A "WEAR" STUDY OF TWO CREASE-RESISTANT TREATED FABRICS SIMULATING WOOL

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This is to certify that the

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Hazel B. Strahan
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A "WEAR" STUDY

OF TWO CREASE-RESISTANT TREATED FABRICS

SIMULATING WOOL

By

Helen Osuch Ransbottom

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INTRODUCTION

I. INTRODUCTION

Extensive technological changesin the textile industry during the post war period have made available to the consumer rayon apparel fabrics which in appearance value, versatility, performance, and price are highly competitive with wool. Consumer acceptance of these new fabrics has resulted in increased rayon production so that in 1950 it was three and one half times as great as the 1939 pre-war output. Production records for the rayon industry also show that with the exception of 1949 there have been an unbroken series of year-to-year increases since 1938(1).Production in 1953 is estimated to reach 1,129 million pounds of rayon and 573 million pounds of acetate (22).

Fabrics chosen for this study were among the first crease resistant rayons manufactured for both men's and women's wear and were considered trial fabrics. Producers have since then made improvements in yarn and weave structures as well as in crush resistant finishes and their application.

Since 1950 there have been pure synthetics placed on the market such as orlon, acrilan, dynel, nylon and dacron which are competing with rayon and acetate for end uses in which traditionally wool was used. These new synthetics are chiefly blended with wool and manufacturers claim they impart to wool special improved qualities such as launderability, improved resistance to abrasion, etc. However, research and development costs of these new synthetics have not yet been written off. Generally a fabric of fifty per cent synthetic and fifty per cent wool costs as much as an

all wool fabric. Rayon and acetate currently cost forty-one and forty-two cents per pound respectively for staple and seventy-three cents for filament. In contrast, the synthetics mentioned above range in price from $1.40 to $1.90 per pound for staple. They are at least three and one-third times as expensive as rayon and acetate. In the filament form nylon ranges in price from $2.25 to $6.00 per pound while orlon is $3.75 and dacron $3.00 per pound. Assuming that there is a mass market for fabrics that give satisfactory performance at lower price, rayon has not lost its competitive place in apparel fabrics for men's and women's garments which resemble and serve the same purpose as wool.(22)

With the vast increases and extensive changes in production, intelligent consumer selection has become more difficult because little research has been done as to the ultimate serviceability and satisfactory performance during use of these new fabrics. In the studies which have been carried out, laboratory tests were used as predictive evidence of inherent serviceability of fabrics for their intended use. Is this testing indicative of actual performance? Only by following laboratory testing with wear studies on identical fabrics can a valid answer be made. However, even less of this latter type of experimentation has been done. It is the purpose of this study to contribute to the meager data now available.

Specifically, this study was designed to evaluate the reliability of the laboratory data as predictive of performance for two specific groups of fabrics made into garments which were given normal use and care. Of necessity, the number of fabrics was limited. Specific objectives were:

A. To compare the serviceability under conditions of normal use and care of a group of rayon dresses of twill weave

with another group of plain weave, crease resistant, rayon fabrics.

1. To compare and evaluate initial specifications.
2. To correlate performance predicted on basis of laboratory test results with data on comparable sampling from garments subjected to actual wear.
3. To compare degree of wear from specimens taken from various parts of the garment.
4. To determine and compare changes which occur as a result of wear and dry cleaning with dry cleaning only.

B. To compare the ease of "handle" of these two types of fabrics during construction, ease in pressing, stitching, fitting, and extent of yarn slippage.

C. To subjectively compare selected seam, hem, and neckline construction finishes for serviceability under conditions of normal use and care.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

Serviceability studies have been evolved to compensate for the inadequacy of laboratory testing for measuring the kind and amount of wear which may be expected from the article of apparel in normal use and care (11). However, available information concerning this aspect of textile research is meager and out of date. Pertinent information available is included in this review of literature. Also included is a brief history of resin finishes imparted to fabrics to improve crease resistance. Their application and limitations are considered and the most recent developments are noted.

Hayes and Rogers (11) state that there are no standard techniques established for serviceability studies. However, they make the following recommendations. Wear studies should be planned so as not to disrupt established routines and should be completed within a relatively short time. A sufficient number of articles should be allowed for laboratory test samples, as well as for unavoidable accidents, loss of articles, and failure of cooperators to complete the test. Also the garment used must be of a styling and construction reasonably acceptable to the cooperator. As many variables as possible should be controlled. For example, uniformity in style of garment, use of same laundry or dry cleaning establishment, specification of the number of hours of wear, and selection of cooperators of the same occupational group in one geographic location.

Some variations in serviceability investigations, however, are outside the control of the experimenter. For example, results may be affect-

ed by the size of the person wearing the garment and the kind of activity engaged in by the wearer (5). Differences in care of clothing would be another variable factor (11).

Hamburger, Platt and Morgan (9) point out that although there has been an ever increasing demand since World War II to create textiles for specific end uses, the general concept of performance still is durability; durability connoting both time to destroy and the rate of failure. Failure in textiles is commonly associated with rupture. However, textiles are seldom subjected to end use requirements where rupture is the absolute criterion of acceptability. Failure must be considered to relate to any deficiencies, lacks, or omissions of the fabric to perform in its end use.

Fletcher is in agreement that many properties determine the length of usefulness of a garment and state that in serviceability studies results are obtained by observing things as they are, by analyzing the data and by making what inferences possible from that data (5).

The history of the practical use of synthetic resins in textile finishing, such as those applied to the fabrics in this study, dates back to 1926 when the Tootal Broadhurst Lee process was introduced in England. The inventors worked with phenolic and ketone aldehyde resins also, but only the urea formaldehyde resins became important. In 1933 the process was first used in this country for treatment of cottons and in 1935 was applied to rayon dress goods (17).

Varying degrees of difficulty are encountered in rendering fabrics crease resistant depending on fiber, yarn, and fabric structure of the material to be treated. This is not surprising since the crease resistance of untreated fabrics is dependent on the same factors (15).

Fiber content perhaps has the greatest single effect on the inherent crease resistance of a fabric, the crease resistant properties of the fiber being dependent on the molecular groupings within it (3). This explains the excellent crease resistance of wool which has cross linking bridges between molecules. The cellulosic fibers, cotton and linen, have poorer crease resistance while the resistance of regenerated cellulose yarns is very poor. In all fibers crease resistance is improved as moisture content is reduced (15).

Similarly, construction of yarn plays a significant role in resiliency. Fine yarns with their smaller diameter but of comparable twist per inch to heavier yarns have less resistance to creasing. Also loose irregular fabric construction and thicker fabric are said to resist creasing better (3).

Fabrics are prepared for application of the crease resistant finish by first being desized, scoured, dyed and washed. This is done so that they will be clean, absorbent and free from alkalies or salts which might retard curing of the resin. They are then impregnated with a resin by being passed through an aqueous solution of resin and catalyst at controlled temperature and pH. The amount of resin required and its effectiveness varies with the chemical type of the resin and with the ratio, type and quality of the catalyst used. Up to a certain point crush resistance is proportional to the amount of resin added.

After impregnation the fabrics are cured at high temperature to polymerize the resin. With increased temperature the catalyst becomes more acid and accelerates the action. The temperature used and the length of time required for polymerization are in inverse relationship. Care

must be taken for over curing will tender the fabric.

Curing time must be determined for each curing set up and each fabric construction because the time for the cloth to reach curing temperature is not only dependent on its moisture content, thickness, construction, fiber content and fabric velocity, but also on the air current in the dryer.

Subsequently the fabric is washed so as to remove any incompletely polymerized resin and to materialize the acidity developed during curing. This step is essential in safe guarding against odor development in storage (15).

Gagliardi and Gruntfest (7) point out that cellulose fabrics may be made resistant to creasing or wrinkling by treatment with a variety of compounds whose action produces chemical or physical cross linking of the molecular chain composing the fiber. Each reduces the swelling of the fiber (8), increases the elastic modulus, reduces creep, and improves elastic recovery. To be effective, however, such cellulose modifying agents must be diffusable in the cellulose. Nondiffusable materials are simply deposited on the surface and do not improve crease resistance but produce stiffness instead (7).

In addition to crease proofing these processes also produce shrinkage control (16), improvement in hand and drape,and increase wet tensile strength (14). Shrinkage control denotes the extension of useful dimension during normal wearing and dry cleaning (21).

One disadvantage is that wear and abrasion resistance is normally decreased (14). Loss is greater in cotton than in viscose or acetate. This loss is not due to degradation of the cellulose but to an alteration in elastic properties of the fabrics. If the resin is stripped from the

fabric, tensile strength returns to its original value (15).

Another disadvantage is that to a greater or lesser degree most dyes are affected by the crease resistant finish but to what extent or exactly what color change is pretty much a trial and error method. Those dyestuffs not affected to shade change are, as a general group, less fast to light (4). However, in the case of direct dyes wash fastness is improved (15).

In recent investigations(18) an odd fact was discovered. An untreated all rayon shirting material had a wrinkle recovery angle as high as the same fabric in the resin treated state. Both fabrics had been subjected to standard conditions for twenty-four hours prior to testing. It is believed that the length of aging of the fabric was the determining factor in the performance of these fabrics. However, further research is being done.

Recently Russell Newton, President of the Dan River Mills, Inc., announced the development of a radical and new chemical process, X-2, and made the following claims. The process is not a resin finish but it assures permanent shrinkage control and offers wrinkle resistance. Immunity to the undesirable effects of chlorine bleaches, and elimination of the problem of unpleasant odor are other special features of this process. It is felt that these factors will double the life of garments, make white fabrics practical for the first time, and rayon fabrics completely washable.

The improvements mentioned are achieved by changing the molecular structure of the fiber and once changed the rayon fiber cannot return to its original state (13).

METHODS AND PROCEDURES

III. METHODS AND PROCEDURES

Organization of Study

Eighteen garments of the same classic pattern but varying in size from fourteen to eighteen were constructed for this study. Nine were rayon gabardine and nine of plain weave suiting of comparable weight. The gabardine was navy blue in color while the suiting was grey and white. Both fabrics were purchased during the summer of 1950 from the J. W. Knapp Company in Lansing, Michigan. This specific study is one aspect of a more comprehensive Experiment Station Project at Michigan State College. The fabrics used in this phase of the study were similar to those of Tsuda's study (19) on comparative performance of crush resistant finish on rayon suiting.

Laboratory specification tests included yarn analysis for twist and size, and fabric analysis including yarn count, weight per square yard, thickness, tensile strength, and elongation. Testing was done under standard conditions of 65% $\pm$ 2% relative humidity and 70° $\pm$ 2° Fahrenheit which is in accordance with A.S.T.M. test procedures (2). Performance tests included drapability, wrinkle recovery, dimensional stability, resistance to abrasion, and color fastness to dry cleaning.

Modified test procedures were necessary for the drapability test and for determination of the dimensional stability of the garments.

In addition to the initial testing of the fabrics from which each garment was cut, a portion of each fabric was dry cleaned with the garments. Specimens of the dry cleaned fabric were withdrawn at specified

intervals for the performance tests previously mentioned. To further determine change which resulted from dry cleaning only, a portion of each fabric was dry cleaned a total of twenty times. In order that the dry cleaning procedure be consistent throughout the study, the dry cleaning of the control fabric, as well as the garments, was done simultaneously at the same commercial establishment. The following table summarizes tests and test intervals for the fabrics.

Test	Number of Dry Cleanings							
	Orig	1	2	4	6	10	15	20
Yarn Number	x							
Yarn Twist	x							
Yarn Count	x	x				x	x	x
Weight	x				x	x	x	x
Thickness	x		x	x	x	x	x	x
Tensile Strength	x		x	x	x	x	x	x
Elongation	x		x	x	x	x	x	x
Dimensional Change	x		x	x	x	x	x	x
Wrinkle Recovery	x		x	x	x	x	x	x
Drapability	x		x	x	x	x	x	x
Resistance to Abrasion	x				x	x	x	x
Colorfastness to Dry Cleaning		x			x	x	x	x

Nine graduate students in the School of Home Economics were cooperators in the wear aspect of this study. Each cooperator was issued two dresses made especially for her by the investigator - one each of the gabardine and suiting fabric. Each dress was carefully checked for size and fit. Each dress was worn for a total of 360 hours. Careful daily records were kept providing information about the exact number of hours worn; record of stains, stain removal, pressing; signs of wear such as rips, yarn slippage, abrasion; subjective observations and personal judgment as to appearance, wrinkling, and extent of wrinkle recovery during wear.

At wear intervals of sixty hours, each garment was returned to the laboratory for subjective analysis and determination of any dimensional change in wear. The garments were then dry cleaned. After dry cleaning the garments were again analyzed subjectively and measured to determine any dimensional restorability in dry cleaning. The subjective analysis of each dress included the following considerations - the amount and points of abrasive wear, the number of snags or roughening, the amount of impression on the right side of garment due to pressing, the number of stains, and the feel or hand of the fabric. In addition to the general appearance specialized construction finishes of seams, buttonholes, hems, and placket openings were analyzed.

Measurements were taken to the nearest sixteenth of an inch with a steel tape. Horizontal measurements were taken at bust, waist, and hip levels, and across the back of the blouse. Linear measurements were taken at center front, side front, side, and center back of both blouse and skirt. The inside of the pleat at center front of the skirt was also measured as well as the side back seam. With the exception of center front measurement on the skirt and blouse, all measurements were made from the inside of the garment.

After the garments had been worn the required 360 hours and dry cleaned six times they were returned for laboratory testing and analysis. Test specimens were taken from specified areas of the skirt and blouse front and back, elbow section of sleeve and under arm section of the blouse as illustrated in the cutting charts, appendix page 73-76.The same tests performed on the original and dry cleaned only fabric, namely; weight, thickness, tensile strength and elongation, wrinkle recovery, and

drapability, were also performed on specimens taken from the worn garments. Percentage change from the original fabric in tensile strength and elongation, weight and thickness was computed and constitutes the criteria for judging the degree of wear.

In planning areas to be used in physical testing, the size fourteen dress was drawn to scale of one-fourth inch to one inch. From this diagram cutting charts of the areas to be tested were made.

