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ABRASION AND HYDROSTATIC HEAD OF WEATHERED RUBBER-COATED FABRIC--ETC(U)

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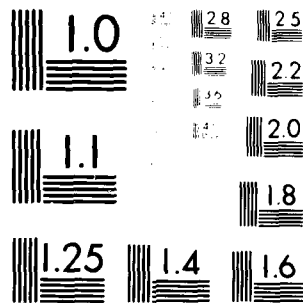
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ROYAL AIRCRAFT ESTABLISHMENT

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⑨ Technical Report 80124
and

MATERIALS QUALITY ASSURANCE DIRECTORATE
Report 306

⑪ Oct 1980

⑫ 33

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⑩ J.E./Swallow
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Procurement Executive, Ministry of Defence
Farnborough, Hants

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ROYAL AIRCRAFT ESTABLISHMENT

Technical Report 80124

and

MATERIALS QUALITY ASSURANCE DIRECTORATE

Report 306

Received for printing 17 October 1980

ABRASION AND HYDROSTATIC HEAD OF WEATHERED RUBBER-COATED FABRICS

by

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A. R. Wakefield*

SUMMARY

The abrasion mass loss and hydrostatic head of a nylon and of a cotton fabric, each coated with natural rubber, neoprene, polyurethane (PU) or chlorosulphonated polyethylene (CSPE) and exposed to various weathering conditions, were determined.

Correlations between hydrostatic head and abrasion mass loss were generally low.

During abrasion, coated nylon fabrics lost more mass than coated cotton fabrics. CSPE was most susceptible to abrasion, particularly on nylon, though with little dependence on conditions of exposure. Neoprene was worse on cotton. PU had the lowest mass loss and least susceptibility to exposure conditions, except at Innisfail. Natural rubber lost more mass on abrasion than neoprene or PU, especially at PERME. Load during exposure had a negligible effect.

Departmental Reference: Mat 411

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1 INTRODUCTION

The exposure of rubber-coated fabrics for up to 1 year of weathering, and the effects of this on their flexibilities, strengths and breaking extensions, and tearing strengths have previously been reported¹⁻³.

In a collaborative trial involving several Establishments of MOD(PE) and JTRU, nylon and cotton base fabrics of similar mass per unit area were coated with natural, neoprene, polyurethane (PU) or chlorosulphonated polyethylene (CSPE) rubber. These coated fabrics were exposed for 3, 6 or 12 months, and a second period of 6 months ('6 months stepped' or '6S') commencing at the end of the first, under loads of 1% or 10% of the nominal breaking strengths. Pieces of fabric were positioned at 45° to the horizontal and facing the equator at a site in the UK (PERME, Waltham Abbey) and at two sites in Queensland (hot, dry at Cloncurry, and hot, wet, cleared jungle at Innisfail).

The coated nylon fabrics were found to be thicker, heavier and less flexible than the coated cotton fabrics; PU rubber, particularly on nylon, stiffened more than the other rubbers during exposure. The coated nylon fabrics were stronger and more extensible than the cotton ones, but those coated with natural-rubber lost strength and extensibility at a faster rate when exposed under load. Nylon coated with PU was initially stronger and more extensible than when coated with the other rubbers, but lost these properties faster at Innisfail. Extension was more severely affected than strength by load during exposure. The coated nylon fabrics had higher tear strengths than the cotton ones, but were more variable. PU-coated nylon increased in tear strength in Australia due to coating failure, but natural-rubber coated cotton decreased on exposure in UK. Load during exposure increased the loss of tear strength of the natural-rubber coated fabrics.

To complete the experimental work envisaged when the trial was set up, mass losses on abrasion and the subsequent hydrostatic heads of the fabrics were determined. The present Report gives the results and their analyses.

2 DETERMINATION OF ABRASION AND HYDROSTATIC HEAD

(a) Abrasion

The abrasion of each specimen was measured⁴ using a Martindale abrasion tester situated in an atmosphere of 65% relative humidity at 20°C. The abradant was 180C silicon carbide paper acting under a pressure of 8.19 kN/m² over a working abradant head area of 6.45 cm². The specimen and abradant were, however, reversed in position compared with the standard because wear was more uniform and the abraded area was larger, allowing sufficient area for subsequent hydrostatic head tests. Abrasion was continued until a degree of wear judged by visual appearance had been attained, the number of cycles being noted. Specimens were weighed before and after abrasion. The test was repeated on the other face of the fabric. Two replicates were available for most of the exposure conditions.

(b) Hydrostatic head

After abrasion the specimens were subjected under standard⁵ conditions to steadily increasing water pressure on one face until penetration occurred. The pressures at which the first, third and multiple bubbles were observed were measured by water manometer or, for pressures between about 100cm and 300cm head of water, by mercury manometer.

3 ARRANGEMENT OF RESULTS

The sums of the losses of mass from both faces over the area abraded during the (variable) numbers of cycles of abrasion actually applied are given in Table 1 (tests a), together with the hydrostatic head in cm water pressure after these cycles (tests b). The first bubble was used as the criterion for the hydrostatic head since more results were available within the capacity of the instrument. Tests a and b were subjected to correlation analysis by fabric and by site, analysis of variance of the hydrostatic head results not being possible because of the different numbers of cycles applied to the specimens.

These correlations are described in section 4 before dealing with the effects of exposure on abrasion. This was because the actual results in Table 1 were used for the correlations, whereas derived values were used for the abrasion effects.

To analyse the abrasion, the mass losses were normalised to g/m^2 per 1000 cycles assuming that the losses were linear with number of cycles over the range considered. The results for each face were then summed and are given in Table 2. It was thought necessary to adopt this procedure rather than to analyse each face separately because, although the trial schedule stipulated that the face carrying identifying markings should be exposed down-facing, there was doubt as to whether this was so in all cases. The reason for this doubt was that, assuming that the exposed face would be more susceptible to abrasion, the difference between the mass loss from the unmarked and marked faces should be positive. However, 39% of all 395 differences, 27% of the 99 differences greater than 10 g/m^2 per 1000 cycles, and 16% of the 49 differences greater than 20 g/m^2 per 1000 cycles were negative.

