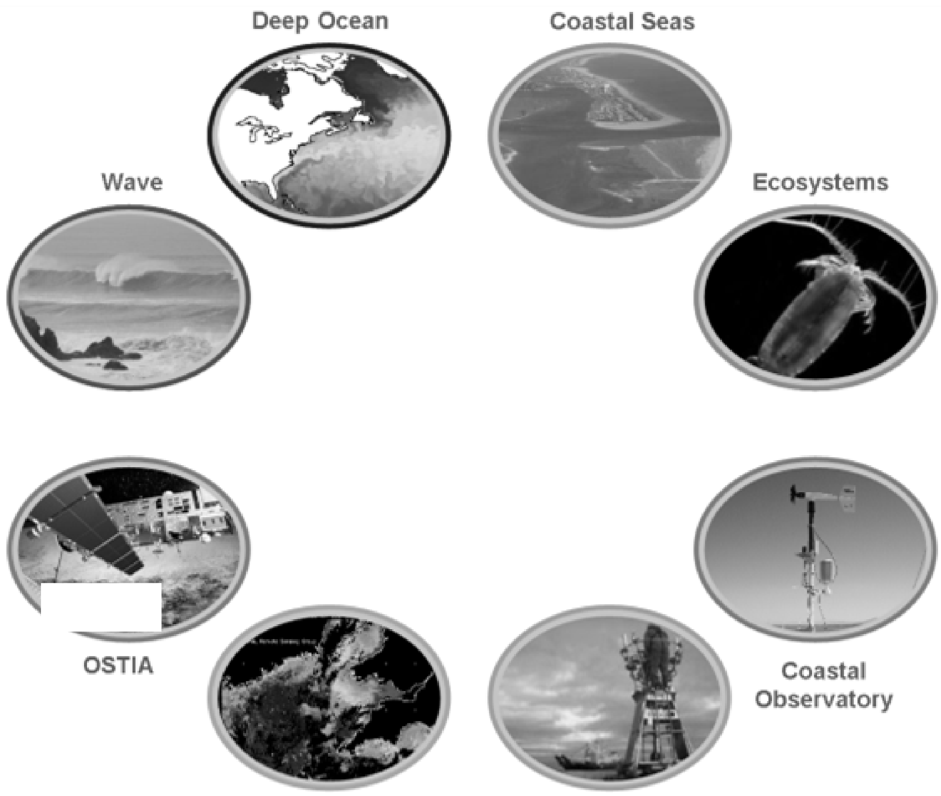
Aquatic Resources Management

ARM 102 1.0 Oceanography

Laboratory and field manual

Basic Oceanographic, underwater survey and safety instruments



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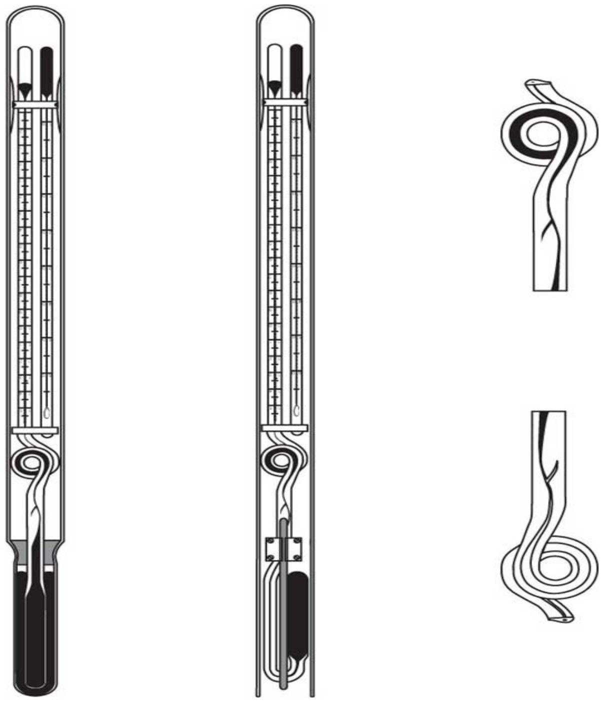
Practical No. 01 Introduction to basic oceanographic instruments

In order to study the physico-chemical properties of seawater, sediments as well as biological studies on plankton and benthic organisms, we have to use number of different instruments and techniques. In this practical some of the commonly used such oceanographic instruments are arranged for your observation and study them thoroughly.

