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A SERVICEABILITY STUDY
ON COTTON GLOVES

Thesis for the Degree of M. A.
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Ruth Marian Heitz
1945

THESIS

This is to certify that the
thesis entitled

"A Serviceability Study on Cotton
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A DURABILITY STUDY ON COTTON GLOVES

by

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I. INTRODUCTION

Fabric gloves have made a definite place for themselves in the modern woman's wardrobe. They are now used not only as a protection for the hands, but also for their color and style contributions. With the beginning of World War II, leather gloves became higher priced and scarcer, and the better grades, formerly imported from Germany, Italy, France, and Czechoslovakia became impossible to obtain. Likewise, the good fabric gloves, made in Munich and Paris, and the cheap washables from Prague and Kaden, were no longer available (12). More and more consumers have been selecting fabric gloves as a substitute for the scarce leather ones, as well as on their own merits.

Knit fabric gloves, because of their construction, have certain advantages over woven fabric gloves and leather ones. Their elasticity, low price, and attractiveness add to their desirability. The fact that the volume of sales on knit cotton gloves has increased significantly in the last few years is shown in a report of the Sixteenth Census of the U. S. (Census of Business Volume) (19). In 1957, 84,242 dozen pairs of cotton knit gloves were sold at a value of \$36,595. In 1959, two years later, the figures had increased to 95,004 dozen pairs which were valued at \$92,823.

Because of the increased use of fabric gloves and the fact that consumer complaints concerning their fit and performance in use are common, a serviceability study was chosen. This study had three specific objectives -- first, to measure changes occurring in fabric gloves during wear which would alter their satisfaction and serviceability; second, to determine the consistency in the sizing of gloves available for consumer purchase; and third, to compare the satisfaction and serviceability of three brands of similarly priced gloves.

II. REVIEW OF RESEARCH LITERATURE

Cleveland (9) reported a study made by the National Bureau of Standards in 1936 at the request of the General Federation of Women's Clubs, to develop test methods for gloves which would give minimum quality standards. Factors to be tested were shrinkage, seam strength, and resistance to abrasion. Nine types of gloves were purchased from department stores in Washington, D. C. Five were made of cotton and four of rayon. One pair of each type of gloves was measured by each of two methods before and after laundering. In Method I, measurements for lengths and widths of the fingers and total hand were made with the glove lying flat in unstretched position, after placing a knot of thread in the glove wrist 7" from the tip of the middle finger. In Method II, the white thread was sewed in the same position. The glove was then pulled over the end of a 2 3/4" diameter hollow iron cylinder and clamped into position with a steel band. Then the glove was suspended in a vertical position from the wrist and filled with 5 pounds of 1/8" diameter lead shot. Dimensions of lengths and circumferences were taken. Circumference measurements were obtained by sewing a fine thread around the section to be measured, cutting any overlapping part, and after the shot had been removed, meas-

uring the thread in a flat position to the nearest 0.05 inch. This method stretched the glove in a manner different from the stretch produced by a hand, showing the glove to be bulged at the palm.

For the laundering process, each glove was placed in a one-pint jar with 200 ml. of 0.5% soap solution at 100° F. and agitated for 30 minutes in a Launder-Ometer. Following a rinse in tap water at the same temperature, the gloves were placed flat on an absorbent material and allowed to dry.

Tables with percentage shrinkage showed that for the total length measurement from the middle fingertip to the thread sewed in the wrist the variation was from 5 to 23% for Method I, and 1 to 13% for Method II. Total hand width at the knuckles, by the first method, varied from a stretch of 8% to 15% shrinkage, and the circumference by the second method varied from 9% stretch to 4% shrinkage. The tests were duplicable because right and left gloves measurements were similar, but the results by the two different methods were quite unlike.

The same gloves were laundered three times and measured each time by the shot method. For the most part greatest shrinkage occurred after the first wash, although many pairs showed change even after the second wash.

Six more pairs of gloves were obtained (9), and the left one was laundered and dried flat in unstretched position, while the right glove was unlaundered. All pairs of gloves were purchased for the same pair of hands. Following

the test, as judged by comfort and appearance, the gloves fitted nearly as well as the unlaundered ones in spite of the apparent shrinkage in length. An exception was one glove which was tight enough so that the finger crotches no longer fitted.

Summarizing, the author suggests that either Method I or II may be used, because neither exactly duplicates the stretch of the hand, but either method is duplicable. Either method might be used to set limits on shrinkage in a performance specification. The small amount of shrinkage indicates shrinkage by laundering may be less important than originally thought, and it may be unnecessary to provide numerical limits for shrinkage.

The following method is recommended for testing shrinkage: Secure polished metal hands graduated in size to correspond to sizes in which women's washable gloves are constructed. Place the glove on the hand of corresponding size. Work the glove onto the hand in the same manner as a glove is fitted on a human hand. Measure distances by the procedure outlined in the above study. Launder and dry by the above method and remount the dry gloves for re-measurement. Shrinkage should correlate with shrinkage occurring in real use.

Seam strength was tested for the gloves by the ordinary grab method except that the jaws were set 1/2" apart. While strength values varied widely for all the gloves, they were consistent for any one pair. In testing, the outer edge

seam of the glove, the range was from an average of 11 pounds to 57 pounds.

An abrasion test was conducted on the gloves, and the number of cycles required to wear a hole in the glove fabric was reported. The fabric was clamped over a flat, circular piece of wood one inch in diameter and pressed against crocus paper by a load of 200 grams. The sample was moved back and forth with a linear motion. Range for the minimum cycles was from 75 to 800, and for the maximum, 100 to 1100 cycles.

Conclusions drawn from this study recommend that these above tests may all be used as a basis for selecting tentative minimum values for gloves, but are too few in number and should be supplemented by data on gloves unsatisfactory in service before sound minimum standards can be established.

The United States Testing Company, Inc., performed a test on numerous samples of ladies' gloves (22). Microscopical identification of the fibers was made. The gloves were examined for workmanship and observations were made for the type of stitching and style of thumb insert. Workmanship was evaluated according to the evenness and cleanliness of seams and glove finish; smoothly cut edges with even, straight stitches; well attached trimmings and fastenings of good quality. Workmanship was given a comparative rating of very good, good, fair, or poor, on the above points. Characteristics of poor construction included seam breaks, loose threads, raw edges, and stitching too close to edges of fab-

ric.

