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HEADQUARTERS QUARTERMASTER RESEARCH & ENGINEERING COMMAND, US ARMY

[REDACTED] Quartermaster Research & Engineering Center

Natick, Massachusetts

TEXTILE, CLOTHING & FOOTWEAR DIVISION

Clothing Branch Series  
Report No. 12

LAUNDERING CHARACTERISTICS OF ENVIRONMENTAL HEADGEAR  
ARMY CAP, FIELD, COTTON, OG 107  
AND  
NAVY CAP, INTERMEDIATE, COLD WEATHER

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## T A B L E   O F   C O N T E N T S

	<u>PAGE</u>
Abstract. . . . .	iii
I. Introduction . . . . .	1
II. Comparison of Manufacturing Requirements . . . . .	2
III. Environmental Use . . . . .	5
IV. Analysis of Sizing . . . . .	5
V. Launderability Tests . . . . .	6
VI. Comparison of Shrinkage . . . . .	6
VII. Conclusion . . . . .	8
VIII. Bibliography . . . . .	16

## L I S T   O F   I L L U S T R A T I O N S

<u>Figure</u>		<u>PAGE</u>
1.	Purchase Description Drawing of Cap, Intermediate, Cold Weather	3
2.	Specification Drawing of Cap, Field, Cotton, M-1951 . . . . .	4
3.	Front View of Caps with Earlaps Inside the crown . . . . .	11
4.	Front View of Caps with Earlaps down . . . . .	12
5.	Side View of Caps with Earlaps Inside the crown . . . . .	13
6.	Side View of Caps with Earlaps down . . . . .	14
7.	Inside View of Caps with Earlaps Inside the crown . . . . .	15

## ABSTRACT

The purpose of the investigation was to compare the laundering characteristics of two similar types of Army and Navy environmental headgear in order to determine the effects of laundering on sizing, fit and appearance.

A total of six caps were obtained, four from Navy stock and two from Army stock. One set of three caps was retained for comparison, and the second set of three caps was laundered three times in accordance with the cotton method. All caps were measured three times each and an average measurement was recorded before and following each laundering/drying cycle. In addition, a comparison was made of the sizing systems and intended environmental use.

The study showed that both types of caps shrank, excessively in the case of the Navy item, and the appearance of each was poor, with the lowest rating accorded the Army Model. To overcome the laundering and appearance problems, development of new material has been undertaken and caps incorporating the first approach, namely, a Dacron/Rayon fabric in a Gabardine weave, have been procured for User Test.

## I. Introduction

Articles of wearing apparel are made in many sizes and shapes. Body clothing, for instance, generally has large overall dimensions when compared to coverings for the head. As a result, tolerances for body clothing can encompass a fairly large span without endangering either fit or appearance of the garment. However, in the area of coverings for the head, which is a much smaller part of the human anatomy, the span of tolerance must be kept to a minimum, so as to achieve and maintain a proper fit of the headgear during its lifetime. In view of the above limitations, it becomes vital to use materials for headgear components which will result in parts manufactured true to pattern and which will show a minimum of shrinkage from laundering. Also, in the interest of maintaining a good military appearance, it is necessary to incorporate materials which will retain, as closely as possible, their original appearance.

It has been recognized that the cotton poplin fabric used in the standard Army cotton field cap exhibits poor shrinkage and appearance characteristics following field laundering of the cap. For the past few years various all cotton, all synthetic (including blends), and synthetic/cotton blends have been made into caps and tested both in the laboratory and the field. Also, caps using the cotton sateen, as in the Navy model, have been tested but were found to have even more shrinkage than the closely woven poplin. However, the Navy had recently standardized the Intermediate Cold Weather cap and it was thought that, should the laundering characteristics prove more satisfactory than in the past, consideration would be given to using it as an item in the Army cold weather clothing ensemble to provide protection when the cotton cap would be too light and the pile type cap would be too warm.

II. Comparison of Manufacturing Requirements

Purchase Description, dated 15 January 1959, for Cap, Intermediate, Cold Weather (Navy Department) and Specification MIL-C-1911D, dated 24 March 1959, for Cap, Field, Cotton, Wind Resistant Poplin, M-1951 (Department of the Army) were obtained and an analysis was made of the requirements for materials, fabrication and sizing. Table I, listed below, is a brief resume of the findings:

TABLE I

CAP, INTERMEDIATE COLD WEATHER (Navy Department) (1) Figure 1. (Pur/Des Drawing)	CAP, FIELD, COTTON, WIND RESISTANT, POPLIN, M-1951, (Department of the Army) (2) Figure 2. (Specification Drawing)												
<p><u>DESIGN</u> 3-piece, semi-form fitting crown having height approx. 3/8" lower than Standard Army cap, large quilted duck visor, inside turn-up hinged earlaps. Crown and earlaps lined with thick insulating material.</p>	<p>3-piece, straight sided crown about 3/8" higher than Navy, small quilted Texon (most issue items presently of duck) visor, inside turn-up earlaps and outside crown band. Crown lined with self material and earlaps lined with thin insulating material.</p>												
<p><u>MATERIALS</u> SHELL - Cloth, Cotton, Wind Resistant, Sateen, Water Repellent, Olive Green 107, (Type I), 9 oz. LINING - Cloth, Nylon, Fleece, Knitted Olive Green 106. VISOR INTERLINING - Two ply Cloth, Cotton, Duck, (Type I), Hard Texture #1 or 6.</p>	<p>SHELL - Cloth, Cotton, Wind Resistant Poplin, Olive Green 107, 5 oz. (Type II, Class B). CROWN LINING - Same as shell. EARLAP LINING - Cloth, Wool/Cotton, Flannel, 12 oz. OD 35, (Type I). VISOR INTERLINING - One ply Alpha Cellulose w/ Neoprene (Texon) .075 ± .003" thick.</p>												
<p><u>OPERATIONS</u> Simple bagging assembly having a hinged earlap.</p>	<p>ITEMS IN STOCK HAVE CLOTH, COTTON DUCK, 48 oz. GREY, TYPE I, 12/0.</p>												
<p><u>BLOCKING</u> REQUIRE STEAM BLOCKING ON BLOCK sizes 6 3/4, 7, 7 1/4, and 7 1/2.</p>	<p>Same as Navy except with hinged visor and has a sewn-on outside crown band (design feature).</p>												
<p><u>SIZES*</u> Small 6 5/8 - 6 3/4 (21 1/4-21 5/8) Medium 6 7/8 - 7 (22-22 3/8) Large 7 1/8 - 7 1/4 (22 3/4-23 1/8) X Large 7 3/8 - 7 1/2 (23 1/2-23 7/8)</p> <p>* Measured with earlaps inside crown.</p>	<p>NO BLOCKING NECESSARY</p> <table data-bbox="695 1543 909 1732"> <tr><td>6 1/2</td><td>21 1/8</td></tr> <tr><td>6 3/4</td><td>21 7/8</td></tr> <tr><td>7</td><td>22 5/8</td></tr> <tr><td>7 1/4</td><td>23 3/8</td></tr> <tr><td>7 1/2</td><td>24 1/8</td></tr> <tr><td>7 3/4</td><td>24 7/8</td></tr> </table>	6 1/2	21 1/8	6 3/4	21 7/8	7	22 5/8	7 1/4	23 3/8	7 1/2	24 1/8	7 3/4	24 7/8
6 1/2	21 1/8												
6 3/4	21 7/8												
7	22 5/8												
7 1/4	23 3/8												
7 1/2	24 1/8												
7 3/4	24 7/8												

