COMPARISON OF SERVICEABILITY FACTORS OF DYNEL, ACETATE AND WOOL CRIB BLANKETS OF COMPARABLE COST

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COMPARISON OF SERVICEABILITY FACTORS OF DYNEL, ACETATE AND WOOL CRIB BLANKETS OF COMPARABLE COST

By

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INTRODUCTION

Consumers are being confronted with an ever increasing number of new textile terms. New fibers as well as new functional treatments and finishes for the well known fibers only add to their confusion. Glamorized advertising and the many wonderful claims made concerning these new fibers and finishes are bewildering, so the consumer needs more factual information pertaining to the respective performance characteristics of the different products.

The high price of wool has added incentive for the development of fibers which can be used in blends with wool or as an alternate for some products which have traditionally been made from wool. Dynel is one of these newly developed fibers recommended as an alternate. It is spun from the "Vinyon N" staple fiber produced by the Carbide and Carbon Chemicals Company. Dynel is said to be non-flammable, chemically-resistant, strong, resilient, and economical to produce. Because of its warm feel as well as its properties of strength and resilience, it has been vigorously promoted for use in blankets.

Another development for increased warmth in fabrics has been advanced by the Celanese Corporation through the permanent crimping of its acetate fibers. These crimped fibers have appeared on the market under the name of "Intercel". It has been quilted to satin, taffeta and other lining fabrics, the intercel constituting the interlining for storm coats, etc. It has also been quilted to knitted acetate fabric for use as crib comforters. Currently these comforters and dynel blankets have been selling at prices comparable to some all wool blankets. It is possible that increased production and improved methods may eventually make them lower in price than wool.

The purpose of this study was to determine, through a series of laboratory tests, how these recently introduced crib blankets of 100 per cent dynel or acetate compare with 100 per cent woolen blankets of comparable cost. The characteristics investigated were those which the average consumer considers desirable in crib blankets including lightness of weight, softness to touch, warmth, and colorfastness to laundering. Because of the necessity of frequent laundering of children's blankets, characteristics which provide ease in washing, i.e., a relatively short drying time; retention of original softness, resilience and hand; and minimum shrinkage and distortion are especially significant. The primary objectives, then, of this investigation were to compare the inherent physical and performance characteristics of the new blankets with their performance after twenty-five launderings.

Two types were chosen for comparison; the woven and the comforter type. The latter had either crimped acetate or dynel as the filler. Analysis of laboratory data constituted the basis for evaluation and comparisons between the wool and dynel woven blankets and between the knit comforters as well as comparison between the woven and the knit constructions.

REVIEW OF LITERATURE

Dynel is the staple fiber spun from "Vinyon N" yarns and produced by the Textile Fiber Department of the Union Carbide and Carbon Corporation. It is composed of 60 per cent vinyl chloride and 40 per cent acrylonitrile in copolymer (8) and is sold in two to twenty denier sizes and in a number of fiber lengths. Its chief properties are said to be dimensional stability, warmth, both dry and wet strength, resistance to combustion, chemicals, and mildew and its marked sensitivity to heat. Industrially it is used for dye and laundry nets, water softener and dust fume bags while in domestic use it is found in drapery and upholstery fabrics, rugs and blankets. It is in blankets that it has been more widely used because of its wool-like characteristics (28). Dynel is warm to the touch, has high covering power and the fibers do entrap air because of the irregularity of their cross-section. These characteristics together with its resilience and strength make it possible to produce heavily napped fabric without impairing the strength of the product. These have been the primary selling points for dynel blankets.

The Textralizing process (20) for crimping synthetic fibers added new horizons in acetate production. This process adds angular crimp and is said to be an improvement on nature's wavy crimp because it can absorb more wear and abrasion. It is also said to increase the bulking capacity of a fiber and so add to its warmth qualities. This crimp is not removed by the tension of high twist. Celanese research has resulted in the crimping of all its staple fibers and subsequently in the thermal insulating material known as Intercel (4). Intercel has been used in interlinings of cold weather garments as well as in crib blankets.

Although no studies of dynel or crimped acetate blankets have been reported, the various general characteristics which make blankets satisfactory to the consumer have been studied throughout the past quarter century.

In 1927 Rudnick (23) reported a study of The Effect of Laundering Upon the Thermal Insulating Value of Cotton Blankets. Thermal resistance, weight, length and width, were determined for each test specimen before laundering. After laundering the samples were reweighed, remeasured and thermal resistance was again determined. The samples were then napped and the same set of measurements taken. This procedure was followed after each laundering. It was concluded from the results of this investigation that an adequate process for laundering cotton blankets must provide means for either preserving or restoring the original fluffiness of the nap. Further, it was concluded that each laundering process may effect a slight decrease in thermal resistance.

Gilmore and Hess (13) investigated the Effect of Fiber Content and Care on the Resiliency, Thickness and Thermal Conductivity of Blankets. Blankets of 100 per cent wool, 100 per cent cotton, blends of cotton, rayon and wool, of rayon and wool, of aralac and wool and one paper blanket were studied. The effects of laundering, drycleaning and storage were determined. The all wool blankets were found to be more resilient than blends and the blends containing wool more resilient than those without.

Laundering and drycleaning tended to reduce resiliency. The thermal conductivity of the blankets was found to be related to the thickness and construction of the fabric rather than to the fiber content. It was found that the heaviest and most expensive wool was slightly less protective than the paper if both were the same in thickness. With one exception, laundering and drycleaning increased the protective value of the blankets containing wool, but in most cases laundering greatly decreased protective value of blankets containing cotton. There was shrinkage in all blankets and in both types of cleaning, however, laundering caused greater shrinkage than dry cleaning. All wool blankets were among those having the lowest per cent shrinkage with the highest in blankets containing rayon. Warp shrinkage was excessive while filling shrinkage did not reduce the widths noticeably except in an all cotton and in a blend of wool and aralac. Cotton and rayon stretched 1.0 per cent and 2.5 per cent in width respectively.

A service study of blanket fabrics made from blends of wool and mohair was reported by Rogers, Hays and Hardy (22). The blankets were used by the United States Naval Hospital in Washington, D. C. and were laundered sixty times at two week intervals. In this study it was found that significant changes were produced in the blankets by service, but increasing amounts of wear and laundering did not produce progressive changes in the various properties. Both compressional resilience and thermal insulation values were significantly lower in laundered blankets than in the unlaundered. A significant increase in strength was noted during the first twelve launderings in both warp and filling, however, subsequent launderings did not produce further significant changes in strength. Shrinkage was greater in the warp than the filling, but less in the all new wool blankets than in those containing reworked wool.

In a study by Hays (17) consumer specifications for household blankets were suggested. Six classes of blankets having different fiber content were studied. The blankets were not laundered; only the initial specifications were determined. Wool and cotton blends were generally more resistant to abrasion and tensile strength varied greatly, particularly in the filling yarns. On the basis of the data collected, it was proposed that; 1) blankets be classified by fiber content and weight; 2) that the classes be defined by minimum requirement for yarn count, breaking strength, weight and thickness, and by maximum requirement for air permeability, heat transmission, and loss of strength after abrasion. The purpose of this classification was to enable the consumer to purchase for individual needs and to be able to compare blankets in different classes not only on basis of price, fiber content and general appearance, but by weight, thickness, strength, air permeability etc. as well. It was suggested that information could be given on the label or by stating that the blanket meets requirements for a specific class of blanket as established by an association such as A.S.T.M.

The performance of blankets, manufactured under war time restrictions, to various cleaning agents was investigated by Ford and Strahan (11). They too noted greater shrinkage in warp than filling and greater distortion in blankets having a high percentage of rayon. Less deformation resulted in dry cleaning than with any of the agents used in laundering. Distilled water with Lux was the most satisfactory agent for laundering.

Scheifer and others (21) in studying 156 different household blankets, found a linear relationship between the compressional resilience and the wool content of cotton-wool blankets and the reciprocal thermal transmission was found to be related linearly to the thickness. They too, found thermal transmission to be independent of the kind of fiber. Empirical relationships were also found among thermal transmission, thickness at 1 lb./in.^{2}, and compressibility; and among thickness at .1 lb./in.^{2}, compressibility and weight. Breaking strength of blankets was found to increase in general with the area weight and to decrease with compressibility. All blankets shrank in both warp and filling directions with greatest shrinkage occurring in the first laundering. Breaking strength generally increased with laundering. It was further noted that decrease in compressibility indicated felting or matting of the blankets.

Since protection from cold is the most important requirement for a blanket, studies related to the warmth qualities of fabrics and the measurement of heat conductivity are also included in this review of literature.

Hock and others (17) concluded from their study of the thermal properties of moist fabrics, that area of contact between the fabric and the skin was a major factor contributing to the chilling effect of moist fabrics. Furthermore they found that progressive improvement was shown by the addition of wool with its rougher surface and greater loft. It was also noted that fabrics which make best contact with the skin produce moist clammy feeling and those with poor contact are less chilling when wet.

Schwarz (28) states that air is a very good insulator and that the function of textile fibers is to keep air trapped in small pockets in a constant position relative to the body. Textile fibers should provide "nap traps" to prevent straight line passages of air through the fabric.

Hoffman (18) also noted that the air-filled spaces between the fibers govern the insulation and warmth properties of the fabric. The factors governing the amount of air space in fabrics are: 1) the way in which individual fibers pack which, in turn, is due to crimp, stiffness and recovery behavior, and 2) yarn construction (ply and twist), shape, size and distribution of fibers.

Rees (21) demonstrates that heat loss is dependent on thickness and that low density fabrics (generally) have higher resistance to heat flow than higher density fabrics. He also notes that surface structure (smoothness and roughness) is a contributing factor in causing the initial chill or cold feel in fabrics when they are brought in contact with the skin.

The relationship between the structural characteristics of fabrics and various functional characteristics was investigated by Baker (2). He notes that textiles which have low density and contain a large proportion of air within their structure have high insulation value. He also notes that fabrics with a lower proportion of fiber to air will have a higher resistance to heat flow. It was evident that the layer of dead air space was of great importance in determining heat flow. He points out that the conditions of test (wind velocity, tension, or compression on the sample) which distribute this layer must be carefully controlled.

Hess and others (16) in comparing the protective value of certain fabrics in still and moving air used the method of compensating electrically the heat loss from an oil filled copper cylinder placed in a well-insulated calorimeter. The electrical energy necessary to compensate for the heat loss from the cylinder to its environment was determined. The ratio of the compensating energy of the bare cylinder to that of the cylinder covered with the cloth sample to be tested was taken as the ratio of protection for the fabric. Tests were conducted in still and in moving air. The rating of fabrics on the basis of increasing protective ratio was found to be the same in still or in moving air. It was also found that when made into closely fitting covers, fabrics having a pile or nap afforded greater protection when the smooth surface was next to the body. This was found to be true in determinations made in both still and moving air.

Investigators agree in general that the warmth of a fabric is dependent on, 1) the amount of air held within its structure, 2) the prevention of air currents through the fabric, and 3) the area of contact of the fabric.

Furry and O'Brien (12) investigated the effect of detergents and washing methods on the fabric properties of wool. Shrinkage, breaking strength and elongation were found to be related to agitation of the fabric during laundering, and agitation was a more important factor than temperature or detergent in producing changes.

Fletcher and Roberts (10) found that in knit goods, changes in dimension in laundering are due largely to a rearrangement of the fabric structure. They demonstrated that fabrics could be given a relaxation treatment to remove distortion so that the structure would exhibit little rearrangement after laundering and the area would remain nearly constant. Dimensional changes usually were not greater than 10 per cent and often less than 5 per cent for relaxed fabrics.

In an earlier study Fletcher and others (9) found that the dimensional change of knit goods varied with the type of construction, the number of courses per inch and the fiber content. Lengthwise shrinkage was less in fabrics having 40 courses per inch than in those having 30. They noted that the greatest change took place in the first laundering and that knitted fabrics usually shrank more in length than woven fabrics of similar fiber content.

EXPERIMENTAL PROCEDURE

A. Organization of the Study

Selection of Blankets

Four groups of crib blankets, 36 by 50 inches, were purchased in April, 1952, at retail stores in Lansing, Michigan and Goshen, Indiana. Two groups of five blankets each were of woven construction and had the same brand name. The blankets in Group I were made of 100 per cent wool and those in Group II of 100 per cent dynel. Because one of the wool blankets was of a different brand, it was not used in the study, so four instead of five blankets constituted Group I.

The blankets in groups III and IV were of a quilted knit construction. The tops and backs were of warp knit acetate quilted over a filling of spun crimped acetate in Group III and over spun crimped dynel in Group IV. The blankets in all four groups were finished with bindings of acetate satin.

The unit cost of the blankets in each group was approximately the same, ranging from $3.95 to 5.98. The pastel colors varied including maize and white in Group I, maize, blue, pink and green in Group II, maize, blue, green and white in Group III, and maize, blue, pink, green and white in Group IV.

Experimental Procedure

A twenty-five inch square was taken from each blanket as shown in Plates V and VI of the Appendix. These sections were bound with the original binding and used for checking dimensional change in laundering and for physical testing after twenty-five launderings. The remainder of each blanket was used for physical testing of the original fabric and for comparison of change in color and hand during the series of launderings. The physical tests, before and after laundering, included tensile and/or bursting strength, resilience, resistance to abrasion and thermal transmission. Yarn count, fabric weight and thickness were also taken of the original blanket fabrics and after twenty-five launderings.

Laundering Procedure

The procedure used in laundering was a modified version of that recommended by the Westinghouse Electric Corporation for washing woolen blankets in the Laundromat. The water saver dial was set at "regular" and the control dial at "warm" (95°F). Two tablespoonfuls of detergent were placed in the machine. The machine was filled with water and the blankets completely submerged in the suds. The blankets were allowed to soak for ten minutes, the minimum time recommended for removing soil, and the water extracted by a two minute spin. They were then rinsed by hand one at a time in a large volume of water by gently squeezing the water through the fabric without lifting the blanket from the water. They were then returned to the machine for a second two minute spin. A second similar rinsing was followed by a four minute spin after which the blankets were dried flat on a metal screen. Before the binding was completely dry it was pressed with a hand iron with the control set at "warm".

Dimensional Change

Prior to laundering, the twenty-five inch squares of the woven blankets were marked with basting lines, into an eighteen-inch square. Subsequent basted lines were placed at six inch intervals between the two sets of parallel lines.

Four vertical and four horizontal measurements correct to the nearest one-sixteenth of an inch were made on each laundered speciman after the first, second, third, fourth, fifth, tenth, fifteenth, twentieth, and twenty-fifth laundering. The average of the four warp and four filling-wise measurements were recorded and the percentage dimensional change calculated. The specimens were allowed to condition on the metal screens from four to twelve hours after pressing the binding, before any measurements were taken.

Shrinkage Testing

The Knit Goods Shrinkage Tester, developed by the United States Testing Company, was used to determine the shrinkage and restorability in the knit blankets. The testing procedure was that accompanying the instrument.

Three ten-inch squares were cut from the blankets as shown in Plate VI of the Appendix. Using a template, a five inch square was marked within a six-inch outline on each ten inch specimen with the sides of the squares parallel and equidistant. The samples were then laundered and dried flat on a metal screen at room temperature.