The abrasion results were divided into the same nine sets as for breaking strength² and tear strength³, it not being possible to consider the results as a whole because of specimen losses. The 342 usable abrasion values were analysed by computer, using as the sets the following columns from Table 2:

Set	No. of columns in set	No. of results in set	Columns from Table 2 used	Brief description
(a)	2	32	A,B	Controls
(b)	6	96	C,D,K,L,S,T	3 months
(c)	12	192	C,E,G,I,K,M,O,Q,S,U,W,Y	1%
(d)	24	96	C-Z	Natural-rubber
(e)	8	128	C-J	PERME
(f)	6	96	A,B,C,E,G,I	PERME, 1%, with controls
(g)	6	96	A,B,K,M,O,Q	Cloncurry, 1%, with controls
(h)	6	96	A,B,S,U,W,Y	Innisfail, 1%, with controls
(i)	24	144	C-Z	Nylon with three rubbers

4 CORRELATION OF ABRASION AND HYDROSTATIC HEAD

The linear and quadratic correlations between the abrasion mass losses and the corresponding hydrostatic heads, by fabric and by site, are given in Table 3, together with the variance ratios for the significance of these correlations. It was not possible to subdivide the data further, *eg* by time, because of too few degrees of freedom. By comparing means, however, it appears that for a given amount of abrasion, the hydrostatic head of PU on nylon was low, whilst for CSPE it was high.

It might be expected that a greater loss of coating would be associated with a lower hydrostatic head, *ie* the linear correlations should be negative. Inspection of Table 3 shows that this was so for 24 of the linear 32 correlations calculated. However, the significance of only 12 of the 32 was above the 95% probability level, and, of these 12, three, all at PERME and including the only correlation significant at the 99.9% level of probability, were positive. Addition of the quadratic components into the correlations did not alter any of the conclusions relating to the linear correlations, although the significance of a few of the quadratic components indicated that curvature might play a part in some instances. Since high hydrostatic head would also be expected to occur with low abrasions on unexposed fabrics, a U-shaped curve is implied in some instances. High hydrostatic heads tended to be associated with high abrasion after exposures of 3 months, suggesting that time might be an influencing factor, but there was no means of confirming this from the recorded data. However, it could mean that in some circumstances the coating may have degraded to an extent such that on abrasion the amount or type of detritus produced improved coating integrity.

5 TEST FOR EQUALITY OF ABRASION ERROR VARIANCES

The values of χ^2 based on cell ranges (in Table 2) in each set are given in Table 4. Also given are the numbers of omissions of the highest of the ranges needed to reduce χ^2 so that the probability was above the 5% level. The omissions needed were as follows:

Set	Omissions needed
(a), (d), (g), (h), (i)	None
(b)	Nylon/CSPE Column C; Cotton/natural Column C
(c)	Nylon/CSPE Column E; Nylon/PU Column U
(e)	Nylon/CSPE Columns F, J, E, C; Cotton/natural Column J; Cotton/neoprene Column H
(f)	Nylon/CSPE Columns E, C; Cotton/natural Column C

There was a preponderance here of nylon/CSPE at PERME. Analysis of variance was performed on all the sets, but circumspection needed to be exercised in respect of conclusions relating to the fabrics and conditions having high error particularly in the higher order interactions.

6 ANALYSIS OF VARIANCE AND MEANS OF ABRASION MASS LOSS

6.1 General

The analysis of errors is given in Table 5. The error variance was lowest in the controls and highest at Cloncurry. Except at Cloncurry, coefficients of variation were around 10%. The lowest overall abrasion loss was in the controls, and the highest in nylon and in natural rubber.

Variance ratios derived from analysis of variance within each set are given in Table 6. The effects are discussed in order of occurrence in Table 6 rather than in order of importance since the latter could differ in the various sets. Only those effects which had better than 99.9% probability of being correct were considered.

The mean mass losses on abrasion, where they were significantly dependent on factors, are given in Table 7, and the associated differences required between means in Table 8.

6.2 Effect of fabric (F)

The variance ratios for F in Table 6 were upwards of 100 in all the sets, indicating that the base fabric was important in affecting abrasion mass loss. The losses from nylon were greater than those from cotton, generally by about 40% (Table 7).

6.3 Effect of rubber (R)

In all the sets the variance ratios for rubber were upwards of 200 and the highest of all the factors, indicating that the rubber was the most important factor determining abrasion. The order was generally CSPE > natural > neoprene > PU, though in the controls the differences between natural and neoprene, or between neoprene and PU were not significant, nor were those between natural and neoprene in sets (g) or (h). An experimental observation on the PU-coated fabrics, however, was that the coating softened during abrasion and tended to spread out under load, rather than be removed; this was most noticeable after exposure.

6.4 Effect of time (T)

Time was significant in all the sets except (a). The latter indicated that the final control determinations did not differ from the originals. In the other sets, the exposed specimens had greater abrasion losses than the unexposed, and generally the 12 months losses were highest, though not always significantly so. The high loss in set (h) at 6 months is anomalous (see also the TS, FT and FRT interactions).

6.5 Effect of load (L)

Load during exposure played a negligible part in determining abrasion losses. The effect is not listed in Table 7.

6.6 Effect of site (S)

Site was significant in all sets. The abrasion losses at PERME were greater than at the other sites, though in set (b) not significantly more than at Cloncurry. Cloncurry was worse than Innisfail in sets (b) and (i), but there was no demonstrated difference between them in sets (c) or (d).

6.7 Fabric $\times$ rubber interaction (FR)

The variance ratios for the FR interaction were upwards of 100 in all sets, indicating the importance of the effect of the base fabric on the rubber type. In particular, CSPE on nylon, whether exposed or unexposed, lost more on abrasion than when on cotton, whereas neoprene on cotton tended to lose more than neoprene on nylon.

6.8 Fabric $\times$ time interaction (FT)

Only in set (h) was this interaction significant, and even there it was at a lower level of probability than most other effects. Since set (h) contained the anomalous 6-month results noted in the discussion on the T effect, it is doubtful whether a time effect which is different for the two base fabrics has been demonstrated. The interaction is therefore not listed in Table 7.

6.9 Fabric $\times$ load interaction (FL)

The effect of fabric was not dependent on the load during exposure, and is not listed in Table 7.

6.10 Fabric $\times$ site interaction (FS)

The poorer abrasion performance of nylon was less marked after exposure at Innisfail than at the other sites.

6.11 Rubber $\times$ time interaction (RT)

Time affected the abrasion losses of the various rubbers to differing extents, though it is not clear to what this should be ascribed. CSPE occasionally appeared to be anomalously high, though not at any consistent time. The doubtful columns in section 5 did not seem to play a part in modifying the results.

6.12 Rubber × load interaction (RL)

The abrasion of the various rubbers was not affected by the load during exposure. The interaction is therefore not listed in Table 7.

6.13 Rubber × site interaction (RS)

The abrasion of the rubbers was affected by the site. The natural-rubber at PERME and PU at Innisfail in set (c) had the poorest results (see FRS and FRTS interactions).

6.14 Time × load interaction (TL)

Time of exposure did not increase the effect of load on abrasion.

