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25 Free flow in a deep diving helmet reduces the dead space to acceptable levels

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One of the most critical characteristics of a diving helmet is the external dead space, which is added to the diver's internal dead space. The possible effects of an increased dead space are increased ventilation. **$C0_2$** retention and finally the risks of intoxication, dyspnea and respiratory muscle fatigue.

To measure the external dead space of a common deep diving helmet (Kirby Morgan Superlite 17) we used a method with a fast mass spectrometer and a respiratory impedance plethysmograph giving a breath by breath analysis. Six divers participated in the study. The divers performed standardised work on a bicycle ergometer just below the surface in an open wet pot. The external dead space at rest was 0.26L BTPS and **0.32L** BTPS at moderate work. When a free flow of 9 L/min was supplied to the helmet the external dead space decreased to 0.06 L BTPS and 0.16 L BTPS respectively. When the free flow was further increased to 18 L/min the external dead space decreased to 0.04 L BTPS at rest and 0.08 L BTPS. Two divers decreased their end tidal C02 % and four divers decreased (only one significantly) their minute ventilation during moderate work when the dead space decreased.

These results indicate that the free flow should not be reduced below 5-10 L/min to maintain a low dead space.