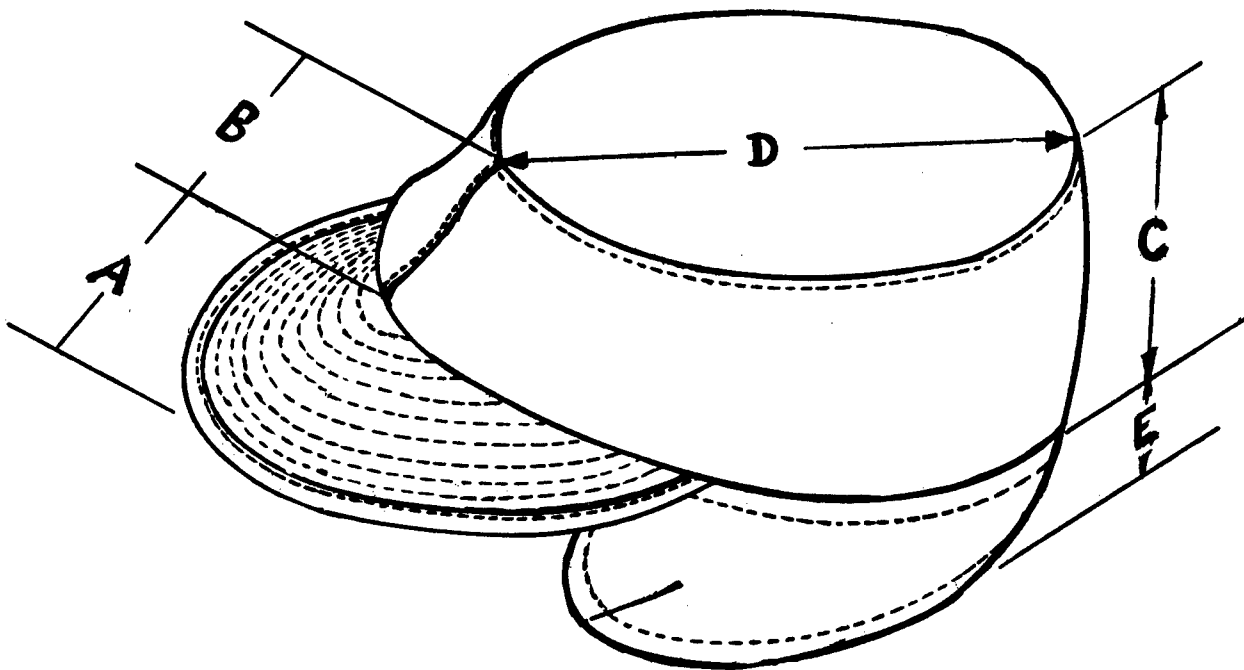


Figure 1 - CAP, INTERMEDIATE, COLD WEATHER

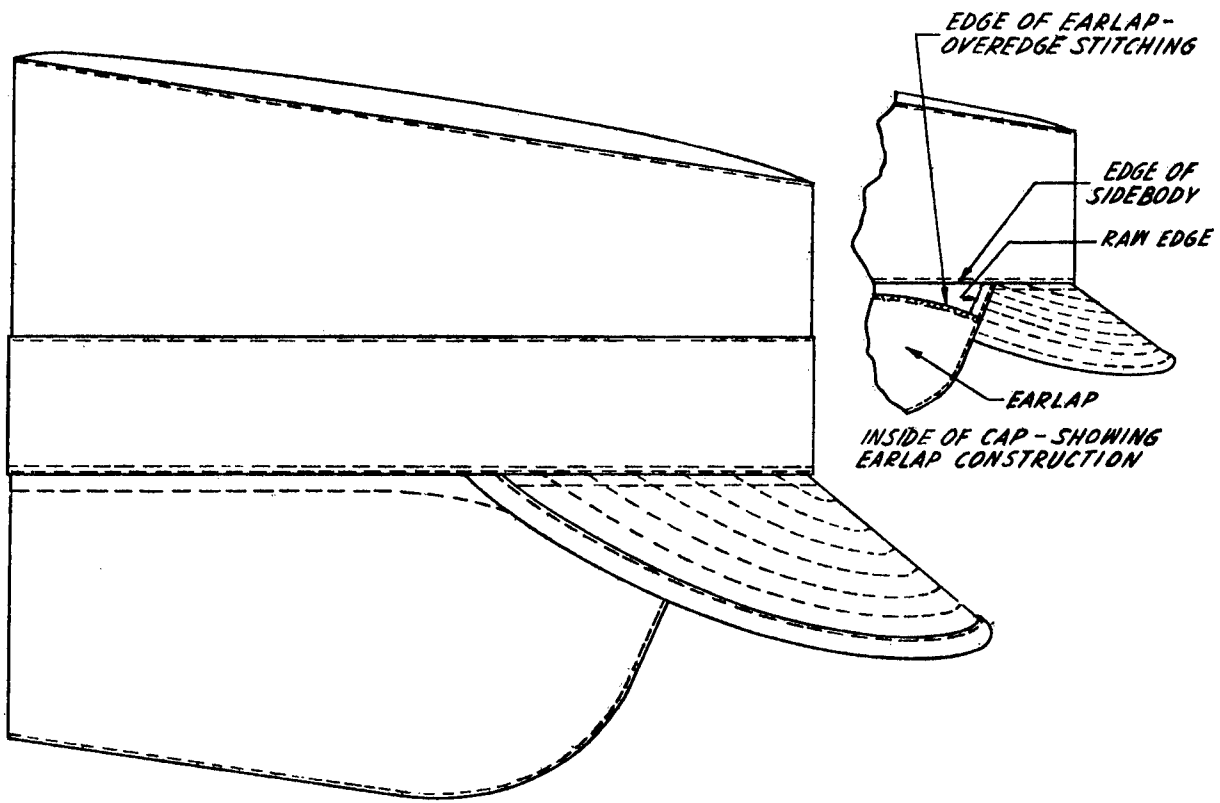


FIGURE 2. Cap, field, cotton, wind resistant poplin, M-1951.

### III. Environmental Use

A parallel comparison of the Army field type headgear with the Navy ship-shore intermediate cap is not considered practical since each service designs to afford different levels of protection for various situations. In this instance, the Navy Intermediate Cap was designed for ship-shore wear in "extremely" (3) cold weather, which is assumed to mean lowest range of cold-wet, and such being the case, it incorporates a thick insulating lining layer throughout. On the other hand, the Army's cotton field cap was designed for ground troop-wear in a range of cold-wet to hot environments (4) and, accordingly, is a light-weight, windproof item incorporating a very thin layer of insulation only in the earlaps.

Pursuing the matter of the Army's environmental protective headgear system one step further, for greater colder weather protection, provision is made for ground troops to use a field cap having a lightly insulated wool-lined crown and more heavily insulated pile-lined earlaps. Again, this is not considered a fair item for direct comparison since it was designed to afford considerably more insulation to a greater area of the head, face, and neck for wear under more severe conditions than the Navy Intermediate Cap. In view of the different levels of protection necessarily required to suit the varying environmental conditions encountered by the two services, it is evident that the systems are staggered and, such being the case, are not directly comparable.

