A COMPARATIVE STUDY OF FOUR BRANDS OF WOMEN'S RAYON WOVEN SLIPS OF COMPARABLE PRICE

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194[illegible]

THESIS

TABLE OF CONTENTS

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I. Introduction

Throughout the four years of war the scarcity of consumer staple textiles became increasingly acute. Cotton and wool, at the beginning of the war practically disappeared from the consumer's market, while rayon, perhaps because it is a man-made fiber, remained plentiful. However, this situation was of short duration, as the armed forces and other governmental agencies had priority to all the rayon. This resulted in curtailment, as well as a lowering of quality in finished consumer goods made of rayon.

Originally, this study was planned as a comparative study of six known brands of similarly priced women's woven rayon slips. However, the effect of wartime conditions and limitations of supply made it necessary to confine the study to four brands, two of which were unlabeled.

The main purpose of the study was first, to compare the four brands of slips for fabric serviceability as predicted by laboratory tests before and after laundering; second, to compare other factors of consumer satisfaction in use by an analysis of style, fit, workmanship, and dimensional change due to laundering; and third, to determine the consistency of sizing between and within the brands. As it was necessary to include two unlabeled brands in the study, a fourth objective was to determine whether there was the same consistency in quality and sizing in the unlabeled brands as in the labeled brands.

Due to limitations of time and availability of slips on the market, this study was limited to laboratory analyses, and the effects of laundering on these service qualities. However, laundering is only one factor to be considered in the durability of a slip. Lack of serviceability may also be attributed to the combined effect of [illegible] body strain on the fabric. For a more [illegible] of the amount of service in a garment it would be necessary, in conjunction with laboratory analyses, to carry out a serviceability study in which the fabric is subjected to normal use.

Analysis of the results of the laboratory tests on the fabrics, dimensional changes due to laundering, together with the factors of style, fit, and workmanship should indicate the comparative wearing quality of the slips and the average of the service to be expected of them. As there are no minimum specifications to date for rayon lingerie, the results of this study may offer some aid in establishing such specifications. By comparison with similar studies carried on before or shortly after the beginning of the war, it should be possible to determine whether the quality of rayon fabrics for consumer use was lowered during the war years.

II. Review of Literature

In the survey of available literature concerning woven rayon fabrics, several studies relating to the service qualities of rayon fabrics were reviewed. Platt[11] tested certain all-silk, all-rayon and silk and rayon mixed fabrics before and after laundering. Eight fabrics were used in this study. These fabrics were of similar appearance, handle, and weight, and resembled those of which ready-made slips were made. She found that the breaking strength of the fabrics tested increased in direct proportion to the number of threads per inch and that there was a tendency for all yarns to have a lower breaking strength after ten launderings, while all breaking strengths definitely decreased after twenty launderings.

An interesting study was carried on in 1944 by the Bureau of Human Nutrition and Home Economics in cooperation with research workers at several of the Agricultural Experiment Stations[illegible]. Mrs. Morrison and Mr. Fletcher of the Bureau were in charge of the project. This study showed how essential fabrics were down-graded during the war and how great is the need for minimum specifications for staple textiles. Included in the study were five types of commonly used rayon fabrics. In shopping for these materials the cooperators found that rayons were generally more plentiful and more comparable to pre-war fabrics than were the cottons and wools; that the type and fiber content of many fabrics were inaccurately represented by salespeople. In fact, many materials sold as "all rayon" proved to be part or wholly cotton. The rayon crepes included in this study were light weight fabrics of the type used for lingerie and often called French or multi-filament crepe. Except for one fabric, all materials in this group were true crepes, that is, they had highly twisted filling yarns and slightly twisted warp yarns. These true crepes were found to have from two and one-half to three times as many warp as filling yarns. The thread count of the best quality crepes varied from 12[illegible] to 1[illegible]0 yarns per inch in the warp and from [illegible] to 1[illegible] yarns to the inch in the filling. The poorest quality fabrics ranged in count from 92 to 1[illegible] and [illegible] to 100 yarns per inch warpwise and fillingwise, respectively. The breaking strengths of these fabrics ranged from 17 to [illegible] pounds in the warp and from [illegible] to [illegible] pounds in the filling. When wet, the breaking strengths of all crepes were found to be roughly one-half to two-thirds that of the dry fabric.

[illegible][12] concluded from her study of viscose rayon fabrics that, as the number of yarns in the warp direction of fabrics of this type is increased, shrinkage increases and the dry breaking strength in the filling direction decreases. Similarly, as the number of yarns in the filling direction is increased, the wet and dry breaking strength in the warp decreases; but the shrinkage in the warp, and to a lesser degree in the filling direction, increases. This study showed that as coarser yarns are used in the warp direction, the breaking strength, both wet and dry, increases. Likewise, as the denier in the filling direction increases, the breaking strength of the filling tends to be greater. This same relationship was found to be true in regard to filament count. As the number of filaments increased in either the warp or filling, the breaking strength in that direction is increased. Tait[13] found the same relationship between tensile strength and filament count.

Williams[15] reported that the loss in strength of rayon fabrics when wet [illegible] commonly vary from 40 to [illegible] percent and it may exceed the limits of [illegible] and [illegible] percent. [illegible][illegible] found this to be true in her study as she reported a loss in wet strength in amounts varying from approximately 45 to [illegible] percent in the warp and from [illegible] to [illegible] percent in the filling. The acetate warp yarns tended to have a lower percentage loss when wet than the viscose warp.

Lyle and [illegible][illegible] carried on a study to determine whether or not breaking strength of a rayon fabric is affected adversely by wringing it during a laundry operation, as opposed to the gentle squeezing methods which have been recommended for rayon fabrics. From this study, they found that the breaking strength results were closely similar, whether the fabric was squeezed gently or wrung during hand washings. They stated that dry and wet strengths of rayon should unquestionably be taken into consideration in any washing instructions, but notwithstanding, the results of this study indicate that it may not be necessary to include in hand-washing instructions for rayons the invariable direction that rayon fabric be squeezed gently as a means of removing the water.

The amount of shrinkage or stretching of rayon fabrics resulting from laundering is perhaps one of the greatest factors of dissatisfaction from the consumer's standpoint. In a [illegible] survey[10] it was found that dimensional change of rayon fabrics has more attention of [illegible] technicians than any other phase of fabric development at this time. This is due to the wide variance obtained when testing rayon fabrics for dimensional change. Morrison and Fletcher[illegible] reported a shrinkage of [illegible] percent in length of the rayon crepes included in their study; also that all rayon fabrics stretched a great deal, wet or dry, but [illegible] in the wet condition. Likewise, [illegible][11] found an average shrinkage of approximately 10 percent in all rayon crepes studied. [illegible][illegible] reported a noticeable variation in the amount of shrinkage of the different rayon fabrics in her study. The shrinkage in the warp varied from 3 to 11 percent while the filling shrinkage ranged from 0.8 to 2.4 percent; one fabric in the study stretching 1.7 percent. Rosebery[13] in her study on the relationship between construction and durability of viscose rayon fabrics concluded that an increase in twist in the filling yarns is associated with an increase in the shrinkage of the rayon fabric in both directions.

Pre-shrinkage of rayon fabrics has been and still is quite a problem for textile manufacturers. Many of the fabrics are not stable and cannot be preshrunk like cotton by wetting but must be treated with chemicals. Textile World[illegible] reports a new development which will stabilize knitted or woven rayon fabrics without preshrinking. In this process, the fabric is padded with an alkali-soluble, water-insoluble cellulose ether which is coagulated on the cloth while the fabric is maintained at the desired dimensions. It forms a tough film around each fiber and tends to fix the position of the yarns and fibers in the fabric, and in that way stabilizes it to size.

Morrison and Fletcher[7], as well as Lamer[illegible], reported a very small amount of sizing in the rayons studied, with a range of from 0 to 0.5 percent. Lamer stated that there seemed to be no agreement between the amount of sizing used and the serviceability of the garment. The slip rendering the least service and the one giving the most satisfactory wear had the least amounts.

From Lamer's[5] study of the serviceability of certain ready-made rayon garments, she concluded that a slip of all viscose gives better service than one of viscose and acetate; also that the higher the thread count and the more nearly balanced are the warp and filling yarns in viscose fabrics, the greater the service which may be expected from the slip.

It is interesting to note that this same conclusion was made by Thi[illegible](13) in his study of the abrasion resistance of rayon linings. He states that from the standpoint of wearing qualities in lining materials made of different types of yarns, the all-viscose fabrics are superior to acetate and viscose combinations and these, in turn, are superior to all acetate constructions. In this same study of 1100 lining fabrics some interesting observations were made. The most noticeable point, upon examination of abraded samples was, that no matter what the weave or yarn size relationship between warp and filling, the warp yarn always wore out first. This was even true on fabrics that had a greater number of filling yarns per inch than the warp. This fact was also found to be true upon examination of worn garments. It was also found that filling yarns play a very minor role in their effect on abrasion resistance; and changes of yarn size and type had no effect if these changes were confined to the filling. This study showed, too, that the number of filling yarns had little effect on abrasion resistance until the number reached such a proportion that it dominated the fabric. Further experimentation in this same study, revealed that as twist was increased in the warp yarns, an appreciable amount of resistance to abrasion resulted.

In reviewing these various studies carried on in the past few years, it is interesting to observe that many of their findings are closely comparable. Consequently, this gives a fairly clear picture of the reactions of typical rayon fabrics to physical testing procedures.

III. MATERIALS AND METHODS

The original plan for this study was to secure four brands of rayon woven slips of similar construction, style, color and price. After surveying the local stores, it was found that the supply and variety of rayon slips was very limited. Although an effort was made to adhere to the original plan, the types of garments available made it necessary to purchase brands of different construction, style, and color within a price range of [illegible] to [illegible].

Thirty-six woven rayon slips (three each in sizes 34, [illegible], and [illegible] in the four different brands) were finally secured through the cooperation of two local stores in Lansing, Michigan. Because of the limited supply, it was necessary to buy two unlabeled brands made by two prominent city manufacturers. While they were not of sub-standard quality the lingerie buyer indicated that perhaps they did not meet the usual specifications of that manufacturer and had been placed on the market to ease the current shortage.

Brands A, C, and D were of crepe construction, except for one slip in brand C which was used as a control for measurements only. Brand B was a satin fabric. Brands A and D were both tailored in design with four-gore bias skirts. Brand A had a double bodice in both front and back, while brand D had a double bodice in front but only a single bodice in back. Brands C and B were identified with the manufacturer's trade name. The label carried the brand name, fiber content, and size. An informative tag was attached to brand D slips stating the feature points of the slip, but no specifications concerning the physical properties of the fabrics were ribbon on top of the slips. Brand C was designed with a four-gore alternating bias-cut skirt, with double bodice in both front and back. Brand D was cut with a two-gore bias skirt, with a single yoke in front and back. The front yoke was lace-trimmed. (See plates in Appendix for design of the garments used in this study). At the time of purchase, only white was available in Brand C, while in Brand D half were available in white and half in pink. Brands A and B were tearose in color. All four brands were made with lapped seams and pinked edge. Lockstitching was used on Brands C and D, and plain stitching on A and B. All slips in the study had double stitched hems.

Within each brand, one slip in each size was kept as a control, and the remaining six slips in each group carried through the launderings and physical testing. (See plates 1-4 in Appendix for samples of the slip fabrics when new, after the tenth, twentieth, and thirtieth launderings).

Design and Workmanship. A study of the design and workmanship of each brand was made in an effort to compare their relative merit in construction and fit. The slips were first placed on a form padded to standard size (34, 36, and 38), and the fit, evenness of hemline, and distance from floor were observed and checked for comparison. For a more complete and informative analysis for fit, models in sizes 34, 36, and 38 tried on the slips. Observations of their fit on the models in both a standing and sitting position, were made and recorded. For design and construction features of the four groups of slips see Table 1, page 1[illegible].

Fabric Analysis. Although all slips in this study were rayon, it was necessary to determine what types of rayon were used as this would influence the

Table 1

Cost, Design and Construction Features
of Four Brands of Rayon Slips

Brand	A	B	C	D
Cost per Slip	$1.9[illegible]	$2.00	[illegible].00	$1.[illegible]0
Style	4-gore Bias-cut	4-gore Bias-cut	4-gore Bias-cut	4-gore Bias-cut
Weave	Plain	Satin	Plain	Plain
Fiber: Warp	Acetate	Acetate	Acetate	Acetate
Filling	Viscose	Acetate	Cuprammonium	Viscose
Straps	Adjustable	Adjustable	Non-adjustable	Adjustable
Seams: Kind	Lapped	Lapped	Lapped	Lapped
Finish	Pinked	Pinked	Pinked	Pinked
Stitching	Plain	Plain	Lock	Lock
Hem	Double Stitched	Double Stitched	Double Stitched	Double Stitched
Label	No label Size	No label Size	Brand name Fiber Size	Brand name Fiber Size
Tag	Identification number. OPA ceiling	Identification number. OPA ceiling Style No.	None	Identification number. OPA ceiling Style No. 3 [illegible] points of the slip

calculations in determination of the weight per square yard. The fibers were first examined microscopically and conclusions were confirmed by the acetone test. Texchrome, a dye product which produces characteristic colors when applied to fibers of different composition, was used for identification of cuprammonium.

The number of yarns per inch was determined by following the procedure accepted by A.S.T.M. Committee D-13 on Textile Materials.[2] A micrometer was used to count the number of warp yarns in one inch at five different places in the slip, so that as not to include the same set of yarns. The same procedure was followed for the filling yarns. From these five counts the average number of yarns per inch was calculated. Since there were no selvedges on the fabrics by which the direction of warp and filling could be ascertained, it was assumed that the higher count indicated the warp and the lower count the filling. A yarn count was made on all slips, when new, and again after the tenth, and twentieth launderings.

The weight per square yard for each slip fabric when new, after the tenth, and twentieth launderings was determined in accordance with A.S.T.M. Committee D-13 on Textile Materials[2]. Four two-inch samples of each fabric were cut from various locations in the slip. These were dried to bone-dry weight in a conditioning oven and then weighed on an analytical balance. The percent of regain was calculated and the corrected weight in grams obtained. The following formula recommended by Lomax[7] was used to put in the weight per square yard in ounces:

$$\frac{45.71 \times \text{grams}}{\text{area in inches}} = \text{ounces per square yard}$$

<u>Yarn Analysis</u>. In counting the filaments per yarn, the yarn was placed on a

piece of the velvet cloth and the filaments separated carefully with two pins in order to obtain the filaments in their [illegible] form. These counts in warp and filling respectively, were made. After counting the filaments and determining the denier size, a check was made by referring to a filament-denier table(10) to see if such a filament count in such a denier size is manufactured.

The denier of the yarn used in the fabric samples was obtained by weighing a [illegible] cm. length of yarn on a [illegible] Yarn and Cloth Balance. The denier was read directly from the balance. This gave the number of unit weights of 0.[illegible] in [illegible] meters of yarn. Three determinations for warp and filling respectively were made. In making the denier determination on crepe yarn, the denier length which is obtained is based upon the yarn after contraction due to twisting. The denier size thus calculated is not the true size because denier should be expressed on the yarn length before contracting. In order to obtain the correct denier, the percentage of take-up due to twisting had to be determined. The method and formula used for correcting denier size was that recommended by the J. S. [illegible] Company(4). This formula is as follows:

$$\frac{\text{Weight of sample} \times [\text{illegible}]}{\text{Corrected length } \dfrac{(\text{original length})}{(100 - \%\text{ of elongation})}} = \text{corrected denier}$$

This correction was made only on the crepe filling yarns of three brands as the warp yarns did not have enough twist in them for elongation to be recorded. In the satin fabric neither warp nor filling had sufficient twist for calculations to be made.

The twist of both warp and filling yarns, when present, was determined on a Suter Twist Counter, according to the method used by Platt(11). A ten-inch length was inserted in the tester and untwisted and then retwisted in the opposite direction until it broke. The number of turns necessary for breaking was recorded. Another ten-inch length was inserted and twisted until it broke. The number of turns necessary for breaking was recorded. Another ten-inch length was inserted and twisted until it broke. The number of turns used here was recorded. From these two recordings, the yarn twist was calculated by the following formula:

$$N_1 - N_2 = 2T$$

and

$$t = \frac{T}{l} = \frac{N_1 - N_2}{2l}$$

in which:

N_2 = number of turns to twist to rupture.

N_1 = number of turns to untwist and retwist to rupture.