1. Reversing Thermometer

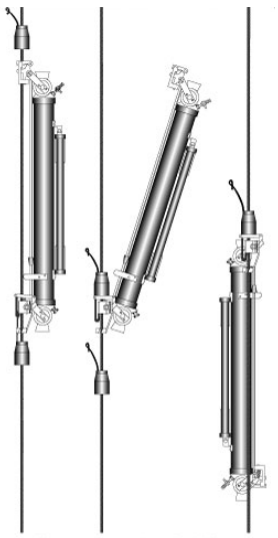


One very important mercury thermometer is the reversing thermometer carried on Nansen bottles. It is a thermometer that has a constriction in the mercury capillary that causes the thread of mercury to break at a precisely determined point when the thermometer is turned upside down. The thermometer is lowered deep into the ocean in the normal position; and it is allowed to come to equilibrium with the water. Mercury expands into the capillary, and the amount of mercury in the capillary is proportional to temperature. The thermometer is then flipped upside down, the thread of mercury breaks trapping the mercury in the capillary, and the thermometer is brought back. The mercury in the capillary of the reversed thermometer is read on deck along with the temperature of a normal thermometer, which gives the temperature at which the reversed thermometer is read. The two readings give the temperature of the water at the depth where the thermometer was reversed. The reversing thermometer is carried inside a glass tube which protects the thermometer from the ocean's pressure because high pressure can squeeze additional mercury into the capillary. If the thermometer is unprotected, the apparent temperature read on deck is proportional to temperature and pressure at the depth where the thermometer was flipped. A pair of protected and unprotected thermometers gives temperature and pressure of the water at the depth the thermometer was reversed.

2. Nansen reversing water sampler

A Nansen bottle is a device for obtaining samples of seawater at a specific depth. It was designed in 1910 by the early 20th-century explorer and oceanographer Fridtjof Nansen and further developed by Shale Niskin.

The bottle, more precisely a metal or plastic cylinder, is lowered on a cable into the ocean, and when it has reached the required depth, a brass weight called a "messenger" is dropped down the cable. When the weight reaches the bottle, the impact tips the bottle upside down and trips a spring-loaded valve at the end, trapping the water sample inside. The bottle and sample are then retrieved by hauling in the cable.



Nansen water bottles before (I), during (II), and after (III) reversing.

A second messenger can be arranged to be released by the inverting mechanism, and slide down the cable until it reaches another Nansen bottle. By fixing a sequence of bottles and messengers at intervals along the cable, a series of samples at increasing depth can be taken.

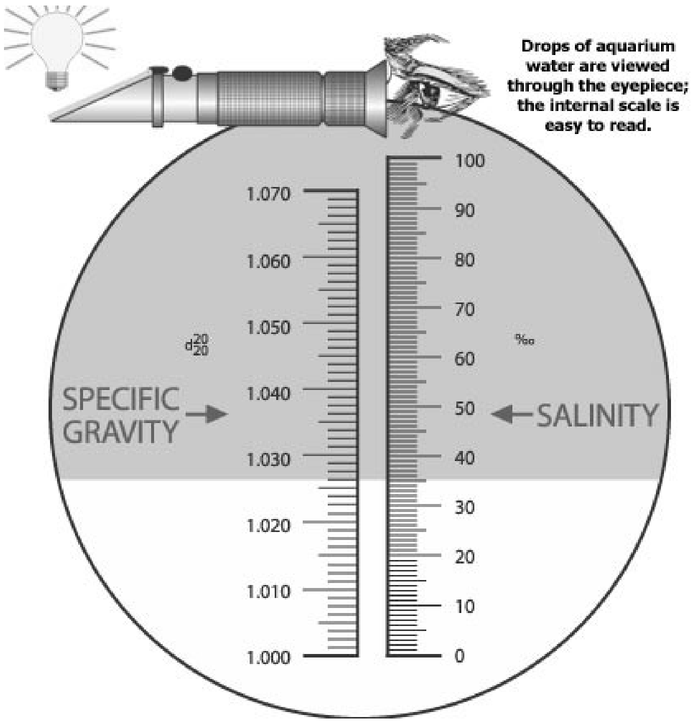
3. Ruttner Sampler

Ruttner water sampler is suitable for taking samples in lakes, water borings, wells, etc. The closing mechanism has proved itself to be most satisfactory over many years;
the water sampler is of simple and practical design and guarantees reliable results.

