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PHILADELPHIA, PENNSYLVANIA 19112  
AERONAUTICAL MATERIALS LABORATORY  
HIGH POLYMER DIVISION

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REPORT NO. NAEC-AML-2604

LABORATORY SHRINKAGE EVALUATION OF  
NOMEX SUMMER FLIGHT SUITS

ASSIGNMENT 8-11 (13E)  
UNDER AIRTASK A32 523 013 200/1 F020 03 01

AD 657853

A. Introduction

1. The development work and evaluation of melt resistant Nomex staple herringbone twill cloths for summer flight clothing is performed under reference (a) authorization.

2. Two summer flight suits (40R) fabricated by Aerospace Crew Equipment Laboratory (ACEL) from the Nomex cloth, reference (b), one suit with cloth overprinted with the camouflage pattern, were received on 31 March 1967. The suits and cloth used in their manufacture were subjected to the laboratory shrinkage evaluation requested by reference (c).

3. The laundering of Nomex staple herringbone twill cloth has previously been performed by shipboard procedures and home laundering procedures and shrinkage has not been excessive (reference (d)). Fabric tests on material to be used in the suit fabrication indicated (reference (e)) that shrinkage was acceptable (reference (b) requirement). The warp direction, shrinkage, however, is normally over 1 percent. Thus service complaints of shrinkage in coveralls may have resulted from warp direction shrinkage when coverall dimensions were on the minus tolerance.

B. Experimental Procedures

1. The laundry shrinkage test was performed by shipboard Formula S procedure in the Navy Laundering Handbook using fresh water. This is a wash at 140°F and is the highest temperature wash used on colored garments.

2. Measurements on the coveralls were taken at the Breast, Sleeve length, and Leg inseam locations specified (reference (f)). The front slide fastener length, seat width, and the length along the crotch seam from the slide fastener seam junction to the back cross seam were also measured.

ENCLOSURE (1)  
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3. A 10 x 10 inch square was marked on the back cloth area to check cloth shrinkage. The standard 18 x 18 inch marks were used on cloth specimens to determine shrinkage.

C. Results and Discussion

1. The results of shrinkage tests are shown in Table 1.

2. The breast and sleeve dimensions are one size larger on the camouflage printed coverall. The printing stiffens the cloth and apparently reduced the fraying at the pattern edge and also enables sewing to be done closer to the edge of the material.

3. The change in coverall dimensions, except for the crotch measurement, correspond closely to the fabric shrinkage percentage. The 5 percent shrinkage in the crotch dimension appears to be due to seam puckering. The cloths are joined in the bias direction at the crotch so the normal restraint of warp or filling yarns on puckering is not present.

D. Conclusions

It is concluded that:

1. The cloth shrinkage is not excessive and conforms to specification (reference (b)) requirements.

2. The coverall dimensions, except for the crotch seam length, do not change excessively and are within coverall tolerance of plus or minus 1/2 inch. The crotch seam shrinkage is about 5 percent and appears due to seam puckering.

3. The camouflage printing stabilizes the cloth so the pattern may give a larger cloth area and/or less cloth is used in seaming. These conditions produce a larger size coverall than intended.

E. Recommendations

It is recommended that:

1. The laundered coveralls be measured and compared to standards to determine if the crotch shrinkage will result in wearer discomfort.

2. The coveralls made of the camouflage printed material be examined to determine if a reduction in pattern dimensions is required.

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REFERENCES

- (a) BUAER ltr Aer-AE-513/68 of 17 Apr 1958
- (b) Military Spec. MIL-G-81280A(WP) Cloth, Herringbone Twill, Polyamide, High Temperature Resistant of 8 Jul 1965
- (c) NAVAIRSYSCOM ltr AIR 5311H/415:LIW of 28 Feb 1967
- (d) Report No. NAEC-AML-2271 - Evaluation of Stern and Stern Nomex Staple Herringbone Twill Cloths of 24 Aug 1965
- (e) Report No. NAEC-AML-2597 - Comparison of Olive Green and Camouflage Printed Nomex Nylon Coverall Cloth of 30 Mar 1967
- (f) Military Specification MIL-C-81126B Coveralls, Flying, Summer, Fire Resistant Polyamide, Type CS/FRP-1 of 3 Dec 1965

TABLES

- 1 - Results of Shrinkage Test - Laundered by Formula S - IGEPON Detergent

**RESULTS OF SHRINKAGE TEST**  
**LAUNDERED BY FORMULA S - IGEPON DETERGENT**

<u>Coverall Dimension</u>	<u>Length in Inches</u>				<u>Reqm't. 4OR MIL-C-81126B</u>
	<u>Regular Cloth</u>		<u>Camouflage Cloth</u>		
	<u>Initial</u>	<u>Laundered</u>	<u>Initial</u>	<u>Laundered</u>	
Breast (Fill)	23-1/2	23-1/8	24-1/4	24-5/16	23 ± 1/2
Sleeve (Warp)					
Left	22-3/4	22-5/8	23-3/16	22-15/16	22 ± 1/2
Right	22-5/8	22-3/16	23	22-9/16	22 ± 1/2
Leg Inseam (Warp)					
Left	29-3/4	29-5/16	29-7/8	29-5/16	29-1/2 ± 1/2
Right	29-1/2	29-15/16	29-1/2	29-3/16	29-1/2 ± 1/2
Front Slider (Warp)	20	19-11/16	20	19-1/2	----
Crotch (Warp*)	17-1/4	16-1/2	17-3/8	16-3/4	----
Seat (Fill)	23-3/8	23-1/4	23-11/16	23-7/16	----
Back Cloth					
Warp	10	9-7/8	10	9-7/8	----
Filling	10	9-15/16	10	10-1/8	----
<u>Cloth</u>	<u>Inches</u>	<u>% Change</u>	<u>Inches</u>	<u>% Change</u>	<u>Reqm't. MIL-C-81280</u>
Warp	18	-1.8	18	-1.37	-2.0 max.
Filling	18	0	18	+1.07	-1.5 max.

\*About 10" of warp and 7" of bias

TABLE 1

Security Classification

DOCUMENT CONTROL DATA - R&D		
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13. ABSTRACT  This reports shrinkage of coveralls made of olive green and camouflage printed Nomex herringbone twill cloths laundered by Formula S. Coverall dimensions, except for crotch seam that apparently puckers, are not shortened excessively.		

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Laundry shrinkage Nomex herringbone twill Camouflage printed						

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