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Accredited test of Pelagian DCCCR according to EN-14143 Work of Breathing, A4 13-01

Reply before

(3 enclosures)

1 Introduction

The Swedish Armed Forces Diving and Naval Medicine Centre are accredited by SWEDAC according to ISO/IEC-17025 to perform work of breathing (WOB) tests according to SS/EN-14143 5.6.1.1/5.6.1.2 and carbon dioxide absorbent canister tests according to SS/EN-14143 5.6.6.

The tests presented in this report comprise the work of breathing and carbon dioxide absorbent canister of a diver controlled closed circuit rebreather (DCCCR), the Pelagian.

2 Method and equipment

The breathing apparatus mouthpiece was connected directly to a breathing simulator, ANSTI, by a silicone nozzle. Measurements are within an uncertainty of 3%. An uncertainty budget is available upon request.

The tested apparatus has serial nr 096 with two configurations, front-mounted counterlungs (FMC) and rear-mounted counterlungs (RMC).

2.1 Work of breathing

The method used during the WOB test conforms to SS/EN-14143 6.3.1/6.3.2. The tests were performed in a breathing simulator ANSTI, verified with a standardized test orifice.

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2.2 Canister test

The method used during the canister test conforms to SS/EN-14143 6.6.1/6.6.2. These tests were also performed in the ANSTI with injection of pure carbon dioxide at prescribed rate, and continuously calibrated Servomex IR-sensor.

3 Procedure

3.1 Work of breathing

Tests are performed according to table 1 at 40 meters, water temperature 4±1°C. Breathing gas was heated and moisturized to achieve BTPS-conditions. Sodalime (*Sofnolime 797 1-2,5mm*) is present in canister. Results are presented as an average of three breaths.

Table 1, ventilation and requirements according to SS/EN-14143

Tidal volume at BTPS l	Breathing frequency min^{-1}	Ventilation rate at BTPS $l\ min^{-1}$	Maximum WOB $J\ l^{-1}$
1,0	10	10,0	0,80
1,5	15	22,5	1,18
2,0	20	40,0	1,70
2,5	25	62,5	2,38
3,0	25	75,0	2,75

Gas supply throughout the test was externally supplied air, although cylinders (5 liter) were mounted, but not connected, when testing RMC.

To obtain reality-based data, optimum breathing loop volume was ensured manually via valves fitted externally to the lid of the breathing simulator.

3.2 Canister test

Tests are performed in upright position with FMC with two profiles. First profile starts at surface with immediate dive to 40 meters and held there. See figure 1. Second profile starts at surface with immediate dive to 40m and kept there for 40 minutes. Then ascend to 15 m and stay for 5 minutes and then to 9 minutes for the rest of the duration. See figure 2.

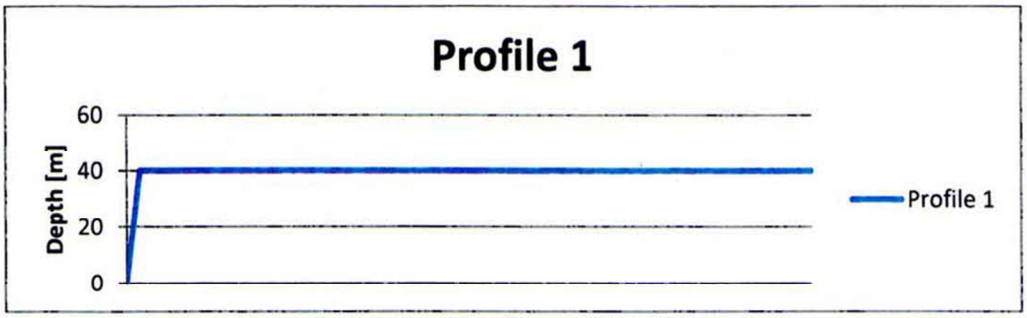

Figure 1, This profile is run three times

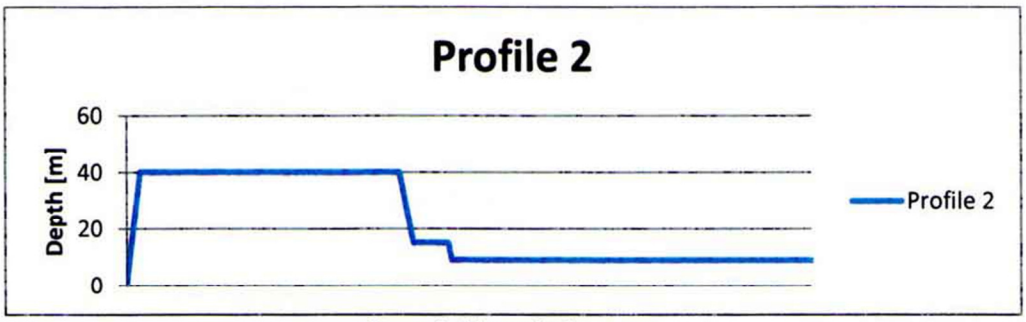

Figure 2, this profile is run once

First profile is repeated three times with a ventilation of 40 l/min and an injection rate of 1,6 l/min pure CO_2, water temperature 4±1°C. Breathing gas was heated to 32±4°C and moisturized >80% RH. Break-through is reached when end-tidal of the breath reaches 5mbar PCO_2. Second profile is run once with the same conditions.