Construction of Garments

Each cooperator was given a paper pattern fitting and a muslin fitting when necessary. The garments were cut from the altered pattern pieces and then assembled in accordance with the pattern directions. Specified procedures and finishes as outlined, pages 14-15 were developed. Observations on ease of "handle" of these two fabrics during construction, ease in pressing, stitching and fitting were recorded. The completed garments were labelled according to fabric, size, and number of dress within the fabric group. The key for the coding of the fabric developed in the previous study by Tsuda follows - Roman numerals designate fabric group; capital letters, weave construction; and Arabic numbers, the specific fabric within the group. The size of the garment was indicated by arabic numbers preceded by s; the number of the dress within the group by a lower case letter. For example IA_6 - $^{s}14a$ is the code number for the first dress in the rayon gabardine, size fourteen.

The same method of pressing and stitching was used for dresses in each group. Throughout construction pressing was done from the wrong side with a steam iron. Twenty stitches per inch were used for all seams; thirty

stitches per inch, for reinforcement. The welt seams in skirt back were top stitched 3/8 inch from the first line of stitching.

The dresses in each fabric group were further divided into groups of three. Different buttonhole, hem, waistline, front facing edge, and armscye finishes were applied to each set of three dresses within the fabric group. The buttonholes were bound, piped, and machine made. Hems were seam taped, pinked, stitched and then hand hemmed with hemming or slip stitches. Waistline seams were pinked and stitched, seam taped, and pinked only. The blouse front facing edge was pinked and stitched, seam taped, or pinked, turned under, and then stitched. Armscye seams were pinked and stitched, seam taped or overcast.

In both fabric groups the inside finishes used for each dress were similar. Different finishes, however, were used on the right and left side of each garment. On the right side of each garment knots were tied and threads snipped to 1/2 inch at dart ends, etc.; vertical seams were pinked to 3/4 inch and stitched and the pocket reinforced with stitching. Also on the right side the facing seam allowance was stitched to the sleeve minus 1/8 inch from the edge, the collar dart tacked to the facing dart with slip stitching and at the waistline the facing seam was tacked to the dress seam. On the left side of each garment the dart ends etc. were finished by stitching back for 1/2 inch. The vertical seams were pinked to 3/4 inch. Seam tape was used to reinforce the pocket.

Test Methods

Yarn Number- The Universal Yarn Numbering Balance was used in determining yarn size. Thirty-six inch lengths of the spun yarns and 90 centi-

meter lengths of the filament yarns were weighed. The average of ten determinations each for warp and filling was computed and recorded as yarn size or denier.

Twist per Inch - An Alfred Suter Twist Counter was used to determine direction and number of twists per inch. For single yarns of spun rayon a 10 inch gauge length with a 3 gram deflection load was used. The yarn was completely untwisted and then retwisted in the opposite direction until the same tension existed. The number of turns recorded on the machine was divided by twenty to arrive at the average number of twists in one inch. An average of ten each warp and filling determinations was computed to determine twist per inch.

For the ply yarns the 10 inch gauge and 3 gram deflection load were again used. The twist was completely removed and the total number divided by 10 to determine the number of twists per inch given the two singles comprising the yarn. Ten determinations were made and the average computed and recorded. The twist of each component in the ply yarn was done separately. The yarn was completely untwisted and the single not being tested was clipped. A gauge length of 5 inches and a deflection of 3 grams were used in determining the number of turns per inch for each ply of the yarn.

For the filament yarns, a five inch length was twisted to rupture. A second yarn was untwisted and then retwisted until ruptured. The following formula was used to determine twist for filament yarns.

$$N_2 - N_2 = 2T$$

$$\text{and } t - \frac{T}{L} = \frac{N_1 - N_2}{2\,(L)}$$

in which:

N_2 = Number of turns (twisted) to rupture

N_1 = Number of turns to untwist and retwist to rupture

T = Total of number of turns in yarns

t = Turns per inch

L = Length of yarn used

Yarn Count - To determine the number of yarns per inch a micrometer was used according to A.S.T.M. procedure. In both warp and filling the yarn count was recorded as the arithmetic average of five determinations with no two taken from areas including the same set of yarns.

Similarly five determinations each for warp and filling were made at designated areas on each garment after wear and dry cleaning.

Weight per Square Yard - To determine weight per square yard five two inch square specimens taken at random from each fabric were conditioned and weighed on a chainomatic balance according to A.S.T.M. procedure. Formula for computing weight per square yard was:

$$\frac{45.71 \times \text{weight of samples in grams}}{\text{area in inches}} = \text{weight in ounces}$$

Weight was computed for the original and fabric withdrawn after 6, 10, 15 and 20 dry cleanings. Similarly weight determinations were done from samples taken from specific areas of the worn garments and weight per square yard for each garment calculated. The average weight of dresses within each fabric group and at the specified areas was also calculated.

Thickness - The Sheifer Compressometer was used to determine thickness. Each thickness reading was taken when the foot of the compressometer exexerted one pound pressure on the fabric and was recorded in inches.

Nine readings were taken on each specimen and were averaged to calculate original thickness of the control fabrics and thickness after withdrawal following 2, 4, 6, 10, 15 and 20 dry cleanings. Thickness readings at specified points on each garment were also taken, averaged, and recorded as thickness for each dress. The average thickness of each of the nine dresses at the specified points were calculated for comparison of difference in wear from the various areas of the garment.

Dimensional Stability - Markings for dimensional stability measurements were made on the specimens which were dry cleaned 20 times. Five basting lines two and one half inches apart on the warp and filling yarns constitute these markings and permitted 10 determinations each for warp and filling to be made. A steel tape was used and the average of measurements to the nearest sixteenth recorded.

Tiny thread knots on the inside of each garment were used as points between which measurements were taken to determine the dimensional stability of the dresses. Each garment was placed over the end of an ironing board while measurements were taken. A steel tape was used and readings were recorded to the nearest sixteenth of an inch.

Tensile Strength and Elongation - The ravel strip method outlined in A.S.T.M. testing procedure was used in these tests. Six determinations each were taken for both wet and dry warp and filling of the original fabric and fabric subjected to 2, 4, 6, 10, 15 and 20 dry cleanings. The average and percentage change from the original was calculated. The method used on specimens from the worn garments after 6 dry cleanings was the same except that sampling had to be limited to one set of determinations. Dry determinations were arbitrarily chosen.

Wrinkle Recovery - The instrument for determining the ability of fabrics to recover from creasing was the Monsanto Wrinkle Recovery Tester. Test specimens, 1.5 cm. by 4 cm., warp and filling were conditioned for a minimum of four hours. Each test specimen was then placed between the metal leaves of the specimen holder in such a way that one edge of the specimen coincided with the edge of the longer metal strip. The exposed end of the fabric was turned back so that the cut edge fell on the horizontal guide line indicated on the shorter leaf. The specimen holder was then placed in a plastic press and under a load of one and one half pounds for five minutes. At the end of this creasing time the weight was removed and the specimen holder taken from the plastic press and mounted in the wrinkle recovery tester so that the protruding fabric was aligned with the vertical guide line on the back panel of the tester. The fabric was allowed to recover for five minutes and was adjusted throughout this period so that it was kept in alignment. At the end of the recovery period the angle of recovery was read on the calibrated scale and recorded in degrees.

Drapability - An improvised drapemeter patterned after the instrument developed by John H. Skinkle and Arthur J. Moreau was used to drape or handle and stiffness of the fabric. The apparatus had previously been set up in the laboratory (12) and consisted of a metal rod supported on two ring stands. Three two and one half inch paper clips were placed on this horizontal rod. A millimeter ruler was held with a clamp and mounted on another ring stand. This ruler was fixed in such a position that it was exactly one hundred millimeters below the jaws of the paper clamps.

Three samples 100 by 250 mm. were cut for the test, the shorter di-

mension being parallel to the set of yarns to be evaluated. Each sample was folded back on itself with the face of the fabric on the convex side and mounted for measuring by attaching the clamp one-fourth of an inch below the edge of the fabric specimen. The fabric was allowed to hang undisturbed for two minutes. The millimeter scale was then moved up to the concave side of the material with one edge of the scale just touching the fabric and the chord length read and recorded. The reading was also a percentage of width since the width was equal to 100 mm. Measurements were made on the original fabrics and fabrics withdrawn after 2, 4, 6, 10, 15 and 20 dry cleanings.

Readings were also made on warp and filling specimens taken from the worn garments.

Resistance to Abrasion - The Taber Abraser equipped with Cs-10 calibrase wheels and exerting 500 grams pressure was used to determine resistance to abrasion. Six specimens, five inches square, from the original fabrics and subsequently from fabrics withdrawn after the 6th, 10th, 15th and 20th dry cleanings were taken. Three of the six specimens were abraded to a constant number of 150 cycles. The remaining three samples were abraded to a constant number of 250 cycles.

Colorfastness to Dry Cleaning - One inch pieces of test cloth were basted to the fabric specimens withdrawn after 1, 6, 10, 15 and 20 dry cleanings.

INTERPRETATION OF RESULTS

IV. INTERPRETATION OF RESULTS

Analysis of Original Fabrics

Initial Specifications - The gabardine was of a warp faced even twill construction woven of single spun yarns which were a blend of acetate and viscose fibers. This fabric weighed 5.2 ounces per square yard and was .016 inch thick. The warp yarn count was twice that of the filling which is customary in a twill weave. The warp and filling yarns were of similar size, the warp being slightly heavier. The warp yarns were of S twist; the filling of Z twist. The twist per inch in the warp was 23 per cent greater than that in the filling.

The suiting was of plain weave with both acetate and viscose yarns in warp and filling. This fabric weighed 6.4 ounces per square yard, and was .019 inch thick. The balance in warp and filling count was good with variation of only six more yarns in the warp direction.

The filament acetate yarns in both warp and filling of this fabric had the same direction and amount of twist. The viscose filling yarn was a spun single with a Z twist. The viscose warp yarn was a ply with an S twist. Two single constituents having similar direction and amount of twist made up the ply yarn.

The fabrics were different in weave and yarn structure. The suiting weighed one ounce or 18.75 per cent more than the gabardine and was .003 of an inch thicker. The suiting had better balance in yarn count than the gabardine. Because of its unbalanced yarn count the gabardine was easily

distorted. The suiting on the other hand, which was almost equivalent in yarn count was firm, smooth of hand, and of good body and weight.

The gabardine measured an average 41.7 inches in width and cost $1.28 per square yard. The suiting was wider, being 58.75 inches in width, but cost seven cents less per square yard than the gabardine.

The gabardine was a Mallinson's Rusteena to which the Unidure finish for creaseresistance had been applied. It was sold as washable, providing that garments made from it were made completely of one color. Burlington Mills was the only identification on the tags attached to the suiting fabric.

No statement as to extent of crush resistance or guarantee of permanency of finish was made for either fabric.

Performance Characteristics - Because the fabrics were not the same in their initial specifications they could not be expected to have the same performance characteristics. The following variations were evident.

Although there were only 6 more yarns in the warp than in the filling count of the suiting, the dry warp strength was approximately twice the filling strength due to use of a ply yarn in the warp. In the gabardine the dry warp strength was slightly more than twice the original dry filling strength because of its high warp count. In wet testing, the original warp and filling strength of both fabrics was approximately one-half their dry strength. Wet strength in the gabardine was higher than in the suiting. Warp - filling strength ratio for each of the two fabrics was approximately the same in wet testing as in dry testing.

The dry warp elongation was greater than filling elongation. Elongation was greater in the gabardine than in the suitings due to the more

highly twisted yarns used in both warp and filling of the gabardine. In the wet testing the ratio of warp to filling elongation was approximately the same as in the dry testing.

The suiting fabric was almost twice as stiff as the gabardine which may have been due to excess resin deposit on the fabric.

Both fabrics had satisfactory wrinkle recovery values both warpwise and fillingwise, the angles being above the standard of 120° recovery set as satisfactory for rayons. In both fabrics the angle of recovery was higher warpwise than fillingwise. Wrinkle recovery values were higher in the suiting than the gabardine.

The resistance to abrasion for first sign of wear of the suiting was approximately one and one-half times as great as that for the gabardines. First break for both fabrics came in the warp. The lower resistance to abrasion of the gabardine was due to its weave structure. This gabardine was characterized by long warpwise floats which could more readily be abraded.

TABLE I

SPECIFICATION ANALYSIS OF ORIGINAL FABRICS

Fabric	Width	Yarn Count[1]		Yarn Size[2]						Thickness in inches	Weight per square yd. in ounce
		Warp	Filling	Warp		Filling		Warp		Filling			
Gabardine	41-6/8	130.4	65	26		29		22.6S		16.3Z		.01598	5.2247
				Filament	Spun	Filament	Spun	Filament	Spun Yarn Ply	Filament	Spun		
Suiting	58-6/8	60.4	54.4	494	10	336	15	2.4Z	15.4S 2Z	2.5Z	16.5Z	.01852	6.3752

1. Average of 5 determinations
2. Average of 10 determinations
3. Based on average of 9 determinations

TABLE II

PERFORMANCE ANALYSIS OF ORIGINAL FABRICS

	Tensile Strength in pounds[1]				Elongation in percent[1]				Wrinkle Recovery in Degrees[2]		Drapability Values[3]	Resistance Abrasion in Cycles[4]
	Dry		Wet		Dry		Wet					
	W	F	W	F	W	F	W	F	W	F		
Suiting	63.33	43.83	36.25	22.0	22.77	16.85	26.37	20.72	138.6	136.8	64.4	223
Gabardine	86.83	39.67	39.67	23.75	26.77	15.45	26.73	15.37	134.2	131.	36.58	146

1. Average of 6 determinations.
2. Average of 5 "
3. Geometric means of chord length (in mm.) of warp and filling based on average of three determinations each for warp and filling.
4. Average of three determinations for first sign of wear.

Analysis of Dry Cleaned Fabrics

Dimensional Stability - The suiting shrank progressively in both warp and filling in dry cleaning. Greatest shrinkage occurred in the first ten dry cleanings, the change in both warp and filling being less than one per cent. However, during the last ten dry cleanings the warp stretched slightly so that terminal shrinkage warpwise was but one-half of one per cent. There was also some stretch in the filling resulting in negligible shrinkage.

