure, the more gas absorbed. On ascent, maintaining a rate of 12 metres a minute, the opposite happens. The excess nitrogen is released from the blood through the lungs, at a partially higher pressure. If you ascend too quickly the nitrogen is cannot be released quickly enough thus contributing to the formation of bubbles in the divers body. This can lead to Decompression Sickness. The symptoms are different according to the tissue affected and can appear between 15 minutes and 2 hours after surfacing. The symptoms of DCS may appear as late as 48 hours after surfacing. Flying after diving may bring on symptoms if attempted too soon.



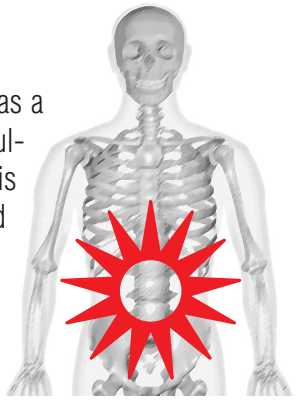
SKIN DECOMPRESSION SICKNESS



This can range from a mild rash to an angry measles like rash or a bluish marble like mottling of the skin. The mottling is associated with severe DCS and is caused by the bubble blocking the blood vessels of the skin. Mild cases may disappear even if untreated. However medical help should be sought if ANY symptoms are seen, the skin symptoms may be masking more serious neurological problems.

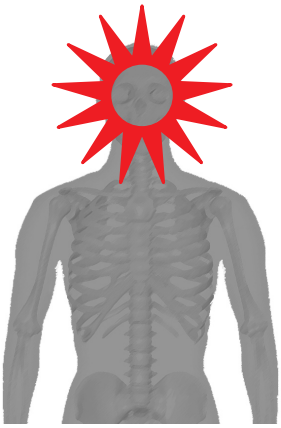


JOINT DECOMPRESSION SICKNESS



This usually starts as a feeling of tenderness or numbness at or near a joint, soon becoming a dull ache. The affected joint may swell and become red. The pain will increase over the next 12 or 24 hours and will not be relieved by heat or pressure – as a bruise may be. It is most common in the shoulder. Commercial divers are more prone to this type of DCS as it is more commonly associated with exertion and long duration's of diving. It is common among caisson workers. Medical help must be sought, as more serious neurological DCS may also be present.

CENTRAL NERVOUS SYSTEM DECOMPRESSION SICKNESS



The brain and spinal cord both have very large blood supplies and are both very susceptible to any bubbles in the blood stream. The symptoms for a CNS Decompression Sickness are varied and diverse. Some of the more common are; extreme fatigue, a strong feeling of malaise, pins and needles and numbness. Partial or total paralysis, loss of bladder function, blurred vision, confusion and even death can be the result of a CNS DCS. This is the most common type of DCS among sport divers and is usually associated with insufficient decompression.

FIRST AID

Contact the nearest Recompression Facility. 100% Oxygen must be given to the casualty as soon as possible after the incident & during the journey to the hyperbaric chamber. The application of pure oxygen guarantees greater oxygenation of the tissues and helps to lessen the risk of damage. In parallel with the administration of oxygen the casualty should be encouraged to drink fluid at a rate of about 1 litre per hour. Avoid diuretic fluids such as coffee or any alcoholic drinks. Still water or Isotonic sports drinks are best. Maintaining a good level of hydration helps the blood volume and reduces the risk of more bubbles forming.

Prevention of accidents

Diving should be considered as an enjoyable and relaxing activity. For this reason diving should be undertaken by divers with good levels of fitness and training at depths of not exceeding 20 metres. This will minimise the risks of decompression sickness. The rules for the prevention of decompression sickness can be divided as follows:

MEDICAL

A visit to the doctor should discover the presence of any pathological problem (for example epilepsy, diabetes etc.)

BEFORE DIVING

Avoid alcoholic or caffeine drinks (coffee, coke etc.) as they dehydrate you and cause diuretic problems
Always drink plenty of still liquids before diving, especially in summer
Avoid stress and excess physical exertion.
Avoid certain medicines or drugs; if in doubt consult your doctor.

DURING DIVING

Follow the tables and keep to the correct rates for descent and ascent
If you are tired end the dive & surface, tiredness causes an increase in the absorption of nitrogen
Avoid “see-saw” or “saw tooth” dive profiles
Be cautious if it is cold, this causes vascular constriction, dehydration, and stress, which increases the circulation activity

DURING ASCENT

Keep to an ascent speed of 10 metres a minute, and obey any ascent alarm given off by instruments. Always carry out a safety stop at 3 metres for 3 minutes.

AFTER DIVING

Avoid heavy physical activity
No snorkelling after scuba diving
Don’t fly immediately after diving
Re-establish normal body temperature

DIVE LETTER GROUP	3		6		9		12		18		24		30		36		42		DEPTH (metres)				
		4,5		7,5		10,5		15		21		27		33		39		45					
A	60	35	25	20	15	5	5												A				0:10 12:00
B	120	70	50	35	30	15	15	10	10	5	5	5	5						B			0:10 2:10	2:11 12:00
C	210	110	75	55	45	25	25	15	15	10	10	10	7	5	5	5	5	5	C		0:10 1:39	1:40 2:49	2:50 12:00
D	300	160	100	75	60	40	30	25	20	15	15	12	10	10	10	8	7		D	0:10 1:09	1:10 2:38	2:39 5:48	5:49 12:00
E		225	135	100	75	50	40	30	25	20	20	15	15	13	12	10	10	E		0:10 0:54	0:55 1:57	1:58 3:22	3:23 6:32	6:33 12:00
F		350	180	125	95	60	50	40	30	30	25	20	20	15	15		F			0:10 0:45	0:46 1:29	1:30 2:28	2:29 3:57	3:58 7:05	7:06 12:00
G			240	160	120	80	70	50	40	35	30	25	22	20		G				0:10 0:40	0:41 1:15	1:16 1:59	2:00 2:58	2:59 4:25	4:26 7:35	7:36 12:00
H			325	195	145	100	80	60	50	40	35	30	25		H					0:10 0:36	0:37 1:06	1:07 1:41	1:42 2:23	2:24 3:20	3:21 4:49	4:50 7:59	8:00 12:00
I				245	170	120	100	70	55	45	40			I						0:10 0:33	0:34 0:59	1:00 1:29	1:30 2:02	2:03 2:44	2:45 3:43	3:44 5:12	5:13 8:21	8:22 12:00
J				315	205	140	110	80	60	50			J							0:10 0:31	0:32 0:54	0:55 1:19	1:20 1:47	1:48 2:20	2:21 3:04	3:05 4:02	4:03 5:40	5:41 8:40	8:41 12:00
K					250	160	130	90				K	0:10 0:28	0:29 0:49	0:50 1:11	1:12 1:35	1:36 2:03	2:04 2:38	2:39 3:21	3:22 4:19	4:20 5:48	5:49 8:58	8:59 12:00
L					310	190	150	100			L	0:10 0:26	0:27 0:45	0:46 1:04	1:05 1:25	1:26 1:49	1:50 2:19	2:20 2:53	2:54 3:36	3:37 4:35	4:36 6:02	6:03 9:12	9:13 12:00
M						220	170			M	0:10 0:25	0:26 0:42	0:43 0:59	1:00 1:18	1:19 1:39	1:40 2:05	2:06 2:34	2:35 3:08	3:09 3:52	3:53 4:49	4:50 6:18	6:19 9:28	9:29 12:00
N						270	200		N	0:10 0:24	0:25 0:39	0:40 0:54	0:55 1:11	1:12 1:30	1:31 1:53	1:54 2:18	2:19 2:47	2:48 3:22	3:23 4:04	4:05 5:03	5:04 6:32	6:33 9:43	9:44 12:00
O						310		O	0:10 0:23	0:24 0:36	0:37 0:51	0:52 1:07	1:08 1:24	1:25 1:43	1:44 2:04	2:05 2:29	2:30 2:59	3:00 3:33	3:34 4:17	4:18 5:16	5:17 6:44	6:45 9:54	9:55 12:00
NEW DIVE LETTER GROUP									O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

BASED ON
U.S. NAVY
DIVE TABLES

SAFETY STOP
3mt/3min

REPETITIVE DIVE DEPTH (metres)												
12	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
15	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
18	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
21	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
24	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4
27	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
30	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3
33	55	51	47	42	38	34	31	27	24	20	16	13	10	6	3
36	50	46	43	39	35	32	28	25	21	18	15	12	9	6	3
39	44	40	38	35	31	28	25	22	19	16	13	11	8	6	3

