

RECENT DEVELOPMENTS TO PROLONG SURVIVAL TIMES IN A SUBMARINE ESCAPE IMMERSION SUIT

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The Submariner who has escaped from a distressed submarine and reached the surface may have to survive for a 24 hour period before help can be given. The necessity to provide such equipment was recognised in 1946, but it was not until 1950, when 57 of the crew of HMS TRUCULENT were swept away on an ebb tide in the dark following successful escape, that serious attempts were made at a solution. A series of suits followed, leading to the current Mark 8. Evaluation of the SEIS indicated that in water at 3.0°C, unless rescued within 12-18 hours, all escapees who survived ascent from a submarine would suffer non-freezing cold injury, and some would die from hypothermia. The modifications that have been made to the Mark 8 SEIS to form the prototype Mark 9 suit have been directed at reducing heat loss within and through the suit. The main modifications are wavesplash protection, compartmentalisation (division of insulating air into compartments), urine disposal (via a penile sheath system), and provision of a quilted jacket.

Comparative trials were made between the Mark 8 SEIS and the prototype Mark 9. In the first trial subjects were immersed two at a time in Waveless stirred cold water (Tw 4.04°C) and in the second in stirred cold water with a small reproducible wave (15-30cm). Oxygen consumption, comfort, rectal, and skin temperatures were all assessed. The insulation and cooling rate of the SEIS was determined by the Institute of Aviation Medicine (IAM) using an aluminium manikin and a mathematical model.

The insulation values for the Mark 8 SEIS was 1.02 Clo and for the Mark 9 1.57 Clo, a substantial increase. The metabolic rate was significantly higher ( $P < 0.05$ ) for the Mark 8 ( $n=6$ ) than the Mark 9 ( $n=7$ ), indicating that the subjects in the Mark 8 had to increase heat production to maintain thermal levels. Both the human and manikin trials indicated that the prototype Mark 9 SEIS improves the chances of survival by reducing the risk of death from hypothermia provided that the suit does not leak and there is no ingress of water.

The risk from non freezing cold injury has been reduced but it is still probable that escapees would incur it within 24 hours. Additional improvements still need to be investigated. The problem of musculo-skeletal tolerance, motion illness, together with the risk of aspiration of stomach contents have not been solved. The use of a single man liferaft may further enhance the survival of the submarine escapee and is being examined next.