T = total number of turns in yarns.

t = turns per inch.

l = length of yarn used.

An average of ten determinations was used in reporting the number of twists per inch of warp and filling yarns of each slip fabric.

<u>Measurements</u>. For purposes of size comparison within a brand, between brands and the change due to laundering and ironing, three horizontal (bust, waist, and hip) and nine vertical (center front, center back, sides, and front right and left gore positions) measurements were taken on each slip in the study. (See slip sketches in Appendix for positions of measurings). Measurements of these same points were taken after each laundering through the fifth and again at the tenth, fifteenth, and twentieth launderings.

In order [illegible] time, each slip in the [illegible] placed [illegible] straightened [illegible]. [illegible], [illegible] tracing line was [illegible] of [illegible], [illegible], and [illegible]. After removing from the form, the [illegible] center [illegible], [illegible], [illegible] uneven beating.

[illegible] from [illegible] to [illegible] slips [illegible] the form. [illegible] to [illegible] the [illegible].

In [illegible] the horizontal and vertical [illegible], [illegible] over [illegible], [illegible] in any direction, [illegible] to the [illegible] .1 of an inch. All slips, [illegible] measured in this manner.

[illegible]. In order to [illegible] for [illegible] testing, [illegible] of [illegible] (from [illegible]) [illegible] of one-fourth inch to the form. [illegible] grams. (See [illegible] in appendix). [illegible] the [illegible] slips [illegible] of [illegible] 1" x 3" [illegible] and filling strength, respectively. The specimens, whenever possible, [illegible]" in length [illegible] 1" [illegible] for [illegible] the warp and filling [illegible], respectively. [illegible], the [illegible] strips were [illegible] for [illegible] used for [illegible]. The [illegible], [illegible]" x [illegible]", and five [illegible] 1" x 1" were [illegible] in the slips. [illegible].

[illegible]

[illegible]. [illegible], [illegible](1), [illegible]. [illegible] each, 1½" x 6" [illegible] from the slips for testing [illegible]; [illegible] respectively; [illegible] and the other [illegible] with longer dimension [illegible] the milling [illegible]. [illegible] the specimens [illegible] milling [illegible] parallel to [illegible].

The specimens, in the dry state, were tested after they had been at room temperature for two hours. The wet breaking strength of the slips was determined, after the strips had been immersed in tap water at room temperature for two hours. The specimens were removed, blotted, and tested within one minute after removal from the water. [illegible] the facilities of conditioning room, it was impossible to maintain the standard conditions of 50 degrees relative humidity and temperature of 70 degrees F. The temperature and relative humidity readings were recorded at the time of each testing. The temperature ranged from 7[illegible] degrees F. to [illegible] degrees F., while the relative humidity range was from 41 percent to 47 percent.

The specimens were placed in the clamps of the machine with the longer dimensions parallel to and the shorter dimensions at right angles to the direction of application of the load, [illegible] the [illegible] grams in both clamps. An average of the [illegible] was taken as the average number of pounds necessary to break the fabric.

Abrasion. In testing these four types of slip fabrics for comparison in resistance to abrasion, the committee [illegible] the need of running two sets of specimens; one set to a point at which the material is judged to show first signs of [illegible] and the second set to complete failure of the material.[illegible]

Colorfastness to Laundering. Visual examination and comparison of the laundered slips with the controls was made after the first, fifth, tenth, fifteenth, twentieth, and thirtieth launderings to determine any loss of color due to launderings. (See Plates 1-[illegible] in Appendix).

Shrinkage. To determine to what extent shrinkage or stretchage occurs in a garment in the initial launderings, and to what extent it progresses throughout the laundering period, measurements were taken at the three horizontal and nine vertical positions as previously explained. Measurements were recorded for each slip when new and after each laundering through the fifth and again at the tenth, fifteenth, and twentieth launderings. Actual dimensions were recorded in inches for comparison with the original measurements and the percentage of shrinkage or stretchage calculated.

Laundry Method. Several methods of laundering rayons were considered and it was felt that the method recommended by Lyle and Black[illegible] would be the best to follow for this study, in that it seemed to more nearly duplicate the procedure most commonly used by consumers. This procedure completed of wetting out the fabric for three minutes, then squeezing the suds gently through the fabric with cupped hands for three minutes. Lux flakes in proportion of two tablespoons to three quarts of soft water at 37.7 degrees ± 1 degree C. were used for the wash solution. This gave a full standing suds. The garment was then rinsed for two minutes in clear water of the same temperature and again placed in a second two-minute rinse at 40 degrees C. After the second rinse the slip was rolled in a towel to remove excess moisture and allowed to remain for thirty minutes before ironing. It was then carefully ironed on the wrong side in the direction of the lengthwise grains; the iron having a temperature range of [illegible] and [illegible] degrees C. The slips were laid on a flat surface after ironing and allowed to become thoroughly dry before being measured.

IV. DISCUSSION OF RESULTS

Physical Properties. Since [illegible] of slips, it was necessary [illegible] by laundering [illegible] after laundering. The physical tests [illegible] fabrics consisted of [illegible] weight, [illegible] thread count, [illegible] breaking strength [illegible] of slip (?) [illegible]. After the specified laundering intervals, the fabric [illegible] weight per square yard, thread count, breaking strength, resistance to abrasion and determination of shrinkage were made in an effort to determine the effect of repeated laundering upon each fabric.

Fiber Content. The fiber content of the slip fabrics was determined in order to better understand the reactions of the fabrics during the testing procedure and for checking the weight per square yard. It was found that the three groups of fabrics had acetate warp yarns; groups A and D had viscose filling yarns, while group C had cuprammonium filling yarn. The other fabric, B, was acetate in both warp and filling.

Table II

Fiber Content of Four Groups of Slips

Group	Warp	Filling
A	acetate	viscose
B	acetate	acetate
C	acetate	cuprammonium
D	acetate	viscose

Table [illegible]

Initial Properties of Four Brands of Nylon Woven Slips
Values Obtained from Average of Three Slips in Each Brand

Brand	A	B	C	D
Weight per square yard in ounces	[illegible]	[illegible]	[illegible]	2.[illegible]
Thread Count per inch (1)				
Warp	[illegible]	[illegible]	[illegible]	[illegible]
Filling	1[illegible]7	72	[illegible]	111
Yarn Twist (2)				
Warp	[illegible]	[illegible]	[illegible].63	[illegible]
Filling	[illegible].19	[illegible]	[illegible]	[illegible].11
*Filaments per yarn (3)				
Warp	[illegible]	[illegible]	[illegible]	[illegible]
Filling	[illegible]	[illegible]	[illegible]	[illegible]
*Denier per yarn (4)				
Warp	76	72	7[illegible]	7[illegible]
Filling	77**	1[illegible]8	7[illegible]	77
Breaking strength in pounds (5)				
Warp-dry	[illegible]	37.[illegible]	[illegible]	[illegible]
Filling-dry	[illegible]	[illegible]	14.[illegible]	21.7
Warp-wet	[illegible]	[illegible]	9.7	[illegible].1
Filling-wet	11.[illegible]	[illegible]	[illegible].8	[illegible]
Resistance to abrasion (6)				
1.	[illegible]	[illegible]	[illegible]	[illegible].7
2.	[illegible]	[illegible]	71.[illegible]	[illegible]

(1) Average of [illegible] counts each in warp and filling
(2) Average of 10 determinations each in warp and filling
(3) Average of [illegible] counts each in warp and filling
(4) Average of [illegible] determinations each in warp and filling
(5) Average of [illegible] determinations each in warp and filling
(6) (1) Number of revolutions for first sign of wear
(2) Number of revolutions for complete breakdown of fabric
* Neither brand A or B were consistent within the brand
** This is an average of only 2 determinations as the denier of the third slip in that brand was much higher than the other two

Thread Count Per Inch. [illegible] the fabrics [illegible] construct-ion, the ratio of warp to filling was 1 to 1.[illegible] in the crepes and 1 to 3 in the satin construction. The thread count of these crepe fabrics in the warp ranged from [illegible] to [illegible] threads per inch. [illegible] (11) reports a range of [illegible] to 1[illegible] threads per inch for the warp and a range of [illegible] to 1[illegible] threads per inch for the filling. In this study, the thread count per inch in the filling ranged from 107 to 111. Crawford (4) reported similar constructions in the crepe fabrics in her study and found a ratio of 1.[illegible] warp yarns to 1.0 filling in the crepes. The satin fabric had a thread count of [illegible] yarns per inch in the warp and 78 in the filling. In all fabrics, the number of warp yarns exceeded the number of filling yarns. The greatest difference was noted in the satin which had approximately three times as many warp as filling yarns, this greater proportion being a characteristic of satin. Within brands in this study the greatest variation was found in the warp of brand [illegible] and the filling of brand A, both having a maximum variation of [illegible] counts.

Weight in Ounces per Square Yard. The weight per square yard was calculated from the bone-dry weight of the fabrics and it was found that the average weights of the three crepe fabrics were comparable, with a range of [illegible] to [illegible] ounces per square yard. The satin fabric was heavier than the crepes with an average weight of [illegible] ounces per square yard. It was evident in the handle of the satin that it contained a considerable amount of sizing and this may account for its greater initial weight. This assumption is later borne out in the weight per square yard of the satin fabric after laundering. It becomes increasingly lighter in weight after each 1 month interval. Platt[11] reports a weight per square yard of [illegible] for the rayon satin and [illegible] for the crepe fabric, while Deaver[5] found a range of [illegible] to [illegible] ounces per square yard in the crepes. Within brands in this study there was a slight difference in the weights, this difference probably due to the variability of natural yarns in cutting the two-inch squares.

<u>Yarn Analysis</u>. For further determination of the specifications of the four slip fabrics an analysis of denier, filament count, and twist per inch was made for each slip and the average of each taken. In checking the denier, the crepe yarns, both warp and filling were found to be comparable, with a denier range of [illegible] to 73 in the warp and 77 to [illegible] in the filling. The satin fabric was similar to the crepes with a warp number of [illegible], but the filling denier was found to be [illegible]. This higher denier number of the satin filling yarns may partially account for the heavier weight per square yard of the satin fabric. In this study, the crepe yarns in warp and filling are found to be approximately the same in size, while the satin filling is considerably heavier than the satin warp. Platt[11] in her study found the same to be true in the satin, with a higher denier in the filling than in the warp yarn. The size of the crepe warp and filling yarns in Platt's study was similar to those reported in this study. Both brands C and D, known and labeled brands on the market were found to be consistent within the brands. Slip fabric A was consistent in denier number in sizes [illegible] and [illegible], both having a warp denier of 73 and a filling of 77 and [illegible], but in size [illegible], the filling yarn number was found to be [illegible]. Although the warp yarns of satin fabric B were consistent within the brand in denier, it was found that the

denier of the filling filament yarn [illegible] listed in the denier-filament table[illegible]. Similarly, the denier of the filling yarn of slip fabric A[illegible] was not listed in this table. After carefully checking and rechecking these yarns, it was concluded that these yarns were either experimental yarns or [illegible], or manufactured specifically for wartime needs. This might account for the variation. As neither of these two brands carried the usual standard label, this finding leads one to believe that these two brands were not manufactured in accordance with their usual specifications.

The average filament count, warp and filling, in crepe fabrics A and B were approximately the same. Both had a count of [illegible] filaments in the warp and [illegible] and [illegible] filaments, respectively, in the filling. Slip C, also a crepe, was exactly reversed in filament count from A and B fabrics. It had a filament count in the filling of [illegible] and a warp count of [illegible]. The satin fabric yarns were nearly the same in filament count, with a warp count of [illegible] and a filling count of [illegible]. There was some inconsistency in the count within brands A and B. In brand A, the filament count of the slip fabric in sizes [illegible] and [illegible] was found to be [illegible] filaments in the filling, but in size [illegible], the filling count there was [illegible] filaments. This corresponds to the same inconsistency in denier in size [illegible], brand A. Brand B was inconsistent in filament count in all three sizes. The warp counts of sizes 34 and [illegible] were both [illegible] filaments, but the warp count of size [illegible] dropped to [illegible] filaments. In the filling, the filament count of sizes [illegible] and [illegible] was [illegible], but size [illegible] increased to [illegible] filaments in the filling. This finding further strengthens the belief that these two brands neglect specifications affected by wartime [illegible] regulations.

The average yarn twist in the crepe fabrics studied varied from [illegible] turns per inch in the filling, the twist in the filling being generally greater than that of the warp twist which ranged from [illegible] to [illegible] turns per inch. [illegible] [illegible] reports high twist in crepe filling yarns of [illegible], with [illegible] in the other. The [illegible] warp and filling yarns [illegible] twist per inch with a range of [illegible] to 2.75 turns per inch in the warp, and [illegible] to [illegible] turns per inch in the filling. [illegible] [illegible] reports [illegible] twist in the warp yarns, the highest being [illegible] turns per inch in a [illegible], and [illegible] turns per inch in a rayon crepe. There was little variation in the twist per inch within brands used in this study. The direction of twist in crepes A and B was S in the warp and Z in the filling. Crepe C had the same direction of twist in both warp and filling. [illegible] Z twist in both warp and filling yarns.

__Breaking Strength.__ The [illegible] breaking strength of the three crepes was greater in the filling than in the warp, with the exception of crepe C which had a slightly lower breaking strength in the filling when wet than that of the warp. The high twist in the filling may account for the greater strength. The breaking strengths of fabrics A and B were very similar in warp and filling, both breaking in the warp direction, dry, at 23.9 pounds, while in the filling, fabric A broke at [illegible] pounds and fabric B at [illegible].7 pounds. In the wet state, the filling breaking strength of A and B was found to be slightly higher than the warp strength. In the warp, fabric A broke at [illegible] pounds and fabric B at [illegible].1 pounds, while the filling strength, when wet, averaged [illegible] pounds for fabric A and [illegible] pounds for fabric B. The breaking strength in the warp and filling yarns of fabric C was nearly balanced both in the dry and wet state but was less [illegible] crepes. [illegible] warp [illegible] from [illegible] pounds to [illegible] pounds [illegible] pounds, while the filling [illegible] ranged from [illegible] pounds [illegible] pounds, with an average of [illegible] pounds. [illegible] [13] [illegible] yarn given [illegible] in [illegible] tensile strength; that is, the [illegible], the higher the tensile strength of the yarn. This relationship [illegible] to be evident in the [illegible] yarns [illegible] in this study. [illegible] in the warp yarns [illegible] the [illegible] fabrics were [illegible] count of 60. [illegible], [illegible] breaking strength [illegible]. In the filling yarn of crepe 3, the filling count is 80, while the warp count of the other two crepes is 60. It is found that the breaking strength of the filling yarns of crepe 3 comes quite closely to the warp breaking strength of the other two crepes. The breaking strength of the satin fabric was higher in the warp yarns than in the filling yarns. [illegible][4] found that the fabrics having the higher strength in the warp also had a much higher percentage of [illegible] than the filling. This may account for the higher breaking strength of the satin warp in this study, as the thread count of the warp yarns is much higher than the filling. The breaking strength on the warp averaged 27.5 pounds while the filling breaking strength averaged 13.5 pounds. Fabrics when wet lost strength in amounts varying from 32 to 67 percent in the warp and from 35 to 50 percent in the filling. [illegible]mer[4] reports a loss in wet strength of amounts varying from 45.4 to 11.3 percent in the warp and from 35.7 to 60.3 percent in the filling, which is comparable to the percentage loss in this study. Generally, the acetate warp yarns in the crepes tended to have a lower [illegible] than [illegible]. Crawford reported that the affinity of [illegible] for moisture is less than that of viscose and its swelling [illegible]. Within the [illegible] in this investigation the breaking strength [illegible] in [illegible] A, C, and D, [illegible] in [illegible] B, [illegible] is found in the filling yarns of the slip. In this case, the filling breaking strength (wet or dry) increases 17 to [illegible] percent [illegible] the breaking strength of the other two slips in the group. This is to be expected in this one slip as analysis showed a higher filament count and a higher [illegible].