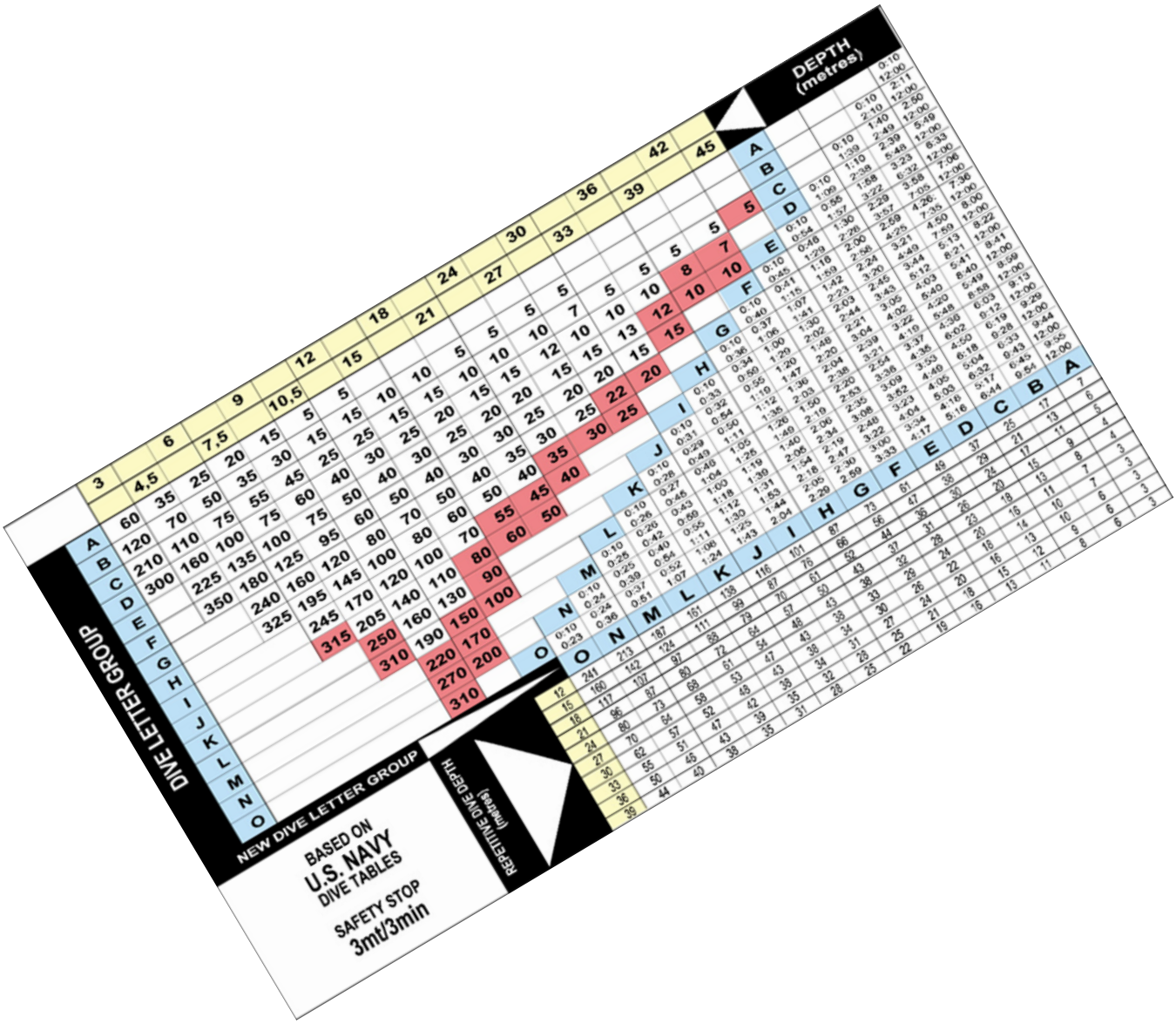
Mt.	Min	9	6	3	Gr
12	210			2	N
	230			7	N
	250			11	O
15	110			3	L
	120			5	M
	140			10	M
	160			21	N
18	70			2	K
	80			7	L
	100			14	M
	120			26	N
21	60			8	K
	70			14	L
	80			18	M
	90			23	N
	100			33	N
24	50			10	K
	60			17	L
	70			23	M
	80		2	31	N
	90		7	39	N

Mt.	Min	9	6	3	Gr
27	40			7	J
	50			18	L
	60			25	M
	70		7	30	N
	80		13	40	N
30	30			3	I
	40			15	K
	50		2	24	L
	60		9	28	N
	70		17	39	O
	80		23	48	O
33	25			3	H
	30			7	J
	40		2	21	L
	50		8	26	M
	60		18	36	M
36	20			2	H
	25			6	I
	30			14	J
	40		5	25	L
	50		15	31	N

Mt.	Min	9	6	3	Gr
39	15			1	F
	20			4	H
	25			10	J
	30		3	18	M
	40		10	25	N
	50	3	21	37	O
42	15			2	G
	20			6	I
	25		2	14	J
	30		5	21	K
	40	2	16	26	N
45	10			1	E
	15			3	G
	20		2	7	H
	25		4	17	K
	30		8	24	L
	40	5	19	33	N

Dive tables

In order to dive safely, the nitrogen absorbed during the dive must be allowed to escape from the body without producing bubbles of a size or in a quantity, that may cause decompression sickness. The rules are; not exceed the ascent rate of 10 metres a minute, to allow the tissues to get rid of the nitrogen by breathing normally on ascent. As an extra precaution a safety stop of 3 minutes at 3 metres must be carried out. On the surface the rest of excess nitrogen is released through the lungs until the partial pressure drops to 0.8 bar. During this course all dives will be performed within the limits of non-decompression. Over the years several dive tables have been put together, some of which are particularly suitable: Buehlmann, BSAC 88, & French navy, tables. The most commonly used dive tables in use today are the US-Navy tables. For many years these tables were the only method used by divers to calculate decompression requirements. Even today, despite the rapid evolution and diffusion of diving computers dive tables are still probably the most common system in use, especially amongst those beginning the sport who prefer to spend their money on other equipment.



TERMINOLOGY

Descent rate

The speed at which the diver descends from the surface. A maximum speed of 20 metres a minute is advised.

Maximum depth

This indicates the maximum depth reached during a dive, even if the time spent at this depth represents only a small part of the total.

Dive time

It is the time spent from the beginning of the descent to the moment when the ascent begins.

Ascent rate

This is the speed that the diver must not exceed when he moves towards the surface, either for final ascent or to reach another depth level during the course of the dive.

Dive letter group

This indicates the saturation level of the residual nitrogen in the tissue at the end of the dive and after a time on the surface. It is used to calculate how much any following immersion might be penalised. It is calculated in letters from A to O.

Surface interval

The time elapsed from leaving the water at the end of one dive to the beginning of the following one.

No decompression dive

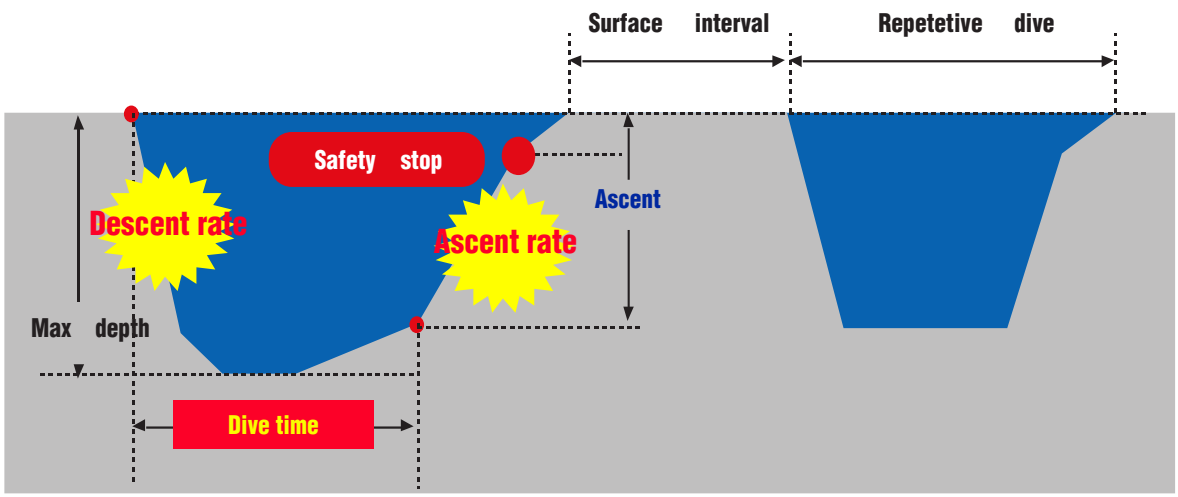
It is a dive performed without exceeding the limits indicated by the tables, always maintaining the ascent rate and the safety stop.

Repetitive dive

It is a dive performed more than 10 minutes but less than 12 hours after the first. This means that the divers body tissues have not yet become completely desaturated of nitrogen. Any new dive within 10 minutes of the last must be considered part of the previous one.