### IV. Analysis of Sizing

The Navy utilizes a four (4) size adjective system, that is, Small, Medium, Large and Extra Large, spanning coupled numerical sizes  $6 \frac{5}{8}$  -  $6 \frac{3}{4}$  to  $7 \frac{3}{8}$  -  $7 \frac{1}{2}$ . According to the Purchase Description requirements, the finished inside circumference of each size is the same measurement as the man's head girth for the upper coupled size, i. e., Medium ( $6 \frac{7}{8}$  to 7) having a minimum measurement of 22 inches but, a plus tolerance of  $\frac{3}{8}$  inch is permitted. This method apparently does not allow for any shrinkage, even dampness from perspiration, and in accordance with information obtained from Army Sizing Studies, it seems highly improbable that men with head measurements equal to sizes  $6 \frac{3}{4}$ , 7,  $7 \frac{1}{4}$  and  $7 \frac{1}{2}$  can be fitted properly in this system without changing to the next larger cap size. In addition, there is no indication that provision is made to fit sizes below  $6 \frac{5}{8}$  or above  $7 \frac{1}{2}$ . Even though the Navy Purchase Description cites certain minimum and maximum inside circumference requirements, none of the caps submitted for evaluation were within the plus  $\frac{3}{8}$  inch tolerance but actually measured from  $\frac{1}{2}$  to  $1 \frac{1}{4}$  inches larger than the minimum. Since these caps are steam blocked, perhaps some of the discrepancy can be attributed to the combination of steam and pressure exerted during the operation.

The Army system is similar to the Navy in that it incorporates a  $\frac{3}{4}$  inch grade between sizes, however, it covers a greater span of head girths by a numerical system of six (6) sizes, ranging from  $6 \frac{1}{2}$  to  $7 \frac{3}{4}$ . Further, Army combat headgear now includes a  $\frac{1}{2}$  to  $1 \frac{1}{2}$  inch overage in circumference, depending upon style, point of fit, method of wearing, materials and shrinkage characteristics. In the case of the cotton field cap, the latest pattern dated 22 April 1959 has a  $\frac{3}{4}$  inch overage for each size, i. e., a size 7 has a  $22 \frac{3}{4}$  inch inside circumference, which was determined by a known average shrinkage of  $\frac{1}{2}$  to  $\frac{5}{8}$  inch for the poplin cap and an allowance for wear over hair with the cap worn straight on the head in a normal military manner.

## V. Laundrying Tests

Four Navy caps (two each Small and Large) and two (7 1/4) Army caps were obtained for comparison of laundrying characteristics. One of each size was selected for laundrying and measurements were taken at eight locations, using a plastic tape measure. These measurements and their equivalents, as listed in Specification Tables of Cap Sizes and Measurements, along with pattern measurements were then recorded.

Following the examination and taking of measurements, three caps were subjected to three washing and tumble drying cycles in accordance with mobile field laundrying method for cotton type items. At the conclusion of the final cycle, each cap was re-examined and remeasured to determine effects on appearance and amount of shrinkage. The results are listed in Table II.

## VI. Comparison of Shrinkage

Comparison of both Navy caps before and after laundrying (see figures 3 through 7) shows that shrinkage occurred in six of the eight dimensions. All length measurements, including crown circumference, showed shrinkage resulting in caps two sizes smaller than they were originally. Some shrinkage occurred in the height dimensions, but they were within the tolerance allowed for manufacturing purposes and were not considered critical.

The Army cap (see figures 3 through 7) shrank in all dimensions, including a one size decrease in circumference, which while critical, is not so severe as in the Navy caps. The other length dimensions shrank about half that exhibited by the Navy cap and the height dimension shrinkage was about equal to that found in the Intermediate Caps.

Outside appearance of both caps (see figures 3 through 6) after laundrying was noted as being poor with both exhibiting white abrasion marks. Overall appearance of the Army cap was judged to be considerably lower than the Navy models due to excessive amount of seam puckering and greater areas of abrasion. Seam puckering on earlaps of the Intermediate caps was more extensive than on the Army cap.

Inside appearance of the all-cotton cap was affected very little since it is a hard finished fabric and it was protected from contact with the other caps during the laundrying. No abrasion or seam puckering occurred in the Navy lining, but pilling of the brushed synthetic fabric was much in evidence and, as could be expected from the better than 7 per-cent circumference shrinkage, the fabric had tightened to form a much thicker layer of insulation than it was originally. (see figure 7)

TABLE II

## LAUNDERING CHARACTERISTICS - SHRINKAGE IN INCHES

SERVICE	SIZE (Adjective) (Numerical)	NAVY				ARMY				
		Specification Reqs.	Actual Measure	1st* Laundry	3rd Laundry	Specification Reqs.	Actual Measure	3rd Laundry	Actual Measure	3rd Laundry
				SMALL (6 5/8 to 6 3/4)		LARGE (7 1/8 to 7 1/4)				
Inside W/Earlap***		21 1/4	22 1/2	22	20 3/4	23 1/8	23 3/4	22 1/4	23 3/8	22 1/2
Inside WO/Earlap***		21 1/2**	22 3/4	22 1/4	21	23 3/8**	24 1/8	22 5/8	23 1/2	23
Inside Earlap Length		16**	16	15 1/2	15	17**	17 1/8	16 7/16	17 7/8**	17 3/16
Inside Earlap Width		2 13/16	2 7/8	2 7/8	2 3/4	3 3/16	3 3/8	3 1/4	2 7/8**	2 3/4
Front Crown Height		2 1/16	2 3/16	2 1/8	2 1/8	2 7/16	2 3/8	2 3/8	2 1/2**	2 1/2
Side Crown Height		2 15/16**	2 15/16	2 15/16	2 15/16	3 7/16**	3 7/16	3 3/8	3 5/8**	3 9/16
Back Crown Height		3 9/16	3 5/8	3 5/8	3 5/8	3 15/16	4 1/8	4	3 3/4**	3 5/8
Top Crown Length		7	7 1/4	7	6 7/8	7 1/2	7 5/8	7 3/8	7 7/8**	7 1/2

\* Cap laundered by Navy one (1) time.