6.15 Time × site interaction (TS)

The sites differed at different times of exposure. In sets (d) and (i), 12 months at PERME gave high abrasion, as did 6 months at Innisfail, though the latter result is anomalous.

6.16 Load × site interaction (LS)

The effect of site was not dependent on load during exposure. The interaction is therefore not listed in Table 7.

6.17 FRT interaction

This interaction was significant in sets (c), (e), (f) and (h), but not in (a) or (g). Natural-rubber on nylon at 12 months and, more particularly, PU on nylon at 6 and 12 months in sets (c) and (h) gave abnormally high abrasion losses (see FRTS interaction).

6.18 FRL interaction

The FR interaction was not dependent on load during exposure, and is therefore not listed in Table 7.

6.19 FRS interaction

Natural-rubber on nylon did rather badly at PERME. In addition, CSPE on nylon was similarly poorer at Cloncurry in set (b), and PU on nylon at Innisfail in set (c).

6.20 FTL interaction

The FT interaction was not dependent on load during exposure, and is therefore not listed in Table 7.

6.21 FLS interaction

In set (c), the significance of this interaction seems to have been due to the somewhat poorer abrasion performance of nylon and cotton fabrics at Innisfail after 6 months, whilst in set (d) it was due to the nylon and cotton at PERME after 12 months.

6.22 FLS and RTL interactions

The FS and RT interactions were not dependent on load during exposure, and are therefore not listed in Table 7.

6.23 RTS interaction

The significance of this interaction seems to have been due to the greater abrasion loss in natural-rubber after being at PERME for 12 months.

6.24 TLS, LSR and FRTL interactions

The TS, RS and FRT interactions were not dependent on load during exposure, and are not listed in Table 7.

6.25 FRTS interaction

The significance of this interaction appears to have been largely due to the poorer performance in abrasion of PU on nylon at Innisfail after 6 months, though the result is anomalous in that it is higher than either the 6S results or the average of the 3 and 12 month results.

6.26 FTLS, FLSR and RTLS interactions

The FTS, FRS and RTS interactions were not dependent on load, and are not listed in Table 7.

7 CONCLUSIONS

- (1) The hydrostatic head and mass loss on abrasion of nylon and cotton fabrics of similar mass per unit area, and coated with natural, neoprene, PU or CSPE rubbers, have been determined after exposure to weathering in UK or Australia for up to 1 year under a load of 1% or 10% of the nominal breaking load.
- (2) The expected decrease in hydrostatic head with abrasion was not generally confirmed; correlations between them were low.
- (3) For a given amount of abrasion on nylon, the hydrostatic head of PU coating was low, whilst for neoprene it was high.
- (4) Abrasion losses from nylon were about 40% higher than from cotton.
- (5) CSPE suffered more abrasion losses than the other rubbers, especially on nylon, but were less affected by weathering.
- (6) Natural-rubber lost more in abrasion than did neoprene or PU, especially at PERME.
- (7) PU had the lowest abrasion loss and least susceptibility to weathering, except at Innisfail, though the coating softened and tended to spread out rather than be removed.
- (8) Neoprene lost more in abrasion when on cotton than when on nylon.
- (9) The effect of load during exposure, whether as a main factor or in an interaction, had a negligible effect on abrasion.

Table 1
 ABRASION AND CORRESPONDING HYDROSTATIC HEAD OF WEATHERED COATED FABRICS

Site		Controls						PERME											
Time, months		Original			Final			3				6				12			
Load level, %								1		10		1		10		1		10	
Test		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
<u>Fabric Rubber</u>																			
Nylon	Natural	0.21	245	0.237	188	0.28	95	0.28	95	0.210	32	0.186	22	0.167	42	0.167	22	0.167	22
		0.17	189	0.213	169	0.28	122	0.31	95	0.239	35	0.200	15	0.163	36	0.138	28	0.138	28
Nylon	Neoprene	0.28	272	0.273	268	0.30	272	0.39	258	0.364	322	0.370	308	0.332	268	0.300	60	0.300	60
		0.26	272	0.275	268	0.29	272	0.40	272	0.320	268	0.319	241	0.283	268	0.263	161	0.263	161
Nylon	PU	0.23	281	0.177	24	0.20	41	0.19	27	0.181	30	0.132	12	0.135	9	0.092	12	0.092	12
		0.25	91	0.187	24	0.20	41	0.19	68	0.184	17	0.158	14	0.136	20	0.111	13	0.111	13
Nylon	CSPE	0.78	119	0.590	32	0.77	177	0.65	150	0.362	241	0.417	265	0.519	121	0.496	134	0.496	134
		0.74	95	0.591	100	0.65	163	0.56	150	0.455	233	0.553	222	0.532	102	0.516	84	0.516	84
Cotton	Natural	0.13	190	0.201	76	0.33	41	0.28	163	0.241	27	0.287	24	0.283	19	0.224	14	0.224	14
		0.10	82	0.180	214	0.34	119	*	*	0.258	38	*	*	0.261	25	0.236	10	0.236	10
Cotton	Neoprene	0.19	82	0.333	59	0.25	272	0.27	177	0.258	221	0.221	228	0.374	100	0.309	53	0.309	53
		0.19	82	0.312	74	0.26	245	0.29	272	0.312	322	0.309	245	0.352	114	0.330	127	0.330	127
Cotton	PU	0.29	177	0.246	134	0.33	204	0.29	41	0.128	308	0.138	70	0.228	50	0.195	*	0.195	*
		0.22	245	0.232	134	0.24	272	0.29	150	0.128	*	0.145	*	0.225	18	0.202	20	0.202	20
Cotton	CSPE	0.23	231	0.540	197	0.49	218	0.52	272	0.404	230	0.435	322	0.598	51	0.511	88	0.511	88
		0.26	231	0.515	28	0.41	272	0.45	272	0.388	161	0.396	77	0.537	82	0.539	25	0.539	25

Table 1 (continued)

