

14. Technical Freediving

14.1 Introduction

Freediving like any other endeavor may mean finding the right tool for the job and technical freediving can be that tool for many freediving applications. Hard working environments such as safety freediving at competitions where repetitive all-day deeper depths can be performed to longer repetitive bottom times in short time frames such as filming or spearfishing. Exploratory/expedition style freediving can also benefit from the use of oxygenated breathing mixtures at the surface to increase safety, reduce decompression fatigue, help with longer bottom times or create a margin of safety to avoid problems with hypoxia and nitrogen related issues such as decompression sickness.

14.2 Who May Teach

An active PFI Intermediate Freediver Instructor that has been certified to teach this specialty

14.3 Student to Instructor Ratio

Academic

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

Confined Water (swimming pool-like conditions)

1. A maximum of 8 students per instructor; it is the instructor's discretion to reduce this number as conditions dictate
2. The instructor has the option of adding 4 more students with the assistance of an active assistant instructor
3. The total number of students an instructor may have in the water is 12 with the assistance of active assistant instructors

Open Water (ocean, lake, quarry, spring, river or estuary)

1. A maximum of 6 students per instructor; it is the instructor's discretion to reduce this number as conditions dictate
2. The instructor has the option of adding 4 more students with the assistance of an active assistant instructor
3. The total number of students an instructor may have in the water is 10 with the assistance of active assistant instructors

Equipment

1. A maximum of 3 students per 1 Technical Freediving System for both high and low mixes

14.4 Student Prerequisites

1. PFI Intermediate Freediver or equivalent
2. Minimum age 18

14.5 Course Structure and Duration

Confined Water Execution

1. One confined water freedive session is required for the pool only certification with complete briefs and debriefs by the instructor (Optional if open water is conducted)
2. Freedive plan must include surface interval calculations, direct supervision procedures, gas mixes used, etc. will be figured and logged

Open Water Execution

1. One open water freedive session is required for the course with complete briefs and debriefs by the instructor (optional for Pool Only certification)
2. Freedive plan must include surface interval calculations, direct supervision procedures, gas mixes used, etc. will be figured and logged

Course Structure

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

14.6 Administrative Requirements

Administrative Tasks:

1. Collect the course fees from all the students
2. Ensure that the students have the required equipment
3. Communicate the schedule to the students
4. Have the students complete the:
 - a. *PFI General Liability Release and Express Assumption of Risk Form*
 - b. *PFI Medical History Form*

Upon successful completion of this specialty the instructor must:

1. Issue the appropriate PFI certification by registering the students online through member's area of the PFI website or submitting the *PFI Student Registration Form* to PFI Headquarters

14.7 Training Material

Required Material:

1. *PFI Technical Freediver* Student Workbook
2. *PFI Technical Freediver* Instructor Guide
3. *PFI Technical Freediver* Final Exam

14.8 Required Equipment

1. Basic freediving equipment as described in section three of this manual plus an additional timing device for each student
2. Float and line
3. One audible and one visual signaling device
4. Scuba cylinders (one with a O₂ high mix 80%+, one with a low O₂ mix 28-34%) with first and second stage regulators

14.9 Approved Outline

Instructors may use any additional text or materials that they feel help present these topics. The following topics must be covered:

1. What is Technical Freediving?
2. History
3. Advantages / Disadvantages of Technical Freediving
 - a. Applications / Advantages
 - i. DCI Avoidance
 - ii. Reduced Decompression Stress
 - iii. Faster Recovery
 - iv. Accelerated Surface Intervals
 - v. Longer Bottom Times
 - vi. Conservatism
 - b. Hazards / Disadvantages
 - i. Lung Expansion Injuries Potential
 - ii. Contamination of breathing gas
 - iii. O₂ toxicity – CNS & Whole-body
 - iv. O₂ Handling
 - v. Decreased Depth-Advantage
 - vi. Possible DCI
 - vii. Increased Equipment Reliance

4. Physiology of Technical Freediving
 - a. Hypoxia > Normoxia > Hyperoxia
 - i. Hypoxia – decreased O₂ to the tissues
 - ii. Normoxia – normal O₂ to the tissues
 - iii. Hyperoxia – increased O₂ to the tissues
 - iv. Partial Pressures of Oxygen
 - b. Oxygen Toxicity
 - i. CNS Oxygen Toxicity
 - ii. NOAA O₂ Exposure Tables
 - iii. Signs and Symptoms
 - iv. First Aid and Treatment
 - v. Predisposing Factors
 - vi. Avoidance
 - vii. Maximum Operating Depths
 - c. CO₂ Narcosis
 - i. Hypocapnia
 - ii. Hypercapnia
 - iii. High O₂ exposure on CO₂ Chemoreceptors
 - iv. CO₂ Narcosis Signs & Symptoms
 - d. Decompression Illness and Decompression Stress
 - i. Partial Pressures and Nitrogen
 - ii. Decompression Illness vs Decompression Stress
 - iii. Type I and Type II DCI
 - iv. Signs and Symptoms
 - v. First Aid and Treatment
 - vi. Avoidance
 - e. Recovery and Lactic Acid
 - i. Decreased uptake time of O₂ saturation
 - ii. O₂ helps Lactic convert back into glucose via glycolysis in ATP
 - f. Surface Intervals (SI)
 - i. Reduced SI vs same but conservative
 - ii. Batle Tables
 - iii. PFI Surface Interval Tables
 - iv. Half normal SI times via 80% O₂ Acceleration
 - v. Equivalent Air Depth
 - vi. Off Oxygen – 2min