Seam strength was tested by pulling the side seam on the glove palm to a rupture. The fabric was inserted between jaws of the Scott Tester which were set one inch apart, and the force required to rupture the seam was noted. The breaking strength ranged from 29.25 to 53.25 pounds. In general, from this study, it can be seen that the seam strength of certain gloves is greater than in the previous study, but that the range in breaking strength is similar (9).

An abrasion test was conducted on the palms of the gloves, and the number of strokes required to wear holes through the fabric was listed. The fabric was mounted over a metal surface and held under a standard tension of 9 pounds. The fabric was moved back and forth over an abrasive fabric with an oscillating motion. This procedure varies from the test described earlier (9). The numbers of strokes were given subjective ratings from poor to very good. The poorly rated gloves ranged up to 585 single strokes; the fair gloves ranged from 950 to 1250 strokes; rating of good was for 1625 to 2500 strokes; and very good from 2875 to 5000 strokes. Because of the difference in procedure there is little basis for comparing the results with the earlier study.

Fastness of black gloves to wet and dry crocking was tested with 20 single strokes on the Crockmeter. The gloves were rated as very poor, poor, fair, or good.

For determining shrinkage, specimens were measured before and after washing, and the percentage was reported for length, palm width, and the opening of the gloves. Comparative shrinkage ratings were given to gloves, with a poor rating for percentage change from 8.04 to 20.75% for length, and nil to 9.52% for palm width; fair rating was given for 5.94 to 7.89% change in length and from nil to 8.55% for palm width shrinkage; a good rating was given for 2.89 to 5.29% shrinkage in length, and 3.70 to 4.54% shrinkage for palm width. These figures varied considerably from those given in the first study.

For all of the above tests, results were tabulated by assigning to each feature a point rating, the most important features receiving the highest number of points. For example, workmanship was considered the most important item in determining value, so it was given the maximum of 25 points. Abrasion and shrinkage were next with 20 points, and the type of thumb and stitching were lowest with 15 points each. The points received on each feature were summarized, and point totals were rated as being very good, good, fair, or poor.

The problem of measuring effects of wear reliability is of almost greater importance than the problem of producing wear. According to Ball (3), eight measurable changes which are produced by wear or abrasion include tensile strength, thickness, weight, surface luster, color, air permeability, character of the fabric, and surface appearance.

Consumers' Research Bulletin for January, 1937, reported a test of women's fabric gloves (20). It was pointed out that no official or trade standards for testing gloves have been developed, so an attempt was made to rate this particular article of clothing. From widely distributed brands on the market, 12 pairs of women's gloves were purchased.

Tests carried out on these gloves included those for shrinkage, and colorfastness, and to determine wear resistance, abrasion tests were performed. The gloves were given a rating on workmanship and finish. Tested gloves were placed in Group A if recommended; in Group B if intermediate; and in Group C, if not recommended.

A more recent study of fabric gloves carried on by Consumers' Research was reported in the March, 1945, issue of the Bulletin(24). In the discussion of fabrics, cotton was considered better than rayon because of its greater tensile strength.

The main purpose of the Consumers' Research study was to discover if current complaints of fabric deterioration applied to fabric gloves, too. It was planned to use both black and white gloves for the testing, but frequently either one or the other color was not available.

Tests were performed on the gloves for dry and wet cracking. All black gloves showed wet cracking, and a warning was given to wash black gloves carefully.

Other tests included abrasion resistance, shrinkage, and seam strength. All gloves were examined for workmanship. Criteria on which gloves were judged for this factor included: evenness of seams and glove finishes; smooth-cut edges, even seams with straight even stitches; decorations and fastenings well attached and of good quality. The English or Bolton thumb was cited as outstanding in fit and wear.

Tested gloves were placed in groups A, B, or C, as in the previous study, according to the rating given after performance of the above tests. No information was given on the methods of testing.

Hays (14) has discussed the value of serviceability tests and has emphasized that such tests are the only way length of use can be predicted for an article. Clothing, to be tested, should be of the same kind and worn by many people at the same time. Good cooperation by the wearers is necessary for a service study.

With a large sample, similar wear, and the same laundry method, the effect of other variables, such as fiber quality, can be compared. From service studies, it has been learned that deterioration is progressive. Specific differences in fiber quality or fabric construction -- all other factors equal -- is reflected in the fabric durability. Such information is valuable as a basis for production of more serviceable textiles.

A test on the durability of cotton garments as affected by laundering and wear was reported by Ginter, Atkins, et. al. (15). The combined laboratory and service tests showed the effect of wear as measured by physical changes on garments worn and laundered until worn out. In discussing the results it was noted that laundering increases fabric thickness while body wear decreases both weight and thickness. Changes in linear measurements showed that laundering causes shrinkage, while body wear causes stretch. Places where garments showed signs of deterioration was a matter of practical interest.

Pauline Beery Mack et. al. at Pennsylvania State College (16) have concluded that shrinkage is inherent in a fabric, and is caused by a washing procedure only when that washing procedure involves unusual variation from accepted practices.

The literature concerning research on fabric gloves is limited, and the studies reviewed above are all that could be located even after extensive investigation.

III. REVIEW OF INFORMATION

Fiber content: A variety of fibers are to be found in fabric gloves. The most common ones in current use are cotton, wool, and rayon. Rayon fabric gloves have replaced the silk tricot gloves fashionable a few years ago. While the first fabric gloves were made of linen, today this fiber is seldom used.

Fabric construction: Knit glove fabric may be either weft knit or warp knit. In weft knitting a continuous yarn moves crosswise on the knitting machine. Weft knitting may be done either on flat machines or circular machines. These processes are described in detail by Caplin in her book Knit Fabrics (7).

In warp knitting several parallel threads move in a vertical direction. The flat machine is ordinarily used. Warp knit fabrics may be classified as single or double knits. Double knits, formerly known as glove silk, may be classified as tricot or milanese. Tricot knit constructions are characterized by lengthwise rows of loops on the face of the cloth and horizontal loops on the back. One-bar tricot is run-resistant, and two-bar tricot is run-proof. In milanese knit construction the threads run diagonally from selvage to selvage and it is run-proof (8).