Site	PERME						Cloncurry											
	6S						3						6					
	Time, months		Load level, %		10		1		10		1		10		1		10	
Test	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
<u>Fabric Rubber</u>																		
Nylon Natural	0.194 0.193	45 30	0.200 0.192	16 28			0.191 0.200	40 80	0.207 0.195	70 70	0.259 0.265	150 147	0.277 0.250	10 72	0.328 0.292	36 58	0.337 0.305	47 30
Nylon Neoprene	0.350 0.335	>268 >268	0.297 0.310	>268 >268	0.329 0.337	255 >268	0.350 0.312	261 >268	0.329 >268	255 >268	0.421 0.434	>268 >268	0.405 0.408	>268 >268	0.488 0.453	241 >268	0.423 0.480	89 78
Nylon PU	0.132 0.150	28 18	0.154 0.159	16 14	0.080 0.102	208 201	0.111 0.097	15 17	0.080 0.102	208 201	0.101 0.102	45 50	- -	- -	0.143 0.195	27 17	- -	- -
Nylon CSPE	0.577 0.583	118 83	0.511 0.473	70 78	0.476 0.497	214 107	0.461 0.461	60 75	0.476 0.497	214 107	0.549 0.525	63 16	0.590 0.545	14 35	0.555 0.523	28 71	0.626 0.603	32 28
Cotton Natural	0.317 0.300	161 107	0.258 0.267	56 72	0.227 0.218	214 60	0.261 0.236	26 163	0.227 0.218	214 60	0.331 0.330	38 >268	0.325 0.300	7 53	0.379 0.365	69 67	0.390 0.390	54 48
Cotton Neoprene	0.342 0.335	85 174	0.293 0.251	93 161	0.295 0.331	65 25	0.268 0.267	94 40	0.295 0.331	65 25	0.328 0.302	65 174	- -	- -	0.365 0.336	93 86	- -	- -
Cotton PU	0.255 0.208	8 30	0.191 0.208	62 54	0.183 0.186	>268 *	0.182 0.175	45 241	0.183 0.186	>268 *	0.245 0.228	>268 >268	0.219 0.220	>268 29	0.171 0.167	41 32	- -	- -
Cotton CSPE	0.514 0.503	134 161	0.486 0.502	60 134	0.432 0.418	194 95	0.463 0.426	45 82	0.432 0.418	194 95	0.503 0.531	181 212	- -	- -	0.591 0.630	134 175	- -	- -

Table 1 (continued)

Site		Cloncurry						Innisfail					
Time, months		6S						3					
Load level, %		1		10		1		10		1		10	
Test		a	b	a	b	a	b	a	b	a	b	a	b
<u>Fabric</u>	<u>Rubber</u>												
Nylon	Natural	0.290	92	0.301	16	0.195	84	0.213	268	0.278	47	0.236	19
		0.268	65	0.268	33	0.185	77	0.181	201	0.259	65	0.244	28
Nylon	Neoprene	0.484	268	0.372	221	0.252	287	0.268	>268	0.334	>268	0.321	>268
		0.434	>268	0.399	134	0.235	236	0.304	>268	0.361	>268	0.339	>268
Nylon	PU	0.055	60	-	-	0.089	30	0.078	5	0.402	7	0.303	6
		0.066	20	-	-	0.072	*	0.086	*	0.343	7	0.351	3
Nylon	CSPE	0.610	126	0.550	26	0.379	244	0.425	94	0.417	21	0.347	72
		0.560	80	0.546	80	0.413	181	0.399	127	0.394	87	0.343	80
Cotton	Natural	0.358	20	0.303	58	0.275	121	0.208	80	0.316	21	0.298	75
		0.342	52	0.274	71	0.241	154	0.199	80	0.312	70	0.314	52
Cotton	Neoprene	0.326	86	0.292	121	0.290	85	0.270	181	0.283	90	0.228	48
		0.289	*	0.289	134	0.283	75	0.252	90	0.279	81	0.234	39
Cotton	PU	0.212	>268	0.250	150	0.119	85	0.130	45	0.392	10	-	-
		0.209	>268	0.253	241	0.089	75	0.099	12	0.381	6	-	-
Cotton	CSPE	0.589	52	0.561	116	0.450	>268	0.463	55	0.491	127	0.512	83
		0.626	126	0.542	50	0.457	201	0.430	87	0.548	143	0.490	163

Table 1 (concluded)

Site		Innisfail									
Time, months		12					6S				
Load level, %		1		10			1		10		
Test		a	b	a	b	a	a	b	a	b	
<u>Fabric Rubber</u>											
Nylon	Natural	0.344	18	0.435	18	0.333		55	0.337	13	
		0.327	40	0.390	19	0.333		72	0.318	15	
Nylon	Neoprene	0.432	67	0.385	43	0.491		273	0.437	126	
		0.425	93	0.376	47	0.441		276	0.403	80	
Nylon	PU	0.303	9	-	-	0.081		45	-	-	
		0.306	8	-	-	0.078		43	-	-	
Nylon	CSPE	0.774	42	0.647	19	0.805		9	0.625	20	
		0.768	11	0.621	30	0.724		20	0.606	20	
Cotton	Natural	0.351	88	0.343	68	0.351		88	0.270	89	
		0.335	137	0.324	90	0.315		87	0.302	42	
Cotton	Neoprene	0.367	62	-	-	0.332		85	0.345	47	
		0.350	57	-	-	0.301		54	0.294	80	
Cotton	PU	0.516	12	*	*	0.264		23	0.211	22	
		0.359	10	0.259	10	0.206		23	0.205	34	
Cotton	CSPE	0.569	41	0.541	55	0.626		134	0.496	59	
		0.544	163	0.489	161	0.581		>268	0.401	56	

NOTES Test a Abrasion, total mass loss from both sides, g, for number of cycles used in test

Test b Hydrostatic head, cm head of water to produce first bubble, on abraded specimen

