18. TDI – Mixed Gas Closed Circuit Rebreather, Unit Specific- Inspiration / Evolution, KISS, Optima, Megalodon

18.1 Introduction

This is the intermediate level certification course for divers wishing to utilize a Closed Circuit Rebreather (CCR) for mixed gas diving. The objective of the course is to train divers in the benefits, hazards and proper procedures for mixed gas diving on the unit specific CCR, utilizing a mixed gas diluent containing sixteen (16%) percent or greater oxygen, and to develop intermediate CCR diving skills appropriate to technical diving to a maximum of two hundred (200) fsw / sixty (60) msw.

18.2 Qualifications of Graduates

Upon successful completion of this course, graduates may engage in technical diving activities utilizing the unit specific CCR to a maximum of two hundred (200) fsw / sixty (60) msw, utilizing a mixed gas diluent containing sixteen (16%) percent or greater oxygen.

18.3 Who May Teach

Who may teach this course:

1. An active TDI Closed Circuit Rebreather Instructor or Instructor Trainer with a **unit specific Mixed Gas Instructor** rating.
2. A "certified assistant" is a TDI or equally qualified Divemaster with an unit specific mixed gas user qualification and a minimum of 120 hours logged diving on the specific unit.
3. The Mixed Gas Instructor rating is awarded to a TDI Instructor who has the following:
   TDI unit specific Instructor with fifteen (15) students taught and one year teaching experience on the specific unit.
   Plus - Open Circuit Trimix Instructor (100 metre full rating) with fifteen (15) students taught and one further year teaching experience of Trimix open circuit.
   Properly verified and logged proof of thirty (30) mixed gas dives on a rebreather with fifteen (15) logged beyond two hundred fifteen (215) fsw / sixty five (65) msw.
   Applied to SDITDI Training Board for the qualification. Proof of each of the above MUST accompany the application.

The above method (3) will only be issued by the SDI TDI Training Board.

Or

4. A unit specific Instructor with fifteen (15) students taught and one year teaching experience on the specific unit.

   Logged proof of thirty (30) mixed gas dives on a rebreather with fifteen (15) logged beyond two hundred fifteen (215) fsw / sixty five (65) msw with at least one years added experience since gaining the Advanced Level Trimix qualification.

   Attendance on a CCR Rebreather Mixed Gas Instructor course undertaken on a properly conducted workshop while assisting a HQ approved Instructor Trainer teaching a minimum of four (4) unit specific Mixed Gas students.

   Gained a minimum of pass in all areas of evaluation from the Instructor Trainer.

18.4 Student – Instructor Ratio

Academic:

1. Unlimited, so long as adequate facility, supplies and time are provided to insure comprehensive and complete training.

Confined Water (Swimming pool-like conditions):

1. A maximum of two (2) students per active TDI Instructor is allowed or four (4) with a certified assistant.

Open Water (Ocean, lake, quarry, spring, river or estuary):

1. A maximum of two (2) students per active TDI Instructor is allowed or four (4) with a certified assistant.
2. The ratio should be reduced as required due to environmental or operational constraints

Special note; A "certified assistant" is a SDI/TDI Divemaster or equivalent from agencies recognized by TDI, with a Mixed Gas CCR user qualification and a minimum of 50 hours logged diving on the CCR being taught.

18.5 Student Pre-Requisites

The student must:

1. Be a minimum age of eighteen (18).
2. Have a verified log of a minimum of fifty (50) rebreather hours distributed over a minimum of fifty (50) dives on the specific rebreather. Fifty (50) % deeper than sixty six (66) fsw / twenty (20) msw. All to be deeper than twenty (30) fsw / nine (9) msw. If the diver has fifty (50) hours on another CCR unit recognized by TDI, only twenty five (25) hours are required to be on the specific unit.
3. Have completed and qualified the TDI Air Diluent Rebreather Course or equivalent from agencies recognized by TDI.

18.6 Course Structure and Duration

Open Water Execution:

1. Minimum of three hundred sixty (360) minutes open water training to be completed over a minimum of six (6) dives including one (1) equipment configuration and drills practice air diluent dive to a maximum one hundred thirty (130) fsw / forty (40) msw.

2. All subsequent dives to build incrementally in no greater than thirty three (33) fsw / ten (10) msw steps.
3. Only one (1) dive is on air diluent all others are to be mixed gas dives.
4. All mixed gas dives are to be deeper than one hundred thirty (130) fsw / forty (40) msw utilizing a mixed gas diluent containing sixteen (16%) percent or greater oxygen.
5. Four (4) dives must be decompression dives.

Course Structure:

1. TDI allows instructors to structure courses according to the number of students participating and their skill level.
2. The exam may be given orally if not available in a language the student understands.

Duration:

1. Minimum of six (6) hours for academic development and a further two (2) hours for equipment configuration workshop.

Special note; If the diver is already open circuit trimix certified, six (6) dives and three hundred sixty (360) minutes is still required.

18.7 Administrative Requirements

The following is the administrative tasks:

1. Collect the course fees from all the students.
2. Ensure that the students have the required equipment.
3. Communicate the training schedule to the students.
4. Have the students complete the Liability Release and Medical history forms.
5. The Instructor should review the Liability Release and Medical Forms before starting on the course.