Duplex gloves are constructed by pressing together two strips of cloth treated on one side with an adhesive substance. While they tend to come apart with repeated washing and wearing(21), these gloves are extremely popular because of their warmth and sturdiness.

Cotton and rayon fabrics may have a smooth finish, or they may be sueded to give a soft dull finish which resembles suede-finished leather. The latter is done by surface roughening with emery or other buffing wheel, or by teazles, according to the Encyclopedia Britannica (12).

Glove construction: Glove parts are known by the following names as described by Wingate et al. (23):

1. trunk--the general glove outline which is made up of the palm, back, and finger sections
2. fourchettes or forks--the finger side pieces which are oblong in shape and are used when the fingers have four sections
3. quirks--the triangular insets, which, when present, are located at the base of the fourchettes, and give added action room between the fingers
4. thumb--is made from a separate piece of fabric

Zelma Bendure, in her bulletin "Selling Gloves,"(5) lists the following types of thumbs (See Figure 2, Appendix, for diagrams):

1. set-in thumb--a round thumb which has been cut in a single piece without a quirk
2. French thumb--a round thumb which has an inserted quirk at the crotch
3. English or Bolton thumb--has the quirk in one piece with the back and palm of the glove, giving good fit and wear
4. inserted thumb--the thumb insert extends to the end of the glove without a seam at the curved thumb base.

At least fifty operations are required to make a pair of gloves. When a single operation is poorly done, an inferior glove is produced, according to Better Housemanship Bulletin on "Gloves" (6). One of the important steps in glove-making is the cutting. Types of cutting include the table-cut, the method used for the finest leather gloves with the best fit; the "pulldown," or modified table-cut, which gives less perfect fit and comfort; and the die, block, or pattern cut, which is done with a metal, trunk-shaped knife cutting through several layers of fabric. This is the quickest and least expensive method (23).

Any point at which a glove is sewed is a potential point of weakness. Quality of thread, length of stitch, and accuracy of stitching determine seam strength. The type of thread used should correspond to the fabric in the glove. Stitches should be small, regularly spaced, and equi-distant from the edge of the glove at all points. Types of stitching include the four given in the Household Finance Better Housemanship Bulletin (6):

1. lockstitching--made with two threads which have been looped into a single stitch.
2. chainstitching--comes from a single spool, and is characterized by a loop on the underside and a single thread on top. This gives elasticity to the glove.
3. triplestitching--or rip-proof seams are made with two stitches taken forward and one backward so the thread will not unravel.
4. handstitching--characterized by a double thread formed into a small running decorative stitch.

The following types of seams are used in closing or

attaching the various parts of the gloves. To a large extent these seams determine the glove quality, its appearance, and its price.

1. inseam--made by stitching edges of glove together on the inside. It is the least expensive, is durable, and easiest to make.
2. outseam, Brinseam, or FMI--both raw edges of glove are visible on the outside. While considered the strongest, it is bulkier in appearance. It is frequently hand-stitched for decoration.
3. overseam--both edges are visible with reinforcement from stitches going over the edges. It is attractive and less bulky than other types, but not durable.
4. pique--one edge is lapped over the other, leaving only one raw edge visible. It is most durable, but is difficult and expensive to make; therefore it is found only on good quality gloves(23).

Glove decoration may be limited to points only, or may include novelty decoration such as fancy turnovers, tucking, narrow bands, ruching, and combinations with other fabrics or with leather. Points, as described by Kneeland (15), refer to the fancy stitching located on the back of the glove, usually in divergent rows which decorate and give a better shape to the hand. On the better grades of gloves, these points do not extend as far as the base of the finger sections. Listed below are the common types of points (See Figure 3, Appendix, for drawings of these points):

1. brosser back--single lines of raised rows giving plain effect.
2. four row back--four rows of crocheted stitching or braid in knot effect
3. hand shaking--made by raising the points and sewing through the rows with plain stitch

4. needleback--design made by 4 - 8 rows of flat stitches
5. paris point--pointing with two rows of flat stitching on each side of raised center
6. single draw--a single row of stitching
7. spear point--three regular rows ending on wrist side of points with raised arrow designs(1)

Types or styles of gloves: "Glove length is designated by 'buttons,' allowing one 'French' inch per button from the thumb seam to the wrist end. A 'French' inch is a special glove measure about 1/12" longer than a standard inch." (6)

Types of gloves on the market include these basic styles:

1. mittens--one sheath for all four fingers
2. slip-on--2-4 button length, popular for women
3. gauntlets--resemble slip-on, but have a triangular inset at the wrist producing a wider flare
4. shorty--wrist length, includes most sport gloves
5. mousquetaire--opening at wrist, 8-button for street wear; 24-button for evening
6. novelty gloves--above types with combinations of trimmings, fabrics, shirring and cuffs
7. cadet--glove made to fit a short, broad-fingered hand (23)

The size of gloves is determined when the trunk is cut. Women's glove sizes range from 5 1/2 to 8. Fabric gloves vary by half sizes, while the leather ones come in quarter sizes. The table below, by Wingate et. al. (23), shows the relationship between the two sizings.

Women's Glove Sizes*

Leather									
5 1/2	5 3/4	6	6 1/4	6 1/2	6 3/4	7	7 1/4	7 1/2	7 3/4 8
Fabric									
5 1/2		6		6 1/2		7		7 1/2	8

A pertinent question relative to glove sizes would be whether or not glove sizes have been standardized to hand sizes. Another consideration in relation to sizes would be whether or not commercial standards have been set up and agreed upon by the industry. According to a reply from the National Association of Leather Glove Manufacturers, no method of standardizing glove sizes to hand sizes has been worked out. While work toward standardization had been done with the Department of Commerce on such a project, they had not, as yet, brought their findings to a conclusion (10).

Care of gloves: Care of gloves should start with daily attention. The Department of Merchandising Education of Good Housekeeping (10) advises that gloves should be smoothed, reshaped, and folded immediately after wearing while the fabric is still warm. This procedure helps in the retention of shape and fit. Ripped seams or tears should be mended before laundering to prevent enlargement of the places or the formation of runs. Cotton thread holds better for mends than silk thread according to information given by Craig and Rush (11).

