ISE Basics of Exploration

(REC & TEC)

 Version 6.0 english

Disclaimer

This Manual is NOT meant for self-study but as an addition to the class held by a certified instructor from InnerSpace Explorers.

Reading this manual does NOT substitute this class or any part of it.

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This class is designed to:

1. ***Document your abilities, strengths and weaknesses***
2. ***Show you the level where your skills should be***
3. ***Provide you the tools to reach that level***

BoE rec / BoE tec what the heck is it all about?

BoE rec is usually done in single configuration and wet or dry. The class is basically designed to fix your skills and make you a competent, comfortable and safe diver. Buoyancy, Trim, Gear config, finning techniques, gas planning, ascent procedures and Nitrox are the main content.

BoE tec is done in doubles and drysuit. It has all of the above plus an additional stage tank (Extender – still one gas) . Intro to decompression diving, Triox 25/25 – Prerequisite to Level 1 classes)

Table of Contents

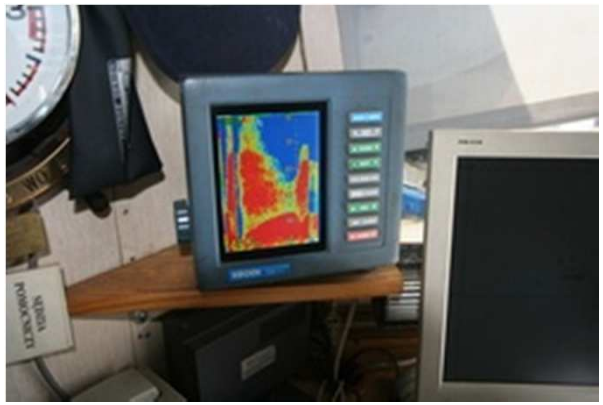
Table of contents

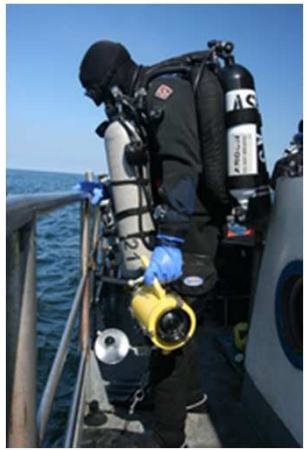
- **Introduction to InnerSpace Explorers**

Mission Statement

Inner Space Explorers was founded to provide the highest quality training available, for all individuals sharing the common goal of underwater exploration and conservation.

The four main pillars of education, training, research and exploration builds the base line of all ISE training that greatly enhances the thrill, safety and ultimately the fun of 'Your Passion'.





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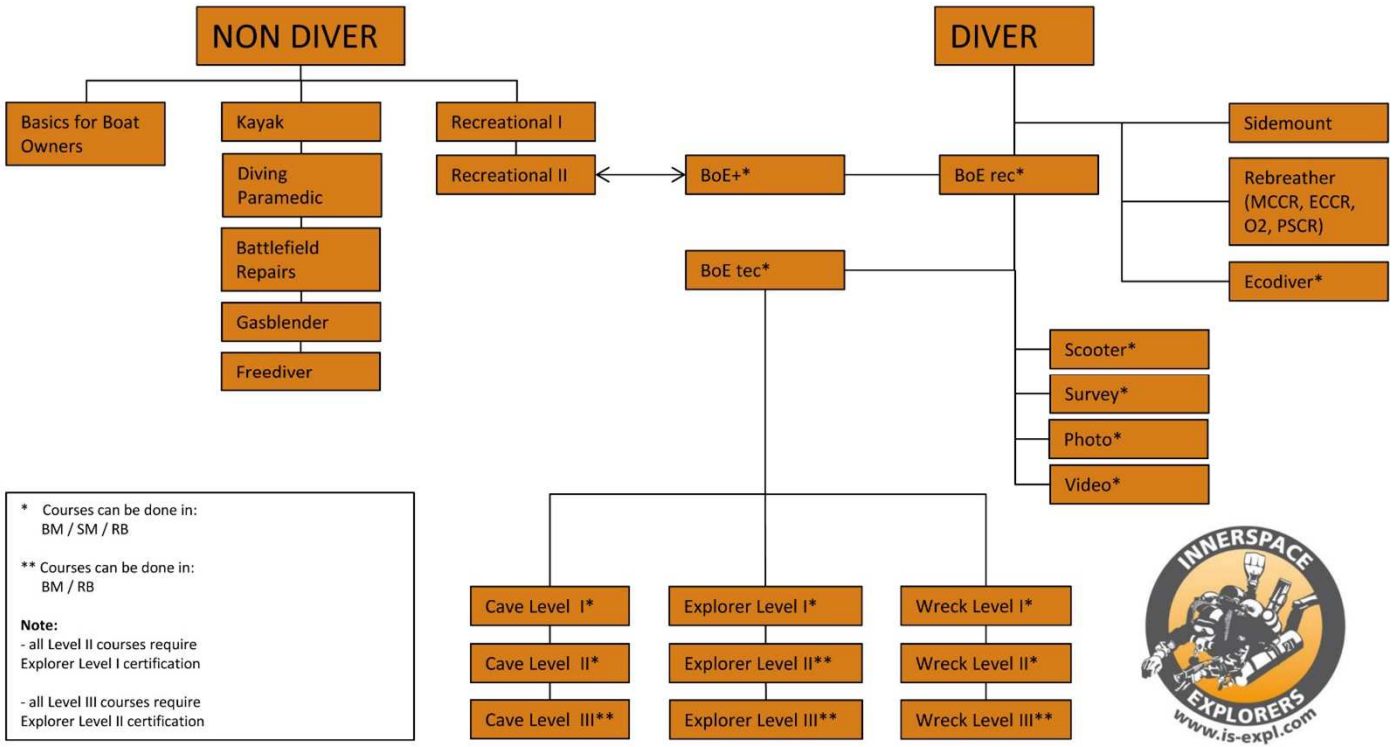
ISE Course Structure



Why ISE?

- **Strict global standard and procedures of the organization**
  All instructors are to follow it so as to have standardized training and procedures, as this greatly removes inconsistency in within the organization.

- **Re-qualification**
  This is to ensure divers and instructors do not jump back into the sport after long period of absenteeism hurting themselves, or greatly reducing the quality of diver training provided by ISE. Divers have to do an evaluation dive with the ISE instructor of that level of training.

- **No ‘back to back’ or ‘bundled’ courses for divers.**
  Experiences have to be gained through personal dives before progression. Such divers enjoy advance training much more and have much better chances of excelling in the advance subject.

- **Non smoking organization.**
  As the founders are active explorers, they know a healthy and fit diver will get the best out of the sport. We allow smokers to enter the foundation class, and give them the mindset that exploration brings more fun then smoking and help them quit.

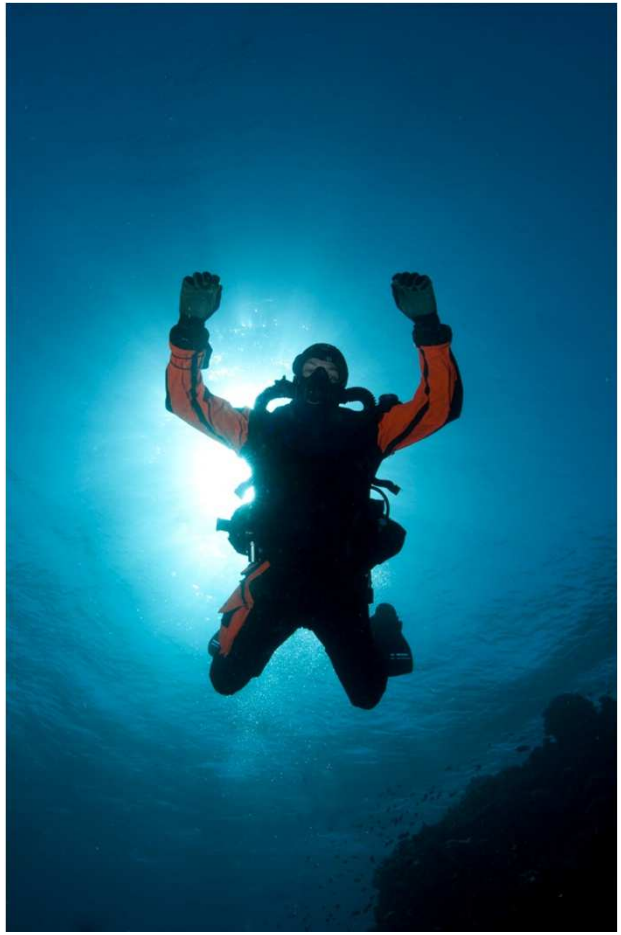
- **Critical skills practice.**
  Due to strong demands around the world, we apply relavant underwater simulation drills as they are critical to a diver survival and allowing divers to understand their true limits. A ‘train the way we race’ approach.

Past, Present…

- ISE was founded by active explorers and educators
- ISE have increased the quality of diver training and education
- ISE is ready to set new standards to the topics of:

Education
Training
Research
Exploration

Diver training have often been focused on getting somebody to breathe underwater fast. By doing so, diver accidents occur at a significant rate. By redefining the four pillars of ISE, we provide a solution to these and significantly turned diving into a sport much enjoyed by all divers alike.



Future

- Develop programs that serve certified divers in their desire to get more out of the sport.
- Develop the highest set of standards in the industry.
- Develop an international base of dedicated instructors to serve divers around the world.
- Develop dive centers around the world to support explorers in their logistics and ability to explore the aquatic realm.



Introduction

- Why this course?
- Back to the basics?
- How is it going to benefit us?
- What to expect from the course?
- What are the minimum standards?
- How does ISE brings us to that level?

You are already a good diver, ISE wants to bring you up to the next level.

