THE DEVELOPMENT OF AN

INSULATED LIFERAFT FOR POLAR CONDITIONS

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Regulations formulated by international regulatory bodies are normally developed to meet a common acceptable standard and in many instances, do not fully address the requirements for vessels operating in extreme conditions. It is the responsibility of national regulatory agencies to develop specific regulations that address their country's unique requirements. Accordingly, The Canadian Coast Guard has been carrying out research and development in the Arctic Region in order to attempt to formulate a required Arctic Survival life saving equipment pack for vessels in extreme cold environments.

This paper describes work sponsored by the Canadian Coast Guard and carried out by The CORD Group Limited. The work involved the design, analysis, construction and laboratory testing *of* a prototype liferaft which can function as part of the envisioned life saving equipment pack.

The design phase of the work consisted of needs analysis, design objectives formulation with constraints, the development of design criteria, the creation of design solution alternatives and finally a design specification. Of the design objectives, the most important were:

The liferaft must provide thermal protection of personnel from hypothermia by maintaining their bodies in thermal equilibrium; and

- The liferaft must maintain an interior atmosphere of acceptable composition.

The constraints included the use of a Dunlop-Beaufort ten-man, navy, twin arch liferaft, compliance with Canadian Coast Guard standards, the existence of 20 km/hr winds, personal insulation of 2.69 Clo with 3 Clo sleeping bags and physiological criteria of the occupants.

Concurrent with design, baseline tests were carried out on the standard (uninsulated) raft for evaluation of the 'insulated' design to assist in the development of design specifications and to use in the development of mathematical models during the analysis phase. Parameters measured were air Infiltration, heat transfer through the envelope and internal air temperatures. These parameters were measured as functions of wind velocity and direction and the number and positions (sitting or lying) of raft occupants.

The design and construction phases culminated in the production of an insulated raft by the modification of the standard one. The design consists of replacing the double-wailed canopy with a manually inflated double canopy with two *(2)* layers of 8 oz. Polarguard batting plus a layer of metallized Mylar between the two (2) shells. A skirt of similar design was added inside the liferaft against the buoyancy tubes or side walls. The floor was replaced with a new manually inflated floor using the same design as the canopy and sidewall skirt except the shell materials and stitching between the shells were stronger because of the higher air pressure required to keep the floor rigid with occupants sitting or lying on the floor. in addition, one door was eliminated and replaced with a 10" vent with adjustable closure, an insulated plug was provided for the remaining door and a removable vestibule was provided to fit over the boarding ramp to provide a double entrance way. Finally, a Nomex removable liner was added to provide some internal fire retardancy and to absorb condensation.

The laboratory testing phase continued with the test protocol used for the baseline tests of the uninsulated liferaft being repeated on the modified insulated liferaft. The results showed a marked improvement of the insulated liferaft in controlling infiltration and envelope heat loss except for the floor directly under the occupants. The insulation in this area actually showed poorer insulation than that for the uninsulated raft.

This can be explained when one considers the fact that both the uninsulated and insulated raft floors are inflatable and that a slow leak in the insulated floor allowed it to deflate and so become very thin under the occupants.

The analysis phase of the work involved the use of mathematical modelling to characterize the heat transfer through the raft envelope, the physiological performance of the occupants and the air quality of the raft atmosphere. A detailed steady state analysis of heat transfer and air quality was done using a spreadsheet and a dynamic analysis including all three mechanisms was done by Dr. Eugene Wissler of the University of Texas at Austin.

The results show that an insulated raft is indeed a benefit and that proper design of the floor is important to maintain an acceptable level of insulation. However, an increased level of personal insulation is still required. Auxiliary heating should also be considered.