Decompression dive

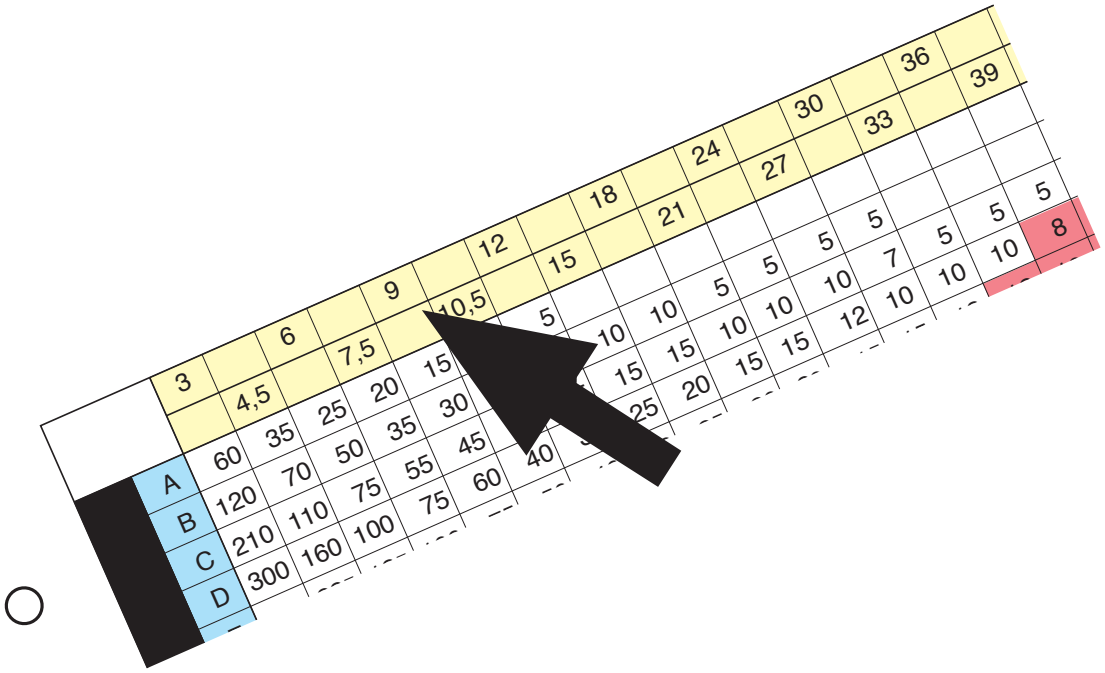
It is a dive for which the tables indicate the need for decompression stops. This subject will be dealt with in a later course.

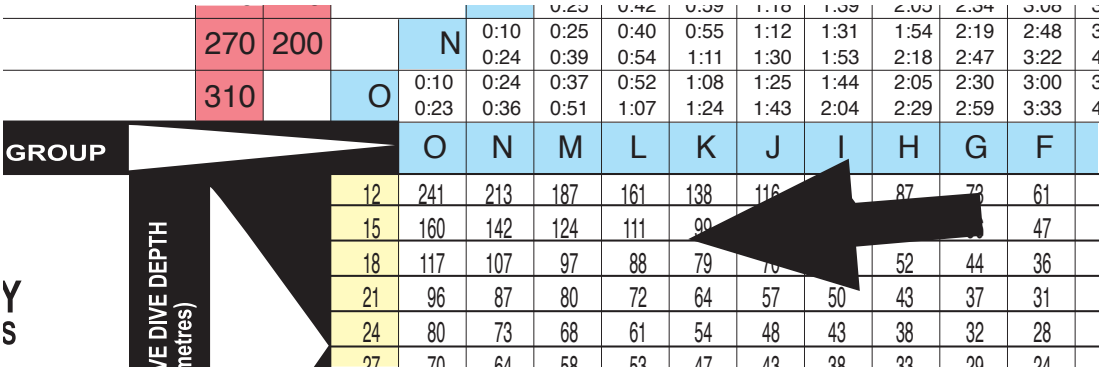


Use of the tables

DIVE TABLES

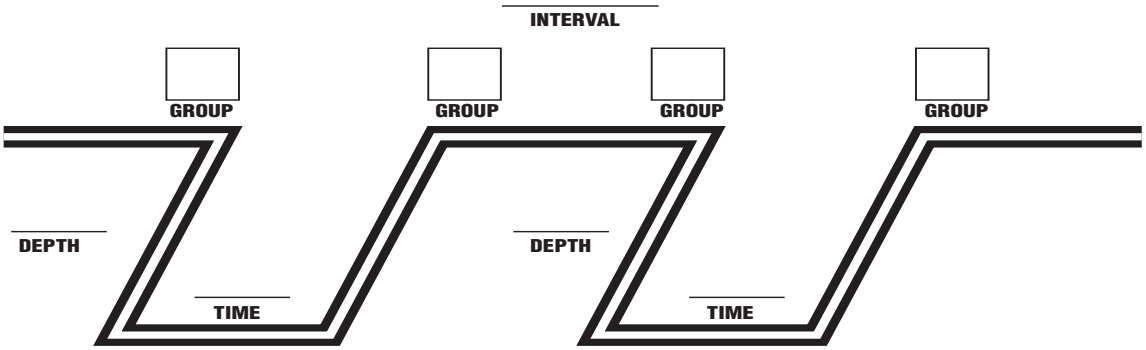
On dive tables the time and depth of the dive are correlated. Along the top, the maximum depth is indicated with intervals from 1.5 to 3 metres. When calculating one must always take the higher figure, for example with 11 metres, 12 is used as the previous number is 10,5 metres. The column along the side indicates dive time. Here too the higher time must be considered. Following the two indications the letter group is indicated. On the extreme right are indicated the times of the surface interval. From this point moving down the column the new letter group is found. The meeting point between these and the depth of the next planned dive indicates the minute of penalisation or residual nitrogen time (RNT).



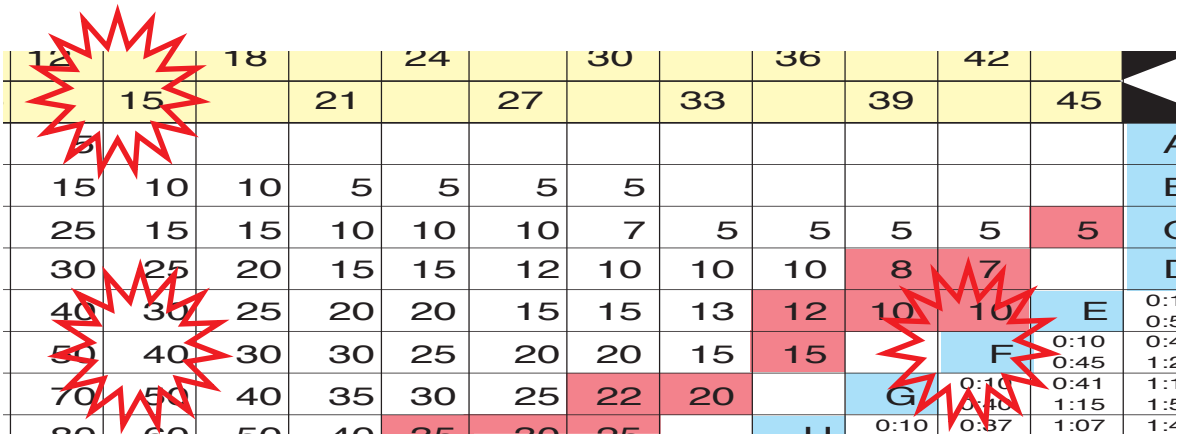


EXAMPLE OF CALCULATION USING THE TABLES

When you plan a dive is a good rule to follow the scheme below, in which the depth one wants to reach and the relative time are indicated.

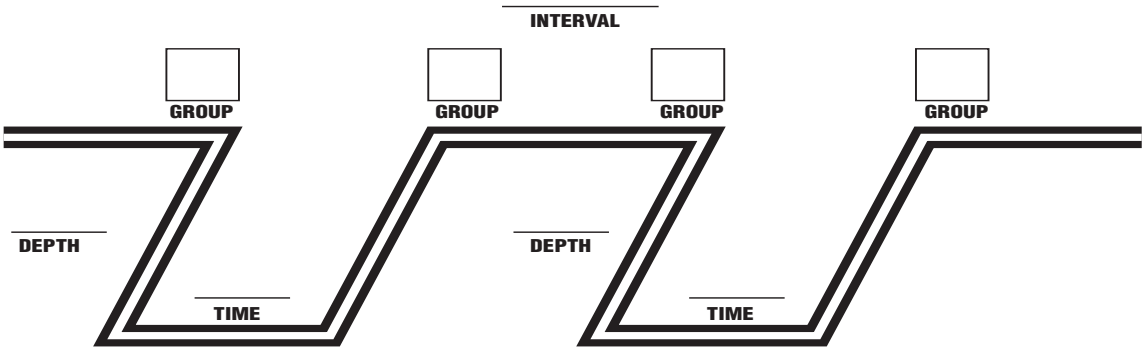


In this way an exact dive profile is created. The first thing is to establish the maximum depth to be reached, for examples 13 metres, naturally considering 15 metres on the tables following down the column the limit of permanence at this depth is shown at 100 minutes. Planning to dive for 35 minutes, 40 minutes must be calculated.