Overview

- Introduction
- Paper Works
- Fees Collection
- General Overview

  Land Theories
  Land Drills
  In-water Demonstrations
  Training Dives
  Surface Debriefs
  Diver Assessment

- Diver Grading

Index & Class Structure (sample)

Day 1	Day 2	Day 3	Day 4	Day 5
09:00 Equipment	09:00 Theory	09:00 Theory	09:00 Dive 4	09:00 He Theory
12:00 Lunch	12:00 Lunch	12:00 Lunch	11:00 Debriefing	
12:30 Gear Mods	13:00 Dryruns	13:00 Dryruns	12:00 Lunch	12:00 Lunch
15:00 Dive 1	15:00 Dive 2	14:00 Dive 3	12:00 Dive 5	13:00 Dive 6
17:00 Debriefing	17:00 Debriefing	17:00 Debriefing	15:00 Debreifing	16:00 Debriefing

ISE Basics of Exploration

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Land Theories

ISE Overview
ISE Basics of Exploration
Define exploration
Exploration grade
Equipment overview
Underwater communication
Proper weighting
Buoyancy and trim
Propulsion techniques
Circle of Basics skills
Critical skills
Stage handling
Training dives review
Dive planning
Breathing Nitrox
Trimix consideration
Ascending techniques
Gas management
Situational awareness
Emergency procedures overview

Land Drills

Equipment fitting
Propulsion techniques
Analyzing cylinders
Pre-dive sequence
Circle of Basics skills
Critical skills
Stage handling
Basic surveying techniques

Training Dives

Dive 1
Dive 2
Dive 3
Dive 4
Dive 5
Dive 6 (TEC version)

Message from the founder:

“You may ask: “what the heck?” Why should I take this class and what is it all about? This class will show you some facts, skills and items that in the end make your diving safer, more efficient and ultimately more fun.
The term “Exploration” is what you may have found a bit strange in the name of the class.

Well, what is Exploration? When a kid strolls through a ruin somewhere, the kid is exploring. If a Geologist wanders through a cave never seen before by human eyes, he is exploring it. If you swim through a popular reef you have never before been to, you explore it. Diving in general has a lot of potential for exploration.

Now we believe that there is a difference in how you do that. You may be able to breathe underwater and see because you have a mask, but that does not make you an explorer. An explorer is not only defined by the desire to cover new ground, but by the heart to preserve this ground, and make the knowledge gained accessible for others, at least through a clear documentation.

Continued:

If you have poor trim, buoyancy and fin techniques for example, you stir up silt that covers anemones or corals that might damage it. Even in clear water, you may ruin your visibility at best. In a cave, a careless fin stroke will damage the pristine limestone formation, in which a geologist may be able to understand the history of millions of years of which nature developed.

Good skills are essential to exploration, the well prepared diver keen on diving new sites will also need some additional equipment to be prepared for the demands of the dive. Although this class can be done on a single tank, we will introduce you to the idea of doubles or at least two regulators on an H valve.

Murphy's law of what might happen, will happen gives an understanding that trouble is always around. The right equipment and skills needed to handle the situation can make a difference between a good dive, or the last dive. You will also be taught the spool – a simple tool that hold lines can be the most valuable piece of equipment ever, from sending up a easuring and surveying a site to doing search patterns – the possibilities are endless.."

Achim R. Schlöffel
President InnerSpace Explorers

Certification Policy

- Every level of ISE training has specific requirements that the student must meet before being awarded certification.
- These requirements include both academic knowledge as well as robust diving skills and techniques.
- The student must fulfill every skill and technique required for each step in the training before progression to the next step is possible.
- It is expected that the ISE student understands and accept the ISE Instructor obligation to deny certification if the training requirements have not been fulfilled.

Students pay for training but earns the certification.

Types of grading

- **Recreational Pass (Single or double – no Stagetank)**
- **Technical Pass (Doubletanks + 1 Stage Skills mastered with “2” or better)**
- **Fail**

Pass: Student have performed well in the required skills and shown positive attitude in training.

Fail: Student is required to consult the instructor again and remedy shortcomings.

There can only be a successful or a failed exploration

“I heard there is a resident Napolean Wrasse somewhere at the first rock off the shore, I want to see it.”

“The government wants to know where does water from the caves flow to in case of pollution. Shall our team volunteer to check it out?”

“Have you been to the deep wrecks of the HMS Repulse or the HMS Prince of Wales?”

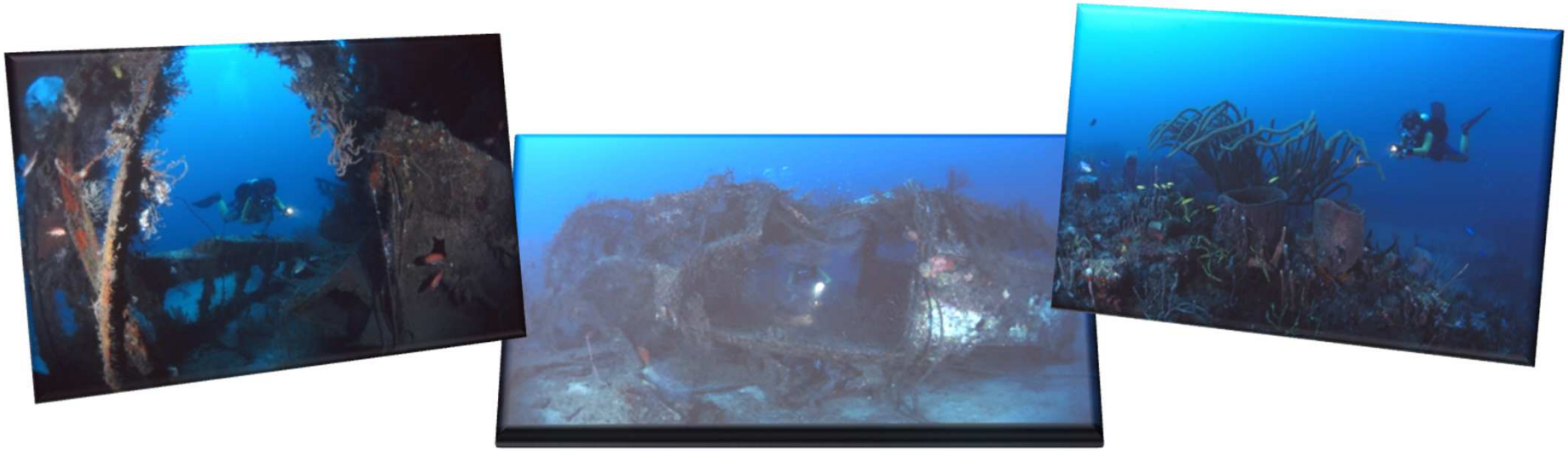
What does exploration means to you?

- Curiosity
- Purpose
- Excitement
- Research
- Share

HOW DO WE ACHIEVE

THE QUALITIES OF AN EXPLORATION

GRADE DIVER?



By primarily receiving the right education!

By selecting the specific equipment to support our dives!

We have to dive to gain experiences, and once we have a concrete foundational support…

We inherit the qualities through constant practice!

- # Equipment Overview

Please note that the equipment section is built around the classical backmounted configuration and is different for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

What to look for (The definition of DIR-Style Equipment):

- Minimalist approach – take only what you need
- Always donate what you breath
- Streamline configuration
- Rugged design
- Safe – simple - intuitive
- Consistent in all types of diving

Backplate

- ‘‘Backbone’ of diving platform
- Rigid and solid construction
- No quick releases
- 5 D-rings
- Crotch strap

Wings

- Durable and robust construction
- Non bungee
- Streamline
- Single air cell and inflator
- One handed operation for inflation and deflation
- Suited for type of cylinder

Cylinders

- Steel or aluminum
- Appropriate volume
- Buoyancy characteristics
- Types of valves threading

Weights

- Releasable
- Non releasable
- V weight vs Weight belt
- Sizes and types

Valves

- DIN or Yoke
- Rubber knobs
- H or K outlet
- 200 or 300 bar

Manifolds

- DIN outlets
- 200 or 300 bars
- International operation
- Isolated manifold - Dual

Tank Bands

- Stainless Steel material
- Fits manifold width
- Welded connection
- Non protruding bolts

Regulators

- Downstream
- Removable faceplate
- Cold water capability
- Ease of breathing
- One primary and one back-up regulator

SPG

- Sturdy design
- Single capsule
- No protective boot
- Burst plug
- Clear markings

Hoses

- Quality construction
- Primary regulator on 210 cm hose. (Long hose)
- Back-up regulator on 22” / 56 cm hose
- HP hose of 24” / 60 cm (single) or 22” / 56 cm (doubles)
- Inflator hose of 22” / 56 cm for wing
- Inflator hose of 22” / 56 cm for drysuitinflation (backgas or argon)

Stagetank

Stagetanks are tanks that we use to carry additional gas either for deco or as bottomgas. There are 3 major sizes that we use as stages:

40 cft (5.1 Liters)
7 Liters
80 cft (11.2 Liters)

Stages are ALWAYS aluminium tanks to make sure they sit neutral in the water and do not affect the trim of the diver. Marking is essential and must not be compromised.

Stage Regulator

need to be „swifel-style“ with a 100 cm hose that is stowed under the rubberband when not in use. No clips on the regs. The second stage should be around the middle of the tank to be protected when not in use and not in the way when handling the valve.

The SPG is on a short hose and attached behind the first stage with bungee or caveline. It is easy to read and in a safe position

Drysuit

- Durable trilaminat design
- Front entry
- Side pockets on thighs
- Easy to vent suit gas
- Flexible but not oversized
- Ease of field repair
- Flexible soles
- Pee Valve

Undersuit

- Comfort
- Fast Drying
- Maximal Movability
- Zipper to be opened from underneath as well
- Isolates as well
- Peevalve can be routed through

Wetsuits

- Well fitting
- Tech shorts
- Meant for warmer waters
- Least amount of zippers possible
- 5 mm or less

Primary Light

- Communication
- Right hip mounted
- Focusable beam
- Goodman handle
- Canister & light head design
- Alternativly a LED light without Tank

Back-up Lights

- Two back-up lights
- Twist on, twist off design
- Non overdrive of bulb (mostly LED today!)
- Solid construction design
- Attachment point at the back

Masks

- Low volume
- Black silicone
- Frameless
- Neoprene strap
- Riggid attachment point

Fins

- Jet fin design
- Rigid non split
- Semi rigid blade
- Spring heels attached

Bottom Timer

- Wrist mounted (Bungees)
- Time & Depth
- Stopwatch
- Max. Depth

Compass

- Wrist mounted
- Analog
- Oil filled
- Reverse bezel

Reels

- Long range application
- Easy handling
- No jam potential
- Various lengths

Spools

- Short range applications
- Jam free
- Double ender to secure
- Easy handling

Surface Markers

- Easy deployment
- Closed circuit design
- Compact stowage

Wetnotes

- Compact
- Divider
- Appropriate pencils
- Clear screen feature

Gloves

- Selected for environment
- Ruggedness
- Good fit for solid gear handling
- As thick as needed <> as thin as possible

DPV

- Neutral buoyancy ability
- Tow back design
- Variable torque for applications
- Durable construction

Please obtain proper ISE DPV workshop training before using !

