

**Summary of the required  
theoretical knowledge  
for diver 1\* .. diver 3\***



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# 1. Designation of the training levels

Diver 1\* - Open water diver

Diver 2\* - Advanced open water diver

Diver 3\* - Special diver

## 2. Summary diver 1\*

### 2.1 Diving physics

- What is pressure. The pressure in general.  
Air pressure, water pressure, ambient pressure and influences on the ambient pressure (e.g. flying).
- Boyle and Mariotte's law, effect on gases at constant temperature.
- Guy Lussack, effect on gases of temperature changes.
- Bernoulli, Behavior of gases when expanding through the breathing regulator.
- Dalton's law, total pressure and partial pressure for gas mixtures, e.g. breathing air.
- Henry's law, saturation and desaturation of different tissues in human body (e.g. fast and slow body tissues).
- The three phases of pressure, compression, isocompression and decompression.
- The Archimedean principle: buoyancy, downforce, hydrostatic balance, differences in density from salt to fresh water and their importance for diving.
- Seeing underwater: colors, light, refraction of light in water.
- Hearing underwater: speed of sound, localization of sound, safety hazards.

### 2.2 Diving medicine

- Basic medical requirements for diving based on fitness to dive.
- Diving diseases: Barotrauma, pressure injuries in rigid and flexible body cavities during the three phases of pressure.
- Effect of pressure on teeth, stomach, intestines, ears with eardrums, equipment e.g. diving mask, dry suit.
- The ear: function, structure, hearing above and below water, sense of balance.
- Rigid body cavities in the cranial region: frontal, maxillary, ethmoid, mastoid and sphenoid.
- The lungs, breathing above and below water gas exchange, lung rupture (central/peripheral/pneumothorax), arterial air embolism, trachea, lungs, lung lobes, bronchi, alveoli, oxygen exchange, air trapping, poisoning by respiratory gases (N<sub>2</sub> / O<sub>2</sub> / CO<sub>2</sub> / CO ), different binding capacities of gases to hemoglobin, e.g. carbon monoxide.
- Heart and circulatory system: heart function, large and small circulatory system, oxygen exchange in the capillaries, patent foramen ovale (PFO)
- Diving diseases: caisson disease, symptoms, triggers, preventive actions (e.g. in case of dehydration), recognition of symptoms e.g. diving fleas, bends, burning pain behind the breastbone, hemiplegia or paraplegia, visual, hearing or speech disorders, first aid  
Rescue equipment (oxygen kit), rescue routes, pressure chamber treatment
- Rapture of the deep, nitrogen poisoning, signs, effect, what to do in an emergency
- Dangerous forms of breathing.

- Tidal volume, residual volume, total lung capacity, impact on freediving.
- General injuries and illnesses: bleeding, shock, cardiac arrest, unconsciousness above and below water, drowning in fresh or salt water, overheating, frostbite, hypothermia, seasickness, ear infection
- Physical and mental stress, avoiding stress
- Medicines, drugs and alcohol.

## 2.3 Accidents and diseases in southern latitudes

- Poisoning + infection from food, damage from heat + sun.
- Heat exhaustion, heat stroke, sunstroke, marine animal injuries.
- Cardiopulmonary Resuscitation: Procedure for CPR one and two rescuers
- Oxygen application in a diving accident.

## 2.4 Diving equipment

- ABC equipment: Properties, requirements, special features of the ABC equipment, mask, snorkel, open and closed fins, booties, weight belt / ballast systems with quick release device, knife.
- Diving suits: wet and semi-dry, gloves, hoods, booties, differences, properties, materials, heat protection, cold and heat balance in the human body.
- Buoyancy control systems/carrying equipment: ADV Jacket, properties, requirements, safety and warning devices, useful accessories, care and maintenance
- Instruments: depth gauge, pressure gauge, watch, dive table or dive computer.
- Handling, care and maintenance of the instruments.
- Regulators: Explanation of the first and second stage of a regulator. Limits of use of regulators, care and maintenance.
- Compressed air diving apparatus: structure, care, regulations. Color coding, inspection intervals, labeling (identification).
- Cylinder valves: DIN, INT, mono or double valve, distinguishing features, areas of application, advantages and disadvantages of the valves.
- Safety devices: pressure gauge, structure, function.
- Overflow from one cylinder into another cylinder. Features, equipment, safety precautions.
- Handling, care, maintenance and repair of diving equipment. Completeness, responsibility, capability, limits, national equipment restrictions.
- Rescue case with oxygen inhalation device, brief instruction.

## **2.5 Diving practice**

- Participation in dive planning
- Safety equipment e.g. rescue kit with O2, diving permits, kind of diving sites, entry and exit, weather.
- Keeping a diver's log
- Safe buoyancy
- Giving, understanding and obeying underwater signs

## 3. Summary diver 2\*

### 3.1 Diving physics

- What is pressure. The pressure in general.  
Air pressure, water pressure, ambient pressure and influences on the ambient pressure (e.g. flying).
- Boyle and Mariotte's law, effect on gases at constant temperature.
- Guy Lussack, effect on gases of temperature changes.
- Bernoulli, Behavior of gases when expanding through the breathing regulator.
- Dalton's law, total pressure and partial pressure for gas mixtures, e.g. breathing air.
- Joule – Thomson – effect.
- Henry's law, saturation and desaturation of different tissues in human body (e.g. fast and slow body tissues).
- The three phases of pressure, compression, isocompression and decompression.
- The Archimedean principle: buoyancy, downforce, hydrostatic balance, differences in density from salt to fresh water and their importance for diving.
- Seeing underwater: colors, light, refraction of light in water.
- Hearing underwater: speed of sound, localization of sound, safety hazards.