Resistance to Abrasion. There is, as yet, no standardized method of performing abrasion tests and evaluating them. The results obtained are comparable only. Schiefer[14] states, "that in many cases, the order of resistance of fabrics to abrasion is also the order of wear, as far as we can tell; but in many cases the order is different. The abrasion test must not be considered as imitating wear because wear is a variable process and we have no means of accurately measuring it; still less should the abrasion test be considered a measure [illegible] of serviceability. The abrasion test is simply a test of the quality of the fabric as to its resistance to a combination of flexing and cutting of the fibers and its results should be considered in connection with other tests". The resistance to abrasion of slip fabrics A and D were comparable ranging from an average of [illegible].7 to [illegible] revolutions for the first signs of wear; and [illegible].7 to 110 revolutions for complete breakdown of the fabric. Slip C showed signs of wear at [illegible] revolutions which may be attributed to the lower filament count in the warp yarns of this fabric. Slip B broke down at [illegible] revolutions which is considerably less than either of the other three slips.

The satin fabric [illegible] the complete breakdown of the material [illegible] revolutions. [illegible](11) found that the type of weave greatly affects the resistance to abrasion. As the float of the warp yarns increases the resistance to abrasion is lowered. This seems to be evident in the satin fabric in this study. Within the brands, there appears to be consistency in the number of revolutions for first signs of wear, but considerable inconsistency in the number of revolutions for complete breakdown.

From this analysis of the physical properties, crepe fabrics A and B seem similar in most respects, while crepe C tends to have a lower filling count, breaking strength and resistance to abrasion than the other two crepes. As is to be expected the satin fabric varies considerably in its properties from the three crepe fabrics, and inasmuch as sampling was small, the results cannot be considered conclusive.

<u>Analysis of Fabrics after Laundering</u>. After laundering, the thread counts were not as consistent within the five counts of the individual slips as they were in the new slips. This was probably the result of the ironing process in which certain parts of the slips were stretched more than others. The average increase in the filling count of the three crepes after ten launderings was much higher than the increase in the warp count. The range of increase in the filling count was from 7.3 percent to 9.8 percent; the warp range was from 1.3 percent to 2.4 percent. Fabric D (satin) increased in the filling count 8.8 percent, approximately the same as the three crepes, but in the warp the fabric showed a decrease in count of 1.4 percent. After twenty launderings, further change was found in fabrics A, B, and C while fabric D retained the same count as taken after the ten launderings. [illegible]

a [illegible] in the warp count and a decrease of [illegible] percent was found in the filling. Fabric B showed a decrease in the warp count of [illegible] percent, while the filling count remained the same as that of the tenth laundering. In fabric C an increase of [illegible] percent was found in the warp, the count for the filling remaining the same.

The three crepe fabrics showed a gain in weight both after the tenth and the twentieth launderings. After ten launderings crepe A was found to have gained 11 percent, increasing to 15 percent after the twentieth laundering. A [illegible] percent gain in weight was recorded for both crepes B and C after the tenth laundering, while after twenty launderings crepe B showed a gain of [illegible] percent and C a gain of 10 percent. [illegible][11] found after laundering that the weights increased [illegible] of the fabrics. Satin fabric A in this study showed an approximate decrease of one percent after ten launderings and 3 percent after twenty launderings. This was probably due to a loss of [illegible].

There seems to be a relationship between the change in weight per square yard and the change in thread count after the ten launderings. All three crepes showed an increase in both thread count and weight per square yard. The decrease in weight of the satin fabric also corresponded with the decrease in the thread count of fabric A after the tenth laundering. In fabric A this same correlation was true through the twentieth laundering, both thread count and weight showing a decrease, but in the three crepe fabrics this relationship does not hold true. In all three crepes, an increase in weight is found after the twentieth laundering but the thread counts do not increase correspondingly, with the exception of crepe C which shows an increase in the warp. The other two crepes maintain approximately the same thread count as the fabric after the tenth laundering. (See Table [illegible], page 2[illegible]).

Analysis showed that crepes A and B showed similarity in initial performance tests in respect to breaking strength. However, the successive launderings did not have the effect of increasing the breaking strength of these two brands correspondingly. Therefore the breaking strength was calculated in relation to the original breaking strength of the fabrics. After the tenth laundering, brand A increased [illegible].7 percent in the warp and [illegible].6 percent in the filling, while brand B increased only 10 percent in the warp and 7.7 percent in the filling. After the twentieth and thirtieth launderings these two brands were comparable in dry breaking strength in the warp with an average increase of 11 percent after the twentieth laundering and [illegible] percent after the thirtieth laundering. This relationship did not hold true for the fillings of these two brands. The filling of brand A was much higher than B with an increase of [illegible] percent after the twentieth laundering, and [illegible].6 percent after the thirtieth laundering. Brand B dropped to [illegible] percent in the filling after the twentieth laundering, but increased to 1[illegible].6 percent after the thirtieth laundering. In the wet state, brand A was found to have a much higher breaking strength, both in the warp and the filling, than brand B. This higher dry breaking strength of the filling, and wet warp and filling strength of fabric A bears a direct relationship to the weight per square yard of these two fabrics. Fabric A was found to weigh approximately 3 percent more than fabric B after the tenth laundering and [illegible] percent more after the twentieth laundering. In the initial analysis of the fabrics, it will be recalled that crepe A had a higher filament count and denier in the filling of the slip, which may ac-

Table 4

Summary of the Thread Count, Breaking Strength, Weight in Ounces PER Square Yard, Resistance to Abrasion, and Dimensional Change of the Four Brands of Slips Before and After Laundering. (1)

Fabric	Times Laund-ered	Thread Count per inch		Breaking Strength in pounds				Weight in oz. per square yard	Resistance to Abrasion		Percentage of Dimensional Change	
		Warp	Filling	Dry		Wet			Sample 1*	Sample 2**	Width	Linear
				W.	F.	W.	F.					
A	0	158	107	23.9	33.5	9.6	11.5	3.05	93.3	115		
	1										-2.2	-4.8
	5										-2.2	-5.7
	10	162	117	26.5	36.2	11.4	17.3	3.41	50	60.3	-4.0	-5.3
	15										-5.2	- 4.3
	20	162	116	26.9	41.3	12.5	20.3	3.44	54	71	-4.3	-4.2
	30			28.5	43.1	12.0	19.5		40	73.3		
B	0	204	73	37.5	19.8	15.9	7.9	3.13	60	88.3		
	1										-2.5	-1.3
	5										-4.9	+0.8
	10	201	78	43.0	24.6	21.9	11.5	3.10	54.3	93.7	-2.9	+3.4
	15										-4.1	+3.9
	20	199	78	37.9	24.2	20.2	11.4	3.04	53	89	-5.2	+3.7
	30			37.7	24.2	19.1	11.9		78.3	102.3		
C	0	158	109	20.5	24.2	9.7	8.3	2.82	57.3	71.3		
	1										-4.6	-4.7
	5										-4.9	-4.4
	10	160	117	27.7	29.9	11.1	12.6	2.98	78.3	91.7	-5.3	-4.0
	15										-6.5	-3.6
	20	162	117	27.7	28.2	10.9	11.3	3.02	81.7	108.3	-5.7	-3.3
	30			26.3	24.3	12.1	10.4		68.0	109.0		
D	0	160	111	23.9	31.7	11.1	12.0	3.00	84.7	93.7		
	1										-6.9	-7.3
	5										-8.0	-7.3
	10	163	121	31.0	38.0	12.3	14.7	3.15	66.7	83	-9.3	-6.8
	15										-8.7	-6.3
	20	163	121	26.5	34.7	10.5	14.7	3.30	56	83	-8.0	-5.6
	30			28.8	35.7	15.2	15.2		48.3	80.3		

(1) Values obtained from an average of determinations on three slips in each brand.
* Number of revolutions for first signs of wear.
** Number of revolutions for complete breakdown of fabric.

Brand	Number of Launderings	Dry Warp	Dry Filling	Wet Warp	Wet Filling
A	10	[illegible]	+ 7.7	[illegible]	[illegible]
	20	[illegible]	[illegible]	[illegible]	[illegible]
	30	[illegible]	[illegible]	[illegible]	[illegible]
B	10	[illegible]	[illegible]	+37.7	[illegible]
	20	+ 1.1	[illegible]	[illegible]	[illegible]
	30	[illegible]	[illegible]	[illegible]	[illegible]
C	10	[illegible]	[illegible]	[illegible]	[illegible]
	20	[illegible]	[illegible]	[illegible]	[illegible]
	30	[illegible]	[illegible]	[illegible]	[illegible]
D	10	[illegible]	[illegible]	[illegible]	[illegible]
	20	[illegible]	[illegible]	[illegible]	[illegible]
	30	[illegible]	[illegible]	[illegible]	[illegible]

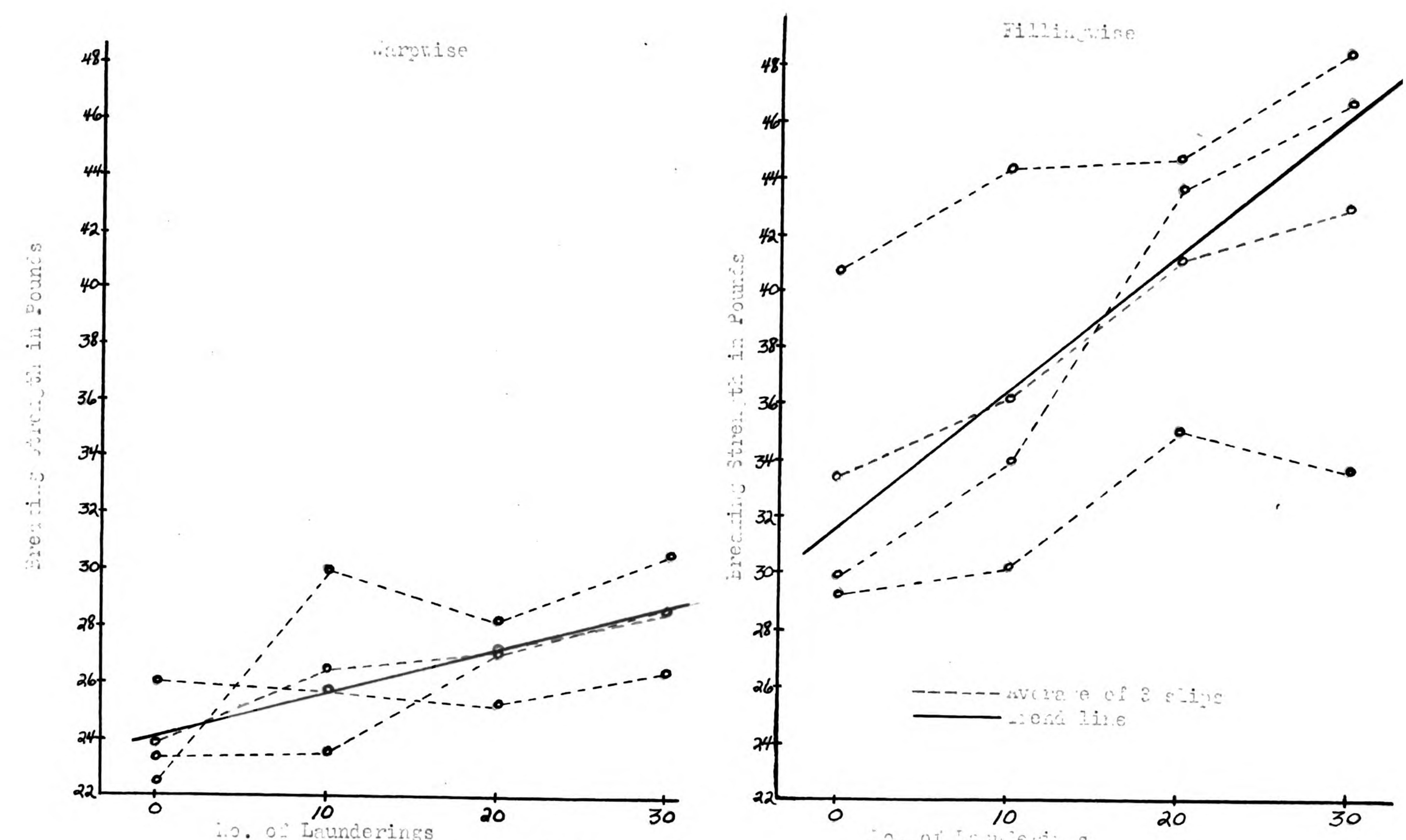
count for the higher average breaking strength of these fabrics.

After the tenth laundering, crepe fabric C increased in dry breaking strength in both warp and filling more than either crepes A or B. The warp breaking strength increased 25.1 percent; the filling [illegible] percent. However, the wet breaking strengths of the warp and filling were comparable to crepe A with an increase of 12.4 percent in the warp and [illegible] percent in the filling. This may be due to the similarity of turns and filament count in the filling of these two fabrics. After the twentieth laundering the dry breaking strength in the warp of crepe C remained the same as after the tenth laundering but the breaking strength of the filling dropped to [illegible] percent. The wet breaking strengths of the warp and filling respectively, increased to 12 and 23 percent of the original wet strength recorded after the tenth laundering. Crepe C after the thirtieth laundering was the only fabric which showed an increase in strength comparable to crepe A.

In the satin fabric an increase of 14.3 percent was found in the warp after the tenth laundering. However, this dropped to 1.1 percent after the twentieth laundering and to .5 percent after the thirtieth laundering. This finding is to be expected considering the decrease in thread count and the loss in weight of this fabric after laundering. This decrease in strength from that after the tenth laundering is also evident in the filling, which drops from 14.2 percent to 2.4 percent after the twentieth and thirtieth launderings. The percentage breaking strengths of the wet samples for both warp and filling after the twentieth and thirtieth launderings were below those after the tenth laundering.

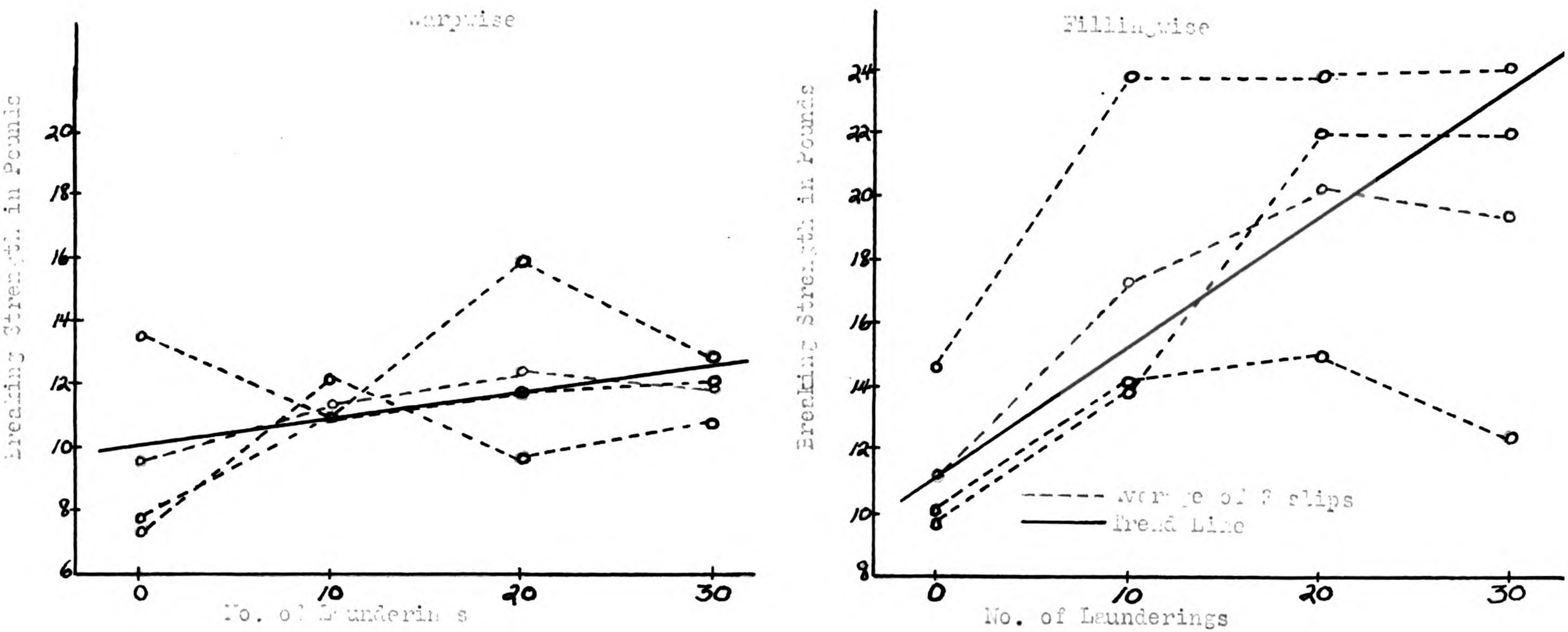
In order to visualize the reaction of the materials to laundering, graphs were made of the warp and filling breaking strengths of each fabric. (See Figures 1-3). The straight line on these graphs is a trend line showing

