A COMPARATIVE INVESTIGATION OF THE PERFORMANCE, RELIABILITY AND SAFETY OF DIVE COMPUTERS WITH SIMULATED AIR-DIVES

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Background/Objective
With multilevel simulations, including repetitive and multi-day, deco-simulations (including deep stop), emergency ascents, yo-yoing, and extreme temperatures, performance of dive computers (DCs) was compared with DCIEM tables, ZH-L16C %M-values, product specifications and mutually.

Materials and Methods
In 60 test-chamber sessions, 46 DCs of 29 types were examined. No-deco limits (NDLs), depths, stop depths and stop times, and no-fly times (NFTs) were logged (260 simulations). Standard test profiles were realistic and discriminative; maximum diving depth (MDD) 45 msw 6 min, total diving time (TDT) 60 min (Fig. 1), and with 4 h surface interval 27 msw MDD 10 min, TDT 60 min, decent and ascent speed 20 and 10 msw/min.

Results/Discussion
DC behaviour did not always conform to manuals, decompression theory and exercise physiology. Two types showed *irreproducible* and seven *oscillatory behaviour* and two unexplainable *inconsistencies* (Fig. 2) of NDL displays (all pre-2001 types). Depth, time and temperature (mostly severely delayed) were within specifications. Display ergonomics were highly variable. NDLs and NFTs of *older DCs* were (far) *too liberal*, but new(er) DCs (1995+, with RGBM or ZH-L8ADT) were more conservative (Fig. 3). However, with large MDDs, at deep and moderate levels all DCs were more liberal than DCIEM allowed. RGBM types became more conservative *with multiday* simulations. The shallower the level after a deep dive, the larger is the inter-type divergence. Some new types correct adequately *emergency ascents* (from 45 to 6 msw, 60 msw/min), others less or not at all. To *extreme yo-yoing*, repetitive (Fig. 4) and 48-0 and 36-0 msw peak-peak in the 45 msw standard profile, no (or minuscule) correction occurred. Haldanian theory does not cover yo-yoing, but RGBM should do. ZH-L8ADT DCs do compensate for *refrigeration*. Benefit of a *deep stop* feature could never be confirmed during the dive. Various types handle *altitude diving* and "*personal setting*" identically. This is a questionable method since surface pressure is the dominant factor in the M-value at altitude whereas the M-values of personal settings should be based at the coefficients of the M-values. *NFTs* are generally shorter than the 12-24-36 (48) h rule.

Conclusion
The more extreme the profile and the larger the aberration from the rules, *the greater the differences* in NDLs and stop-times become, even with RGBM and ZH-L8ADT DCs. The implementation of established theory sometimes raises questions. Nowadays sold DCs are generally not equipped for handling extreme profiles but for normal use *modern DCs are* (very) *save*.

Fig. 1 %M-values not critical with ZH-L16C (shown) and RGBM, critical with ZH-L8ADT.

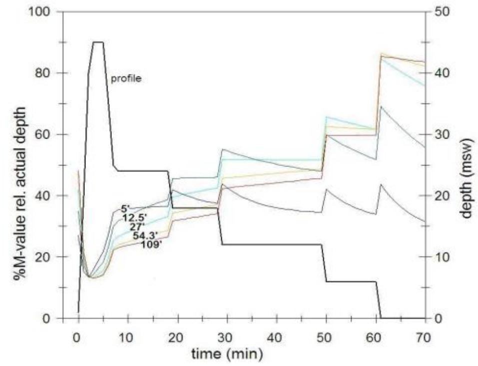

Fig. 2 Several older DCs showed some type of miraculous instability.

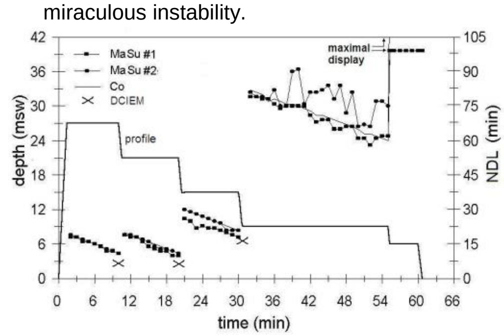

Fig. 3 Large differences of NDLs mainly due to large differences in M-values, not to ½times.

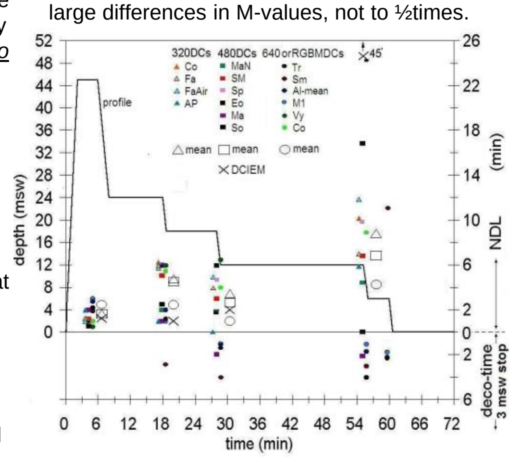

Fig. 4 DC–implemented %M-values (RGBM with/or ZH-L) are not sufficient to penalize severe yo-yoing.