



# Rebreather Training Council

## Standard

### Recreational Rebreather Diver Level One

#### **Rebreather Training Council: WARNING - IMPORTANT NOTICE - DISCLAIMER**

Scuba diving (Recreational and Technical) is a potentially dangerous activity that can result in serious injury and death. Diving with Rebreathers amplify inherent risks of hypercapnia, hyperoxia, hypoxia and equipment failures that can result in divers becoming incapacitated without warning, which creates even greater risk of death. For these reasons the Rebreather Training Council (“RTC”) was formed by industry experts, training agencies and stakeholders to develop rebreather training standards to be utilized as a minimum curriculum for all RTC Members.

RTC Standards are developed as a membership service by the RTC to enhance rebreather training procedures for a minimum level of consistency set forth by RTC Member Training Associations. The RTC Standards contain information and practices designed to promote safer rebreather diving applicable to all local, regional and international rebreather training. The RTC Standards are designed as broadly as possible to incorporate minimum information and skills applicable for training all types of rebreathers produced by all rebreather manufacturers. Any member training organization wishing to offer a course complying any of the standards shall publish detailed course outlines that meet or exceed the applicable RTC Training Standard.

The RTC Standards shall be construed as minimum training standards to be enhanced and expanded upon at the discretion of each RTC Member Training Association. RTC Standards shall be modified as new technologies and trends effect rebreather divers. HOWEVER, NO BOOK, TRAINING CURRICULUM, CHECKLIST, DIVE PLAN AND OR CONTINGENCY PLAN CAN ELIMINATE ALL RISKS ASSOCIATED WITH REBREATHER DIVING. ULTIMATELY IT IS EACH DIVER’S PERSONAL RESPONSIBILITY TO ACCEPT THE INHERENT RISKS OF REBREATHER DIVING.

THE RTC MAKES NO WARRANTIES OR REPRESENTATIONS AND ASSUMES NO LIABILITY CONCERNING THE VALIDITY OF ANY INFORMATION, PROCEDURES OR GUIDELINES EXPRESSED IN THESE MATERIALS. EACH TRAINING AGENCY IS RESPONSIBLE FOR DEVELOPING THEIR OWN MINIMUM TRAINING CURRICULUMS FOR REBREATHER TRAINING AND CERTIFICATION. ALL INDIVIDUALS AND ENTITIES RELYING ON RTC STANDARDS DO SO AT THEIR OWN RISK.

THE RTC IS AN INTERNATIONAL NON-FOR-PROFIT ORGANIZATION COMPRISED OF VOLUNTARY MEMBER TRAINING ASSOCIATIONS AND AFFILIATE STATEHOLDERS TO PROMOTE RESPONSIBLE REBREATHER TRAINING. THE RTC IS A NON-REGULATORY ORGANIZATION WHICH HAS NO LEGAL AUTHORITY TO REGULATE OR CONTROL INDIVIDUAL TRAINING AGENCIES OR INDIVIDUALS AND SHALL NOT BE HELD LIABLE FOR ANY TRAINING AGENCIES, TRAINING FACILITIES, TRAINERS OR PARTICIPANTS THAT RESULTS IN INJURY OR DEATH TO ANY PERSON OR PERSONS.

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#### 1. Scope

This standard describes the requirements for the training of a Recreational Rebreather Diver Level One. Training Organizations offering a course that complies with this standard may exceed any of the requirements in terms of the volume or complexity of training, but must at least ensure the students master all the skills and knowledge defined in this standard. Safety limits for depth, partial pressures of gases, etc. may not be exceeded during a course.

