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Physiological Basis for Performance Standards of Immersion Protective Clothing
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35 The physiological basis for the development of Immersion protective clothing

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The purpose of immersion protection clothing is to minimise the occurrence of cold shock, prevent hypothermia and non freezing cold injury, and in conjunction with personal buoyancy aids prevent drowning from wind and wave splash as well as from facial immersion. Several analyses were performed on predicting model data which related survival time to the environmental, anthropometric and clothing characteristics.

If survival time is determined solely by body temperature (e.g. core<34OC), the analyses show that the clothing, water temperature and body fat thickness are the three most important factors determining the likely survival time in water. Various multiple interactions involving clothing, temperature, fat and weight were involved but were of less importance; the three single variables accounting for over 80% of the variance in the predicted survival time.

If we are to continue to use mathematical models of thermal regulation as a technical basis for the performance standards for immersion protection clothing, it is essential that the physiological basis for the model is rigorously researched and validated. The predictive models are only as good as the information on which they are based and therefore we require a thorough knowledge of the effects of clothing, body composition, waves, water temperature and heat production on any change in body temperature and susceptibility to cold injury.

This paper attempts to highlight, by example, areas of continued controversy and experimental activity within cold physiology which are relevant to immersion protection. Three areas are examined followed by a summary section suggesting the physiological design criteria one could adopt for the optimum performance of immersion suit protection. The three areas are: 1) Factors affecting heat production, which include habituation and regional sensitivity, fatigue and physical fitness; 2) Insulation and body fat, dealing with effects of flushing and waves on the clothing insulation and the measurement of body fat insulation by magnetic resonance imaging, and 3) The measurement and impact of heat loss, with particular attention to the results found during long slow cooling in water.