Heating Vest

- Reputable brand
- Proper installation
- Safe against burns
- Good fitting

- **Proper Weighting**

Introduction

- The human body is usually neutrally buoyant and due to breathing and equipment becomes positive.
- Therefore we need enough weight to keep us neutral but do not want to overweigh ourselves.

Conclusion 1: To be weighted as light as possible.

Conclusion 2: To be weighted as enough as possible.

Associated Problems

Over weighted:

- Uncontrollable descend in events of BCD failure
- Unnecessary energy expanded
- Unnecessary pre-dive stress
- Unnecessary solution by getting a bigger lift capacity BCD

Underweighted:

- Inability to descend
- Inability to hold shallow stops when cylinder low on pressure
- High risks of surface accidents

Static vs Dynamic

Static equipment do not change characteristics before, during and after a dive.

Static vs Dynamic

Dynamic equipment changes characteristics before, during and after a dive.

Start of a dive

Surface

BCD must be able to lift the whole system

Start of a dive

Middle

There must be enough weight to descend

Start of a dive

Depth

Diver must be able to swim to surface if BCD fails

Summary

Surface	BCD must be able to lift the whole system
Middle	There must be enough weight to descend
Depth	Diver must be able to swim to surface if BCD fails

Finishing a dive

Shallows

Diver must be able to maintain stops with emptying cylinder

- **Descending Techniques**

Descending Techniques

Decending sounds easy in the first place but when You watch divers go down you may understand why we created this chapter…

Descend in a horizontal position while maintaining contact with your partner (eýe contact or light comunication

Maitain a SLIGHT negative bouancy and keep adding air so You can stop in time

You must not “touch down” but hover above the ground at all times.

- **Buoyancy & Trim**

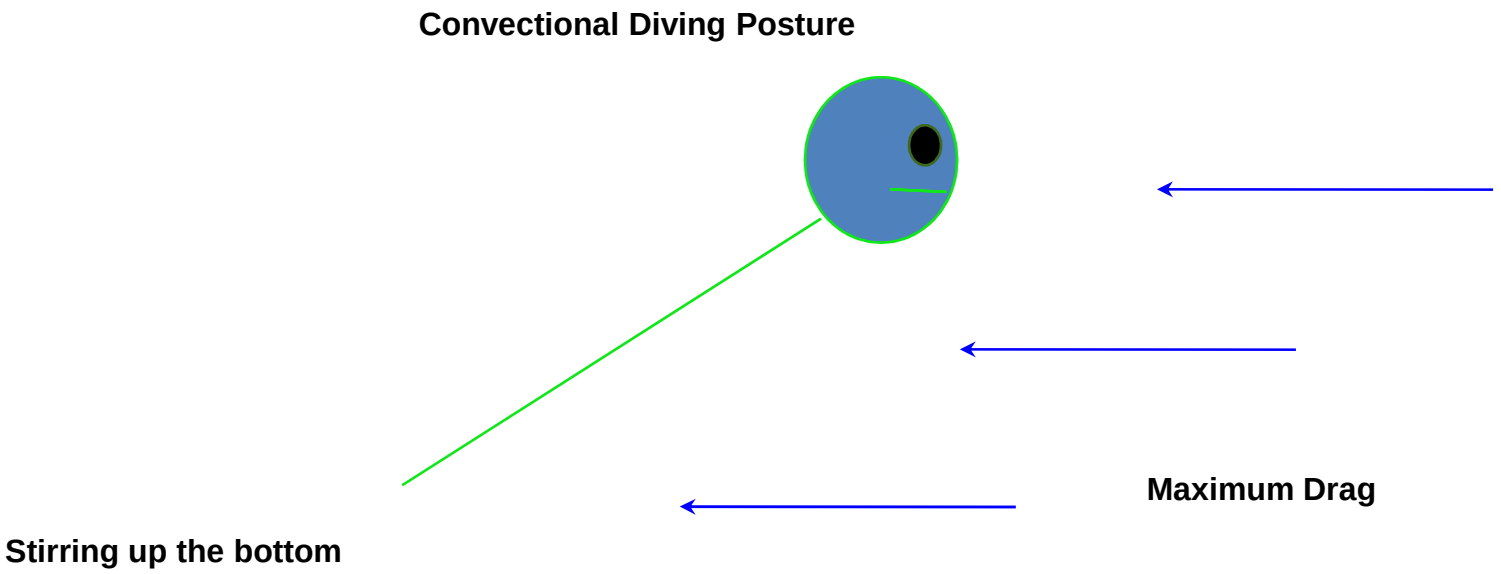
Buoyancy

The ability to hold a specific depth for a specific time.

Buoyancy

Positively Buoyant		Diver struggling to fin downwards
Neutral Buoyant		“The Comfort Zone”
Negative Buoyant		Diver struggling to fin upwards

Understanding Trim



Benefits of the posture

- Controlled descents and ascents
- Increased team awareness
- Efficient
- Anti silting

- **Propulsion Techniques**

Tools in a toolbox

- Stable and precise
- Efficient
- Anti Silting

Propulsion Kicks

Frog Kick
Minor Frog Kick
Flutter Kick
Minor Flutter Kick

Positioning Kicks

Backward Kick
Helicopter Turn

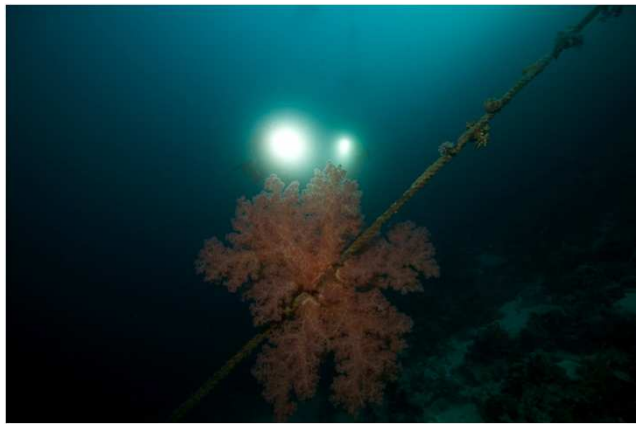
- **Underwater Communications**

Introduction

- We cannot speak or scream underwater
- Sound travels 4 times fast in water then in air, thus not a feasible too
- We have three forms of underwater communication

Hand

Written



Lights

Hand Communication

- Possible under close proximity
- Possible with clearer waters
- Can be tough with dry gloves
- Touch contact

Sprecht die verschiedenen Arten von Handzeichen durch

Discuss the various types of hand communications

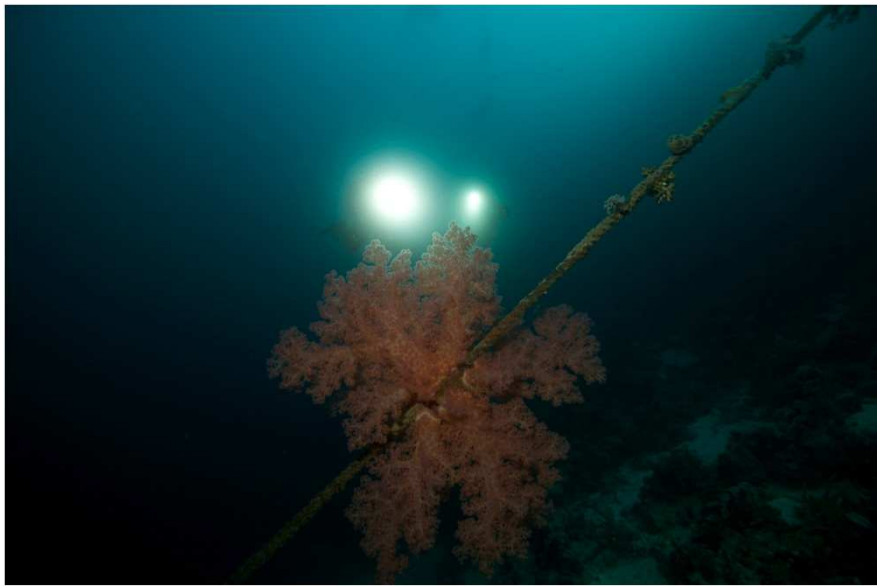
Written communications

- Possible under close proximity
- Possible with clearer and murky waters
- Can be tough with dry gloves

Light communications

- Possible under both close and further proximity
- Possible with clearer and murky waters
- Possible with both no and dry gloves
- Both hands still free to work

Discuss the various light signals



• CoB & Critical Skills

Please note that this skill related section is built around the classical backmounted configuration and is different for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

Circle of Basics skills

Why?

- Building a Team
- Become comfortable with the gear
- Build aquatic Comfort
- Build foundational skills for further advanced Training

How?

- Switch regulator and clip off primary
- Take off Mask and put back on with one hand
- Temporary stowage of primary light
- Deploy back up light
- Stow Backuplight
- Primary Light back on left hand
- Switch back to primary regulator

Critical skills

- Mask failure
- Out of gas (OOG) drill
- Valve failure
- Leaking gas
- Line entanglement

• Emergency Procedures

Please note that this section is built around the classical backmounted configuration and is different for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

Leaking gas

- Your instructor will run you through the leaking gas procedure
- You will perform the procedure with a simulated gas leak

Leaking gas

Diver is horizontal in good trim.

- Light is in left hand and switched on
- Turn down right post with right hand and signal with light
- Breath regulator empty - DOES GAS STOP?
- If yes – FINE – If not:
- Turn right post back on and simultaneously turn off left post with left hand
- Purge back up regulator - DOES GAS STOP?
- If yes - FINE - If not:
- Turn left post back on with left hand and simultaneously turn center off with right hand.
- Gas will not stop! - Check SPG and breathe leaking side
- Abort dive
- Drill should be run in 30-35 seconds total.