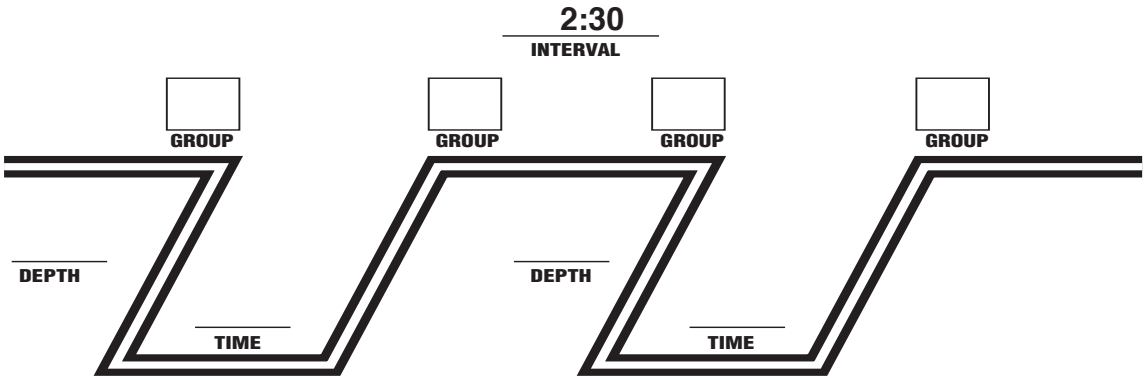
12		18		24		30		36		42		
	15		21		27		33		39		45	
5												A
15	10	10	5	5	5	5						B
25	15	15	10	10	10	7	5	5	5	5	5	C
30	25	20	15	15	12	10	10	10	8	7		D
40	30	25	20	20	15	15	13	12	10	10	E	0:1 0:5
50	40	30	30	25	20	20	15	15		F	0:10 0:45	0:2 1:2
70	50	40	35	30	25	22	20		G	0:1	0:41 1:15	1:1 1:5
								H	0:10	0:37	1:07	1:4

At this point on the right the corresponding dive letter group, in this case F is found.



15	12	10	10	10	8	7		D	0:10 1:09	1:10	2:39	5:49
20	15	15	13	12	10	10	E	0:10 0:54	0:51	1:58	3:23	6:33
25	20	20	15	15		F	0:10 0:45	0:46 1:29	1:36	2:29	3:58	7:06
30	25	22	20		G	0:10	0:41	1:16	2:06	2:59	4:26:	7:36
35	30	25		H	0:10 0:36	0:37 1:06	1:07 1:41	1:42 2:23	2:24 3:20	3:21 4:49	4:50 7:59	8:00 12:00
40			I	0:10 0:33	0:34 0:59	1:00 1:29	1:30 2:02	2:03 2:44	2:45 3:43	3:44 5:12	5:13 8:21	8:22 12:00
		J	0:10 0:31	0:32 0:54	0:55 1:19	1:20 1:47	1:48 2:20	2:21 3:04	3:05 4:02	4:03 5:40	5:41 8:40	8:41 12:00
	K	0:10 0:28	0:29 0:49	0:50 1:11	1:12 1:35	1:36 2:03	2:04 2:38	2:39 3:21	3:22 4:19	4:20 5:48	5:49 8:58	8:59 12:00
L	0:10 0:26	0:27 0:45	0:46 1:04	1:05 1:25	1:26 1:49	1:50 2:19	2:20 2:53	2:54 3:36	3:37 4:35	4:36 6:02	6:03 9:12	9:13 12:00
0:10 0:25	0:26 0:42	0:43 0:59	1:00 1:18	1:19 1:39	1:40 2:05	2:06 2:34	2:35 3:08	3:09 3:52	3:53 4:49	4:50 6:18	6:19 9:28	9:29 12:00
0:25 0:39	0:40 0:54	0:55 1:11	1:12 1:30	1:31 1:53	1:54 2:18	2:19 2:47	2:48 3:22	3:23 4:04	4:05 5:03	5:04 6:32	6:33 9:43	9:44 12:00
0:37 0:51	0:52 1:07	1:08 1:24	1:25 1:43	1:44 2:04	2:05 2:29	2:30 2:59	3:00 3:33	3:34 4:17	4:18 5:16	5:17 6:44	6:45 9:54	9:55 12:00
M	L	K	J	I	H	G	F	E	D	C	B	A
187	161	138	116	101	87	73	61	49	37	25	17	7

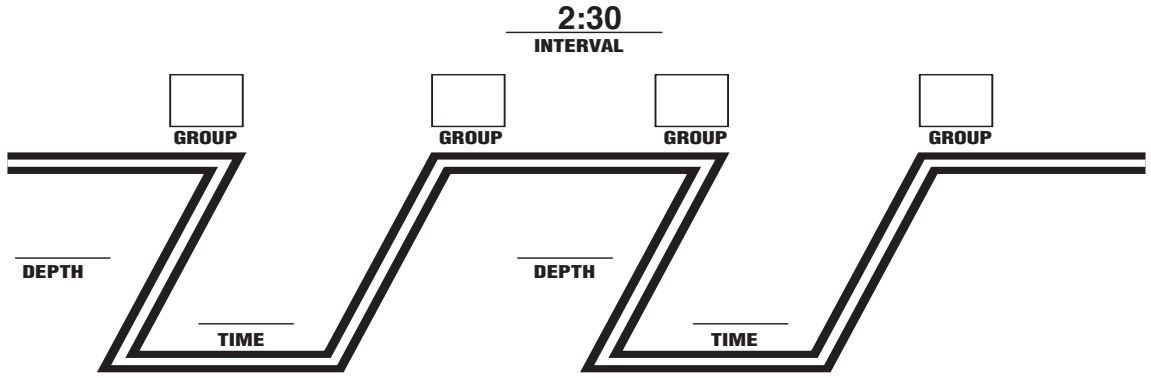
Now, wanting to plan a second dive, after a break on the surface of 2 hours and 30 minutes, moving to the right to find the box corresponding to this time, we find the interval from 2 hours
29 minutes to 3 hours 57 minutes. Below the new dive letter group is indicated: in this case C.



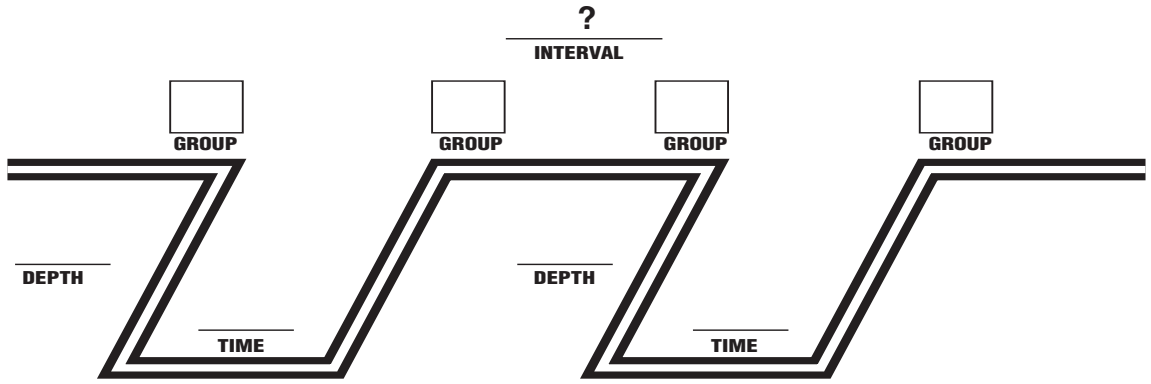
The change of dive letter group shows that the tissues have got rid of a part of the nitrogen during the interval on the surface.
Now wanting to plan a second dive where the maximum depth must never exceed the previous one, in this case 13 metres for 25 minutes, the first thing is to find the minutes which penalise the dive and add them to the real dive time. To do this one follows down under letter C to the point corresponding to the maximum depth programmed, always calculating the higher figure. This cross check between letter C and the depth of 15 metres gives 21 minutes. This means that a dive of 25 minutes must be calculated at a total time of 46 minutes.

O	0:10 0:23	0:24 0:36	0:37 0:51	0:52 1:07	1:08 1:24	1:25 1:43	1:44 2:04	2:05 2:29	2:30 2:59	3:00 3:33	3:34 4:17	4:18 5:16	5:17 6:44	6:45 9:54	9:55 12:00
	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
12	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
15	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
18	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
21	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
24	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4

Programmed dive time	**25**	**+**
Residual nitrogen time	**21**	**=**
Total dive time	**46**	



The tables can be used also to calculate the surface interval that indicates when a second dive can be carried out following the relative data of the two planned dives.

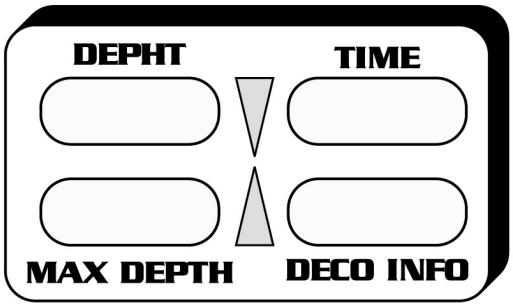


Dive computer

Progress in technology has made it possible to make diving computers easy to use and reliable in operation. They are becoming a common part of diving equipment.
Nonetheless it should be pointed out that any computer, however sophisticated and precise could never be a substitute for the human brain. Careful preparation and common sense is better than any instrument.

HOW TO USE THE COMPUTER

A personal dive computer cannot calculate the exact saturation state of our tissue but works with theoretical calculations, being unable to consider all the personal characteristics such as obesity, age, tiredness, smoking etc....