The percentage of shrinkage in the completely dried sample was noted by measuring the five inch squares first in the direction of the wales then in the direction of the courses. A ruler divided into one-tenth inch units was used for measuring, one-tenth inch being equal to two per cent change in the five inch square. The average of three measurements in each direction was recorded as the percent dimensional change.

Based on the calculated shrinkage in the relaxed square, the sample was placed on the stretcher of the shrinkage tester to gauge the tension required to restore the fabric to shape and size. The six inch outline was first applied to the fixed sides of the frame and the movable sides were brought up to meet the two remaining sides of the inked outline and the fabric pressed onto the needles with a stencil brush. Alternate tension was applied to wales and courses until the original five-inch square was obtained. The movable needles were guided along the frame in the direction of the stretch as tension was registered on the scales. The registered tension was taken as the final determination of the fabric restorability.

b. Laboratory Tests

<u>Fiber Content Confirmation</u>

The fiber content was confirmed by burning tests, by the use of sodium hydroxide for wool, and acetone for dynel and acetate. In distinguishing between acetate and dynel a solution of 20 per cent water and 80 per cent acetone, by volume, was used. This solution dissolved the acetate but did not affect the dynel, while 100 per cent acetone dissolved both acetate and dynel (5).

Yarn Count

A Suter Micrometer was used for determining the number of yarns per inch for both warp and filling. The counts were taken on the specimens for abrasion tests and no two contained the same warp or filling yarns. The woven fabric squares were placed over a light box for counting the number of yarns in one and one-half inches. The average of five counts was recorded for the warp and filling.

For the knit blankets the wale and course count was determined in accordance with the standard procedure for knit fabrics as approved by Committee D-13 of the American Society for Testing Materials (1). The number of wales and courses per inch was determined by counting a space of two inches with a micrometer. The average of five counts in each direction divided by two was recorded as the wale or course count per inch.

Yarn number

The instrument used for this test was the Universal Yarn Numbering Balance. According to the directions accompanying the instrument, a length of yarn was removed from the fabric and measured to the proper length on the metal tape provided for that purpose. The length required for wool was 12 and 27/32 inches; for the dynel 36 inches (as required for spun rayon). The yarn was looped and hung centrally on the balance hook, and the index lever rotated until the beam was in balance. Readings were recorded directly from the scale with the average of ten determinations recorded as the yarn number. This procedure was followed for both warp and filling in the woven blanket fabrics.

Since it was impossible to obtain yarns of the required length from the knit blankets neither yarn number nor twist was taken.

Yarn Twist

An Alfred Suter Twist Tester was used to determine the number of twists per inch. The procedure followed was the modified procedure described in Haven, Mechanical Fabrics (14). A one inch guage length was used which is the length recommended for single yarns. The yarn was ravelled back from the 30 inch strip for a distance of four inches and inserted in the right hand jaw. The remaining length was carefully removed with a pick needle so as to retain original twist. The yarn, under a deflection load of three grams was insertec into the left hand jaw. The deflection load was lifted, the jaw tightened and the yarn untwisted until all twist was removed and the fibers were parallel. The number of turns required to parallelize the yarns was recorded as the number of turns per inch. An average of ten determinations was used in reporting the twist per inch for warp and filling yarns respectively.

Weight per Square Yard

Five specimens, two inches square were taken from each blanket in such a manner as not to incluce the same warp or filling yarns in any two squares. These were then conditioned for four hours and weighed on the Chainomatic balance. Weight per square yard was computed according to the following formula (27).

$$\frac{36 \times 36 \times \text{weight of samples in grams}}{\text{square inches of samples} \times 28.35} = \text{oz. per sq. yd.}$$

or simplified;

$$\frac{45.71 \times \text{weight of samples in grams}}{20 \text{ square inches}} = \text{oz. per sq. yd.}$$

Breaking Strength

The raveled-strip method was used for the woven blanket fabrics as the size of the blankets did not allow for the larger specimens required for the grab method. In accordance with A.S.T.M. procedures (1), ten specimens one and one-half by twelve inches were taken. Five were cut having the longer dimension parallel with the warp yarns and five having the longer dimension parallel with the filling yarns. No two specimens for warp breaking strength contained the same warp yarns and no two specimens for filling strength the same filling yarns. Each specimen was raveled to one inch by removing approximately the same number of yarns from each side. Each strip was then divided into two six-inch strips for wet and dry testing. For determination of wet strength the specimens were soaked in distilled water for four hours, after which they were removed one at a time and tested within two minutes.

Elongation

The per cent elongation of the specimens was obtained simultaneously with the tensile strength and was recorded on the autographic tensilgram sheet. The elongation was calculated from the start of the line as shown on the graphic record until the point of rupture. An average of five determinations each for warp and filling was considered the percent elongation respectively for warp and filling yarns for that fabric.

Bursting Strength

The bursting strength of the knit fabrics was determined in accordance with the standard general method for testing bursting strength as approved by Committee D-13 of the American Society for Testing Materials (1). The instrument used was a motor driven pendulum Scott Tensile Testing Machine, equipped with the ball bursting attachment. Five samples, four and one-fourth inches square were used to determine the dry bursting strength. After conditioning, the specimen was placed in the ring clamp mechanism and held securely under a tension which was uniform in all directions, and the center of the specimen was pressed against a polished steel ball until ruptured. The direction of the bursting motion of the ring clamp was at right angles to the original plane of the specimen. A second set of five specimens, after immersion in distilled water for four hours, were burst in the same manner as the dry specimens. The average bursting strength in pounds in the five specimens was reported as the bursting strength respectively for wet and dry determinations. The bursting strength of the knit fabrics was too high for use of the Scott Tensile Strength machine which had the tensilgram attachment for recording elongation.

Thickness

The thickness of the fabric was determined with the Shiefer Compresso-meter, the procedure that outlined by Schiefer (25). The sample to be tested was placed on the anvil of the instrument smooth but without tension. The five inch foot was used and lowered upon the specimen and the pressure gradually increased. When the pressure reached .1 lb./in.^{2}, the lower dial reading was recorded. Similar observations were made and recorded at seven other pressures up to 2. lb./in.^{2}. The standard thickness was recorded as the difference between the zero reading of the instrument and the reading at .1 lb./in.^{2}. The series of readings were taken at three different areas of the fabric specimen and the average of the three determinations recorded as the standard thickness.

Compressibility and Compressional Resilience

The compressibility and compressional resilience of the fabric were calculated from the data recorded when the thickness of the fabric was measured. Compressibility was recorded as the ratio of the rate of decrease in thickness at a pressure of one pound per square inch to the standard thickness and was computed by the following formula:

$$\frac{\Delta t}{t} = C \qquad \text{where}$$

C = compressibility
Δt = thickness at 1 lb./in.^{2}
t = standard thickness

The compressional resilience of the specimen is the amount of work recovered when the pressure is decreased from 2. lbs./in.^{2} to .1 lb./in.^{2} expressed as a percentage of the work done on the specimen when the pressure is increased to 2 lbs./in.^{2} (29). The reported compressional resilience was calculated by the following formula:

$$\frac{R}{C} = \% \, CR$$

where

R = the amount of work recovered

C = the total compression

and CR = compressional resilience

Abrasion Resistance

The Taber Abraser was used as the laboratory means of creating destruction of the fabric by abrasion. The calibrase wheels were prepared by the procedure recommended for this instrument, before starting the test and after each 1000 cycles.

The test specimens were placed on the turntable of the machine and tightly secured against the clamping plate by means of a nut. The fabric was tautly pulled to prevent wrinkling of the specimen during the test. Finally the clamping ring was securely attached.

Six specimens from each blanket were tested for purposes of comparison of the abrasion resistance qualities of the fabrics. Plates V and VI in the Appendix show the position of the test specimens which were taken from the blankets.

In the woven blankets the specimens were abraded a constant number of cycles and the samples compared in terms of signs of wear. Signs of wear were considered to be changes in the appearance of the napped surface as well as the appearance of the yarns, but not necessarily a break in the yarn. Two specimens each were run 150, 300, and 450 cycles.

Three specimens from the knit blankets were abraided to a point at which the material was judged to show first signs of wear. The number of cycles was recorded and the abrasive action continued to complete breakdown of the material. The average of the number of cycles for three samples at each test interval was reported as the number of wear cycles for that group. The second set of three specimens were run a constant number of cycles.

Thermal Transmission

Accurate measurement of heat transfer is difficult to accomplish even with adequate instruments, so at best the test procedure and instrument of test for this study provides only a comparison of warmth values of the different blankets and is not represented as complete or as a measurement of their warmth under specified conditions of still and moving air.

The method used to test the heat transfer properties of the blankets was that for use with the Fitch thermal conductivity apparatus (27). The apparatus consisted of: 1) a copper cylinder, a "source", which held water maintained at the boiling point by an immersion heater; 2) a receiver consisting of a known mass of copper insulated from its surroundings except at the top; and 3) a galvanometer. The galvanometer was connected to two thermocouple junctions, one in the bottom of the source and one in the top of the receiver. To insure proper contact with the sample the source was weighted so that the total weight of source, water and heater applied to the face of the receiver gave a pressure of 3.3 pounds per square inch.

The specimen to be tested was placed on the receiver and the source, which had been heated to boiling, lowered onto the sample and receiver. The current was read and recorded at two minute intervals until ten readings had been recorded. The readings were plotted on semi-logarithmic graph paper and the thermal conductivity calculated by the formula:

$$m = -2.303 \quad \frac{lMc}{KA}$$

where

m = slope of the graph

l = thickness of the material

M = mass of the copper plate

c = specific heat of the copper plate

A = surface area of the copper plate

K = coefficient of thermal conductivity

DISCUSSION OF RESULTS

A. Analysis of Original Fabrics

An analysis of the initial physical test data on the four new blanket fabrics, to determine differences or similarities in characteristics and performance included analysis of yarn for number or size, and the amount and direction of twist, and verification of fiber content. Fabric analysis consisted of weave, weight per square yard, yarn and/or wale and course count.

Bursting and/or breaking strength, elongation, resistance to abrasion, and thermal conductivity constituted the performance tests.

Fiber Content

Microscopic and chemical analysis verified fiber content. Wool fibers were verified microscopically, by burning, and chemically by boiling in a five per cent solution of sodium hydroxide. From reactions obtained it was concluded that all blanket fabrics constituting Group I were of 100 per cent wool content.

Dynel was distinguished from acetate fibers by immersion in an 80 per cent solution of acetone. From the reactions noted it was concluded that fabrics in Group II were 100 per cent dynel and the covering fabrics in Groups III and IV were 100 per cent acetate. The fibers of the batt in Group III were acetate and those in Group IV were dynel. A very thin layer of matted cotton fibers covered each side of the acetate batt in Group III while a similar layer covered one side of the dynel batt.

Yarn Analysis

Due to the construction of the knitted fabrics it was not possible to analyse their yarns. Both warp and filling yarns in the wool blankets were number ten yarns. In the dynel blankets there was a marked difference in the size of the warp and filling yarns. Filling yarns were much coarser (number 3), than the warp yarns which were number 16. This difference in yarn size was no doubt due to the fact that only the filling yarns in the dynel blankets were napped. In the wool blankets double or "two directional" napping was done.

In both the wool and dynel woven blankets, the warp yarns were more tightly twisted than their filling yarns. However, the differences in amount of twist between warp and filling yarns was much greater in the dynel than in the woolen blankets. The average number of twists per inch given the wool warp yarns was 9 and 6 turns per inch in the filling yarns. The warp yarns of the dynel blankets had 16 turns per inch but the filling yarns had only 4. All yarns were given a Z twist.

Weave

The wool blanket fabrics were constructed in a 2/2 twill weave while the dynel blankets were of double weave construction, one set of warp and two sets of filling yarns.

Yarn Count

Both the wool and the dynel woven fabrics were well balanced in construction, but the total yarn count in the woolen blankets was only two-thirds of the dynel. The yarn count in the wool blankets was 26 and

25 yarns respectively for warp and filling. The dynel fabrics had a warp-filling count ratio of 37 to 35 yarns per inch.

Course Count

There were slight differences in the wale and course counts of the acetate-filled and the dynel-filled blanket fabrics. In the acetate-filled group the average wale count was 40 and the course count 56 per inch. In the dynel-filled group the wale count of the knit covering was 38 and the course count was 50 per inch. This difference in the wale-course ratio in the two knit constructions would indicate that differences in their behavior in the subsequent launderings might be expected.

TABLE I

ORIGINAL SPECIFICATIONS

Fabric	Yarn Number[1] W	Yarn Number[1] F	Twist Per Inch[2] W	Twist Per Inch[2] F	Yarn Count[3] W	Yarn Count[3] F	Course Count[4] Wales	Course Count[4] Courses	Weight Per Sq.Yd. in Ounces[5]	Thickness in Inches[6]
Wool I (woven)	10	10	8.6	5.55	26	25			11.35	.2245
Dynel II (woven)	17.55	3.26	15.52	4.44	37	35			10.8	.2372
Acetate (knit)							40	56	13.98	.1573
Dynel (knit)							38	50	12.56	.1518

[1] Ave. of 10 determinations
[2] Ave. of 10 determinations
[3] Ave. of 5 determinations
[4] Ave. of 5 determinations
[5] Ave. of 5 determinations
[6] Ave. of 3 determinations

Weight in Ounces Per Square Yard

The weight per square yard was calculated from samples conditioned for at least four hours under standard conditions of 75° ± 2 temperature and 65 ± 2 per cent relative humidity. The wool and dynel blankets weighed 11.3 ounces and 10.8 ounces per square yard respectively. The dynel was initially one-half ounce per square yard lighter than the woolen blankets.

The weight of the acetate-filled blankets was 14 ounces per square yard and the dynel-filled blankets weighed 12.6 ounces per square yard. The average weight of the acetate-filled blankets was one and one-half ounces per square yard greater than that of the dynel-filled group. Differences were greater between the two types of fiber-filled blankets than differences between the two groups of woven blankets.

Thickness

Original thickness measurements showed the woven dynel blankets to be approximately 5.5 per cent thicker than the woolen blankets. Original values were .2245 inches for the wool and .2372 for the dynel. The original dynel blanket fabric had greater thickness in relation to its weight than the woolen fabric.

The difference in thickness between the two knit fabrics was slight. The acetate-filled group averaged .1573 inches in thickness and the dynel-filled group .1518 inches.

E. Performance Tests on Original Fabrics

Breaking Strength

The dry warp breaking strength of the woven dynel blankets was approximately thirteen per cent greater than that of the woolen blankets. Wet warp breaking strength in both the dynel and the wool was lower than dry. However, the wet strength relationship to dry in the wool was 32 per cent lower while the wet strength of the dynel was only 7 per cent less than its dry strength. Dry breaking strength of the dynel warp (37 lbs.) and of the wool (33 lbs.) are not as significantly different as the wet strength differences; 35 and 22 pounds respectively for the dynel and the wool. Filling-wise the dynel was five times as strong as the wool in dry testing and four times as strong in wet testing. Filling strength for the dynel was 15 pounds dry and 22 pounds wet while the dry strength of the wool was only 3 pounds and wet strength 5 pounds. The gain in wet strength of the wool filling yarns was attributed to the increased tenacity of the napped fibers when wet. These tests verify the claim of greater fiber strength for dynel; a particularly significant characteristic for consideration when frequent laundering of the product is required.

