TECHNICAL REPORT
67-21-CM

APPRAISAL OF WHITE MARKING MEDIA FOR APPLICATION ON AIR FORCE BLUE COTTON WEBBING

by

Allen P. Snyder and Theodore Kapala

September 1966

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760

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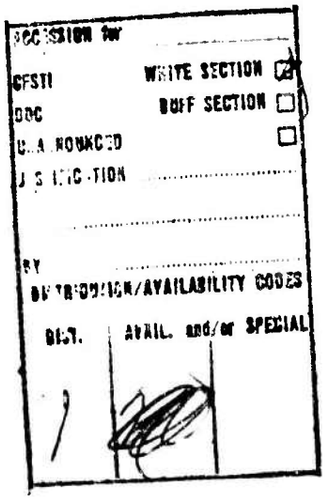

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APPRAISAL OF WHITE MARKING MEDIA FOR APPLICATION ON AIR FORCE BLUE COTTON WEBBING

by

Allen Paul Snyder and Theodore Kapala
Chemical Products and Paper Engineering Branch

Project Reference:
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Clothing and Organic Materials Division
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

FOREWORD

U. S. Air Force Manual Number 35-10E, dated 4 September 1964, "Service and Dress Uniforms for Air Force Personnel," specifies a name tag on the Air Force fatigue uniform. This tag is to consist of white letters on ultramarine blue colored tape.

Prior to this study, there was no known means of marking ultramarine blue tape with a white marking medium that is resistant to at least 50 washings.

The U. S. Army Natick Laboratories agreed to undertake the task of developing a suitable white marking medium for application on blue cotton tape because of our overall interest in marking textiles of all types.

The results show a successful development of a suitable white marking ink having excellent fastness after more than 50 washings. Only a practical method remains to be established for the easy preparation of name tags using the specified silk screen printing technique at Air Force induction centers.

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ABSTRACT

This report covers an evaluation of 31 different marking media for producing name tags on Air Force Blue cotton webbing. Inks, heat transfers (decalcomanias), thermo-plastic films, embroidered letters, and fabric letters with thermo-plastic adhesives were included. Different methods of applying these media were tried in an effort to improve their fastness to laundering.

The most satisfactory opaque markings were subjected to 25 and 50 launderings. Their opacity, legibility, resistance to cracking, and resistance to yellowing after laundering are described in detail. Those giving the most promising results were also subjected to 5 dry cleanings.

Although several of the marking media show promise for white lettered name tags on blue webbing, some are impractical to apply at an induction center. Heat transfers (white decalcomanias), embroidered white lettering, and silk-screen printing white inks exhibit the best fastness to laundering.

APPRAISAL OF WHITE MARKING MEDIA FOR APPLICATION ON AIR FORCE BLUE COTTON WEBBING

I. Introduction

Military Interdepartmental Purchase Request (MIPR) AS 5-273, dated 5 June 1964 (control symbol No. 64-6799-6314 from Aeronautical Systems Division, ASCFC-12, Wright-Patterson Air Force Base, Ohio) proposes that the U. S. Army Natick Laboratories (NLABS), Natick, Mass., establish a white ink to use on Air Force blue webbing name tags.

The scope of the proposed NLABS study was as follows:

a. To evaluate commercial white inks and, if necessary, to develop a white indelible ink for the marking of colored cotton tape.

b. To recommend markings that 1) do not crack but remain sharp, clear, and flexible on the webbing after at least 50 military launderings, 2) do not change color, adhesion, or flexibility after laundering or dry cleaning, and 3) do not emit any noxious odors at room temperature or at an elevated temperature either before or after laundering.

Although originally the work was limited to commercial inks, it was agreed that all types of marking media would be included. It was also agreed that candidate products would be washed 15 times and that only the most promising would be washed 25 or 50 times.

Of the various industries informed of the marking requirements, the best response came from the ink industry. Samples received for evaluation included marking inks, heat transfers (decalcomanias), plastic films, embroided white letters on blue webbing, blue ink on white webbing, and a white fabric printed to resist subsequent dyeing. Some of the marking media were applied to webbing by the supplier and others were applied at the U. S. Army Natick Laboratories (NLABS). Additional markings developed at NLABS included white fabric letters with adhesive backing, coated white fabric letters with adhesive backings, white marking inks, and white thermoplastic adhesives.

