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MATERIALS SUITABLE FOR CLOTHING AIRCRAFT FIRE CRASH RESCUE WORKERS

PART V : TESTS ON FURTHER TYPES OF FOOTWEAR

by

P. L. Hinkley and D. L. Simms

SUMMARY

Further samples of footwear have been tested to determine their suitability for use in protective clothing for aircraft fire crash rescue workers. Of three types of interlining tested only expanded neoprene was found to be satisfactory. Black chrome was slightly superior to white chrome as an outer leather.

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Fire Research Station
Boreham Wood,
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PART V : TESTS ON FURTHER TYPES OF FOOTWEAR

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1. Introduction

Part I of this report (1) described tests on protective clothing and footwear to determine their suitability for aircraft fire crash rescue workers. Horsemeat, used to simulate human flesh, was placed in contact with the inner surface of a footwear assembly and flames from a small petrol fire allowed to impinge on the outer surface. The time for the surface of the horsemeat to rise in temperature by 25°C was taken as a measure of the protection afforded by the assembly. These tests showed (1, 2) that the most effective type of footwear had uppers consisting of inner and outer layers of leather with an inter layer designed to provide an air gap. This note gives test results for a further set of materials supplied by Ministry of Supply (R.D.A.E.). Details of these materials are given in Table 1.

TABLE 1

Materials supplied for test

Purpose	Material	J.F.R.O. reference number	Thickness cm.	Weight per unit area gm/cm ² .
Outer leather	{ White chrome hunting side	R 156	0.19	0.119
	{ Polished black chrome side	R 161	0.19	0.106
Interlining	{ Rubazote X 826	R 157	0.32	0.209
	{ Expanded neoprene	R 159	0.31	0.098
	{ Soft dry chrome split	R 160	0.16	0.119
Lining	Natural kip	R 158	0.13	0.098

2. Experimental procedure and results

The apparatus used was similar to that described previously (1). A 2 in. square area of the front face of the assembly under test was exposed to flames from a small petrol fire. Four specimens of each type of assembly were tested; the pieces of material were allocated randomly between the assemblies and the tests were carried out in a random order. The remainder of the front face was protected by a metal plate and the back and sides were protected by an asbestos wood shield. Horsemeat was held against the inner surface of the assembly and the rise in temperature of the surface of the horsemeat in contact with the assembly was measured by a 36 S.W.G. copper-constantan thermocouple soldered to a disc $\frac{1}{2}$ in. in diameter by 0.008 in. thick.

The fire was extinguished when the temperature of the surface of the meat had risen by 25°C and any subsequent temperature rise noted. The results are shown in Table 2, each result being the mean of four tests. The appearance of the materials after test is shown in Plate 1.

TABLE 2

Results of flame tests

Outer leather	Interlining	Lining	Time for 25°C temperature rise sec.	Further temperature rise °C	Time for further temperature rise sec.
White chrome hunting side (Suede out)	Expanded neoprene	Natural kip (grain to leg)	167	16	150
	Chrome split	"	64	18	170
	Rubazote	"		Rubazote ignited	
Black chrome	Expanded neoprene		185	12	36

3. Discussion

3.1. Repeatability of tests

The standard deviation of the times for a 25°C temperature rise in the flame tests on footwear assemblies was 6 sec.

3.2. Materials

The only satisfactory interlining tested in this investigation was expanded neoprene. It is about as effective as one layer of the open weave asbestos cloth tested previously (1, 3). The rubazote interlining ignited very easily and was difficult to extinguish. The chrome split leather interlining had little value as an insulator.

The polished black chrome side outer leather gives slightly more protection than the white hunting side. After about two minutes exposure to flames the black leather was in a slightly better condition than the white but both types of leather had shrunk very badly. When used in assemblies having a long protection time it was generally found that the outer leather was smouldering when the flames were extinguished.

3.3. Continued temperature rise

The temperature of all the assemblies continued to rise for a long period after the extinction of the flames. As it appears that the materials from which footwear has to be made exhibit this continued temperature rise, footwear must be designed for quick and easy removal.

4. Conclusion

(1) The only satisfactory interlining tested was expanded neoprene; it is about as effective as one layer of open weave asbestos cloth.

(2) The polished black chrome side outer leather is slightly superior to the white chrome hunting side.

(3) Footwear should be constructed so that it can be quickly and easily removed.