#### 2. Terms and Definitions

a. Training Organization

An RTC member organization that designs the training program, authorises instructors, issues certifications and quality assures the delivery of the training.

b. Certification

A certificate of competency may be issued to the student by the training organization and RTC member organizations can state that the certification meets the requirement of this standard. Certification will be issued at the instructor's discretion when the student has met all the requirements of this standard.

c. Instructor

An individual approved by an RTC member organization to certify divers at this level.

d. Certified Assistant

An individual approved by an RTC member organization to act as an assistant to an instructor for this course.

e. Confined Water

Swimming pool with a depth appropriate to the activity or body of water that offers similar conditions with regard to visibility, depth, water movement and access

f. Open Water

A body of water significantly larger than a swimming pool offering conditions typical of a natural body of water

g. Rebreather

A breathing device that recirculates some or all of the diver's exhaled breath and replenishes any consumed oxygen to maintain a breathable mixture.



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#### 3. Competencies of a Recreational Rebreather Level 1

A diver able to dive with a rebreather in the company of at least one other certified diver without supervision in conditions similar to those experienced during this course.

#### 4. Prerequisites for Course

##### a. Minimum Age

The minimum age for participants is defined by the training organization.

##### b. Medical Screening

Documented evidence shall be obtained that the student has been medically screened as suitable for recreational diving by means of an appropriate questionnaire or medical examination. In any case of doubt, or at the instructor's discretion, students shall be referred to proper medical resources. If the student is not examined by an appropriate medical professional (e.g. physician) the student shall be obliged to confirm by signature that he or she has understood written information given by the instructor on diseases and physical conditions which may pose diving-related risks.

##### c. General Diving Skills and Knowledge

If diver is not already a certified entry level diver before the course, the course shall cover the theory knowledge and practical skill requirements consistent with ISO Diver Level 2 – Autonomous Diver (ISO 24801-2) and ISO Enriched Air Nitrox Diver (ISO 11107)

#### 5. Breathing Gas

##### a. Acceptable Gas Mixtures

Course participants must be trained in the use of oxygen/nitrogen mixtures, so that in the case of Closed Circuit Rebreathers (CCRs) the diluent shall be air or a nitrox mixture. Helium may form part of the breathing mixture at the training organization's discretion.

##### b. Maximum Oxygen Partial Pressures

- i. The maximum pO<sub>2</sub> during the dive is 1.4 bar.

#### 6. Training Dive Limits

- a. No training dives will require decompression stops, however safety stops are strongly recommended.
- b. The training organisation may specify a maximum depth for certified divers up to a maximum of 30 metres/100 feet. Students shall have experience of at least half of the specified maximum working depth during this course.

#### 7. Theory Knowledge

- a. By the end of the course the candidate shall have an appropriate knowledge of the following concepts (course content should include all the following concepts unless inapplicable for the rebreather model used):
  - i. Definition of a rebreather
    - a. Primary difference between a rebreather and open-circuit scuba



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- b. Two basic types of rebreathers, and how they differ (SCR/CCR)
- ii. Function of following components (if appropriate)
  - a. Loop
  - b. Counterlung
  - c. Inhalation and exhalation hoses
  - d. Mushroom (non-return) valves
  - e. Scrubber (CO<sub>2</sub> absorbent)
  - f. Oxygen sensor (cell)
  - g. Oxygen supply
  - h. Diluent supply
  - i. ADV (automatic diluent valve)
  - j. OPV (overpressure valve)
  - k. Mouthpiece
  - l. BOV (bailout valve)
  - m. HUD
  - n. Handset
  - o. Gas cylinder(s)
  - p. Regulator(s)
  - q. Cylinder valve(s)
  - r. SPG(s)
  - s. Manual gas addition valves
  - t. CO<sub>2</sub> monitoring system
  - u. eCCR
  - v. mCCR
  - w. eSCR
  - x. mSCR
- iii. Rebreather assembly (manufacturer checklists)
- iv. How/when to analyse gas(es)
- v. Dive planning
- vi. Dive conduct
- vii. Definition of “minimum/optimum loop” and loop volume
- viii. Checks to be carried out prior to diving with unit (these may be during unit assembly or immediately prior to diving as specified by the training organisation and manufacturer)
  - a. Battery power
  - b. O<sub>2</sub> cells
  - c. Scrubber duration
  - d. Gas supplies
  - e. Bail out
  - f. Loop integrity checks