II. Methods of Applying the Marking Media

The marking media (App. A) were first evaluated for opacity and resistance to cracking before laundering. The most promising samples were then evaluated for legibility, resistance to yellowing, and resistance to cracking and, if applicable, to fraying after 5, 10, 15, 25, and 50 launderings.

Commercial white inks Nos. 3, 4, 17, and 18 were applied by rubber or metal stamp or by stencil and then reapplied for a total of 5 times, after drying for 5 minutes between applications to obtain a marking of acceptable opacity.

To get acceptable opacity with fewer applications, a sample of the webbing was pretreated with a thin film of Dupont Cement No. 5457. When applied with a rubber stamp, No. 3 ink required only three applications to obtain an opaque impression. This application is listed as Sample No. 7.

Some inks (Nos. 1, 2, 10, 11, 12, and 13) were applied to the webbing by the ink manufacturers or marked-tape suppliers.

Commercial decalcomanias consisting of 5/8-inch and 3/16-inch white letters were applied by moderate pressure of a heated iron to blue webbing (Nos. 8 and 9). This method of application was also used for letters cut from a white fabric with thermoplastic adhesive backing (No. 5), the same letters coated with Dupont cement to prevent fraying (No. 6), and letters cut from a white opaque plastic film having a thermoplastic adhesive backing (No. 20).

White opaque adhesives containing an organic solvent were applied to the webbing (Nos. 15 and 16) by a rubber stamp. It was necessary to re-mark the webbing four times to obtain opaque markings.

A label was produced by printing a dye resist on white fabric before subsequent dyeing (No. 19). This opaque white lettering was as flexible as the undyed fabric and the dyed area was equal in fastness to the specified dyed webbing.

A sample of blue webbing embroidered with white thread in Germany (No. 14) for a local U.S.A. merchant was also evaluated.

Some of the above inks, when properly applied to the webbing, exhibited good fastness to laundering. For that reason, samples of silk-screen inks that were especially made for application on textiles were used. Sample Nos. 21 through 31, save for No. 26, are white; No. 26 is yellow. All of the silk-screen inks were applied by following the normal commercial practice, but using a water-soluble coating on a 6 XX mesh screen, as follows:

a) the blue webbing was fastened into position,

b) the previously prepared screen with lettering was placed over the webbing,

c) the ink was poured into the reservoir area of the screen,

d) the ink was lightly drawn across the markings from one end to the other, using a squeegee to obtain a flood coat,

e) using moderate pressure, another pass was made to force the ink through the screen and onto the webbing,

f) the screen was raised and cleaned.

When additional coats were required to obtain an opaque marking, steps c) through f) were repeated, leaving the webbing and the screen in position. Inks that required curing were cured after application of the final coat.

Sample Nos. 23 and 31 required heat for drying and curing. The other screen-printing inks were allowed to air dry for 24 hours prior to testing. Because of its outstanding performance, a number of variations in the application and curing of No. 23 were followed (App. B).

III. Methods of Preparing, Laundering, and Dry Cleaning Test Items

Samples of blue webbing with markings applied in-house or by the supplier were sewn onto a square yard of 8-oz. cotton sateen OG-107. Because of the poor fastness of the OG-107 fabric to laundering and the subsequent staining of the white markings, additional samples were sewn onto an undyed cotton cloth.

All samples were laundered in accordance with Standard Wash Formula D, which is a relatively heavy-duty laundry formula referenced in TM 10-354, Quartermaster Fixed Laundry Organization.

The commercial laundering procedure consisted of

a) a 7-minute wash in a soap and alkali solution at a temperature between 140° and 145°F.

b) an 8-minute wash in a soap solution at a temperature between 140° and 145°F.

c) an 8-minute wash in a bleach and alkali solution at a temperature between 140° and 145°F.

d) an 8-minute rinse with water at 150°F.

e) an 8-minute rinse in a solution of "Inex" at 150°F.

f) an 8-minute rinse in a blueing solution at 110°F.

g) a 4-minute rinse in a sour solution at 145°F.

h) a 4-minute rinse in a sour solution at 100°F.

Sample Nos. 23N, 23P, and 23Q (App. B) were applied to the blue webbing and dry cleaned in accordance with the standard Method 5620 (petroleum solvent) and 5621 (perchlorethylene solvent) of Federal Specification CCC-T-191.