\*\* Not listed in Specification (taken from pattern).

\*\*\* Crown girth measured 3/8" from crown seam (larger at seam).

In addition to the record of measurements contained in Table II, a second table, shown below, was prepared to show the exact amount of shrinkage and the relationship in percentage to the original eight measurements.

TABLE III  
THIRD LAUNDERING - PERCENT OF SHRINKAGE

SERVICE	NAVY						ARMY		
	SMALL (6 5/8 to 6 3/4)			LARGE (7 1/8 to 7 1/4)			7 1/4		
SIZE	*Actual Meas.	Shrinkage Inch	%	*Actual Meas.	Shrinkage Inch	%	*Actual Meas.	Shrinkage Inch	%
Inside W/Earlap	22 1/2	1 3/4	7.78	23 1/8	1 1/2	6.31	23 3/8	7/8	3.74
Inside WO/Earlap	23 3/4	1 3/4	7.69	23 3/8	1 1/2	6.22	23 1/2	1/2	2.13
Inside Earlap Length	16	1	6.25	17	11/16	4.01	17 1/8	11/16	3.84
Inside Earlap Width	2 7/8	1/8	4.35	3 3/16	1/8	3.70	2 7/8	1/8	4.35
Front Crown Height	2 3/16	1/16	2.86	2 7/16	0	0	2 1/2	1/16	2.40
Side Crown Height	2 15/16	0	0	3 7/16	1/16	1.82	3 5/8	1/16	1.73
Back Crown Height	3 5/8	0	0	3 15/16	1/8	3.03	3 3/4	1/8	3.33
Top Crown Length	7 1/4	3/8	5.17	7 1/2	3/8	3.28	7 7/8	3/8	4.76

\* Original Finished Cap Measurements

### VII. Conclusion

Inasmuch as most items of headwear are worn in contact with the skin and hair, they quite naturally absorb hair oil (natural and applied) and perspiration, which usually filters through to the outside. Soil is also accumulated readily on the outside of utility type headgear. Thus, in the interest of cleanliness, some method of cleaning becomes a necessity and since dry cleaning facilities are seldom, if ever, available in the field or aboard ship, it is only logical that environmental utility type headgear be capable of laundering without radical change in size or appearance. In view of the foregoing, it is evident that neither the Army nor Navy cap can be considered as satisfactory because of a very poor appearance in one case and excessive shrinkage in the other.

It appears, then, that development of a new fabric is of major importance to overcome the launderability problems. At present the Army has under development a blend of 60% Dacron with 40% Rayon in a 7.5 oz. Gabardine weave for use as a base fabric in hot weather caps. This fabric was especially designed with an additional number of picks in order to build in crease resistance without having to add a special finish. Limited launderability tests, (see table IV) indicate that shrinkage is not progressive after the first laundering, which is about .658 per cent of the circumference at that time. No fading or abrasion has been observed. Also, shape retention and crease resistance are excellent. Taking into consideration the

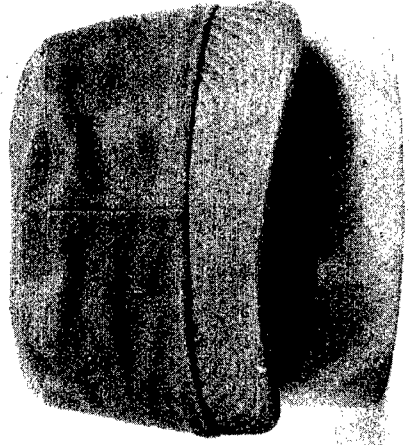
TABLE IV

CAP, HOT WEATHER, T59-3 --- SHRINKAGE (3 LAUNDERINGS)

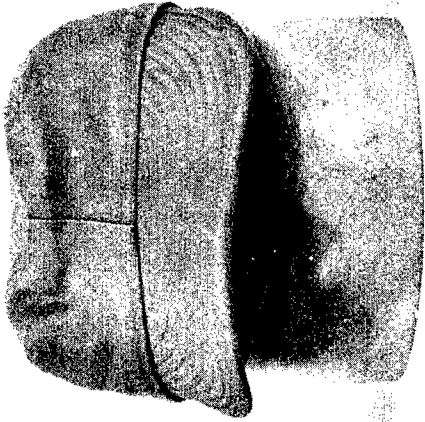
MEASUREMENT	Size 7 -- A - 4				Size 7 1/4 -- B - 4			
	Original	Laundered	Shrinkage Inch	Shrinkage %	Original	Laundered	Shrinkage Inch	Shrinkage %
Inside Crown Girth	23 1/4	23 1/8	-1/8	.54	24	23 13/16	-3/16	.78
Front Crown Height	2 11/16	2 5/8	-1/16	2.38	2 11/16	2 5/8	-1/16	2.33
Back Crown Height	4 9/16	4 7/16	-1/8	2.73	4 1/2	4 3/8	-1/8	2.78
Side Crown Height	3 3/8	3 5/16	-1/16	1.85	3 3/8	3 1/4	-1/8	3.41
Top Crown Length	6 1/8	5 15/16	-3/16	3.06	6 1/8	6 1/16	-1/16	1.02
Top Crown Width	5 7/16	5 5/16	-1/8	2.30	5 1/2	5 7/16	-1/16	1.14
Visor Depth	2 7/16	2 7/16	---	---	2 7/16	2 7/16	---	---
Visor Width	7 5/16	7 1/4	-1/16	.71	7 3/8	7 5/16	-1/16	.85