As in the suiting, the general trend in the gabardine was both linear and horizontal shrinkage through repeated dry cleaning. Greatest shrinkage in both directions of the fabric (.62%) occurred during six dry cleanings. The terminal shrinkage, only .38 per cent was the same in both directions. Both fabrics were judged acceptable for their intended use. Total dimensional change was slight and may be considered negligible in terms of a garment. This insignificant change in dimension was evidence that the crease resistant finish had a stabilizing effect on the fabric.

Yarn Count - The amount of shrinkage of both fabrics during dry cleaning resulted in proportional yarn count change. The greatest increase in both warp and filling count of the suiting occurred in the first ten dry cleanings. In subsequent dry cleanings the change was less than one per cent. Terminal increase was 2.7 per cent warpwise and 3.64 per cent fillingwise. However, the percentage changes are negligible and did not alter the appearance or hand of the fabric.

In the gabardine the warp count remained constant through ten dry cleanings and then increased progressively through the remaining ten. Filling

count increased progressively through the first ten dry cleanings and conversely decreased progressively through the remaining ten. Terminal increase was approximately four per cent from the original in the direction of the warp and three per cent in the filling.

Weight - In repeated dry cleanings both fabrics increased in weight. However, increase in the gabardines was under one per cent while that in the suiting was 16.5 per cent. The greatest increase in the suiting occurred in the first six dry cleanings followed by a six per cent decrease in weight in the last fourteen. The erratic change may be due to the dispersion of excess resin in the dry cleaning process indicating improper finishing. Terminal gain was fourteen per cent.

Thickness - In dry cleaning both fabrics increased in thickness, the percentage change in the gabardine being greater than that of the suiting throughout the series of dry cleanings. Shrinkage, although slight for both fabrics during dry cleaning, was greater in the gabardine and may account, in part, for thickness variation. The higher percentage increase in thickness in the gabardine may also indicate that this fabric retained more of its resin finish in the dry cleaning process. Thickening cannot be accounted for by shrinkage.

In both fabrics the greatest change was noted in the second dry cleaning. Terminal thickness gain in the suiting was four per cent from the original and in the gabardine eleven per cent. However, this change was not enough to alter appearance or hand of the fabrics.

TABLE III

SPECIFICATIONS OF DRY CLEANED FABRIC

Fabric	No. of D. C.	Yarn Count: Warp Ave.[1]	Warp %Ch.[2]	Filling Ave.	Filling %Ch.	Weight in ounces Ave.[1]	Weight %Ch.	Thickness in inches Ave.[3]	Thickness %Ch.
Suiting	0	60.4		54.4		6.3752		.01852	
	1	59.8	- .99	54.4	0				
	2							.01895	∠ 2.32
	4							.01879	∠ 3.88
	6					7.4256	∠16.48	.01902	∠ 2.69
	10	62.4	∠3.31	56.4	∠3.68	7.0464	∠10.5	.01912	∠ 3.23
	15	62.6	∠3.64	56.6	∠4.05	7.2846	∠14.3	.01932	∠ 4.31
	20	62.2	∠2.98	56.4	∠3.64	7.2700	∠14.0	.01934	∠ 4.42
Gabardine	0	130.4		65.		5.2247		.01598	
	1	130.4	0	65.8	∠1.24				
	2							.01692	∠ 5.07
	4							.01698	∠ 5.39
	6					5.5396	∠ .60	.01690	∠ 4.96
	10	130.0	- .38	68.	∠4.63	5.65	∠ .81	.01752	∠ 9.46
	15	132.4	∠1.53	67.6	∠4.0	5.5273	∠ .58	.01801	∠10.96
	20	135.6	∠3.98	67.2	∠3.38	5.677	∠ .85	.01804	∠11.1

1. Average of five determinations
2. Percentage change from the original
3. Average of nine determinations

Tensile Strength - In repeated dry cleaning dry tensile strength change in the suiting was negligible. In wet testing this fabric decreased progressively in strength to a terminal loss of nine per cent in the warp and eleven per cent in the filling.

In the gabardine dry strength change was gradual resulting in a seven per cent loss warpwise and a three per cent gain fillingwise. There was an increase in the wet strength in this fabric of thirteen per cent in the warp and less than one-half of one per cent in the filling. The negligible change in shrinkage does not explain the increased wet tensile strength of the dry cleaned gabardine. The increased yarn count relates to increased tensile strength and might partially account for higher strength.

Wet tensile strength change in both fabrics was greater than dry strength change as a result of dry cleaning.

Elongation - In the suiting, dry elongation was erratic throughout dry cleaning. The terminal loss in this fabric was seven per cent in the warp and fourteen per cent in the filling in dry testing and ten and sixteen per cent in wet testing.

In the gabardine, dry elongation results were also erratic throughout the series of dry cleanings. Terminally there was an increased filling elongation of four per cent. Warp loss was negligible. In wet testing terminal change was reversed with four per cent in the warp and a negligible amount in the filling.

In both fabrics dry elongation was erratic but greater in the suiting than in the gabardine. In wet testing both fabrics showed decreased elongation at the termination of dry cleaning; the loss being greater for the suiting than for the gabardine.

TABLE IV

FABRIC PERFORMANCE IN DRY CLEANING

Fabric	No. of D.C.	Tensile Strength in Pounds								Elongation in Percent							
		Dry				Wet				Dry				Wet			
		Warp		Filling		Warp		Filling		Warp		Filling		Warp		Filling	
		Ave.[1]	%Ch.[2]	Ave.	%Ch.	Ave.	%Ch.	Ave.	%Ch.	Ave.[3]	%Ch.[2]	Ave.	%Ch.	Ave.	%Ch.	Ave.	%Ch.
Suiting	0	63.33		37.16		36.25		22.		22.77		16.85		26.37		20.72	
	2	62.42	-1.44	36.83	- .89	34.25	- 5.52	19.92	- 9.45	20.7	-9.09	15.68	- 6.94	23.8	-9.75	17.85	-13.85
	4	64.33	≠1.58	35.17	-5.36	34.08	- 5.99	20.08	- 8.7	20.92	-8.12	14.8	-12.17	24.18	-8.30	18.45	-10.96
	6	63.83	≠ .79	34.25	-7.83	32.75	- 9.66	19.17	-12.86	22.23	-2.37	14.22	-15.61	24.08	-8.68	17.97	-13.27
	10	65.75	≠3.82	35.17	-5.36	33.75	- 6.9	18.58	-15.54	20.58	-9.62	15.35	- 8.9	24.1	-8.61	16.93	-18.29
	15	64.17	≠1.33	34.92	-6.04	33.0	- 8.97	19.67	-10.59	21.17	-7.03	15.03	-10.8	23.53	-10.77	17.17	-17.13
	20	62.5	-1.31	36.67	-1.32	33.0	- 8.97	19.58	-11.	21.08	-7.42	15.9	-13.87	23.75	-9.94	17.33	-16.36
Gabardine	0	86.83		39.67		39.67		23.75		26.77		15.45		26.78		15.37	
	2	85.03	-2.07	42.67	≠7.58	39.58	- .23	23.75	0	25.43	5.0	16.53	≠ 6.99	25.35	-5.34	15.42	≠ .33
	4	85.08	-2.02	39.5	- .43	44.33	≠10.92	22.33	- 6.02	26.4	-1.38	15.3	- .97	27.77	≠3.7	15.9	≠ 3.45
	6	80.17	-7.67	39.67	0	48.08	≠21.2	24.0*	≠ 1.05	25.17	-5.98	16.07	≠ 4.01	28.55	≠6.61	14.02	- 8.78
	10	80.5	-7.29	41.58	≠4.81	42.92	≠ 8.19	22.92	- 3.49	25.13	-6.13	16.25	≠ 5.18	23.57	-11.99	14.88	- 3.19
	15	82.33	-5.18	37.92	-4.41	41.17	≠ 3.78	23.92	≠ .72	25.77	-3.74	15.17	- 1.81	23.35	-12.81	14.47	- 5.86
	20	80.92	-6.81	40.83	≠2.92	44.75	≠12.8	23.83	≠ .34	26.75	- .074	16.15	≠ 4.53	25.75	-3.85	15.25	- .78

1. Average tensile strength in pounds based on 6 determinations
2. Percentage change from original
3. Average elongation in per cent based on 6 determinations

* Average of five

TABLE IV. Cont.

FABRIC PERFORMANCE IN DRY CLEANING

Fabric	No. of D.C.	Wrinkle Recovery				Drapability Value	Resistance to abrasion in cycles	
		Warp		Filling				
		Ave.[1]	%Ch.[2]	Ave.	%Ch.	Mean[3]	Ave.[4]	%Ch.
Suiting	0	138.6		136.8		64.4	223	
	2	135.6	-2.17	141.2	±3.22	45.86		
	4	140	±1.01	135.2	-2.49	45.72		
	6	138.6	0	137.0	-1.17	43.99	283	± 31.4
	10	140.8	±1.59	132.4	-4.53	45.15	294	± 31.8
	15	130.2	-6.06	135.8	-2.07	45.3	276	± 23.8
	20	135.6	-2.17	136.4	- .29	44.28	276	± 23.8
Gabardine	0	134.2		131.0		36.58	146	
	2	135.4	± .89	131.4	± .31	34.48		
	4	136.4	±1.64	135.0	±3.05	33.75		
	6	140.2	±4.46	135.4	±3.36	31.8	212.5	± 45.55
	10	136.6	±1.79	134.6	±2.75	20.76	171.	± 17.12
	15	139.2	±3.73	136.8	±4.43	29.59	120.3	- 17.16
	20	137.4	±2.39	135.6	±3.51	31.49	145.0	- 6.85

1. Average angle of recovery in degrees based on five determinations.
2. Percentage change from the original.
3. Geometric mean of cord length (in mm.) of warp and filling based on average of three determinations each for warp and filling.
4. Average of three determinations for first sign of wear.

Wrinkle Recovery - Both fabrics maintained acceptable crush resistance since fluctuations in wrinkle recovery either warpwise or fillingwise for both fabrics at each dry cleaning interval remained above the commercial standard. In the gabardine, wrinkle recovery values of both warp and filling increased progressively through the first six dry cleanings. From the sixth through the twentieth dry cleaning the changes were erratic but even the terminal wrinkle recovery value of the gabardine was greater by two and three and one-half per cent respectively, for warp and filling than initially. Higher initial recovery warpwise than fillingwise was maintained throughout the twenty dry cleanings.

In the suiting, the change in wrinkle recovery during dry cleaning was erratic but indicated a tendency toward loss in wrinkle recovery. The higher initial recovery of the warp was not maintained throughout the sequence of dry cleanings. Terminal wrinkle recovery loss in the suiting fabric was approximately two per cent warpwise and three per cent fillingwise.

As a result of dry cleaning, wrinkle recovery angles in the two fabrics were similar varying only two degrees whereas variation in the originals was approximately five per cent.

Since angles of recovery were satisfactory both before and after dry cleaning, either fabric shows satisfactory recovery from wrinkling. Differences at interim dry cleanings were so slight that they were not apparent to the wearer.

Drapability - Decrease in stiffness was greater in the suiting than in the gabardine after repeated dry cleanings; the suiting losing more stiffness in the first two dry cleanings than in subsequent cleanings. This

twenty-five per cent loss may have been due to removal of excess resin in dry cleaning since change in stiffness in the suiting from the second to the twentieth dry cleaning was negligible. It is apparent that excess surface resin was almost entirely removed in the second dry cleaning.

In the gabardine, the loss in stiffness was progressive through fifteen dry cleanings, the amount of decrease between test intervals being approximately the same. Terminal decrease in stiffness was thirty-one per cent in the suiting or more than twice that in the gabardine.

Percentage loss in stiffness was twice as great in the suiting as in the gabardine. The suiting, however, had higher drapability values than the gabardine after repeated dry cleanings. The gabardine throughout was limp and without body.

Resistance to Abrasion - In twenty dry cleanings, resistance to abrasion had increased in the suiting and decreased in the gabardine. The gabardine may have retained more of its finish, therefore lowering its resistance to abrasion. In both the suiting and the gabardine the greatest increase in resistance occurred in the first six dry cleanings due to increased yarn count. At this interval both fabrics showed greatest abrasion resistance. The successive loss in abrasion resistance in the suiting was negligible. The gabardine decreased progressively in resistance thereafter with terminal decrease of approximately seven per cent whereas terminal abrasion resistance in the suiting was twenty-four per cent greater than originally.

Color Change in Dry Cleaning - Test cloths sewed to each of the five specimens of each fabric showed no color change through twenty dry cleanings.

Comparison of Original, Dry Cleaned Only, and Worn Fabrics

In the worn and dry cleaned suiting fabric the terminal percentage decrease in yarn count was negligible being one per cent warpwise and fillingwise, indicating slight stretching in both directions.

Yarn count change in the worn gabardines was also negligible, decreasing one per cent in the warp direction and a seven-tenths of one per cent gain in the filling. This indicates that the worn gabardine stretched warpwise. However, dimensional change does not account for this slight gain in filling yarn count.

In weight per square yard the control suiting showed a gain of sixteen and one-half per cent in six dry cleanings, while the worn fabric had a loss of approximately one per cent. Similarly, the gabardine dry cleaned control gained slightly in weight and the worn gabardine lost slightly. The percentage change for the gabardines was lower in both cases being under one per cent. Loss of weight in the worn fabric was due to fiber deterioration in wear.

The dry cleaned control suiting increased approximately three per cent in thickness while the worn fabric decreased twelve per cent. Similarly the gabardine showed five per cent increase due to dry cleaning only and a decrease of four per cent in the worn fabric. The per cent increase in the dry cleaned gabardine was greater than that for the suiting. Conversely, the per cent decrease in thickness of the worn suiting was greater than that for the gabardine. Decrease in thickness in the worn fabric resulted from fiber deterioration in wear.