Out of Gas

- buddy gives OOG signal
- Diver grabs hose of primary reg with right hand
- left hand with light reached for the right side of OOG diver
- Remain Eyecontact
- Primarxy reg goes in front of OOG divers mounth - mouthpiece points to divers mounth in a horizontal way
- OOG diver takes reg with left hand and placed it in mouth,
- OK? - OK!
- Donator gets Lightcord free
- Donator turns his right side a bit towards the OOG diver to take tension out of the hose
- Donator unhooks Hose from lightcanister and pulls it free

- if Donator travles right from OOG diver:
- light goes on right hand –
- left hand grabs OOG divers ellbow.
- long hose goes in front and is held in a loop in the OOG divers right hand.
- light of OOG divers stays in left hand

- if Donator is on the left side of the OOG diver:
- light stays left
- right hand grabs OOG divers ellbow
- long hose goes behind OOG divers head and to his mouth in a natural way.

- Swim

- **Ascending Techniques**

Decompression Sickness

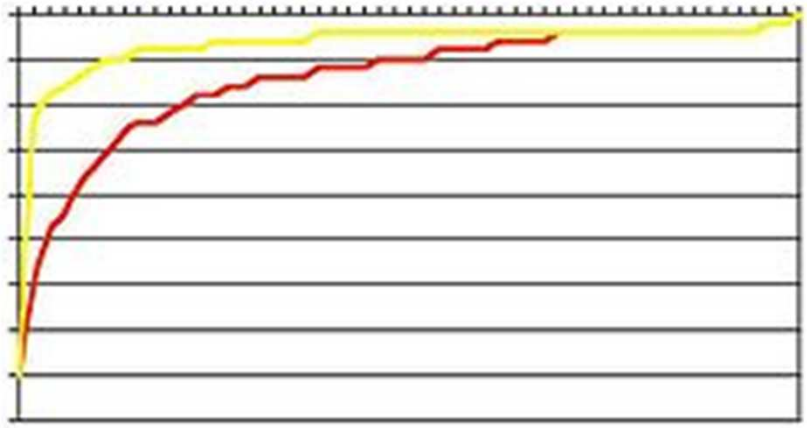
- DCS is caused when inert gas dissolved in tissues starts to bubble
- DCS often caused by uncontrollable ascent
- Uncontrollable ascents are usually due to poor skills

Deep Stops

- A decompression strategy to control and reduce the formation of bubbles.

- Noted by Richard Pyle, a diving scientist who significantly experienced lesser hit of DCS after implementing Deep Stops into his profiles.
- The Concept was further fine tuned by divers of the WKPP who experienced Pyles stops to be still too shallow and developed the base of what we use today.
- First stop is @ 50% of the max. depth in **recreational** diving (18 meters or deeper)

  Example 1: Max depth 30 meters, first stop at 15 meters
  Example 2: Max depth 25 meters, first stop at 12 meters
  Example 3: Max depth 18 meter, no deep stop – min deco only

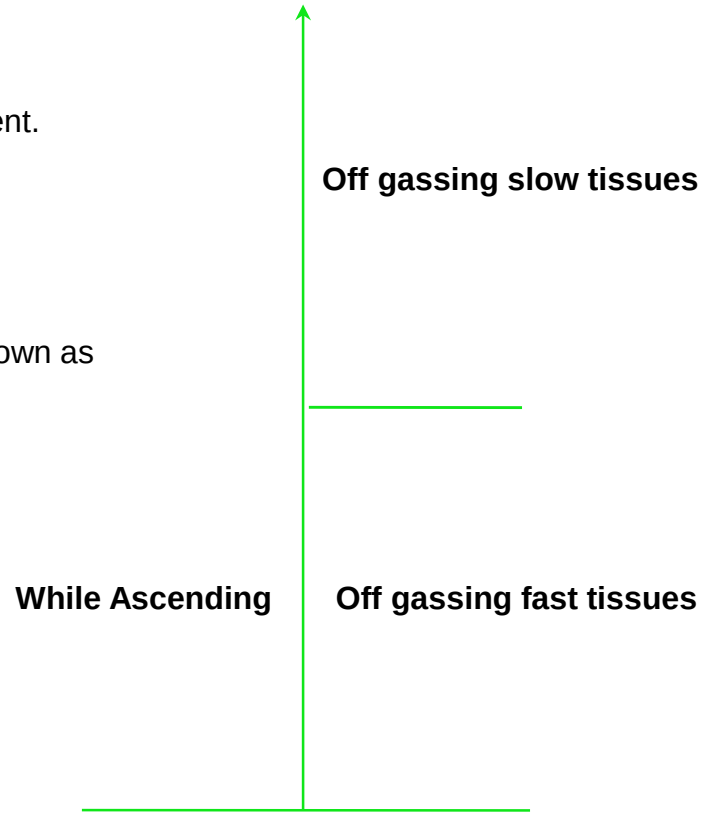


Tissues Overview

Our body are divided into both slow and fast tissues compartment.

- Fast tissues - On and off gas fast
- Slow tissues - On and off gas slow

We must allow time for our tissues to off gas and the term is known as **MINIMUM DECO**



ISE Minimum Deco 1-2-3 (Recreational)

How to use:

- For Nitrox 32 or Trimix 30/30 only.
- For Dives 18 Meters or depper
- Ascend rate from depth to first stop: 10 meters / minute
- Deep Stopps from 50% of max Depth upwards. (every 3 Meters)
- Deep stops are the so called “1 min stops” which are 40 sec rest / 20 sec ascent to next stop (3 meters / min)
  Ascend rate from last stop to surface: 1 meter / minute

- # Dive Planning

Please note that the dive planning section is built around the classical backmounted configuration and is different for Sidemount and CCR diving. If You take the class in one of these configurations – please also refer to the ISE Sidemount or CCR Manual.

Pre-dive planning

I **Intention**

S **Support & Team**

E **Enviroment**

R **Runtime & Depth**

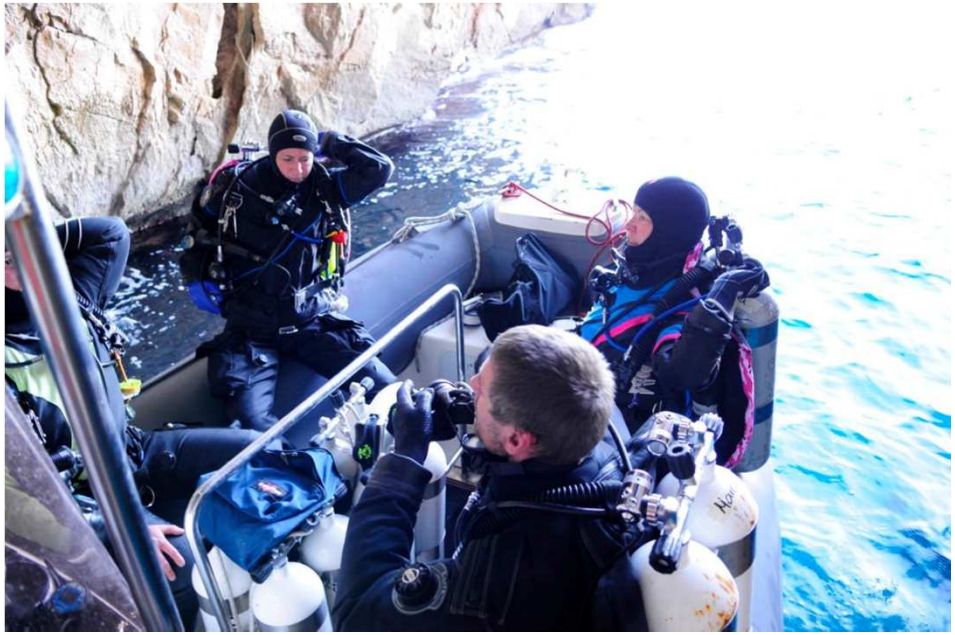
U **Used Gases**

L **Levels of Deco**

E **Equipment**

Pre-dive Sequence

- **ISE RULE**
- Flow check (Valve reachable, turnable, open)
- SPG Check and Announcment
- Longhose deployment
- Pasisive Bubble check



Basics of Dive Planning

- Every dive must be planned accordingly
- Most plans can covered with 5 simple questions

WHO?

WHEN?

WHERE?

WHY?

HOW?

WHO?

- What is their diving background?
- Do they have experience in the actual environment?
- What is their motivation to do the dive (Photographers usually dive more with their camera than with their buddy)
- What equipment do they use and are they familiar with yours?
- Are you able to handle their gear and vice versa?

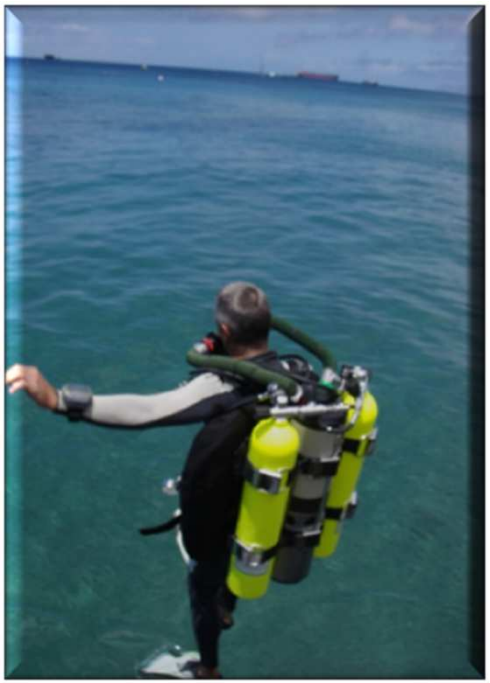
WHEN?

- What is the best season for a special dive?
- Currents, temperature, visibility, ice, marine lives?
- What is the best time of the day?
- Ambient light, habits of animals, shipping traffic, weather and sea conditions?

WHERE?

Even if the dive site in general is given there might be still plenty of alternatives to that question.

- A safe entry and exit point? (e.g steep or slippery rocks?)
- Emergency procedures?
- Permission for dive sites? (e.g caves or marine parks)
- Local environmental criteria to meet?



WHY?

- Purpose of the dive?
- What do you expect?
- What is the goal of the team?
- What can be achieved from that dive?

HOW ?

- Depth and time limits?
- Reserve Gas, deco, emergency procedures?
- Special briefings in case of filming, surveys or other complex tasks that are planned for the dive?