Figure 1



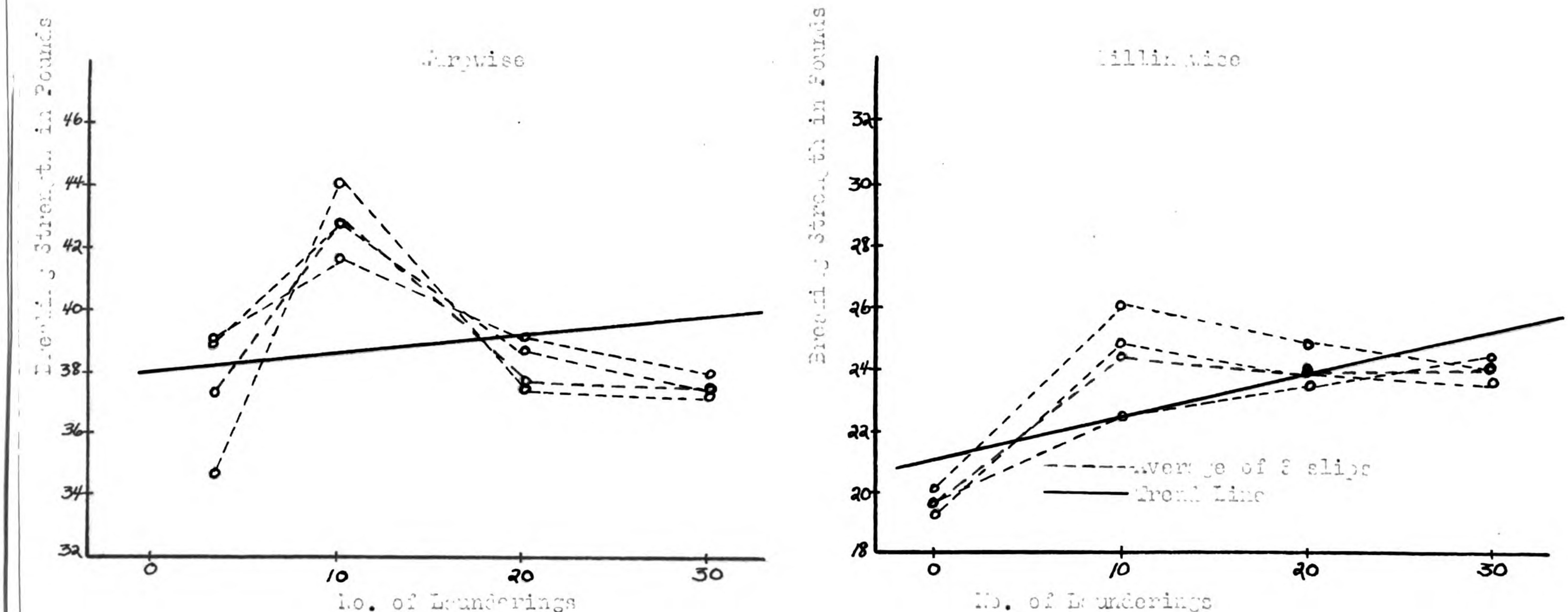
Breaking Strength, dry, of three slips of Brand A

Figure 2



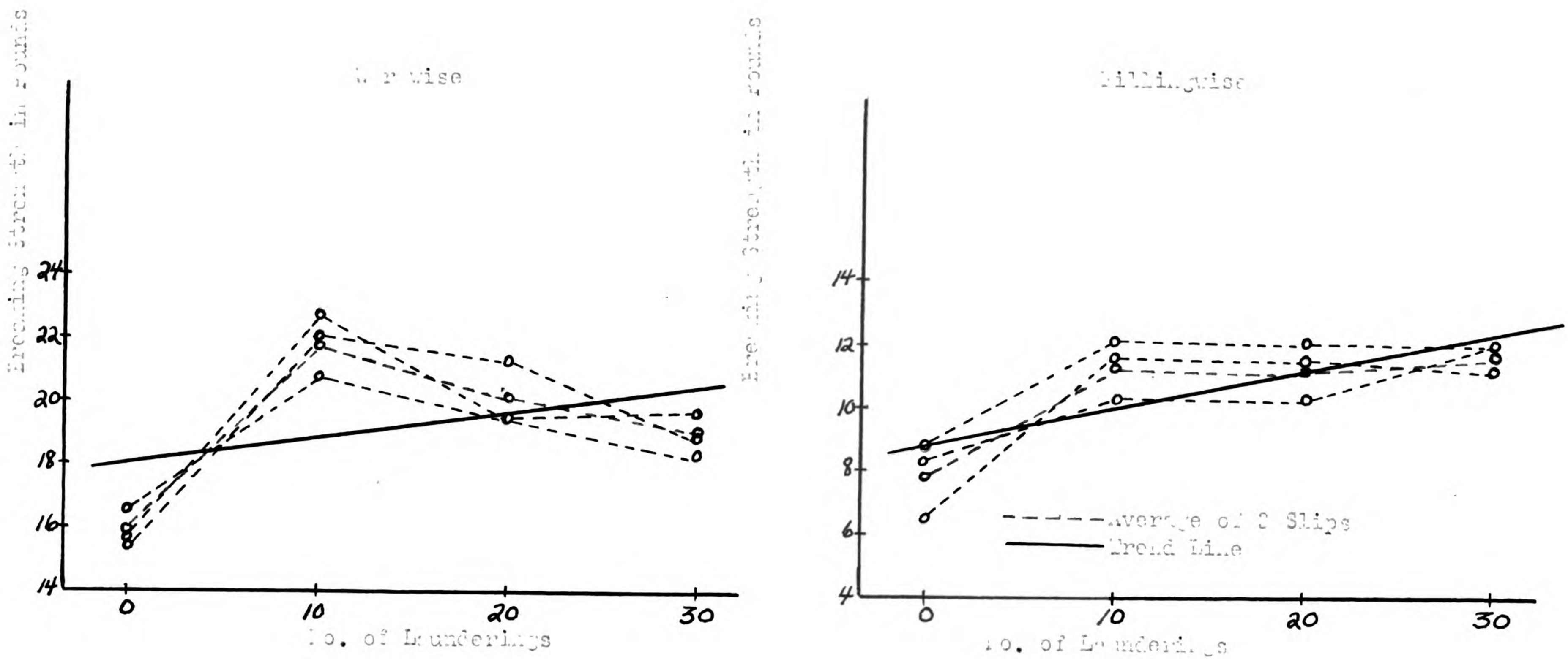
Breaking Strength, Wet, of Three Slips of Brand A

Figure 3



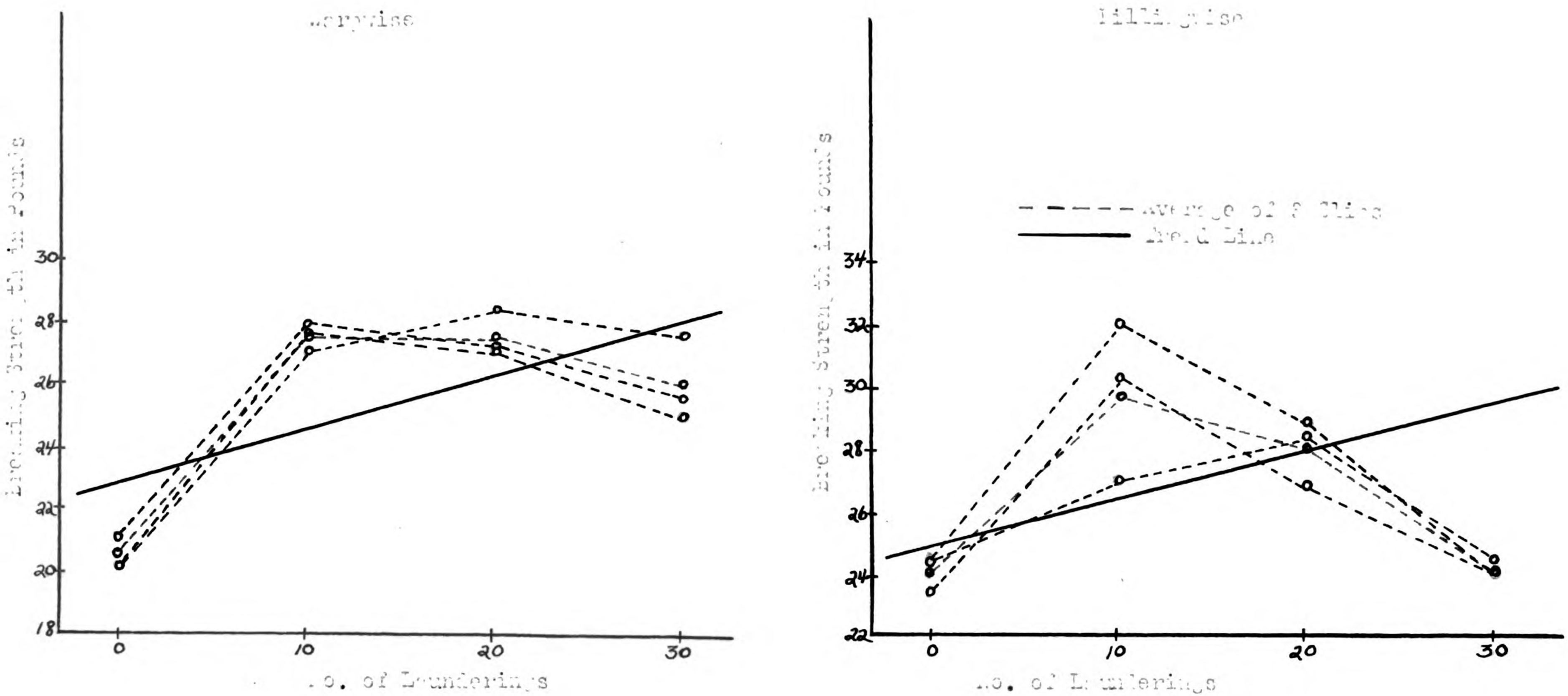
Breaking Strength, Dry, of Three Slips of Brand

Figure 4



Breaking Strength, Lbs., of Linen Slips of Brand I

Figure 5



Breaking Strength, Dry, of Three Slips of Brand C

Figure 3

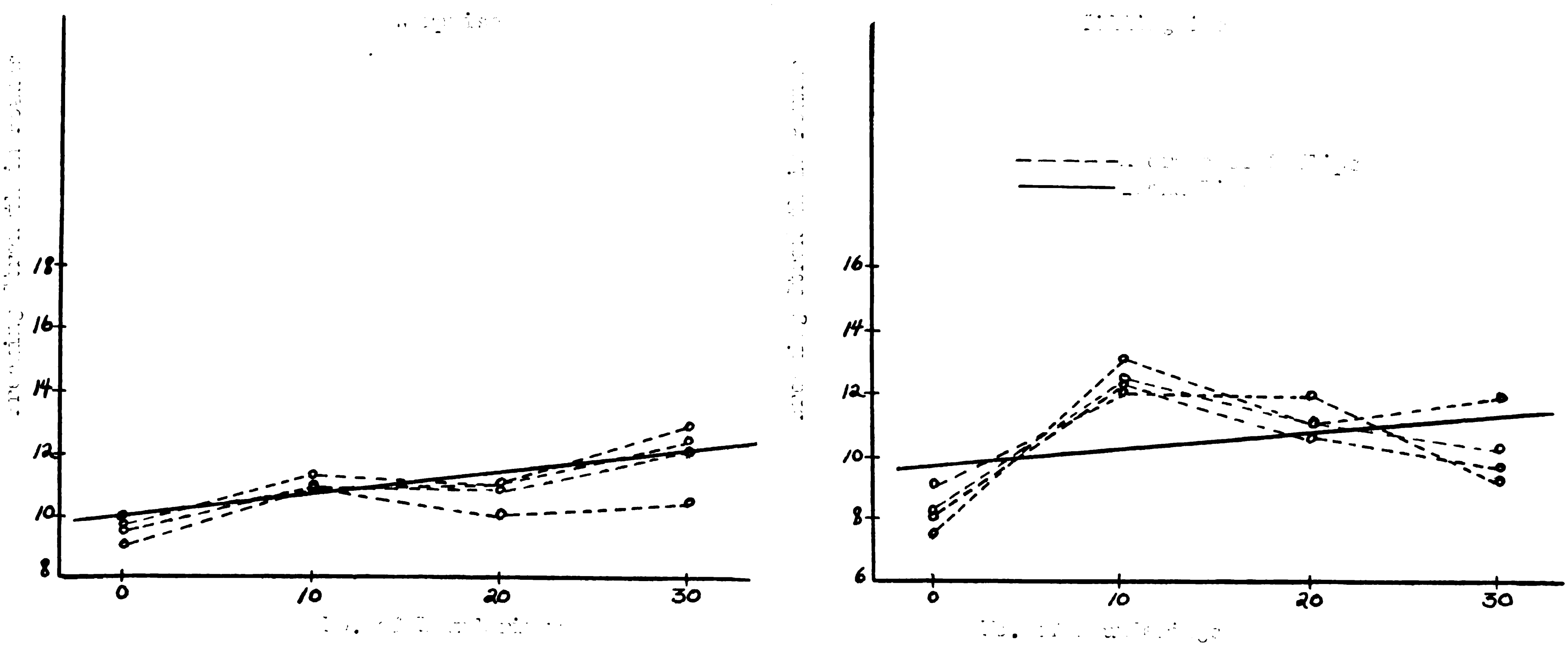
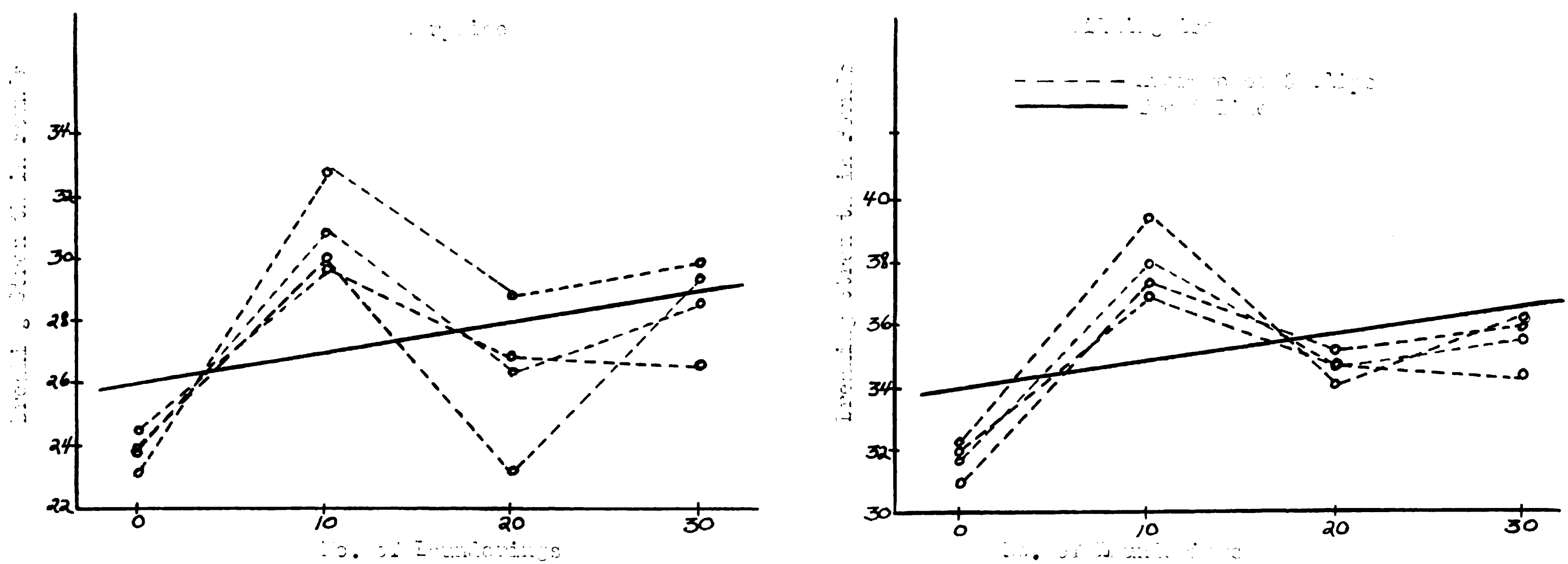
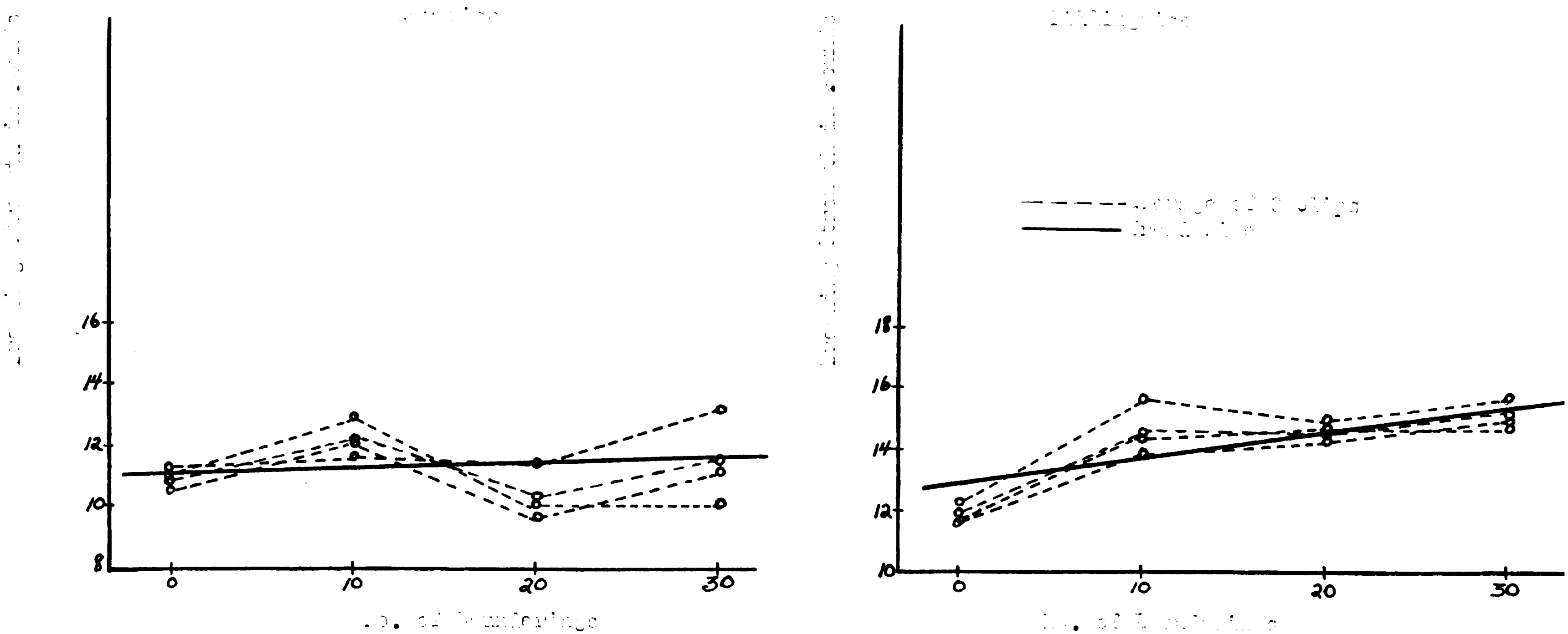