VII. Conclusion (Con't)

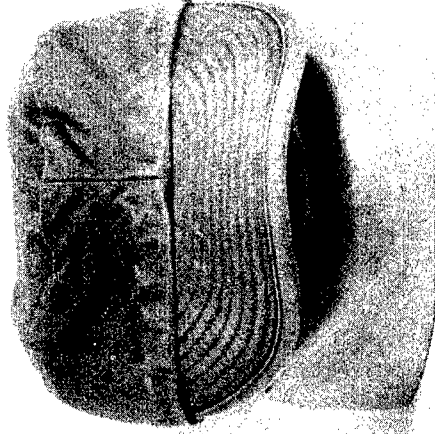
.658 per cent shrinkage of this fabric in the crown girth, which amounts to about a  $3/16$  inch decrease in size, further development of this particular type of fabric is proceeding to incorporate a slight amount of stretch in order to compensate for the shrinkage. It is hoped, then, that by using a stretchable fabric, shrinkage will have little or no effect on the fit of the cap throughout its normal lifetime.



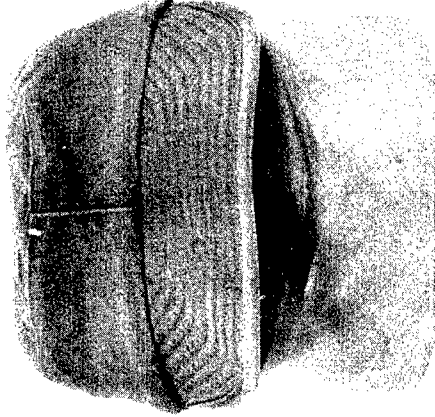
NAVY (Large)



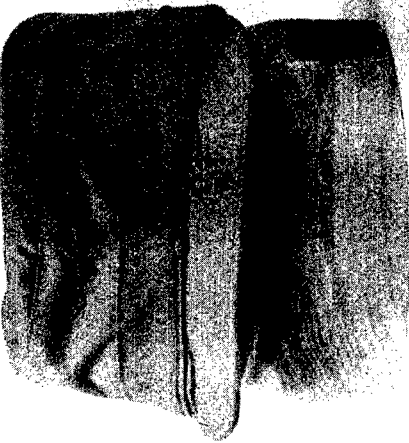
NAVY (Small)



NAVY (Large)

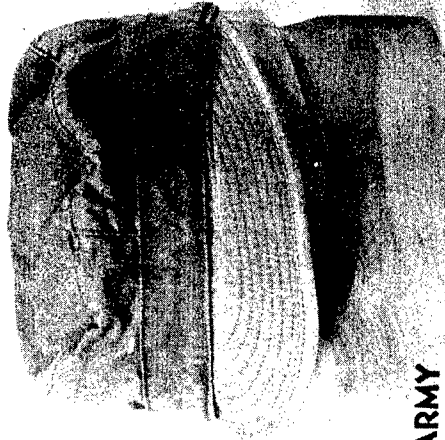


NAVY (Small)



U S ARMY

ARMY



J S ARMY

ARMY

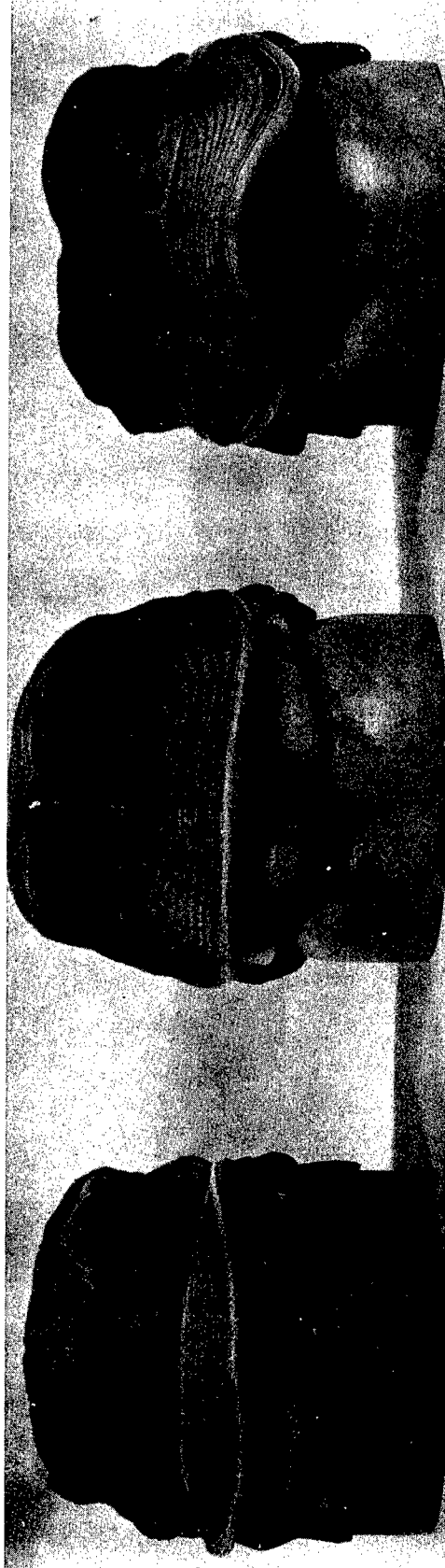
Figure 9. NAVY (Large) (Small) (Small) (Small) (Small) (Small)