The suiting showed a warpwise gain in strength of approximately one

per cent in the six dry cleanings while the worn fabric lost approximately seven per cent due to the effects of comparable dry cleaning and wear. However, fillingwise loss of strength occurred in both the dry cleaned and worn fabrics, the loss being two per cent greater in the former.

The dry cleaned gabardine lost eight per cent in strength in six dry cleanings but the filling did not change in strength. Loss was greater in both warp and filling in the worn fabric than in the dry cleaned only fabric. The percentage strength loss in the worn and dry cleaned gabardine was approximately three times greater in the warp than in the filling. A portion of this loss in warp strength may be due to decreased yarn count but primarily to fiber deterioration in wear. Loss in filling strength can also be attributed to the effects of wear.

The usual increased elongation accompanying decreased strength was not apparent in either the dry cleaned control fabrics or the worn suiting and gabardine. In fact, greater loss in breaking strength was accompanied by greater loss in elongation. The per cent loss in warp elongation in the suiting was two per cent for the control and fourteen per cent in the worn. Fillingwise loss was fifteen per cent in the control and seven and one-half per cent in the worn. In the gabardine, per cent warp elongation loss in dry cleaning was approximately six per cent but twice as great in the worn fabric. Fillingwise the dry cleaned control fabric gained four per cent and the worn fabric lost six and one-half per cent.

Change in wrinkle recovery was negligible in both warp and filling determinations of the suiting dry cleaned control. Worn fabric loss was approximately eleven per cent in both directions. By contrast, the worn gabardine had a less than one per cent loss in wrinkle recovery warpwise,

and six per cent gain in recovery fillingwise.

Wrinkle recovery angles for both the worn suiting and the gabardine were above the commercial standard value. Although initial wrinkle recovery values were higher in the suiting than in the gabardine, the values in the dry cleaned and worn gabardine were higher than in the suiting. In both fabrics wrinkle recovery values were higher for either the original or dry cleaned control fabrics than for the worn fabrics.

The drapability values of the dry cleaned control suiting decreased thirty-two per cent while the worn fabric decreased twenty-seven per cent. Loss in drapability was likewise greater for the dry cleaned control than for the worn gabardine, being thirteen and seven per cent respectively. The fact that both worn fabrics lost less in stiffness than those dry cleaned only may be explained, in part, by soil retention in the worn fabrics even through dry cleaning. Drapability change was greater in the suiting, However, inasmuch as the suiting had greater stiffness initially, the gabardine seemed limp by contrast throughout the entire study.

Analysis of Worn Garments

Yarn Count - Decrease in warp and filling count in each dress made of the suiting was negligible being less than two per cent. Change in yarn counts for each of the gabardine dresses was also slight, no gain being greater than one and one-half per cent nor loss greater than two per cent. Differences in per cent changes between the dresses constituting one group, as well as differences between the two groups was slight. Changes evident in the dresses of either group may be due to individual differences in the wearers.

For the suiting group the average warp yarn count of the nine dresses taken at the center front of the skirt showed a decrease of three per cent. This may have resulted from stretching at the waist and hip.

In the gabardine group of dresses increase was negligible. Greatest decrease in yarn count was two and a half per cent across the center back of the blouse and center front of the skirt, and was probably due to stretching resulting from strain in activity. The greatest filling gain, two and one-half per cent, was at the center front of the blouse.

Weight - Change in weight resulting from wear and dry cleaning for the suiting group ranged from a gain of approximately one and one-half per cent to a loss of three per cent. The range for the gabardines was from a negligible amount to four per cent loss. Variation in weight loss for the dresses within both groups seemed to be due to differences in the activity and type of wear by the individual participants in the study. Gain in weight might be attributed to soil retention or redistribution of soil in dry cleaning. The variation in average weight change of samples taken from the specified areas in the nine dresses did not differ signifi-

cantly in either group.

Thickness - Decrease in thickness ranged from ten per cent to sixteen per cent in the dresses made from the suiting and from a negligible amount to ten per cent in the gabardine. Variation in thickness between the nine gabardine dresses was greater than variation in the other group. In general, in the gabardine dresses decrease in thickness related to a loss in weight. This was not true in the dresses of the suiting fabric.

In the 18 dresses, the decrease in thickness occurred in the blouse, in the sleeve, at the side front and at the center back. Sampling from the skirt sections showed uniform decrease in thickness. The decreased thickness of the fabric did not show corresponding decrease in yarn count. Therefore, it would seem fiber loss was greatest in those areas where the fabric was subjected to both abrasive wear and strain.

Dimensional Stability - In general, changes in dimensional stability of both the suiting and gabardine dresses after 360 hours of wear and 6 dry cleanings were so slight that they may be considered negligible. In both horizontal and linear measurements restoration to size and deviation from one cleaning to the next was less than one per cent in the majority of cases. This was exceedingly low and verifies the claim that dimensional stability is imparted by the resin and is as significantly important as the crease resisting quality.

Distortion occurred in wear but there was partial restoration to size in dry cleaning and steam pressing. With progressive hours of wear and repeated dry cleaning the dresses showed inability to return to their original proportions. There was a marked tendency to limited restorability in the last two dry cleanings.

Six dresses worn by three cooperators showed greater change than the other dresses in the groups.

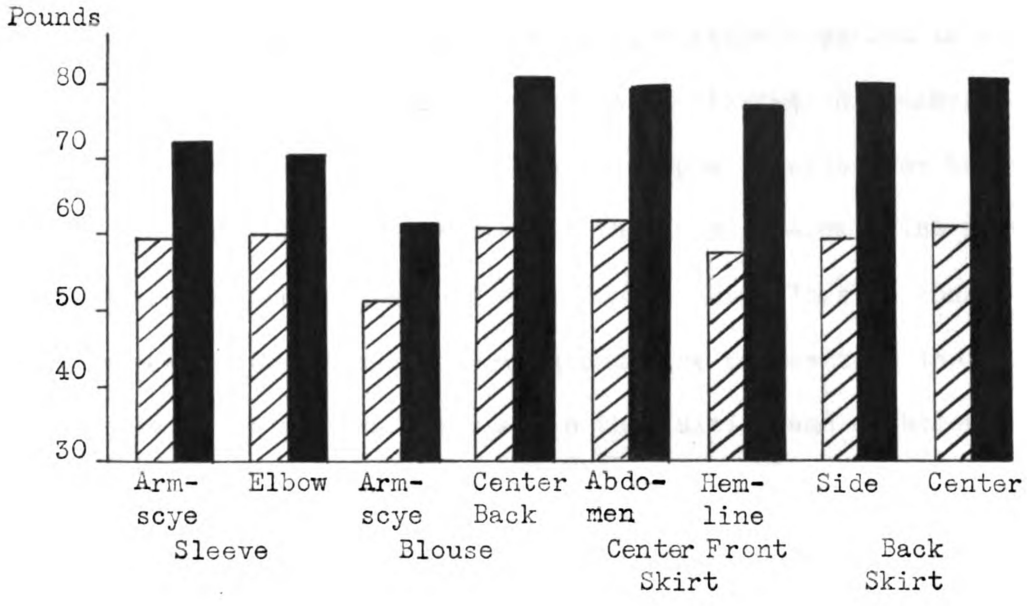
Tensile Strength - There was loss in strength as a result of wear and dry cleaning for all garments with greater loss of strength in the gabardine group. However, loss in tensile strength was not excessive except at certain areas where abrasion and chemical deterioration due to perspiration was excessive. Fabrics given crease resistant finishes originally have lowered strength than the untreated fabrics. As the crease resistant finish was removed in dry cleaning these fabrics tended to regain the tensile strength of the untreated fabric. The suiting which initially had an excessive amount of finish lost a greater amount of the resin in cleaning and thus initial and terminal strength relationship was closer in the case of the suiting than in the gabardine. This tendency for restoration of strength in loss of finish was counteracted by abrasion and chemical deterioration. Hence tensile strength change in the garments was affected by the amount and durability of the finish as well as the type and extent of wear. Dimensional change was not significantly high to have affected strength change.

The widest range in loss and the greatest loss in warp strength occurred at the armscye area for both groups of dresses. Greatest filling loss occurred across the back of the blouse. Variation in strength between the nine dresses of either fabric at any specific area was due to individual differences between the wearers in the amount of strain, their activity and other unknown variables. The strength losses show considerable differences between the individuals especially in respect to perspiration.

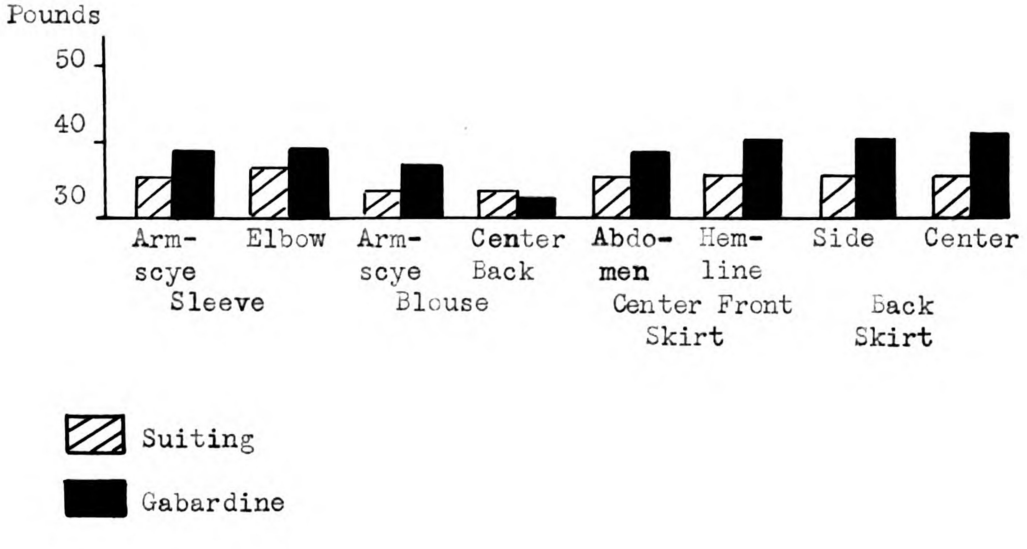
In analyzing overall strength losses in the dresses it was found that two dresses in the suiting group, and two dresses in the gabardine group, showed greater loss in both warp and filling than the other seven dresses of each group. The same two cooperators wore the four dresses which showed the greatest loss. Records show that one of these two co-operators worked in food chemistry. The range of warp strength loss in the suiting was from thirteen to eleven per cent; in the filling from four to eight per cent. Similarly, the range of strength loss in the gabardines was from nine to seventeen per cent in the warp and a negligible gain and loss in the filling.

PLATE I

Warp Tensile Strength at Specified Areas



Filling Tensile Strength at Specified Areas



Elongation - Fabric properties of elongation, elastic recovery, pliability, and bending strength are interrelated so that the whole picture is complicated (10). In the original fabrics the gabardine had more stretch without rupture than the suiting. Loss in elongation occurred in all the dresses and from all areas tested. Decrease in elongation accompanied the loss in tensile strength. Greatest loss in warp elongation for both the suiting and gabardine dresses occurred at the armscye area. The greatest filling loss was across the back of the blouse. Warp loss at these areas was twenty-seven per cent in the suiting and five per cent in the gabardine.

Filling loss was sixteen per cent in the suiting and eighteen per cent in the gabardine. Thus, greatest loss in elongation occurred in the fabric from those areas which were subjected to the greatest and most frequent strain. The repeated stretch and straining across the back may have changed the molecular alignment within the fibers,thus lowering their ability to elongate. It is possible that after both wear and dry cleaning the fabrics were not as pliable; tended to be more brittle and more easily broken. Wrinkle recovery values can be related to this elongation change and substantiate this changed behavior of the yarns. Areas showing lower elongation also had lower stretchability and lower recovery from wrinkling.

There was variation in elongation loss between the nine dresses from each group due to inherent individual differences among the cooperators who wore them. More variation also was evident both warpwise and fillingwise between different areas of the gabardines than those same areas in the suiting dresses.

Wrinkle Recovery - As previously mentioned,in the process of wear and dry cleaning yarns of both fabrics were reduced in extensibility or elong-

ation and became somewhat stiffer. This resulted in loss in recovery from creasing in the worn garments. Loss was greater in the suiting than in the gabardine. The gabardines showed greater stability in that there was less change from original values. The extent of recoverability varied from dress to dress and within specific areas of each dress. Recoverability changes were more marked in sampling from certain areas than others. Again, greatest change occurred in those areas subjected to more frequent and greater strain. In dresses of the suiting greatest loss in wrinkle recovery occurred at the sleeve; warp loss being fourteen per cent and filling loss, nineteen per cent. Second greatest loss, approximately eleven and one-half per cent, in both warp and filling occurred at center back of the blouse.

In the gabardines greatest filling loss, nineteen per cent, also occurred at the sleeve. Two per cent warp loss occurred across the center front of the skirt.

In the suiting the terminal average wrinkle recovery values for each entire dress was above the commercial standard with the exception of three dresses in which filling values were but two to three degrees lower. Gabardines were satisfactory with the exception of one dress which had a filling recovery one degree below the standard.

Drapability - Lower drapability values accompanied lower wrinkle recovery. Loss in drapability values in the suiting group was greater and may be due to the greater loss of resin in dry cleaning. However, original drapability values were higher in the suiting than in the gabardine. Values ranged from twenty-two per cent to thirty-five per cent in the suiting while those in the gabardine were from plus two to minus fifteen per cent.

Drapability values taken at sleeve, skirt center front and back showed that greatest change occurred in those areas of greatest strain. In the suiting the value was forty-five degrees at the sleeve; twenty degrees lower than originally. In the gabardine the greatest loss occurred across the skirt back. The value there was thirty-two; five degrees lower than the original. Even though the per cent loss was greater for the suiting, this fabric was a better choice for the design of the garment because the higher drapability value gave the needed body.