Figure 7


34
32
30
28
26
24
22
0
10
20
30
No. of Launderings
40
38
36
34
32
30
0
10
20
30


16
14
12
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8
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18
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10
0
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20
30

[illegible] in breaking strength. [illegible], [illegible], [illegible] plotted [illegible]. Also, [illegible] plotted [illegible] follows [illegible]. It could be perceived from a study of these graphs that, in general, [illegible] in the warp and filling [illegible]. [illegible] twentieth laundering [illegible] tendency [illegible] breaking strength [illegible] twentieth laundering, while brand [illegible] continued to decrease. [illegible] laundering. In contrast to the [illegible] strength [illegible], the [illegible] breaking strength [illegible] increase through the tenth laundering. [illegible], showed a tendency to increase [illegible] through the tenth [illegible] laundering with little or no change [illegible] after the twentieth laundering.

Further analysis of this data consisted of determination of the correlation coefficients of the two variables, breaking strength and number of launderings, for each brand. The coefficient of correlation, r_{yx}, serves as a measure of the interdependence of two series of correlated variables. It compares the association of two variables in relation to their relative deviation about their means. The magnitude of the correlation coefficient varies from plus one for perfect relationship, through zero for none, to minus one for perfect inverse relationship. The formula used in this study for calculating the correlation coefficient is:

$$r_{yx} = \frac{\Sigma x'y' - \frac{(\Sigma x')(\Sigma y')}{N}}{\sqrt{\left(\Sigma x'^2 - \frac{(\Sigma x')^2}{N}\right)\left(\Sigma y'^2 - \frac{(\Sigma y')^2}{N}\right)}}$$

where n represents the number of pairs [illegible] the same order. To decide whether a given value of r was significantly different from zero, a table of the values of the correlation coefficient for different levels of significance was used. The levels of significance of 1 percent and 5 percent were chosen, to accord with Snedecor [illegible]. Significant and highly significant correlation coefficients are listed in Table 5, page 41. It will be noted that there are given only the [illegible] calculated from the graphs.

Before laundering, there seemed to be no consistency of relationship in terms of the number [illegible] for resistance to abrasion [illegible], between the average [illegible] of each blend to the fibre content. Groups A and B [illegible]; while group C [illegible] fabric [illegible] less resistance to [illegible]. Further, after laundering, there appeared to be little consistency [illegible] fraction of [illegible], either within blends or in the [illegible] of the [illegible] terms.

Groups A and B, and the cotton fabric E dropped in resistance to abrasion after the tenth laundering, while group C showed an increase in its resistance. A continued increase in abrasion resistance was recorded for group C after the twentieth laundering. (See Table 11, in Appendix) for comparative results of resistance. All fabrics showed a decrease in resistance to abrasion after the twentieth laundering with the exception of cotton fabric E which showed an increase in resistance in both [illegible]. (See Table 6).

An attempt was made to [illegible] the results of resistance to abrasion after laundering [illegible] to the results [illegible] but it is felt

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]		[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	.[illegible]*	.7[illegible]**	.[illegible]	.[illegible]**
[illegible]	.[illegible]7	.[illegible]*	.[illegible]	.[illegible]**
3	.[illegible]*	.[illegible]*	.[illegible]*	.[illegible]
[illegible]	.[illegible]7	.[illegible]	.[illegible]	.[illegible]*

* [illegible]

** [illegible]

[illegible]

<u>Shrinkage in Laundering</u>. Shrinkage was determined by comparison of original measurements with those after the first, second, third, fourth, and fifth, and again after the tenth, fifteenth, and twentieth launderings. The percentage of shrinkage was calculated. The averages of the results on shrinkage are given in Tables 7 and 8, pages 46, and 47. The average shrinkage for fabric A in width varied from 1.4 percent after the first laundering to a maximum of 4.0 percent after the tenth. The average was practically the same for the linear change, although it shrank the maximum amount in the first laundering with a percentage change of 4.5 percent. After the twentieth laundering the shrinkage was 1.4 percent. In the warp fabric B a shrinkage of 2.5 percent in width occurred in the first laundering, reaching an average shrinkage of 3.2 percent after the twentieth laundering. However, the linear measurements tended to increase with successive launderings after an initial shrinkage of 1.8 percent. The average linear stretchage of this fabric amounted to 3.7 percent. In fabrics C and D the maximum shrinkage occurred in the first laundering, both in width and length. Fabric C shrank in width 4.0 percent in the first laundering, increasing to 6.7 percent through the twentieth. In length, the strips of this fabric shrank 4.7 percent in the first laundering, but only 2.3 percent shrinkage was recorded after the twentieth laundering. In comparison with the other fabrics in this study, fabric D shrank the greatest amount in both width and length. The shrinkage in width after the first laundering amounted to 6.8 percent, increasing to

Table 7

Summary of Total Dimensional Change*

Brand	Times Laundered	Percentage Change Size [illegible]	[illegible]	[illegible]
A	1	-[illegible].1	-1.[illegible]	-3.3
	2	-3.[illegible]	-1.4	-4.[illegible]
	3	-3.[illegible]	-[illegible].0	-3.[illegible]
	4	-3.[illegible]	-[illegible]	-[illegible]
	5	-2.[illegible]	-1.[illegible]	-[illegible]
	10	-[illegible].3	-2.[illegible]	-[illegible]
	15	-[illegible].3	-3.7	-[illegible].7
	20	-4.[illegible]	-3.1	-[illegible].7
B	1	-3.[illegible]	-[illegible].1	-[illegible].9
	2	-2.9	-3.4	-1.3
	3	-[illegible]	-[illegible].2	-2.1
	4	-1.3	-[illegible].1	-1.7
	5	-[illegible]	-[illegible]	-[illegible]
	10	-[illegible]	-3.[illegible]	-[illegible].2
	15	-2.[illegible]	-[illegible].1	-[illegible]
	20	-[illegible].4	-3.[illegible]	-3.2
C	1	-[illegible].7	-[illegible].3	-[illegible]
	2	-3.3	-[illegible]	-[illegible]
	3	-3.[illegible]	-3.1	-[illegible]
	4	-3.[illegible]	-4.1	-[illegible]
	5	-[illegible]	-[illegible].1	-[illegible].7
	10	-3.[illegible]	-[illegible].7	-7.[illegible]
	15	-[illegible]	-[illegible].1	-[illegible].1
	20	-[illegible]	-[illegible].3	-7.[illegible]
D	1	-[illegible].1	-[illegible].7	-7.[illegible]
	2	-[illegible]	-3.1	-7.3
	3	-7.9	-7.[illegible]	-7.[illegible]
	4	-1[illegible]	-7.[illegible]	-[illegible]
	5	-[illegible]	-7.4	-7.[illegible]
	10	-1[illegible]	-[illegible]	-[illegible]
	15	-10.7	-7.3	-7.9
	20	-[illegible]	-7.[illegible]	-7.[illegible]

* Average of bust, waist and hip for each time laundered

[illegible]

[illegible] *

Group	Times Examined	[illegible]		
		[illegible]	[illegible]	[illegible]
[illegible]	1	-4.7	[illegible]	[illegible]
	2	[illegible]	-3.1	[illegible]
	3	[illegible]	[illegible]	[illegible]
	4	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	10	[illegible]	[illegible]	-5.2
	[illegible]	[illegible]	-4.3	[illegible]
	[illegible]	-3.7	-4.3	[illegible]
B	1	[illegible]	[illegible]	-1.0
	[illegible]	+1.8	[illegible]	[illegible]
	[illegible]	+2.4	[illegible]	[illegible]
	4	[illegible]	+1.0	[illegible]
	5	[illegible]	+1.0	[illegible]
	10	[illegible]	[illegible]	+0.6
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
C	1	[illegible]	[illegible]	[illegible]
	[illegible]	-4.3	[illegible]	-4.1
	3	-4.1	[illegible]	[illegible]
	4	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	-4.4	[illegible]
	10	[illegible]	-6.7	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	-8.7
D	1	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	-7.3	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	10	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	-7.1	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]

* [illegible]

6 percent after the treatment. Shrinkage in length of the fabric after laundering was approximately the same as the width shrinkage before treatment, 7.2 percent. Shrinkage after the treatment was 3.6 percent.

Throughout the laundering procedure, there was variation in the amount of shrinkage which occurred in all fabrics. This is to be expected due to the fact that the slips were hand ironed and to the difficulty of controlling tension during the ironing process. [illegible] (6) reports a noticeable variation in the amount of shrinkage of the different rayon fabrics in her study. The average shrinkage in warp was 5.4 percent; the filling average was 0.9 percent. One fabric stretched 1.7 percent. In a study which Hendrickson and Fletcher (8) directed they found that most of the rayon crepes shrank more than 5 percent in both the warp and fill. Fillingwise, the shrinkage in two of the fabrics exceeded 10 percent. [illegible] (14) found that all-rayon crepes exhibited the greatest amount of shrinkage of all fabrics in her study. In the warp it ranged from 1.6 to 10 percent, and in the filling, from a stretch of 5.8 to a shrinkage of 7.[illegible] percent. She found that the warp and filling shrinkage for the fabric varied after the different launderings. [illegible]eplotz (17) states that a rayon fabric is considered satisfactory in laundering from a stability standpoint if it does not show more than a 2 percent (plus or minus) dimensional change in warp or filling directions when compared with the original measurements.

The average shrinkage in this study ranged from [illegible] percent to [illegible] percent in width and from 1.8 to 5.3 percent in length, which is slightly lower than those amounts in the studies cited. This lower percentage may be attributed to the extreme care with which fabrics in this study were ironed. However, the amounts of shrinkage which occurred in the fabrics in this study are high enough to affect the fit of a garment and this [illegible] laundering [illegible].

In this study color retention [illegible] was determined by comparing the samples after laundering with the original material. Slips [illegible] seemed to retain their color somewhat better than the other colored fabrics in the study. Slip [illegible] showed a slight trace of fading after the tenth laundering, but no apparent loss of color during the remainder of the study. Fabric [illegible] showed considerable change through [illegible] launderings, the original [illegible] color fading to a [illegible] grayed [illegible]. No [illegible] change in color is noted after the [illegible] laundering. [illegible] white, no comparison [illegible] colorfastness of that brand [illegible]. The fading of brand [illegible] color loss to the eye, [illegible] compared with the new fabric after [illegible] of the [illegible] launderings. In general, fabric [illegible] the only fabric in [illegible] in color. This result does not correspond with the findings reported in other studies but [illegible] explained by the fact that the slips in this study were all carefully laundered under controlled conditions. (See Plates 1-3 in Appendix for laundered samples). Morrison and Fletcher[?] reported that practically all rayon fabrics in their study were poor in colorfastness to light, [illegible] and perspiration. Blair[11] found that the [illegible] in her study faded to a marked degree after successive launderings.

Design and Workmanship. A study was made of the style features, workmanship and fit of the four brands of slips. The way a slip will fit and wear is determined not only by its actual measurements [illegible] points, but also by the manner in which it is constructed. Two and four-gore slips are usually cut on the bias and generally fit better than straight-cut [illegible] tendency to twist [illegible]. [illegible] slips in this [illegible] [illegible] [illegible] A and C [illegible] with four-gore alternating [illegible] panel. [illegible] of [illegible], the [illegible], [illegible] bias-cut [illegible], [illegible] un-[illegible].

In the [illegible] the [illegible] unevenness, [illegible] found [illegible] off-grain, [illegible] of the [illegible] in slip [illegible], [illegible] in [illegible]. [illegible] in [illegible] off-grain; in [illegible] C, the off-grain [illegible] found, [illegible] in [illegible] [illegible] tested.

[illegible] first [illegible] of [illegible] slip, [illegible] also [illegible] derived [illegible]. In the [illegible] of the slips it was noted that slips A and C both [illegible] through the [illegible], waist [illegible] line, [illegible] followed [illegible] lines in both standing and sitting positions. [illegible] tendency to ride up when in a sitting position. Neither of slips B nor D fit well on the normal figure. Both [illegible] short in length with excessive fullness through the [illegible] front [illegible] lines. [illegible] tendency to pull across the hipline in [illegible] position [illegible] pulled [illegible] the knees in [illegible] position. [illegible] observations, it is [illegible] that slips A and C could be recommended for the normal figure, while slips B and D would be a better cut for the [illegible] full waistline. (See [illegible] slip [illegible]).

[illegible] taken from the hemline to floor at various locations around the hemline [illegible] slips were on the [illegible] form [illegible] the feet that the two unlabeled brands A and B were not evenly cut as to length. Both slips were more than one inch longer in the back than in the front. In brands C and D, the hemlines of the slips were very nearly even, little variation being found at any of the points of measurements.

As there were three slips in the same size in a brand, a comparison of measurements of these similar sizes were made and it was found that within the same size of a brand there was a variance of between .[illegible] inches to 2.[illegible] inches in both width and line measurements. This variance was found in all brands. In comparison of the measurements of the three sizes, 34, 36, and 38 within a brand, it was found that the width measurements increased proportionately in accordance with the increase in size but that there seemed to be little consistency in the increase in the line measurements. From these findings, it appears evident that if it is at all possible, a slip should be tried on before buying if one is to be assured of the proper fit, as each slip varies somewhat from the standard measurements of the brand.