DIVE LETTER GROUP	3		6		9		12		18		24		30		36		42		DEPTH (metres)
		4,5		7,5		10,5		15		21		27		33		39		45	
A	60	35	25	20	15	5	5												A
B	120	70	50	35	30	15	15	10	10	5	5	5	5						B
C	210	110	75	55	45	25	25	15	15	10	10	10	7	5	5	5	5	5	C
D	300	160	100	75	60	40	30	25	20	15	15	12	10	10	10	8	7		D
E		225	135	100	75	50	40	30	25	20	20	15	15	13	12	10	10	E	
F		350	180	125	95	60	50	40	30	30	25	20	20	15	15		F		
G			240	160	120	80	70	50	40	35	30	25	22	20		G			
H			325	195	145	100	80	60	50	40	35	30	25		H				
I				245	170	120	100	70	55	45	40			I					
J				315	205	140	110	80	60	50			J						
K					250	160	130	90				K							
L					310	190	150	100			L								
M						220	170			M									
N						270	200		N										
O						310		O											
NEW DIVE LETTER GROUP									O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

BASED ON
U.S. NAVY
DIVE TABLES

SAFETY STOP
3mt/3min

REPETITIVE DIVE DEPTH (metres)																							
12	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
15	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
18	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
21	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
24	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4
27	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
30	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3
33	55	51	47	42	38	34	31	27	24	20	16	13	10	6	3
36	50	46	43	39	35	32	28	25	21	18	15	12	9	6	3
39	44	40	38	35	31	28	25	22	19	16	13	11	8	6	3

Let 's try to sum up the five main points in the use of the computer:

ALWAYS REFER TO THE HANDBOOK OF INSTRUCTION BEFORE USING THE INSTRUMENT

Every computer has its own characteristic

EVERY DIVER MUST HAVE HIS OWN COMPUTER

Is possible that all the members of the group dive together, but even at the same depth small differences can result in serious risks

RESPECT THE ASCENT RATE

This is a very important element to takeinto account

NEVER MAKE COMPARISON WITH THE TABLES

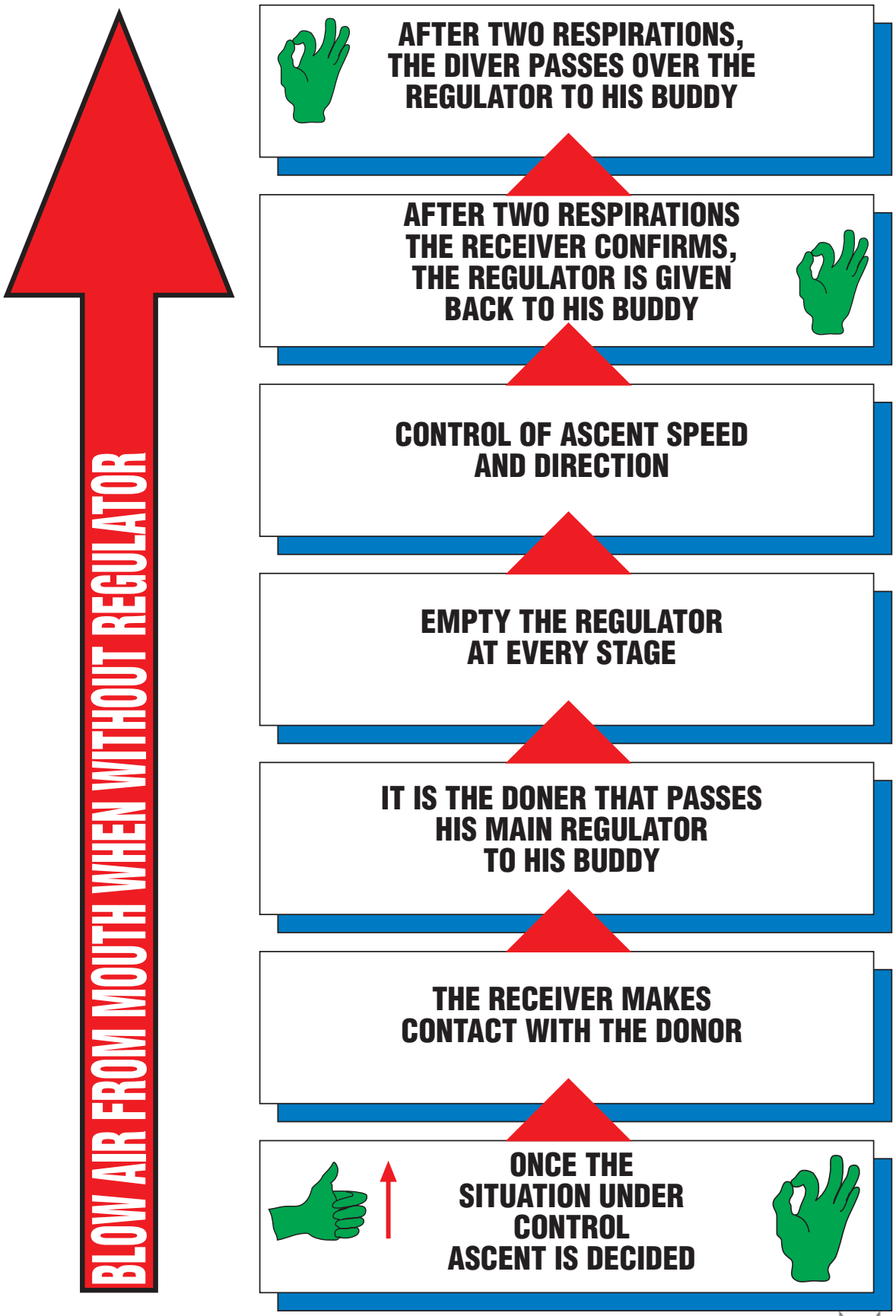
Or you use the table or the computer, never mix them

THE MAXIMUM DEPTH MUST BE REACHED AT THE BEGINNING OF THE DIVE

One must reach the maximum depth first and then ascend to a shallower depth.

In water

BUDDY BREATHING ASCENT



NEVER HOLD THE BREATH

CHECK
THE ASCENT DIRECTION

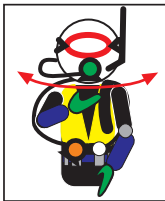
WITH LEFT HAND BOTH
DIVERS CONTROL THE
SPEED OF ASCENT

EVERYTHING UNDER
CONTROL
ASCENT IS DECIDED

THE DONOR PASSES OVER
HIS ALTERNATIVE AIR SOURCE
TO HIS BUDDY

THE RECEIVER CONTACTS
THE DONOR

THE DIVER THAT HAS AIR
LEFT JOINS HIS
BUDDY WHO IS IN NEED



SIGNAL: THE AIR
HAS RUN OUT
LET'S SHARE
YOUR AIR

EMERGENCY ASCENT USING THE FINS AND B.C.D.

NEVER HOLD THE BREATH

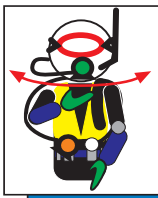
ONCE ON THE SURFACE THE
WEIGHT BELT IS RELEASED
TO OBTAIN A POSITIVE BUOYANCY

CONTROL THE ASCENT PATH

WITH THE RIGHT HAND
THE WEIGHT BELT BUCKLE
MUST BE LOCATED

BREATHING CONTINUES

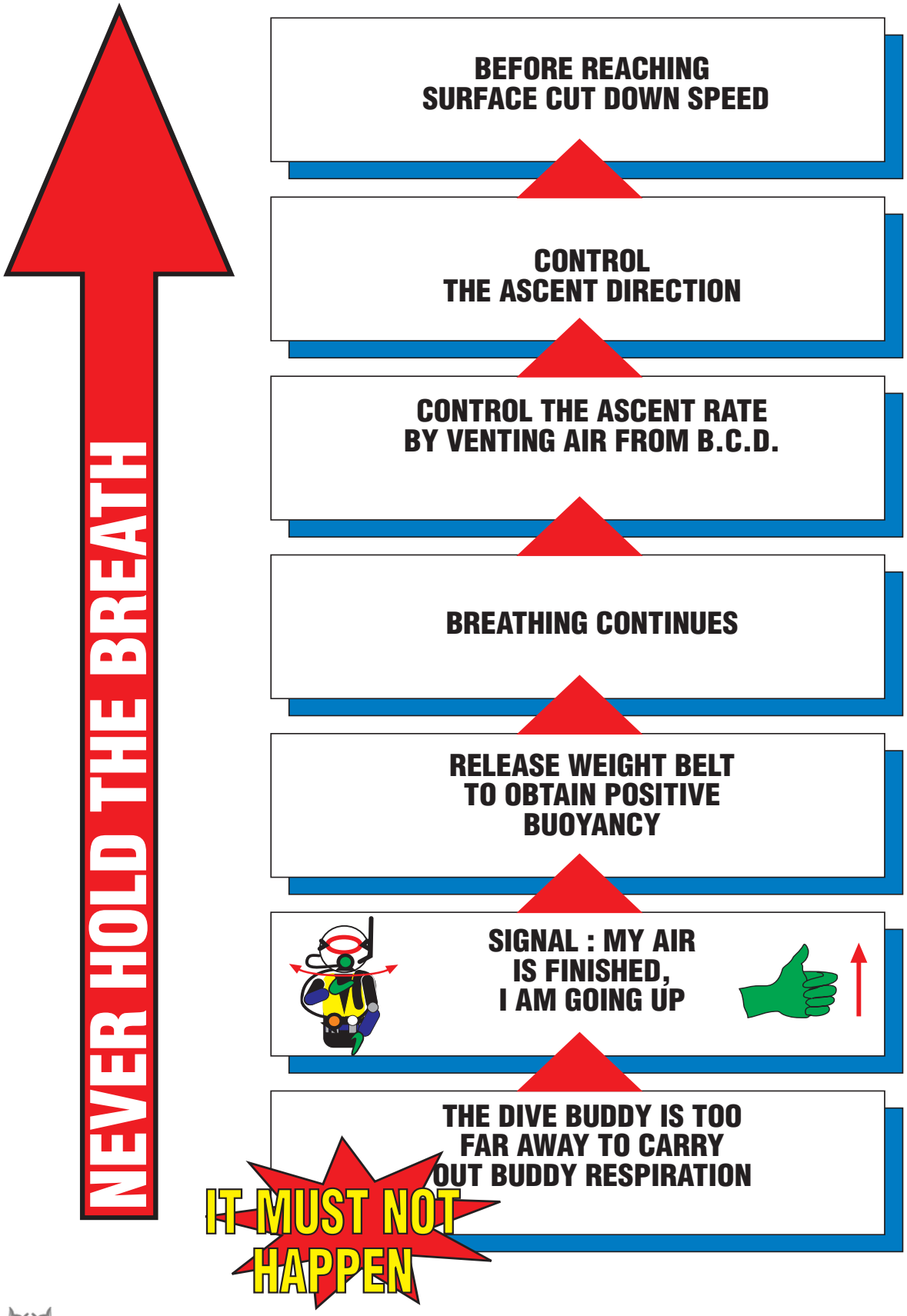
FINNING WE START TO LEAVE
THE BOTTOM AND TO
RELEASE AIR FROM
THE B.C. TO CONTROL SPEED



