18 Determination of ventilation indices of helicopter pilot suits

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The main function of helicopter pilot suits in offshore flights is to provide thermal protection in the event of accidental cold water immersion and to allow maintenance of thermal comfort during normal use. In hot air environments, as may be encountered in cockpits during summer months, adequate ventilation of the suit microenvironment is essential for prevention of thermal discomfort and ultimately heat stress.

The quantity of heat lost from the microenvironment of the suit is proportional to the volume of warm humid microenvironment air exchanged for cool dry ambient air. Crockford and Rosenblum (1974) were the first to emphasize that the determination of volume air exchange through the clothing assembly, termed the Ventilation Index, is defined as the algebraic combination of the microenvironment volume (Vμ, liters) and the rate of air exchange between the microenvironment and ambient air (R, min^{-1}). The capacity for volume air exchange was determined of four types of helicopter pilot suits: A. Goretex (dry suit design); B. Cotton ventile (dry suit design); C. Nomex/ Insulite (wet suit design); and D. Nomex/Neoprene (wet suit design).

The method for determining the microenvironment volume was improved from the original suggestions of Crockford and Rosenblum (1974). Subjects wearing the four different helicopter pilot suits were enclosed in an impermeable polyvinyl suit. Air within the enclosed environment was evacuated at a constant rate with a vacuum source until internal pressure decreased to -30cm H_2O. The volume of air evacuated from the microenvironment was estimated by integrating the exhaust flow rate. The inherent complicance of the polyvinyl outersuit was first converted into a volume (Ve) during the trials for subjects wearing only shorts. The clothing microenvironment volume (Vμ) was then calculated by subtracting Ve from the volume evacuated while the subjects wore suits.

The gas exchange rates (R) were determined using the oxygen tracer gas method suggested by Crockford and Rosenblum (1974). Combining the values of Vμ with the gas exchange rates, it was observed that the Nomex and Cotton ventile suits had the highest indices of ventilation (1.53 and 0.91 liters.$min.^{-1}$, respectively). The Nomex/Insulite and Goretex suits had substantially lower ventilation indices of 0.07 and 0.03 liters. $min.^{-1}$, respectively.

The ventilation indices observed are due to the fabrics used in the construction and the design of the suit. It appears that suits based on the wet suit principle and constructed of low permeability fabric, should incorporate adjustable vents to allow adequate ventilation of the suit microenvironment. Suits based on the dry suit principle, should be constructed with fabric of high permeability.

Acknowledgements

This work was supported by the Science Council of British Columbia and Mustang Industries Inc.