[illegible]. Conclusions

From the analysis of the laboratory tests carried out on the slips in this study both before and after laundering, it became evident that there is considerable variability in [illegible] of [illegible] available slips. While the two [illegible] were similar in most respects, [illegible] varied in almost every analysis with the exception of thread count and denier.

In a final analysis of the collected data, it is found that of the three brands of slips, slip A, an unlabeled brand, ranks first in fabric construction and performance, slip B second, and slip C third. However, this ranking does not hold true [illegible] in [illegible], but [illegible] of fit. In these respects, the unlabeled brand [illegible] seem to be more satisfactory with slip B ranking much higher than slip A. Therefore, from these findings it is evident that no one brand of slip can definitely be said to be the best in all respects. No conclusions or comparisons of the cotton slip could be made as it was the only one of its kind constructed in the [illegible].

Little variance within brands was found in initial physical properties or in performance tests before and after laundering with the exception of the unlabeled brand A, which varied in the filling yarn of one size. This yarn had a higher filament count and denier in the filling than the other two sizes in that brand. Correspondingly, this one filling yarn had a higher breaking strength both before and after laundering. Therefore, it is concluded that the higher the filament and denier of a yarn, the greater will be the tensile strength of that yarn. This lack of consistency within the unlabeled brand is felt to be a result of [illegible], when in many cases, fabrics woven, dyed, and finished with one end-use in view were used for other [illegible].

Tensile strength consistently increased through the twentieth laundering, after which there was a slight decrease. If further launderings were carried on, it would be expected that tensile strength would decrease accordingly.

In general, the maximum amount of shrinkage occurred with the first laundering. In the satin fabric, the shrinkage was [illegible] progressive with successive launderings. However, much variation was found in the measurements after the various launderings, due to the limitations of the garments. The results of this study indicate that the measurements of bias-cut slips after laundering are highly dependent upon the laundering and ironing procedure. The average percentage of shrinkage which occurred in the slips in this study was sufficiently high to materially affect the fit of the slips after laundering. This was particularly true of brand [illegible]. Results of this study emphasize the need for improved methods of shrinkage control, as well as standardization in slip sizes and improved styling for various figure types.

With the exception of satin fabric [illegible], the colored slips in this study showed excellent colorfastness to laundering. As this finding was contrary to that reported in several studies of similar fabrics, it is concluded that the difference was due to the controlled laundering method used in this study.

The four-gore, alternating bias cut slip proved to be the most satisfactory slip in fit. It fitted the figure smoothly through the bust, waist and hips and did not have a tendency to ride up when the wearer was in a sitting position. However, as much inconsistency in measurements was found within and between sizes of all brands, and because of variations in cut or design, it was impossible for the consumer to [illegible] intelligently before making purchase.

The results of this study indicate a need for more informative labels on slips in order that the consumer may make satisfactory purchases. This is particularly important at the present time when so many new fabrics [illegible] are on the market of clothing [illegible]. Adequate informative labeling would aid in [illegible] the consumer in making an intelligent purchase. The information which would be desirable on such a label might include the following items: name of fabric; fiber content; design features; type of seam; thread count; color fastness to washing and perspiration; and special laundering instructions. Because of variance in the qualities of fabrics used in lingerie, there is a very definite need for the establishment of [illegible] minimum specifications for this type of fabric. These minimum specifications would necessarily include: warp count; weight in ounces per square yard; breaking strength; resistance to yarn slippage [illegible] and [illegible] resistance of [illegible].

This study was, of necessity, limited to laboratory analyses and the findings cannot be considered as an [illegible] predictive measure of serviceability. The study does, however, supply the product of one [illegible] and other with those of another in respect to initial physical properties of the fabrics and the effect of laundering upon these fabrics. The study, likewise, [illegible] features of fit and construction which [illegible] contribute to the total satisfaction [illegible] by the consumer. [illegible] the [illegible] serviceability of [illegible] of slips [illegible] used in this study, it would be necessary to [illegible] a [illegible] study in conjunction with laboratory analyses.

[illegible]I. [illegible]

In January, 1953, thirty-[illegible] [illegible] (three [illegible] in [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] for this study. [illegible], [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] 1.[illegible] [illegible] ....

[illegible] [illegible]; the filling of the [illegible], the [illegible] [illegible]. [illegible] found [illegible] in both warp and filling.

In all the fabrics, the number of warp yarns exceeded the number of filling yarns, the ratio of warp to filling being 1 to 1.[illegible] in the crepe and 1 to 2 in the satin fabrics. There was very little variation in thread count within the brands.

The average weights of the three crepe fabrics were very similar. [illegible] the satin fabric was approximately 3 percent heavier than the crepe fabrics. Values within brands showed very slight difference in weight.

The denier in the warp yarns of all fabrics, as well as the filling yarns of the three crepes approximated 75, but the satin filling was found to be considerably heavier with a denier of 1[illegible]. The two labeled brands, C and D were consistent in denier within the brand, but both unlabeled brands A and B showed inconsistency in denier.

The average filament count, warp and filling, in crepe fabrics A and D were approximately the same, with the higher count in the warp, while crepe C was exactly reversed in filament count. The satin yarns in both warp and filling were nearly the same in filament count. Again, inconsistency was found in brands A and B in the three [illegible], while brands C and D [illegible] had the [illegible] count than [illegible] the [illegible].

The average yarn twist of the three crepe fabrics in the filling was slightly more than [illegible] of the warp twist, while the twist in [illegible] of filling yarns was practically the same in [illegible]. All yarn twist [illegible] consistent within the fabrics.

The average breaking strength of the three crepes [illegible] in the filling than in the warp. The breaking strength of crepes A and B were very similar in warp and filling, while the breaking strength of crepe C [illegible] less than [illegible] the other two crepes. The breaking strength of the satin fabric was higher in the warp than in the filling yarns. Within the fabrics, the breaking strength [illegible] in fabrics A, C, and D, but in fabric B, the breaking strength of the filling [illegible] greater than that of the warp [illegible] in the fabric.

[illegible] the elongation of all [illegible] A and B were only [illegible]; crepe C and the satin fabric [illegible] had less [illegible] than crepes A and B. Considerable inconsistency was found within the fabrics.

After ten launderings the thread count in the filling of the crepe fabrics increased more than the warp count. Satin fabric D increased in the filling count approximately the same as the crepes, but showed a decrease in the warp count. After twenty launderings, further changes were found in fabrics A, B, and C, while fabric D retained the same count as [illegible] after ten launderings.

The three crepe fabrics gained in weight after successive launderings, while satin fabric D showed a decrease in weight after each laundering [illegible].

The breaking strength of all four fabrics [illegible] the [illegible] laundering, after which there was a tendency for all fabrics to lose a little in breaking strength. Little or no change occurred after the third laundering.

All fabrics increased in resistance to abrasion after the [illegible] laundering, except fabric [illegible] which increased [illegible].

Throughout the laundering procedure, there was variation in the amount of shrinkage which occurred in all fabrics. The average shrinkage ranged from [illegible].8 to [illegible] percent in width and from 1.7 to [illegible] percent in length.

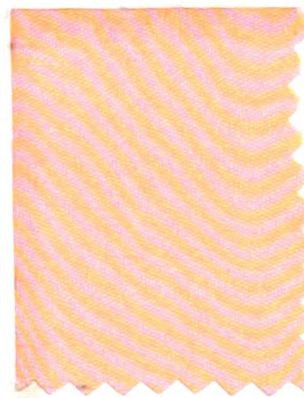
Fabric [illegible] was the only fabric to show any appreciable loss of color throughout the laundering process.

<u>Design and Workmanship</u>. Several [illegible] in each of the brands were found to have been cut off-grain, and the [illegible] were not evenly cut as to length. Therefore, [illegible] to be the most [illegible] defect in fit and length. Considerable variation of [illegible] measurements in similar sizes [illegible] found in all four groups of slips.

Plate 1

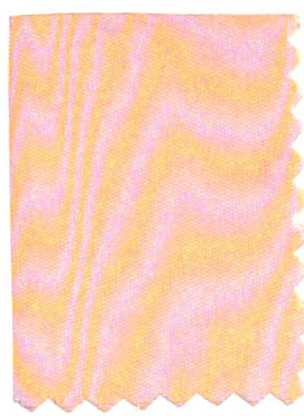
Samples of Slip Fabrics
Brand A

New



After Tenth
Laundering

After Twentieth
Laundering

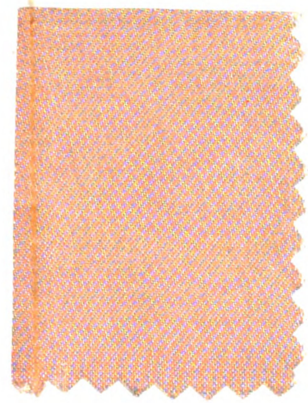


After Thirtieth
Laundering

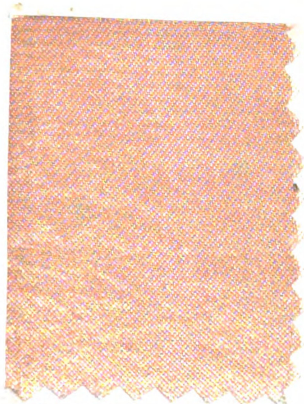
Plate 2

Samples of Slip Fabric
Brand B

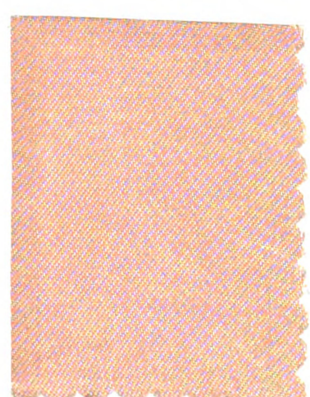
New



After Tenth
Laundering



After Twentieth
Laundering



After Thirtieth
Laundering

Plate [illegible]

[illegible]

[illegible]