SIGNAL : MY AIR
IS FINISHED,
I AM GOING UP

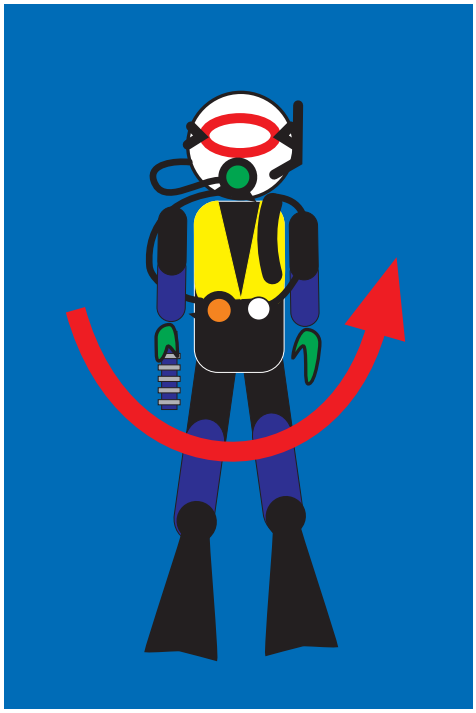
THE DIVE BUDDY IS TOO
FAR AWAY TO CARRY
OUT BUDDY RESPIRATION

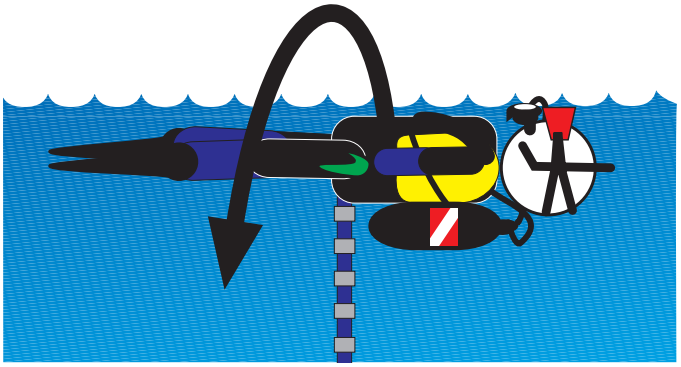
IT MUST NOT HAPPEN


NEVER HOLD THE BREATH
BEFORE REACHING SURFACE CUT DOWN SPEED
CONTROL THE ASCENT DIRECTION
CONTROL THE ASCENT RATE BY VENTING AIR FROM B.C.D.
BREATHING CONTINUES
RELEASE WEIGHT BELT TO OBTAIN POSITIVE BUOYANCY
SIGNAL : MY AIR IS FINISHED, I AM GOING UP
THE DIVE BUDDY IS TOO FAR AWAY TO CARRY OUT BUDDY RESPIRATION
IT MUST NOT HAPPEN

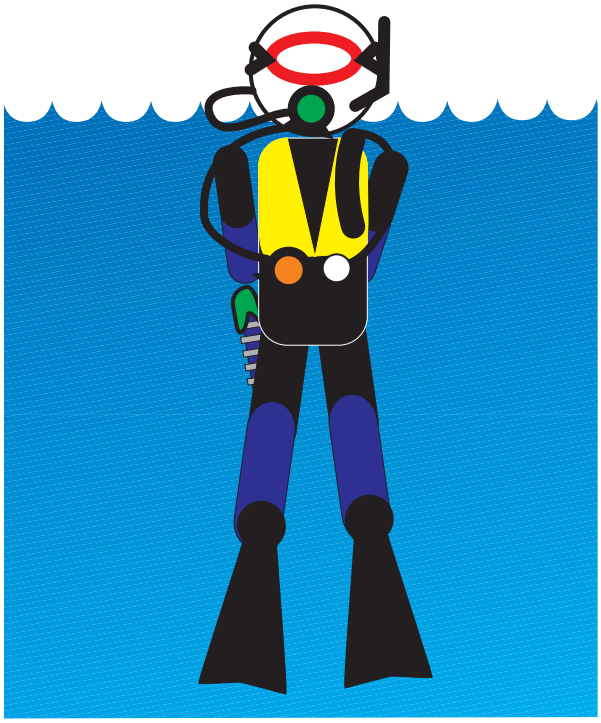
IN WATER WEIGHT BELT DRESSING

ROTATION





BACK PASSAGE



LESSON 4

CMAS

WORLD UNDERWATER FEDERATION

Safety equipment

A group of divers, who dive together, should always have a small first aid and oxygen kit handy. All the divers should have at least a basic understanding of first aid and O^2 administration. When diving from a boat there should always be someone aboard who is able to operate the VHF radio and other emergency equipment. If the type of dive and or the conditions dictate, then a Surface Marker Buoy (SMB) must be used by each buddy pair. If you are not directly involved with the immediate dive then you should be prepared to give a hand during the first phases of assembling the equipment, dressing and entering the water.

SAFETY PROCEDURES

As part of your dive planning the emergency procedures which prevail in the area or country in which you are diving must be digested.
It will be necessary to know were the nearest telephone is how to get there and how to use it.
In the case of an accident first aid should be given immediately, a case history kept and the injured divers buddy monitored.
Begin the ascent with no less than 50 bar in the cylinder.
A weighted (shot) line in the water will always be useful.
During a night dive the shot buoy must have its own flashing yellow light, visible up to 200 meters.
When diving from a boat it is a good idea for every diver to have a small line with a snap link (Karabiner) on the end attached to the BCD so that it can be attached to the boat after diving for security and support.
When handling the cylinders both on land and sea, care must be taken to avoid injury. Never strain, get help.
When there is current, the dive should generally begin against it if no boat cover is available. In current, swimming near the bottom will lessen its effects.

PRE DIVE BRIEFING

Before each dive a briefing must be carried out. The briefing must be suited to the people undertaking the dive. The Divemaster or the Instructor may explain the following:

-EQUIPMENT
Check the equipment, tank pressure and the instruments It may also be necessary to check your buoyancy / weight requirements.

-GENERAL SAFETY
May include: -
Breath normally to avoid hyperventilation & avoid skip breathing.
Carrying out proper equalisation of both ears and mask.
Look out for any danger.

-TYPE OF DIVE
Description of the site and any reference points to be used.
Training, enjoyment, exploration etc.
-Method of entering the water
From shore - Step entry or roll from boat

-DIVE FORMATION
For larger groups the position of each diver and buddy to be kept during dive. All must know safety procedures.

-SIGNALS
To be used underwater and on the surface.

BUDDY SYSTEM

Before a dive it is good to carry out a thorough check with your buddy, helping him/her to prepare and put on the equipment before entering the water. Each half of the buddy pair must be aware of the dive plan, safety / emergency procedures and the signals to be used agreed. It is the duty of the person leading the dive to ensure that this is done.

PREPARATION FOR ENTERING THE WATER

Put on the weight belt, checking the accessibility of the quick-release buckle.
Turn on your air and put on the scuba equipment, if necessary getting help from the buddy. (Check that weight belt is still freely accessible)
The pressure of the cylinder must be checked by taking 3 breaths from each regulator whilst watching the contents gauge.
Set the watch and depth gauge to record the time and depth.
Ensure that your Personnel Dive Computer (PDC) is working.
Connect up any direct feeds to dry suit & BCD.
Put on mask, snorkel, gloves & hood.
Check ancillary equipment is properly stowed e.g. reel and torch.
Finally put on fins
At this point everything is ready to enter the water as planned.

DIVE PROCEDURES

Once in the water it is a good thing to carry out a last overall check and to make sure that no BCD controls have become unreachable.
At the beginning of the dive, it might be necessary to enlarge the hood to let in a drop of water around the ears.
Before commencing final descent check your buddies kit for any air leeks.

DISORIENTATION DURING DESCENT / ASCENT

A dive without visible reference points i.e. “in the blue” has a particular fascination but can create difficulties, with divers becoming dizzy and disoriented. For the first couple of dives are better to descend down a wall or anchor line which can help as a guide.
If your dive involves using a shot or anchor line, check when able, that the line is holding fast to the bottom. At the end of the dive check that the line is not caught on rocks or wreckage.
Descending and ascending through the bubbles discharged by another diver below, can cause dizziness, try not to look at the bubbles.