- g. Longer Bottom Times
 - i. Oxygen Hemoglobin Disassociation Curve
 - ii. Bohr Effect
 - iii. CO2 Blood Buffering
- h. Lung Over-pressurization
 - i. Pressure – Volume
 - ii. Breath-hold on scuba
 - iii. Signs and Symptoms
 - iv. First Aid and Treatment
 - v. Avoidance
- 5. Oxygen vs Nitrox: Types, Selection and Procedures
 - a. Oxygen
 - i. Types of Oxygen
 - ii. Types of Nitrox
 - b. Nitrox and Oxygen Selection for Technical Freediving
 - i. Pre-Breathe – longer bottom times
 - ii. Post-Breath – accelerated surface intervals
 - iii. Best Mix
 - iv. Multi Mixes
 - c. Common Procedures:
 - i. 5min Recovery (non-trained athletes)
 - ii. Low bottom mix:
 - iii. High surface mix:
 - iv. High / Low mix:
- 6. Equipment Parts, Assembly and Use for Technical Freediving
 - a. Tanks and Valves
 - i. Tanks – markings, inspection, testing, stickers
 - ii. Valves – types, O-rings, burst disk
 - iii. Storing / Transporting / Maintenance
 - b. Regulators and Pressure Gauge
 - i. 1st Stage & Assembly
 - ii. Pressure Gauges
 - iii. 2nd Stage Operation
 - iv. Storing / Transporting / Maintenance
 - c. Setting Up A Scuba System
 - d. Breathing Off Scuba Units
 - e. Oxygen Analyzers – Use and logging of mixes
 - f. Floats and Rigs
 - g. Nitrox and Oxygen Blending / Filling
 - h. Freedive Computers

- 7. Oxygen Handling and Servicing
 - a. Fire Triangle
 - i. O₂
 - ii. Fuel
 - iii. Ignition
 - b. O₂ Cleaned
 - i. Markings and stickers
 - c. O₂ Serviced
 - i. Markings and stickers
 - d. O₂ Regulator and Tank Handling
- 8. Procedures when Technical Freediving
 - a. Dive Session Gas Selection
 - i. Freedive profiles and objectives
 - ii. Application – single or multi use
 - iii. Selecting Best EAN_x / O₂
 - iv. Multi-Mixes
 - b. Scuba System Set-Up
 - i. Filling/Analyzing/Verification
 - ii. Technical Scuba System Assembly
 - iii. Tow-floats vs stationary
 - c. Gas Switching Procedures
 - i. On Gas
 - ii. Off Gas
 - iii. High Mix
 - iv. Low Mix
 - v. Switching Gases
 - vi. 2-5min Lung Flush

14.10 Required Skill Performance and Graduation Requirements

Students are required to successfully complete the following. Academic Workshop, Confined Water (required for Pool Only certification), and Open Water are required for full certification. Open Water is optional for Pool Only certification. Additional dives may occur for more experience.

1. Academic Workshop and Briefing
 - a. Plan freedive session, to include:
 - i. Objective and maximum depth/target time
 - ii. Single or multi-mix
 - iii. Surface support system
 - iv. Purchasing and checking labels
 - v. Analyze mixes
 1. Calibration
 2. Flow
 3. Verification and logging
 - b. Review and walk through safety procedures including
 - i. Rotation
 - ii. Recovery breathing
 - iii. Surface and underwater hypoxic procedures
 - iv. DCI Signs/Symptoms/Procedures
 - v. Setting up freedive computer alarms
 - c. Review and walk through gas switching procedures
 - i. Recovering using 'high mix'
 - ii. Safety 'high/low mix'
 - iii. Performer 'low mix' or '2-minute flush'
 - d. Complete dry max static (optional if confined water is used)
 - i. Two warmup statics breathing air
 - ii. 10 min breathe-up on 80% or higher mix
 - iii. Signals start at 2:00
 - iv. Proper recovery breathing then switch buddies
 - v. Disassemble and store equipment

2. Confined Water session (optional if open water is conducted)
 - a. Plan freedive session
 - b. Two warmup statics breathing air
 - c. 10 min breathe-up on 80% or higher mix
 - d. Signals start at 2:00
 - e. Proper recovery breathing then switch buddies
 - f. Disassemble and store equipment
 - g. Log freedive session
3. Open Water Freedive Session (optional for Pool Only)
 - a. Plan freedive session
 - b. Set up freedive platform/FRS and prepare technical freediving equipment
 - c. Complete at least 3 shallow warmup dives using air
 - d. Complete at least 3 depth freedives with bottom hang using 'low mix'
 - e. Complete at least 3 depth freedives with bottom hang using 'high mix' for surface interval acceleration
 - f. Complete at least 3 depth freedives with bottom hang using 'high mix' and 'low mix' procedures
 - g. Disassemble and store equipment
 - h. Log freedive session