IV. Methods of Evaluation

The various marking media on ultramarine blue webbing or on the fabric furnished by the supplier were rated visually for opacity and resistance to cracking before laundering and for opacity, legibility, and resistance to cracking, yellowing and fraying (if applicable) after laundering, as follows:

Opacity or Covering Power before Laundering

1. The white markings completely obscure the blue webbing.

2. The white markings are pale blue as a result of some transmission of the blue color from the webbing.

3. The white markings are medium blue as a result of poor opacity.

4. The white markings are dark blue; marking is barely visible.

Resistance to Cracking Rating before Laundering

1. No cracking.

2. Objectionable cracking.

Opacity after Laundering or Dry Cleaning

1. Marking not affected and the white markings completely obscure the blue webbing.

2. Slight removal of marking.

3. Some removal of marking.

4. Considerable removal of marking.

5. Complete removal of marking.

Legibility after Laundering or Dry Cleaning

1. No change in legibility.

2. Still legible without difficulty.

3. Readily legible but with some difficulty.

4. Barely legible but not needing deciphering.

5. Not readily legible; needs deciphering.

Resistance to Cracking after Laundering or Dry Cleaning

1. No cracking.

2. Objectionable cracking.

Resistance to Yellowing after Laundering or Dry Cleaning

1. No change in color.
2. Slight change in color.
3. Some change in color.
4. Considerable change in color.
5. Objectionable and complete change in color.

Resistance to Fraying after Laundering or Dry Cleaning

1. No fraying.
2. Slight fraying.
3. Some fraying.
4. Considerable fraying.
5. Objectionable fraying.

After examining the laundered specimens, it was considered that a satisfactory marking medium for name tapes should have a rating of "1" for opacity and resistance to cracking before laundering and a rating of "1" for resistance to cracking and a rating of "1" or "2" for opacity, legibility, resistance to yellowing, and, if applicable, fraying after laundering or dry cleaning.

V. Results

Before laundering, eleven of the twenty-seven markings met the minimum requirements of a "1" rating for opacity and resistance tc cracking (Table II, Appendix C). After 15 launderings, six samples (one having five variations), passed the minimum after-laundering requirements (Table III, Appendix C). After 25 launderings, sample numbers 1, 14, 19 and nearly all of the variations in applying and curing number 23 passed (Table III, Appendix C); after 50 launderings, sample numbers 1, 14, 19, 24, and seven variations of number 23 passed the minimum after-laundering requirements (Table IV, Appendix C). The most promising marking media met the qualifications as follows:

Sample No.		Marking and Laundering Performance					
		Launderings					
		Original	5	10	15	25	50
1 and 24	White on blue webbing	P	P	P	P	P	P
5	White fabric letters with adhesive backing	P	F	F	F		
6	Cement-coated white fabric letters with adhesive backing	P	P	F	F		
9	White-letter heat transfers	P	P	P	P		
14	White embroidered letters	P	P	P	P	P	P
16	White adhesive	P	P	P	F		
17	White Allmark marker	P	P	F	F		
19	Resist dye	P	P	P	P	P	P
20	White plastic film with adhesive backing	P	P	F	F	F	
23*	Rub-R-White	P	P	P	P	P	P

*only those cured for one or more minutes

P = Passed
F = Failed

Sample Nos. 1 and 24, both applied to blue webbing by the potential supplier, show excellent legibility and fastness after 50 launderings. This ink is probably a plastisol (a paste dispersion of a synthetic resin (vinyl) in a plasticizer with pigments, fillers, and a stabilizer). Fastness and legibility after 5 dry cleanings in both petroleum solvent and perchlorethylene are excellent but some cracking was observed after the perchlorethylene treatment.

Sample No. 9, a heat transfer decalcomania, meets the minimum requirements established after 15 launderings; however, these letters (3/16-inch) are too small. Sample No. 8, with 5/8-inch letters, although manufactured by the same company, fails to meet the fastness and legibility requirements after 15 launderings. These markings also appear to be plastisols, however, the resin in No. 8 appears to be different from that in No. 9.

Sample No. 14, embroidered white lettering, also meets the minimum requirements after 50 launderings and there is reason to believe that it would be fast to 50 dry cleanings. At present, this product can not be favorably considered because the embroidery equipment is manufactured in Germany, is not available in this country, and highly trained personnel are needed to obtain good markings.

Sample No. 19, a marking prepared by the use of a resist dye, meets the minimum requirements after 50 launderings and there is reason to believe that the sample would be fast to 50 dry cleanings. However, it is considered impractical to print an undyed fabric with a dye resist and then dye the resultant name tag with a fast dye at an induction center because special equipment and experience are required.