EMERGING FROM THE WATER

How the diver de-kits will depend on the situation. However, if re-entering a boat after a dive then the first thing to remove is always the weight belt. This should be handed into the boat holding on to the open end, opposite the buckle. Once the diver is without a weight belt he will be positively buoyant. The remainder of the kit may now be removed if necessary before entering the boat. In no circumstance however should the mask be removed until safely back into the boat.
Never struggle yourself or let others do the same.
Help each other to exit from the water and de-kit.
The equipment used on your dive must be stored so that it does not get into the way of others. Remember to wash and dry your equipment as soon as you are able, it should then be properly stored. After a dive you should take things easy as over exertion can lead to an increased risk of DCI.
Before leaving the dive site or boat, check that nothing has been left behind.

READY TO DIVE ?

THE CYLINDER VALVE IS OPEN ?

THE PRESSURE GAUGE IS OK ?

B.C.HARNESS ?
WEIGHT BELT ?

INSTRUMENTS IN RIGHT PLACE ?

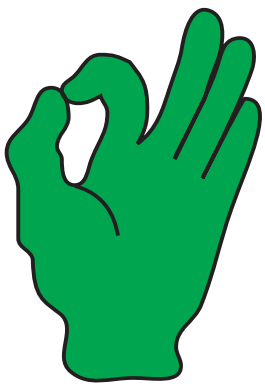
KNIFE ?
MASK ?
SNORKEL ?

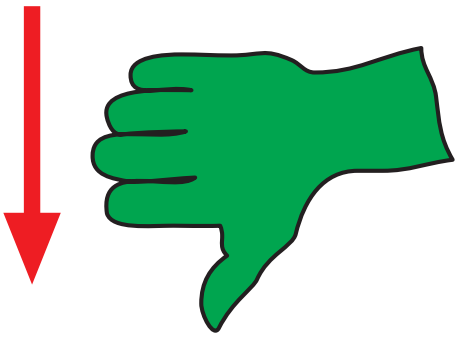
GENERAL CHECK ?

SIGNALS ?

DIVE PLAN ?
SAFETY PROCEDURES ?

OK
DIVE

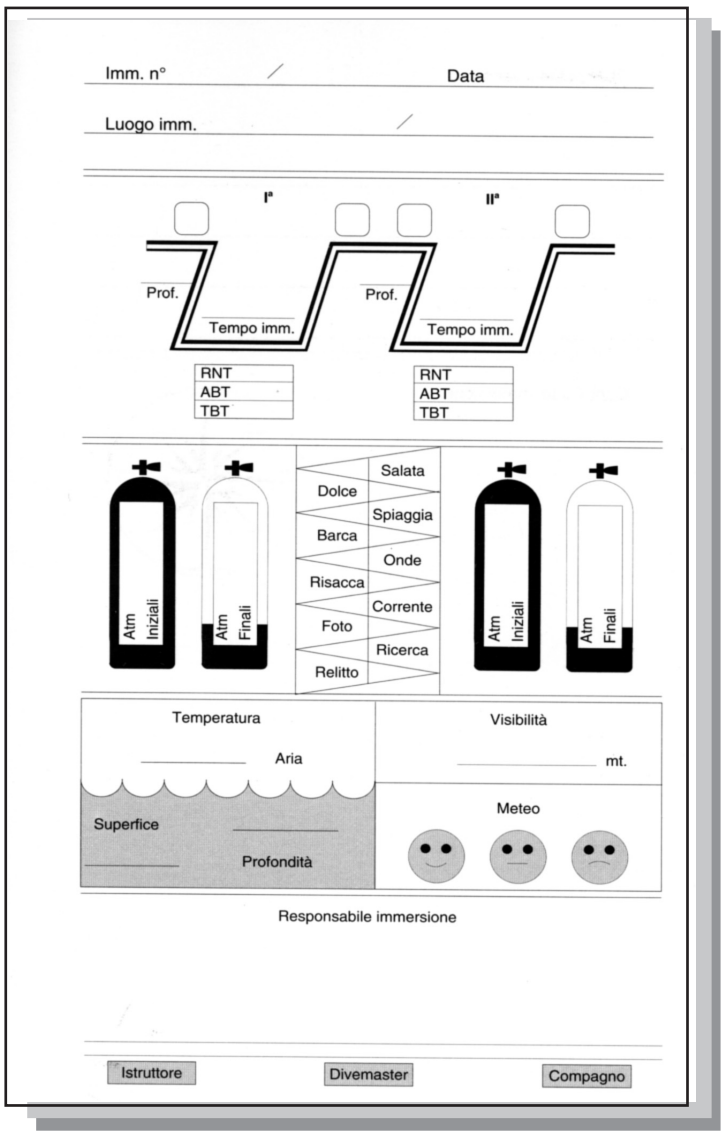




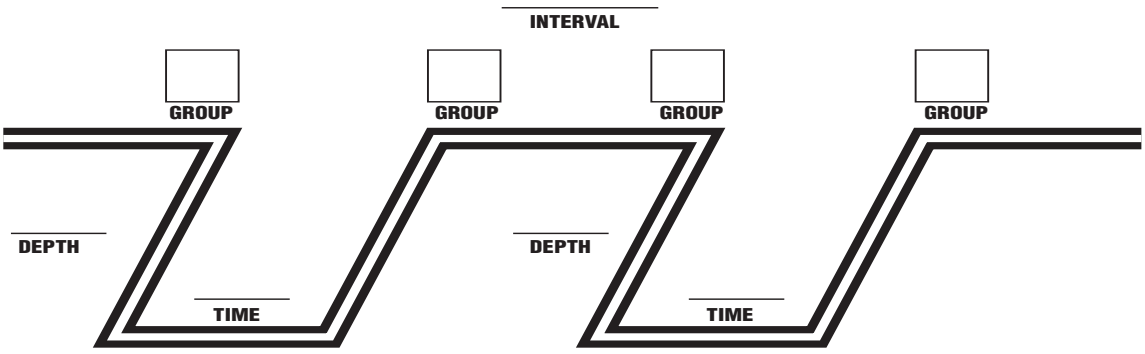
DIVE LOG RECORDING

After each dive a log sheet should be completed. The information recorded should include the following:

Date
Place
Time
Max depth
Sea conditions
Visibility
Purpose of dive
Air consumption
Weight used



This information can then be used in the planning of future dives.
A divelog well kept is a document that shows the divers experience and is of much more value than a certificate.



THE FIRST FEW DIVES

The first stages of any new activity are very important.
In the early days the experiences gained will influence whether or not an individual will go on to actively participate in the sport.
Some of the difficulties, which may be experienced during the first few dives, are:

The suit is tight, I am suffocating!
What a lot of equipment and instruments,
how will I handle them?

What if I fill seasick?
The mask is steaming up!
I can't get my buoyancy right!
Where is my buddy, I can't turn around to find him!
It's so cold! …and so on.

These worries can cause anxiety and fear during the dive. The result can be that little or no attention is paid to the surroundings.

But we have an important suggestion:

Don't worry before or during dive

Advise:

Always follow instructions given by the instructor.

Give yourself plenty of time when kiting up.

Ensure the equipment is in good working order.

Know how to use all the equipment.

Be aware that feeling awkward is normal.

We all felt the same at the start.

LET'S LOOK AROUND US

Once the pair or group is together and the instructor / dive leader is content that each diver is happy, the slow descent towards the bottom finally begins. During the descent the instructor should encourage the divers to take in the scene. This should help to calm any anxiety being experienced. During the descent the diver should adjust his buoyancy and monitor his equipment. At the required depth neutral buoyancy must be achieved, equipment checked and the diver settled. Now the diver is ready to follow the instructor in accordance with the DIVE PLAN. At this point the sensitive and relaxed diver could ask:

…. what are the rules of behaviour in such anunusual and often fragile environment?

THE IMPORTANCE OF GOOD BUOYANCY CONTROL

IN RELATIONSHIP TO THE ENVIROMENT

Don't overweight your belt. The diver with too much weight tends too descend to quickly. A badly controlled descent risks of damaging the sensitive marine environment as the diver crashes into the bottom. The natural way to move through the water is in a horizontal position, face towards the bottom. This way we are able to maintain our position in relation to the bottom. If you were tempted to turn on one's back then you will run the risk of hitting other divers and or damaging the seabed.

Fins

Using fins well preserves the environment. Avoid finning too strongly near fragile corals, even water pressure created by the fins can damage them. Be careful not to fin too near the seabed and keep a safe distance, especially near a sandy bottom.

MEMORIES

TAKE NOTHING BUT PHOTOGHRAPHS, LEAVE NOTHING.

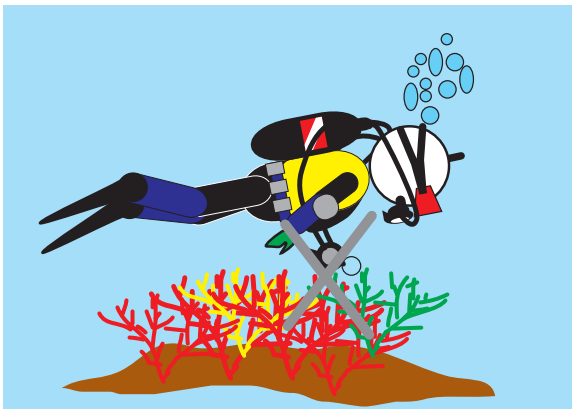
Your memories should be the only other thing to leave the dive site. Buy your T-shirts from the dive shop. Don't collect shells and coral even if dead, they could be a shelter for other living creatures. Breaking these rules in a natural park can bring about severe penalties.