ARMY

NAVY (Small)  
UNLAUNDERED

NAVY (Large)



ARMY

NAVY (Small)  
THREE LAUNDERINGS

NAVY (Large)

Figure 4. FRONT VIEW WITH EARPLUG DATA



ARMY

NAVY (Small)  
UNLAUNDERED

NAVY (Large)



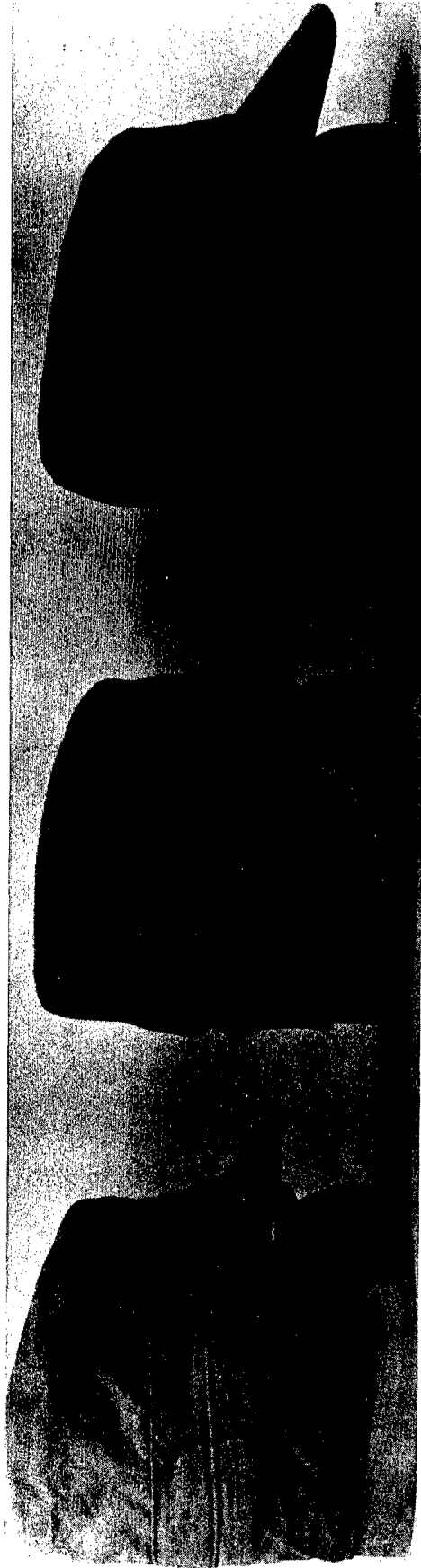
ARMY

NAVY (Small)

NAVY (Large)