Of all the inks, No. 23, a silk-screen printing ink, is the most promising. This ink shows excellent legibility and fastness after 50 launderings. Fastness and legibility after 5 dry cleanings in petroleum solvent are excellent but some cracking of the marking was observed after the perchlorethylene treatment.

Three variations of applying and curing ink No. 23, together with sample No. 1, were subjected to 5 dry cleanings in accordance with Method 5620 (petroleum solvent) and Method 5621 (perchlorethylene) of Specification CCC-T-191. All samples cleaned in petroleum solvent show good resistance (App. C Table V) whereas the markings crack when flexed after cleaning in perchlorethylene.

VI. Conclusions

Several of the white marking media that were applied to the ultramarine blue cotton webbing for subsequent use as name tags exhibit good fastness to laundering. The heat transfers (white decalcomanias), embroidered letterings, a printing of the resist on

undyed fabric prior to subsequent dyeing, and a silk screen printing white ink are fast after at least 50 washings. Of these, two-- a commercial white marking ink applied to blue webbing by a current supplier of name tags, and a white ink that can be applied to the blue webbing by the silk-screen printing process-- appear to be practical for name tags. They show good fastness to 5 dry cleanings in petroleum solvent, but they crack when flexed after 5 dry cleanings in perchlorethylene.

VII. Recommendations

It is recommended that further studies of markings on webbing be conducted.

a) to develop a practical method for the easy preparation of name tapes at Air Force induction centers using the silk screen printing technique and the most promising ink established by this study, and

b) to initiate a program to determine the exact cost of the equipment required and the subsequent cost of printing as compared to the cost of obtaining the same name tags from a commercial source. The second part of this program should include the purchase of the most suitable equipment and the development of the best techniques for printing the name tapes. The equipment would include a strip printer photo composing machine or a Var-o-Type headliner, a carbon arc lamp, and an exposing frame. The cost of this equipment would range from $558.00 for a small production portable unit to $1795.00 for a large stationary unit.

APPENDIX A

MARKING MEDIA AND MANUFACTURER OR SUPPLIER

Sample No.	Identification	Manufacturer or Supplier
1*	White marking (ink)	Ken Nolan, Inc. San Clemente California
2*	White marking (ink)	S&W Plastics, Inc. Riverside California
3	#22 White laundry ink	Missouri Brush & Crayon Co. St. Louis, Missouri
4	#488 White indelible ink	Carter's Ink Co. Cambridge, Mass.
5	White fabric letters with adhesive backing	U.S. Army Natick Laboratories
6	Letters of cement-coated white fabric with adhesive backing	U.S. Army Natick Laboratories
7	Webbing sized with DuPont cement prior to marking with #22 white laundry ink	Missouri Brush & Crayon Co. St. Louis, Missouri
8	Heat transfers, 5/8-inch letters	Superior Trademark, Inc. Waldwick, N.J.
9	Heat transfers, 3/16-inch letters	Superior Trademark, Inc.
10*	Blue ink marking on white webbing	Markem Machine Co. Keene, N. H.

APPENDIX A (Cont'd)

MARKING MEDIA AND MANUFACTURER OR SUPPLIER

Sample No.	Identification	Manufacturer or Supplier
11*	Dark blue ink marking on white webbing	Markem Machine Co.
12*	White ink marking on blue webbing	Markem Machine Co.
13*	Black ink marking on white webbing	Source: Ft. Dix, N. J. December 1963
14*	Embroidered white letters	Zuber & Co., Inc. Brookline, Mass.
15	White industrial adhesive applied with rubber stamp	B. F. Goodrich Adhesives Division Akron, Ohio
16	White industrial adhesive	B. F. Goodrich
17	White Allmark marker (ballpoint pen)	Industries' Research, Inc. Providence 10, R. I.
18	White ink - experimental	U. S. Army Natick Laboratories
19*	Resist dye	E. I. duPont de Nemours & Co., Inc. 50 North Broadway Rumford, R. I. 02916
20	White plastic film with adhesive backing (letters cut out of films and applied to webbing)	Minnesota Mining & Mfg. Co. 1750 Pennsylvania Ave., N.W. Washington, D. C. 20006

APPENDIX A (Cont'd)