ANCILLARY EQUIPMENT

Ensure that all ancillary equipment such as console mounted depth and contents gauges and spare second stage regulators (octopus) are not permitted to drag along the bottom when you are swimming horizontally just above the sea bed. This can cause damage to both your equipment and the fragile environment through which you are swimming. Make sure that all such equipment is secured to your BCD.

WEIGHT BELT

All weight belts must have a quick release buckle, which requires a positive action to open them. Accidental opening of the weight belt in the coral reef can have disastrous effects for the marine life as well as the obvious dangers for the diver.



…. How and where to look to see something during a dive?

You needn't descend to a great depth to find life, because it is more prolific where there is light (0-30 m).

Look carefully in the cracks and the holes, you will find lots of life sheltering there (sponges, squids, rock plants….)

Every so often look away into the blue an unusual fish or shoal might pass by

Move slowly if you want to get near a fish

Don't move animals from one part of the reef to another

Remember that lives found in large numbers are often small and difficult to identify Look carefully!

Bear in mind what you see and when on the surface ask you instructor or consult a marine life book to find out more

"I didn't see anything" is like saying, "I didn't look for anything"

…. which are the most common dangers?

YOU OR OTHER DIVERS ARE PROBABLY THE MOST DANGEROUS THINGS YOU WILL MEET, BUT:

Generally animals defend themselves mainly in two ways, by stinging or letting off dangerous substances when touched.

Fish generally sting with prickles and spines.

Don't put your hands on rocks or corals, you could be stung by a Stonefish.

Fish that let off toxic and stinging substances at touch usually have tentacles more or less visible.

Be careful of contact with creatures with fixed or moving tentacles like: Jelly Fish, Sea Anemones and dangerous Fire Corals.

A piece of advice …It is best not to touch but just enjoy nature, observe and respect.

REGISTRATION FORM

WORLD UNDERWATER FEDERATION

Student

Name - Surname

Born date

Address

State Zip

Note

Instructor

Name - Surname Certification N°

CMAS

1 STAR CMAS PROGRAM

DISCOVER DIVING
Basic equipment
MASK
SNORKEL
WEIGHT BELTS
FINS
SUITS
GLOVES AND FOOTWEAR
SNORKELLING EQUIPMENT
KNIFE
Surface Marker Buoy
BAG
Put on the basic equipment
Environment adaptation
BUOYANCY CONTROL
MANOEUVRE Of COMPENSATION
SIGHT
SENSE OF HEARING
SENSE OF TOUCH
SENSE OF SMELL
Underwater accidents
SYNCOPE
RESCUE PROCEDURES
General points to consider
TO IMPROVE PERFORMANCE
PLANNING
In water
ENTERING THE WATER
FROM A LOW POINT
FROM A HIGH POINT
POSITION
BREATHING
MASK AND SNORKEL
FINNING ON THE SURFACE
DIVING ROUTE
Signals
ELEMENTARY SIGNALS ON THE SURFACE
THE ROLL OVER
DURING DIVING
ASCENDING
SAFETY PROCEDURES
EMERGING FROM THE WATER
EQUIPMENT MAINTENANCE

LESSON 1
Basic equipment
MASK
SNORKEL
WEIGHT BELTS
FINS
SUITS
GLOVES AND FOOTWEAR
Scuba equipment
CYLINDER
REGULATOR
ALTERNATIVE AIR SOURCE (AAS)
PRESSURE GAUGE
BUOYANCY CONTROL DEVICE (B.C.D.)
Device
DEPTH GAUGE
KNIFE
Surface Marker Buoy
DIVING TORCH
COMPASS
WHISTLE
BAG
KIT BOX
Preparation and assembly of scuba diving
Putting on the scuba equipment
Enter the water
FROM A LOW POINT
Signals
BASIC SIGNALS TO DO WHEN ON SURFACE
Adjustment
MANOEUVRE Of COMPENSATION
SOUNDS UNDERWATER
SIGHT UNDERWATER
In water
CONTROL OF THE BUOYANCY
BREATHING WITH THE REGULATOR
EMPTYING THE MASK
STARTING THE DIVE
FINNING UNDERWATER
REGULATOR RECOVER
ASCENDING
GETTING OUT OF WATER
MAINTENANCE OF THE EQUIPMENT

LESSON 2
Basic physics
TORRICELLI 'S LAW
PASCAL'S LAW
ARCHIMEDE 'S PRINCIPLE
BUOYANCY IN WATER
BOYLE'S LAW
SIGHT UNDERWATER
SOUND UNDERWATER
COMPENSATION
INCREASE IN PRESSURE
REDUCTION OF VOLUME
COMPENSATING THE EQUIPMENT
The human body
THE RESPIRATORY SYSTEM
THE ALVEOLI AND THE CAPILIARIES
THE CARDIO - CIRCULATORY SYSTEM
Human metabolism
SHORTNESS OF BREATH
HYPOXIA
HYPOTHERMIA
HYPERTHERMIA
Diving accidents
EMBOLISM
AIR EMBOLISM SYNDROME
PNEUMOTHORAX
MEDIASTINAL EMPHYSEMA
SUBCUTANEOUS EMPHYSEMA
TREATMENT OF PULMONARY OVERDISTEN-
SION
In Water
ENTERING AND COMING OUT OF THE WATER
FROM THE SHORE
FROM A ROCKY SHORE
FROM THE BEACH
FROM AN INFLATABLE
FROM A BOAT
Signals
DIVING SIGNALS
Buoyancy
CONTROLLING BUOYANCY IN DIVING
Safety procedures
ASCENDING
BUDDY BREATHING
ALTERNATIVE AIR SOURCE RESPIRATION
RELEASE OF THE WEIGHT BELT

LESSON 3
Absorption of gas in the human body
COMPOSITION OF THE AIR AT SURFACE LEVEL
COMPOSITION OF THE AIR DURING DIVING
Nitrogen narcosis
Decompression sickness
SKIN DECOMPRESSION SICKNESS
Joint DECOMPRESSION SICKNESS
CENTRAL NERVOUS SYSTEM DECOMPRESSION
SICKNESS
FIRST AID
Prevention of accidents
Medical
Before diving
During diving
During ascent
After diving
Dive tables
Terminology
Use of the tables
Dive tables
Example of calculation using the tables
Divec omputer
How to use the computer
In water
BUDDY BREATHING ASCENT
EMERGENCY ASCENT USING THE FINS AND
B.C.D.
EMERGENCY ASCENT WITHOUT BELT
IN WATER WEIGHT BELT DRESSING

LESSON 4
Safety equipment
SAFETY PROCEDURES
PRE DIVE BRIEFING
BUDDY SYSTEM
PREPARATION FOR ENTERING THE WATER
DIVE PROCEDURES
Disorientation during descent / ascent
EMERGING FROM THE WATER
DIVE LOG RECORDING
The first few dives
Let's look around us
THE IMPORTANCE OF GOOD BUOYANCY
CONTROL
How and where to look

SKILL UPDATE

Student

Name - Surname

Born date

Address

State Zip

Note

Instructor

Name - Surname Certification N°

CMAS

SKILL UPDATE PROGRAM

	STUDENT			INSTRUCTOR		
	☹	😐	☺	☹	😐	☺
Preparation and assembly of scuba diving equipment						
TANK						
B.C.D.						
REGULATOR						
Putting on the scuba equipment						
DRESSING ORDER						
PUTTING ON EQUIPMENT WHILE STANDING						
PUTTING ON EQUIPMENT WHILE SITTING						
PUTTING ON THE EQUIPMENT IN WATER						
Entering and coming out of the water						
FROM A SHORE						
FROM AN INFLATABLE						
FROM A BOAT						
In water						
CONTROL OF THE BUOYANCY						
BREATHING WITH THE REGULATOR						
EMPTYING THE MASK						
STARTING THE DIVE						
FINNING UNDERWATER						
REGULATOR RECOVER						
BUOYANCY CONTROL						
SIGNALS						
ASCENDING						
Safety procedures						
ASCENDING						
BUDDY BREATHING						
ALTERNATIVE AIR SOURCE ASCENT						
EMERGENCY ASCENT USING THE FINS AND B.C.D.						
IN WATER WEIGHT BELT DRESSING						
Procedure di risalita						
RISALITA CON RESPIRAZIONE IN COPPIA ALTERNATA						
RISALITA IN COPPIA CON FONTE D'ARIA ALTERNATIVA						
RISALITA IN EMERGENZA PINNEGGIANDO						
RISALITA IN EMERGENZA IN ASSETTO POSITIVO						
MANOVRE CON LA CINTURA DI ZAVORRA IN ACQUA						
In water						
IN WATER DRESSING						
EQUIPMENT CHANGE						
GETTING OUT OF WATER						
MAINTENANCE OF THE EQUIPMENT						

Summary P1

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Finito di stampare nel Aprile 2002

Euro 12,91
Usd 15,00