Elongation

Dry warp elongation for the dynel blankets was 37 per cent and 23 per cent for the wool. Wet warp elongation was 40 per cent for the dynel and 56 per cent for the woolen blankets. Difference in dry and wet elongation was but 3 per cent in the dynel but elongation of the wet wool

TABLE II

ORIGINAL PERFORMANCE

Fabric	Breaking Strength[1] Dry W	Breaking Strength[1] Dry F	Breaking Strength[1] Wet W	Breaking Strength[1] Wet F	Elongation[2] Dry W	Elongation[2] Dry F	Elongation[2] Wet W	Elongation[2] Wet F	Bursting Strength[3] Dry	Bursting Strength[3] Wet	Comp. Res.[4]
Wool (woven)	32.9	3.1	22.3	5.1	23.5	14.	56.57	36.11			37.17
Dynel (woven)	37.3	15.06	34.7	22.1	37.13	33.45	40.4	32.6			24.59
Acetate (knit)									135.	94.9	49.13
Dynel (knit)									129.58	90.76	36.44

[1] Ave. of 5 determinations
[2] Ave. of 5 determinations
[3] Ave. of 5 determinations
[4] Ave. of 3 determinations

was considerably more than twice as great as its elongation when dry. In the filling direction, dry elongation was 33 per cent for the dynel and 15 per cent for the wool while wet determination showed dynel filling elongation 32 per cent, which is comparable to the wool's 36 per cent elongation. This test data indicates that dynel was not greatly affected by moisture. Elongation in the wool was twice as great wet as dry. In addition to the fact that the wool lost 32 per cent strength warpwise when wet, elongation difference would indicate that much greater care would be required in laundering the woolen than the dynel blankets.

Bursting Strength

Initial bursting strength of the dynel-filled blankets was approximately four per cent lower than the acetate-filled blankets in both dry and wet testing. In both groups, the wet tests showed a 31 per cent loss in strength. However, there was some variation in bursting strength within the two groups. One blanket from each group deviated as much as five per cent from the average of the other four in its group. The average bursting strength of the four acetate-filled blankets was 135 pounds when dry and 95 pounds when wet. The average dry bursting strength of the four dynel-filled blankets was 130 pounds and the wet strength was 91 pounds. These figures represent the breaking strength of the cover only and part of the difference may be due to the difference in the closeness of the quilting.

Compressional Resilience

In the new blankets the compressional resilience of the woven all wool blankets was fifty per cent greater than the woven dynel. The acetate-filled blankets showed thirty-three per cent greater compressional resilience than the dynel-filled blankets. Resilience values of the original blanket fabrics was 37 per cent for the wool, and woven dynel 25 per cent. The knit acetate-filled was 49 per cent and dynel-filled 36 per cent.

Abrasion

No standard method of test procedure and subsequent evaluation for abrasion tests has, as yet, been agreed upon since results obtained from the different instruments of test show considerable variation. Skinkle (27) states that the results obtained on an abrasion tester are only comparative and that, in some cases, the order of resistance of fabrics to abrasion is also the order of wear, but in many other cases is different.

In the dynel-filled blankets, the first sign of wear occurred after 34 cycles on the Taber Abraser and a hole after 66 cycles. The acetate-filled group showed little difference for first signs of wear occurred at 37 and a hole at 64 cycles, so the two knit fabrics initially had comparable resistance to abrasion.

In the abrasion testing on the woven blankets no attempt was made to run the test until yarns were ruptured. Because of the nature of the blanket fabrics, signs of wear were considered to be changes in the appearance of the napped surface as well as the appearance of the yarns, but not necessarily a break in the yarn. After 150 cycles the dynel yarns showed greater signs of wear than the woolen. This was due both to the fiber length and the density of the dynel nap which appeared matted and tangled after 150 abrasion cycles. After 450 cycles the base yarns of the dynel blankets were badly distorted although there was no break. The woolen warp and filling yarns were still at right angles to each other with no evidence of distortion after the same number of abrasion cycles but the nap had been almost entirely removed from the surface and the fabric appearance was significantly changed.

Thermal Conductivity

The tests for thermal conductivity were made for purposes of comparison and do not claim to show actual warmth values of the different blankets. According to the test data the woven dynel blankets had the greatest resistance to heat flow in the four groups tested. The coefficient of thermal conductivity of the original blanket fabrics was found to be as follows: woven dynel .00102, wool .00130, acetate-filled .00155, and dynel-filled .001[illegible]6. Since a higher coefficient of thermal conductivity indicates lower resistance to heat flow, this data indicates that the woven dynel blanket has greater resistance to loss of heat than the wool blanket. The acetate-filled blankets had greater resistance to heat flow than the dynel-filled. The descending order of initial warmth values of the four blankets are woven dynel, woven wool, crimped acetate-filled and dynel-filled.

C. Analysis of Fabrics After Laundering

Yarn Count

Change in yarn count after twenty-five launderings was negligible. In the wool blankets the average warp count was exactly the same and in the filling there was an increase of one yarn per inch after twenty-five launderings. The change in the dynel blankets was slight with the warp count decreasing by one and the filling count increasing by one yarn per inch.

Course Count

In both groups of the fiber-filled knitted blankets laundering increased wale and course count of the cover. Wale count increased 10 per cent in the acetate-filled blankets and 7 per cent in the dynel-filled.

TABLE III

YARN COUNT*
ORIGINAL AND LAUNDERED FABRICS

Fabric	Warp Percent			Filling Percent		
	Orig.	Laund.	Change	Orig.	Laund.	Change
Wool	26	2[illegible]	0	25	25	0
Dynel	37	36		35	36	
	Wales			Courses		
Acetate (knit)	40	44	10	56	59	5.0
Dynel (knit)	38	41	7.4	50	55	10.[illegible]

* Average of 5 determinations

The course count increased 5 per cent in the acetate-filled and 10 per cent in the dynel-filled group. These increases resulted from shrinkage since the greatest shrinkage in the acetate-filled blankets was in the direction of the courses. Change in count in the dynel-filled blankets was similar in the two directions as was their shrinkage.

Weight Per Square Yard

All of the blankets except one from Group I gained in weight. Gain in weight in the two knit groups was greater than in the two woven blankets. This might be expected inasmuch as shrinkage was greater in the knit construction than in the woven constructions. The woven wool blankets increased in weight approximately 2.5 per cent and the woven dynel approximately 7 per cent. This difference in weight gain can not be attributed to differences in shrinkage since the dynel shrank less than the wool. It may, however, be due to greater adherence of the chemical residue of the detergent to the dynel than to the wool fibers.

TABLE IV

WEIGHT PER SQUARE YARD
IN OUNCES

Fabric	Original	Laundered	Percent Change
Wool	11.35	11.64	+ 2.4
Dynel (woven)	10.[illegible]	11.5	+ [illegible].7
Acetate (knit)	13.90	15.	+ 7.7
Dynel (knit)	12.[illegible]	15.3	+ 13.22

Average of five determinations

The weight increase in the acetate-filled blankets was approximately 8 per cent; that of the dynel-filled blankets was 13 per cent. In view of the fact that shrinkage in the dynel group was only one per cent greater than in the acetate group this substantiates the preceding assumption that dynel tends to gain weight due to a deposit of chemical residue of the detergent used in the laundering process.

Thickness

During the first five launderings both the woven dynel and the wool blankets increased in thickness. During subsequent launderings a slight decrease was noted, being greater in the wool than in the dynel blankets.

Terminal measurements, however, showed the dynel to have increased seven per cent and the wool to have decreased 6.4 per cent in thickness.

TABLE V

[illegible] THICKNESS*
(IN INCHES)

Fabric	Original	Laundering Interval 5	10	15	20	25	Percent Change
Wool	.2245	.2429	.2332	.2202	.2204	.2103	-6.43
Dynel	.2372	.2763	.2620	.2620	.2501	.2533	6.9
Acetate (knit)	.1573	.1519	.1444	.1416	.1404	.1327	-15.51
Dynel (knit)	.1516	.1531	.1451	.1403	.1357	.1334	-12.16

* Average of three determinations

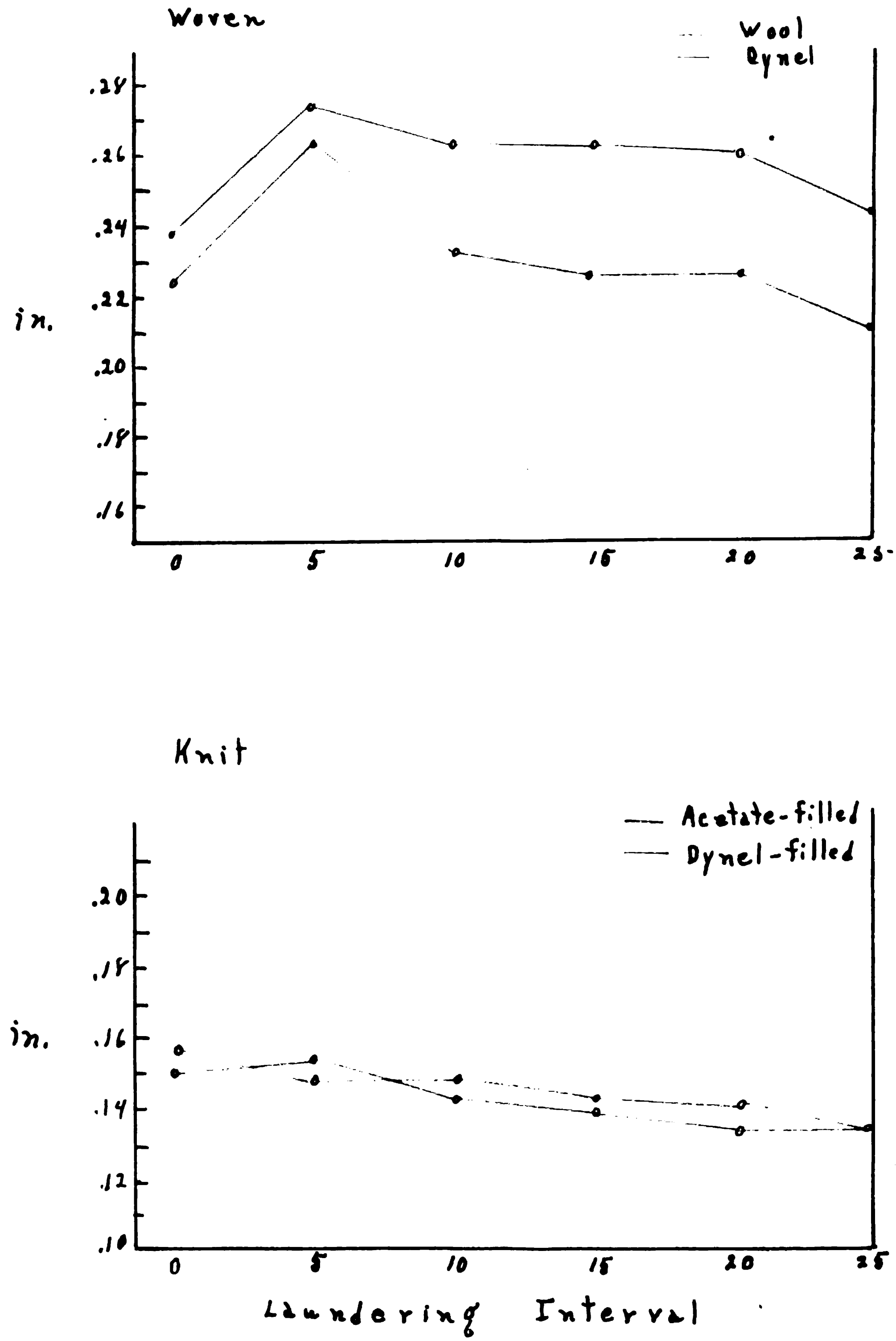
The knit blankets in general showed decrease in thickness as a result of launderings. There were no significant differences in change between the two groups, the acetate-filled decrease being slightly more. Terminal thickness decrease of the acetate-filled blankets was 15.5 and 12 per cent for the dynel-filled fabrics.

Dimensional Change

Woven Blankets. Since dimensional stability is one of the characteristics for which dynel has been so highly recommended it was expected that there would be less dimensional change in the dynel than in the woolen blankets. This claim for dynel was substantiated to a degree.

FIGURE I

STANDARD THICKNESS



In lengthwise measurements a slight increase was noted in the first laundering; slight shrinkage in the next three launderings followed by increases through the fifteenth laundering. During the last ten launderings, slight shrinkage was again noted with a terminal shrinkage of slightly more than one per cent warpwise. The wool blankets, on the other hand, showed progressive shrinkage in length in each of the first ten launderings. The greatest shrinkage (2.6 per cent) occurred in the first laundering. Terminal shrinkage was four per cent.

Both groups of woven blankets increased one per cent in width during the laundering series. There was little difference in the pattern of change in the two groups. Total area change in the wool blankets was a decrease of three per cent whereas the dynel blankets showed no change.

Knit Blankets. There was much greater change in the dimensions of the knit blankets than in the woven blankets. The acetate-filled blankets shrank less in length (wales) than the dynel-filled ones. Crosswise or in the direction of the courses, shrinkage was approximately twice as great in the acetate as in the dynel. Terminal shrinkage in length was 9.5 per cent in the dynel-filled fabrics and but 3.3 per cent in the acetate. The greatest shrinkage took place in the first laundering; both groups exhibiting similar change. In subsequent launderings, however, the dynel continued to shrink while the acetate increased slightly.