- # Gasmanagement

Please note that Gasmanagement is built around the classical backmounted configuration and is different for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

References

- Tank volume calculation:
  Bar x Cylinder Size = Volume
  Example: 200 bars x 11L = 2200 volume liters

- Surface consumption rate calculation:
  SCR= Volume Liters / Time / Average ATA
  Expl: 1500litre / 50min / 2 ATA = 15l SCR

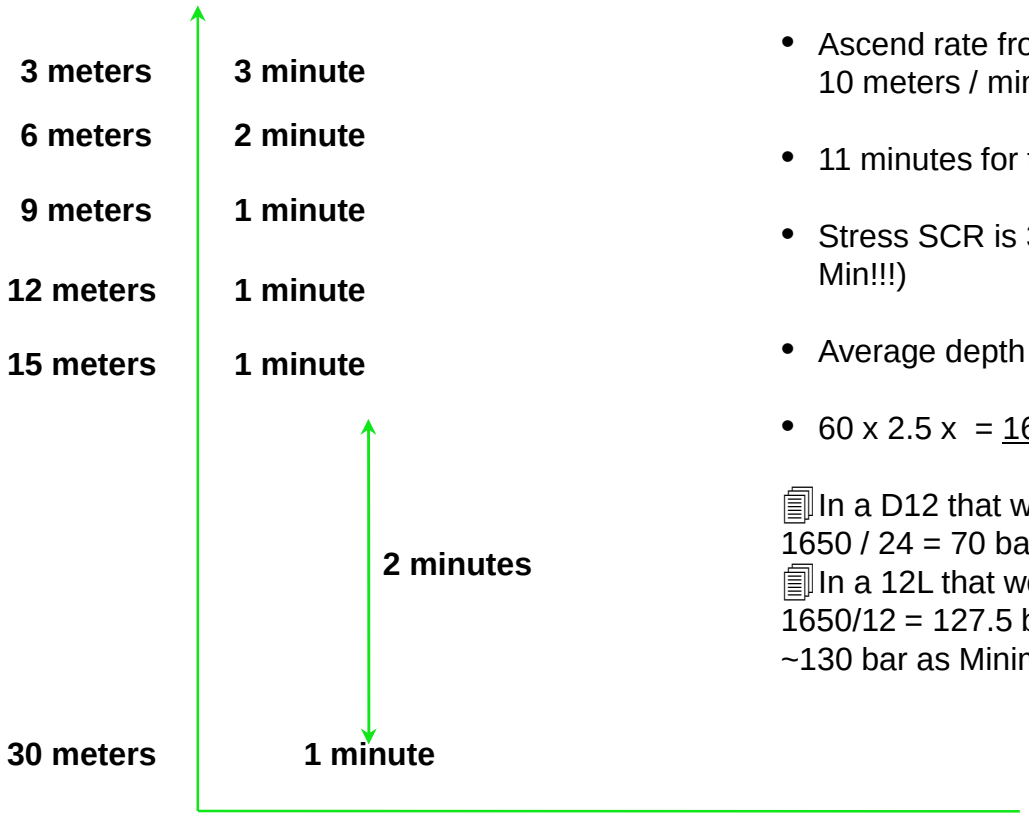
- Volume Liters used calculation:
  SCR x Average ATA x Time = Volume Liters
  Expl: 20l x 2ATA x 45min = 1800 litre volume

- General surface consumption rates:
  Rest = 15 liters per minute
  Work = 20 liters per minute
  Stress = 30 liters per minute

Minimum Gas

- Minimum Gas is the amount of gas needed for two divers to reach the next available gas source in events of failures
- Once your minimum gas is reached, the only option is to call the dive.

Minimum Gas Calculation



- 1 minute is needed to sort out the problem
- Ascend rate from depth to first stop:
  10 meters / minute → 2 Minutes
- 11 minutes for total ascent
- Stress SCR is 30L / minute (can be more!) (x 2 Divers = 60 L / Min!!!)
- Average depth is 2.5 ATA
- 60 x 2.5 x = <u>1650 volume liters</u>

In a D12 that would be:
1650 / 24 = 70 bar as Minimum gas
In a 12L that would be:
1650/12 = 127.5 bar as Minimum gas
~130 bar as Minimum gas

Gas rules

- End pressure - Minimum Gas = Usable Gas
- End pressure - Usable Gas = Turn Pressure
- Although there are other strategies for gas planning in more advanced diving scenarios, during BoE we strictly follow Minimum Gas as the absolute limit.
- Nevertheless, depending on the environment we dive in it can be necessary to make further considerations regarding the usable gas.

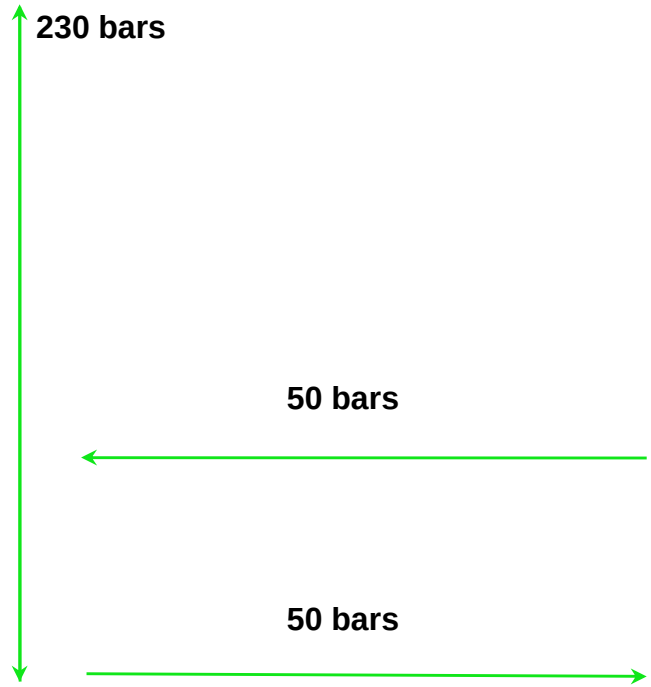
All usable

Example of diving a 12L cylinder at 230 bars to 30 meters:
230 bar - 130 bar (Minimum Gas) = 100 bar usable

Direct ascent is possible and not necessary to return to starting point

Half usable

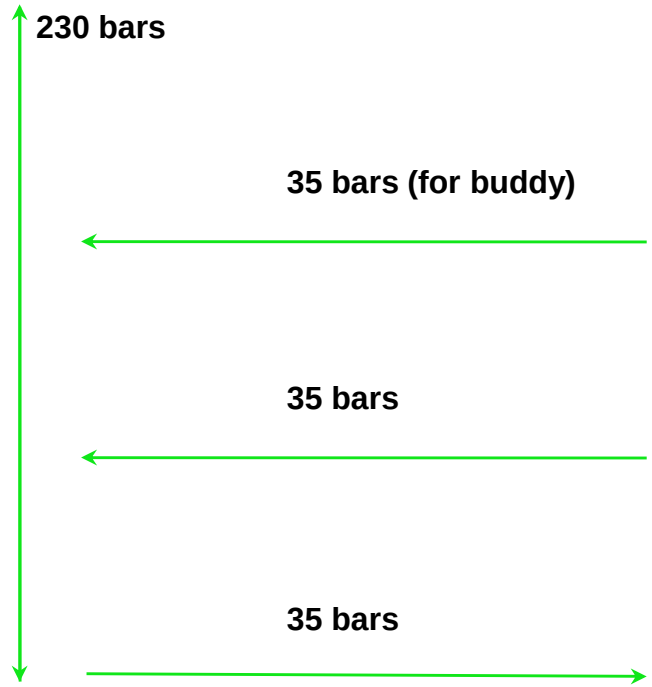
Example of diving a 12L cylinder to 30 meters:
230 bar - 130 bar (Minimum Gas) = 100 bar
100 bar / 2 = 50 bar usable
230 bar - 50 bar = 180 bar (Turn Pressure)



Direct ascent is possible and coming back to start point is favorable

One third usable

Example of diving a 12L cylinder on to 30 meters:
230 bar - 130 bar (Minimum Gas) = 100 bar
100 bar / 3 = 33.3 bar usable ~35 bar
230 bar - 35 bar = 195 bar (Turn Pressure)



Direct ascent is not possible and coming back to start point is a must

- **Situational Awareness**

Introduction

- The awareness of what is going on around you
- Situational Awareness skills builds through constant practice
- Commonly known as ‘thinking beyond self’

Lack of awareness leeds to the snowballing of problems.

The awareness

EQUIPMENT ENVIRONMENT TEAM

These have be simultaneously monitored underwater

Equipment

- What of yours and your team are working, improper or have failed?
  SPG leaking gas?
  Regulator failure?
  Back up light turned on?
  Light failure?
  Hand signal for items failed?

- Anticipate problems
  Left post rolled off
  Poor ‘housekeeping’
  Line entanglement hazards
  Buddy missing

All equipment are the resources of the team

Environment

- These are the ‘internal’ environmental factors.
  Depth
  Dive time
  Compass headings
  Gas monitoring

- These are the ‘external’ environmental factors.
  Currents, surges and swells
  Silt out
  Boats above
  Hazardous marine creatures

The team is as strong as the weakest diver but not stronger than its weakest Link

Team

- Team responsibility
  Shared roles
  Surface support
  Clear dive plans
  Navigation

- Team positioning
  Wing on wing
  Single file
  In events of failures

- **Breathing Nitrox**

Introduction

- By reducing Nitrogen and increasing Oxygen in our breathing gas, we gain advantages like:

- Longer no decompression limits
- Less post-dive fatigue
- Shorter surface intervals

- Oxygen when not used properly can trigger toxicity.