*"The standard of glove sizes is based on actual measurement in French inches around the hand." (1)

Almost every reference has some discussion of directions for washing gloves. The American Glove Craft (3) has recommended the following procedure:

"Make a lukewarm suds of mild soap flakes. Immerse the gloves and squeeze the suds several times through the soiled spots. Rinse in two lukewarm waters. Without wringing, press water out of gloves, pull them into shape and dry them on a Turkish towel. Dry in the air, but do not expose to sun, steam or extreme temperature."

Zelma Bendure, in "Caring Gloves," (4), suggests washing in the same way as most cotton items, and drawing gloves out flat with fingers and seams straight. Suggestions by Craig and Rush (11) are to squeeze the gloves after rinsing, roll in a towel to remove excess water, then blow into the fingers and dry away from direct heat.

The final item in caring for gloves is the storing. Rathbone and Tarpley (17) recommend that after wearing or cleaning, gloves should be carefully smoothed, fingers should be pressed into shape, and the gloves should be wrapped in tissue paper or cloth and placed in a case or box.

IV. EXPERIMENTAL PROCEDURE

This section includes detailed explanations on selection of samples, serviceability record, laboratory methods, and the statistical treatment of the results.

Selection of Samples

To determine a price range for gloves in the proposed study, questions were directed to 50 instructors and college girls on the Michigan State College campus. The results indicated that the general price paid was from \$1.00 to \$1.75 for cotton knit gloves of the slip-on type. White was worn by approximately half and the remainder preferred a neutral color.

Because styles, colors, and sizes of cotton gloves were limited in the local stores of Lansing, and East Lansing, letters stating the problem were sent in May, 1944, to mail order houses and to department stores in Grand Rapids, Detroit, and Chicago. Favorable replies were received from Kern's and Hudson's in Detroit, so an order was placed for beige, cotton slip-on gloves at \$1.55 per pair. The original plan had been to make a comparative study of the serviceability of three popular brands of fabric gloves, and likewise it had been intended that the same number of gloves

of each brand be used. However, as required sizes were not available in each brand, the plan had to be adjusted to the gloves available. In consequence there are not the same number of gloves in each brand group. The gloves purchased included 15 pairs of "Kayser," 5 pairs of "Shalimar," and 11 pairs of "Wear Right."

Characteristics common to all the gloves in the three groups were fabric construction,* the Bolton thumb, single turndown hand-stitched hem, and single drawn points with one needle stitch around. A-gloves (Kayser brand) were "shorties" with hand-stitched outseams. B-gloves (Shalimar brand) were plain slip-on type with machine-stitched inseams. C-gloves (Wear Right brand) were of medium length with hand-stitched outseams (See mounted samples of fabric, Exhibit 3, Appendix, and photographs of the original gloves, Exhibits 1 and 2, Appendix). One pair from each group was purchased as a control. The number of gloves in each size group is indicated below.

Numbers of Gloves in Size Groups

Gloves	Sizes			
	6	6 1/2	7	7 1/2
A		7	7	1
B		2	2	1
C	2	3	5	1

*Beige, double weft knit construction. C₁ proved to be duplex construction.

Serviceability Record

It has been pointed out by Hays (14) that the only method which can be used to predict length of use is a serviceability study in which an article is subjected to normal use. Thirty-one glove wearers were carefully selected as ones who would probably give the gloves a comparable kind and amount of wear, and would be cooperative in keeping records. Those selected included housewives, teachers, secretaries and research personnel. The gloves were purchased in the size stated by the wearer.

In order that all of the gloves might be worn over the same period of time, the wearing period was from June 1, 1944, to June 1, 1945. Each pair was mailed to the wearer and was accompanied by an explanation of the study, a standard method for washing the gloves, and charts for recording data (Exhibit 4 and Charts 1 and 2, Appendix). In the explanation which was sent to the wearers (Exhibit 4, Appendix) it was suggested that the wearer use the gloves as often as possible. This would approximate the normal wear for a pair of gloves. A chart was included (Chart 1, Appendix) for data and information on the serviceability of gloves. There was a check list on the fit of gloves, as to whether it was excellent, good, fair or poor fit, and a place for recording reasons for the answer. It was thought that the above would take care of any subjective opinions on the gloves not included in the day-to-day record.

The record for wearing and laundering was to be kept on a daily chart (Chart 2, Appendix) marking "W" for wearing, and "C" for washing. The standard washing method recommended for the wearers was derived by combining the methods found in the literature. The directions are as follows:

- Wash frequently so gloves will not be too badly soiled
- Prepare suds, almost cool, with any pure white flake soap
- Rinse two or three times in almost cool water
- Knead between folds of turkish towel to remove moisture
- Blow into gloves to put them into shape
- Work between hands to soften and stretch into shape just before entirely dry

To note all of the changes which took place during the year of wear, two types of analyses were made. One had to do with observations of change for factors not easily measured, and the other, with laboratory tests.

A study was made on the wearers' comments, and on the charts with data for wearing and laundering of the gloves. The gloves were examined for the location and type of wear received on seam edges, inside and outside palm, and fingertips, seam rips, vertical runs, and loose hairs. Seven judges, two trained and two untrained, ranked the gloves on color change, general wear, feel, and dimensional change. (See Chart 3, Appendix, for score sheet).

