

## 2.3.5 Closed-Circuit Rebreather Diver Level 1

### 2.3.5.1 Course Outcomes

GUE's Closed-Circuit Rebreather Diver Level 1 course is an entry-level closed-circuit rebreather course designed to educate GUE technical divers in basic rebreather technologies and to cultivate diver proficiency in the use of GUE-approved closed-circuit rebreather configurations.

### 2.3.5.2 Prerequisites

Applicants for a CCR 1 course must:

- a. Submit a completed Course Registration Form, Medical History Form, and Liability Release Form to GUE HQ.
- b. Hold insurance that will cover diving emergencies such as hyperbaric treatment, e.g., DAN Master-level insurance or equivalent.
- c. Be physically and mentally fit.
- d. Be a nonsmoker.
- e. Obtain a physician's prior written authorization for the use of prescription drugs, except for birth control, or for any medical condition that may pose a risk while diving.
- f. Be a minimum of 21 years of age.
- g. Be a certified GUE Technical Diver Level 1 diver.
- h. Have completed at least 25 non-training Tech 1 dives beyond GUE Technical Diver Level 1 certification.
- i. Have completed at least 50 non-training dives in a double tank configuration.

### 2.3.5.3 Course Content

The Closed-Circuit Rebreather Diver Level 1 course is normally conducted over six days. It requires a minimum of eight dives and at least forty-eight hours of instruction, encompassing classroom lectures, land drills, and at least ten hours of in-water work.

### 2.3.5.4 Closed-Circuit Rebreather Diver Level 1 Specific Training Standards

- a. Student-to-instructor ratio is not to exceed 6:1 during land drill or surface exercises; it cannot exceed 3:1 during any in-water training.
- b. Maximum depth of 100 ft/30 m
- c. All dives must be within minimum decompression limits (MDLs), i.e., no required stops.
- d. No overhead diving
- e. The oxygen supply valve must never be closed completely during drills.

### 2.3.5.5 Required Training Materials

GUE training materials and recommended reading as determined by the course study packet received via online download after GUE course registration.

### 2.3.5.6 Academic Topics

- a. Introduction: GUE organization and course overview (objectives, limits, expectations)
- b. Anatomy of rebreathers, common components and how they function
- c. Benefits and disadvantages of using closed-circuit rebreathers
- d. Inherent risks of using closed-circuit rebreathers

- e. Closed-circuit rebreather operation, alarms, and warnings
- f. Breathing gas dynamics, hyperoxia, hypoxia, hypercapnia, and gas density
- g. Absorbent material: properties and canister endurance
- h. Gas management: consumption, use, requirements, and reserves
- i. Decompression considerations while using closed-circuit rebreathers
- j. Diver safety and responsibilities

#### 2.3.5.7 Land Drills and Topics

- a. Rebreather assembly and setup
- b. Rebreather pre-dive checklist
- c. Rebreather on-site checklist
- d. CHAOS critical control checks and 5-minute pre-breathe
- e. Dry land experience dive, including basic operations such as: switching to and off the loop (DSV/BOV open/close); achieving a proper seal around the mouthpiece; preventing nose exhalation; testing for, achieving, and maintaining optimal loop volume; pO<sub>2</sub> awareness using HUD and controller; communicating own pO<sub>2</sub> and current setpoint; requesting pO<sub>2</sub> and setpoint information from team
- f. Electronically controlled setpoint and switches
- g. Manually controlled setpoint and switches
- h. Diluent flush techniques, including two-handed, one-handed, and exhalation-triggered ADV diluent gas addition
- i. Basic failure management
- j. Bailout and out-of-gas procedures
- k. Unconscious diver recovery
- l. Maintenance and repair of closed-circuit rebreather

#### 2.3.5.8 Required Dive Skills and Drills

- a. Demonstrate a safe and responsible demeanor throughout all training.
- b. Demonstrate proficiency in underwater communication.
- c. Demonstrate basic proficiency in managing a closed-circuit rebreather configuration.
- d. Demonstrate reasonable proficiency with the use of the closed-circuit rebreather during ascents, descents, and bottom phase of the dive.
- e. Demonstrate good buoyancy and trim, i.e., approximate reference is a maximum of 20 degrees off horizontal while remaining within 3 ft/1 m of a target depth.
- f. Must be able to swim at least 500 yds/450 m in less than 14 minutes without stopping. This test should be conducted in a swimsuit and, where necessary, appropriate thermal protection.
- g. Must be able to swim a distance of at least 60 ft/18 m on a breath hold while submerged.
- h. Demonstrate the ability to manage a flooded closed-circuit rebreather while discharging excess water.
- i. Demonstrate the ability to diagnose and correctly respond to simulated closed-circuit rebreather problems.
- j. Demonstrate the ability to switch and maintain desired pO<sub>2</sub> setpoints electronically through a dive.
- k. Demonstrate the ability to switch and maintain desired pO<sub>2</sub> setpoints manually through a dive.

- l. Demonstrate effective valve management.
- m. Demonstrate proficiency in safe diving procedures, including assembly and setup; rebreather pre-dive checklist; rebreather on-site checklist; CHAOS critical control checks and 5-minute pre-breathe; GUE-EDGE; flow check; in-water activity; and post-dive assessment, breakdown, and maintenance.
- n. Efficiently and comfortably demonstrate how to donate gas to an out-of-gas diver while using the closed-circuit rebreather.
- o. Be able to comfortably demonstrate use, manipulation, and failure management of the gas addition systems supplying the rebreather.
- p. Demonstrate awareness of a team member's closed-circuit rebreather function and an overall concern for safety, responding quickly to visual or audible indications and dive partner needs during diving and failures.

