

Appendix A:

Dive protocol

Each dive followed a fixed protocol:

1. The dive leader briefs the diver and load cell operator, who is also a trained dive physician.
2. The diver completes a pre-dive system check list as prescribed by the rebreather manufacturer.
3. The diver, wearing swim trunks, the rebreather unit, a conventional wing bladder BCD, adequate weights to stay negative at depth, and mask climbs into the pool, and breathes on the circuit for 2 min with pO_2 setpoint of 0.5 bar.
4. A static line, with length corresponding to the bottom depth is secured between the rebreather, close to the neck of the diver, and the load cell.
5. The diver emptied enough gas from the BCD to submerge to approximately 2 m depth. At this depth, the diver rotates along all axes, and shakes until bubbles trapped in fabric and crevasses of the equipment were no longer emerging. At this point an ocular check is performed through bathyscope by the dive leader. If any leaks are suspected, the diver resurfaces, and the procedure is repeated until it is confirmed that the diver plus equipment constitutes an entirely closed system. At this point, a clearance to descent is given by the dive leader through an underwater speaker system.
6. The diver empties the BCD bladder entirely and descended by passively sinking vertically, feet first, until stopped by the line.
7. Using hand-sign communication via underwater camera, the electrically actuated traverse crane to which the load cell is attached is vertically adjusted by the dive leader until the primary rebreather dive computer indicates a depth corresponding to an ambient total pressure of 2.5 bar. The line is tethered to a remote operated traverse crane over the pool. The dive leader fine-adjusts crane height until the diver gives hand signal that the depth—measured as pressure in the breathing circuit in level with the lung centroid of the diver—exactly matches 2.5 bar of ambient pressure.
8. Once depth has been stabilized, the diver fills the breathing circuit to approximately two-thirds full, using deep inhalations that trigger the automatic diluent valve (ADV).
9. The dive leader counts down from five through microphone, audible both to diver through the underwater speaker system, and operator of the load cell logger. At zero, the diver momentarily switches the mouthpiece position switch from closed-loop to open-loop and back, without inhaling or exhaling in-between, to create a time-sync entry in the rebreather log. Simultaneously the load cell log operator pushed a button to start load cell logging.
10. The diver remains completely still, breathing normally through the mouth only, while suspended by the line connected to the load cell.
11. The dive leader commences a countdown from five, so that zero is reached exactly 20 min following commencing of load cell logging. At zero, the diver performs the mouthpiece position switch sequence described under item 9, and the load cell log operator stops logging.
12. The diver sets the pO_2 setpoint to 0.7 bar while swimming up to the decompression depth, with BCD bladder remaining empty. Excess expanded gas is vented through the nose.
13. The load cell operator takes in slack on the line, and once the diver is at the decompression depth, the line connection is switched, to a pre-mounted carabiner at the line at correct distance from the bottom mount point.