The crosswise change was much greater in the acetate-filled than in the dynel-filled blankets. Terminal shrinkage in crosswise dimensions of the acetate-filled blankets was approximately twice as great as the

FIGURE II

DIMENSIONAL CHANGE
WOVEN BLANKETS

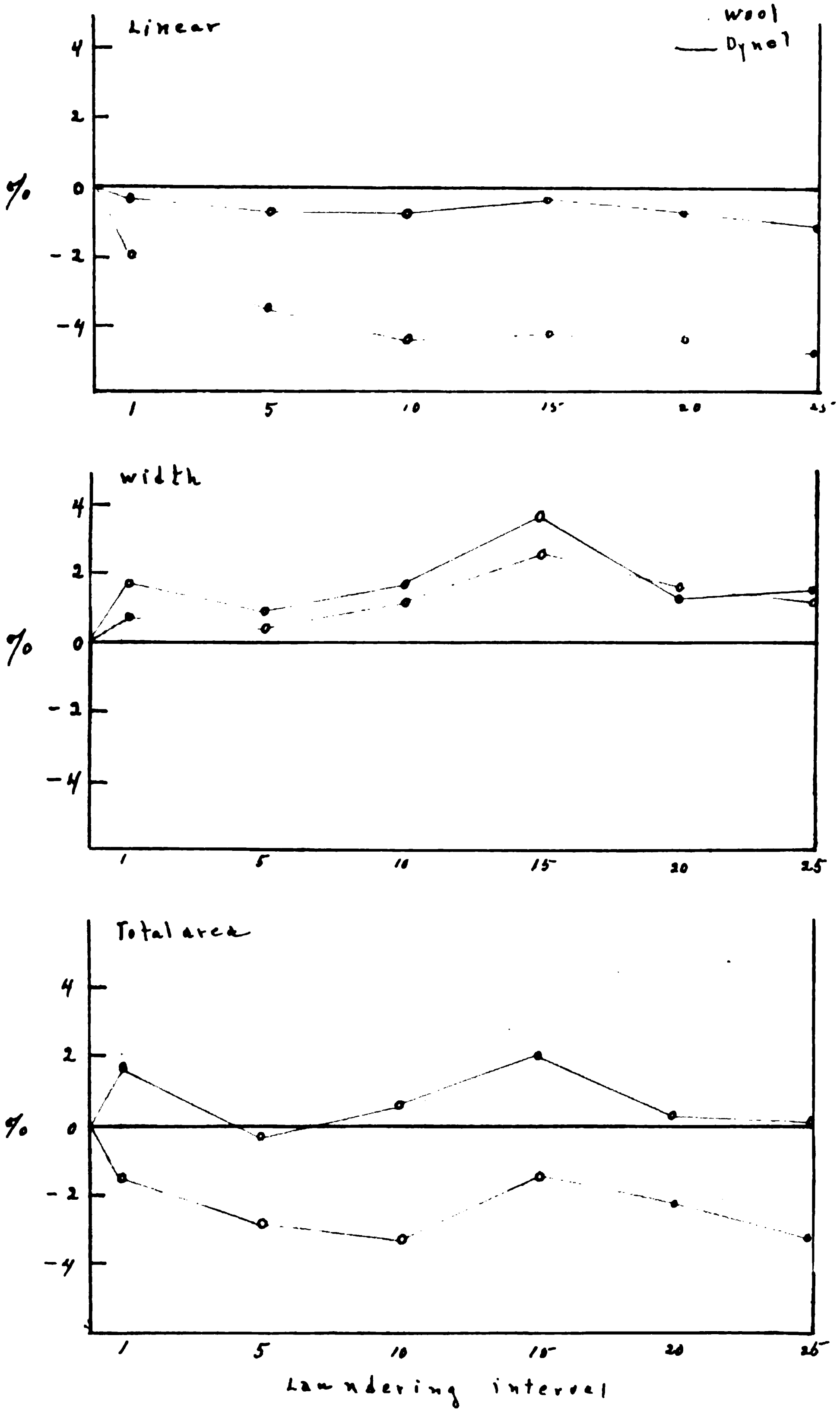


FIGURE III

DIMENSIONAL CHANGE
KNITTED BLANKETS

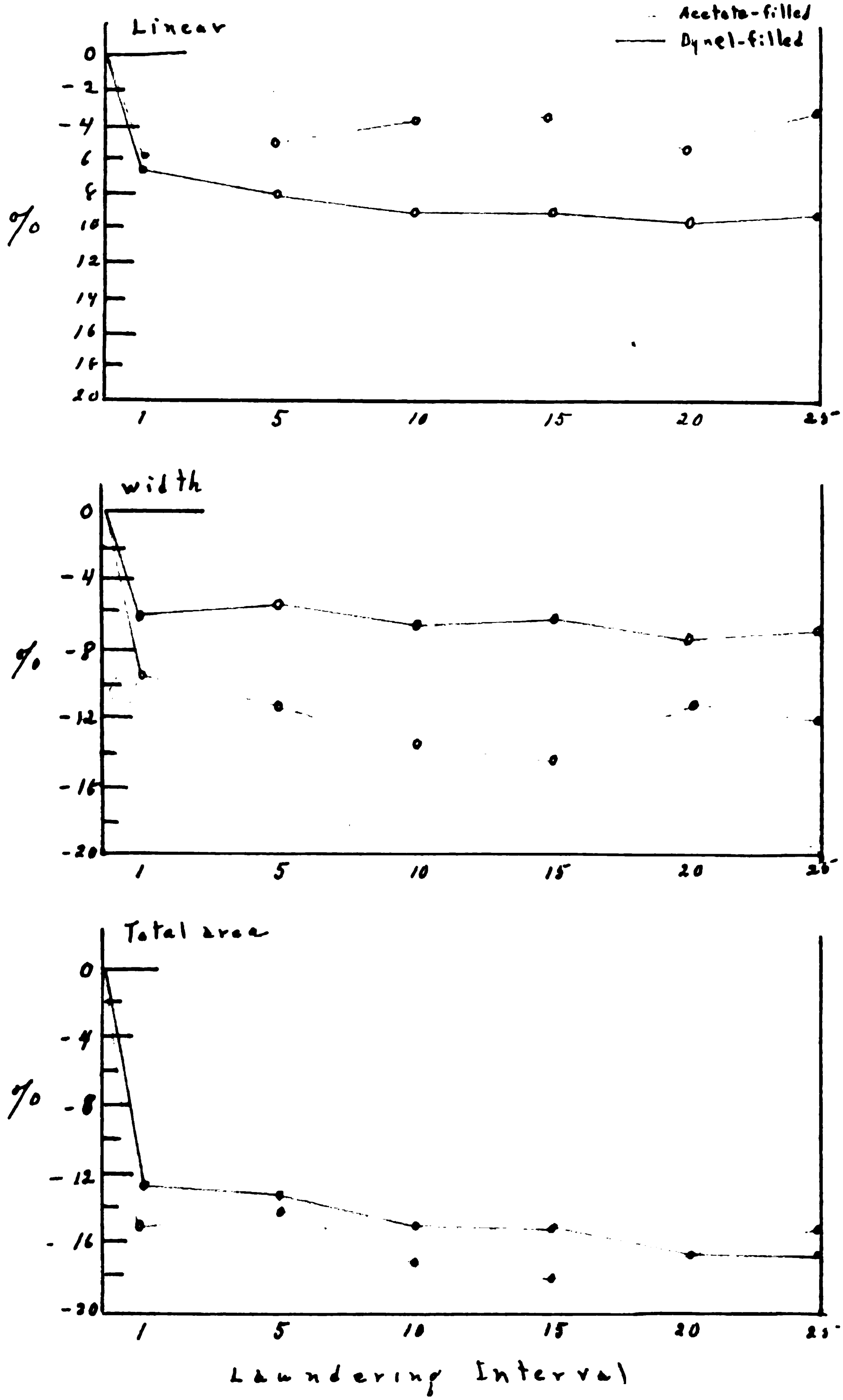


TABLE VI

DIMENSIONAL CHANGE IN PERCENT

	Woven[1]				Knit[2]			
Laundry	Wool		Dynel		Acetate		Dynel	
Interval	Linear	Width	Linear	Width	Linear	Width	Linear	Width
1	-2.[illegible]2	.98	.14	1.6	-5.59	-9.73	-6.3	-6.06
2	-2.71	.52	-.21	.42	-5.24	-10.39	-7.82	-6.12
3	-3.06	.26	-.63	.67	-4.74	-11.69	-7.96	-6.23
4	-3.24	1.05	-1.33	.56	-4.31	-10.56	-8.03	-6.53
5	-3.41	.44	-.91	.7	-4.49	-11.25	-8.1	-5.62
10	-4.35	1.16	-.85	1.6	-3.66	-13.56	-9.66	-6.36
15	-4.11	2.76	-.31	2.1	-3.9	-14.14	-9.01	-6.01
20	-4.15	1.79	-.65	1.33	-5.68	-11.13	-9.66	-7.04
25	-4.09	1.05	-1.26	1.15	-3.64	-12.06	-9.64	-6.71

[1] Average of four determinations
[2] Average of nine determinations

dynel-filled fabrics. Again, greatest change took place in the first laundering. The acetate showed greater fluctuation as well as greater terminal shrinkage in width. The total area change was one per cent less than the dynel. Although the total shrinkage (16 per cent) in the dynel was slightly greater, these blankets showed less distortion of shape than the acetate-filled blankets.

The standard tension allowed to restore knit goods to their original shape has been set at three pounds in the direction of both the wales and courses. Fabrics which do not exceed these tensions for restorability are considered elastic enough to reshape after laundering. In the acetate knit fabrics the average tension required was 1.6 pounds in the direction of the wales and 3.3 pounds in the direction of the courses. The dynel required a tension of 2.9 pounds and 2.7 pounds respectively for wales and courses. This shows the dynel blankets to be just within the limits of acceptability. The acetate required more than the standard tension in the direction of the courses but came well within the limits in the lengthwise direction.

Compressional Resilience

Although the original compressional resilience of the wool fabrics was 50 per cent greater than the woven dynel, the wool was only 15 per cent greater after twenty-five launderings. The wool resilience values in the first ten launderings were erratic but after twenty-five launderings they had lost 20.6 per cent of their resilience. The dynel blankets gained 5.7 per cent in their compressional resilience so terminally the resilience of the wool and the dynel were comparable.

There was negligible change in resilience of the dynel-filled knit fabric whereas the acetate-filled fabric lost more than 10 per cent of its resilience. However, because the original resilience of the acetate was so much higher, at the end of the test period its compressional resilience was still approximately twenty per cent better than the dynel-filled blankets.

TABLE VII

COMPRESSIONAL RESILIENCES*
(IN PER CENT)

Fabric	Original	Laundering Interval 5	10	15	20	25	Percent Change
Wool	37.17	35.17	37.39	35.61	33.67	29.98	-20.6
Dynel	24.59	23.75	33.23	25.23	24.37	25.99	5.7
Acetate (knit)	49.13	46.97	39.48	39.04	42.23	43.696	-10.6
Dynel (knit)	36.44	32.17	32.65	35.36	38.63	36.33	-.3

* Average of three determinations

Abrasion

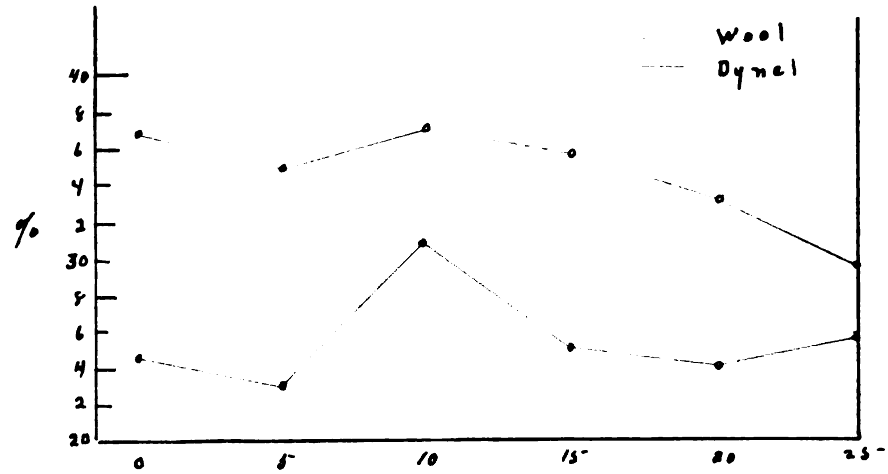
Resistance to abrasion in both the wool and dynel woven blankets increased slightly as a result of laundering with the same relationship of resistance existing between the two groups as originally. After 450 abrasion cycles the nap of the dynel fabric was much more matted and tangled than the nap of the wool. The warp yarns of the dynel were badly distorted although none was ruptured. The warp and filling yarns in the woolen blankets maintained original alignment but did not appear as threadbare as in the original sampling.

The knit blankets showed some loss in their resistance to abrasion as a result of laundering. The loss in resistance of the acetate-filled fabric was nine per cent and of the dynel-filled blankets six per cent. This difference is not great enough to be a significant factor in their wearing qualities.

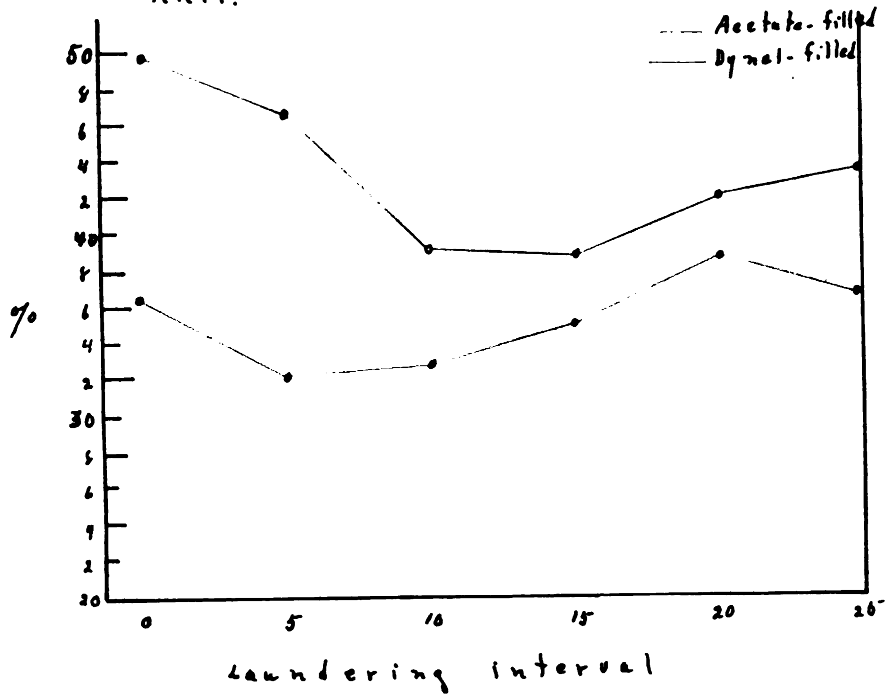
FIGURE IV

COMPRESSIONAL RESILIENCE DURING LAUNDERING

Woven



Knit.



Breaking Strength

After twenty-five launderings the warp strength of the wool blankets had increased about 10 per cent in the dry tests and 7 per cent in wet strength determinations. The woven dynel blankets lost approximately 3.5 per cent in dry strength and 1.5 per cent in wet strength. This gain in strength in the wool blankets cannot be accounted for by an increase in yarn count since the warp count was the same as originally. Since the warp count in the dynel fabric changed but one yarn per inch, the loss in strength of the dynel can not be explained solely on the basis of change in yarn count. Since the dynel blankets increased in thickness and gained in weight this loss in strength is probably due to fiber deterioration.

TABLE VIII

WARP BREAKING STRENGTH IN POUNDS*

Fabric	Dry			Wet		
	Original	Laund.	Change	Original	Laund.	Change
Wool	32.9	36.2	10.4	22.3	23.8	7.32
Dynel	37.3	36.1	3.63	34.7	34.	1.63

* Average of five determinations

The average dry strength of the filling yarns increased appreciably in both the wool and dynel blankets. Filling yarn breaking strength in the wool blankets increased 168 per cent in dry testing and the dynel 132 per cent. In the wet determinations the wool blankets showed little

TABLE IX

FILLING BREAKING STRENGTH IN POUNDS*

Fabric	Dry			Wet		
	Original	Laund.	Change	Original	Laund.	Change
Wool	3.1	9.27	188.7	5.5	5.0	10.
Dynel	15.06	34.04	132.25	22.1	26.94	20.