Before and after the wearing period, measurements of lengths, circumferences, and thicknesses were made on the right glove. Photographs were taken of the gloves to show typical wear and dimensional change (Exhibits 1 and 2, Ap-

Laboratory Procedure

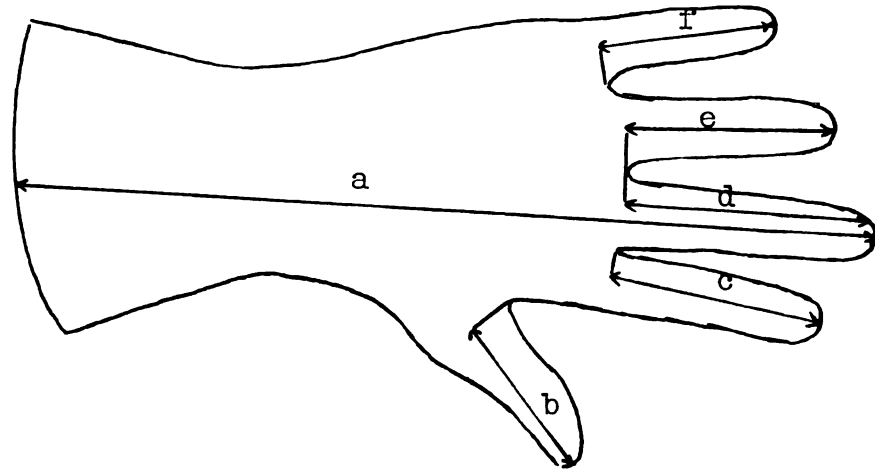
One change occurring in gloves during a period of washing and wearing is change in dimensions. In order to make a careful study of the shrinkage or stretch, accurate measurements were taken before and after wearing. Although several methods have been proposed, no standard method has been devised for measuring gloves. The plan in this study was to follow the methods set up in the research conducted for the National Bureau of Standards (9). The measurements were made two times on each dimension and the mean of the two values was used in the analysis. Percentage shrinkage was calculated from the original measurements on the gloves.

Length measurements: All measurements were made with a linen tape and recorded to the nearest 0.1 inch. Lengths were taken with the glove lying in a flat, unstretched position. Length (a), total glove length, represented the number of inches from the extreme tip of the middle finger through the center of the glove to the wrist end. Length (b), the thumb length, was measured from the tip of the thumb to a line horizontal with the crotch of the thumb. Lengths c, d, e, and f, were the forefinger, middle, fourth, and little fingers respectively (See Figure 1 for exact location of these measurements).

Circumference measurements: Rather than taking widths -- which scheme would not allow for the fourchettes or side finger sections -- it was thought to be a more accu-

Figure 1

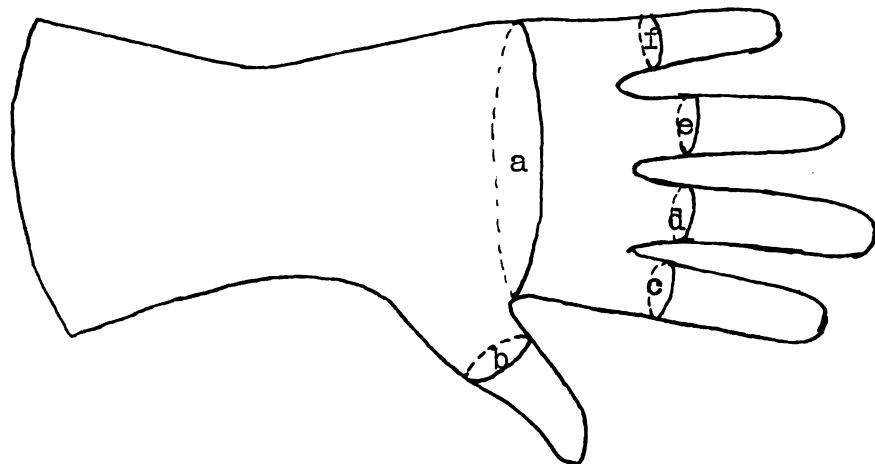
- A. Location of length measurements made with glove lying flat in unstretched position (9)



a. total hand
b. thumb
c. forefinger

d. middle finger
e. fourth finger
f. little finger

- B. Location of circumference measurements made with the glove filled with white sand (9)



a. total hand at the palm
b. thumb
c. forefinger

d. middle finger
e. fourth finger
f. little finger

rate procedure to record circumferences. Procedures for measuring, as set up for the National Bureau of Standards(9) were followed. Deviations from these original methods will be explained later.

Since lead shot, as recommended by Cleveland (9) was not available, white sand was found to be a suitable substitute. This was heavy enough to fill the fingers to a normal roundness without excessively stretching the fabric. The glove was filled with sand to a height slightly beyond the base of the thumb and suspended with fingers down, from a ringstand (Exhibit 1, Appendix). Even though the sand, like the lead shot (9), produced an abnormal bulge in the palm section, it was thought to be a valid measurement, useful for comparative purposes and a measurement which could be duplicated after the gloves were worn. Circumference (a), or the palm measurement, was taken halfway between the thumb crotch and the knuckle sections. Circumferences b, c, d, e, and f, were of the thumb, forefinger, middle, fourth, and little finger measurements respectively. These measurements were taken between the finger crotch and the first bend of the finger, or approximately one-half inch above the base of the fingers. A series of preliminary tests showed the circumference was the same for more than an inch from the base section, so it was not necessary to be exact in the location of the tape(See Figure 1 for diagram of circumference measurements).

Thickness: In addition to changes in lengths or circumferences, it is known that gloves are subject to abrasion during the wearing period. For this particular study, the thickness test was chosen as an indication of the wear. The thickness was measured at the parts of the glove receiving the greatest amount of wear. Measurement (a) was located on the forefinger tip, equidistant from the end and two side seams of the finger. In a similar manner, measurements b, c, d, and e, referred to as middle fingertip, side palm, thumb, and knuckles, respectively, were taken. Careful testing showed that it was important to locate the thickness tester in the same place on the finger tips, but in the knuckle and palm sections, the measurement was the same over a large area. Figures were recorded for the above locations on the front or inside, and the back or outside, of both right and left gloves. The Conco Thickness Gauge, which measures to the nearest 0.001 inch was used. After the spring was released and the fabric lay between the instrument's calipers, an interval of five seconds was allowed to elapse before the thickness was read on the dial. A mean of three measurements was taken as the thickness of the fabric.

Statistical Analysis

The data collected in this study are adaptable to simple statistical analysis. Recorded changes in measurements were converted into percentage of the original meas-

urements. The test used to determine if the mean of these percentage changes was a significant change can be explained after giving the following formulae:

$$\sigma = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{N}}{N - 1}} \quad \sigma_m = \frac{\sigma}{\sqrt{N}} \quad t = \frac{\bar{x} - 0}{\sigma_m}$$

The last of these formulae, that of the t-value, is the one that is useful here. The first two are only used in computing the third. If the t-value is greater than 2.6 the change is significant and not attributable to pure chance.