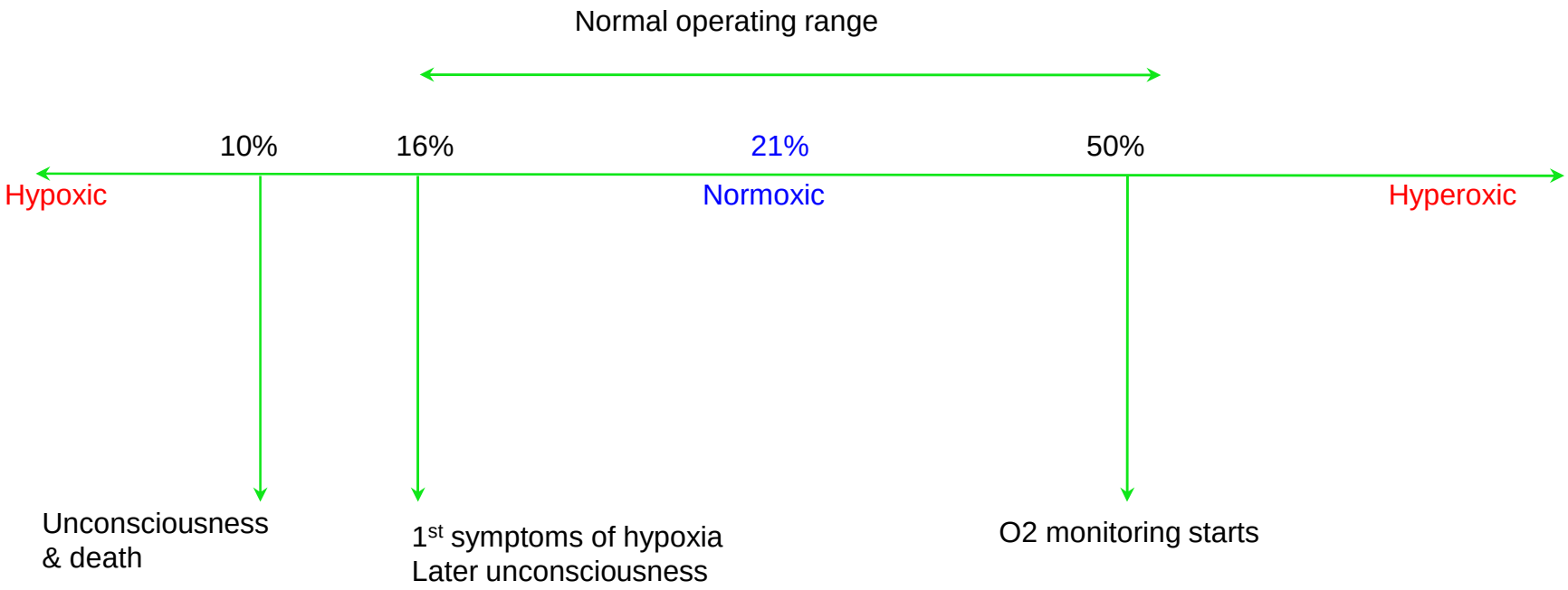
- CNS Toxicity (Central Nervous System)
- Pulmonary Toxicity (Lungs)

Oxygen is always a good servant but bad master

No Decompression Limits using Nitrox compared to Air

Depth / GAS	AIR	32%
20 M	45 min	60 min
30 M	20 min	30 min
40 M	10 min	n/a

Oxygen contents



Partial Pressure

- We use partial pressure of Oxygen to monitor the limits.

  Example of finding the PPO2 of Nitrox 32 at 20 meters:

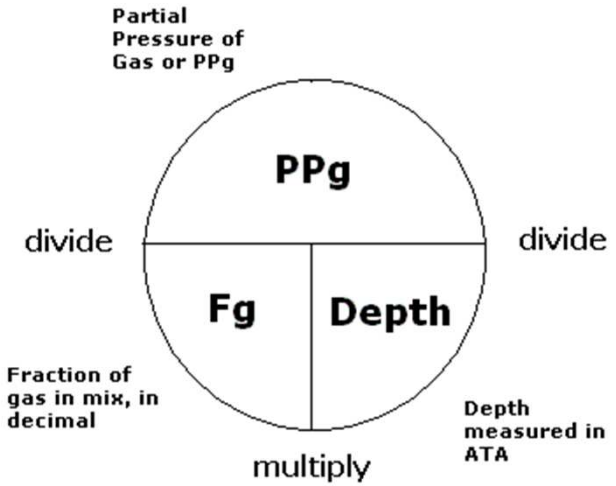
  0.32 x 3 = 0.96

- Dalton Triangle is used to calculate Partial Pressure of gas and maximum operating depth.

  Example of finding the MOD of Nitrox 32:

  1.4 / 0.32 = 33 meters
  *We do not go beyond 30 meters on Nitrox 32 in ISE.

Dalton's Triangle



The deeper we go, the greater the effect of the gas

ISE PPO2 Limits

Maximum Limit	PPO2
Decompression	1.6
Recreational Diving	1.4
Technical Diving	1.2

CNS Toxicity

- Toxicity of the Central Nervous System due to high PPO2.
- Observed by Kenneth Donald (1944) that there is no consistency of onset and quoted diving beyond 1.6 PPO2 is pure suicide.

C	
O	**Convulsion**
N	
V	**Visual disturbance**
E	**Ears disturbance**
N	**Nausea**
T	**Tingling sensation**
I	**Irritability**
D	**Dizziness**

In fact the above symptoms are more likely prawn to narcosis, may this be triggered by N_2 or O_2

CNS Clock

We have a quick method for CNS % calculation.

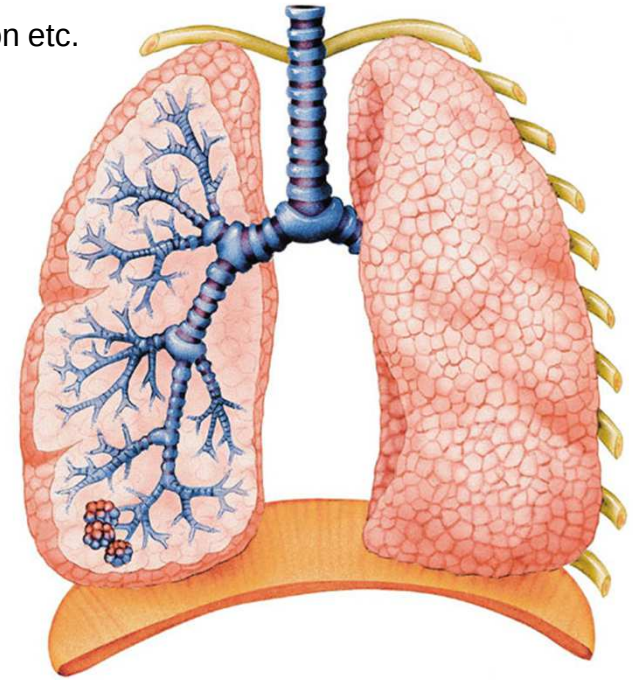
(Bottom Time + Deco) / 2 = CNS %

PPO2	Maximum Single Exposure (Minutes)
1.6	45
1.5	120
1.4	150
1.3	180
1.2	210
1.1	240
1.0	300

The CNS % drops to half with every 90 minutes of surface interval

Pulmonary Toxicity

- Toxicity of the pulmonary due to long exposures of Oxygen.
- Symptoms include: dry cough, shortness of breath, painful inhalation etc.
- Leads to reduction of vital capacity.



Pulmonary Toxicity

- We monitor Pulmonary Toxicity by OTUs (Oxygen Toxicity Units)

- 1 minute of oxygen at 1.0 PPO2 = 1 OTU
- 1 minute of oxygen at 1.2 PPO2 = 1.32 OTU
- 1 minute of oxygen at 1.4 PPO2 - 1.63 OTU

- Do not exceed 850 OTUs in 24 hours

- OTU resets to zero after 24 hours off Oxygen

Equivalent Air Depth

- With reduced Nitrogen, we want to find the equivalency depth when compared to diving on Air.

EAD is something not really used today anymore but as you will come across the term frequently here´s the explanation:

When diving Nitrox, but having only air tabled at hand, you can calculate the equivalent depth of the gas in relation to air:

Nitrox 32 at 30 Meters gives you 2,72 PN_2 (0,68 Bar $_{PN2}$ x 4 Bar)
This set in relation with the Nitrogen content of air of 79% (2,72 / 0,79) is 3,4 Bar = 24 Meters

Now you can refer to the NDL of 24 Meters of an air table while using Nitrox 32 @ 30 meters.

When using Nitrox 32, there is a quick method of minus 20%.

30 meters - 20% = 24 meters

Standard Gases

ISE incorporate the use of standard gases to internationally:

- improve dive planning efficiency
- Be more efficient in planning, mixing and procedures
- to have more fun!

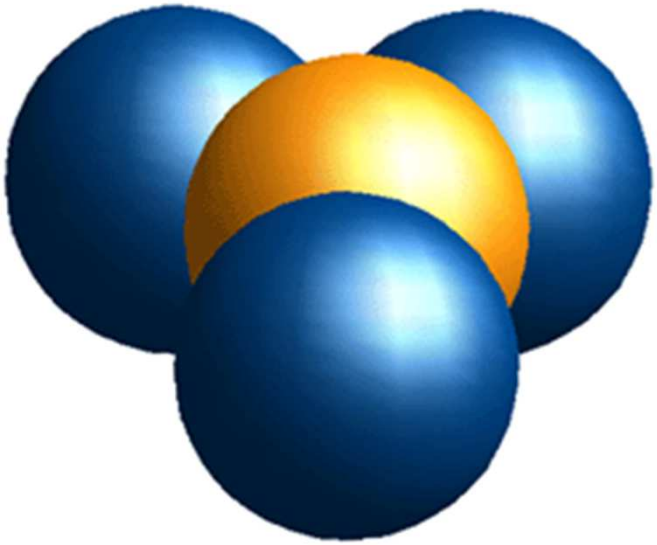
Standard Gas	Depth Range
Nitrox 32	0 - 30 meters
Trimix 25/25	0 - 40 meters

Standard gasses are also used in advance ISE level classes for the same beneficial reasons

Gas properties

- Dense gas
- High narcotic potential
- Not metabolized (inert)
- Low mobility molecules
- Tendency to bubble if ascend rapidly

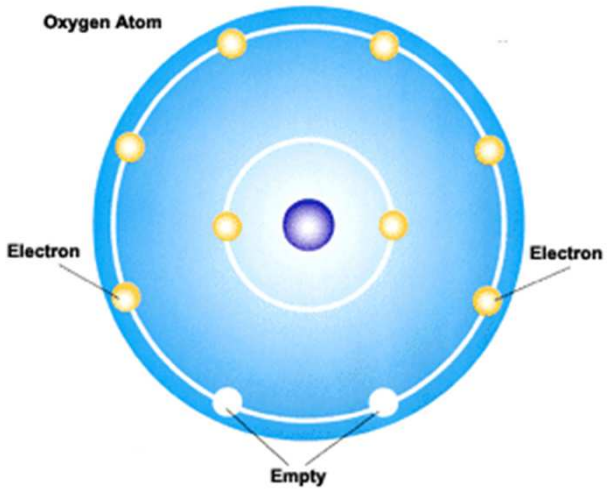
NITROGEN (N2)