A thermometer ranging from -2 to + 30°C indicates the temperature of the sample; it can easily be read through the plastic tube of the sampler. The sample can be drawn off through the discharge cock in the lower lid for the various analyses.

4. Refractometer

The best way to measure the salinity and specific gravity of water is to use a refractometer. These precision optical instruments are incredibly accurate even at very low salt levels, and are equally easy to use. This refractometer is designed for testing the concentration of salt water and is made totally from high quality plastics. It provides a direct reading of the specific gravity and concentration (‰ Parts Per Thousand) of salt in water. This refractometer provides reliable refractive index and salinity readings of total dissolved solids of aqueous solutions. It is used for quality control in research and clinical laboratories. It can be used to check and maintain stock solutions and dilutions. In the food industry, it is especially effective in the preparation of frozen vegetables, fruits, seafood and ocean byproducts. The salinity refractometer is also used in oceanography and seawater studies for determining soil quality.

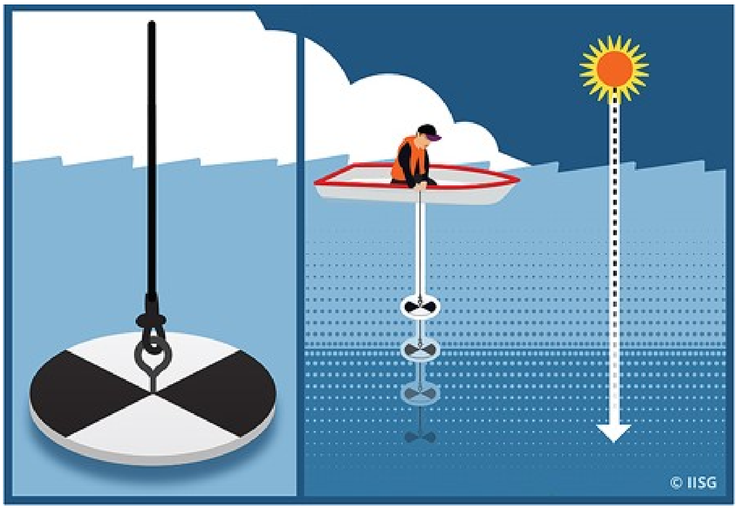


Measurement of water clarity (turbidity) using a secchi disk

The turbidity of a body of water is related to the cleanliness of the water. Waters with low concentrations of total suspended solids (TSS) are clearer and less turbid than those with high TSS concentrations. Turbidity can be caused by high concentrations of biota such as phytoplankton, or by loading of abiotic matter such as sediments. Turbidity is important in aquatic systems as it can alter light intensities through the water column, thus potentially affecting rates of photosynthesis and the distribution of organisms within the water column. Lowered rates of photosynthesis may in turn affect the levels of dissolved oxygen available in a given body of water, thus affecting larger populations such as fish. High turbidity can also cause infilling of lakes and ponds if the suspended sediments settle out of the water column and are deposited.

Turbidity can be measured using several methods. The easiest and least expensive method is through the employment of a Secchi disk. A Secchi disk is an 8-inch diameter disk with alternating black and white quadrants that is lowered into the water column until it can no longer be seen from the surface. The point at which the disk disappears is a function of the turbidity.

Secchi disks may be purchased by science equipment suppliers, but they can also be hand-made. Below is a set of instructions on how to use a secchi disk.