Duplicate results refer to replication

- Specimen lost or damaged during exposure

* No test made

> Beyond range of apparatus to measure

Table 2
ABRASION OF WEATHERED COATED FABRICS, g/m² PER 1000 CYCLES

Site	Controls		PERME										Cloncurry			
Time, months	Original	Final	3		6		12		6S		3		6			
Load level, %			I	10	I	10	I	10	I	10	I	10	I	10	I	10
Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N		
<u>Fabric</u>																
Nylon Natural	35.80	34.70	74.97	74.97	83.50	73.58	129.40	111.78	80.75	93.82	43.91	49.39	62.07	82.41		
	29.08	25.41	74.97	83.00	86.73	78.64	125.17	107.31	90.87	77.40	46.07	46.61	55.71	74.37		
Nylon Neoprene	14.72	14.86	53.54	45.13	33.13	39.12	54.65	50.53	42.38	38.34	48.40	43.87	51.84	46.95		
	17.41	13.96	51.76	41.81	37.32	36.40	42.61	46.75	39.24	35.77	42.26	46.81	44.23	42.49		
Nylon PU	20.53	19.42	21.04	19.70	17.90	19.61	13.10	7.84	14.73	27.71	13.96	9.94	10.51	-		
	18.44	16.74	21.04	20.46	18.00	22.55	12.43	10.49	15.73	26.94	11.35	11.14	9.94	-		
Nylon CSPE	104.42	109.46	121.04	98.62	98.71	117.17	107.25	103.17	133.79	149.48	138.56	142.17	101.36	108.97		
	99.07	109.79	99.95	86.12	123.89	149.63	108.83	104.33	130.13	123.73	138.29	148.93	96.94	101.06		
Cotton Natural	15.80	16.95	66.94	59.79	47.22	59.60	95.89	103.57	48.15	65.38	45.62	37.38	43.89	51.72		
	11.78	15.19	50.87	-	53.52	-	82.40	85.53	44.80	44.30	36.17	33.25	39.37	40.53		
Cotton Neoprene	21.68	27.88	44.62	41.50	71.14	59.06	87.68	93.55	69.54	61.26	53.90	52.65	67.76	-		
	18.74	25.73	40.16	51.76	73.33	60.97	79.68	77.21	56.96	48.98	56.73	61.12	62.57	-		
Cotton PU	15.93	11.53	25.24	22.18	14.77	15.24	14.15	16.07	14.70	11.34	16.60	16.64	19.80	18.65		
	15.68	10.87	18.35	22.18	8.95	13.50	17.38	15.25	12.28	14.11	16.70	16.94	18.31	22.47		
Cotton CSPE	31.14	51.41	49.96	52.70	28.67	31.92	46.12	42.20	57.18	40.04	47.17	40.81	53.80	-		
	34.01	44.81	41.39	45.78	26.92	27.97	42.94	37.07	51.77	38.98	38.76	36.12	54.20	-		

Table 2 (concluded)

Site	Cloncurry						Innisfail					
	12		6S		3		6		12		6	
	1	10	1	10	1	10	1	10	1	10	1	10
Load level, %												
Column	C	I	Q	R	S	T	U	V	W	X	Y	Z
Fabric												
Rubber												
Nylon	63.45	71.89	51.69	52.98	53.29	41.17	67.45	60.58	63.70	63.03	40.06	43.11
Natural	56.50	65.14	48.66	46.80	47.03	43.09	54.86	62.38	57.40	53.11	37.72	41.03
Nylon	50.33	54.60	49.14	36.41	39.95	28.80	38.07	37.19	47.60	57.43	36.99	37.27
Neoprene	47.99	63.38	39.77	35.91	45.42	33.59	39.30	40.03	46.56	57.97	29.59	32.76
Nylon	73.19	-	8.46	-	8.90	7.25	145.87	119.31	53.80	-	13.37	-
FF	79.64	-	10.44	-	7.43	8.23	125.03	130.84	54.32	-	10.55	-
Nylon	110.15	108.04	113.28	105.48	88.88	95.85	120.96	115.81	86.45	77.97	89.73	76.73
(SFE)	105.01	99.48	103.16	96.60	91.24	88.35	116.87	113.98	85.75	74.68	80.76	74.42
Cotton	49.66	58.91	38.36	48.04	55.45	33.31	61.70	71.45	52.68	51.30	40.35	38.96
Natural	48.41	57.15	36.52	42.58	41.76	35.07	60.55	64.92	48.47	49.58	35.39	35.62
Cotton	67.98	-	48.30	53.11	48.12	52.33	59.92	69.54	80.32	-	55.50	52.67
Neoprene	66.70	-	50.57	54.58	46.39	48.80	57.81	69.79	76.54	-	50.13	43.87
Cotton	11.61	-	14.00	18.20	12.81	14.50	64.20	-	33.06	-	18.08	19.83
FF	12.00	-	13.73	20.25	9.88	10.44	60.25	-	22.03	24.19	16.32	19.33
Cotton	39.83	-	46.38	43.66	40.16	45.03	69.22	56.44	42.94	40.93	46.24	42.16
(SFE)	41.84	-	44.37	47.69	34.56	40.48	51.72	48.75	42.26	37.76	39.99	31.35

Table 3
CORRELATION OF ABRASION AND HYDROSTATIC HEAD

Fabric	Rubber	Site	No. of results	Linear correlation			Multiple correlation				Mean abrasion mass loss, g	Mean hydrostatic head, cm water
				Coeffi- cient	Variance ratio a	Error degrees of freedom	Coeffi- cient b	Variance ratio		Error degrees of freedom		
								Linear a	Quadratic a			
Nylon	Natural	All PERME Cloncurry Innisfail	52	-0.22	2.6	50	0.29	2.7	1.9	49	0.251	69
			16	+0.84	32.5	14	0.89	44.0	6.0	13	0.212	47
			16	-0.25	1.0	14	0.41	1.0	1.6	13	0.265	64
			16	-0.59	7.3	14	0.64	7.7	1.3	13	0.288	65
Nylon	Neoprene	All PERME Cloncurry Innisfail	27	-0.22	1.4	25	0.33	1.4	1.6	24	0.374	192
			7	+0.67	4.0	5	0.68	3.3	0.1	4	0.337	224
			8	-0.27	0.5	6	0.67	0.7	3.5	5	0.416	193
			10	-0.25	0.5	8	0.84	1.4	15.2	7	0.388	153
Nylon	PU	All PERME Cloncurry Innisfail	40	-0.14	0.8	38	0.15	0.7	0.1	37	0.168	41
			16	+0.65	10.2	14	0.72	11.6	2.6	13	0.156	24
			10	-0.31	0.8	8	0.30	0.6	0.1	7	0.105	63
			10	-0.74	9.6	8	0.75	9.0	0.3	7	0.233	16
Nylon	CSPE	All PERME Cloncurry Innisfail	52	-0.36	7.3	50	0.40	7.6	1.5	49	0.352	94
			16	-0.23	0.8	14	0.61	1.2	6.6	13	0.340	149
			16	-0.39	2.6	14	0.44	2.5	0.7	13	0.242	66
			16	-0.66	10.9	14	0.67	10.4	0.4	13	0.543	67
Cotton	Natural	All PERME Cloncurry Innisfail	49	-0.30	4.8	47	0.32	4.7	0.6	46	0.285	77
			14	+0.58	6.2	12	0.60	5.7	0.3	11	0.277	63
			15	-0.52	4.8	13	0.66	4.8	3.2	12	0.313	67
			16	-0.19	0.5	14	0.14	3.3	0.0	13	0.297	52

Table 3 (continued)