Canister was packed by test house with Molecular Products Sofnolime S-grade (*1-2,5 mm, Lotnr 0171211, Exp date Dec 2016*). The weight of sodalime packed was 3,17±0,03 kg.

4 Results

4.1 Work of breathing

Results for FMC are presented in figure 3.

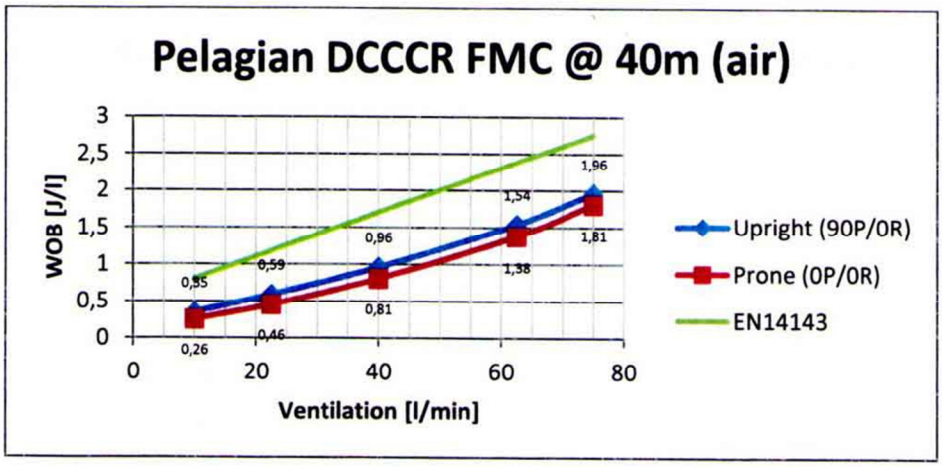

Figure 3, results from work of breathing test with front-mounted counterlungs

Results for RMC are presented in figure 4.

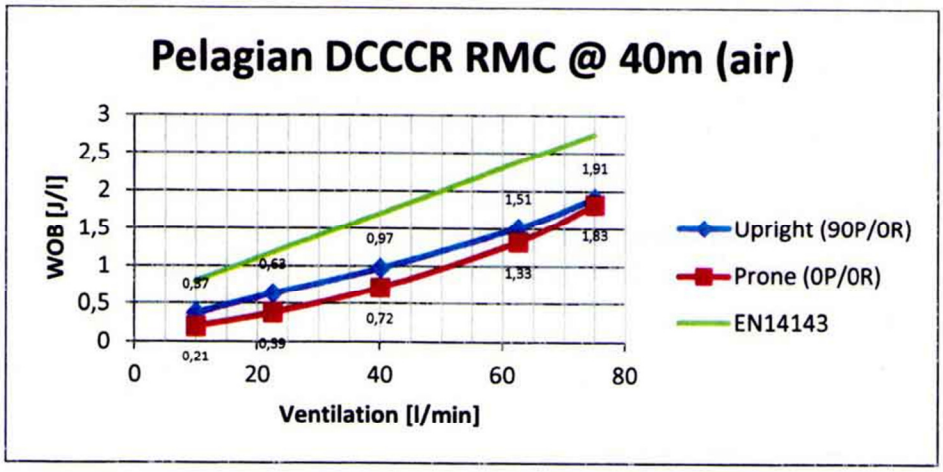

Figure 4, results from work of breathing test with rear-mounted counterlungs

The complete data sheets from the breathing simulator are presented in appendix 1. All of the results are within allowed limits.

4.2 *Canister test*

Results for the canister duration test are presented as an average of three runs for profile 1 and one single run for profile 2, see table 2.

Table 2, canister duration for profile 1 and 2

Profile	n	Time to reach 5 mbar	Time to reach 10 mbar
1	3	3 hours (avg.)	3 hours 28 minutes (avg.)
2	1	3 hours 22 minutes	3 hours 50 minutes

A complete data sheet for the canister duration is presented in appendix 2 and 3.

5 Conclusion

The Pelagian DCCCR, is approved according to SS/EN-14143, 5.6.1.1/5.6.1.2 regarding work of breathing.

The test of the carbon dioxide absorbent canister according to SS/EN-14143 5.6.6, is completed with profile 1. The average time to reach 5 mbar PCO_2 end-tidal is 3 hours. Profile 2 does not meet the terms of SS/EN-14143 5.6.6 since it is only run once. The time to reach 5 mbar PCO_2 end-tidal for profile 2 is 3 hours and 22 minutes.

Conclusions in this report are approved by the commander of SwAF DNC Magnus Claesson. Presentation of the work and results are performed by diving engineer Mårten Silvanius.

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