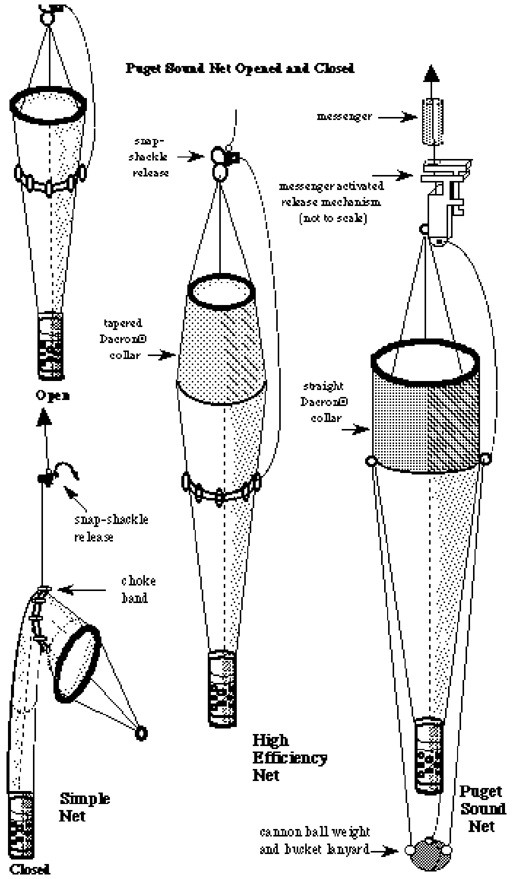
How to use a Secchi Disk

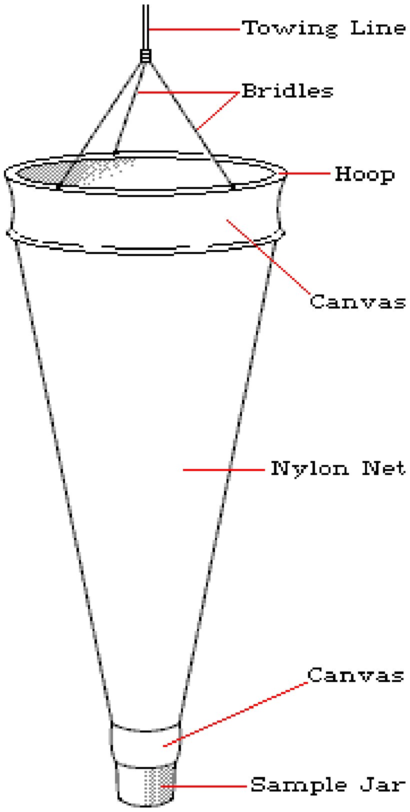
1. Slowly lower the Secchi disk into the water on the shady side of the boat until it is no longer visible. Record this depth.
2. Slowly raise the disk until it just becomes visible once again. Record this depth.
3. Average the depths from steps 1 and 2 to get the Secchi depth.
4. This may be repeated for a measurement of precision.

In general, lower turbidity is associated with cleaner, healthier water. Turbidity measurements can vary across different types of environments, so they are especially useful when comparing similar environments or the same water body through time.

5. Plankton nets

Plankton Nets are a modification on the standard trawl used to collect planktonic organisms, of nearly any size, intact. Towed by a research vessel, Plankton Nets have a long funnel shape that allows them to catch differently sized plankton simply by changing the mesh size of the net. At the end of the funnel is a collection cylinder called a cod-end.





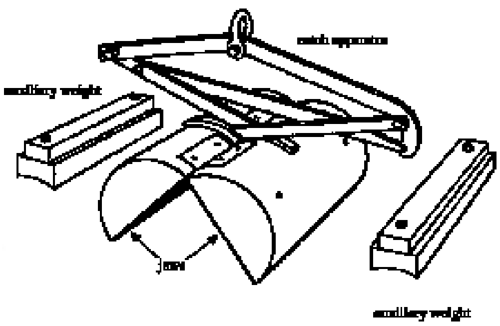
6. Winch

A winch is a mechanical device that is used to pull in (wind up) or let out (wind out) or otherwise adjust the "tension" of a rope or wire rope (also called "cable" or "wire cable"). In its simplest form it consists of a spool and attached hand crank. In larger forms, winches stand at the heart of machines as diverse as tow trucks, steam shovels and elevators. The spool can also be called the winch drum. More elaborate designs have gear assemblies and can be powered by electric, hydraulic, pneumatic or internal combustion drives. Some may include a solenoid brake and/or a mechanical brake or ratchet and pawl device that prevents it from unwinding unless the pawl is retracted.

Sampling tools for benthic organisms

The type of gear selected for sampling seabed substrata and the benthic macrofauna is primarily determined by the hardness/ compactness of the substrata. Whilst a wide variety of sampling methods are available, only a small proportion of these have the ability to effectively collect samples from areas of relatively coarse sediments which are characteristic of dredging sites. In certain situations, it may be necessary to use more than one technique in order to sample the full range of benthic organisms present in an area.

7. Peterson Grab



Petersen Grab

The Petersen grab consists of a pair of weighted semi-cylindrical jaws which are held open by a catch bar. Upon impact with the sediment (slackening of the rope), the tension on the catch bar is reduced allowing the jaws to close. Auxiliary weights can be added to the jaws to improve penetration into harder, more compacted sediments. There is no access to the sample through the top of the grab, consequently the sediments must be dumped into a tray and treated as a bulk sample. The Petersen grab is suited to the collection of hard bottom material such as sand, marl, gravel, and firm clay.