* Average of five determinations

change, but the dynel gained 20 per cent over original wet values. Since there was only slight gain in filling count, some of this increase in strength is attributed to the matting of the fibers.

Elongation

The average elongation in the wool blankets increased both warpwise and fillingwise for both wet and dry tests. The dynel blankets showed increased warp elongation when dry, but decreased elongation in wet determinations. In both wet and dry determinations, the filling yarns of the laundered dynel blankets decreased in elongation. These tests indicate that as yarn strength increased in the woolen blankets, elongation likewise increased. In the dynel blankets there was no similar relationship between gain or loss in strength and increased or decreased elongation.

Bursting Strength

As would be expected from an increased wale and course count, the bursting strength of the knit blankets increased as a result of laundering.

TABLE X

WARP ELONGATION IN PERCENT*

Fabric	Dry			Wet		
	Original	Laundered	Percent Change**	Original	Laundered	Percent Change**
Wool	23.57	2[illegible].24	1[illegible].[illegible]	56.57	60.5	7.22
Dynel	37.13	43.51	17.66	40.4	37.22	-8.24

* Average of five determinations
** Calculated by dividing the difference between the original and laundered by the original elongation and converting to per cent.

TABLE XI

FILLING ELONGATION IN PERCENT*

Fabric	Dry			Wet		
	Original	Laundered	Percent Change**	Original	Laundered	Percent Change**
Wool	15.62	19.72	26.6	36.1	38.9	22.6
Dynel	33.45	29.1	-[illegible].	32.6	31.6	.8

* Average of five determinations
** Calculated by dividing the difference between the original and laundered by the original elongation and converting to per cent.

However, strength increase was not in the same ratio as change in the course count of the two fabrics. The total increase in wale and course count in the dynel-filled fabrics was 17.5 percent and increased dry bursting strength 16 per cent while the acetate-filled blankets increased 15 per cent in total course count but only 8 per cent in bursting strength.

Both fabrics also showed higher wet bursting strength as a result of laundering. Here again increase in strength was greater in the dynel-filled than in the acetate-filled blankets. Gain was 10 per cent in the dynel and 6 per cent in the acetate-filled blankets.

TABLE XII

BURSTING STRENGTH IN POUNDS*

Fabric	Dry			Wet		
	Original	Laundered	Change	Original	Laundered	Change
Acetate (knit)	135.	145.7	8.8	94.9	100.9	6.36
Dynel (knit)	129.58	152.9	18.44	90.76	100.1	10.

* Average of five determinations

TABLE XIII

THERMAL CONDUCTIVITY*

Fabric	Original	Laundered	Percent Change
Wool	.00130	.00163	25.4
Dynel (woven)	.00102	.00145	42.2
Acetate (knit)	.00155	.00175	12.9
Dynel (knit)	.00186	.00207	11.3

* Average of five determinations

Thermal Conductivity

The thermal conductivity values increased for all of the blankets as a result of repeated launderings. Rudnick (23) found that in order to retain thermal resistance in cotton blankets, a means for restoring the original fluffiness of the nap must be provided. Others, Rumford (29) and Bergonie and Coulier (3) found that the protective value of a fabric is determined largely by the amount of air held enmeshed within its fibers. From these findings it was expected that the woven dynel would show greatest resistance to heat flow. Although the woven dynel blankets showed greatest increase in conductivity, or a lowered resistance, as a result of laundering, its resistance was still 11 per cent greater than that of the wool after the series of launderings.

Both groups of knit blankets also lost resistance to heat flow as a result of repeated laundering. Although the acetate-filled blankets lost slightly more resistance than the dynel-filled blankets, they were still 15 per cent more efficient after laundering than the laundered dynel-filled blankets.

The resistance of the laundered wool and woven dynel blankets could probably have been improved with more brushing to raise the nap flattened in laundering. The protective value of the knit blankets could probably also have been improved by using more care in stretching and pulling to shape and by fluffing the filler more frequently as it was drying.

Colorfastness

Although some fading occurred in the acetate and dynel-filled blankets during the twenty-five launderings, neither group showed enough change to merit discontinuance in use.

There was no perceptible color change in the woven dynel blankets during laundering. The white wool blankets became somewhat dingy with repeated laundering but the yellow blankets showed little change in color even after twenty-five launderings. The blue and pink dynel blankets showed considerable fading to light after sixty hours, but the yellow was not perceptibly changed in color. However, this fact was not considered significant in this study since crib blankets as a rule would not be subjected to much sunlight.

Subjective Analysis

Subjective analysis of the blankets as to hand, contour, color and general appearance of the nap was based on the rating of three people. These various characteristics were rated as good, acceptable or objectionable.

The all wool blankets were judged objectionable in hand as they were considered harsh and boardy. Although the appearance of the nap itself was acceptable, they were rated as objectionable because of thick and thin spots and some threadbare areas. The white woolen blankets were rated as acceptable in color while the yellow wool were thought to be good after the twenty-five launderings. Their contour and general appearance was rated as acceptable.

Although the dynel blankets were also considered to be somewhat harsh and boardy, they were rated better than the wool in this respect. They were thought to be less felted than the wool and more uniform in thickness. Their general appearance was considered better than that of the wool and the shape retention of the laundered dynel blankets was rated as good. There was no perceptible difference in the color of the laundered and the original blankets.

Differences between the two groups of fiber-filled knit blankets were considered to be slight. In over-all softness of hand, both groups were judged to be good although some shifting of the fibers in the batt was noted. This shifting of the fibers which resulted in some bunching of the filling material, was largely due to the thin layer of cotton which covered both sides of the acetate batt but only one side of the dynel. Consequently the knotty or bunched appearance was more noticeable in the acetate-filled blankets. In color the dynel-filled blankets were rated slightly better than the acetate-filled blankets after laundering. The retention of shape in both groups was rated as acceptable. However, it was more difficult to restore the acetate-filled blankets to shape than the dynel-filled ones.

CONCLUSIONS

The findings of this comparative study of four different types of crib blankets showed certain differences in their initial properties and performance as well as their performance in laundering. The results of laboratory tests will not, however, altogether simulate the conditions to which crib blankets are subjected during actual service. Some aspects of satisfaction in service cannot be shown in laboratory tests. The sampling, too, was not sufficiently large to indicate conclusive evidence for an evaluation of certain characteristics and tests. However, there were aspects of serviceability which, judged on the basis of the consistency of test data, can be considered as valid conclusions.

After evaluating the data obtained in this laboratory study, the investigator concluded that in many respects the woven dynel blankets would give the greatest over-all satisfaction to the user. In lightness of weight, thickness, warmth and dimensional stability the dynel blankets were superior to the woven woolen ones. Although the resilience of the dynel blankets was initially lower than the wool, it retained its resilience in laundering better than the wool. Coupled with the fact that the filling yarns of the woolen blankets were so weak that exceptional care was necessary in handling in laundering, these findings indicate that for the same price, the dynel blankets were the better investment. However, the dynel had some disadvantages not apparent in the laboratory tests. The foremost disadvantage was the excessive static electricity generated in the fabric through handling. A second undesirable characteristic which became apparent in handling was the shedding of the fibers. Due to the static electricity, these fibers cling tenaciously to the clothing of one in contact with the blankets. In crib blankets both of these characteristics would be undesirable.

In evaluating the results of the various tests, less difference in performance was noted between the two groups of knitted blankets. The dynel-filled blankets rated higher in restorability to shape and in colorfastness in laundering. However, in resistance to heat flow and resilience, the acetate-filled blankets were more satisfactory. The acetate-filled blankets were slightly heavier, and had greater bursting strength. Choice between these two groups, then, would depend upon which characteristics the individual considered of greater importance. It was felt that both groups would have been more satisfactory if the layer of matted cotton had been omitted from the batt.

In comparing the two types of construction, the woven blankets retained shape, warmth, and resilience better than the knit construction. For most purposes the woven blankets would probably give better service.

The need for further study of these and other new blanket fabrics is evident. A study of different types of blankets in an actual service situation would be a valuable supplement to laboratory testing. The opinions of a representative group of mothers would be most valuable in subjectively comparing total satisfaction for the various types of blankets. In future studies it is recommended that a larger sampling for each of the types be provided.

SUMMARY

Five crib blankets for each of four different fabrics costing approximately six dollars each were purchased for this investigation. Groups I and II were of woven construction and consisted of 100 per cent wool and 100 per cent dynel respectively. Groups III and IV respectively, had knitted covers quilted to batts of crimped acetate and dynel. The study was designed to compare through laboratory tests, the initial properties and performance characteristics of these blankets and their performance after twenty-five launderings. Because of similarity in construction, comparisons have been made primarily between the two types of woven blankets and between the two comforter types.

After determination of original dimensions, the blanket fabrics were labeled and specimens prepared for testing. Analysis of the initial properties of the blankets showed the woolens of Group I to be heavier than the dynel, but lower in breaking strength. The woolen blankets also had a lower yarn count and yarns of lower twist. Wool yarns were of the same size in warp and filling. In the dynel blankets the warp yarns were much finer than the filling yarns and much more highly twisted. The dynel blankets were thicker and had greater resistance to heat flow than the wool, but were lower in compressional resilience.

Analysis of the initial properties showed the acetate-filled blankets to be heavier than the dynel-filled with higher bursting strength, compressional resilience and resistance to heat flow. The wale and course count and thickness, too, were slightly greater in the acetate-filled blankets.

One section from each blanket was bound with the original binding and laundered twenty-five times duplicating acceptable home laundering procedures. Measurements for determination of dimensional change were taken after each of the first five launderings and subsequently at each fifth laundering interval. Thickness and compressional resilience were measured after each five launderings.

Dimensional change was greater in the woven wool than in the dynel in the lengthwise direction, but neither changed appreciably in width. This difference accounts for less distortion of shape and lower total area shrinkage in the dynel than in the woolen blankets. Both groups gained in weight; the dynel gain being slightly more. The wool lost in thickness and resilience while the dynel gained in both. Although the warp breaking strength of the dynel decreased it was still much higher than that of the wool which had increased slightly as a result of laundering. The two woven groups showed similar decrease in their resistance to heat flow, but the resistance of the dynel was still greater than the wool after the twenty-five launderings. Analysis of test data indicated that in dimensional stability, in strength, in thermal resistance, and ease of care, the dynel blankets were more satisfactory than the woolen blankets. However, the fact that an excessive amount of static electricity is generated in the dynel is a decided disadvantage for its use in crib blankets.

In every way except in dimensional change, both groups of the comforter type blankets were affected similarly by laundering. The acetate-filled blankets showed greater distortion of shape because of the difference in shrinkage in the direction of the wales and the courses. The dynel-filled blankets showed slightly greater over-all shrinkage, but were more easily restored to shape. Both groups increased in wale and course count as well as in weight and bursting strength. Both groups decreased in thickness and in resilience as a result of laundering. Although both groups lost resistance to heat flow, the laundered acetate-filled blankets maintained greater resistance.

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APPENDIX

PLATE I

Woolen Blanket Fabrics

Original

Laundered
(25 times)

PLATE II

Dynel Blanket Fabrics

Original

Laundered
(25 times)

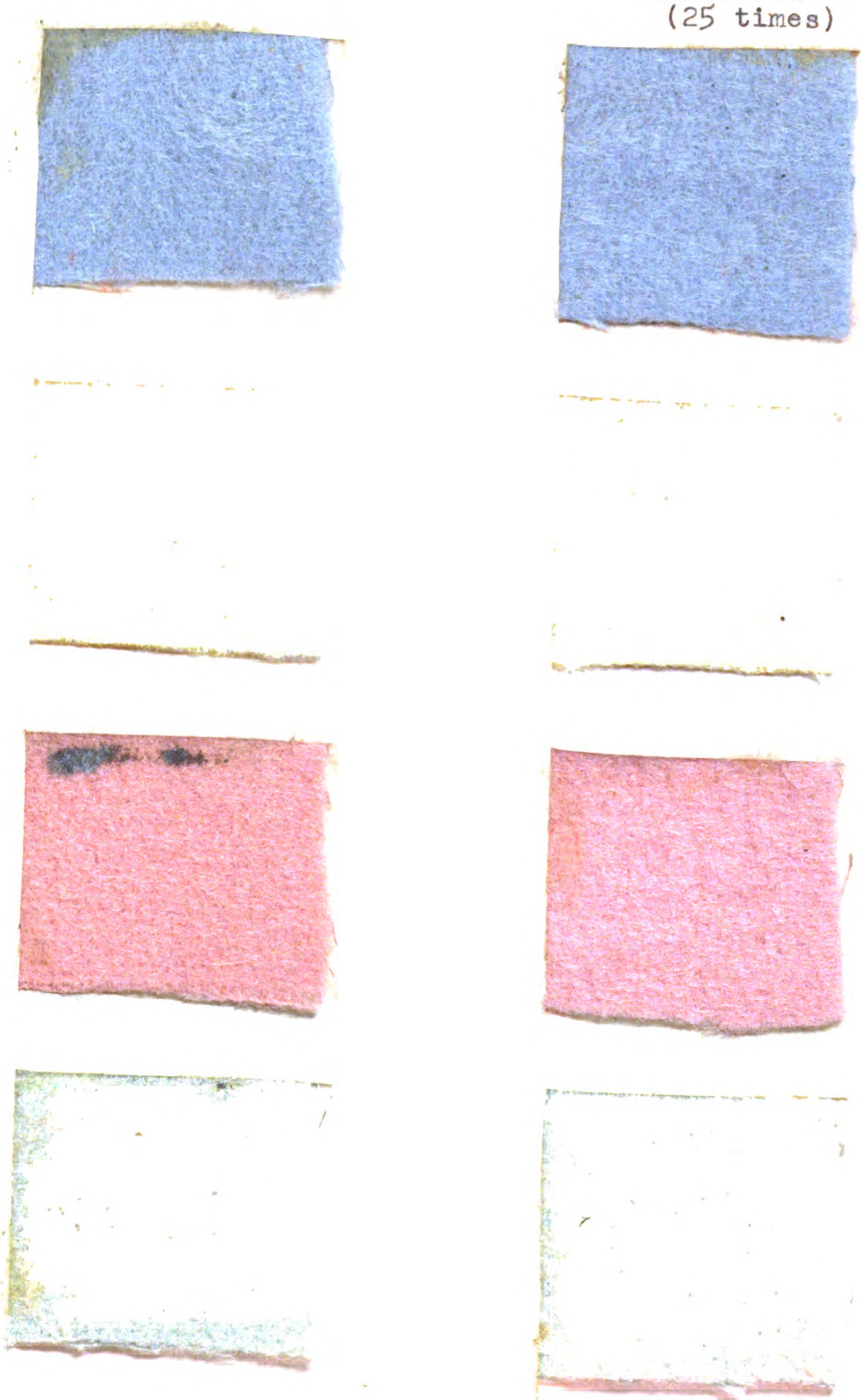


PLATE III

Acetate-filled Blanket Fabrics

Original	Laundered ([illegible] times)

PLATE IV

Dynel-filled Blanket Fabrics

Original | Laundered (25 times)