SUBJECTIVE ANALYSIS

Although laboratory testing showed that the gabardine fabric had less body and was more easily distorted than the suiting, laboratory tests could not predict the violent reaction of the cooperators to the gabardine dresses during wear. The cooperators did not like this group of dresses and did not enjoy wearing them because as they stated, "the dresses did not give a neat trim appearance." The following are a few quotes of the many similar comments made by them concerning these dresses - "Mighty tired looking", "limp", "looks like a rag." The wearers felt that these dresses did not retain their shape during wear and also that they "attracted lint and picked up soil." Some said that the gabardine wrinkled easily and did not hold a press, while others felt that they did not get as mussed or wrinkled looking but became shapeless through fabric distortion in wear. There was agreement that this fabric was easily pressed. Two cooperators noted that in the first wear period, there was slight crocking of color at the underarm area. Stain removal in dry cleaning caused color change, a darkening of the fabric. Even after dry cleaning there was some evidence of the spot.

The dresses of the suiting fabric were more satisfactory to the wearers and, in general, the cooperators liked them. However, they noted that the fabric in these dresses was stiff prior to the first dry cleaning with little or "no give" in the fabric, and made them less comfortable than the gabardines during the first wear period. Their wrinkle resistance during this first period was excellent. "The only place they really wrinkled was across the back of the skirt." However, they observed

that once creased wrinkles would not hang out. After one dry cleaning the dresses were considerably softer, and did not feel tight or stiff but wrinkled more easily. Wrinkle recovery, however, was satisfactory. Areas in the dresses which were heavily soiled with perspiration remained stiff, indicating that soil was not removed in cleaning. Soil retention in the suiting is further substantiated by the fact that stains were only partially removed.

Observations made during the construction of the garments of either fabric substantiated the fact that synthetics do not mold with the ease and nicety of wool. However, of the two fabrics, the suiting lent itself to greater ease in the various construction processes and more attractively finished garments regardless of the type of finish used. The lack of body, sleaziness, and distortion of the gabardine presented problems in handling in most of the construction processes used. Only those construction finishes which compensated for lack of body and sleaziness could be considered suitable for this gabardine fabric. For example, piped buttonholes looked better in the finished, unworn garments than either the bound or machine made. This type also held up better throughout wear and six dry cleanings. It should be made clear, however, that no construction finishes could make up for the inadequacies characterizing this fabric for a semi-tailored garment. The gabardine frayed badly during construction and even more so during wear.

The pinked and stitched or taped seams were more satisfactory initially as well as throughout the wear period. Type of seam finish at the armscye appeared to be the more important than other finishes. It was at this seam that greatest frayage occurred. From the photographs on page 85

taken of the worn and unworn garments, it can be seen that the taped seam was significantly more satisfactory.

One disadvantage of the suiting fabric was that once a filament yarn was broken frayage readily followed. This caused yarn slippage at the bottom of the center front opening. See Appendix page 87 .

In the dresses of both fabrics there was less distortion at the line of stitching where the facing was attached to the garment proper, when the facing was also tacked to the garment than when it was not tacked.

CONCLUSION

V. CONCLUSION

Laboratory tests for initial properties of a fabric are indicative of serviceability to a limited degree only. Laboratory tests cannot duplicate the effects of actual wear. Results of those same laboratory tests compared with results obtained on identical fabrics which have been worn, combined with subjective analysis and evaluation of the garments during wear give a more complete picture.

Both the laboratory and subjective analysis showed the suiting was more satisfactory. It was firm, easy to handle in construction and had sufficient body and weight to hold its shape. The gabardine was sleazy, limp, and easily distorted. The suiting gave a neat trim appearance, wrinkled less and showed better recovery from wrinkling.

This wear study substantiates the fact that resin finishes applied for crease resistance also stabilize the fabric and minimize dimensional change. The wear aspect of this study indicated that the extent or degree of wear was influenced by many factors but apparently chemical deterioration caused greater loss in strength than abrasion.

Variation in the degree of wear between individuals resulted from variable factors such as size, activity, amount and type of perspiration etc.

In wear there was distortion and in dry cleaning restorability. With increased wear there was a decrease in the extent of restorability to original proportions.

Repeated dry cleanings indicated progressive loss of finish which

altered the behavior of the fabric in wear.

These fabrics treated for crush resistance did not show the usual tensile strength elongation relationship.

Certain construction finishes were better suited to the fabrics and more satisfactory throughout wear and dry cleaning. In general, the construction finishes used were more durable than the fabric.

SUMMARY

VI. SUMMARY

This study purposed an evaluation of the reliability of laboratory data as predictive of performance for two crease resistant fabrics simulating wool. Eighteen garments of the same classic pattern design were constructed; nine each of rayon gabardine and plain weave suiting of comparable weight. Initial specifications and performance characteristics of each fabric were determined. The eighteen dresses were issued to nine cooperators who wore them a total of 360 hours. At wear intervals of sixty hours the dresses were dry cleaned at the same commercial establishment.

A portion of each fabric was dry cleaned six times along with the dresses. However, this fabric was subsequently dry cleaned for a total of twenty dry cleanings. Daily records were kept by the cooperators about the garments including number of hours worn, stains and their removal, pressing, observable signs of wear as well as subjective observations and judgment as to general appearance, wrinkling and extent of recovery. Specimens of the dry cleaned fabric were withdrawn at intervals of 2, 4, 6, 10, 15, and 20 dry cleanings and tested to determine change in performance resulting from dry cleaning.

At the termination of the study worn and dry cleaned garments were similarly tested and analyzed for change in performance resulting from combined wear and dry cleaning. Specimens were taken from the following specified areas of each dress: skirt and blouse front and back, elbow section of sleeve, and underarm section of blouse. Evaluation of performance test results was used as the criteria for judging the extent

of wear. Comparison of wear within and between the eighteen garments were made. Comparison was made of the original, dry cleaned only, and worn and dry cleaned fabrics.

It was found that the dimensional stability of both fabrics was excellent, although restorability to original dimension decreased with increased hours of wear. Wrinkle recovery was satisfactory throughout the study as rated by commercial standards. The gabardine was easily distorted, limp, and sleazy initially and throughout the study while the suiting maintained a smooth firm hand. The suiting fabric was initially stiff due to excess resin which was lost after one dry cleaning.

The above properties influenced ease of construction and appearance of the garments; the suiting being notably more satisfactory.

Greatest breaking strength loss occurred in all dresses at those areas where chemical deterioration, strain and abrasion were most evident, namely; at the underarm area and across the blouse back. It was at these areas that the widest range in results occurred and differences were attributed to variables among the wearers in size, activity, etc.

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LITERATURE CITED

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APPENDIX

TABLE V

COMPARISON OF SPECIFICATIONS OF ORIGINAL, DRYCLEANED ONLY, AND WORN AND DRYCLEANED FABRICS

Fabric	Times Dry Cleaned	Yarn Count				Weight		Thickness	
		Warp		Filling					
		Average	%Change	Average	%Change	Average[1]	%Change	Average[2]	%Change
Suiting									
Original	0	60.4		54.4		6.3752		.01852	
Dry-cleaned only	6					7.4256	↗16.48	.01902	↗ 2.69
Worn & dry-cleaned	6	59.76	-1.06	53.69	-1.31	6.312	- .99	.01626	-12.2
Gabardine									
Original	0	130.4		65		5.2247		.01598	
Dry-cleaned only	6					5.5396	↗ .60	.01690	↗ 4.96
Worn & dry-cleaned	6	128.88	-1.17	65.44	↗ .68	5.1161	- .21	.01528	- 4.38

1 Average weight per square yard in ounces
2 Average thickness in inches

TABLE VI

COMPARISON OF PERFORMANCE OF ORIGINAL, DRY CLEANED ONLY, AND WORN AND DRY CLEANED FABRICS

Fabric	No. of D.C.	Tensile Strength Dry				Elongation Dry			
		Warp		Filling		Warp		Filling	
		Ave.[1]	%Ch.[2]	Ave.	%Ch.	Ave.[3]	%Ch.[2]	Ave.	%Ch.
Suiting									
Original	0	63.33		37.16		22.77		16.85	
Dry-cleaned only	6	63.83	+ .79	34.25	-7.83	22.23	-2.37	14.22	-15.61
Worn & dry-cleaned	6	59.01	-6.82	35.11	-5.52	19.57	-14.05	15.25	- 9.5
Gabardine									
Original	0	86.83		39.67		26.77		15.45	
Dry-cleaned only	6	80.17	-7.67	39.67	0	25.17	-5.98	16.07	+ 4.01
Worn & dry-cleaned	6	75.31	-13.27	38.38	-3.25	23.66	-11.61	14.44	- 6.54

1 Average tensile strength in pounds based on 6 determinations
2 Percentage change from original
3 Average elongation in percent based on 6 determinations

TABLE VI Cont.

COMPARISON OF PERFORMANCE OF ORIGINAL, DRY CLEANED ONLY, AND WORN & DRY CLEANED FABRICS

Fabric	No. of D.C.	Wrinkle Recovery				Drapability Values	
		Warp		Filling			
		Ave.[1]	%Ch.[2]	Ave.	%Ch.	Mean[3]	%Ch.
Suiting							
Original	0	138.6		136.8		64.4	
Dry-cleaned only	6	138.6	0	137.0	-1.17	43.99	-31.68
Worn & dry-cleaned	6	123.16	-11.14	122.07	-10.77	46.95	-27.1
Gabardine							
Original	0	134.2		131.0		36.58	
Dry-cleaned only	6	140.2	∕4.46	135.4	∕3.36	31.8	-13.07
Worn & dry-cleaned	6	132.98	- .91	123.35	∕5.84	34.01	- 7.03

1 Average angle of recovery in degrees based on five determinations.
2 Percentage change from the original.
3 Geometric means of cord length (in mm.) of warp and filling based on average of three determinations each for warp and filling.

TABLE VII

FABRIC SPECIFICATIONS OF EACH WORN GARMENT

Fabric	Dress	Yarn Count				Weight in ounces		Thickness in inches	
		Warp		Filling					
		Ave.	%Ch.	Ave.	%Ch.	Ave.per sq.yd.	%Ch.	Ave.	%Ch.
Suiting	S_{14a}	59.8	- .99	53.9	- .92	6.164	- 3.31	.01648	-11.02
	S_{18b}	59.9	- .83	53.2	-2.21	6.4782	≠ 1.62	.01647	-11.07
	S_{18c}	59.6	-1.32	53.4	-1.84	6.2698	- 1.65	.01637	-11.61
	S_{14d}	59.3	-1.82	53.8	-1.1	6.3091	- 1.04	.01582	-14.58
	S_{16e}	60.1	- .5	53.8	-1.1	6.4568	≠ 1.28	.01631	-11.93
	S_{18f}	59.6	-1.32	54.0	- .74	6.2556	- 1.88	.01666	-10.04
	S_{14g}	59.7	-1.16	53.6	-1.47	6.4076	≠ .51	.01657	-10.53
	S_{14h}	59.6	-1.32	54.0	- .74	6.2289	- 2.17	.01610	-13.07
	S_{14i}	60.2	- .33	53.6	-1.47	6.2380	- 2.15	.01559	-15.82
Gabardine	S_{14a}	130.4	0	65.9	≠1.38	5.192	- .63	.01563	- 2.19
	S_{18b}	129.6	- .61	65.7	≠1.08	5.0713	- 2.94	.01495	- 6.45
	S_{18c}	128.9	-1.15	66.0	≠1.54	5.2151	- .18	.01508	- 5.63
	S_{14d}	128.9	-1.15	64.7	- .46	5.0078	- 4.15	.01494	- 6.51
	S_{16e}	128.4	-1.53	65.9	≠1.38	5.1271	- 1.87	.01594	- .25
	S_{18f}	129.2	- .92	65.9	≠1.38	5.1917	- .63	.01581	- 1.06
	S_{14g}	127.9	-1.92	65	0	5.1917	- .63	.01584	- .88
	S_{14h}	128.9	-1.15	65.3	≠ .46	5.0274	- 3.78	.01440	- 9.89
	S_{14i}	127.7	-2.07	64.7	- .46	5.0212	- 3.90	.01496	- 6.38

Average of all determinations taken at specified areas within each dress.

TABLE VIII

FABRIC SPECIFICATIONS AT SPECIFIED AREAS OF WORN GARMENTS

Fabric	Area Determination Taken	Yarn Count				Weight in grams	Thickness in inches	
		Warp		Filling				
		Ave.	%Ch.	Ave.	%Ch.		Ave.	%Ch.
Suiting								
	Sleeve	60.2	-.33	52.9	-2.76		.01545	-16.58
	Blouse							
	Side front	59.6	-1.32	53.2	-2.21	.55	.01634	-11.77
	Center "	60.6	± .33	53.8	-1.1		.01712	- 7.56
	Center back	60.1	- .5	53.0	-2.57	.55	.01562	-15.66
	Skirt							
	Center front							
	Right	58.6	-2.98	53.9	- .92		.01657	-10.53
	Left	59.6	-1.32	53.8	-1.1		.0163	-11.99
	Side front							
	Right					.55		
	Left					.56		
	Side back							
	Right	59.4	-1.66	54.1	- .55		.01642	-11.34
	Left	59.6	-1.32	54.1	- .55		.01622	-12.42
	Center back	60.1	- .5	54.4	0	.56	.01633	-11.83
Gabardine								
	Sleeve	129.8	- .46	65.3	± .46		.01438	-10.01
	Blouse							
	Side front	130.6	± .15	65.2	± .31	.45	.01523	- 4.69
	Center "	131.8	±1.07	66.7	±2.62		.01571	- 1.69
	Center back	127.0	-2.61	64.6	- .62	.44	.01515	- 5.19
	Skirt							
	Center front							
	Right	127.0	-2.61	66.2	±1.85		.01548	- 3.13
	Left	128.2	-1.69	66.2	±1.85		.01566	- 2.60
	Side front							
	Right					.45		
	Left					.45		
	Side back							
	Right	128.0	-1.84	65.3	± .46		.01522	- 4.8
	Left	127.3	-2.38	64.6	- .62		.01527	- 4.4
	Center back	130.2	- .15	64.9	- .15	.45	.01546	- 3.25

