CMAS

CONFÉDÉRATION MONDIALE
DES ACTIVITÉS SUBAQUATIQUES

WORLD UNDERWATER FEDERATION

Closed Circuit Rebreather

Standards and Requirements

Training Program

Version 2002/05

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CMAS CLOSED CIRCUIT REBREATHER DIVER

Course Outline

CMAS CLOSED CIRCUIT REBREATHER : PART 1 (STANDARDS & REQUIREMENTS)

I. Course Classification [Type & Level]

1. Classification

The CMAS REBREATHER COURSE CLOSED CIRCUIT is considered a specialty course. For each other type of unit an adoursement can be added.

2. Validity period

There is no specific period of validity for this certificate.

3. Benefits & responsibilities

Successful students will be qualified to dive using closed circuit - nitrogen based

II. Aims & Objectives of Course

1. To provide the diver with a good understanding of the techniques involved in the use of closed circuit.
2. To make the diver aware of the additional physiological and technical problems encountered when using a closed circuit system.
3. To provide the diver with a good understanding of the special dive planning procedures appropriate to diving with closed circuit system.

III. Entry Requirements [prerequisites]

1. Student's minimum age : 18 years
2. Certification Level : Certified CMAS Basic Nitrox Diver or equivalent of a recognized agency.
3. Medical Certificate : current diving physical, according to member federation requirements.

IV. Maximum Student/Instructor Ratios

1. Equipment practical Ration Instr./Student 1:6
2. Water Ratio Instr./Student 1:2

V. Instructor/Assistant Requirements

1 Instructor/Course Director

1.1 Certificate Level: CMAS 2-Star Instructor

1.2 Specialty: CMAS Rebreather Instructor

1.3 Proof of Experience: Instructor must be in active teaching status as required by his/her national federation

2 Assistants

As required by the course director.

VI. Equipment

1. Closed circuit system being used must be of the same model
2. Apparatus units used must to be approved by a third party testing agency
3. Instructor will provide all additional supplies and equipment including audio visuals, support material, safety equipment, etc.
4. Students will provide all personal diving equipment
5. Units per Student : 1 unit per 2 students

VII. Special Course Requirements

1. Course outline: Must use the CMAS Training program (see Part 2)
2. Approval by the manufacturers of the closed circuit units used
3. Facilities: adequate classroom, according to the needs of the course and the students, normal open water diving site.
4. Depth limits according to qualification level of each diver [as a maximum under best conditions] and according to local circumstances. First dive should be in a shallow, sheltered water or pool – initially shoulder deep with a max depth of 4 m. Open water : progressively working to max depth 30 m. No Decompression dives.
5. Minimum duration of any qualifying dive is 30 minutes .
6. All diving is to be done within a maximum oxygen partial pressure limit of 1.5 bar.
7. Supervision: During the course an authorized instructor as outline above, must always be present.

VIII Student Performance Objectives

By the end of the course, students will be able to:

1 Knowledge-related:

1.1 Classroom 1:

1.1.1. Identify the differences between a semi-closed and a fully closed diving system, including;
- 1.1.1.1. Functions.
- 1.1.1.2. Structure.
- 1.1.1.3. Components (unit, displays, bailout).

1.1.2. List the advantages and disadvantages of both systems.

1.1.3. Explain the physiological considerations of:
- 1.1.3.1. Oxygen.
- 1.1.3.2. Nitrogen.
- 1.1.3.3. Helium.
- 1.1.3.4. Carbon dioxide.