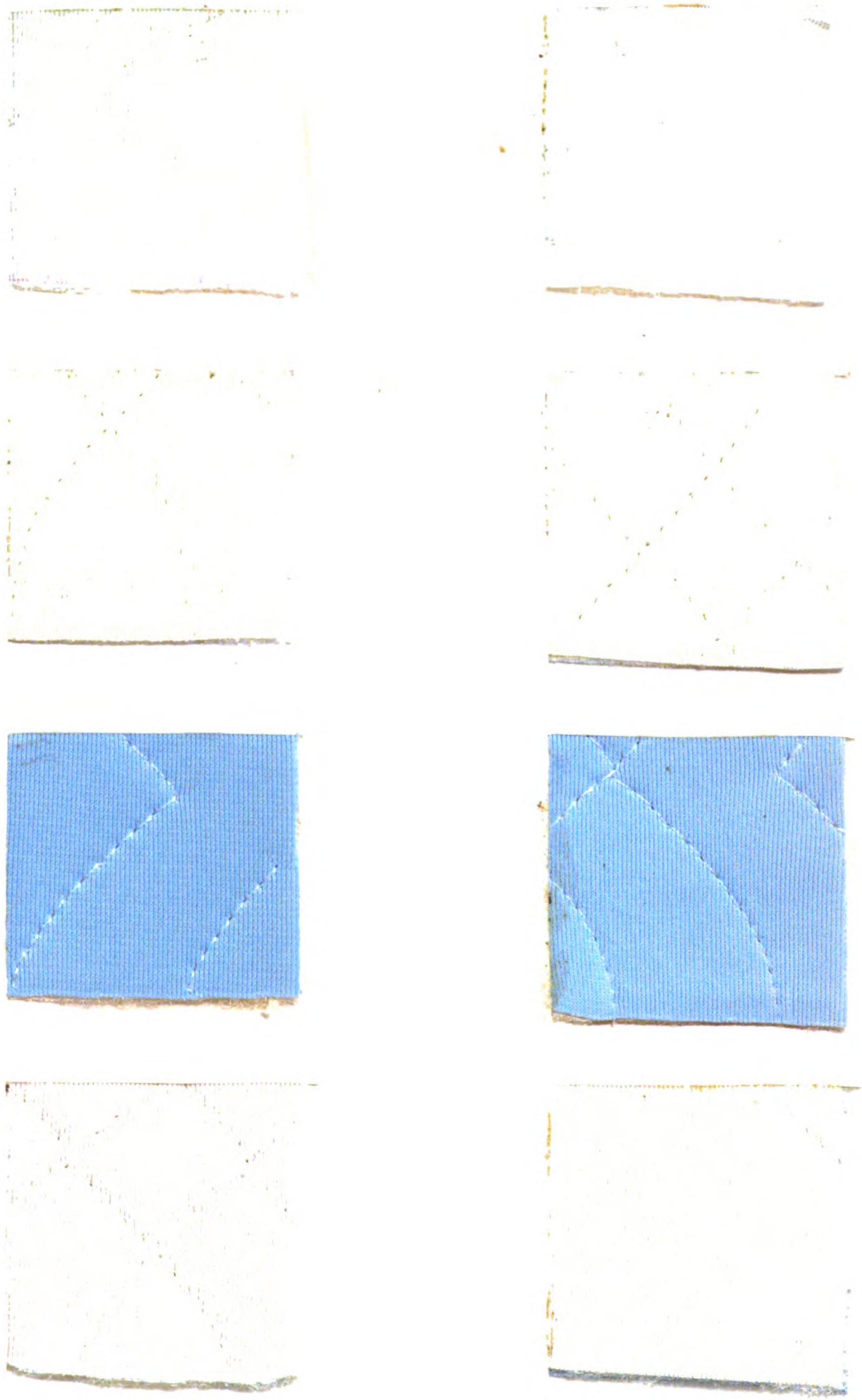
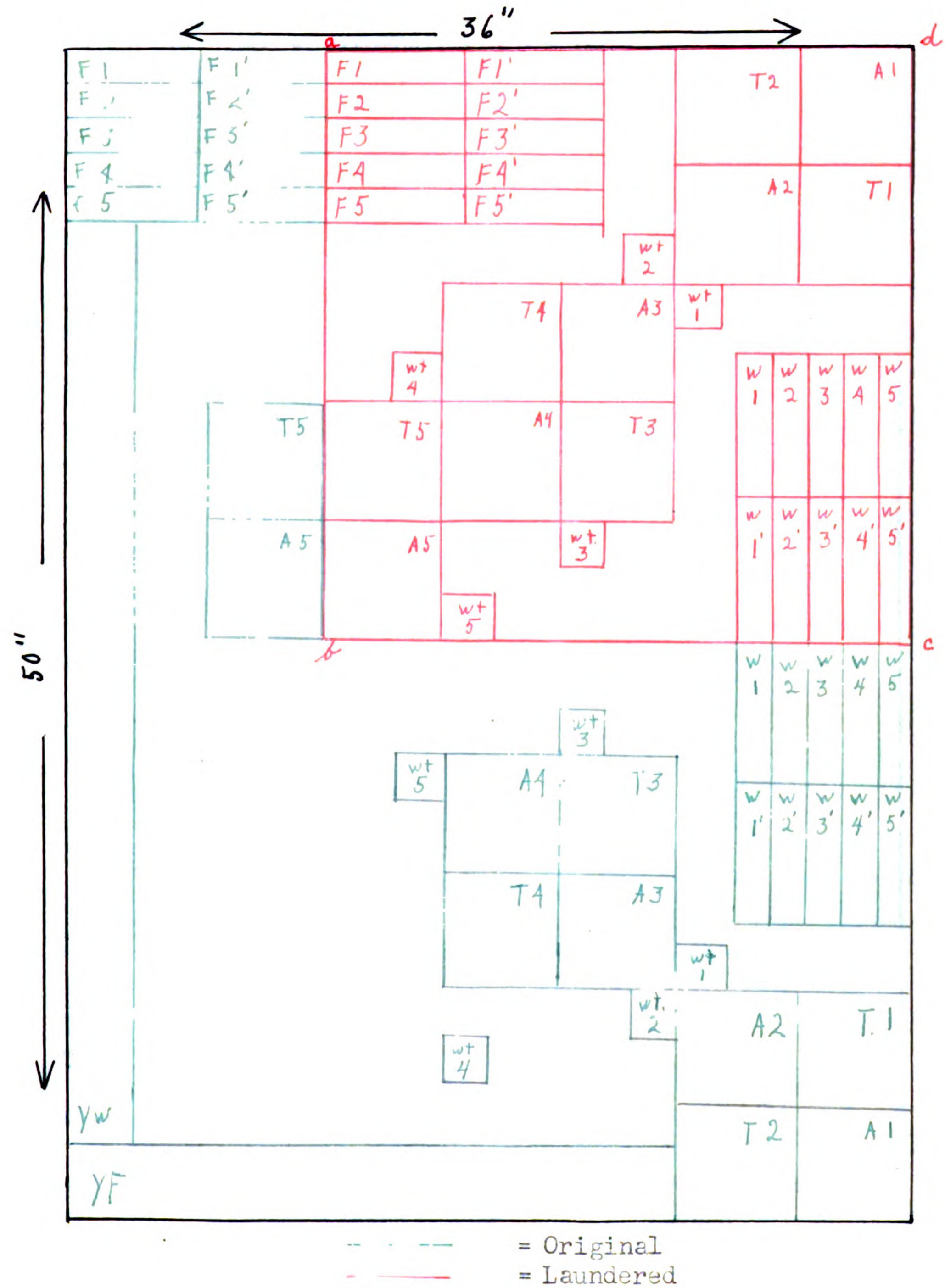


PLATE V

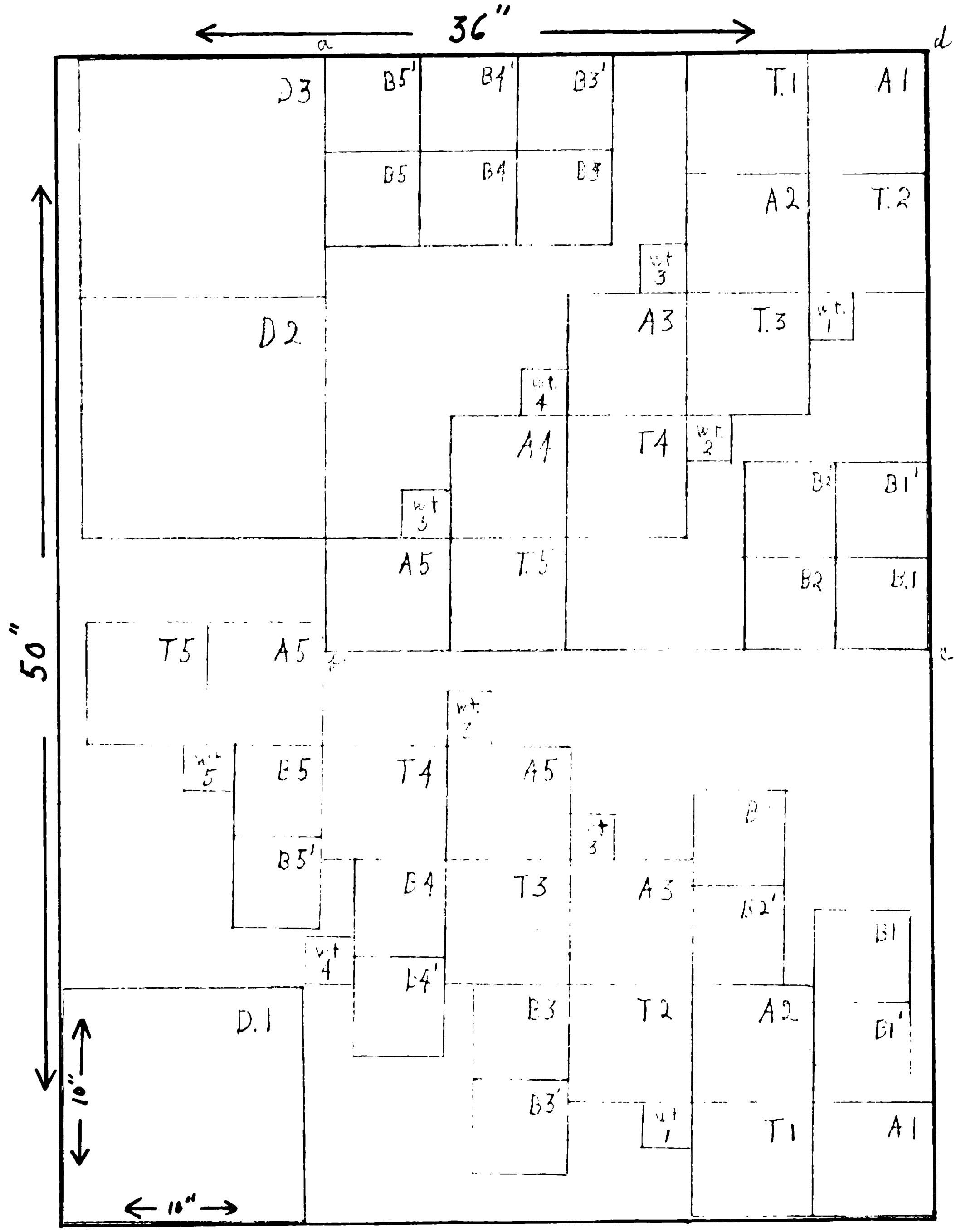
Location of Test Specimens on Woven Blankets



A Abrasion
T Thermal conductivity
F Filling breaking strength (dry)
F' Filling breaking strength (wet)
W Warp breaking strength (dry)
W' Warp breaking strength (wet)
Wt Weight
WY Warp yarn number and twist
FY Filling number and twist
abcd Section for laundering

PLATE VI

Location of Test Specimens on Knit Blankets



---- = Original fabric

———— = Laundered fabric

A (1-5)	Abrasion	W (1-5)	Weight
B (1-5)	Bursting Strength (dry)	D (1-3)	Dimensional
B (1'-5')	Bursting Strength (wet)	abcd	Section for laundering
T (1-5)	Thermal Conductivity		

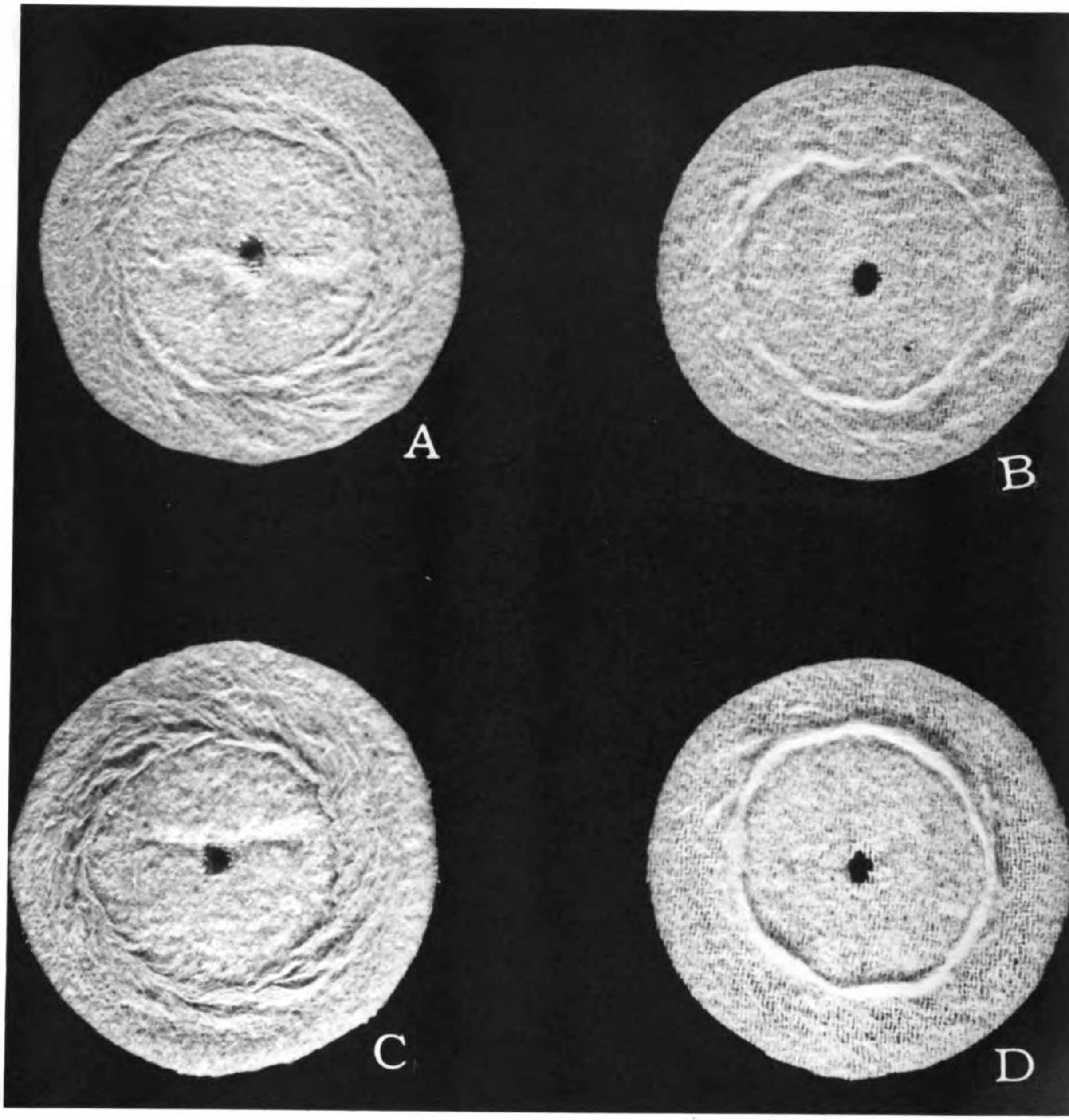


PLATE VIII

Abrasion
Laundered Woven Fabrics

A - Dynel	150 cycles
B - Wool	150 cycles
C - Dynel	450 cycles
D - Wool	450 cycles