Gas properties

- Dense gas
- Narcotic potential similar to Nitrogen
- High PPO2 or long exposure can be toxic.
- Active in metabolism

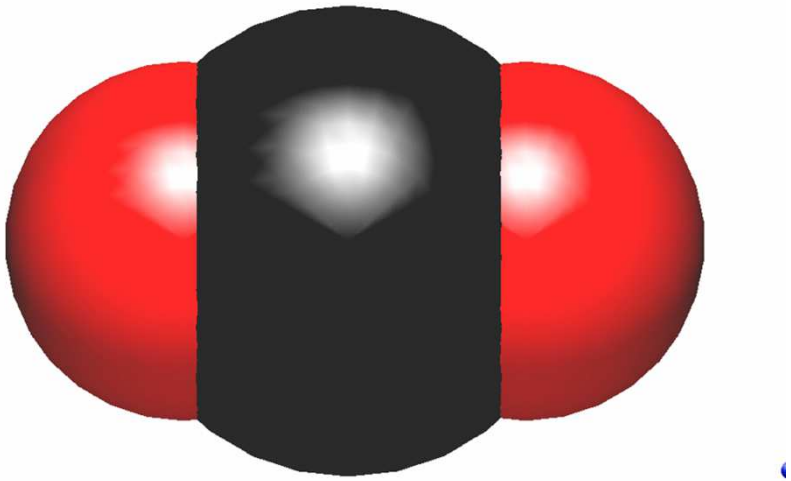
OXYGEN (O2)



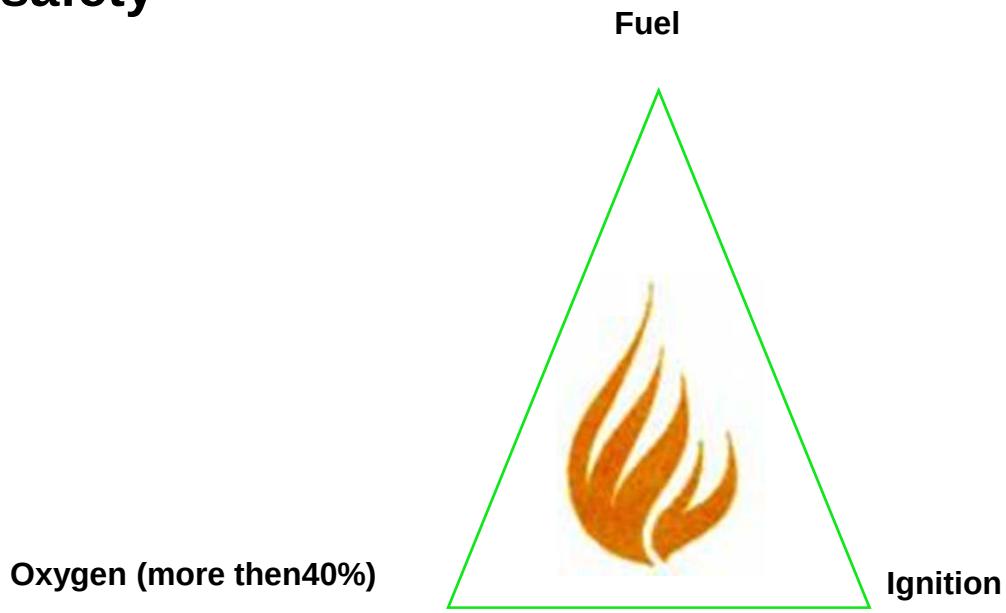
Gas properties

- The use of Air or Nitrox below 30 meters is prohibited in ISE due to narcotic potentials and heavy density of the gas.
- ISE practice a maximum narcotic depth of 30 meter / 4 ATA or less.
- Ease of breathing is important for efficient ventilation and gas exchange.
- Increase breathing effort promotes CO2 build up. CO2 is one of the biggest killer in diving due to its extremely high narcotic potential.

Carbon Dioxide



Oxygen safety



Always use oxygen compatible equipment

Nitrox Mixing

Desired Mix: 220 Bar of Nitrox 32

Question: How many bars of Oxygen do I need?
Thoughts: The mixture contains two gases: O2 and N2. While the Oxygen comes from two sourced (Storage tank and air from compressor), the Nitrogen comes only from the air of the compressor.

Calculation: 220 bar of Nitrox 32
=> 220 bar x 0.32 bar = 70.4 bar of O2
=> 220 bar x 0.68 bar = 149.6 bar of N2

If the 149.6 bar N2 are only from the air that the compressor deliveries, it is 79% of this air. Now we can calculate how much O2 we get from that source as well.

®149.6 bar = 79%
® X = 21%
®149.6 bar / 79% x 21% = 39.8 bar of Oxygen delivered with the air from the compressor.

We need a total 70.4 bar of O2 minus 39.8 Bar of O2 from the compressor = 30.6 Bar O2 that we have to fill from the storage. After that the tank gets filled up to 220 bar with the compressor and we are done.

Analyzing cylinders

- Always take charge of analyzing own cylinders!
- Never assume, visual inspect and label personally!
- Always analyze before diving!
- Most cases of oxygen toxicity originated from wrong analysis. (Human Error)

Never dive a cylinder that has no analysis label

- **BoE TEC**

Please note that the dives are designed around the classical backmounted configuration and there might be more or different skills for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

Trimix

Trimix is a breathing gas consisting of:

- Oxygen
- Helium
- Nitrogen

Benefits of Helium in breathing gas:

- Significant reduction of Nitrogen content
- Significant reduction of narcosis potential
- Significant ease of breathing
- Significant improvement of awareness

Triox

Triox is a gas mixture that allows you to benefit from the advantage of Nitrox and Helium diving at the same time.

Triox is defined as a mixture off Oxygen, Nitrogen and Helium with a Oxygen content of 21% or higher.

The two common mixes are 21/35 and 25/25. While 21/35 is a typical gas for Intro to Tech dives with a extra decompression gas to be carried along in a stage. 25/25 is the perfect gas for recreational divers who want to get more out of their diving, more bottom time, more focus and overall more safety and fun due to zero narcosis in the depth rang

Oxygen content

21 %

Hypoxic Trimix | Normoxic Trimix | Hyperoxic Trimix

Associated Oxygen risks of:

Hyperoxic Trimix - Oxygen Toxicity
Hypoxic Trimix – Unconsciousness

Use only the mixture that you are trained for!

What goes on in our body?

Our body absorbs non metabolic gas (e.g Nitrogen) when we dive
.

- Dissolved phrase: In tissues (Gradient)
- Free phrase: Silent bubbles

When we ascend, we are getting rid of the non metabolic gas in our body.

- Free phrase: Trapped and exhaled by the lung
- Dissolved phrase: Removed while ascending (Gradient)

Decompression is a science, ascending is an art to master

Diving Triox

Diving Triox merges the two benefits of Nitrox with its extended NDL and the lack of narcosis from Trimix diving. In the BoE Range is not very different from diving Nitrox, except from the fact that it can be used down to 40. The main issue you have to be aware is that Helium is much less forgiving when it comes to ascent rates and therefore your buoyancy skills have to be perfect before you consider diving helium mixes. The reason for that is that Helium takes much less of a pressure difference to form bubbles than for comparison Nitrogen. Reduces Ascent rates and a strict ascent protocol are essential for a safe dive.

- # Training Dives Review

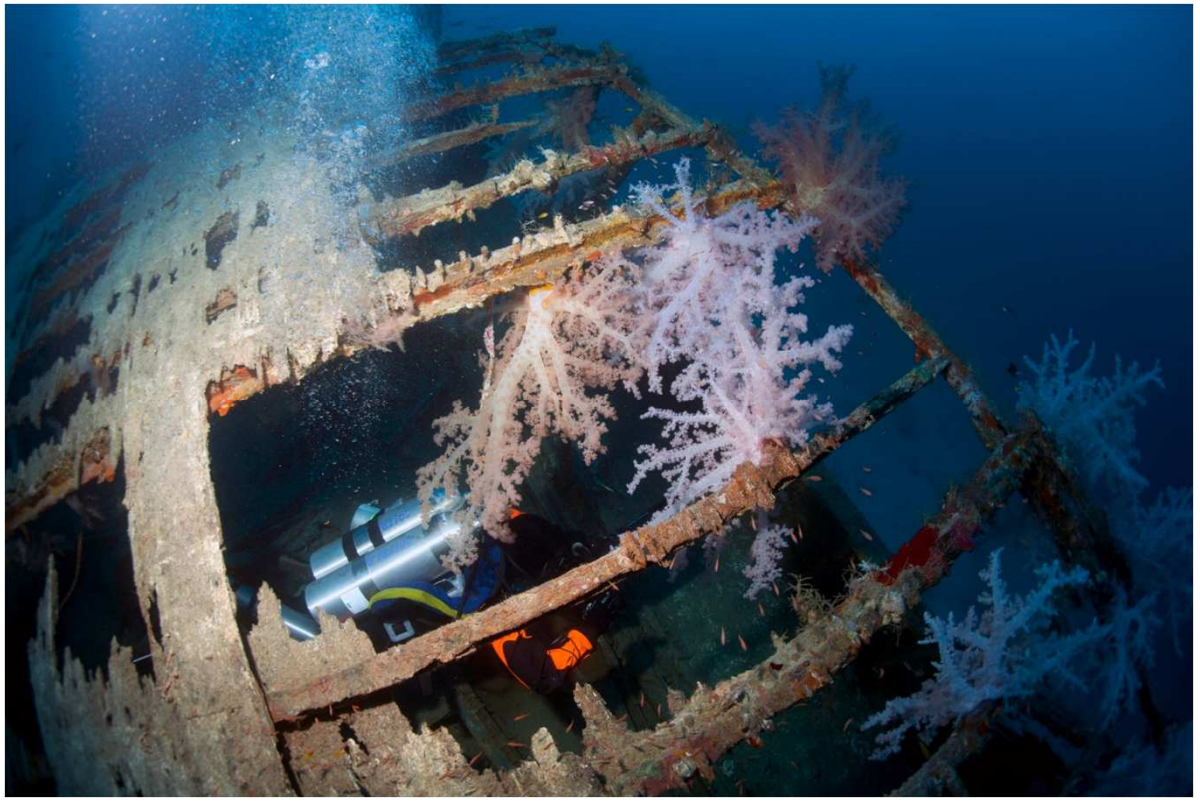
Please note that the dives are designed around the classical backmounted configuration and there might be more or different skills for Sidemount and CCR diving. If You take the class in one of these configurations – please refer also to the ISE Sidemount or CCR Manual.