Average of nine dresses in each fabric group

TABLE IX

AVERAGE PERCENTAGE DIMENSIONAL CHANGE THROUGHOUT WEAR AND DRY CLEANING IN EACH DRESS

Fabric	Measurement	Dress								
		S_{14a}	S_{18b}	S_{18c}	S_{14d}	S_{16e}	S_{18f}	S_{14g}	S_{14h}	S_{14i}
Suiting	Horizontal									
	Bust level	.40	.86	.43	.74	- .17	.75	.41	.68	.28
	Waist level	.24	1.84	.68	.76	.24	.96	.02	.90	.84
	Hip level	.24	- .13	.91	- .88	.33	1.30	.30	- .42	.002
	Across back blouse	.34	-1.01	.54	- .08	-1.68	-1.23	-1.09	.80	- .11
	Linear									
	Blouse									
	Center front	.86	.07	- .32	2.42	1.22	0	- .29	1.23	.07
	Side front	-.42	.03	.29	.06	- .12	- .08	.53	1.31	.16
	Side	-.49	.43	.37	3.51	1.05	.13	.96	.48	.39
	Center back	.64	.10	.19	.62	.45	.59	.39	1.34	- .12
	Skirt									
	Side front	-.06	.30	.12	- .17	.03	- .60	- .43	- .42	- .64
	Side	-.63	- .62	- .87	- .47	- .47	- .30	- .57	- .68	- .83
	Side back	-.65	-.001	- .61	.05	- .80	- .65	- .33	- .48	- .53
	Center back	-.02	- .12	- .58	- .24	- .74	- .48	- .58	- .35	- .83
	Seam at back of pleat	-.13	.36	0	.08	- .07	- .84	.36	- .12	- .72
	Center front to indenture	.71	1.02	.62	2.14	1.02	.14	1.29	.98	- .07
	Pleat edge	-.28	- .21	.02	.22	.44	- .28	- .16	.30	- .22
Gabardine	Horizontal									
	Bust level	.32	-1.32	- .93	- .97	- .18	.01	.23	.01	.03
	Waist level	.14	.46	1.10	.40	- .09	.83	1.07	.34	1.13
	Hip level	.53	1.69	- .22	.42	1.07	-1.04	- .10	- .66	.10
	Across back blouse	-.61	- .26	- .73	- .07	- .27	- .34	- .24	-1.45	- .03
	Linear									
	Blouse									
	Center front	2.48	- .57	1.09	- .76	1.10	.08	- .08	- .49	.70
	Side front	.35	.27	1.40	- .60	.96	.05	- .10	- .60	- .84
	Side	.68	.07	.07	2.37	2.58	2.39	- .08	1.90	.91
	Center back	.09	1.49	1.08	.98	.75	1.25	.32	1.20	.22
	Skirt									
	Sidefront	-.45	- .29	-1.28	.04	- .22	- .86	- .76	- .76	.15
	Side	-.88	- .08	- .60	- .25	- .51	- .48	- .82	- .78	1.63
	Side back	-.45	- .05	- .53	- .35	- .58	- .18	- .71	.18	.54
	Center back	-.68	.66	- .79	- .63	- .70	- .40	- .13	0	- .55
	Seam at back of pleat	-.37	- .49	.46	.17	-1.30	-1.10	.16	-1.39	-1.05
	Center front to indenture	3.08	.52	- .22	.54	-1.73	2.80	.87	1.22	.39
	Pleat edge	-1.38	- .31	- .83	-1.05	-1.09	.76	- .27	-1.24	-1.25

Average of the percentage changes computed before and after six dry cleanings.

TABLE X

AVERAGE PER CENT DIMENSIONAL CHANGE IN THE SUITING DRESSES AT SPECIFIED AREAS

Measurement	Number of Dry Cleanings											
	Before 1	After 1	Before 2	After 2	Before 3	After 3	Before 4	After 4	Before 5	After 5	Before 6	After 6
Horizontal												
Bust level	.76	.27	.64	.50	.62	.08	.67	.35	.68	.54	.35	.36
Waist level	.20	.24	-.44	.59	.34	.38	.54	.86	.88	.97	1.12	2.09
Hip level	.47	-.04	.30	-.10	-.03	-.26	.13	.03	.16	.28	.57	.70
Across blouse back	-.04	-.08	-.33	-.12	-.93	-.31	-.60	-.46	-.20	-.43	-.09	-1.10
Linear												
Blouse												
Center front	-.09	.44	.54	.36	.40	.32	.62	.80	.43	1.03	.72	1.42
Side front	.26	-.27	.03	-.12	-.32	-.27	.01	.01	.36	.60	.66	1.40
Side	.004	-.08	.01	.70	.09	.37	1.08	.54	1.56	2.15	1.62	1.07
Center back	-.34	.13	.52	.21	.31	.48	.13	.60	.51	.66	1.06	1.05
Skirt												
Side front	-.05	-.03	-.03	.23	-.32	-.53	-.49	-.34	-.37	-.44	-.08	-.04
Side	-.14	-.46	-.28	-.40	-.67	-.86	-.62	-.73	-.71	-.85	-.35	-1.20
Side back	-.16	-.34	-.34	-.17	-.64	-.77	-.44	-.43	-.55	-.43	-.16	-.89
Center back	-.19	-.31	-.33	-.17	-.67	-.77	-.50	-.57	-.57	-.30	-.26	-.82
Seam at back of pleat	-.23	⁄.20	.14	.24	-.38	-.04	-.18	-.19	-.38	-.20	.03	-.43
Center front to indenture	⁄.47	⁄.58	1.08	.50	.40	.48	.80	.04	1.48	1.08	1.67	1.77
Pleat edge	-.37	⁄.38	.30	-.002	-.20	-.59	-.19	.13	-.12	.01	.06	.39

Average per cent change of nine dresses

TABLE XI

AVERAGE PER CENT DIMENSIONAL CHANGE IN THE GABARDINE DRESSES AT SPECIFIED AREAS

Measurement	Number of Dry Cleanings											
	Before 1	After 1	Before 2	After 2	Before 3	After 3	Before 4	After 4	Before 5	After 5	Before 6	After 6
Horizontal												
Bust level	- .19	- .26	- .49	- .43	.15	- .41	.19	- .42	- .31	- .88	- .42	- .27
Waist level	- .07	.59	.33	.42	.70	.29	.40	.83	.60	.75	1.00	1.31
Hip level	.36	.03	.59	- .12	.16	.09	.16	.24	- .10	.35	.23	.41
Across blouse back	- .09	- .46	- .27	- .63	- .40	- .55	- .28	- .68	- .64	- .46	- .38	- .46
Linear												
Blouse												
Center front	.01	.47	.22	.83	.15	.71	.23	.62	.13	.60	- .43	1.18
Side front	- .21	- .01	- .38	- .49	.04	.04	.13	.64	.34	.47	.17	.46
Side	.11	- .19	.38	.83	.40	1.61	1.83	2.13	1.70	2.52	1.59	1.61
Center back	- .26	.36	.71	.93	.62	.84	.75	.85	1.06	1.20	.98	1.84
Skirt												
Side front	.19	.01	- .57	- .52	- .68	- .39	- .76	- .61	- .90	- .70	- .84	- .11
Side	.13	- .13	- .36	- .43	- .46	- .46	- .81	- .25	- .33	- .40	- .11	- .10
Side back	- .08	- .33	- .43	- .24	- .35	- .14	- .38	.14	- .35	- .14	- .35	- .17
Center back	- .03	.03	- .43	- .45	- .75	- .21	- .74	.12	- .86	- .17	- .57	- .25
Seam at back of pleat	- .37	- .20	- .56	- .37	- .63	- .20	-1.21	- .65	-1.43	- .53	- .63	- .20
Center front to indenture	1.07	- .33	.91	- .14	1.02	1.15	.85	1.04	.47	1.30	.74	1.88
Pleat edge	- .77	- .23	-1.06	-1.09	- .80	-1.07	-1.20	- .92	-1.70	- .75	- .97	- .35
Average per cent change of nine dresses												

TABLE XII

TENSILE STRENGTH AND ELONGATION OF EACH WORN GARMENT

Fabric	Dress	Tensile Strength						Elongation			
		Warp			Filling			Warp		Filling	
		Ave.	Range	%Ch.	Ave.	Range	%Ch.	Ave.	%Ch.	Ave.	%Ch.
Suiting	S14a	60.4	10.95	- 4.63	35.7	3.97	-3.93	20.09	-11.77	15.63	- 7.24
	S18b	59.74	10.3	- 5.67	35.63	3.62	-4.12	19.75	-13.26	15.54	- 7.77
	S18c	58.57	10.6	- 7.52	35.39	3.32	-4.76	19.24	-15.5	15.03	-10.8
	S14d	61.26	8.77	- 3.27	35.17	7.5	-5.36	20.15	-11.51	14.39	-14.6
	S16e	58.41	18.1	- 7.77	35.35	4.78	-4.87	19.61	-13.88	15.39	- 8.66
	S18f	59.08	14.2	- 6.71	34.88	3.62	-6.14	20.21	-11.24	15.19	- 9.85
	S14g	57.38	10.95	- 9.4	34.12	4.13	-8.18	19.63	-13.79	15.69	- 6.88
	S14h	56.17	16.7	-11.31	34.76	2.9	-6.46	19.43	-14.67	15.47	- 8.19
	S14i	60.12	9.72	- 5.07	34.98	2.59	-5.87	18.0	-20.95	14.94	-11.34
Gabardine	S14a	72.58	24.42	-16.41	38.57	6.5	-2.77	23.08	-13.78	14.56	- 5.76
	S18b	75.73	19.9	-12.78	36.3	14.08	-8.5	23.73	-11.36	14.01	- 9.32
	S18c	71.75	26.33	-17.37	35.95	9.18	-9.38	23.25	-13.15	14.45	- 6.47
	S14d	77.9	15.5	-10.28	39.42	12.92	- .63	24.35	- 9.04	15.04	- 2.65
	S16e	74.75	19.35	-13.91	38.56	6.0	-2.8	24.58	- 8.18	14.51	- 6.08
	S18f	73.7	20.08	-15.12	39.28	9.25	- .98	22.95	-14.27	14.28	- 7.57
	S14g	77.05	24.42	-11.26	34.41	9.66	-13.26	24.37	- 8.97	14.85	- 3.88
	S14h	75.56	20.58	-12.98	38.1	7.58	-3.96	22.91	-14.42	13.58	-12.1
	S14i	78.79	28.33	- 9.29	39.86	6.25	+ .48	23.78	-11.17	14.64	- 5.24

Average of all determinations taken at specified areas within each dress

TABLE XIII

TENSILE STRENGTH AND ELONGATION AT SPECIFIED AREAS OF WORN GARMENTS

Fabric	Area Determinations Taken	Tensile Strength						Elongation			
		Warp			Filling			Warp		Filling	
		Ave.	Range	%Ch.	Ave.	Range	%Ch.	Ave.	%Ch.	Ave.	%Ch.
Suiting											
	Sleeve										
	Armscye section	59.66	9.	- 5.8	36.65	2.23	- 4.06	20.44	-10.23	15.96	-5.28
	Elbow section	60.09	6.3	- 5.2	36.33	3.9	- 2.23	20.05	-11.95	16.01	-4.98
	Blouse										
	Armscye section	50.96	10.3	-19.53	33.65	3.08	- 9.45	16.59	-26.7	14.52	-13.83
	Center back	60.89	7.12	- 3.85	33.42	5.25	-10.06	19.3	-15.24	14.16	-15.96
	Skirt front										
	Abdomen section	61.93	5.5	- 2.21	35.53	3.2	- 4.39	20.56	- 9.71	15.92	- 5.52
	Hemline section	57.77	8.83	- 8.78	35.74	2.	- 3.82	19.42	-14.71	15.26	- 9.44
	Skirt back										
	Side hip level	59.5	8.97	- 6.05	35.41	2.	- 4.71	20.08	-11.81	15.17	- 9.97
	Center hip level	61.3	4.92	- 3.21	35.14	2.67	- 5.44	20.09	-11.76	15.0	-10.97
Gabardine	Sleeve										
	Armscye section	72.2	12.08	-16.85	38.49	6.67	- 2.97	22.03	-17.7	13.86	-10.29
	Elbow section	70.84	23.84	-18.42	38.91	7.08	- 1.92	21.75	-18.75	14.01	- 9.32
	Blouse										
	Armscye section	61.28	11.75	-29.43	37.3	5.5	- 5.97	19.84	-25.89	14.08	- 8.87
	Center back	80.53	12.75	- 7.23	32.39	9.91	-18.35	24.88	- 7.06	12.86	-18.06
	Skirt front										
	Abdomen section	79.91	10.83	- 7.97	38.71	4.59	- 2.42	25.48	- 4.82	15.09	- 2.33
	Hemline section	77.16	10.59	-11.14	40.12	3.33	∤ 1.13	24.83	- 7.25	15.12	- 2.14
	Skirt back										
	Side hip level	80.06	6.43	- 7.8	40.31	4.68	∤ 1.61	25.31	- 5.45	14.93	- 3.37
	Center hip level	80.52	11.27	- 7.27	40.84	5.0	∤ 2.95	25.19	- 5.9	15.75	∤ 1.94

Average of nine dresses in each fabric group

TABLE XIV

WRINKLE RECOVERY AND DRAPABILITY VALUES
OF EACH WORN GARMENT

Fabric	Dress	Wrinkle Recovery				Drapability	
		Warp		Filling		Geometric Mean	
		Ave.	%Ch.	Ave.	%Ch.	Ave.	%Ch.
Suiting	S14a	119.8	-13.56	119.87	-12.38	46.7	-27.48
	S18b	121.87	-12.07	116.77	-14.64	50.07	-22.25
	S18c	122.8	-11.4	117.77	-13.91	49.05	-23.84
	S14d	121.97	-12.0	120.83	-11.67	48.32	-24.97
	S16e	123.33	-11.02	124.77	- 8.79	41.52	-35.53
	S18f	124.6	-10.1	127.33	- 6.92	47.04	-26.96
	S14g	120.07	-13.37	123.8	- 9.5	44.64	-30.68
	S14h	126.4	- 8.8	121.95	-10.86	48.92	-24.04
	S14i	127.6	- 7.94	125.5	- 8.26	46.31	-28.09
Gabardine	S14a	131.73	- 1.84	123.73	- 5.55	37.36	∕ 2.08
	S18b	131.03	-2.36	121.8	- 7.02	32.57	-10.96
	S18c	130.0	- 3.13	121.73	- 7.08	37.64	∕ 2.9
	S14d	132.97	- .92	121.0	- 7.63	33.29	- 8.99
	S16e	132.73	- 1.1	121.27	- 7.43	31.06	-15.09
	S18f	135.4	∕ .89	125.4	- 4.27	34.35	- 6.09
	S14g	132.4	- 1.39	118.8	- 9.31	31.75	-13.2
	S14h	135.02	∕ .61	122.4	- 6.56	33.47	- 8.5
	S14i	135.5	∕ .97	121.53	- 7.23	34.57	- 5.5