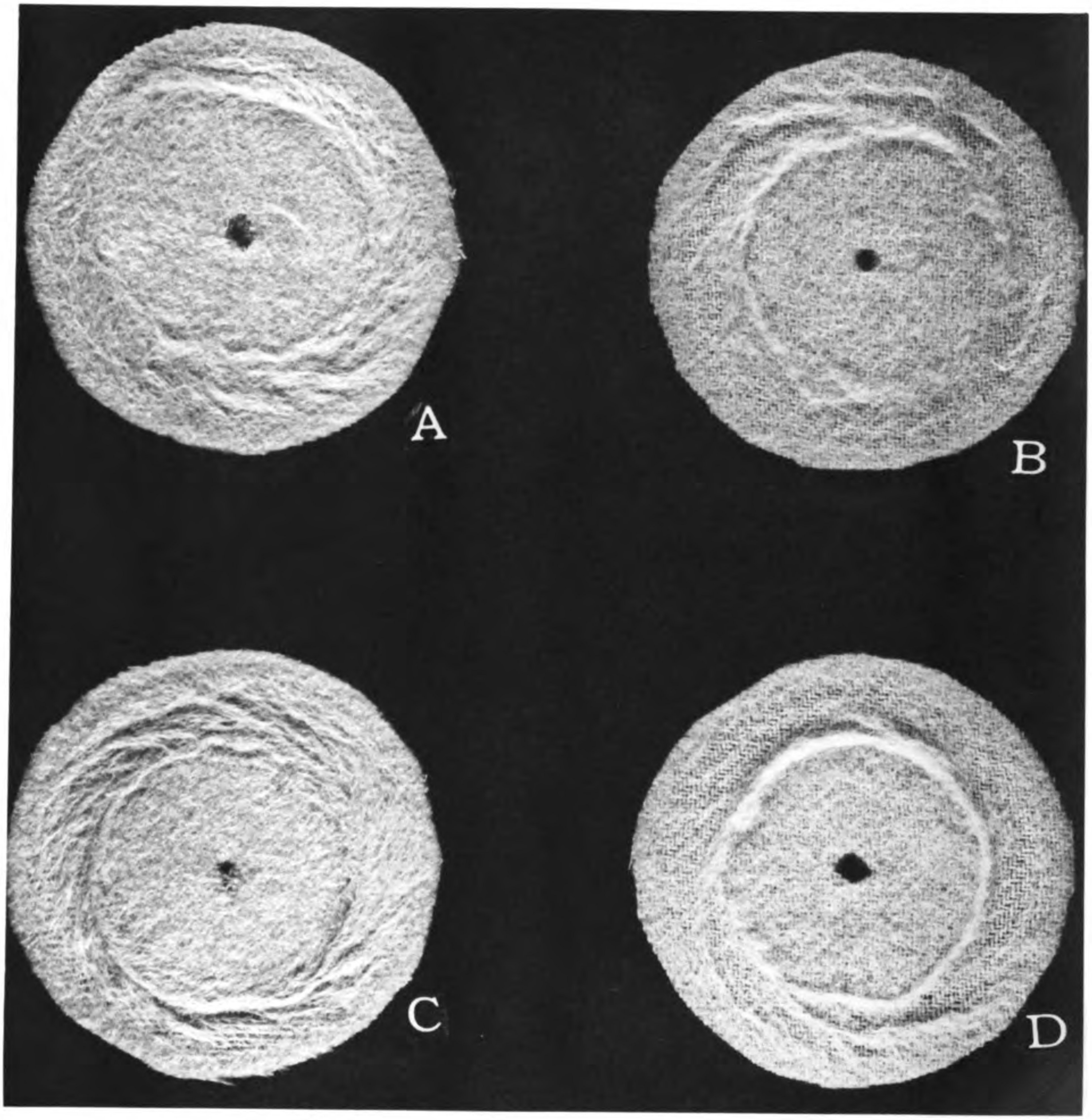


PLATE VII

Abrasion
Original Woven Fabrics

A - Dynel	150 cycles
B - Wool	150 cycles
C - Dynel	450 cycles
D - Wool	450 cycles

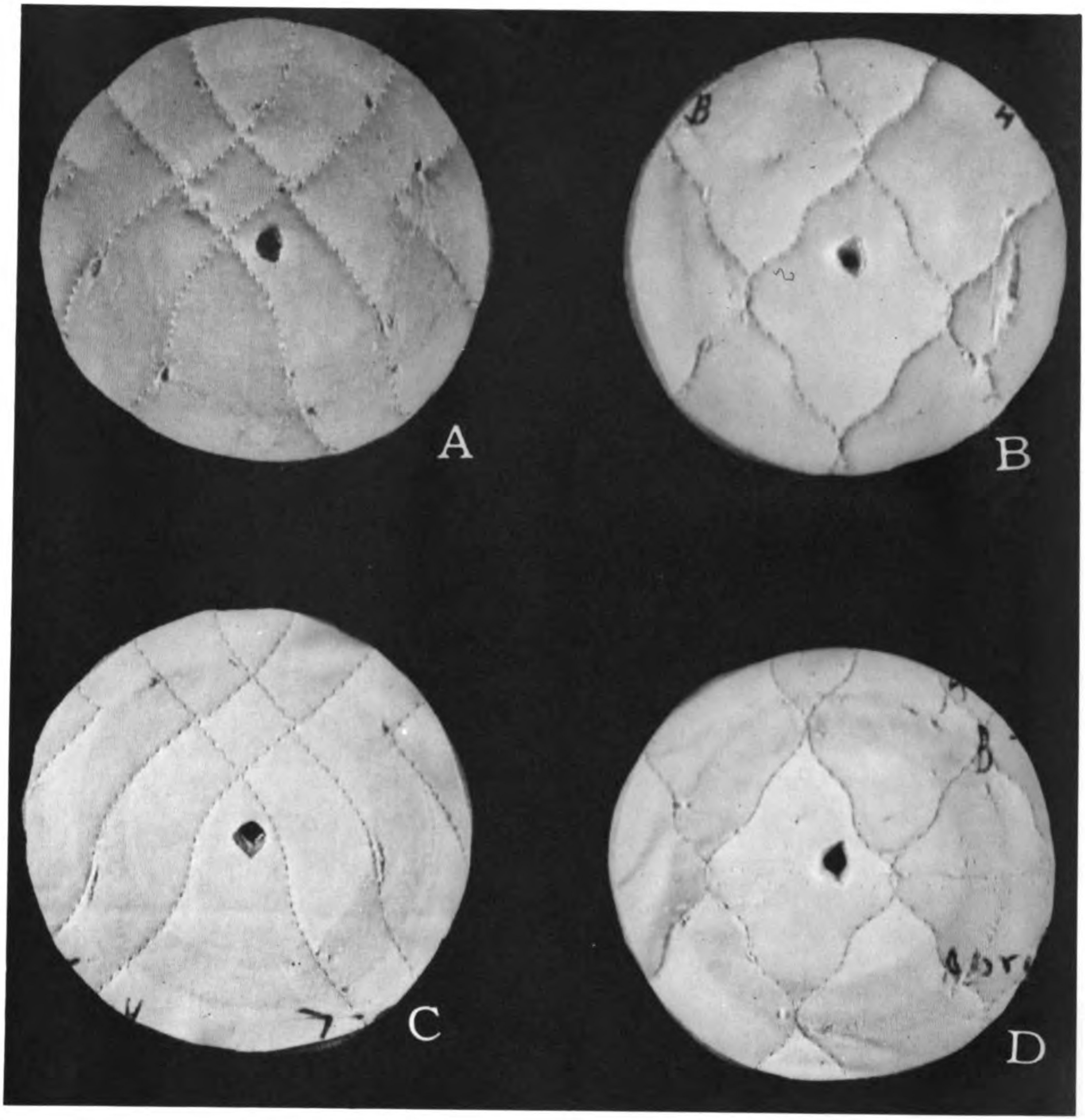


PLATE IX

Abrasion
Knit Comforter Fabrics

Original 150 cycles
A - Dynel-filled
B - Acetate-filled
Laundered 150 cycles
C - Dynel-filled
D - Acetate-filled

CHART I

SPECIFICATION ANALYSIS OF ORIGINAL BLANKETS

Code		Fiber Content W	Fiber Content F	Weight Per Yd.[2] (Oz.)	Yarn Count (Per In.) W	Yarn Count (Per In.) F	Breaking Strength Dry W	Breaking Strength Dry F	Breaking Strength Wet W	Breaking Strength Wet F	Elongation Dry W	Elongation Dry F	Elongation Wet W	Elongation Wet F
W-W	A	Wool	Wool	11.69	27	24	34.3	0	25.7	0.6	24.	0	63.1	0
W-W	B	Wool	Wool	10.82	25	24	31.1	1.7	22.5	2.5	22.3	13.6	53.4	17.9
W-W	C	Wool	Wool	11.38	26	25	33.3	5.2	20.5	6.1	23.2	18.8	50.2	50.9
W-W	D	Wool	Wool	11.52	25	25	32.8	2.6	20.6	6.1	24.8	14.5	59.6	39.5
D-W	A	Dynel	Dynel	11.20	37	35	38.8	20.8	37.7	28.6	36.2	31.4	36.8	31.1
D-W	B	Dynel	Dynel	10.33	36	35	39.0	8.1	34.2	17.1	35.4	25.0	39.6	32.3
D-W	C	Dynel	Dynel	10.32	37	35	35.8	12.0	33.0	19.7	36.7	34.4	37.7	32.4
D-W	D	Dynel	Dynel	11.22	36	36	37.5	18.8	33.6	22.7	37.0	31.0	42.5	26.3
D-W	E	Dynel	Dynel	10.82	36	36	36.6	15.6	35.1	22.4	39.7	37.1	45.3	34.6
		Cover.	Batt.		Wales	Courses	Bursting Strength Dry		Bursting Strength Wet					
A-K	A	Acetate	Acetate	15.14	39	49	141.4		102.6					
A-K	B	Acetate	Acetate	13.25	38	59	127.2		93.4					
A-K	C	Acetate	Acetate	13.00	41	59	134.6		89.0					
A-K	D	Acetate	Acetate	13.93	40	59	133.2		92.8					
A-K	E	Acetate	Acetate	14.58	41	56	133.6		96.8					
D-K	A	Acetate	Dynel	12.45	39	50	125.0		92.6					
D-K	B	Acetate	Dynel	13.31	38	49	132.0		93.2					
D-K	C	Acetate	Dynel	12.67	38	52	126.6		82.4					
D-K	D	Acetate	Dynel	11.73	37	50	122.6		86.4					
D-K	E	Acetate	Dynel	12.06	39	50	140.2		99.2					

Average of five determinations in each test.

CHART II

ANALYSIS OF LAUNDERED BLANKETS

Code		Fiber Content W	Fiber Content F	Weight Per Yd.² (Oz.)	Yarn Count (Per In.) W	Yarn Count (Per In.) F	Breaking Strength Dry W	Breaking Strength Dry F	Breaking Strength Wet W	Breaking Strength Wet F	Elongation Dry W	Elongation Dry F	Elongation Wet W	Elongation Wet F
W-W	A	Wool	Wool	11.8	26	25	40.8	6.9	27.0	4.3	29.9	22.5	62.6	46.3
W-W	B	Wool	Wool	10.7	25	24	32.6	3.8	22.3	2.1	27.1	19.2	54.6	31.9
W-W	C	Wool	Wool	12.2	26	26	34.1	14.6	21.9	7.3	27.4	19.0	61.6	43.7
W-W	D	Wool	Wool	11.9	26	25	37.4	9.4	24.0	5.7	28.6	21.0	63.1	41.0
D-W	A	Dynel	Dynel	11.4	35	35	37.7	14.2	34.9	37.8	56.2	31.7	38.8	32.5
D-W	B	Dynel	Dynel	11.0	36	34	35.2	28.6	34.9	17.3	53.7	27.2	37.5	29.1
D-W	C	Dynel	Dynel	11.3	35	35	35.9	31.3	35.5	24.0	35.3	28.8	35.6	31.0
D-W	D	Dynel	Dynel	11.9	36	37	35.4	37.2	31.7	30.9	36.6	26.6	35.3	30.3
D-W	E	Dynel	Dynel	11.8	36	36	36.3	28.9	34.0	24.7	35.6	30.9	37.9	35.1

Code		Cover	Batt.	Weight Per Yd.² (Oz.)	Wales	Courses	Bursting Strength Dry	Bursting Strength Wet
A-K	A	Acetate	Acetate	16.2	44	52	160.4	104.0
A-K	B	Acetate	Acetate	15.1	43	62	139.6	95.8
A-K	C	Acetate	Acetate	14.5	45	62	125.4	96.4
A-K	D	Acetate	Acetate	14.5	44	61	145.0	99.8
A-K	E	Acetate	Acetate	14.6	44	59	157.8	107.4
D-K	A	Acetate	Dynel	14.6	41	55	159.0	98.2
D-K	B	Acetate	Dynel	14.2	40	55	136.0	101.2
D-K	C	Acetate	Dynel	14.9	39	57	154.0	97.2
D-K	D	Acetate	Dynel	13.3	42	55	150.4	93.5
D-K	E	Acetate	Dynel	14.4	43	54	165.0	110.6

Average of five determinations in each test.

