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DEVELOPMENT OF A SECOND GENERATION IMMERSION MANIKIN

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The first generation immersion manikin was developed from the work of Macintosh & Pask (1) regarding the testing of lifejackets. To reproduce the condition of unconsciousness, Pask was anaesthetised and then immersed wearing different equipment assemblies. Whilst this approach may be followed given the exigency of warfare, it is doubtful whether the work could be repeated on ethical grounds. Ethical considerations have had a major role in the development of thermal manikins for the determination of immersion protective clothing assemblies.

Seaworthy Sierra Sam as the first imnersion manikin was known was finally located in West Germany but effectively not serviceable. As the testing of lifejackets is normally undertaken in calm water, the performance under more realistic conditions has never been evaluated. Since there would be definite risks to human volunteers in such realistic testing under wave and wind conditions, a clear requirement was identified to produce a second generation immersion manikin - RAMM (Robert Gordon's Anthropometric Maritime Manikin). RAMM has been based on anthropometric data derived from the following sources: Society of Automative Engineers; Royal Aircraft establishment; UK Office of Populations, Censuses & Survey; Anthropometric data of Pheasant (3).

The basic specification of RAMM is as follows:

Height: 1.74 metres Weight: 71.02 kg

Body Segment	Design Density	Actual Density	Design Weight (kg)	Actual Weight (kg)
Head and neck	1.11	1.15	5.0	5.25
Upper arm	1.07	1.10	2.4	2.46
Lower arm and hand	1.12	1.10	2.2	2.28
Upper leg	1.05	1.10	8.0	5.99
Lower leg and foot	1.08	1.03	4.4	4.60
Thorax	0.94-1.2	0.94-1.2	(18.3) 35.3	(17.3) 35.11
Abdomen and pelvis	1.05	1.09	(17.0)	(17.68)

A full ranqe of movements at head relative to trunk, arm at shoulder, forearm at elbow, hand at wrist, thigh at hip, leg at **knee**, foot at ankle and spine has been achieved. The performance of RAMM has been compared against original film obtained from archive sources of Pask during his anaesthetised immersions. The characteristic behaviour of Pask is closely mimicked by RAMM.

Extensive trials using **RAMM** undressed, dressed in standard clothing (2) and wearing imnersion suits have been undertaken in combination with lifejackets. In addition to eliminating ethical considerations, **RAMM** has the following advantages:

1) reproduces the exhausted, incapacitated unconscious imnersion victim
2) performance is reproduceable
3) eliminates variability in the subjects between testing
4) can be safely exposed to wind and wave conditions
5) allows comparative perfomance testing of lifejackets to be undertaken in more realistic conditions

The development of **RAMM** has resulted in an unparalleled research tool that will allow critical analysis of lifejacket performance and further development of personal in-water survival equipment with no risk in the development stages to human subjects.

References: (1) Macintosh, R R & Pask, E A. Brit J. Industr. Med. 1957, 14, 168
(2) Department of Transport Immersion Suit Testing Requirement
(3) Pheasant, S. 1984. BSI Publication Cat. No. 89731O