1.1.4. Explain the special considerations while handling oxygen.

1.1.5. Explain the safety considerations while filling cylinders with oxygen.

1.1.6. List the components of a pre-dive inspection.

1.1.7. Explain what to look for in choosing an absorbent.

1.1.8. Explain the procedure for filling and emptying a CO2 canister.

1.1.9. Explain locations for proper disposal of absorbents.

1.2 Classroom 2:

1.2.1. Explain the advantages and disadvantages of diving with a raised PO2.

1.2.2. Explain the differences between CNS and pulmonary oxygen toxicity.

1.2.3. List the PO2 values and associated condition.

1.2.4. Explain how to monitor oxygen accumulation (both on a daily and long-term basis).

1.2.5. Explain how to monitor the oxygen levels in the system.

1.2.6. Explain the various decompression tables available as backups to the dive computer.

1.3 Classroom 3:

1.3.1. Explain the proper emergency procedure as related to a given situation.

1.3.2. Electronic control failure.

1.3.3. High PO2.

1.3.4. Low PO2.

1.3.5. Flooded canister.

1.3.6. Catastrophic failure/abort.

1.4 Classroom 4

1.4.1. Practical Exam.

1.4.2. Assembly/disassembly of system.

1.4.3. Cleaning of system.

1.4.4. Refill of canister and gas.

1.4.5. Emergency procedures.

2 Skill-related

2.1 Workbench 1

2.1.1. Demonstrate the elements of the basic structure and function, including
- 2.1.1.1. Gas flow.
- 2.1.1.2. Components (i.e., sensors, orifices, etc.).
- 2.1.1.3. Breathing loop.
- 2.1.1.4. Electronic controls.

2.1.2. Perform the pre-dive check.

2.1.3. Draw the basic gas flow diagram.

2.1.4. Perform the proper monitoring procedures of the displays:
- 2.1.4.1. During descent.
- 2.1.4.2. On bottom.
- 2.1.4.3. During ascent.

2.1.5. Perform the proper use of the computer and downloading procedures.

2.1.6. Perform the proper cleaning process.

2.2 Workbench 2

2.2.1. Demonstrate the proper post-dive check.

2.2.2. Perform the efficient disassembly of the system.

2.2.3. Demonstrate the proper cleaning of the system's components.
- 2.2.3.1. Breathing hoses.
- 2.2.3.2. Canister.
- 2.2.3.3. Breathing bag.

2.2.4. Perform the safe filling of the gas cylinders.

2.2.5. Perform the safe charging of the canister.

2.3 Pool 1

2.3.1. Demonstrate the pre-dive check.
2.3.2. Perform the proper donning and adjustment of the system.
2.3.3. Demonstrate proper trimming in the water while swimming.

2.4 Pool 2

2.4.1. Demonstrate the proper procedure for handling a “low oxygen” situation.
2.4.2. Demonstrate the proper procedure for handling a “high oxygen” situation.
2.4.3. Demonstrate the proper procedure for switching to a bail out.
2.4.4. Demonstrate the proper procedure for handling a “high oxygen” situation.
2.4.5. Demonstrate the proper procedure for handling an “electronic failure“ situation.
2.4.6. Demonstrate the proper procedure for emptying a flooded canister.

IX. Minimum Course duration :

1.	Core knowledge :	12 hours
3.	Practical Workshop :	4 hours
5.	Swimming pool or shallow- sheltered water	2 hours
7.	Open Water dives	4 dives min 1/2 hour each max. 3 dives per day

X. Quality assurance

CMAS strongly recommends and encourages all federations to use adequate system for quality assurance. A system in widespread use and of proven effectiveness is to send questionnaires to the students , followed by an analyses of the feedback .

CMAS CLOSED CIRCUIT DIVER : PART 2
(TRAINING PROGRAM)

I. Course Schedule

Minimum Duration

1.	Classroom / Core Knowledge :	12 hours
2.	Practical Workshop /Workbench :	4 hours
3.	Swimming pool or shallow- sheltered water	2 hours
4.	Minimum number of Open Water dives	4 dives

II. Sample Course Outline

1 SESSION 1 (Classroom-1)(3 Hours)

Outline

1.1 Course overview.
1.2 History.
1.3 Need and rationale for advanced diving systems.
  1.3.1. Fully closed, oxygen.
  1.3.2. 3.2 Fully closed, mixed gas.
  1.3.3. 3.3 Semi-closed.
1.4 Physiological considerations of gases involved.
  1.4.1. Oxygen.
  1.4.2. Nitrogen
  1.4.3. Helium.
  1.4.4. Carbon dioxide.
1.5 Depth/logistical limitations.
1.6 Basic structure and function.
  1.6.1. Gas flow.
  1.6.2. Components (i.e., sensors, orifices, etc.).
  1.6.3. Breathing loop.
  1.6.4. Bailout system.
1.7 Special considerations when handling and filling O2 systems.
  1.7.1. O2 cleaning procedures.
  1.7.2. O2 handling (high and low pressure).
  1.7.3. Filling procedures.
1.8 Pre-dive inspection.
  1.8.1. General approach to a system.
  1.8.2. Method.
  1.8.3. Procedure.
1.9 Canister considerations.
  1.9.1. Classifications of absorbents.
  1.9.2. Filling/packing procedures.
  1.9.3. Emptying/disposal procedures.

