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HEAT TRANSFER PROPERTIES OF CHEMICAL PROTECTIVE OVERGARMENTS WITH VARIABLE PERMEATION PROPERTIES

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The human ergonomic and biophysical potential of prototype chemical protective (CP) overgarments (OG) with variable permeation properties and/or easily attached or removable hoods is a desirable option during extended work covering wide environmental temperatures. Several CP, OG options were studied to determine differences in insulation (clo) and vapor permeabi lity (i_m). Each OG was evaluated alone on a copper manikin with mask, gloves and boots (T_a=27° C, rh 50%, V=0.5m•s^{-1}). Table 1 gives this data along with a US attached permeable hood (70-mil) integrated hood with standard OG and two vapor permeable rainsuits (polytetrafluoroethylene [PTFE] laminate) calculated with ASTM moisture vapor transmission rates (MVT) of 700 and 450 g•m^{-2}•24h^{-1}.

Table 1. CP overgarment properties

Items	clo	i_m	i_m/clo
1. NATO			
a. French integrated hood - closed	2.57	.33	.13
b. UK integrated hood - closed	2.27	.32	.14
c. Netherlands integrated hood - closed	2.49	.27	.11
d. US standard without hood - open	2.24	.35	.16
US standard - closed	2.55	.28	.11
2. US Permeable Hood			
a. Battle Dress Uniform with Permeable Hood (70-mil)	2.01	.32	.16
b. Standard Battle Dress Uniform with Impermeable Hood (90-mil)	2.01	.27	.13
3. Vapor Permeable			
a. Battle Dress Uniform (standard)	1.49	.39	.26
b. Battle Dress with standard rainsuit	2.00	.22	.11
c. Battle Dress with MVT 450g/m²/24hr PTFE rainsuit	1.89	.34	.18
d. Eattle Dress with MVT 700g/m²/24hr PTFE rainsuit	1.89	.37	.20

The i_m/clo of the permeable hood was some 23% larger between U.S. integrated hood garments; but this showed little difference from NATO OG. The minimal difference in heat transfer between hoods probably does not compensate for any reduction in agent protection which is afforded by the impermeable hood. PTFE showed a 40% increase in the i_m/clo over the standard impermeable rainsuit. Higher potentials for evaporative cooling may reduce heat strain on the wearer in hot environments but warrant further testing by physiological studies. These data illustrate the protective merits of thermally integrating various clothing materials in structural military clothing.