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- g. Control systems checks
- h. Check all gas feeds to system
- i. OPV setting
- j. Pre-breathe rebreather
- ix. Counterlung placement, loading and rigging
- x. Water entries
- xi. Surface swims with rebreather
- xii. Descents with rebreather
  - a. Bubble check and safety drill
  - b. ADV (automatic diluent or gas valve) function during descent
- xiii. Ascents with rebreather and exits
- xiv. Minimum/optimum loop volume
- xv. Functions of the mouthpiece of a rebreather
- xvi. Use of the BOV
- xvii. Alternative bail out options
- xviii. Weight, buoyancy and trim when diving with a rebreather
- xix. Control system monitoring (use of displays and gauges)
- xx. Hand signals and communications
- xxi. Circumstances when a diver might need to breathe from an alternate air source supplied by another diver
- xxii. Potential failures and actions to be taken
  - a. Oxygen sensor
  - b. O<sub>2</sub> solenoid failure
  - c. Incorrect PO<sub>2</sub> readout
  - d. Failed ADV
  - e. Water in the loop
  - f. Caustic cocktail
  - g. CO<sub>2</sub> issues
    - I. scrubber malfunction/exhaustion
    - II. mushroom valve failure
    - III. diver breathing style
    - IV. CO<sub>2</sub> monitoring systems
    - V. unit assembly errors
- xxiii. Battery depletion problem
- xxiv. Exhausted diluent (eCCR) or supply gas (eSCR)



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- xxv. Hypercapnia
  - a. definition
  - b. causes
  - c. signs and symptoms
  - d. system warnings or indications
  - e. why they are not reliable warnings of carbon dioxide problems
- xxvi. Hypoxia
  - a. definition
  - b. causes
  - c. signs and symptoms
  - d. system warnings or indications
- xxvii. Hyperoxia
  - a. definition
  - b. causes
  - c. signs and symptoms
  - d. system warnings or indications
  - e. system warnings or indications
- xxviii. Caustic Cocktail
  - a. definition
  - b. causes
  - c. signs and symptoms
- xxix. When it is necessary to disinfect a rebreather and how to do so
- xxx. What the main consumables are in a rebreather and when to replace them
  - a. Oxygen sensor
  - b. Scrubber
  - c. Battery
  - d. Gas
- xxxi. Factors affecting the work of breathing in a rebreather
  - a. Unit design
  - b. Diver positioning
  - c. Fit and placement of counterlungs
  - d. Loop volume
- xxxii. Gas metabolism with rebreathers
  - a. Oxygen consumption
  - b. CO<sub>2</sub> production
- xxxiii. Factors affecting the gas supply duration of a:
  - a. CCR
  - b. SCR
- xxxiv. O<sub>2</sub> Setpoint



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- xxxv. How to track your oxygen exposure with a rebreather
- xxxvi. Maximum depth of the diluent (eCCR) or supply gas (eSCR)
- xxxvii. Action to be taken in the case of rebreather malfunction
  - a. Switch to an open circuit bailout breathing supply
  - b. Alert team members/buddy
  - c. Abort the dive
- xxxviii. Control of buoyancy when ascending while breathing from bailout source
- xxxix. How to help an unresponsive rebreather diver at the surface and underwater
  - xl. How to dive with an open-circuit buddy
  - xli. Importance of staying up to date with use of rebreather
  - xlii. Need for unit specific training for rebreathers

#### 8. Confined Water Training

- a. All new skills shall be introduced in a confined water situation and all critical skills should be mastered by the student in that environment before attempting them in open water.