Van veen grab sampler

Grab sampling is the simple process of bringing up surface sediments from the seafloor. Once it is launched, the jaws of the grab sampler open and it descends to the seafloor. A spring closes the jaws, and they trap sediments or loose substrate. The grab sampler is then brought up to the surface where its contents are studied in detail.

8. Sediment core samplers

Sediment samples can be collected using a small core (2.5 cm in diameter) and Large core sampler (diameter 18 cm) sampler with the assistance of divers. Samples are carefully collected from the top later of the sediment without disturbing.

A

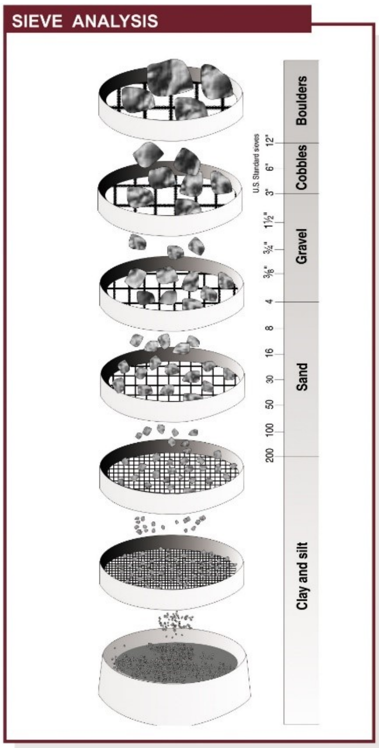
B

C

Different types of core sampler used for sediment collection (A and B above are usually used with the assistance of divers, whereas C is used in beaches and shallow waters)

Samples can be further analysed for particle size and organic matter content.

9. Particle size



A portion of the sediment collected will be air dried. A 100 g air dried sample will be sieved using a sieve set consisting of different sizes (i.e.,4 mm, 2 mm, 1.7 mm, 500 µm, 125 µm, 90 µm, 63 µm, 45 µm sieves). The proportion of each sieve fraction will be calculated as a percentage of the 100 g air dried sample. The classification system used to distinguish sediment types will be a standard methods described by Buchanan *et al.* (1984).

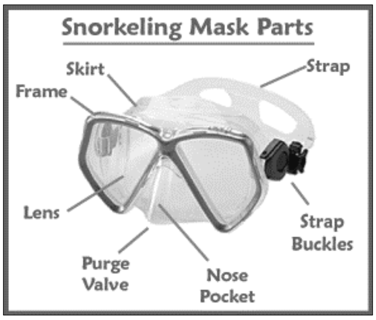
10. Organic matter content

Approximately 25 g samples of sediment collected from each site will be air dried for about 24 hours**.** Air dried samples are oven dried at 80 ^{0}C for 48 to 96 hours. 10 g of each oven dried sample transferred to a crucible and heated in the muffle furnace at 480 ^{o}C to form ash**.** The crucibles transfer into a desiccating chamber, allowed to cool for 1 hour and weighed.

Snorkeling and diving for underwater visual observation is key for a marine biologist. For that we use specific gear (snorkeling and diving gear) which help scientific studies.

Snorkeling gear

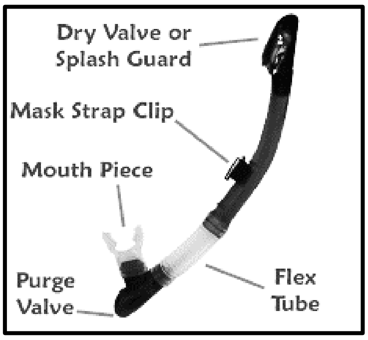
1. **Snorkeling mask**



Snorkeling mask is the most important piece of equipment that need to be perfect fit. If the mask is leaky, too tight, or painful that it may even be dangerous.

The snorkeling mask should be fit over nose and makes an air tight around forehead, and on the sides of face. If the mask is too wide or tall for your face it will not seal properly.