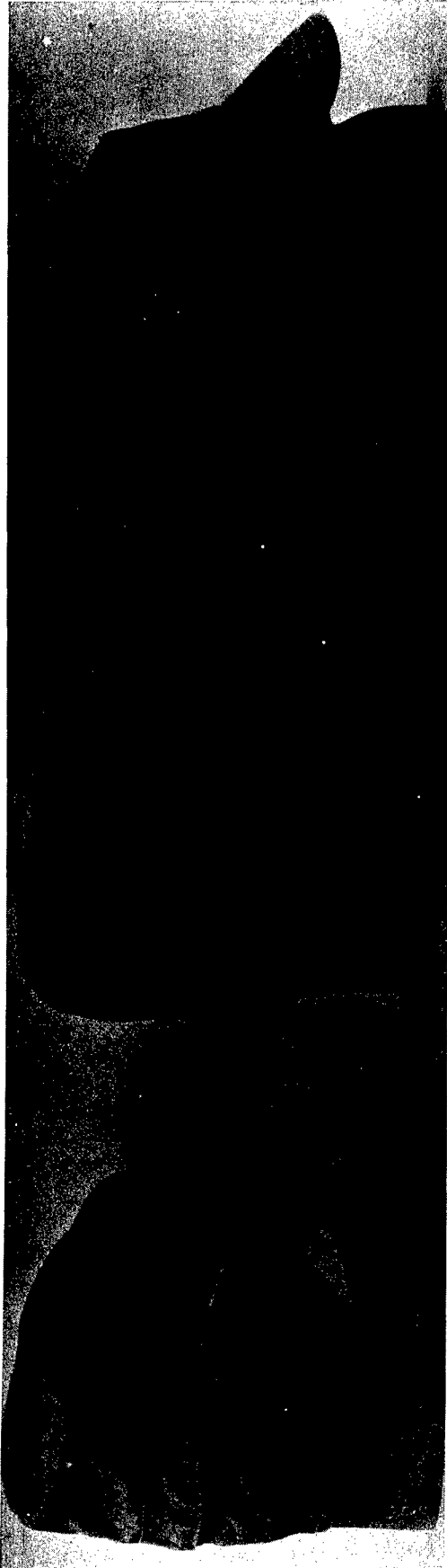
THREE LAUNDERINGS

Figure 5. SIDE VIEW WITH EARL'S INSIDE CROWN



ARMY

NAVY (Small)  
UNLAUNDERED

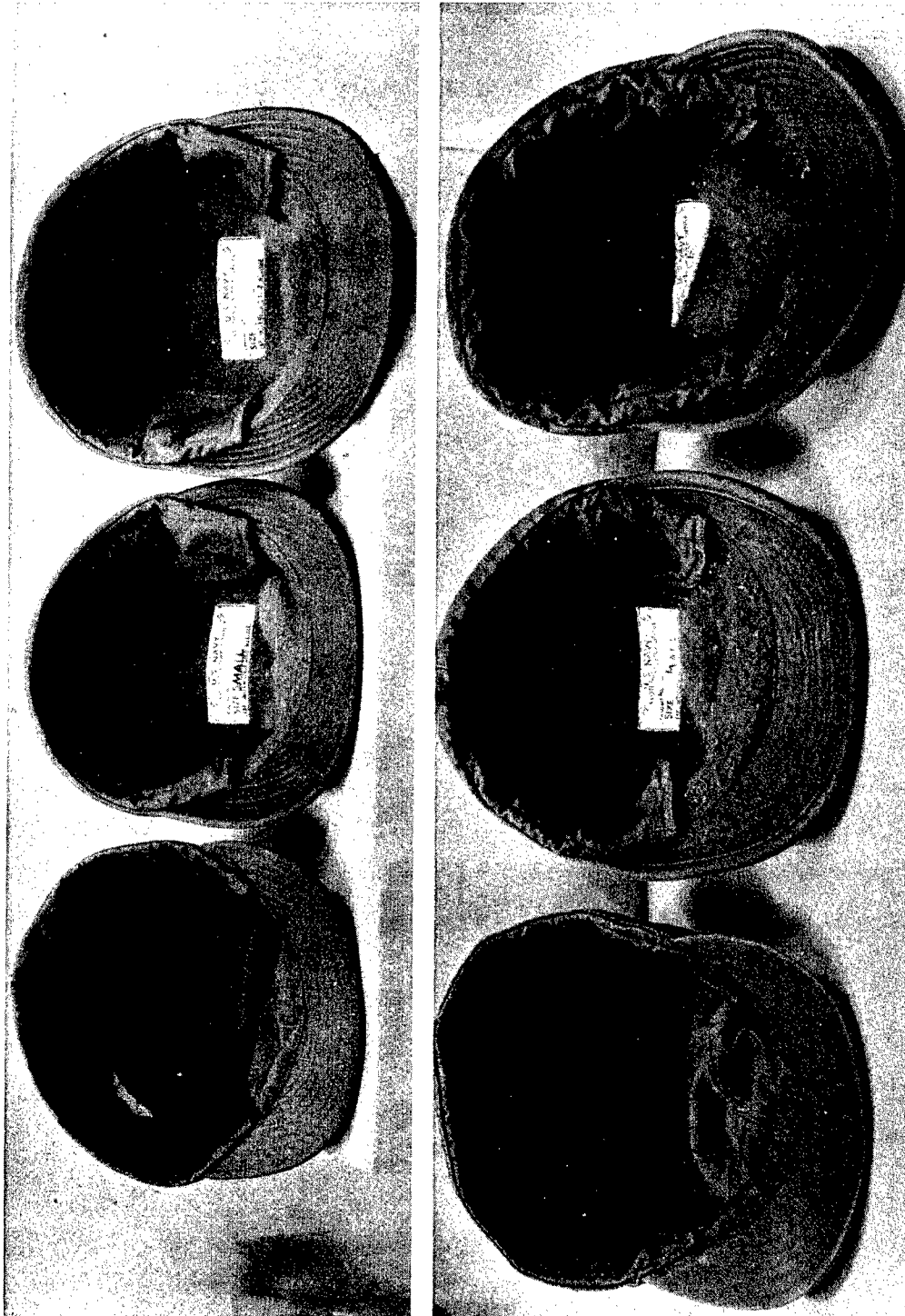


ARMY

NAVY (Small)  
THREE LAUNDERINGS

NAVY (Large)

Figure 6. SIDE VIEW WITH EARLAPS DOWN



ARMY

NAVY (Small)

NAVY (Large)

UNLAUNDERED AND THREE LAUNDERINGS

Figure 7. INSIDE VIEW WITH OVERLAP INSIDE CROWN

VIII. Bibliography

1. Navy Department Purchase Description, Dated 15 January 1959, Cap, Intermediate Cold Weather.
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