Seven judges were selected and each one was asked to rank each brand type of gloves according to the characteristics of general wear, color change, dimensional change, and feel. For example, the glove with the most color change was ranked one, and so on, until the glove with the least change was given the highest number (See Chart 3 in the Appendix). Correlation between the seven judges was very high, even though two of them had no previous training in judging. However, in judging the feel, there was no correlation in the ranking by the judges or even between two sets of rankings made by the same person at different times. For this reason the "feel" was not considered measurable.

To determine if there was any relationship between various items such as the number of times worn and the amount of color change, some method of correlation had to be set up. The gloves in each group were ranked as to the number of washings and then again as to the number of wearings.

In order to compare the ranks on any two characteristics the rank correlation coefficient was used. Its formula is

$$R_{xy} = 1 - \frac{6\sum D^2}{N(N^2 - 1)}$$

where D is the difference in ranks of each glove and N is the number of gloves in the group. In general, a correlation close to 1 is most significant.

V. RESULTS AND DISCUSSION

Dimensional Changes

Dimensional measurements are reported for the right gloves only. A test showed no significant difference in the gloves for the right and left hands either before or after washing.

Lengths: Length measurements were studied in two ways. First, the individual measurements were obtained, including total glove length and the finger lengths (Figure 1). Secondly, these six measurements were averaged to find the dimensional change in length for the glove-as-a-whole. For the purpose of analysis, differences in measurements before and after wearing were converted to percentages to show change which had taken place (Table 1).

The individual measurements in A-gloves showed an average shrinkage of 8% (0.2") for total glove and for the forefingers to 10% (0.3") for the middle, fourth, and little fingers. In B-gloves the shrinkage ranged from 6% (0.3") for the middle fingers to 15% (0.5") for the thumb. For C-gloves shrinkage ranged from 4% (0.1") for the little finger to 8% (0.1") for the forefinger (See Table 1). This shows the smallest range in A-gloves, the greatest in B-gloves. There is little consistency among the three groups as to

Table 1

Shrinkage in Length of Right Gloves after Wearing

	Total Glove	Thumb	Fore- finger	Middle finger	Fourth finger	Little finger	Average glove as a whole
<u>A-Gloves</u>							
1	8	4	7	12	13	14	10
2	5	7	7	3	7	7	6
3	16	21	11	13	11	11	14
4	2	4	4	7	7	7	5
5	8	11	11	3	11	11	9
6	14	12	12	10	7	7	10
7	6	4	11	9	11	11	9
8	4	9	4	7	4	5	6
9	8	4	0	10	11	11	9
10	9	19	7	13	11	10	12
11	6	16	11	7	7	14	10
12	5	12	7	3	4	5	6
13	8	12	4	12	4	5	8
14	11	8	7	13	4	5	8
15	5	12	14	16	11	5	11
<u>Average</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>10</u>	<u>10</u>	<u>10</u>	
<u>t values</u>	<u>7.85</u>	<u>8.96</u>	<u>6.59</u>	<u>10.95</u>	<u>5.55</u>	<u>7.71</u>	
<u>B-Gloves</u>							
1	16	23	11	9	14	13	15
2	26	16	4	0	15	5	11
3	6	9	11	7	7	10	9
5	4	9	4	4	7	0	5
<u>Average</u>	<u>12</u>	<u>15</u>	<u>8</u>	<u>6</u>	<u>14</u>	<u>9</u>	
<u>t values</u>	<u>2.61</u>	<u>4.08</u>	<u>5.64</u>	<u>1.11</u>	<u>5.47</u>	<u>2.12</u>	
<u>C-Gloves</u>							
1	5	9	12	13	8	5	9
2	8	9	12	7	8	5	8
4	3	9	4	0	4	0	3
5	7	4	12	10	4	0	6
6	7	8	12	7	3	5	8
7	7	0	8	7	8	5	6
8	7	5	4	7	8	0	5
9	3	7	3	6	7	5	5
10	7	13	4	7	4	10	8
<u>Average</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>7</u>	<u>4</u>	
<u>t values</u>	<u>8.97</u>	<u>5.75</u>	<u>6.15</u>	<u>12.50</u>	<u>9.71</u>	<u>3.57</u>	

which part of the gloves shrank the least or the most. The range of measurements within a single dimension varied greatly. For example, the middle finger measurements ranged 3% to 10%, or an average of 10% shrinkage for the A-gloves; for the B-gloves, the range was from nil to 9% or an average of 6% shrinkage; the middle finger of the C-gloves varied from nil to 13% change, with an average of 7% shrinkage. The "t" values showed significant shrinkage for the gloves on all measurements in A-gloves (Table 1). The "t" values for C-gloves showed significant shrinkage with the exception of measurements on fourth and little fingers.

To study the glove-as-a-whole (the average of 6 measurements was used; see Table 1), shrinkage for A-gloves was from 5% (.2") to 14% (.6"). In B-gloves, least shrinkage was 5% (.2"), and the greatest was 15% (.7") change. In the C-gloves, the range of shrinkage was from 3% (.1") to 9% (.5"). This shows the C-gloves to be less changed than the other two groups.

In studying the length changes for individual measurements, it can be seen that all gloves shrank in each length measurement. There was no consistency as to which section of the glove shrank the most or the least, either within a group, or when the three groups of gloves were compared. These facts are similar to the results of the studies by Cleveland (9) and by the U. S. Testing Co. (22). The range of shrinkage is also similar to that reported in these

studies.

The table below shows variation in average shrinkage for individual glove parts (see Table 1 for all measurements). Some sections of the gloves showed wider variation than others. For example, the thumb shrink 7.5 to 10.5 (0.2" - 0.4"), while the forefinger shrinkage was very consistent with 0.5 (0.2") for all three brands. Measurements are apparently accurate; so the question arises as to the cause for the variation.

Shrinkage* in Length of Individual Measurements

Group	Total Glove <u>2 (av.)</u>	Thumb <u>2 (av.)</u>	Fore- finger <u>2 (av.)</u>	Middle finger <u>2 (av.)</u>	Fourth finger <u>2 (av.)</u>	Little finger <u>2 (av.)</u>
A-gloves	<u>8</u>	<u>9</u>	<u>8</u>	<u>10</u>	<u>10</u>	<u>10</u>
B-gloves	<u>12</u>	<u>15</u>	<u>8</u>	<u>6</u>	<u>14</u>	<u>9</u>
C-gloves	<u>6</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>7</u>	<u>4</u>

Circumferences: Circumference measurements were studied in two ways. First the individual measurements were recorded and averaged for an entire group of gloves to show in which section the greatest amount of change occurred. Secondly, the six measurements were averaged to show the amount of circumference change within the glove-as-a-whole (See Table 2 for percentage changes).