Fabric	Rubber	Site	No. of results	Linear correlation			Multiple correlation			Mean abrasion mass loss, g	No. of head, cm after
				Coefficient	Variance ratio	Error degrees of freedom	Coefficient	Variance ratio	Error degrees of freedom		
Cotton	Neoprene	All PERME	44	-0.24	2.6	42	0.31	2.6	1.8	0.295	112
		Cloncurry	15	-0.62	8.1	13	0.62	7.5	0.0	0.296	171
		Innisfail	11	-0.12	0.2	9	0.23	0.1	0.3	0.309	89
			14	-0.14	0.3	12	0.47	0.3	2.8	0.293	77
Cotton	PU	All PERME	36	-0.04	0.0	34	0.26	0.1	2.4	0.234	78
		Cloncurry	12	+0.42	2.0	10	0.49	2.0	0.8	0.234	82
		Innisfail	7	+0.44	1.2	5	0.58	1.2	0.8	0.203	111
			13	-0.66	8.4	11	0.73	9.3	2.3	0.248	28
Cotton	CSPE	All PERME	45	-0.32	4.8	43	0.34	4.8	0.8	0.492	131
		Cloncurry	15	-0.46	3.2	13	0.52	3.4	1.1	0.483	149
		Innisfail	12	+0.10	0.1	10	0.10	0.1	0.0	0.526	122
			14	+0.10	0.2	12	0.18	0.1	0.3	0.506	129

NOTES a One degree of freedom

b Sign not defined

Table 4

TEST FOR EQUALITY OF ABRASION ERROR VARIANCES

Set	No. of highest ranges omitted	No. of degrees of freedom	F
(a)	0	15	16.2
(b)	0	46	70.8
(b)	2	44	61.2
(c)	0	95	132.2
(c)	2	93	118.8
(d)	0	45	48.6
(e)	0	61	103.4
(e)	7	54	75.9
(f)	0	47	76.5
(f)	3	44	59.4
(g)	0	47	49.6
(h)	0	47	58.0
(i)	0	71	85.5

Table 5

ANALYSIS OF ERRORS

Property	Set									
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Error variance	8.303	21.399	24.460	30.654	47.391	27.262	63.122	21.175	36.523	
Standard deviation	2.882	4.626	4.946	5.537	6.884	5.221	7.945	4.602	6.043	
Coefficient of variation, %	8.8	9.7	9.3	9.3	12.2	10.7	18.1	9.9	8.4	
Set mean, g/m ² per 1000 cycles	32.91	27.48	33.43	50.47	56.59	48.92	43.86	46.40	72.32	
Number degrees of freedom in error	16	48	46	48	64	48	48	48	72	

Table 6

TABLE OF VARIANCE RATIOS

Effect	No. of degrees of freedom	No. of levels	No. of results per level	Set								
				(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
F	1	2	16	372.3								
F	1	2	48		327.2		157.4		375.1	124.7	273.8	
F	1	2	96			640.7		287.0				
F	1	2	64									
R	3	4	8	696.5								
R	3	4	24		726.3				588.9	238.1	340.4	
R	3	4	48			851.1		560.6				1389.6
R	3	4	32									
R	2	3	48									
T	1	2	16	7.4								
T	3	4	48									
T	3	4	24			88.5	84.7					
T	3	4	32					22.0	105.8	20.5	201.3	16.8
T	5	6	16									
T	3	4	36									
L	1	2	48									
L	1	2	64		2.2		1.5	0.3				0.3
L	1	2	72									
S	2	3	32			27.3	166.2					
S	2	3	64		41.1							
S	2	3	48									156.2

Table 6 (continued)

Effect	No. of degrees of freedom	No. of levels	No. of results per level	Set								
				(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
FR	3	8	4	247.9								
FR	3	8	12		348.6	552.4			308.6	109.9	239.1	
FR	3	8	24					280.5				
FR	3	8	16									
FT	1	4	8	4.5								
FT	3	8	24			3.0	1.3	7.4				
FT	3	8	12									
FT	3	8	16						1.5	1.6	13.7	
FT	5	12	8									
FL	1	4	24				1.5	0.2				
FL	1	4	32		1.3							
FS	2	6	16									
FS	2	6	32		19.0	10.6	34.8					
RT	3	8	4	9.7								
RT	9	16	12									
RT	9	16	8			30.6		20.9	38.3	5.6	48.5	26.4
RT	15	24	4									
RT	6	12	12									
RL	3	8	12									
RL	3	8	16		0.5			0.7				0.1
RL	2	6	24									

Table 6 (continued)

Effect	No. of degrees of freedom	No. of levels	No. of results per level	Set								
				(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
RS	6	12	8		33.7							
RS	6	12	16			91.9						
RS	4	9	16									56.5
TL	3	8	12				2.7	1.0				
TL	3	8	16									
TL	3	8	18									2.2
TS	6	12	16									
TS	6	12	8			64.0	25.6					17.5
TS	6	12	12									
LS	2	6	16		0.5		4.1					2.9
LS	2	6	24									
FRT	3	16	2	1.7								
FRT	9	32	6									
FRT	9	32	4			18.4						
FRT	15	48	2					8.0	6.4	2.3	14.0	
FRL	3	16	6									
FRL	3	16	8		2.6			2.2				
FRS	6	24	4									
FRS	6	24	8		68.1	24.0						
FTL	3	16	6				1.2	2.5				
FTL	3	16	8									

Table 6 (concluded)

Effect	No. of degrees of freedom	No. of levels	No. of results per level	Set								
				(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
FTS	6	24	8			14.4						
FTS	6	24	4				11.5					
FLS	2	12	8		3.6		4.2					
RTL	9	32	4					1.3				2.0
RTL	6	24	6									
RTS	18	48	4			29.5						17.7
RTS	12	36	4									
TLS	6	24	4				1.8					1.7
TLS	6	24	6									
LSR	6	24	4		2.5							2.1
LSR	4	18	8									
FRTL	9	64	2					1.7				
FRTS	18	96	2			15.5						
FTLS	6	48	2				1.2					
FLSR	6	48	2		1.3							
RTLS	12	72	2									2.2