MARKING MEDIA AND MANUFACTURER OR SUPPLIER

Sample No.	Identification	Manufacturer or Supplier
21	Cloth #3 white ink	Lambert Company, Inc. 920 Commonwealth Ave. Boston, Mass. 02115
22	SS Lacquer 12657 Super-H-Coverwhite ink	Lambert Company, Inc.
23	Rub-R-White C8674 (silk screen) ink (Union Ink Company)	Lambert Company, Inc.
24	White marking (ink) (already laundered 25 times)	Ken Nolan, Inc.
25	Naz Dar #VF-112 - white ink	Ardon Silk Screen Supplies 176 Brookline Ave. Boston, Mass.
26	5570 Lemon yellow ink - denim (Colonial Process Co.)	Ardon Silk Screen Supplies
27	5505 White denim ink (Colonial Process Co.)	Ardon Silk Screen Supplies
28	PAT-120 Super white ink	Advance Process Supply, Inc. 2315 West Huron St. Chicago 12, Ill.
29	CDS-175 Pigment white ink	Advance Process Supply, Inc.
30	TEX-12 Super white ink, textile lacquer color	Advance Process Supply, Inc.
31	Poly-100 white ink	Advance Process Supply, Inc.

*Samples received at NLABS with markings applied to tape or fabric.

APPENDIX B

VARIATIONS IN THE APPLICATION AND CURING OF SAMPLE NO. 23 SILK SCREEN INK

Sample 23	Number of Applications	Drying Temperature (°C)	Drying Time (min.)
A	1	150	5
B	2	150	30
C	3	150	30
D	1	100	60
E	2	100	60
F	3	100	60
G	1	180	10
H	2	180	10
I	3	180	10
J	4	180	10
K	1	180	5
	2	180	5
L	1	180	5
	2	180	5
M	4	180	5
	3	180	5

APPENDIX B (Cont'd)

VARIATIONS IN THE APPLICATION AND CURING OF SAMPLE NO. 23 SILK SCREEN INK

Sample 23	Number of Applications	Drying Temperature (°C)	Drying Time (min.)
N	4	170	5
O	3	170	5
P	2	170	5
Q	1	170	5
R*	2		1/4**
S*	2		1/2**
T*	2		1**
U	2		1-1/2**
V	2		2**
X	2		3**

*Plus heat curing in oven at 100°C for one hour

**Cured with infrared lamp

APPENDIX C

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TABLE I

OPACITY AND RESISTANCE TO CRACKING RATING BEFORE LAUNDERING

Sample No.	Opacity	Cracking	Passed
1	1	1	yes
2	1	2	
3	1	2	
4	1	2	
5	1	1	yes
6	1	1	yes
7	2	2	
8	2	2	
9	1	1	yes
12	3	1	
14	1	1	yes
15	2	1	
16	1	1	yes
17	1	1	yes
18	1	2	
19	1	1	yes
20	1	1	yes
21	2	2	
22	4	2	

TABLE I (Cont'd)

OPACITY AND RESISTANCE TO CRACKING RATING BEFORE LAUNDERING

Sample No.	Opacity	Cracking	Passed
23 (all variations)	1	1	yes
24*	1	1	yes
25	4	1	
27	1	2	
28	1	2	
29	1	2	
30	1	2	
31	4	2	

Note: Only white marking media were evaluated.

*already laundered 25 times

TABLE II

FASTNESS TO LAUNDERING OF THE MOST PROMISING MARKINGS AFTER FIFTEEN LAUNDERINGS

Sample No.	Opacity	Legibility	Resistance to Cracking	Resistance to Yellowing	Resistance to Fraying	Passed
1	1	1	1	2	-	yes
2	2	1	2	5	-	
3	4	3	2	2	-	
4	3	1	2	2	-	
5	5	5	-	1	5	
6	1	5	-	1	2	
7	3	1	1	2	-	
8	4	3	1	1	-	
9	2	1	1	1	-	yes
10	3	1	1	-	-	
11	3	1	1	-	-	
12	3	1	1	1	-	
13	3	1	1	-	-	
14	1	1	1	1	1	yes
15	2	1	1	1	-	yes
16	2	3	1	1	-	
17	2	1	2	1	-	

TABLE II (Cont'd)

FASTNESS TO LAUNDERING OF THE MOST PROMISING

MARKINGS AFTER FIFTEEN LAUNDERINGS

Sample No.	Opacity	Legibility	Resistance to Cracking	Resistance to Yellowing	Resistance to Fraying	Passed
18	3	1	2	2	-	
19	1	-	1	1	-	yes
20	1	1	2	4	-	
21	2	1	2	5	-	
22	4	2	1	1	-	
23R	3	1	2	1	-	
23S	3	1	2	1	-	
23T	2	1	1	2	-	yes
23U	2	1	1	2	-	yes
23V	2	1	1	2	-	yes
23X	2	1	1	2	-	yes
24*	2	1	1	2	-	yes
25	2	1	2	2	-	
26	2	1	2	-	-	