Average of all determinations taken at specified areas within each dress

TABLE XV

WRINKLE RECOVERY AND DRAPABILITY VALUES
AT SPECIFIED AREAS OF WORN GARMENTS

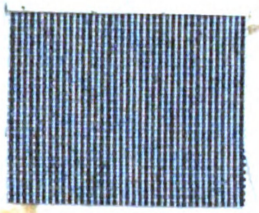
Fabric	Area Determination Taken	Wrinkle Recovery				Drapability
		Warp		Filling		
		Ave.	%Ch.	Ave.	%Ch.	
Suiting						
	Sleeve	119.02	-14.13	110.56	-19.18	44.98
	Blouse					
	Sidefront	123.4	-10.97	123.17	- 9.96	47.35
	Center back	122.71	-11.46	120.89	-11.63	48.39
	Skirt					
	Center front	123.67	-10.77	124.82	- 8.75	34.2
	Side back	125.62	- 9.38	127.44	- 6.86	
	Center back	124.53	-10.15	125.51	- 8.25	
Gabardine						
	Sleeve	133.11	- .81	105.53	-19.44	
	Blouse					
	Side front	133.04	- .86	132.67	- 1.27	
	Center back	133.18	- .77	124.36	- 5.07	
	Skirt					
	Center front	131.13	- 2.28	126.51	- 3.43	34.13
	Side back	133.91	- .22	125.62	- 4.11	31.75
	Center back	133.51	- .59	125.38	- 4.29	

Average of nine dresses in each fabric group

PLATE II

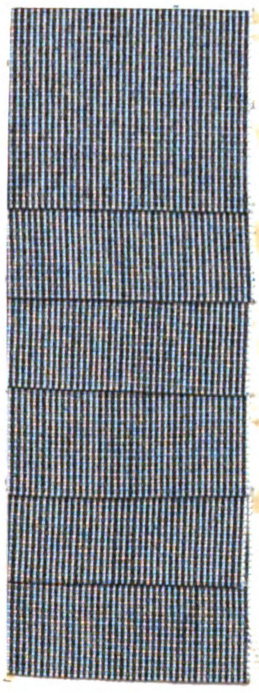
Dress Fabrics

Suiting



Gabardine

After Drycleaning



2

4

6

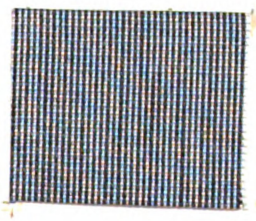
10

15

20

After Drycleaning

Worn 360 Hours



6

Worn 360 Hours

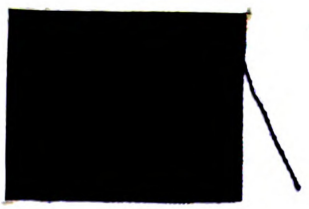
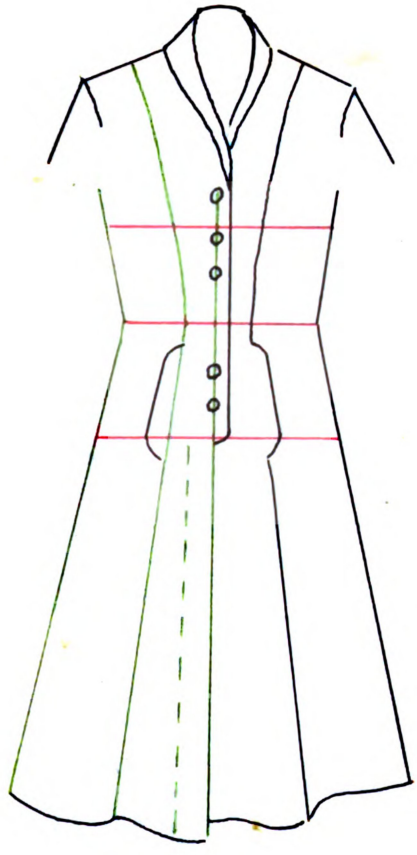
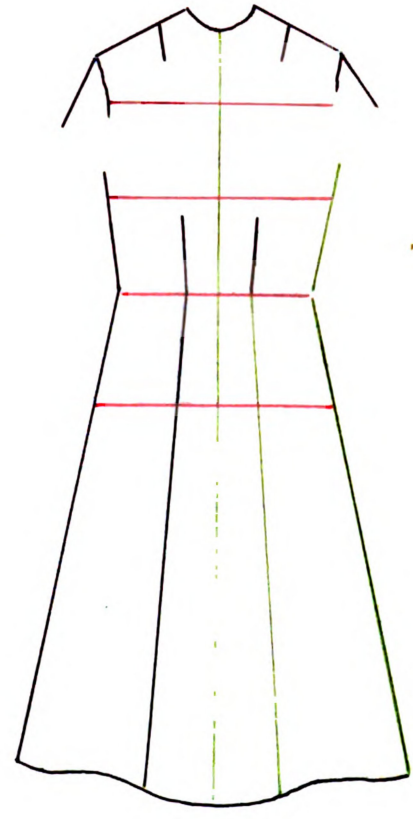


PLATE III



Front View



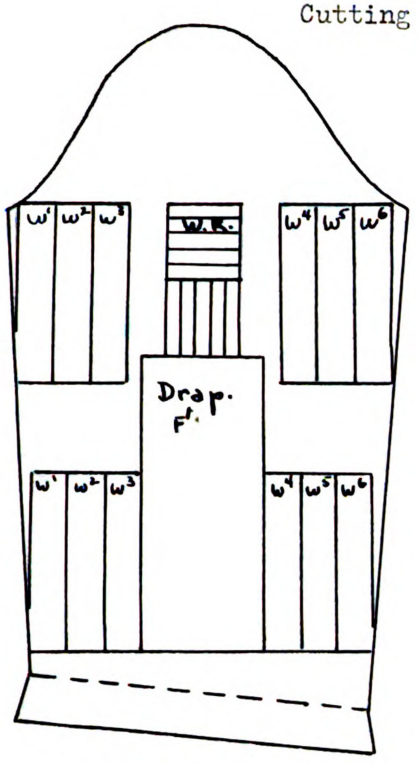
Back View

Indicate location for width measurements

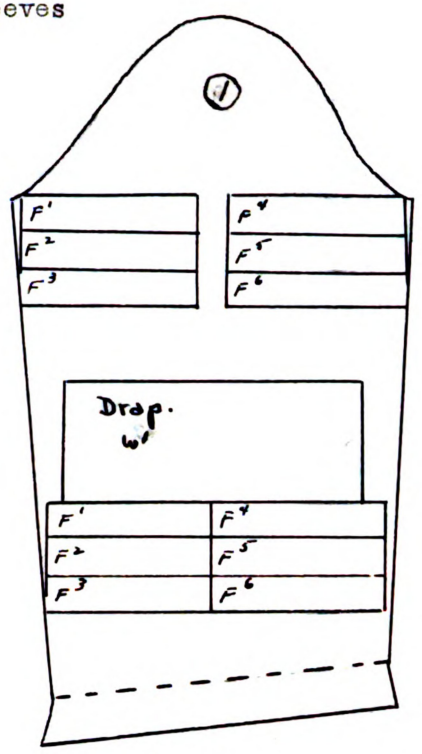
Indicate location for linear measurements

PLATE IV

Cutting Chart for Sleeves



Left Sleeve

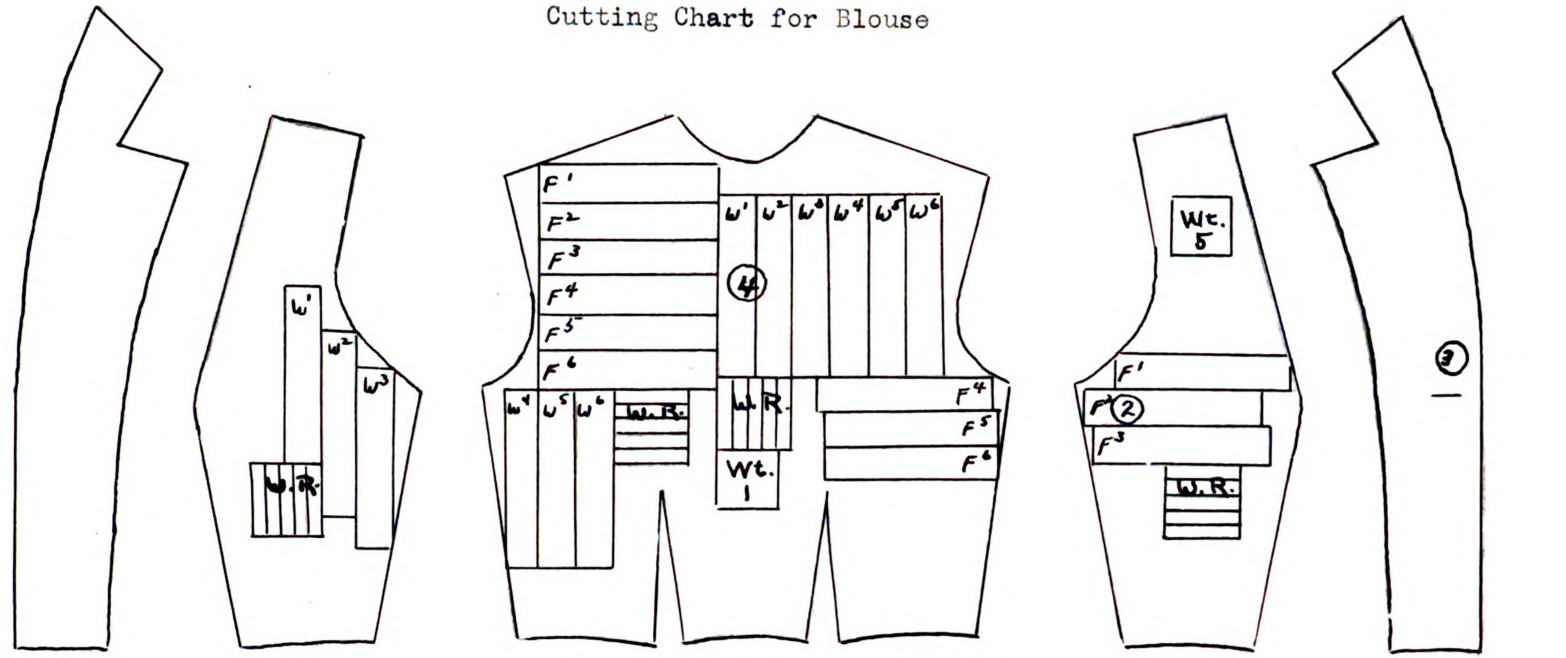


Right Sleeve

W = warp breaking strength
F = filling breaking strength
O = thickness
wt. = weight
W.R. = wrinkle recovery
Drap. = drapability

PLATE V

Cutting Chart for Blouse

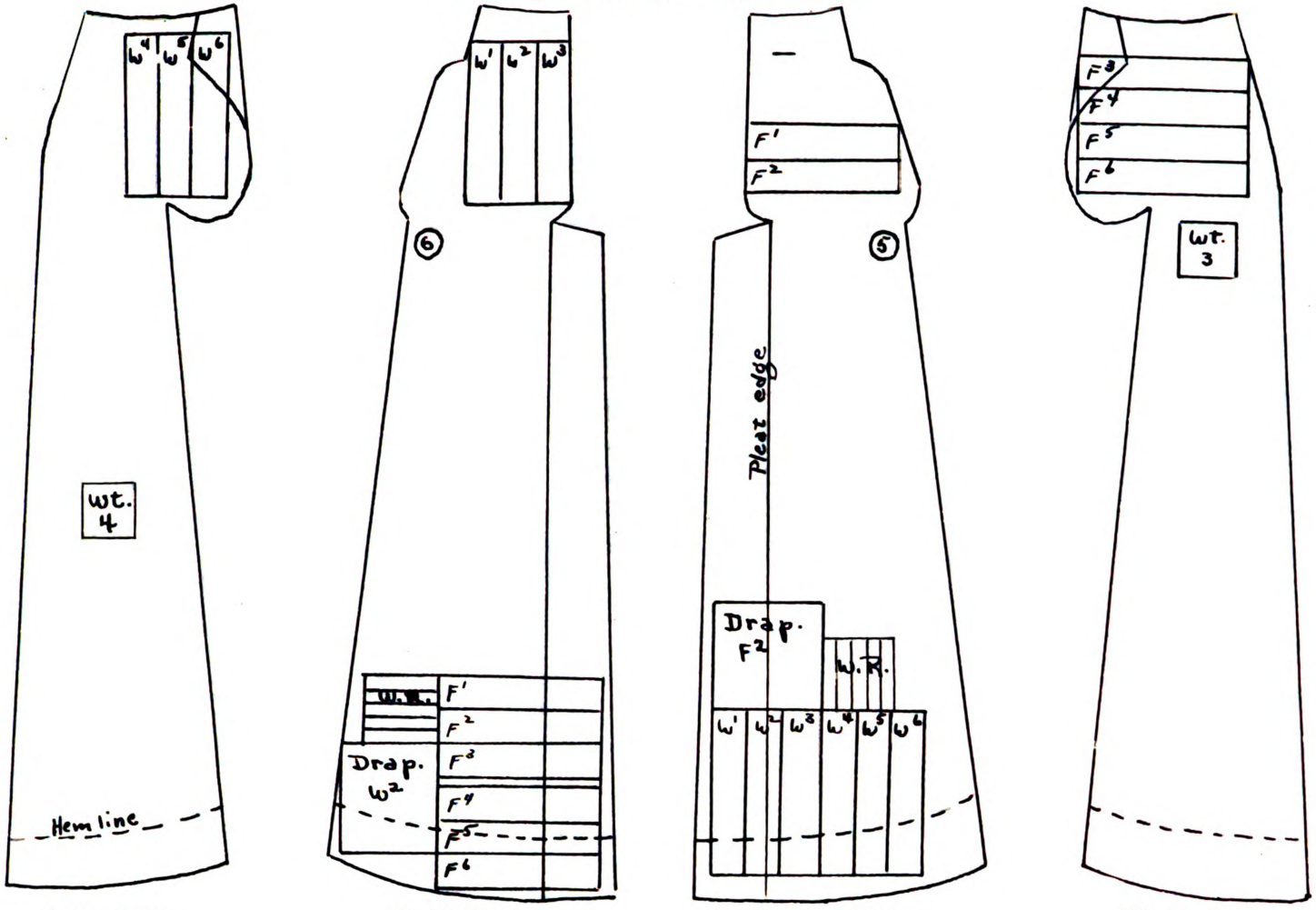


Left Center Front | Left Side Front | Center Back | Right Side Front | Right Center Front

w = warp breaking strength
F = filling breaking strength
O = thickness
wt. = weight
W.R. = wrinkle recovery
Drap. = drapability

