

Syllabus Number: 3.B.35 / BOD n. 188 ( 09-06-2014 )

## CMAS CCR Diver diluent air/nitrox Training Program Minimum Training Program Content

### 1. Required theoretical knowledge

#### 1.1 Subject Area 1: Introduction

- 1.1.1 The participant shall be provided with all such information, as provided for in Clause 4.2 of Chapter 1 in order to enable him to take an informed decision about his participation in the CMAS CCR Diver Diluent air/nitrox Training Program.
- 1.1.2 The participant shall be provided with the information about the CMAS as provided for in Clause 4.3 of Chapter 1.

#### 1.2 Subject Area 2: Equipment

- 1.2.1 The participant shall have an appropriate knowledge concerning the physical characteristics operating principles, maintenance and use of the following items of specific diving equipment.
- 1.2.1.1 Specific Equipment
- 1.2.1.1.1 A Closed Circuit Rebreather (M-CCR or E-CCR).
- 1.2.1.1.2 Appropriate stage(s)  
Appropriate depends on:
- Depth and bottom time
  - Type of gases
  - Self-sufficient or team bailout
- 1.2.1.1.3 Regulator(s) with pressure gauge and inflator (where applicable)
- 1.2.1.1.4 Extra mask
- 1.2.1.1.5 Reel(s) and / or spool(s) – the length of the rope in function of the situation (depth)
- 1.2.1.1.6 At least one yellow DSMB and one red DSMB
- 1.2.1.1.7 Tanks and regulators need to be correctly labelled.  
Stages are provided with appropriate clips to attach them on the frame or the harness

**Note 1:** Only the specific diving equipment is listed in article 1.2.

**Note 2:** Prior to the commencement of class, students should consult with a CMAS representative to verify equipment requirements

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## 1.3 Subject Area 3: Land Drills and topics

- 1.3.1 Dive team protocols and procedures (general team briefing, personal team briefing, safety briefings).
- 1.3.2 Equipment fit and function
- 1.3.3 Pre-dive drills
- 1.3.4 Delayed surface marker deployment

## 1.4 Subject Area 4: Theory

- 1.4.1 The participant shall have an appropriate knowledge concerning the physical principles and their application to CCR diving, skills, equipment and hazards relating to:

### 1.4.2 Knowledge-related (Module 1):

#### 1.4.2.1 Classroom 1:

- 1.4.2.1.1 History of rebreathers
- 1.4.2.1.2 CMAS and rebreather diving
- 1.4.2.1.3 Overview of technical diving – situating this course
- 1.4.2.1.4 Explain the special considerations while handling oxygen.
- 1.4.2.1.5 Explain the safety considerations while filling cylinders with oxygen.
- 1.4.2.1.6 Identify the differences between a semi-closed and a fully closed diving system
- 1.4.2.1.7 What is a rebreather
  - Advantages of diving a rebreather
  - Disadvantages of diving a rebreather
- 1.4.2.1.8 Mechanical part of a rebreather
  - The basics
  - Regulators for rebreathers, tanks, tubes
  - Lungs of a rebreather
    - Front mounted counter lungs
    - Back mounted counter lungs
  - Injection valves for diluent and oxygen
  - Mouthpiece and hoses (BOV)
  - Carbon dioxide canister/scrubber
    - Explain what to look for in choosing an absorbent.
    - Explain the procedure for filling and emptying a CO<sub>2</sub> canister.
    - Explain locations for proper disposal of absorbents.
  - The overpressure valve
  - Our lungs; the motor of the system
  - Trim and weights
  - Control of the buoyancy while diving a rebreather.
  - The jacket
  - Understanding the partial pressure of oxygen
    - Explain the advantages and disadvantages of diving with a raised PO<sub>2</sub>.
    - Explain the differences between CNS and pulmonary oxygen toxicity.
    - List the PO<sub>2</sub> values and associated condition.
    - Explain how to monitor oxygen accumulation (both on a daily and long-term basis).
  - Setting the set points (low set point and high set point)
    - Oxygen control
    - Accuracy of the oxygen control
    - Interpreting of the shown partial pressures
    - Reading and interpreting the values of the oxygen cells

#### 1.4.2.2 Classroom 2:

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- 1.4.2.2.1 The electronics of a closed circuit rebreather
  - Set points
  - Monitoring the oxygen
  - The galvanic oxygen cell
  - Calibrating the system
  - Moisture on the oxygen cells
  - The life time of oxygen cells
  - The solenoid
  - Batteries
- 1.4.2.2.2 Physiology of the rebreather
  - The physiology of the rebreather
  - MOD – maximum operational depth
  - Control of the oxygen toxicity
  - Hypoxia
  - Hyperoxia
  - Hypercapnia
  - Nitrogen management
  - Breathing warm gases
  - Checks before the dive
    - Positive check
    - Negative check
    - Pre-breathing
  - Descending
  - Clearing mask and equalizing ears
  - Opening and closing mouth piece
  - Ascending
  - Breathing resistance
  - Choice of the counter lungs
  - Gas consumption
  - Batteries
  - Swimming at the surface
  - Buoyancy and trim
  - Checks after the dive
  - Understanding partial pressure of oxygen
  - Solenoid activity and relationship with oxygen partial pressure
- 1.4.2.3 Classroom 3:
  - 1.4.2.3.1 Maintenance of the rebreather
    - Changing the content of the canister – skills
      - How to avoid mistakes
    - Maintenance of the cylinders
    - Maintenance of the regulators (first stages)
    - Maintenance after a dive
    - Cleaning and disinfecting the system
    - Lubricating
    - Changing and maintenance of the oxygen cells
    - How to store away the rebreather
    - Precautions if using pure oxygen at high pressure
    - Service intervals
    - Maintenance and service of the Auto air
    - Maintenance and service of the BOV
  - 1.4.2.3.2 Procedures
    - Procedures before the dive
    - Procedures during the dive
    - Procedures after the dive
    - Safety procedures and solving problems