Table 7
MEAN ABRASION MASS LOSSES, g/m^2 PER 1000 CYCLES

Factor	Level	Set								
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
F	Nylon Cotton	42.74	56.02	62.48	66.56	66.90	59.24	52.92	54.17	
		23.08	38.93	44.38	52.38	46.28	38.59	34.81	38.62	
R	Natural Neoprene PC CSPE	23.09	51.41	58.79		77.32	59.20	39.62	41.84	66.56
		19.40	46.25	52.30		53.31	43.03	41.65	39.29	43.07
T		16.14	15.12	26.18		17.06	16.25	16.80	32.71	
		73.01	77.12	76.45		78.67	77.18	77.38	71.74	107.33
S	Original Final 3 months 6 months 12 months 6S months	31.51					31.51	31.51	31.51	
		34.29					34.29	34.29	34.29	
S	PERME Cloncurry Innisfail		52.54	56.93	77.32					83.15
			49.63	50.37	50.77					72.46
FR	Nylon/Natural Nylon/Neoprene Nylon/PU Nylon/CSPE Cotton/Natural Cotton/Neoprene Cotton/PU Cotton/CSPE		40.25	52.99	50.33					61.35
		31.25	56.54	66.58		90.43	72.61	46.09	45.67	
FR		15.24	42.65	43.25		43.03	34.63	35.92	31.18	
		18.78	13.37	32.14		18.14	17.51	18.87	41.20	
FR		105.68	111.50	107.96		115.99	112.19	110.79	98.62	
		14.93	46.28	51.01		64.21	45.79	33.14	38.01	
FR		23.55	49.84	61.35		63.59	51.43	47.38	47.40	
		13.50	16.87	20.22		15.98	14.99	14.73	24.22	
FR		40.34	42.74	44.93		41.35	42.17	43.98	44.87	
FS	Nylon/PERME Nylon/Cloncurry Nylon/Innisfail Cotton/PERME Cotton/Cloncurry Cotton/Innisfail		61.76	67.49	90.43					
			61.35	60.06	57.33					
FS			44.94	59.90	51.94					
			43.33	46.36	64.21					
FS			37.91	40.68	44.22					
			35.57	46.09	48.72					

Table 7 (continued)

Factor	Level	Set											
		(a)				(c)				(e)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE
RT	Original	23.12	18.14	17.64	67.16	53.09	46.81	15.27	77.50	68.16	46.28	21.27	74.44
	Final	23.06	20.61	14.64	78.87	59.71	53.05	42.79	78.60	67.80	51.31	16.32	75.61
	3					72.76	62.31	33.00	71.61	105.13	66.58	13.34	73.99
	6					49.61	47.01	13.64	78.06	68.18	49.06	17.32	90.64
	12												
	6S												

Factor	Level	Set							
		(f)				(g)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE
RT	Original	23.12	18.14	17.64	67.16	23.12	18.14	17.64	67.16
	Final	23.06	20.61	14.64	78.87	23.06	20.61	14.64	78.87
	3	66.94	47.52	21.42	78.02	42.94	50.32	14.65	90.70
	6	67.74	53.73	14.90	69.55	50.26	56.60	14.64	76.58
	12	108.22	66.16	14.26	78.28	54.50	58.02	27.49	74.21

Factor	Level	Set							
		(h)				(i)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	CSPE	
RT	Original	23.12	18.14	17.64	67.16				
	Final	23.06	20.61	14.64	78.87				
	3	49.38	42.60	9.76	63.71	56.54	42.65	111.50	
	6	61.14	48.82	98.84	89.69	70.19	40.52	113.78	
	12	55.56	62.76	40.80	66.85	80.65	51.57	97.59	

Table 7 (continued)

Factor	Level	Set									
		(b)				(c)				(i)	
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE	Natural	Neoprene
RS	PERME	68.16	46.28	21.27	74.44	77.26	54.86	16.30	79.28	90.42	43.03
	Cloncurry	42.30	50.72	14.16	91.35	47.88	52.79	21.24	79.57	57.33	46.46
	Innisfail	43.77	41.74	9.93	65.57	51.24	49.25	40.99	70.48	51.94	39.71
											CSPE
											115.99
											113.61
											92.40

Factor	Level	Set									
		(c)				(d)				(i)	
		3	6	12	6S	3	6	12	6S	3	6S
TS	PERME	53.49	51.48	66.23	56.50	68.16	67.80	105.13	68.18	75.49	90.98
	Cloncurry	49.65	49.52	57.67	44.63	42.30	56.26	58.88	45.65	77.94	74.60
	Innisfail	41.36	74.62	55.87	40.11	43.77	62.99	54.91	39.66	57.26	64.95
											51.60

Table 7 (continued)

Factor	Level	Set							
		(c)				(e)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE
FRT	Nylon	Original							
		Final							
		3	45.30	13.95	112.99	76.98	48.06	20.56	101.43
		6	68.39	40.68	54.54	80.61	36.49	19.52	122.35
		12	82.60	48.14	47.63	118.42	48.64	10.96	105.90
	Cotton	6S	58.62	38.86	12.43	108.48	38.93	21.53	134.28
		Original							
		Final							
		3	49.47	48.32	16.60	59.35	44.51	21.99	47.46
		6	51.04	65.42	31.05	54.98	66.12	13.12	28.87
		12	62.92	76.48	18.37	91.85	84.53	15.71	42.08
		6S	40.60	55.17	14.85	50.66	59.18	13.11	46.99

Factor	Level	Set							
		(f)				(h)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE
FRT	Nylon	Original							
		Final							
		3	32.44	16.06	19.48	32.44	16.06	19.48	101.74
		6	30.66	14.41	18.08	30.06	14.41	18.08	109.62
		12	74.97	52.65	21.04	50.16	37.94	8.16	90.06
	Cotton	6S	85.12	35.22	17.95	61.16	38.78	135.45	118.92
		Original							
		Final							
		3	127.28	48.63	12.76	60.55	47.08	54.06	86.10
		6	85.81	40.81	15.73	39.66	32.82	11.96	85.24
		12	13.79	20.21	15.80	13.79	20.21	15.80	32.58
		6S	16.07	26.80	11.20	16.07	26.80	11.20	48.11
		Original							
		Final							
		3	58.90	42.39	21.80	48.60	47.26	11.34	37.36
		6	50.37	72.24	11.86	61.12	58.86	62.22	60.47
		12	89.14	83.68	15.76	50.58	78.43	27.54	47.60
		6S	46.48	63.25	13.49	37.87	52.82	17.20	43.12

Table 7 (continued)

Factor	Level	Set							
		(b)				(c)			
		Natural	Neoprene	PU	CSPE	Natural	Neoprene	PU	CSPE
FRS	Nylon { PERME Cloncurry Innisfail	76.98	48.02	20.36	101.43	93.30	44.33	16.78	115.45
		46.50	45.34	11.60	141.99	53.51	46.26	27.14	113.34
		46.14	34.56	7.95	91.08	52.94	39.15	52.41	95.08
	Cotton { PERME Cloncurry Innisfail	59.35	44.51	21.99	47.46	61.22	65.39	15.73	43.12
		38.10	56.16	16.72	40.72	42.25	59.31	15.34	45.79
		41.40	48.91	11.91	40.06	49.54	59.34	29.58	45.89