*40th laundering

TABLE III

FASTNESS TO LAUNDERING OF THE MOST PROMISING MARKINGS AFTER TWENTY-FIVE LAUNDERINGS

Sample No.	Opacity	Legibility	Resistance to Cracking	Resistance to Yellowing	Passed
1	1	1	1	1	yes
14	1	1	1	1	yes
19	1	1	1	1	yes
21	2	1	2	1	
22	4	3	2	1	
23A	1	1	1	1	yes
23B	1	1	1	1	yes
23C	1	1	1	1	yes
23D	1	1	1	1	yes
23E	1	1	1	1	yes
23F	1	1	1	1	yes
23G	1	1	1	1	yes
23H	1	1	1	1	yes
23I	1	1	1	1	yes
23J	1	1	1	1	yes
23K	1	1	1	1	yes
23L	1	1	1	1	yes

TABLE III (Cont'd)

FASTNESS TO LAUNDERING OF THE MOST PROMISING

MARKINGS AFTER TWENTY-FIVE LAUNDERINGS

Sample No.	Opacity	Legibility	Resistance to Cracking	Resistance to Yellowing	Passed
23M	1	1	1	1	yes
23N	1	1	1	1	yes
23O	1	1	1	1	yes
23R	3	2	2	1	
23S	3	1	2	1	
23T	2	1	1	1	yes
23U	2	1	1	1	yes
23V	2	1	1	1	yes
23X	2	1	1	1	yes
24*	2	1	1	1	yes
25	3	3	2	1	
26	2	1	2	-	

*50th laundering

Note: All of these samples were applied on and laundered with white fabric.

TABLE IV

FASTNESS TO LAUNDERING OF THE MOST PROMISING MARKINGS AFTER FIFTY LAUNDERINGS*

Sample No.	Opacity	Legibility	Resistance to Cracking	Resistance to Yellowing	Passed
1	1	1	1	1	yes
14	1	1	1	1	yes
19	1	1	1	1	yes
23M	1	1	1	1	yes
23N	1	1	1	1	yes
23O	1	1	1	1	yes
23P	1	1	1	1	yes
23Q	2	1	1	1	yes
23M*	1	1	1	1	yes
23N*	1	1	1	1	yes
24	1	1	1	1	yes

Note: All samples were on white fabric and were laundered with white material.

*After fifty launderings in a commercial laundry

TABLE V

FASTNESS AFTER FIVE DRY CLEANINGS

Method 5620 (Petroleum Solvent)

Sample No.	Opacity	Legibility	Resistance to	
			Cracking	Yellowing
23N	1	1	1	1
23P	1	1	1	1
23Q	1	1	1	1
1	1	1	1	1

Method 5621 (Perchlorethylene)

Sample No.	Opacity	Legibility	Resistance to	
			Cracking	Yellowing
23N	1	1	2	2
23P	1	1	2	2
23Q	1	1	2	2
1	1	1	2	2

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13. ABSTRACT

This report covers an evaluation of 31 different marking media for producing name tags on Air Force Blue cotton webbing. Inks, heat transfers (decalcomanias), thermo-plastic films, embroidered letters, and fabric letters with thermo-plastic adhesives were included. Different methods of applying these media were tried in an effort to improve their fastness to laundering.

The most satisfactory opaque markings were subjected to 25 and 50 launderings. Their opacity, legibility, resistance to cracking, and resistance to yellowing after laundering are described in detail. Those giving the most promising results were also subjected to 5 dry cleanings.

Although several of the marking media show promise for white lettered name tags on blue webbing, some are impractical to apply at an induction center. Heat transfers (white decalcomanias), embroidered white lettering, and silk-screen printing white inks exhibit the best fastness to laundering.

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	ROLE	WT	ROLE	WT	ROLE	WT
Testing	8					
Evaluation	8					
Physical properties	8,9					
Ink	9					
Decalcomanias (Heat transfers)	9					
Thermoplastic film	9					
Embroidered letters	9					
Fabric letters	9					
White	0					
Armed Forces supplies	4					
Labels	4					
Washing	10					
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