- Mouth piece is coming loose
- The canister content has no capacity left
- The system is flooded
- The counter lung is broken
- There is no breathing gas (oxygen) left
- The batteries are empty
- The oxygen cells are failing
- Forgotten to change to the high set point
- General safety rules (federation depended)
  - How to compose the diving teams
  - Who with whom
  - Exercises in other dive courses in open water with an instructor on rebreather

## 1.4.3 Dive Planning and Procedures (Module 2):

### 1.4.3.1 Practical session in the classroom (classroom 4):

#### 1.4.3.1.1 Gas consumption and decompression

- Metabolic oxygen consumption
- Decompression while diving a rebreather
  - Using open circuit tables
  - Using constant partial pressure oxygen tables
  - Using dive computers
  - Using planning software

#### 1.4.3.1.2 Dive planning and decompression in practice

- General approach
- What's the planned operational depth?
- What are the conditions of the dive (temperature, current, visibility,...)
- Which bailout?
- Amount of diluent and oxygen
- Open circuit bailout
- Emergency procedures
  - Manual control of the rebreather (manually adding diluent in the loop) (manually adding oxygen in the loop)
  - Running the rebreather as a pure oxygen rebreather
  - Running the rebreather as a semi closed rebreather
- Briefing (general briefing, team briefing, briefing of the skippers/boat captain, safety briefing)
- DO's and DON'T's

#### 1.4.3.2 Theoretical exam (module 1 and module 2): classroom 5

## 2 Required SCUBA skills

### 2.1 Subject Area 1: Skills on the rebreather (Module 3)

#### 2.1.1 Workbench 1

##### 2.1.1.1 Assembly/disassembly of system.

##### 2.1.1.1.1 Demonstrate the elements of the basic structure and function, including

- Gas flow
- Components (i.e., sensors, orifices, etc.).
- Breathing loop.
- Electronic controls.

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- 2.1.1.1.2 Perform the pre-dive check
- 2.1.1.1.3 Draw the basic gas flow diagram
- 2.1.1.1.4 Perform the proper monitoring procedures of the displays:
  - During descent.
  - On bottom.
  - During ascent.
- 2.1.1.1.5 Perform the proper use of the computer and downloading procedures.
- 2.1.1.2 Cleaning of system.
- 2.1.1.3 Refill of canister and gas.

## 2.1.2 Workbench 2

- 2.1.2.1 Demonstrate the proper post-dive check.
- 2.1.2.2 Perform the efficient disassembly of the system.
- 2.1.2.3 Demonstrate the proper cleaning of the system's components.
  - 2.1.2.3.1 Breathing hoses.
  - 2.1.2.3.2 Canister.
  - 2.1.2.3.3 Breathing bag.
- 2.1.2.4 Perform the safe filling and added of the gas cylinders.
- 2.1.2.5 Perform the safe loading of the canister.

## 2.2 Shallow Water Drills (SWD) - (Module 4)

### 2.2.1 Session 1

- 2.2.1.1 Prepare unit for an open water dive.
- 2.2.1.2 Explain and demonstrate the actions on the machine before diving
  - 2.2.1.2.1 Properly filling of the canister
  - 2.2.1.2.2 Analyzing the content of the diluent and oxygen and bailout tanks (4 eyes principle)
  - 2.2.1.2.3 Checking the pressure of the diluent and oxygen tanks
  - 2.2.1.2.4 Positive check
  - 2.2.1.2.5 Negative check
  - 2.2.1.2.6 Pre-breathing
- 2.2.1.3 Demonstrate proper trim in the water while swimming
- 2.2.1.4 Briefing of the dive (performed by the student)
- 2.2.1.5 Briefing of the exercises (performed by the instructor)
- 2.2.1.6 Briefing of the safety team (performed by the instructor and the student)
- 2.2.1.7 Exercises performed by the student
  - 2.2.1.7.1 Signs
  - 2.2.1.7.2 Plasticized instruction cards (short action exercises)
  - 2.2.1.7.3 Bailout scenario's
- 2.2.1.8 Evaluation by the instructor
- 2.2.1.9 Debriefing and feedback (performed by the instructor and the student)
- 2.2.1.10 Post diving actions

### 2.2.2 Session 2

If needed - see session 1

## 2.3 Deep water dives (Module 5)

During the deep dives at least 5 small exercises (instruction cards) and at least 1 bailout exercise have to be performed.

### 2.3.1 Dive 1

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    - 2.3.1.2.4 Positive check
    - 2.3.1.2.5 Negative check
    - 2.3.1.2.6 Pre-breathing
  - 2.3.1.3 Demonstrate proper trimming in the water while swimming
  - 2.3.1.4 Briefing of the dive (performed by the student)
  - 2.3.1.5 Briefing of the exercises (performed by the instructor)
  - 2.3.1.6 Briefing of the safety team (performed by the instructor and the student)
  - 2.3.1.7 Exercises performed by the student
    - 2.3.1.7.1 Signs
    - 2.3.1.7.2 Plasticized instruction cards (short action exercises) maximum 2
    - 2.3.1.7.3 Bailout scenario maximum 1
  - 2.3.1.8 Evaluation by the instructor
  - 2.3.1.9 Debriefing and feedback (performed by the instructor and the student)
  - 2.3.1.10 Post diving actions
- 2.3.2 Dive 2 – 5: see dive 1