PLATE VI

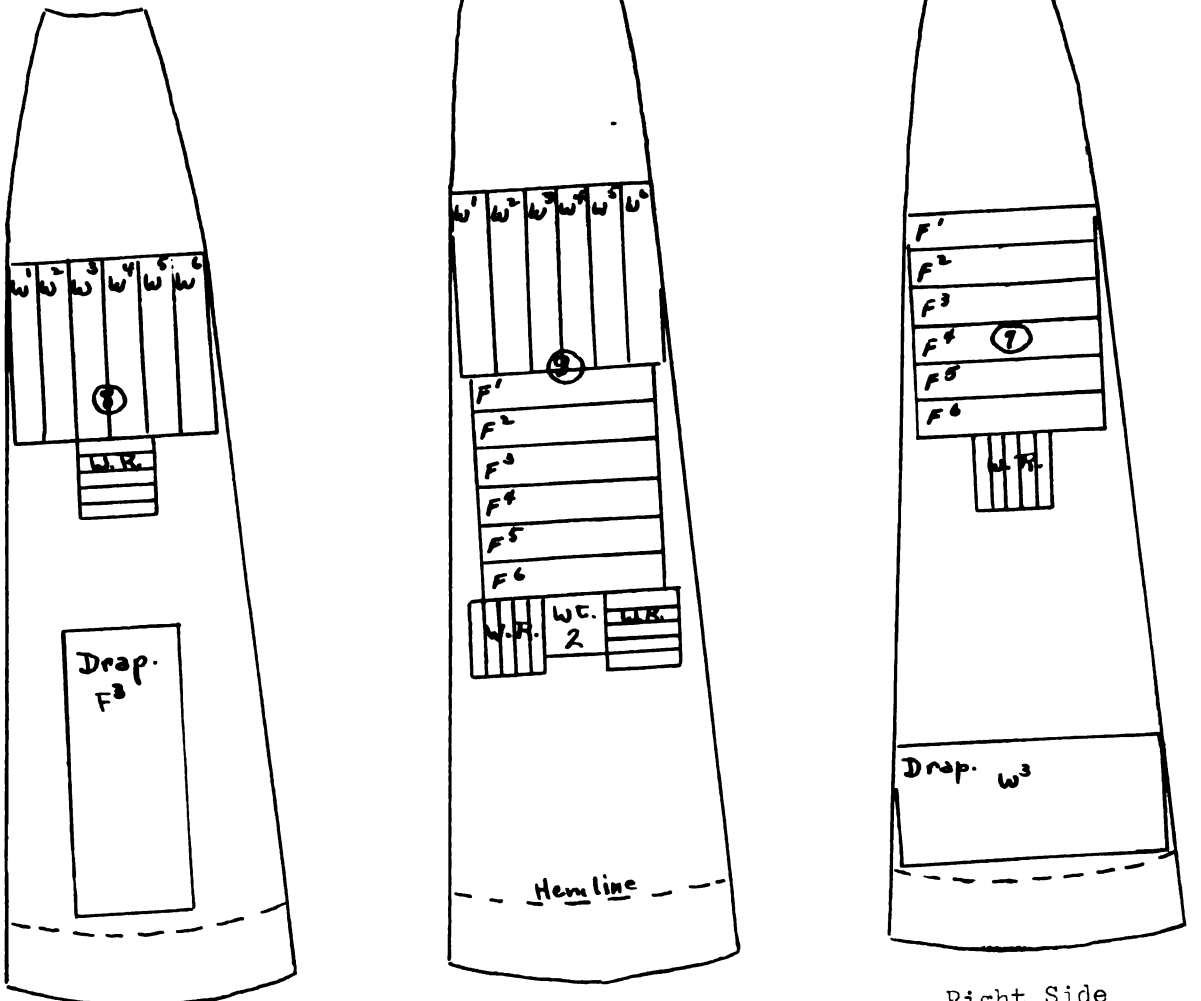
Cutting Chart for Skirt Front



Left Side | Left Center | Right Center | Right Side

PLATE VII

Cutting Chart for Skirt Back



Left Side

Center Back

Right Side

INSTRUCTIONS TO COOPERATOR OUTLINED

A. Purpose and objectives of study - You are participating in a study that has been designed to evaluate the reliability of laboratory testing as predictive of fabric performance during normal use and care. Without your cooperation this study could not be carried on. You and the records you are asked to keep are very important to this project.

B. Requirements of cooperators

1. Wear garments
2. Return dresses for inspection and dry cleaning at specified intervals.
3. Keep records
   a. How to fill out wear record
   b. Importance of keeping them accurately

C. Specific instructions concerning care of garments by cooperators

1. Pressing - with cool iron on wrong side
2. Spot and stain removal
   a. Start when stain is fresh
   b. Use cool water or, in case of grease or ink stains, an absorbent powder such as - corn meal, chalk, talcum powder, or cornstarch.
   c. Stains of unknown origin had best be left to the commercial cleaner or bring the garment to the textile laboratory. Improper treatment may set certain stains (6).

D. Expression of (1.) appreciation to cooperators for part in the study and (2.) desire that cooperators enjoy taking part in study.

WEAR RECORD KEPT BY COOPERATOR

Return to H. Osuch - Rm. 202

9/50

Project 329 - D

CODE _____

DRESS NUMBER _____

WEAR PERIOD _____

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Hours worn (AM-PM)						
Total hours worn						
Cumulative total hours						
Activity during wear						
General appearance - Wrinkled slightly						
Wrinkled moderately						
Wrinkled badly						
Was it necessary to press before wearing?						
Any stains? Kind						
Treatment						
Any rips, tears, etc.? Seams						
Hems						
Other						
COMMENTS:						

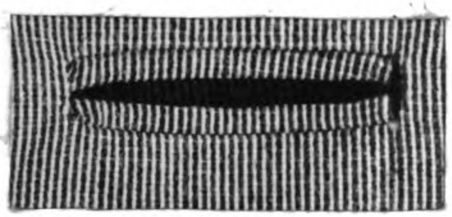
Investigator's Record Sheet

Code No.
Dress No.
Wearer's Name

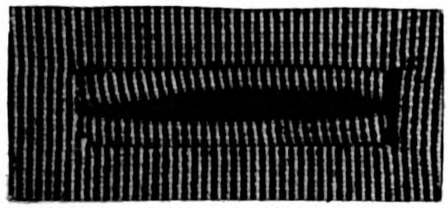
Inclusive Dates of Wear Periods	Wear Period Completed	Total Hours Worn	Total Dry Cleanings To date	Observations made during inspection	
				Before dry cleaning	After dry cleaning

Plate VIII - Dress of the suiting fabric before 360 hours of wear and six dry cleanings.

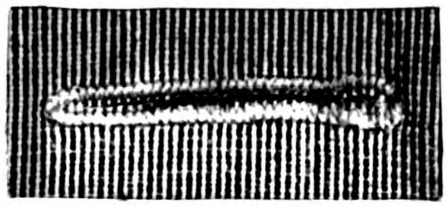
Plate IX - Dress of the suiting fabric after 360 hours of wear and six dry cleanings.



Bound



Piped



Machine Made

Plate X - Types of buttonholes used. Photographs taken of unworn dresses of the suiting fabric.

Plate XI - Effect of 360 hours wear and six dry cleanings on buttonholes of the suiting garments. From left to right are machine made, piped, and bound buttonholes.

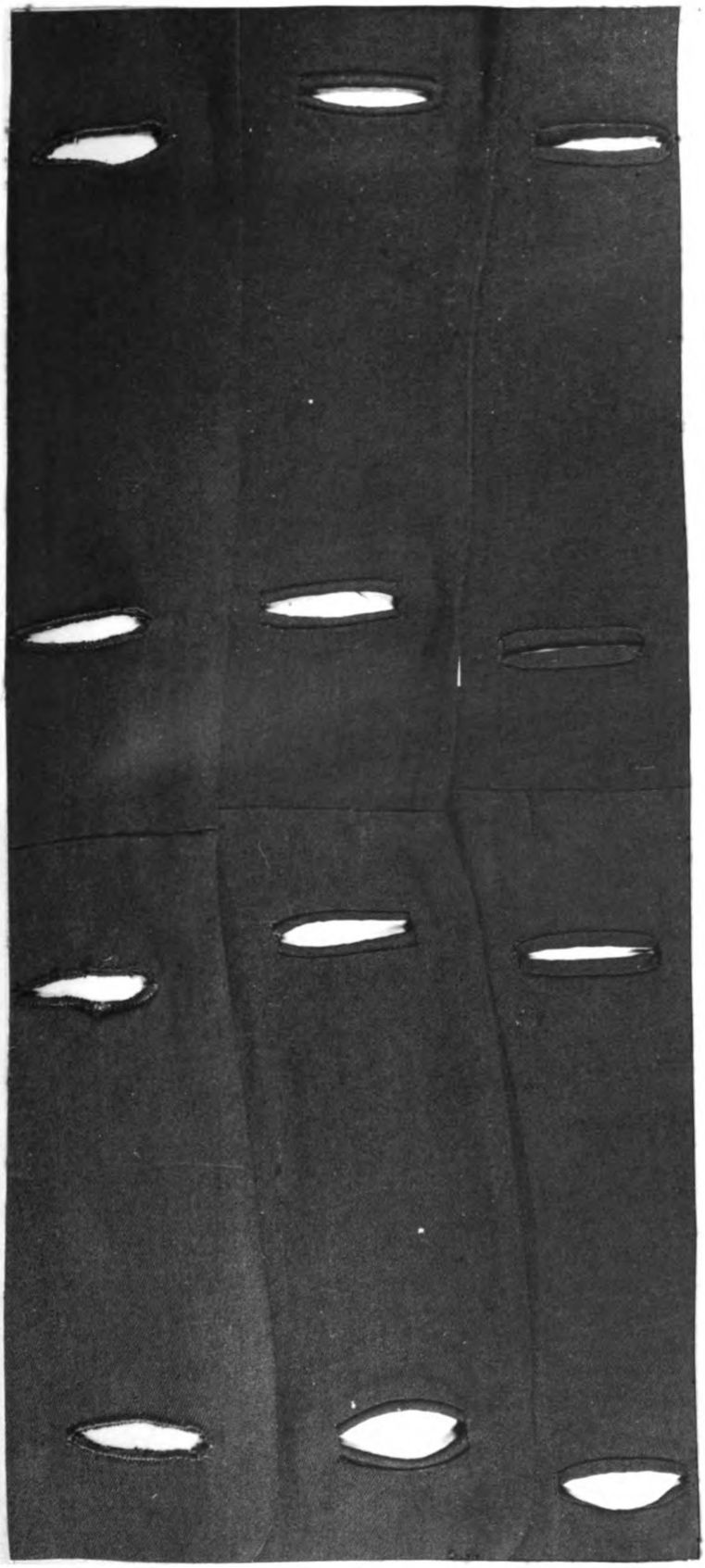


Plate XII - Effect of 360 hours wear and six dry cleanings on buttonholes of the gabardine garments. From left to right are machine made, piped and bound buttonholes.

Plate XIII - Overcast, seam taped, and pinked and stitched armscyes of the gabardine dresses showing effect of 360 hours wear and six dry cleanings.

Plate XIV - Gabardine fabric deterioration at under arm at termination of 360 hours wear and six dry cleanings.

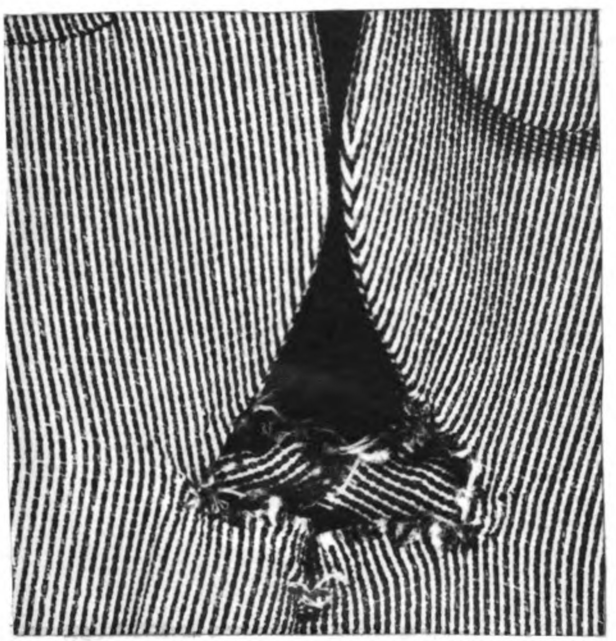


Plate XV - Frayage in garment of the suiting at the bottom of the front opening at termination of 360 hours wear and six dry cleanings.