Individual circumference measurements for A-gloves showed that the average range was from 1.5 stretch for the

*Significant figures are underlined.

Table 2

Stretch in Circumference of Right Gloves after Wearing

	Total Glove	Thumb	Fore- finger	Middle finger	Fourth finger	Little finger	Average glove as a whole
<u>A-Gloves</u>	%	%	%	%	%	%	%
1	3	16	19	17	17	15	15
2	2	12	0	8	4	5	5
3	15	9	23	35	30	22	23
4	5	8	21	17	24	5	13
5	5	4	15	13	13	10	10
6	7	14	15	14	9	5	11
7	-3*	13	5	4	14	16	8
8	0	0	10	0	10	11	5
9	-3	0	10	8	14	5	6
10	-3	14	15	9	19	0	8
11	0	14	10	0	9	0	6
12	-2	25	15	13	14	5	12
13	-5	0	0	8	9	0	2
14	3	24	10	21	9	0	11
16	0	4	9	4	4	0	4
<u>Average</u>	<u>1</u>	<u>10</u>	<u>12</u>	<u>12</u>	<u>13</u>	<u>7</u>	
<u>t values</u>	<u>1.08</u>	<u>5.05</u>	<u>4.60</u>	<u>17.0</u>	<u>6.15</u>	<u>3.76</u>	
<u>B-Gloves</u>							
1	3	12	9	8	13	10	9
2	3	0	4	-9	4	5	1
3	11	11	14	19	5	-10	8
5	7	-11	0	-5	5	0	-1
<u>Average</u>	<u>6</u>	<u>3</u>	<u>7</u>	<u>3</u>	<u>7</u>	<u>1</u>	
<u>t values</u>	<u>2.94</u>	<u>0.08</u>	<u>2.25</u>	<u>0.03</u>	<u>3.23</u>	<u>0.03</u>	
<u>C-Gloves</u>							
1	5	-4	0	-5	-5	-5	-3
2	10	0	9	0	4	25	8
4	3	11	24	19	20	0	13
5	3	7	8	12	8	10	9
6	6	7	32	20	13	5	16
7	4	22	0	-4	0	0	4
8	7	4	4	-7	0	5	2
9	3	-4	0	-5	-5	-5	-2
10	10	11	13	12	4	10	10
<u>Average</u>	<u>6</u>	<u>6</u>	<u>10</u>	<u>5</u>	<u>4</u>	<u>2</u>	
<u>t values</u>	<u>6.49</u>	<u>2.99</u>	<u>2.63</u>	<u>0.89</u>	<u>1.94</u>	<u>1.67</u>	

*The minus sign denotes shrinkage in the dimension.

little finger to 7% for the forefinger and fourth fingers. C-gloves showed an average percentage stretch ranging from 2% for the little fingers to 10% for the forefingers. There is a closer relationship between the change in parts for B- and C-gloves in respect to sections of the gloves showing a relative degree of circumference change. Circumference measurements varied greatly within a single dimension.

Studying the changes for the middle finger, A-gloves varied from nil to 33% stretch, an average of 12%; B-gloves ranged from 9% shrinkage to 19% stretch, with an average of 5%; C-gloves varied from 7% shrinkage to 26% stretch, or an average of 5%. Other dimensions varied similar amounts. The "t" values showed significant change or stretch in all circumferences in A-gloves except the total glove circumference taken at the palm (Table 2). In B-gloves, there was significant gain in three sections, the total hand circumference taken at the palm, the forefinger, and the fourth finger. For the C-group, "t" values indicated significant change in total glove measurement taken at the palm, the thumb, and forefinger.

Circumference measurements for glove-as-a-whole show a range of 2% (.1") to 23% (.5") gain for the A-gloves (Table 2). For B-gloves measurements ranged from 1% (.1") shrinkage to 9% (.2") stretch. In C-gloves, the least change was 2% (.05") shrinkage to 10% (.4") stretch. From this it can be seen that B-gloves stretched the least amount in circumference, and A-gloves stretched the most.

A study of circumference changes showed that most gloves stretched after use. There was greater consistency between the parts of the gloves showing change than was true in the length measurements. There was little relationship between parts of the gloves showing greatest length change and parts with the greatest circumference change. Gloves tested by Cleveland (3) showed a comparable amount of stretch in the circumference measurements.

Dimensional change: By combining the changes in length and circumference for the gloves, a more accurate picture of the complete dimensional change may be obtained. Judges ranked the gloves on dimensional change, which was described as distortion in length and circumference, as compared with the original, unworn gloves. Relationship between the rank in dimensional change and the actual numbers of washings and wearings can be shown.

There was significant correlation of .605 between the number of washings for the A-gloves and dimensional change as ranked by the judges, and a highly significant correlation of .663 between the number of wearings and dimensional change (Table 6). Correlation between dimensional change and other factors was not significant in the A-gloves, although there was closer relationship between the number of wearings and dimensional change than between the number of washings and dimensional change (Table 6). The lack of correlation might be attributed to the small sample. Analysis showed no significant correlation, in the C-gloves, between dimension-

al change and the number of washings, but a significant correlation of .643 between dimensional change and the number of wearings. Photographs (Exhibit 2, Appendix) show the gloves in each group with varying degrees of dimensional change.

Work done at the Pennsylvania State College (15) showing that shrinkage is inherent in a fabric suggests that shrinkage in length and stretch in circumference probably occurred because of fabric characteristics or manipulation of the gloves after washing, and it was not due to washing techniques. Figures on dimensional change vary so greatly that the reaction of a glove is unpredictable. There was no way of checking to see if the wearers put the gloves on when they were damp, practically dry, or bone dry, but this factor would have influenced the shrinkage or stretch. There is also an individual difference in the way in which gloves are put on, as well as differences among the hands themselves.