Factor	Level	Set							
		(c)				(d)			
		3	6	12	6S	3	6	12	6S
FTS	Nylon { PERME Cloncurry Innisfail	64.79	62.40	74.18	68.58	76.98	80.61	118.42	85.71
		60.35	54.08	73.08	52.74	46.50	68.64	64.24	49.93
		46.58	88.58	61.95	42.48	46.14	61.32	59.31	40.98
	Cotton { PERME Cloncurry Innisfail	42.19	40.56	58.28	44.42	59.35	54.99	91.85	50.66
		38.96	44.96	42.25	36.53	38.10	43.88	53.53	41.38
		36.14	60.67	49.78	37.75	41.40	64.66	50.51	38.33

Table 7 (continued)

Factor	Level	Set									
		(c)					(i)				
		3	6	12	6S	3	6	12	6S	3	6S
RTS	PERME { Natural Neoprene PU CSPE	66.94	67.74	108.22	66.14	76.98	80.61	118.42	85.71		
		47.52	53.73	66.16	52.03	48.06	36.49	48.64	38.93		
		21.42	14.90	14.26	14.61						
	Cloncurry { Natural Neoprene PU CSPE	78.08	69.54	76.28	93.22	101.43	122.35	105.90	134.28		
		42.94	50.26	54.50	43.81	46.50	68.64	64.24	49.93		
		50.32	56.60	58.02	46.20	45.34	46.38	53.90	40.23		
	Innisfail { Natural Neoprene PU CSPE	14.65	14.64	43.94	11.73	141.99	102.08	105.67	104.68		
		90.70	76.58	74.21	76.80						
		49.38	61.14	55.56	38.88	46.14	61.32	59.31	40.98		
		42.60	48.82	62.76	42.82	34.56	38.70	52.16	33.41		
		9.76	98.84	40.80	14.58						
		63.71	89.69	64.35	64.18	91.08	116.90	81.21	80.41		

Table 7 (concluded)

Factor	Level	Set (c)				
		3	6	12	6S	
FRIS	Nylon	PERME { Natural Neoprene PU CSPE	74.97	85.12	127.28	85.81
			52.65	35.22	48.63	40.81
			21.04	17.95	12.76	15.73
		Cloncurry { Natural Neoprene PU CSPE	110.50	111.30	108.04	131.96
			44.99	58.89	59.98	50.18
			45.33	48.04	48.71	42.96
	Cotton	Innisfail { Natural Neoprene PU CSPE	12.66	10.22	76.07	9.60
			138.42	99.15	107.58	108.22
			50.16	61.16	60.55	39.89
		PERME { Natural Neoprene PU CSPE	37.94	38.78	47.08	32.82
			8.16	135.45	54.06	11.96
			90.06	118.92	86.10	85.24
	Nylon	PERME { Natural Neoprene PU CSPE	58.90	50.37	89.14	46.48
			42.39	72.24	83.68	63.25
			21.80	11.86	15.76	13.49
		Cloncurry { Natural Neoprene PU CSPE	45.68	27.80	44.53	54.48
			40.90	41.63	49.04	37.44
			55.32	65.16	67.34	49.44
	Cotton	Innisfail { Natural Neoprene PU CSPE	16.65	19.06	11.80	13.86
			42.96	54.00	40.84	45.38
			48.60	61.12	50.58	37.87
		PERME { Natural Neoprene PU CSPE	47.26	58.86	78.43	52.81
			11.34	62.22	27.54	17.20
			37.36	60.47	42.60	43.12

Table 8

DIFFERENCES BETWEEN ABRASION MEANS, g/m^2 PER 1000 CYCLES,
AT 99.9% PROBABILITY

Effect	Set								
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
F	4.10	3.30	2.43	3.96	4.20	3.73	5.68	3.29	
R	5.79	4.67	3.43		5.94	5.28	8.03	4.65	4.24
T	4.10		3.43	5.59	5.94	6.46	9.83	5.69	4.90
L		3.30		3.96	4.20				3.46
S		4.05	2.97	4.84					4.24
FR	11.58	9.35	6.86		11.88	10.55	16.05	9.30	
FT	8.19		6.86	11.19	11.88	12.92	19.66	11.39	
FL		6.61		7.91	8.40				
FS		8.10	5.94	9.69					
RT	11.58		9.71		16.79	18.27	27.81	16.11	12.00
RL		9.35			11.88				8.49
RS		11.45	8.41						10.39
TL				11.19	11.88				9.80
TS			8.41	13.70					12.00
LS		8.10		9.69					8.49
FRT	23.17		19.42		33.59	36.55	55.61	32.21	
FRL		18.70			23.75				
FRS		22.90	16.82						
FTL				22.38	23.75				
FTS			16.82	27.40					
FLS		16.19		19.38					
RTL					33.59				24.01
RTS			23.78						29.40
TLS				27.40					24.01
LSR		22.90							20.79
FRTL			47.56		67.18				
FRTS									
FTLS				54.81					
FLSR		45.79							
RTLS									58.80

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REPORT DOCUMENTATION PAGE

Overall security classification of this page

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1. DRIC Reference (to be added by DRIC)	2. Originator's Reference RAE TR 80124	3. Agency Reference N/A	4. Report Security Classification/Marking UNCLASSIFIED	
5. DRIC Code for Originator 7673000w	6. Originator (Corporate Author) Name and Location Royal Aircraft Establishment, Farnborough, Hants, UK			
5a. Sponsoring Agency's Code N/A	6a. Sponsoring Agency (Contract Authority) Name and Location N/A			
7. Title Abrasion and hydrostatic head of weathered rubber-coated fabrics				
7a. (For Translations) Title in Foreign Language				
7b. (For Conference Papers) Title, Place and Date of Conference				
8. Author 1. Surname, Initials Swallow, J.E.	9a. Author 2 Wakefield, A.R.	9b. Authors 3, 4	10. Date October 1980	Pages Refs. 31 5
11. Contract Number N/A	12. Period N/A	13. Project	14. Other Reference Nos. Mat 411	
15. Distribution statement (a) Controlled by - DRIC (b) Special limitations (if any) -				
16. Descriptors (Keywords) (Descriptors marked * are selected from TEST) Abrasion. Hydrostatic head. Coated fabrics. Weathering.				
17. Abstract The abrasion mass loss and hydrostatic head of a nylon and of a cotton fabric, each coated with natural rubber, neoprene, polyurethane (PU) or chlorosulphonated polyethylene (CSPE) and exposed to various weathering conditions, were determined. Correlations between hydrostatic head and abrasion mass loss were generally low. During abrasion, coated nylon fabrics lost more mass than coated cotton fabrics. CSPE was most susceptible to abrasion, particularly on nylon, though with little dependence on conditions of exposure. Neoprene was worse on cotton. PU had the lowest mass loss and least susceptibility to exposure conditions, except at Innisfail. Natural rubber lost more mass on abrasion than neoprene or PU, especially at PERME. Load during exposure had a negligible effect.				

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