### 2.3.5.9 Equipment Requirements

GUE base equipment configuration as outlined in Appendix A, plus:

- a. Modified tank configuration as appropriate for use with a GUE-approved closed-circuit rebreather
- b. Modified regulator configuration as appropriate for use with a GUE-approved closed-circuit rebreather
- c. A GUE-approved closed-circuit rebreather
  - i. The closed-circuit rebreather used by the student, with all associated components, must be fully functional (pass all tests on the rebreather pre-dive checklist) and serviced according to manufacturer specifications.
  - ii. All oxygen sensors must be less than one year from manufacturing date.
  - iii. Both the rebreather controller and SOLO board must be updated with the latest software and firmware versions published by the manufacturer.
- d. Spare parts and consumables, including one set of controller, HUD, and solenoid batteries; one oxygen sensor; and one DSV/BOV mouthpiece.
- e. One primary and two backup lights
- f. Drysuit inflation system independent from back gas cylinders (optional). If using a drysuit inflation cylinder attached to the backplate, extended inflation cylinder straps need to be used to ensure that it does not interfere with or restrict the counterlung's function.

Prior to the commencement of the class, students should consult with a GUE representative to verify equipment requirements and appropriateness of any selected equipment.

## Appendix A - GUE Base Equipment Configuration

The GUE base equipment configuration is comprised of:

- a. Tanks/cylinders: Students may use a single tank/cylinder with a single- or dual-outlet valve. Students may also use dual tanks/cylinders connected with a dual-outlet isolator manifold, which allows for the use of two first stages. Dual tanks/cylinders connected with a dual-outlet, non-isolator manifold can be used, but only in recreational (no

decompression) diving, and are considered an alternative for a single tank/cylinder. Consult course-specific standards and your instructor to verify size requirements.

- b. Regulators:
  - i. Single tank: The first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose. A backup second stage must be necklaced and supplied via a short hose. The first stage must also supply an analog pressure gauge, inflation for the buoyancy compensator (BC), and (when applicable) inflation for a drysuit.
  - ii. Double tank: One first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose (7 ft/2 m hose is required for all cave classes), and inflation for the buoyancy compensator (BC). The other first stage must supply a necklaced backup second stage via a short hose, an analog pressure gauge, and (when applicable) inflation for a drysuit.
- c. Backplate system:
  - i. Is held to the diver by one continuous piece of webbing. This webbing is adjustable and uses a buckle to secure the system at the waist.
  - ii. A crotch strap is attached and looped through the waistband to prevent the system from riding up a diver's back.
  - iii. The continuous webbing must support five D-rings;
    - 1. The first placed at the left hip
    - 2. The second placed in line with a diver's right collarbone
    - 3. The third placed in line with the diver's left collarbone
    - 4. The fourth and fifth are placed on the front and back of the crotch strap when divers plan to use advanced equipment such as DPVs.
  - iv. The harness below the diver's arms has small restrictive bands to allow for the placement of backup lights. The webbing and system retains a minimalist approach.
- d. Buoyancy compensation device (BC):
  - i. A diver's BC is back-mounted and minimalist in nature.
  - ii. It is free of extraneous strings, tabs, or other material.
  - iii. There are no restrictive bands or restrictive elastic affixed to the buoyancy cell.
  - iv. Wing size and shape is appropriate to the cylinder size(s) employed for training.
- e. At least one time/depth measuring device
- f. Wrist-mounted compass
- g. Mask and fins: Mask is low-volume; fins are rigid, non-split.
- h. Backup mask
- i. At least one cutting device
- j. Wetnotes with pencils
- k. Surface marker buoy (SMB) with spool: when required, the SMB should be appropriate for environmental conditions and deployed using a spool with at least 100 ft/30 m of line.
- l. Exposure suit appropriate for the duration of exposure

### Additional Course-Specific Equipment

- a. Where required, back gas and stage cylinders are marked in accordance with the GUE General Training Standards, Policies, and Procedures document and configured in line with GUE protocols.

- b. When drysuit inflation systems are applicable, they should be sized appropriately for the environment; small tanks are placed on the left side of the backplate with larger supplies affixed to the diver's left back gas tank.
- c. Underwater lights:
  - i. When required, backup lights should be powered by alkaline batteries (not rechargeable) and stowed on the D-rings at a diver's chest.
  - ii. Backup lights should have a minimal amount of protrusions and a single attachment at the rear.
  - iii. The primary light should consist of a rechargeable battery pack and be fitted with a Goodman-style light handle.
  - iv. When burn time requirements create the need for an external battery pack, it should reside in a canister mounted on the diver's right hip.
- d. Guideline devices, as required during cave diving activities:
  - i. A primary reel is required for all cave diving and provides a minimalist form factor with a handle designed to support a Goodman or "hands free" handle operation. The primary reel must contain at least 150 ft/45 m of line.
  - ii. A safety spool is required for each diver while cave diving and must contain at least 150 ft/45 m of line.
  - iii. A jump or gap spool is required during Cave 2 diving and must contain at least 75 ft/23 m of line.