New

After Tenth Laundering

After Twentieth Laundering

After Thirtieth Laundering

Plate 4

Samples of Slip Fabrics
Brand D

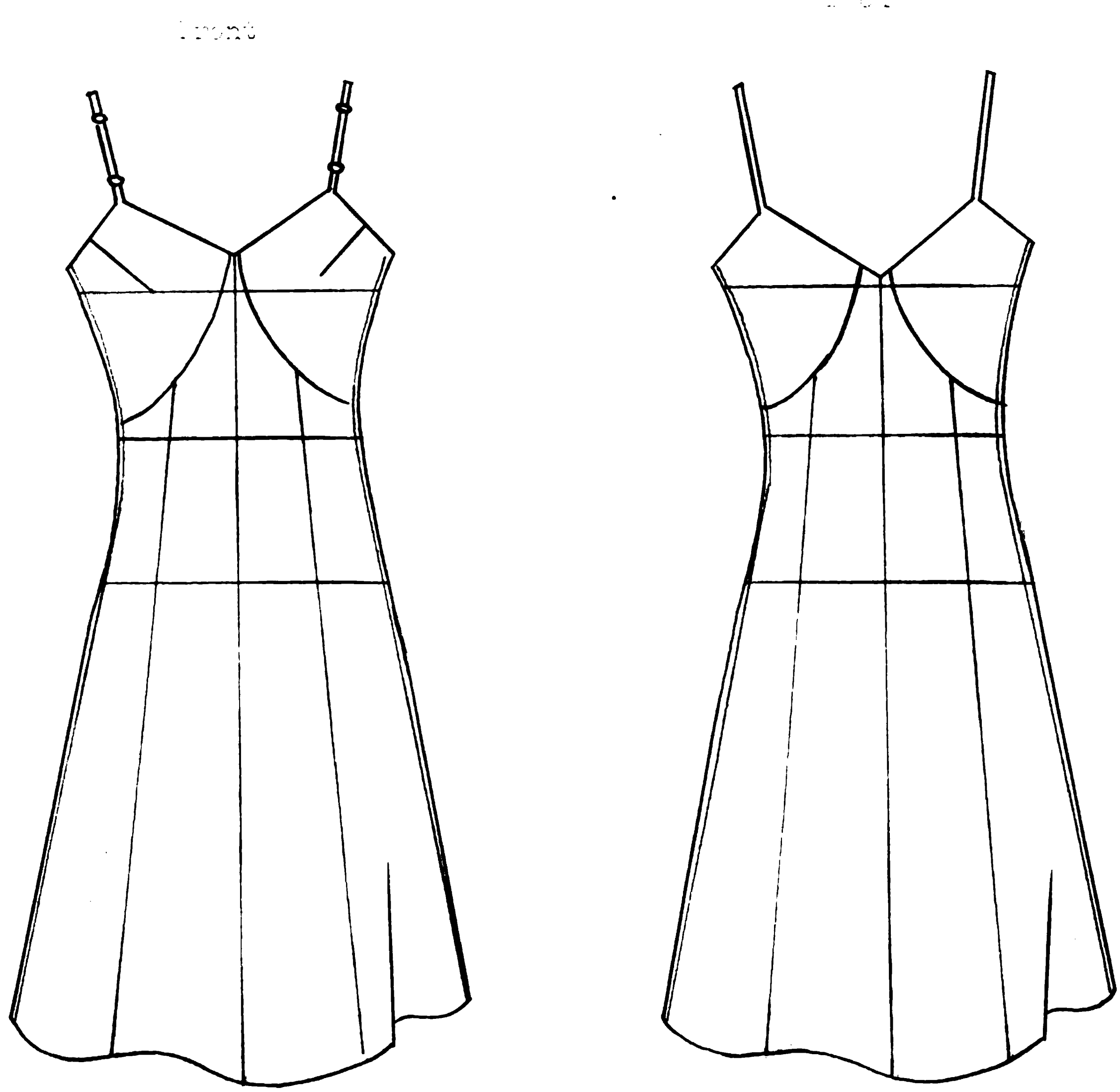
New

After Tenth
Laundering

After Twentieth
Laundering

After Thirtieth
Laundering

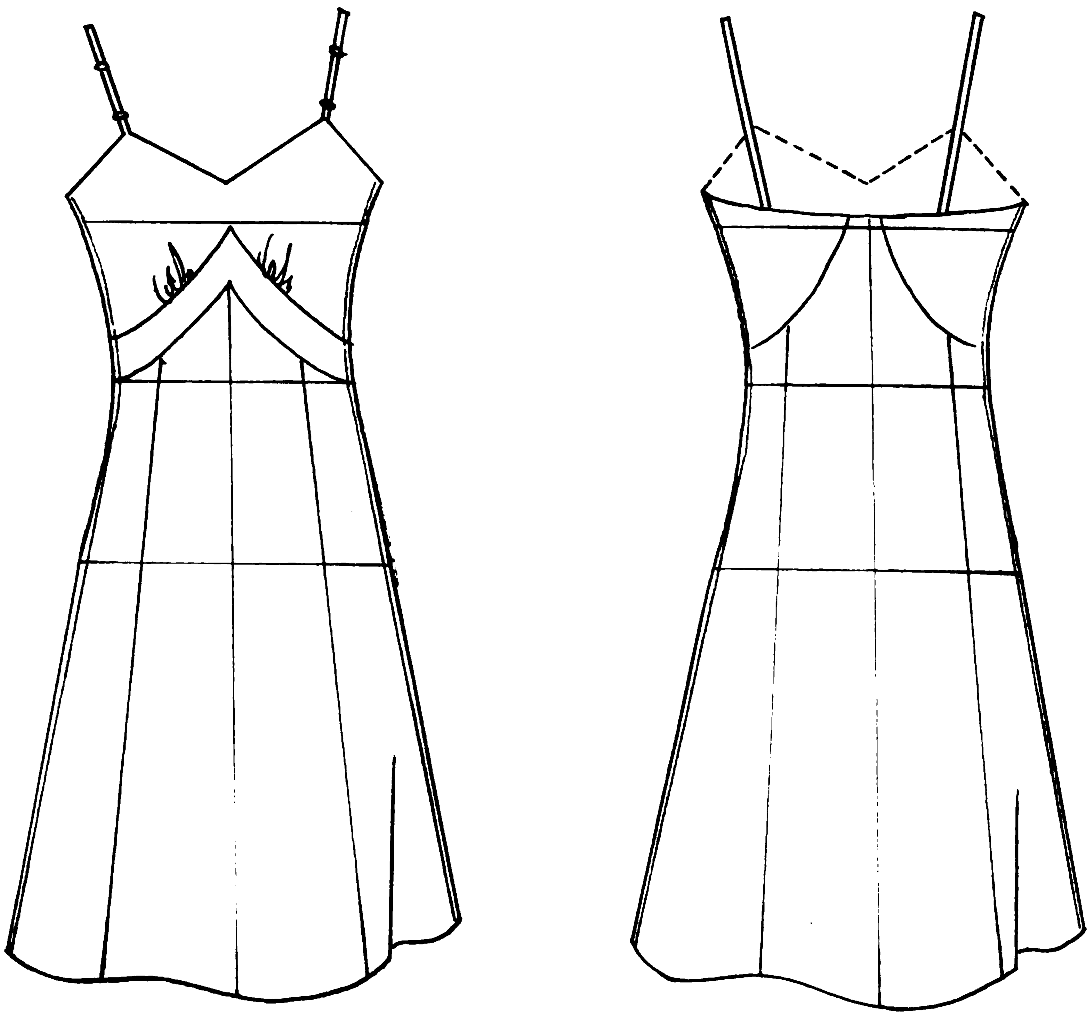
Standard Slip



——— Indicates Lines for Width Measurements

Bridal Slip

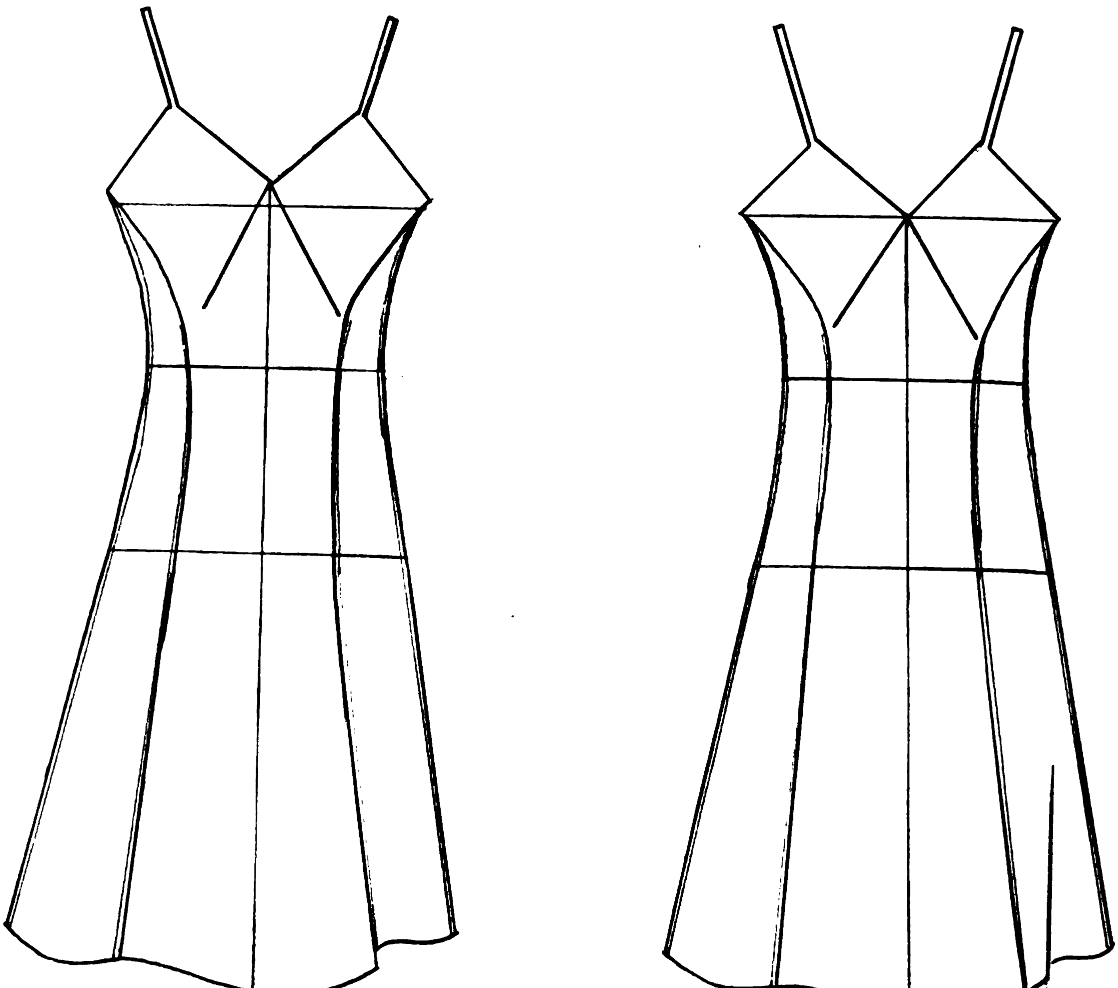
Front Back



Indicates Linear and Width Measurements

Brand C Slip

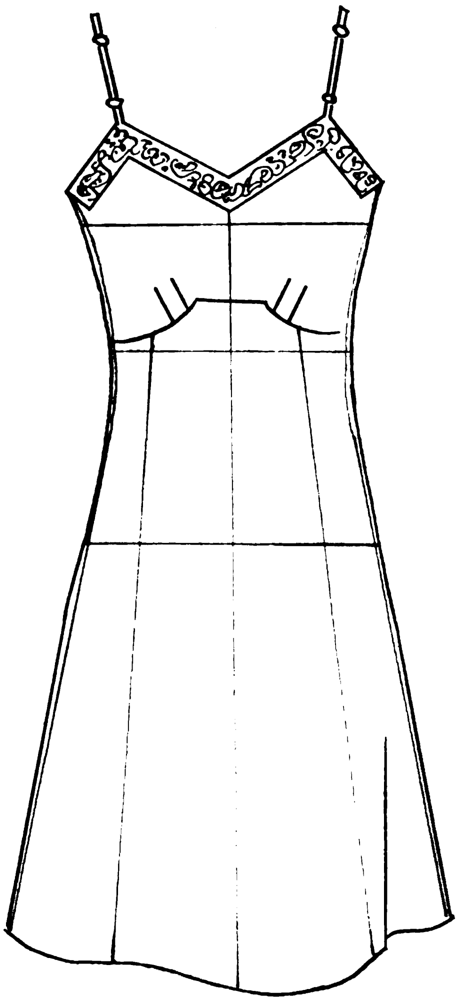
Front Back



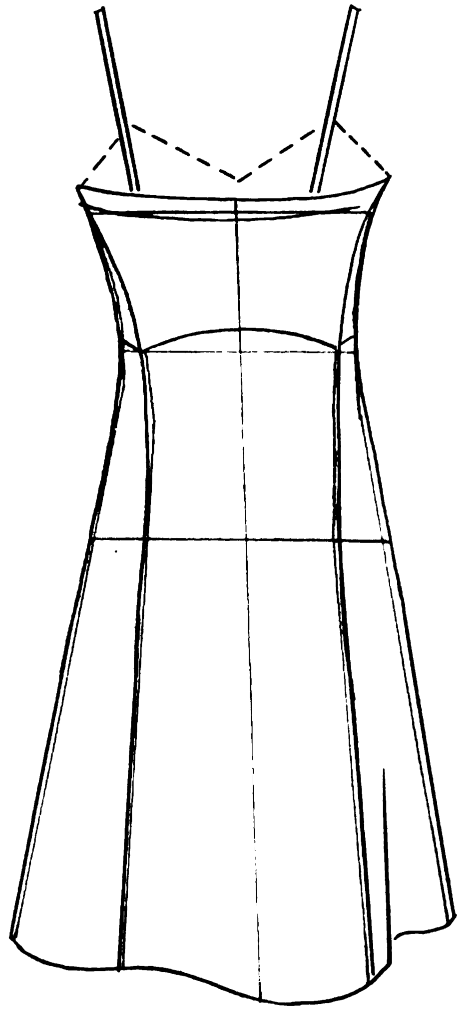
——— Indicates Linear and Width Measurements

