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## **10. TDI – Semi-Closed Circuit Rebreather Diver Course, Unit Specific- DOLPHIN, RAY, Atlantis, SUBMATIX ST100 & AZIMUTH**

### **10.1 Introduction**

This is the entry-level certification course for recreational divers wishing to utilize one of the following Semi-closed circuit Rebreathers; Dolphin, Ray, Submatix ST100 or Azimuth. The objective of this course is to train recreational divers in the benefits, hazards and proper procedures for using SCR Rebreathers.

### **10.2 Qualifications of Graduates**

Upon successful completion of this course, graduates may engage in no decompression diving activities utilizing the Dolphin, Ray, Submatix ST100 or Azimuth to a maximum depth of forty (40) msw / one hundred thirty (130) feet, without decompression. Utilizing nitrox mixes not exceeding their level of certification.

### **10.3 Who May Teach**

Who may teach this course:

1. Any active TDI Rebreather Instructor may teach this course. Specific instructor certification required for each specific rebreather.

### **10.4 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. N/A.

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

1. A maximum of six (6) students per Instructor for the Draeger units, for the Azimuth and Submatix units a maximum of four (4) students per instructor. However, it is the instructor's discretion to reduce this number as conditions dictate.



## **10.5 Student Pre-Requisites**

The student must:

1. Be a minimum age of fifteen (15).
2. Have a minimum certification of TDI Nitrox Diver (may be combined in program), or equivalent at the discretion of the instructor.

## **10.6 Course Structure and Duration**

Open Water Execution:

1. A minimum of six (6) dives with a minimum of one hundred (100) accumulated minutes for the Azimuth .
2. A minimum of four (4) dives with a minimum of one hundred (100) accumulated minutes for the Drager units
3. A minimum of five (5) dives with a minimum of one hundred twenty five (125) accumulated minutes for the Submatix ST100

Course Structure:

1. TDI allows instructors to structure courses according to the number of students participating and their skill level.

Duration:

1. The minimum number of classroom and briefing hours is six (6).

## **10.7 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 must 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.
2. Award certification card.

## **10.8 Training Material**

Required material

1. TDI Semi-Closed Circuit Rebreathers diver manual.
2. Specific manufacturer manual for the rebreather being dived

Optional Material

1. TDI plastic EAD and PO2 tables
2. TDI Semi-Closed Circuit Rebreathers diver PowerPoint
3. Nitrox & Rebreather Equations Software



## **10.9 Required Equipment**

The following equipment is required for each student:

1. Rebreather specific to the training being conducted
2. Integrated PO<sub>2</sub> monitoring device for inhaled PO<sub>2</sub> for each rebreather
3. Mask and fins.
4. Exposure suit appropriate for the open water environment.
5. Access to oxygen analyzer (instructor may supply).
6. Appropriate weight.
7. Bailout cylinder (minimum size 3L / twelve (12) cu. ft.)
8. Flow meter (instructor may supply)

## **10.10 Required Subject Areas**

The Rebreather Manual and the manufactures' manual are mandatory for use during this course but instructors may use any additional text or materials that they feel help present these topics. The following topics must be covered during this course:

1. History and Evolution of Rebreathers.
2. Comparison of Open Circuit, Closed Circuit, and Semi-closed Circuit.
3. Practical Mechanics of the System
  - A. Assembly and disassembly of the Rebreather.
  - B. Layout and design.
  - C. Scrubber recharge.
  - D. System maintenance.
  - E. Breathing loop decontamination procedures.
4. Review of nitrox
  - A. Dalton's Law (triangle)
  - B. Optimum nitrox mix
  - C. Oxygen Tracking
  - D. Gas preparation
  - E. Dive planning examples
5. Gas physiology
  - A. Oxygen toxicity.
  - B. Hyperoxia.
  - C. Hypoxia.
  - D. Asphyxia
  - E. Hypercapnia
  - F. Nitrogen absorption.
  - G. CO<sub>2</sub> toxicity.
  - H. Gas consumption.
    - i. Cylinder sizes
    - ii. Depth and workload
6. Formula work / metabolic consumption
  - A. O<sub>2</sub> metabolizing calculations.
  - B. Inspired O<sub>2</sub> calculations (Rebreather Equation).
  - C. Equivalent air depth.



7. Dive Tables
  - A. Inspired O<sub>2</sub> table.
  - B. Equivalent air depth.
8. Dive Computers
  - A. Mix adjustable.
  - B. O<sub>2</sub> integrated.
  - C. PO<sub>2</sub> monitoring devices
9. Problem Solving
  - A. Canister flooding
  - B. Mouthpiece loss
  - C. Scrubber exhaustion
  - D. Battery or sensor loss
  - E. Breathing Bag rupture
  - F. Open circuit bailout system
    - I. On board gas
    - II. Off board gas
  - G. Hyperoxia scenario
  - H. Hypoxia scenario
  - I. hypercapnia scenario
  - J. Post problem maintenance of equipment
10. Dive Planning
  - A. Operational Planning
    - I. Gas requirements.
    - II. Oxygen limitations.
    - III. Nitrogen limitations.

### **10.11 Required Skill Performance and Graduation Requirements**

The dive depth shall not exceed one point six (1.6 ATM) P<sub>O<sub>2</sub></sub>. The following skills must be completed by the student during open water dives:

1. Properly analyze gas mixture.
2. Perform all pre dive checks (positive, negative, flow rate, by-pass regulator operation, relief valve pressure) a minimum of six (6) times.
3. Demonstrate a leak check and repair scenario.
4. Demonstration of integrity of exhale counterlung for Submatix ST100
5. Properly packing a scrubber canister a minimum of two (2) times (if using the ExtendAir cartridge one packing must be with granular material).
6. Properly execute set-up and breakdown a minimum of six (6) times for Azimuth or four (4) times for Draeger and Submatix ST100 rebreathers.
7. Demonstrate adequate pre-dive planning
  - A. Limits based on system performance.
  - B. Limits based upon oxygen exposures at planned depth with mix.
  - C. Limits based upon nitrogen absorption at planned depth with mix.
8. Properly execute the planned dives within all pre-determined limits.



9. Properly execute a recovery from a system failure and switch to bail-out stationary a minimum of two (2) times.
10. Properly execute a recovery from a system failure and switch to bail-out hovering a minimum of two (2) times, one of the bail-out scenarios the diver must switch to open circuit and complete dive and safety stop on open circuit (direct ascent must begin when diver switches to open circuit, this scenario should be conducted no deeper than 60 fsw / 20 meters).
11. Properly demonstrate hose clearing technique after each bail-out scenario.
12. Perform block switch a minimum of two (2) times, **Azimuth only**.
13. Proper PO<sub>2</sub> monitoring on all dives (if unit is equipped with P<sub>O</sub><sub>2</sub> monitoring device).
14. Properly execute a mask clearing exercise with emphasis on minimal gas loss.
15. Safely and properly execute a buddy out of air scenario, it is preferable the buddy is on a SCR unit also.
16. Diver will demonstrate actual safety stops at pre-determined depths.
17. Properly execute cleaning and maintenance of the Rebreather, including breathing loop decontamination.

In order to complete this course, students must:

1. Satisfactorily complete the TDI Rebreather Course written examination.
2. Complete all open water requirements safely and efficiently.
3. Demonstrate mature, sound judgment concerning dive planning and execution.