Dive 1: (Check Out Dive)

- Lead by instructor
- ISE RULE
- Flow check
- Hose Deployment
- Bubble check

- Buoyancy and trim
- Propulsion Techniques Overview
- Intro to CoB
- Alertmarker Deployment (from bottom – no contact)
- Ascent 1-1-1

- Kurzes Debriefing Instruktor
- Videorückblick und Diskussion



Dive II:

- Lead by instructor
- ISE RULE
- Flow check
- Hose Deployment
- Bubble check

- Buoyancy and trim
- Stage Handling (if tec!)
- Propulsion Techniques
- Frog kick
- Minor Frog kick
- Flutter kick
- Modified flutter kick
- Backward kick
- Helicopter turn
- OOG Ascent 1-1-1

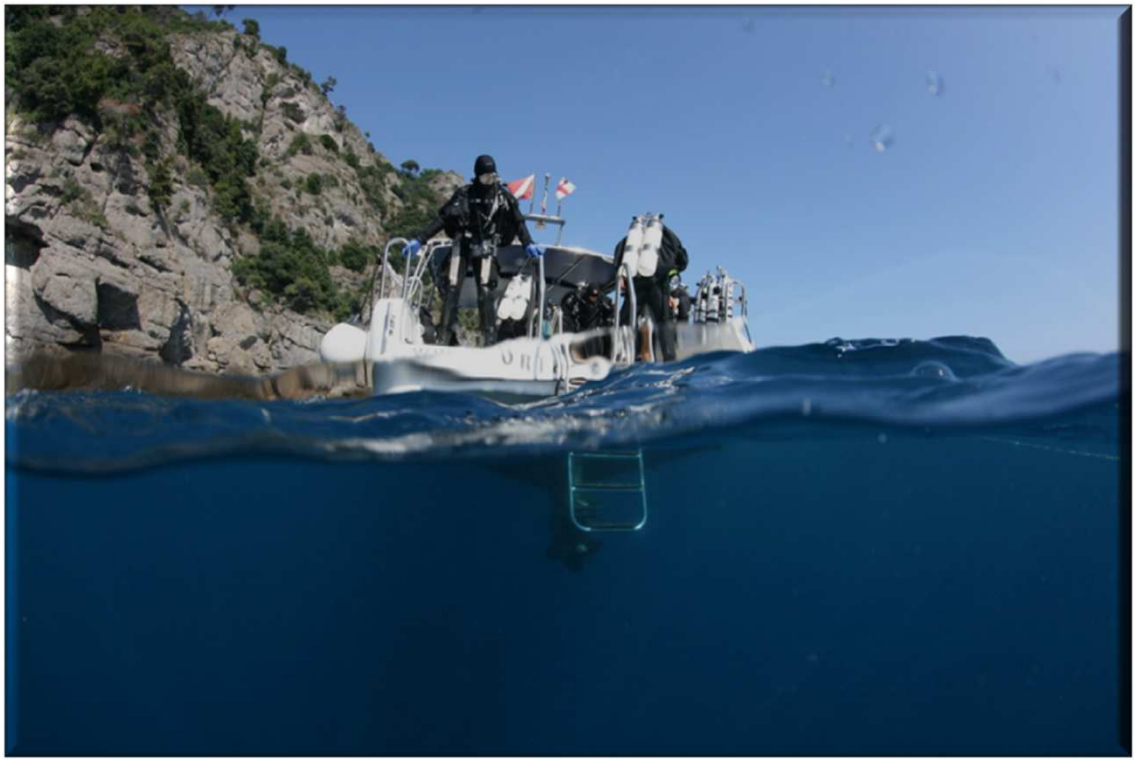
- Quick debrief by team leader
- Quick debrief by instructor
- Video review and discussion

Dive III:

- Lead by team captain
- ISE RULE
- Flow check
- Hose Deployment
- Bubble check

- SPG check
- Valve Freeflow Management
- Stage Handling (if tec!)
- Circle of Basic skills (CoB)
- Surface marker deployment (in midwater)
- Ascent 1-2-3

- Quick debrief by team leader
- Quick debrief by instructor
- Video review and discussion



Dive IV:

- Lead by team captain
- ISE RULE
- Flow check
- Hose Deployment
- Bubble check

- Compass
- Wetnotes
- Spool
- CoB
- Stage Handling (if tec!)
- Surface Marker deployment (40 seconds)
- SMB Failure
- Free Ascent 1-2-3

- Quick debrief by team leader
- Quick debrief by instructor
- Video review and discussion

Dive V:

•Lead by team captain
•ISE RULE
•Flow check
•Hose Deployment
•Bubble check

•Desent 1-1-1-1…
•Stage Handling (if tec!)
•No Mask Swim
•OOG + OOM (Donator & SMB) Ascent with Surface Marker
•OOG & OOM Diver swims to Donator (around 10 Meters, Donat
is faced the opposite direction)
•Recovery of unconscious Diver

•Quick debrief by team leader
•Quick debrief by instructor
•Video review and discussion

Dive VI:
(TEC)

- Lead by team captain
- ISE PDS (Pre-Dive-Sequence)
- Bubble check

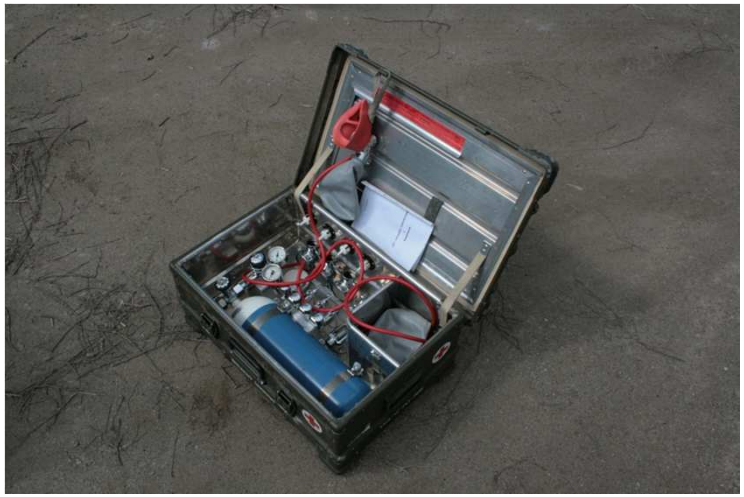
- Stage handling
- Taking on & off
- Switch to stage
- Go off stage and store
- Loss of stage
- Donation from stage
- Donation of Stage

- Quick debrief by team leader
- Quick debrief by instructor
- Video review and discussion

- **Final Words**

Emergency Oxygen – A MUST

It is barely understandable how divers can spend thousands for training and gear but fail to understand that the - compared to the rest of their gear – cheap Oxygen Set may safe their live or the live of fellow divers.
Divers Emergency Oxygen can be the classical set up like from Wenol or a budget solution using ex commercial stuff like seen on the pictures.
No matter what, the importance is to create the awareness amongst divers that having their own Emergency Oxygen Kit on the dive site without having to rely on others in case of ..



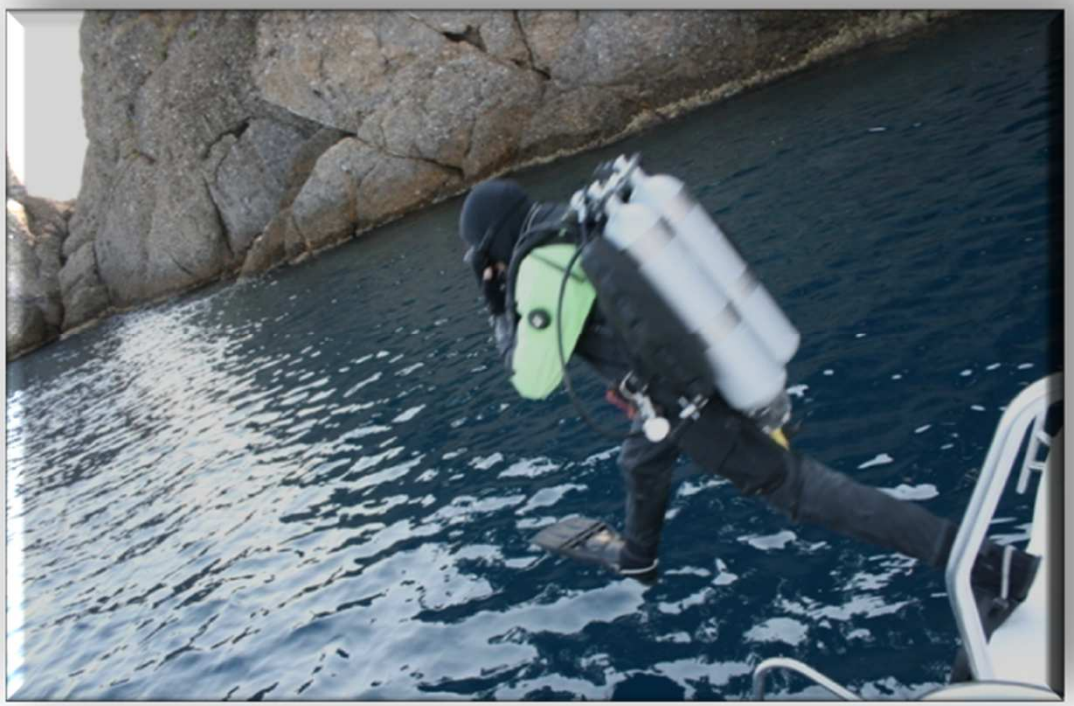
Thank You!

We would like to thank you very much for all your time and commitment to enroll in this course, and are sure this course have greatly benefited your diving career by enhancing you aquatic fun.

Please remember to fill up the ISE instructor QA forms.

ISE is dedicated to promote the best possible dive training in the world and to open possibilities for divers to participate in the kind of dives they dreamed of and were trained for by ISE. Please help to spread word about ISE and support our projects.
Thank You!

Have fun!



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