2 SESSION 2 (Workbench-1) (2-Hours)

Outline

2.1 Review of system.
2.2 System pre-dive check.
  2.2.1. Computer.
  2.2.2. Canister.
2.3 Gas flow.
  2.3.1. System gas flow
  2.3.2. Breathing loop
2.4 Monitoring procedures of the displays.
2.5 Reading of computer and downloading (when applicable).
  2.5.1. Function of dive computer and controls.
  2.5.2. Application of the dive computer.
  2.5.3. Interface of PC and dive computer (if applicable).
2.6 Cleaning procedures.
  2.6.1. Proper removal of components.
  2.6.2. Proper use of cleaning solutions.

3 SESSION 3 (Classroom-2) (3 Hours)

Outline

3.1 Oxygen considerations.
- 3.1.1. Advantages and disadvantages of raised ppO2.
- 3.1.2. Oxygen toxicity (CNS vs pulmonary).
- 3.1.3. PO2 values and how they relate to the human body.
- 3.1.4. Methods of evaluating the oxygen level in the body.

3.2 Monitoring of oxygen in the system.

3.3 Dive tables (nitrox and heliox).

4 SESSION 4 (Pool-1) (3 Hours)

Outline

4.1 Pre-dive check review.

4.2 Donning and adjustment of systems.

4.3 Swimming orientation.
- 4.3.1. Proper weighting.
- 4.3.2. Adjustments in diving procedures.

4.4 Familiarization (time on bottom).

5 SESSION 5 (Workbench-2) (2 Hours)

Outline

5.1 Post-dive check.

5.2 Disassembly of system.

5.3 Cleaning of system.

5.4 Filling of canister and gas.

6 SESSION 6 (Classroom-3) (3 Hours)

Outline

6.1 Practical Exam.
- 6.1.1. Assembly/disassembly of system.
- 6.1.2. Cleaning of system.
- 6.1.3. Refill of canister and gas.

6.2 Emergency procedures.

7 SESSION 7 (Pool-2) (3 Hours)

Outline

7.1 Emergency procedures.
- 7.1.1. Manual oxygen addition.
- 7.1.2. Manual diluent addition.
- 7.1.3. Use of bailout.
- 7.1.4. Electronic failure.
- 7.1.5. Flooded canister.

8 SESSION 8 (Workbench-3) (2 Hours)

Outline

8.1 Post-dive check.

8.2 Disassembly of system.

8.3 Cleaning of system.

8.4 Filling of canister and gas.

9 SESSION 9 (Open Water 1)[1]

9.1 Dive #1: Open Circuit SCUBA Air (Review of CMAS skills)

9.2 Dive #2: Shallow, long duration

10 SESSION 10 (Classroom-4) (3 Hours)

10.1 Written Exam.

11 SESSION 11 (Open Water)[2]

11.1 Dive #3: 40 to 60 fsw.

11.2 Dive #4: 40 to 60 fsw.

12 SESSION 12 (Open Water)

12.1 Dive #5: 100 to 120 fsw.

12.2 Dive #6: 100 to 120 fsw.

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[1] The goal of the open water sessions is to repeat what has taken place during the entire course including the pre-dive check, post-dive check, disassembly of system, cleaning of system, and the filling of canister and gas

[2] The difference with this course is the addition of emergency procedures

III. Knowledge review & skills assessment

1 Theoretical knowledge :

1.1 suggested type : final evaluation
1.2 suggested form : written
1.3 suggested structure : 4 main topics , 5 questions for each , allotted time 45 minutes
1.4 question technique : multiple choice
1.5 allowed support material (for student) : decompression tables

IV. Awarding of certification material

May be given to successful students at end of the course Only students who have attended the whole course (an /or successfully passed any required assessment /evaluation) may receive the corresponding recognition material :

- CMAS CARD
- WALL CERTIFICATE

CMAS CLOSED CIRCUIT REBREATHER INSTRUCTOR
Standards and Requirements

I. Entry Requirements

1 Minimum Age : 18 years
2 Certification level : CMAS 2 Star Instructor ,
CMAS Basic Nitrox Instructor
3 Minimum number of hours in open water
25 hours bottom time in open water
4 Experience : Must have participated on at least one Rebreather Diver closed circuit course in the role of Assistant Instructor

II. Assessment and certification

1 Pass a written examine
2 Demonstrate the ability to instruct a group of students in Rebreather techniques and theory

III. Qualification

The CMAS Rebreather Instructor closed circuit is qualified to organize and instruct on CMAS Rebreather Diver courses and to evaluate and certify successful candidates .