## 3.2 Diving medicine

- Basic medical requirements for diving based on fitness to dive.
- Diving diseases: Barotrauma, pressure injuries in rigid and flexible body cavities during the three phases of pressure.
- Effect of pressure on teeth, stomach, intestines, ears with eardrums, equipment e.g. diving mask, dry suit.
- The ear: function, structure, hearing above and below water, sense of balance.
- Rigid body cavities in the cranial region: frontal, maxillary, ethmoid, mastoid and sphenoid.
- The lungs, breathing above and below water gas exchange, lung rupture (central/peripheral/pneumothorax), arterial air embolism, trachea, lungs, lung lobes, bronchi, alveoli, oxygen exchange, air trapping, poisoning by respiratory gases (N<sub>2</sub> / O<sub>2</sub> / CO<sub>2</sub> / CO ), different binding capacities of gases to hemoglobin, e.g. carbon monoxide.
- Heart and circulatory system: heart function, large and small circulatory system, oxygen exchange in the capillaries, patent foramen ovale (PFO)
- Diving diseases: caisson disease, symptoms, triggers, preventive actions (e.g. in case of dehydration), recognition of symptoms e.g. diving fleas, bends, burning pain behind the breastbone, hemiplegia or paraplegia, visual, hearing or speech disorders, first aid  
Rescue equipment (oxygen kit), rescue routes, pressure chamber treatment
- Rapture of the deep, nitrogen poisoning, signs, effect, what to do in an emergency
- Dangerous forms of breathing.
- Tidal volume, residual volume, total lung capacity, impact on freediving.
- General injuries and illnesses: bleeding, shock, cardiac arrest, unconsciousness above and below water, drowning in fresh or salt water, overheating, frostbite, hypothermia, seasickness, ear infection
- Physical and mental stress, avoiding stress
- Medicines, drugs and alcohol.

## 3.3 Accidents and diseases in southern latitudes

- Poisoning + infection from food, damage from heat + sun.
- Heat exhaustion, heat stroke, sunstroke, marine animal injuries.
- Cardiopulmonary Resuscitation: Procedure for CPR one and two rescuers
- Oxygen application in a diving accident.

## 3.4 Diving equipment

- ABC equipment: Properties, requirements, special features of the ABC equipment, mask, snorkel, open and closed fins, booties, weight belt / ballast systems with quick release device, knife.
- Diving suits: wet and semi-dry, gloves, hoods, booties, differences, properties, materials, heat protection, cold and heat balance in the human body.
- Buoyancy control systems/carrying equipment: ADV Jacket, properties, requirements, safety and warning devices, useful accessories, care and maintenance
- Instruments: depth gauge, pressure gauge, watch, dive table or dive computer.
- Handling, care and maintenance of the instruments.
- Regulators: Explanation of the first and second stage of a regulator. Limits of use of regulators, care and maintenance.
- Compressed air diving apparatus: structure, care, regulations. Color coding, inspection intervals, labeling (identification).
- Cylinder valves: DIN, INT, mono or double valve, distinguishing features, areas of application, advantages and disadvantages of the valves.
- Safety devices: pressure gauge, structure, function.
- Breathing air compressor: Rough structure, filter systems, air quality, who is allowed to operate a compressor.
- Joule - Thomson - Effect: Why do gases cool down when they expand? How does that help a compressor?
- Overflow from one cylinder into another cylinder. Features, equipment, safety precautions.
- Handling, care, maintenance and repair of diving equipment. Completeness, responsibility, capability, limits, national equipment restrictions.
- Rescue case with oxygen inhalation device, detailed instruction in using and handling

### 3.5 Diving practice

- Dive planning: requirements, people, group, health, training, experience and performance limits, diving equipment, additional equipment (reserve equipment e.g. deco cylinder)
- Safety equipment e.g. rescue kit with O<sub>2</sub>, diving permits, kind of dive sites, entry and exit, weather.
- Transport and means of transport (car, boat), signals, spare parts, self-help, partner help.
- Natural orientation, orientation with the compass
- Daytime dive leading.
- Dive table: handling and calculation of one to three dives per day with and without decompression obligation, repetitive diving, time supplements, residual saturation, flying after diving.
- Comparison of a dive profile with a dive table compared to a dive computer, advantages and disadvantages.
- Air requirement calculation for a simple dive. The student should be able to choose the right diving device for the upcoming dive based on the cylinder size, the inflation pressure and a given respiratory minute volume, the diving depth and the diving time.
- Pressure equalization, technique, execution, problems when descending and surfacing.
- Underwater hand sign language: The most important underwater signs are to be conveyed.
- Situations when diving: Diving alone, what to do if you lose a partner, diving with poor or limited visibility, partner help and partner system, safe ascent and descent with caution.
- Diving with current or tide, reserve / equipment, dive planning briefing, check, debriefing, emergency equipment with O<sub>2</sub>.
- Boat diving.
- Signaling devices: buoys, diving flags, whistles, horns, glow sticks, lamps.
- Boat knowledge: port, starboard, windward, leeward, conduct on board, securing equipment, surface hazards.
- Diving and environmental protection: good conduct, collecting and touching sea creatures, entry and exit, diving requirements, regulations, restrictions (see the 10 rules for divers).
- Diving environment: water (visibility, movement, temperature, thermoclines), bottom, condition, banks and coastline, behavior when a direct ascent to the surface is not possible e.g. overhang, grotto or cave.
- Keeping a diver's log.

## 4. Summary diver 3\*

### 4.1 Diving physics

- What is pressure. The pressure in general.  
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- Seeing underwater: colors, light, refraction of light in water.

Hearing underwater: speed of sound, localization of sound, safety hazards.

## 4.2 Diving medicine

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