2. **Snorkel**



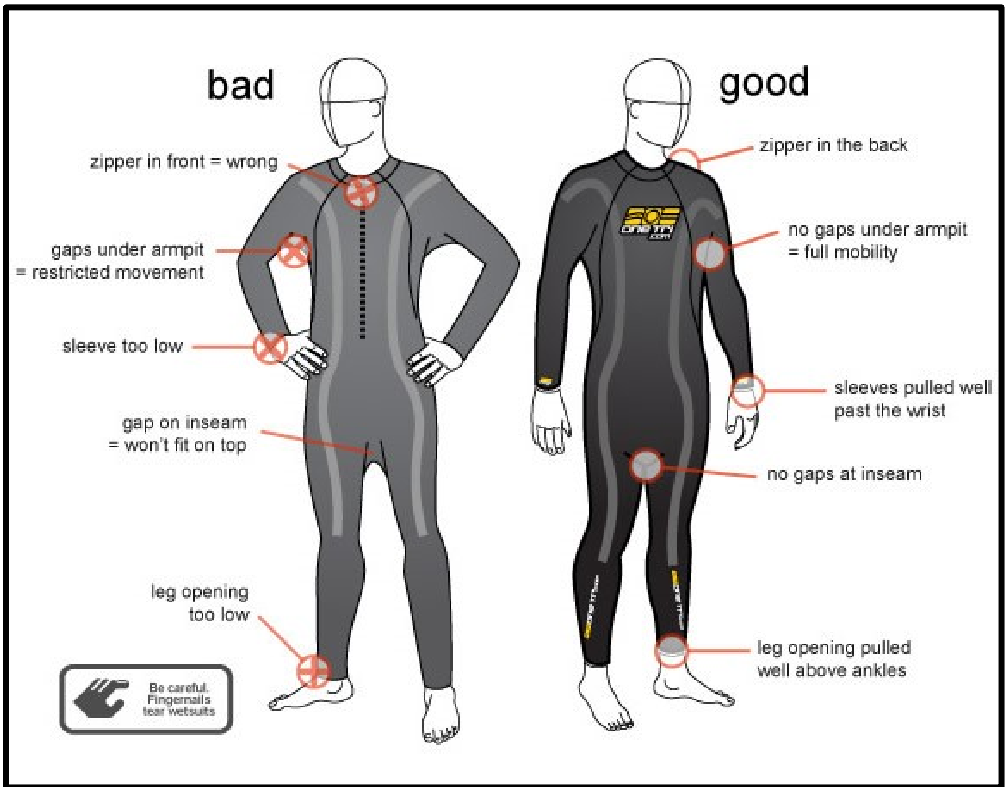
Snorkel is a breathing tube used for swimming underwater.

Scuba diving gears

1. **Diving mask**

A mask is one of the most important, and personal, pieces of scuba diving equipment you own because it lets you explore with your eyes. You want a good quality mask that fits you well and gives you the best viewing area.

2. Wet suit



providing thermal insulation, abrasion resistance and buoyancy

3. Fins

Diver's swim fins or flippers are accessories worn on the foot. These are made from rubber, plastic or combination of both to help move through the water.

4. Buoyancy compensator / Buoyancy Control Device (BCD)

BCD is a diving equipment containing a bladder which is worn by divers to establish buoyancy underwater and positive buoyancy on the surface.

5. Air tank

Scuba diving tank is used to transport high pressure breathing gas.

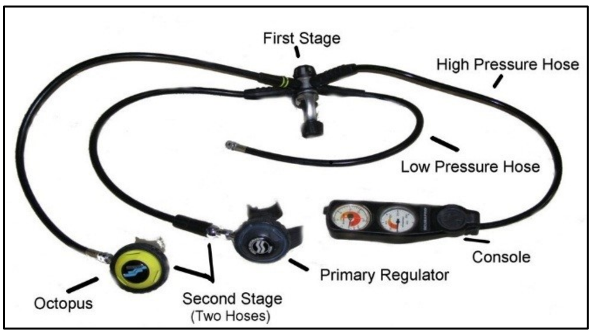
6. Pressure gauge

Indicate the cylinder pressure

7. Dive computer

This is used to measure the time and depth of a dive so that a safe ascent profile can be calculated and displayed so that the diver can avoid decompression sickness.

8. Regulator



The primary function of the diving regulator is to reduce the compressed air from the cylinder to an ambient pressure and automatically activate the demand valves when divers inhale and exhale; giving them just the air they need for each inhalation. In diving helmets, the airflow is constant making the modern regulator the perfect choice for divers.

- First Stage: Reduce the compressed air from the cylinder to an ambient pressure.
- Second Stage: That consist in a primary regulator and secondary regulator or OCTOPUS, and activate valves when divers inhale and exhale.
- Low Pressure Inflater Hose: That is connected to the BCD to control your buoyancy.

- High Pressure Hose: with Console at the end, to monitor your air on the tank and depth.