#### 9. Practical Skills

- a. The student shall have experience of at least four open water dives/water sessions and at least 300 minutes total open water time during the course.
- b. The diver's primary emergency action in the event of rebreather malfunction will be to switch to an open circuit breathing supply and then abort the dive.
- c. A separate bail out cylinder and regulator system is required for any dives deeper than 21m/70 feet.
- d. By the end of the course the candidate shall be able to perform the following skills (course content should include all the following items unless inapplicable for the rebreather model used):
  - i. Plan appropriate time, depth and supply (gas, scrubber, etc.) limits for the dive based on the rebreather manufacturer's specification, the environment, rebreather, no stop limits, oxygen exposure, previous dives and other factors that may apply.
  - ii. Assemble the rebreather in accordance with manufacturer guidelines, using a checklist (manual or digital).
  - iii. Perform a complete rebreather pre-dive check, in accordance with manufacturer recommendations, using a checklist (manual or digital).
  - iv. Don and adjust the rebreather for proper fit, including breathing hose, mouthpiece and counterlung placement.
  - v. Establish proper weighting and weight placement (trim) with the rebreather.
  - vi. Enter the water using a technique appropriate for the environment.
  - vii. Demonstrate awareness of system status by continuously monitoring the rebreather's displays frequently throughout the dive.



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- viii. Demonstrate monitoring of gas CO<sub>2</sub> absorbent as appropriate.
- ix. Demonstrate proper habits for retaining loop integrity.
- x. Demonstrate clearing mask with a rebreather while maintaining neutral buoyancy.
- xi. Perform a proper descent in water too deep to stand, under control, with a buddy.
- xii. During descent, perform a bubble check and display check.
- xiii. Change to appropriate set-point if not initiated automatically.
- xiv. Check oxygen sensors are not current limited (linearity check) if not initiated automatically.
- xv. Demonstrate proper operation of mouthpiece closure mechanism.
- xvi. On signal of a simulated emergency, bail out to an open circuit source, then return to the loop after the exercise following proper procedures.
- xvii. Demonstrate the procedure for removing water and purging it from the loop through the OPV (or other valve) or into a water trap, as appropriate.
- xviii. Swim in a horizontal position, maintaining neutral buoyancy.
- xix. Demonstrate buoyancy control ability by remaining at a single depth without rising or sinking more than 1 metre/3 feet and with minimum use of fins or sculling.
- xx. Demonstrate correct procedure for manual addition of oxygen (where appropriate).
- xxi. Demonstrate correct procedure for manual addition of diluent (where appropriate).
- xxii. Demonstrate correct procedure for diluent flush (where appropriate).
- xxiii. Deploy a DSMB and reel, inflate the DSMB and send it up on the line.
- xxiv. In water too deep to stand, make a normal, controlled ascent maintaining buddy contact, looking up and ascending at the appropriate rate.
- xxv. At the surface in water too deep in which to stand, demonstrate proper procedures by establishing buoyancy with the BCD, then closing the mouthpiece before removing the mouthpiece from the mouth.
- xxvi. At the surface in water too deep in which to stand, demonstrate oral inflation of the BCD.
- xxvii. Respond to a simulated rebreather emergency by bailing out to the BOV and/or switching to the off-board bailout cylinder and ascending to the surface at an appropriate controlled rate accompanied by a buddy.
- xxviii. Exit the water using a technique appropriate for the environment.
- xxix. Demonstrate appropriate post-dive care and disassembly for the rebreather, in accordance with manufacturer's guidelines.
- xxx. Don an off-board bailout cylinder at the surface.\*
- xxxi. Remove and replace an off-board bailout cylinder while underwater.\*





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- xxxii. Remove an off-board bailout cylinder at the surface.\*
- xxxiii. On signal of a simulated emergency, demonstrate proper procedure for switching to the off-board bailout cylinder, then return to the loop after the exercise.\*
- xxxiv. On signal of a simulated emergency, as both a donor and a receiver, use an off-board bailout cylinder to share gas with another diver.\*

*\* When a separate bail out cylinder and regulator system is used*

#### 10. Instructor Requirements

An instructor in teaching status with the training organisation who is authorised to certify at this level for the rebreather used in the course.

#### 11. Certification

Once the instructor has ensured the student has met all the requirements of this standard, the instructor shall send a certification application to the training organisation who shall issue a certification to the student.