CHART III

COMPARISON OF WEIGHTS PER SQUARE YARD IN OUNCES ORIGINAL FABRICS AND AFTER 25 LAUNDERINGS

Code		Fiber Content: Warp	Filling		Weight: Original	Laundered	Percent Change*
				Woven			
W-W	A	Wool	Wool		11.69	11.764	+ .63
W-W	B	Wool	Wool		10.82	10.67	- 1.35
W-W	C	Wool	Wool		11.38	12.175	+ 6.9
W-W	D	Wool	Wool		11.52	11.93	+ 3.47
				Average	11.35	11.64	+ 2.41
D-W	A	Dynel	Dynel		11.20	11.41	+ 1.8
D-W	B	Dynel	Dynel		10.33	11.09	+ 7.35
D-W	C	Dynel	Dynel		10.32	11.27	+ 9.2
D-W	D	Dynel	Dynel		11.22	11.93	+ 6.32
D-W	E	Dynel	Dynel		10.82	11.77	+ 8.78
				Average	10.8	11.5	+ [illegible]
				Knit			
		Cover	Filling				
A-K	A	Acetate	Acetate & Cotton		15.14	16.25	+ 7.33
A-K	B	Acetate	Acetate & Cotton		13.25	15.10	+13.96
A-K	C	Acetate	Acetate & Cotton		13.00	14.50	+11.53
A-K	D	Acetate	Acetate & Cotton		13.93	14.50	+ 4.08
A-K	E	Acetate	Acetate & Cotton		14.58	14.82	+ 1.64
				Average	13.98	15.03	+ 7.71
D-K	A	Acetate	Dynel & Cotton		12.45	14.62	+17.4
D-K	B	Acetate	Dynel & Cotton		13.31	14.1[illegible]	+ 6.46
D-K	C	Acetate	Dynel & Cotton		12.67	14.87	+17.36
D-K	D	Acetate	Dynel & Cotton		11.73	13.34	+13.72
D-K	E	Acetate	Dynel & Cotton		12.06	13.41	+11.19
				Average	12.[illegible]	14.3	+13.22

Average of five determinations
* Calculated by dividing the difference between original and laundered by the original weight and converting to percent.

CHART IV

COMPARISON OF WARP BREAKING STRENGTH IN POUNDS ORIGINAL FABRICS AND AFTER 25 LAUNDERINGS

Code		Fiber Content Warp	Filling	Dry Orig.	Laund.	Percent Change*	Wet Orig.	Laund.	Percent Change*
W-W	A	Wool	Wool	34.3	40.8	+18.95	25.7	27.0	+ 5.06
W-W	B	Wool	Wool	31.1	32.6	+ 4.82	22.5	22.3	- .88
W-W	C	Wool	Wool	33.3	34.1	+ 2.4	20.5	21.9	+ 6.83
W-W	D	Wool	Wool	32.4	37.4	+15.43	20.6	24.0	+16.50
			Average	32.9	36.2	+10.4	22.3	23.8	+ 7.52
D-W	A	Dynel	Dynel	38.8	37.7	- 2.577	37.7	34.9	- 7.42
D-W	B	Dynel	Dynel	39.0	35.2	- 9.74	34.2	34.9	+ 2.05
D-W	C	Dynel	Dynel	35.8	35.9	+ .28	33.0	35.5	+ 6.00
D-W	D	Dynel	Dynel	37.5	35.4	- 5.33	33.6	31.7	- 5.66
D-W	E	Dynel	Dynel	36.6	36.3	- .82	35.1	34.0	- 3.13
			Average	37.3	36.1	- 3.37	34.7	34.0	- 1.63

Average of five determinations.

* Calculated by dividing the difference between original and laundered by the original breaking strength and converting to percent.

CHART V

COMPARISON OF FILLING BREAKING STRENGTH IN POUNDS
ORIGINAL FABRICS AND AFTER 25 LAUNDERINGS

Code		Fiber Content Warp	Fiber Content Filling	Dry Orig.	Dry Laund.	Dry Percent Change*	Wet Orig.	Wet Laund.	Wet Percent Change*
W-W	A	Wool	Wool	0	6.9	0	.6	4.3	+616.6
W-W	B	Wool	Wool	1.7	3.82	+125.0	2.5	2.1	- 16.0
W-W	C	Wool	Wool	5.2	14.[illegible]	+1[illegible]0.0	8.1	7.3	- 9.87
W-W	D	Wool	Wool	2.6	9.4	+261.0	6.1	5.7	- 6.56
			Average	3.1	9.27	+166.7	5.5	5.0	- 10.00
D-W	A	Dynel	Dynel	20.8	44.2	+ [illegible]	2[illegible].6	37.8	+ 32.16
D-W	B	Dynel	Dynel	8.1	2[illegible]	+253.0	17.1	17.3	+ 1.17
D-W	C	Dynel	Dynel	12.0	31.3	+160.[illegible]	19.7	24.0	+ 21.82
D-W	D	Dynel	Dynel	18.8	37.2	+ 97.8	22.7	30.9	+ 36.12
D-W	E	Dynel	Dynel	15.6	2[illegible].9	+ 85.25	22.4	24.7	+ 10.27
			Average	15.06	34.04	+132.29	22.1	26.94	+ 20.31

Average of five determinations
* Calculated by dividing the difference between original and laundered by the original breaking strength and converting to percent.

CHART VI

COMPARISON OF BURSTING STRENGTH IN POUNDS
ORIGINAL FABRICS AND AFTER 25 LAUNDERINGS

			Dry			Wet		
Code		Fiber Content	Orig.	Laund.	Percent Change*	Orig.	Laund.	Percent Change*
A-K	A	Acetate	[illegible]	1[illegible]0.4	+13.4	102.6	104.0	+ 1.3[illegible]
A-K	B	Acetate	127.2	139.[illegible]	+ 9.96	93.4	9[illegible]	+ 3.[illegible]
A-K	C	Acetate	13[illegible]	125.4	- 6.83	[illegible]9.0	[illegible]	+ [illegible].31[illegible]
A-K	D	Acetate	133.2	1[illegible].0	+ 8.86	92.[illegible]	[illegible]	+ 7.[illegible]2
A-K	E	Acetate	13[illegible]	1[illegible]7.[illegible]	+18.1	[illegible]	107.4	+1[illegible]
		Average	1[illegible].0	1[illegible].7	+ [illegible]	9[illegible]	100.[illegible]	+ [illegible]
D-K	A	Acetate & Dynel	125.0	159.0	+27.2	92.6	9[illegible].2	+ [illegible]
D-K	B	Acetate & Dynel	132.0	13[illegible].0	+ 3.03	93.2	101.2	+ 7.[illegible]1
D-K	C	Acetate & Dynel	12[illegible]	15[illegible].0	+21.[illegible]3	[illegible]2.4	97.2	+1[illegible]
D-K	D	Acetate & Dynel	122.[illegible]	1[illegible]0.4	+22.[illegible]9	[illegible]	93.5	+ [illegible].21
D-K	E	Acetate & Dynel	1[illegible]0.2	1[illegible].0	+17.[illegible]	9[illegible].2	1[illegible]0.[illegible]	+11.[illegible]
		Average	12[illegible]	1[illegible]2.[illegible]	+1[illegible]	90.7[illegible]	100.1	+10.01

Average of five determinations
* Calculated by dividing the difference between original and laundered by the original bursting strength and converting to percent.

CHART VII

COMPARISON OF WARP ELONGATION IN PERCENT ORIGINAL FABRIC AND AFTER 25 LAUNDERINGS

Code		Fiber Content Warp	Fiber Content Filling	Dry Orig.	Dry Laund.	Dry Percent Change*	Wet Orig.	Wet Laund.	Wet Percent Change*
W-W	A	Wool	Wool	24.0	29.86	+24.4	63.1	62.64	- .7
W-W	B	Wool	Wool	22.3	27.12	+21.61	53.4	54.62	+ 2.28
W-W	C	Wool	Wool	23.2	27.36	+17.93	50.2	61.58	+22.67
W-W	D	Wool	Wool	24.8	28.62	+15.4	59.6	63.14	+ 5.94
			Average	23.57	28.24	+19.84	56.57	60.49	+ 7.22
D-W	A	Dynel	Dynel	36.2	56.2	+55.24	36.8	38.78	+ 5.38
D-W	B	Dynel	Dynel	36.36	53.74	+47.8	39.6	37.46	- 5.40
D-W	C	Dynel	Dynel	36.7	35.32	- 3.76	37.7	35.62	- 5.51
D-W	D	Dynel	Dynel	37.0	36.6	- 1.08	42.5	36.34	-13.88
D-W	E	Dynel	Dynel	39.7	35.78	- 9.87	45.3	37.88	-16.38
			Average	37.13	43.51	+17.67	40.4	37.22	- 8.24

Average of five determinations.

* Calculated by dividing the difference between the original and laundered by the original elongation and converting to percent.

CHART VIII

COMPARISON OF FILLING ELONGATION IN PERCENT ORIGINAL FABRIC AND AFTER 25 LAUNDERINGS

Code		Fiber Content Warp	Filling	Dry Orig.	Dry Laund.	Dry Percent Change*	Wet Orig.	Wet Laund.	Wet Percent Change*
W-W	A	Wool	Wool	0	22.48	-	0	46.25	-
W-W	B	Wool	Wool	13.6	19.17	+40.95	17.9	31.88	+78.1
W-W	C	Wool	Wool	1[illegible].78	19.0	+ .119	50.9	43.68	-14.18
W-W	D	Wool	Wool	14.5	21.0	+44.8	39.5	41.02	+ 3.84
			Average	15.6	19.7	+28.6	36.1	38.9	+22.6
D-W	A	Dynel	Dynel	31.36	31.72	+ 1.15	31.1	32.5	+ 4.5
D-W	B	Dynel	Dynel	25.0	27.16	+ 8.64	32.3	29.08	- 9.96
D-W	C	Dynel	Dynel	34.36	28.76	-16.29	32.4	31.0	- 4.32
D-W	D	Dynel	Dynel	31.0	26.76	-13.67	26.3	30.32	+15.3
D-W	E	Dynel	Dynel	37.1	30.88	-16.76	34.6	35.08	+ 1.38
			Average	33.5	29.1	- 8.0	32.6	31.6	+ .8

Average of five determinations.

* Calculated by dividing the difference between the original and laundered by the original filling elongation and converting to percent.

CHART IX

STANDARD THICKNESS DURING LAUNDERING
(I. INCHES)*

Code		Laundering Interval						Percent
		Original	5	10	15	20	25	Change**
					Woven			
W-W	A	.250	.269	.265	.2475	.240	.230	- 8.69
W-W	B	.2153	.2253	.2116	.2086	.2085	.1983	- 7.89
W-W	C	.2218	.248	.2333	.231	.2291	.211	- 4.87
W-W	D	.211	.2293	.223	.2176	.2161	.202	- 4.27
Average		.2245	.2429	.2332	.2262	.2264	.2103	- 6.43
D-W	A	.2265	.2886	.2647	.2601	.2531	.244	+ 7.73
D-W	B	.246	.2666	.2527	.2575	.2546	.2418	- 1.71
D-W	C	.241	.275	.2567	.2621	.262	.255	+ 5.81
D-W	D	.2333	.277	.263	.261	.2568	.2448	+ 4.93
D-W	E	.2391	.2696	.2767	.2695	.2741	.261	+ 9.15
Average		.2372	.2753	.2628	.2620	.2601	.2433	+ 6.9
					Knit			
A-K	A	.161	.1581	.1561	.1466	.1453	.140	-13.04
A-K	B	.144	.1468	.1418	.1355	.1326	.1251	-13.12
A-K	C	.1466	.1356	.1346	.1266	.127	.1186	-19.1
A-K	D	.159	.155	.1491	.143	.1463	.139	-12.51
A-K	E	.175	.164	.1606	.1535	.151	.141	-19.8
Average		.1573	.1519	.1484	.1415	.1404	.1327	-15.51
D-K	A	.1561	.1591	.1503	.145	.1388	.1366	-12.49
D-K	B	.1653	.1556	.156	.1505	.1456	.142	-14.09
D-K	C	.162	.164	.157	.150	.1456	.1435	-11.42
D-K	D	.1255	.1266	.1213	.1143	.1108	.1088	-13.3
D-K	E	.1503	.1503	.145	.1416	.1377	.136	- 9.51
Average		.1516	.1531	.1461	.1403	.1357	.1334	-12.16

* Average of three determinations
** Calculated by dividing the difference between the original and laundered by the original and converting to percent.

CHART X

COMPRESSIONAL RESILIENCE DURING LAUNDERING
(IN PER CENT)*

Code	Original	5	10	15	20	25	Percent Change**
	Laundering Interval						
			Woven				
W-W A	37.28	32.52	34.37	28.83	32.[illegible]1	29.54	-20.7
W-W B	42.52	30.36	32.02	35.05	33.52	27.17	-36.1
W-W C	33.77	44.7	44.7	45.38	34.3	32.26	4.4
W-W D	35.1	33.12	38.5	34.0	34.25	30.97	11.7
Average	37.17	35.17	37.39	35.81	33.07	29.98	-1[illegible].2
D-W A	25.5	22.2	36.92	25.6	19.4	30.1	+18.0
D-W B	23.56	23.71	41.04	25.72	25.42	23.58	+ .08
D-W C	22.7	26.0	24.27	26.07	27.24	23.56	+ 3.8
D-W D	26.0	19.44	24.77	24.64	24.76	26.7	+ 2.7
D-W E	25.2	23.7	39.17	23.95	25.0	25.9	+ 2.7
Average	24.59	23.15	33.23	25.23	24.57	25.99	+ 5.46
			Knit				
A-K A	[illegible]2.45	50.0	42.49	37.44	44.76	44.3	-29.0
A-K B	50.1	46.74	37.47	36.57	42.48	42.48	-15.2
A-K C	40.83	40.69	38.86	43.6	47.67	39.42	- 3.45
A-K D	50.28	36.52	38.21	36.24	39.6	43.8	-12.8
A-K E	41.98	41.83	40.37	40.78	38.65	49.49	+17.8
Average	49.13	43.15	39.48	38.93	42.23	43.898	-10.6
D-K A	26.98	29.88	29.97	33.67	34.15	36.24	+38.0
D-K B	44.4	34.39	34.18	38.54	36.74	23.05	-48.0
D-K C	37.64	29.96	35.66	35.46	40.47	39.61	+ 4.6
D-K D	37.22	31.26	37.7	37.61	41.31	41.31	+10.8
D-K E	35.77	35.38	36.69	31.62	40.49	41.44	+15.0
Average	36.44	32.17	32.[illegible]	35.38	38.63	36.33	- .3

* Average of three determinations.
** Calculated by dividing the difference between original and 25th laundering by original and converting to percent.

CHART XI

COEFFICIENTS OF THERMAL CONDUCTIVITY*
ORIGINAL FABRIC AND AFTER 25 LAUNDERINGS

Code			Original	Laundered	Percent Change
			Woven		
W-W	A		.00144	.00164	+14.58
W-W	B		.00127	.00156	22.8
W-W	C		.00128	.00172	34.3
W-W	D		.00119	.00161	+35.3
		Average	.00130	.00163	+25.4
D-W	A		.00107	.00154	43.9
D-W	B		.00106	.00141	33.0
D-W	C		.00097	.00144	48.4
D-W	D		.00101	.00142	40.6
D-W	E		.00098	.00144	42.1
		Average	.00102	.00145	+42.2
			Knit		
A-K	A		.00167	.00188	12.5
A-K	B		.00158	.00179	13.3
A-K	C		.00156	.00161	3.2
A-K	D		.00140	.00168	20.0
A-K	E		.00153	.00181	18.3
		Average	.00155	.00175	+12.9
D-K	A		.00177	.00204	15.2
D-K	B		.00186	.00206	10.7
D-K	C		.00185	.00206	11.3
D-K	D		.00186	.00208	11.8
D-K	E		.00198	.00209	5.5
		Average	.00186	.00207	+11.3

* Average of five determinations.