Upon successful completion of the course the Instructor must:

1. Complete the Student Registration Form and send the Registration Form to TDI HQ.
2. Award card and certificate.

18.8 Required Equipment

The following are required for this course:

1. TDI unit specific Rebreather Manual.
2. TDI Slide Set.
3. Manufactures' Manual & Updates.

The following equipment is required for each student:

1. A closed circuit rebreather. This should be the students own unit.
2. Minimum of two (2) bottom timers and depth gauges or one (1) CCR mixed gas computer & one (1) bottom timer and depth gauge.
3. Bailout gas supply in a minimum of two (2) separate off-board oxygen clean cylinders. Calculated at 30 litres (1.06 cubic feet) per minute usage to cover stress situations.
4. Two (2) open circuit regulators and gauges fitted to the configuration.
5. Mask, fins & a suitable line-cutting device.

6. Slate & pencil.
7. Reel with a minimum of two hundred (200) fsw / sixty (60) msw of line.
8. Reel with a minimum of one hundred (100) fsw / thirty (30) msw of line.
9. Two (2) Lift Bags / Delayed Surface Marker Buoys (DSMB's) with a minimum of twenty five (25) lb / twelve (12) kg Lift.
10. Exposure suit adequate for the open water environment where training will be conducted.
11. Access to an oxygen analyzer.
12. Access to a helium analyser
13. Adequate weight.

18.9 Required Subject Areas

The TDI Rebreather manual is required for use as a review/recap document. The Instructor may use any additional text or materials they feel will represent the topic in an educational manner. The following topics must be covered during the course.

1. Gas Physiology.
   - A. Oxygen toxicity.
   - B. Hypoxia.
   - C. Nitrogen absorption.
   - D. Helium absorption.
   - E. HPNS
   - F. CO_2 toxicity.
   - G. Gas consumption.
   - H. Gas mixing.
2. Formula Work.
   - A. O_2 metabolizing calculations.
   - B. Manually controlled closed circuit rebreathers
   - C. Equivalent Narcosis Depth theory.
   - D. CNS tracking.
   - E. OTU Tracking.
   - F. Gas management.
3. Dive Tables.
   - A. Creation of custom dive tables appropriate to dive depths.
   - B. Creation of lower PO_2 diluent to support loop flushing and bailout at depth.
4. Dive Computers.
   - A. Mix adjustable.
   - B. Constant PPO_2.
   - C. O_2 integrated.
5. Dive Planning.
   - A. Operational Planning.
     - I. Gas requirements including bailout scenarios.
     - II. Decompression on a CCR.
     - III. Oxygen limitations.
     - IV. Nitrogen limitations.
     - V. Helium limitations.

6. Equipment Maintenance
    A. Fuel Cell Management.
        I. Date stamps
        II. Replacement
    B. Loop configurations.
    C. Additional fitted equipment and modifications
        I. Auto Diluent Addition.
        II. Dual Mode Mouthpieces.
        III. Head Up Display.
        IV. Additional Manual Injectors.
        V. Integrating Oxygen Monitors for Dive Computers.

Special note; If the TDI Trimix course is taught in conjunction all subject matter from both courses must be covered.

18.10 Required Skill Performance And Graduation Requirements

The following open water skills must be completed by the student during open-water dives with the following course limits:

1. No dives deeper than two hundred (200) fsw / sixty (60) msw
2. No dives shallower than one hundred thirty one (131) fsw / forty (40) msw other than the one (1) air diluent configuration dive.
3. Equivalent narcosis depth not to exceed one hundred (100) fsw / thirty (30) msw.
4. Calculate all off-board gas at 30 litres (1.06 cubic feet) per minute usage to cover stress situations.
5. PO_2 not to exceed manufacturer recommendation or a working limit of 1.3 bar during the bottom phase of the dive and 1.4 bar during the decompression phase of the dive.
6. All dives to be completed within appropriate fixed PO2 decompression tables.
7. All dives to be completed within CNS% limits with a recommend maximum of eighty (80) % of the total PO_2 CNS limit.
8. The student is only certified for CCR mixed gas diving on the rebreather being used.

Open Water Skills:

1. Verify diluent and O_2 cylinder contents using O_2 analyzer where appropriate.
2. Demonstrate correct pre dive planning procedures including:
    A. Limits based on system performance.
    B. Limits based on oxygen exposures at chosen PPO_2 levels.
    C. Limits based on manually controlled closed circuit rebreathers.
    D. Limits based on nitrogen absorption at planned depth and PPO_2 (Setpoint) level.
    E. Limits based on helium absorption.
    F. Correct narcotic depth planning and diluent selection to allow cell flushing at target depth.
3. Properly execute a recovery from a system failure and conclude the dive and decompression on open circuit gases carried.
4. Gas shutdowns and loss of gas, correct choice and switching to off board gases.
5. Broken hoses – disaster scenarios.
6. Flooded absorbent canister.
7. Oxygen rebreather mode shallower than twenty (20) fsw / six (6) msw.
8. Controlled use of BC/suit for buoyancy control.
9. Pre dive checks.
10. Stop at ten to twenty (10 – 20) fsw / three to six (3-6) msw on descent for leak bubble check.

11. Remove and replace side mounted stage cylinders under water.
12. Deployment of a Lift Bag / Delayed Surface Marker Buoy (DSMB) at depth and mid water.
13. Electronics systems monitoring for PPO_2 levels.
14. Proper execution of the dive within all pre-determined dive limits.
15. Demonstration of decompression stops at pre-determined depths.
16. Post dive clean of unit to avoid contamination and spread of disease.

In order to complete the course and achieve the TDI Mixed Gas CCR rating the student must:

1. Complete to the Instructors satisfaction all confined and open water skill development sessions.
2. Demonstrate mature, sound judgment concerning dive planning and execution.
3. Satisfactorily complete a written examination with a pass mark of greater than eighty (80) %.
4. Course must be completed within six (6) weeks from the starting date.
5. Complete a refresher course following a period of inactivity greater than six (6) months following the course.