Br[illegible] Slip

Front

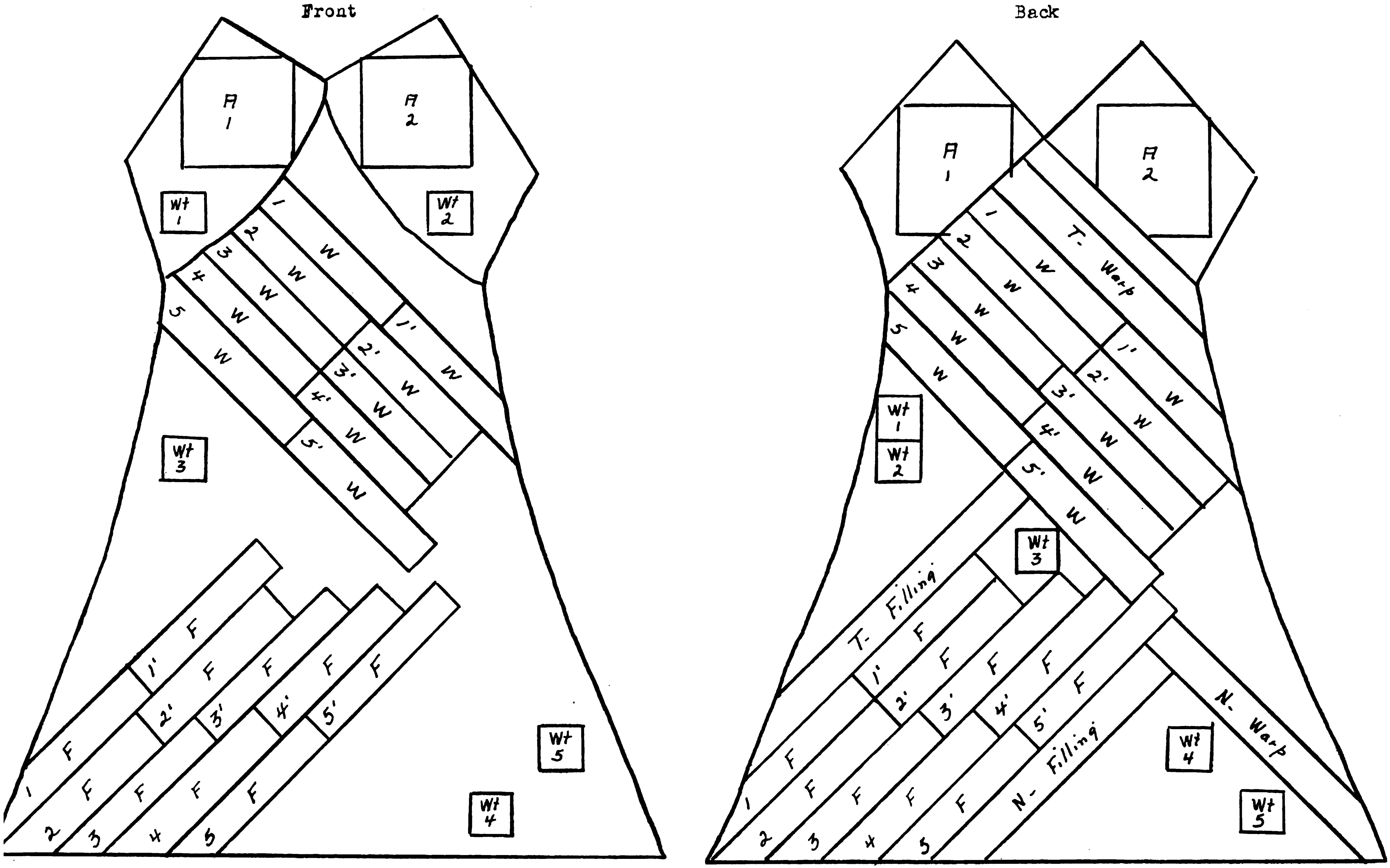


Back



——— Indicates Line and Width Measurements

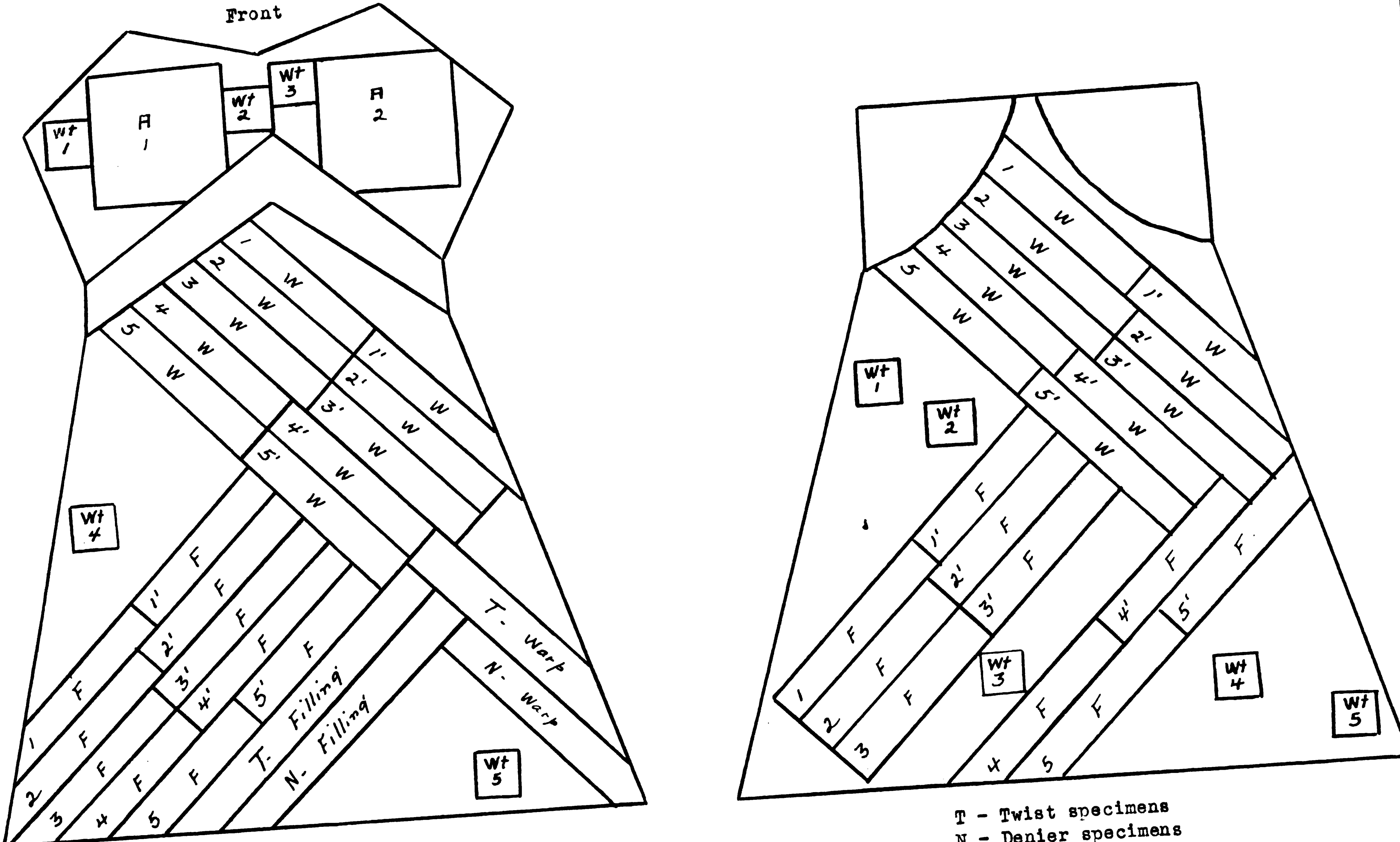
Chart I
Sampling Diagram
Brand A



A - Abrasion squares
W - Warp tensile strength
F - Filling tensile strength

T - Twist specimens
N - Denier specimens
Wt - Weight squares

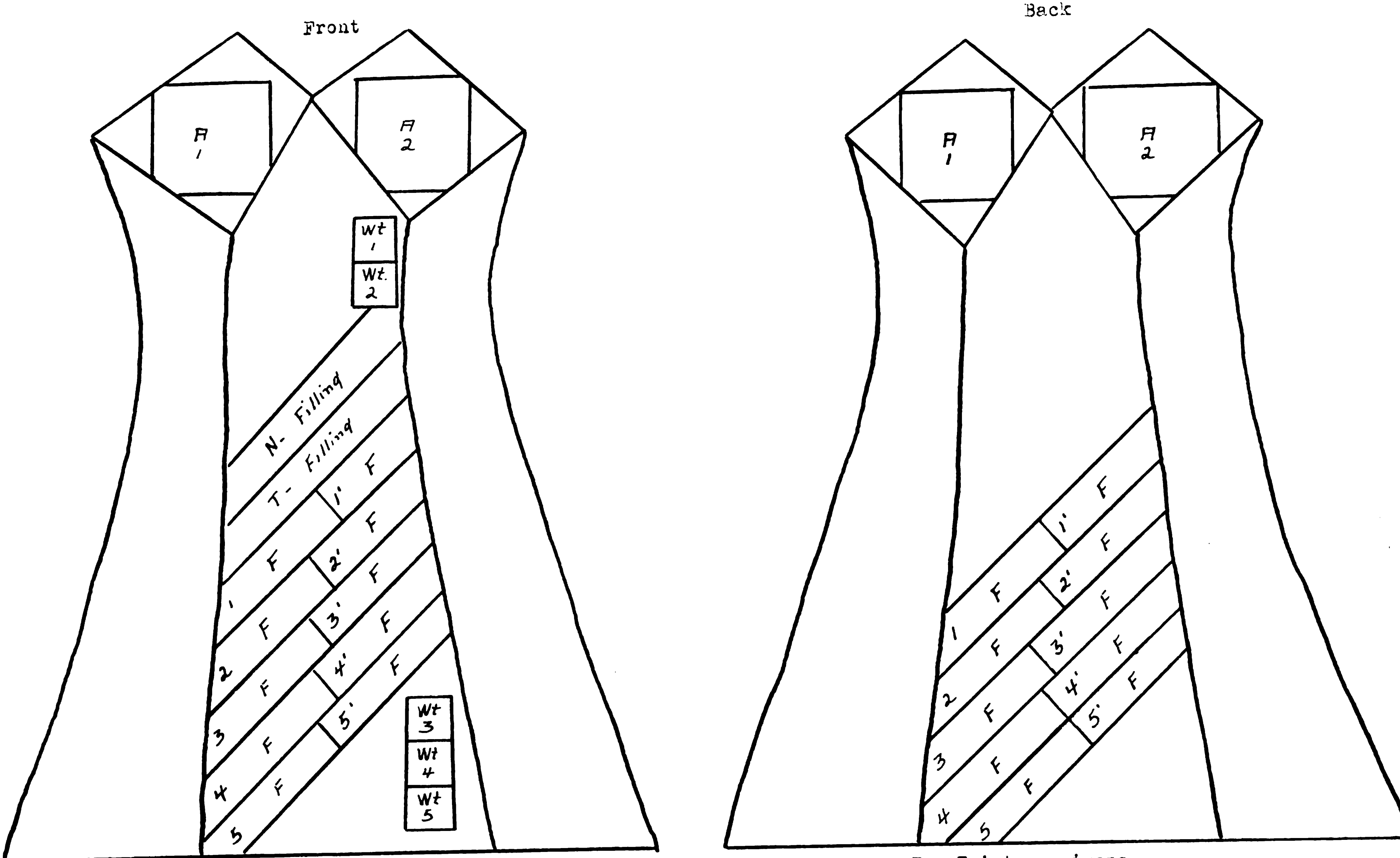
Chart 2
Sampling Diagram
Brand B



A - Abrasion squares
W - Warp tensile strength
F - Filling tensile strength

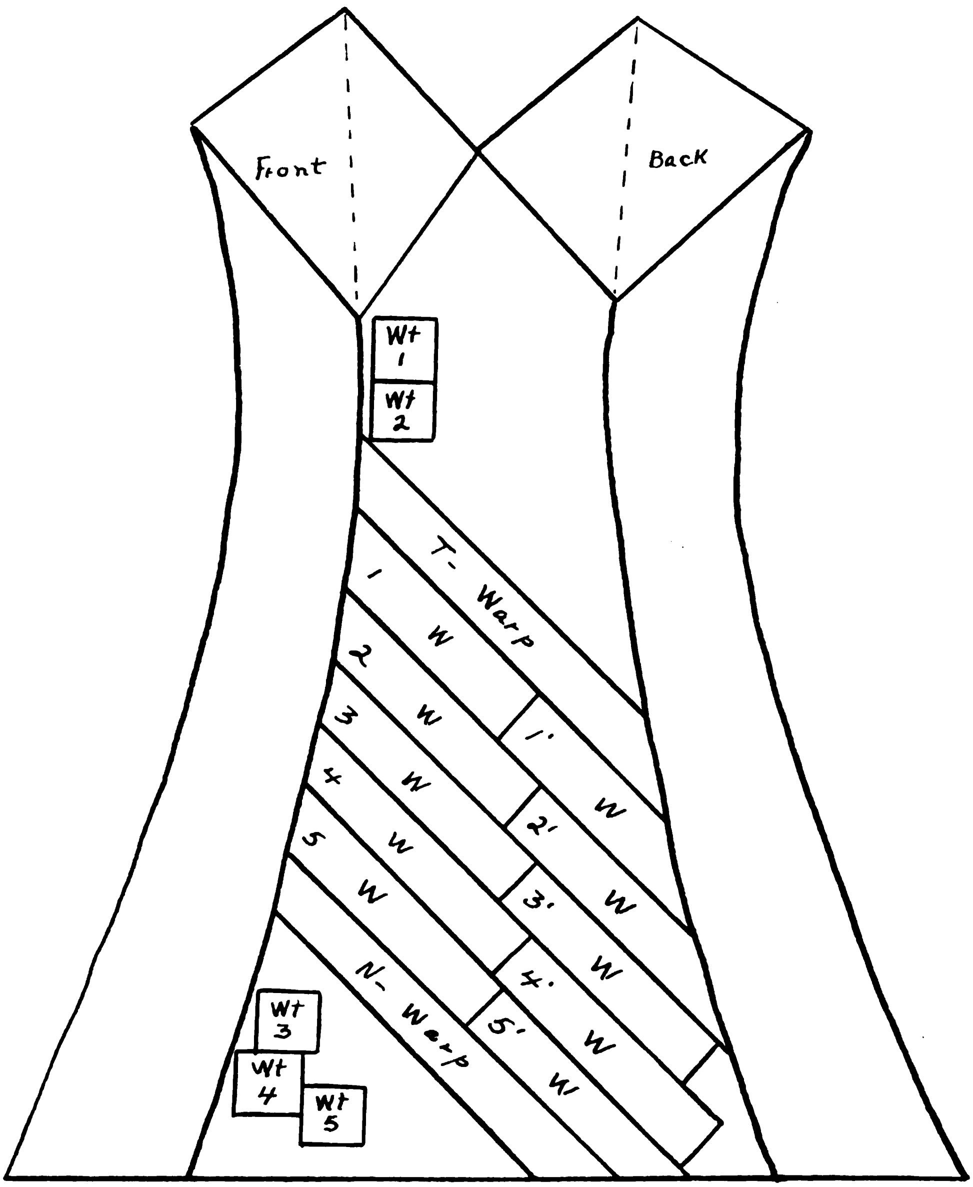
T - Twist specimens
N - Denier specimens
Wt - Weight squares

Chart 3
Sampling Chart
Brand C

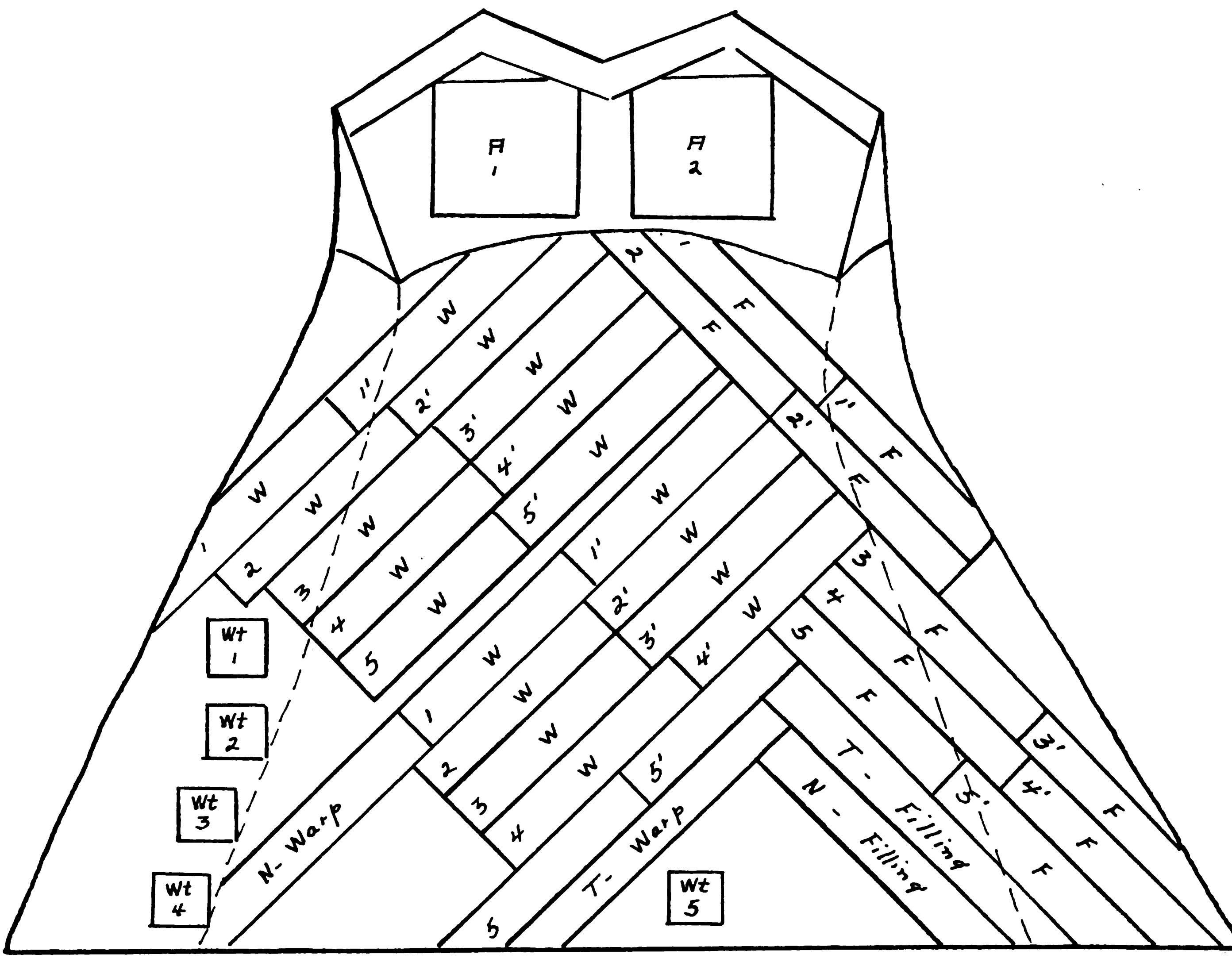


A - Abrasion squares
W - Warp tensile strength
F - Filling tensile strength

T - Twist specimens
N - Denier specimens
Wt - Weight squares



A Abrasion squares — T Twist specimens
W Warp tensile strength — N [illegible] specimens
F Filling tensile strength — Wt Weight squares

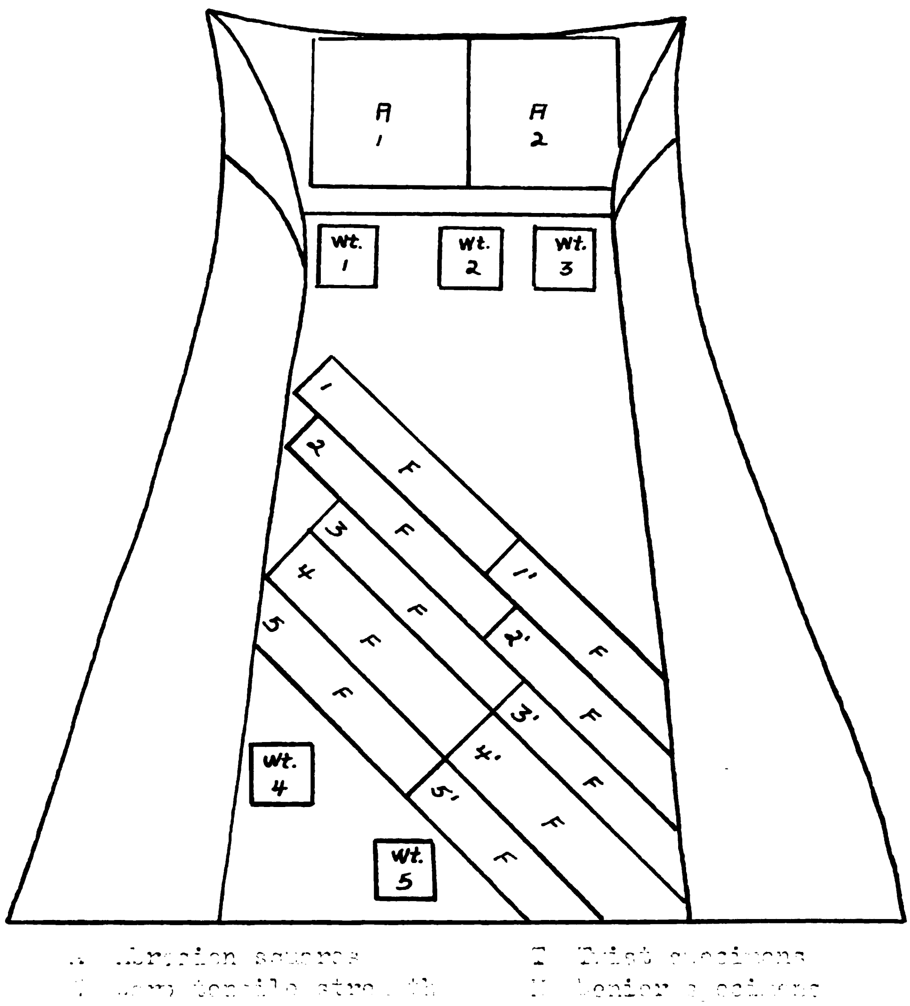


A Abrasion squares   T Twist specimens
W Warp tensile strength   N [illegible] specimens
F Filling tensile strength   Wt Weight square

[illegible]

[illegible]

[illegible]



A Abrasion squares
T Twist specimens
[illegible] tensile stre[illegible]th
H [illegible] specimens
F Fillin[illegible] tensile stren[illegible]th
Wt Wei[illegible]ht s[illegible]re

[illegible]

Thread Count *
Per Inch

[illegible]	5		10		20	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	120	111	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	109	[illegible]	117	110	[illegible]	[illegible]
[illegible]	117	[illegible]	**	**	**	**
[illegible]	[illegible]	114	[illegible]	117	***	***
[illegible]	[illegible]	110	121	110	131	[illegible]
[illegible]	[illegible]	104	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	111	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	77	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	120	110	[illegible]	[illegible]
[illegible] (1)			**	**	**	**
[illegible]	[illegible]	[illegible]	121	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	120	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	**	**	**	**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	***	***
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* [illegible]

** [illegible]

*** [illegible]

(1) [illegible] omitted because of [illegible] construction.

[illegible]

[illegible]

[illegible]	[illegible]		
	[illegible]	[illegible]	[illegible]
[illegible]			
34	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	3.11	[illegible]	3.05
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Table 11

[illegible] (1)

[illegible]

[illegible]	[illegible]		[illegible]		[illegible]	
[illegible]	[illegible]	10.17	0.47	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	6.01	1.75	[illegible]	[illegible]	[illegible]
[illegible]	0.77	[illegible]	0.78	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible].04	[illegible]	10.61	0.01	[illegible]

(1) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]		[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	59	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible] (1)
[illegible]

[illegible]	[illegible]		[illegible]		[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	[illegible]	[illegible]	[illegible]	[illegible]	74	[illegible]
C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) [illegible] of [illegible] taken
in each [illegible]

Table 16

[illegible]

Laundry Intervals	Brand	Sample No. 1*	Sample No. 2*
Low	[illegible]	119	111
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	51
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	100
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
Monthly	[illegible]	[illegible]	70
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]

[illegible]

[illegible] (continued)

[illegible] Interval	[illegible]	[illegible] No. 1*	[illegible] No. 2**
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	81.7	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	34
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
Thirtieth	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	10	[illegible]
	Total	[illegible]	[illegible]
	Average	[illegible]	[illegible]

* Number of revolutions [illegible]

** Number of revolutions for [illegible]

[illegible]

[illegible] [1]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	13.6	[illegible]
	[illegible]	[illegible]	[illegible]	17.1	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) [illegible] of five [illegible] listed.

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	[illegible]	[illegible]	[illegible]	[illegible]	7.3
	[illegible]	[illegible]	23.6	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

(1) [illegible]

[illegible]

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