5. Acknowledgments

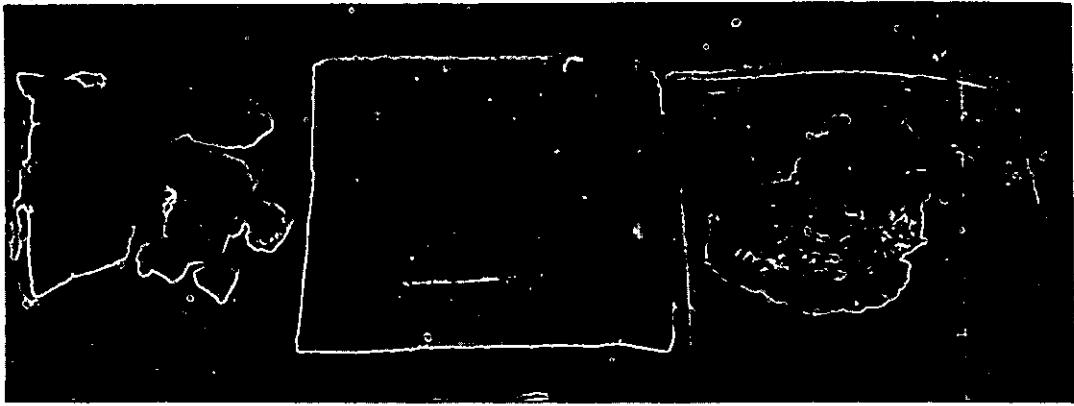
This work was carried out for the Ministry of Supply under contract.

6. References

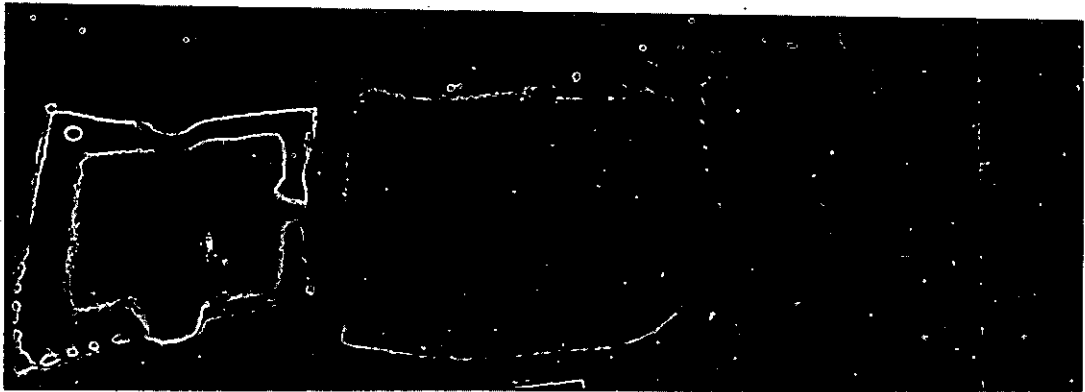
(1) PICKARD, R. W. and SIMMS, D. L. Materials suitable for clothing aircraft fire crash rescue workers, Part I. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization F.R. Note No. 153/1955.

(2) The Protection Afforded Against Fire of a Prototype Crash Rescue Boot. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization Special Investigation No. 491, 1954.

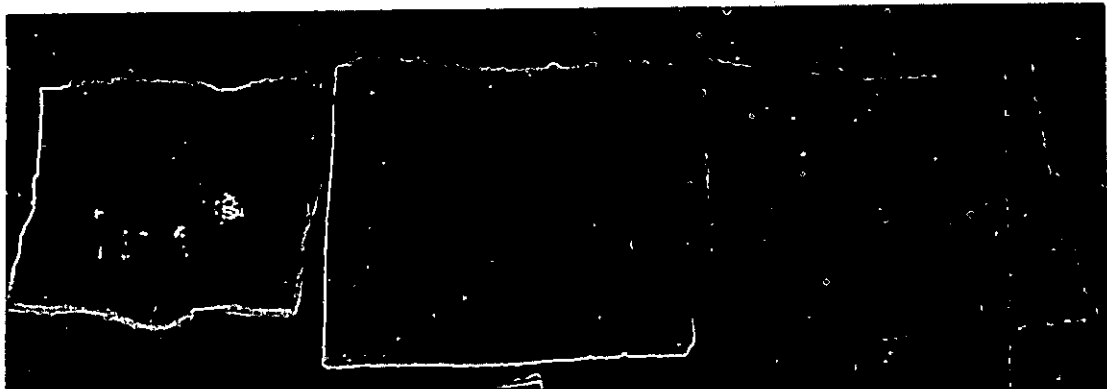
(3) HINKLEY, P. L., SIMMS, D. L. and MILLAR, D. W. Materials suitable for clothing aircraft fire crash rescue workers, Part II. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization F.R. Note No. 220/1955.



White chrome / neoprene / natural kip



White chrome / dry chrome split / natural kip



Black chrome / neoprene / natural kip

ASSEMBLIES AFTER FLAME TEST
PLATE. I.