

THE EFFECTS OF MILITARY USE ON SYNTHETIC-FIBRE SLEEPING BAGS

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INTRODUCTION

A single sleeping assembly for general issue in the British Army was designed by the Stores and Clothing Research and Development Establishment (SCRDE) to replace the in-service, down and feather General Service and Arctic sleeping bags. This new sleeping assembly consists of a synthetic, hollow, staple-fibre filled sleeping bag; a waterproof "bivvy" bag; a compression sack and a sleeping mat (Davies, 1987). The British Army required a sleeping bag which permitted 4 hours rest at -35°C and 8 hours at -20°C. It was therefore necessary to investigate the effects of use in the field and of laundering on the synthetic filling of the sleeping bags using both physical and physiological methods.

METHODS AND RESULTS

A sample of sleeping bags was weighed and the (uncompressed) thermal insulation value was assessed using a non-destructive method in which a complete sleeping bag is placed over a heated plate and a steady-state temperature gradient established and measured (Watson-Hopkinson, 1990). After this initial measurement the bags were issued to selected Army units for use during operational training. These same sleeping bags were recalled after 4 and 12 month's use to be re-weighed and to have their thermal insulation value re-measured. The effects of this field use are shown in Table 1.

Table 1. Insulation and weights of 46 sleeping bags

Time of testing	Insulation value tog		Weight kg	
	Mean	Range	Mean	1 SD
Before use	19.3	21.7-12.7	2.94	0.11
After 4 month's use	12.1	16.5-9.8	2.95	0.11
After 12 month's use	12.7	15.2-10.0	2.95	0.11

The results clearly show that after use as short as 4 months there was a marked decrement in the thermal insulation values. The synthetic filling of the sleeping bag appeared to have been damaged either by compression, by laundering or by a combination of the two. Therefore in separate experiments, the effect of repeated laundering on synthetic filled sleeping bags was also investigated. Fifteen new synthetic-fibre sleeping bags were weighed and the thermal insulation measured. Five of these sleeping bags were then washed 10 times and the other five 20 times. After washing, the sleeping bags were retested. Table 2 shows that washing reduced the insulation value and the loft of the sleeping bags.

Table 2. The effect of repeated laundering on synthetic sleeping bags (Sin each group)

Number of washes	Loft mm		Insulation value tog		Weight kg	
	Mean	1 SD	Mean	1 SD	Mean	1 SD
0	73.5	7.2	17.5	1.3	2.79	0.02
10	39.3	7.2	12.2	0.3	2.68	0.06
20	42.9	9.0	11.7	0.4	2.78	0.05

Physiological trials were carried out on sleeping bags with a low insulation value (9.3 tog 1SD = 0.4) which had been in use in the field for one year to investigate whether these bags still fulfilled the Army's original requirement. Fourteen volunteers slept overnight in a new or a used sleeping bag in an ambient temperature of -20°C. Chest, arm and calf temperatures were measured and weighted mean skin temperature calculated (Burton, 1935). The skin temperatures of the toes and fingers were also measured, as was deep body temperature by a thermistor inserted 12 cm into the rectum.

Deep body temperature followed diurnal rhythm and fell by approximately 1°C. There was no significant difference ( $p > 0.05$ ) in the rectal temperatures of the individuals sleeping in the **used** compared with the new sleeping bags. The Figure shows that the fall in the mean **great toe** temperature was significantly larger in the **used** sleeping bag (19.22°C 1SD = 4.23 after 8 hours), compared with the volunteers sleeping in the new sleeping bag (14.92°C 1SD = 4.94). There was also a significantly greater ( $p < 0.05$ ) fall in the **small toe** temperature of the subjects sleeping in the **used** sleeping bag of 16.4°C (1SD = 3.46) compared with 12.18°C (1SD = 3.63) for those sleeping in the new sleeping bags. It therefore **appears** that the deep body temperature is maintained *within normal limits* at the expense of extremity temperatures which fall to low levels.

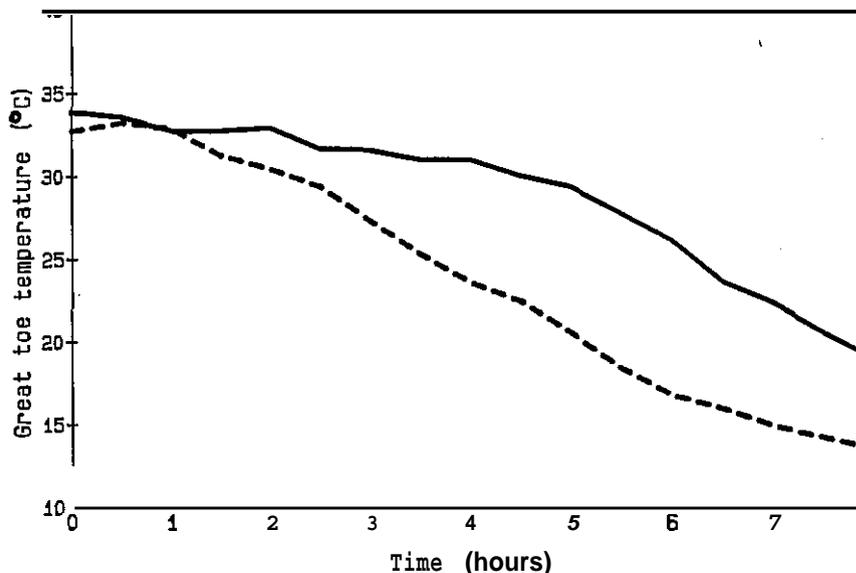


Figure: **Great toe** temperature of 10 subjects sleeping in new (solidline) and used sleeping bags (dashedline)

## CONCLUSIONS

The insulation value of hollow, staple-fibre filled sleeping bags is **reduced** by **use** in the field and by repeated laundering. The reason for this loss is unclear but it is not due to fibre loss, **as** the weights of the sleeping bag remain unchanged. However the loft is **reduced**, which presumably **reduces** the amount of air trapped between the fibres and hence the insulation value. The physiological trial shows that hollow, staple-fibre filled sleeping bags **after** 4 months field **use** are unsuitable for **use** in cold climates **as** the low toe temperatures may predispose soldiers **in** the field to cold injury if their duties following sleep involve exposing the feet to further cold or cold/wet conditions.

## REFERENCES

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3. Watson-Hopkinson W.I. 1990, An apparatus for the determination of the thermal insulation of sleeping bags. **APRE** Memorandum 89M512.