Analysis of Wear

Relationship between wear and thickness change:

Thickness was tested on the forefinger and the middle finger tips, the side palms, thumbs, and knuckles, because those places were expected to show the greatest amount of wear. When the data were tested statistically, it was found that the thickness figures for the right gloves were so nearly the same as for the left gloves that the fabric was homo-

neous, and either set of figures might be used. This was true both before and after washing. For this study, measurements for the right gloves were chosen. It was also found that in the original gloves, the fabric on the inside and the outside of the hand was the same thickness (See Table 3 for percentage changes in thickness, and Tables 7-23, Appendix, for original measurements).

A-gloves showed an average original thickness of .025 inches for the single fabric, and .031 inches after wearing. The "t" values indicated significant increase in thickness for all parts of the gloves (Table 3). In the A-gloves, average percentage change in thickness for the various sections of the glove ranged from 16% for the thumbs to 22% for the side palms, on the front or inside of the gloves, or an average of 19%.

B-gloves averaged .026 inches on the inside before wearing, and .029 inches after wearing, with significant increase for the side palm and knuckle areas. B-gloves ranged from 2% increase for the thumbs to 14% at the knuckles, or an average of 5% (Table 3).

C-gloves had an average of .027 inches before wearing, and .031 inches thickness after wearing. There was significant increase in thickness for the side palm and knuckle measurements. Change of thickness on the inside ranged from 2% for the forefingers to 15% for the side palms with an average of 6% change (Table 3).

Considering the outsides or backs of the gloves,

Table 3

Change in Thickness for Right Gloves after Wearing
(inside and outside)

	Forefinger		Middle finger		Side Palm		Thumb		Knuckles		Average		Total average
	in- side	out- side	in- side	out- side	in- side	out- side	in- side	out- side	in- side	out- side	in- side	out- side	
A-Gloves	%	%	%	%	%	%	%	%	%	%	%	%	%
1	12	0	12	8	19	15	20	20	19	19	14	12	13
2	21	21	17	21	29	34	21	23	20	22	21	24	23
3	8	8	8	16	20	24	4	4	8	8	8	12	10
4	20	23	23	23	23	29	20	16	15	15	21	22	22
5	24	24	12	19	24	23	24	23	15	15	22	23	23
6	16	23	21	29	24	23	23	23	12	12	20	25	23
7	19	19	20	20	15	19	15	19	15	15	17	18	18
8	20	24	29	34	20	24	23	23	12	12	19	29	24
9	13	29	13	29	20	24	8	12	15	15	14	22	18
10	17	29	16	20	31	35	16	24	23	23	21	26	24
11	15	23	20	23	15	23	23	29	24	24	20	25	23
12	16	20	23	23	24	20	19	19	20	20	20	20	20
13	20	24	29	29	20	24	12	12	24	24	21	23	22
14	15	19	29	29	24	23	23	29	16	16	21	24	23
16	15	23	12	23	19	23	16	23	15	15	15	24	20
Average	17	21	19	24	22	27	16	22	17	17	19	21	
t values	16.17	15.25	7.16	14.1	25.8	22.1	10.1	20.0	14.3	14.3			
B-Gloves													
1	-15	0	-12	0	-12	-15	4	-8	4	4	-6	2	-2
2	0	2	0	4	15	15	0	8	19	19	7	12	10
3	-4	-8	-4	4	23	23	-8	0	15	15	4	7	6
5	4	-8	21	17	21	23	12	12	19	19	15	13	14
Average	4	-1	5	6	12	12	2	3	14	14	5	9	
t values	1.5	0.75	1.47	1.90	8.10	8.70	0.50	0.75	3.85	3.85			
C-Gloves													
1	(omitted because of duplex construction)												
2	0	10	4	11	11	14	14	21	0	0	6	10	9
4	0	21	8	30	11	13	-4	19	7	7	4	19	12
5	14	111	7	14	19	19	19	19	7	7	11	14	13
6	-11	15	8	15	12	23	-4	-4	12	12	3	12	8
7	14	23	12	15	16	24	8	15	15	15	15	20	17
8	-8	12	-4	16	12	19	-4	12	8	8	1	13	7
9	-10	13	-10	6	17	17	-10	-13	6	6	-1	6	3
10	16	32	17	33	20	24	4	15	15	19	14	23	19
Average	2	18	5	18	15	18	3	10	9	9	6	15	
t values	0.003	1.06	0.55	0.57	8.60	26.2	0.67	5.0	4.7	4.7			

er Wearing

Knuckles		Average		Total
in-	out-	in-	out-	average
side	side	side	side	
19	19	14	12	13
20	22	21	24	23
8	8	8	12	10
15	15	21	22	22
15	15	22	23	23
12	12	20	25	23
15	15	17	18	18
12	12	19	29	24
15	15	14	22	18
23	23	21	26	24
24	24	20	25	23
20	20	20	20	20
24	24	21	23	22
16	16	21	24	23
15	15	15	24	20
17	17	19	21	
14.3	14.3			

4	4	-6	2	-2
19	19	7	12	10
15	15	4	7	6
19	19	15	13	14
14	14	5	9	
3.85	3.85			

0	0	6	10	9
7	7	4	19	12
7	7	11	14	13
12	12	3	12	8
15	15	15	20	17
8	8	1	13	7
6	6	-1	6	3
15	19	14	23	19
9	9	6	15	
4.7	4.7			

thickness in A-gloves ranged from 17% on the knuckles to 27% increase on the side palms, an average of 21% increase in thickness for the entire group (Table 3). B-gloves showed a maximum of 14% increase for the knuckles, or an average of 9%. C-gloves showed a range from 9% change for the knuckles to 18% for each of the forefingers, middle fingers, and the side palms, or an average of 15%.

This analysis shows that for every group of gloves, the outsides or backs of the gloves thicknesses were greater than on the insides. In analyzing the change in fabric thickness it can be seen that in all the gloves the least wear occurred on the side palm and knuckles sections and the thickness measurements were greater in those areas. Thickness change was most evident on the thumbs and forefingers where friction was greatest. This is supported by the theory that body wear decreases thickness, whereas laundering increases it (15).

Analyses of wear: As shown in table 5, A-gloves were worn an average of 92 times during the year, with a range from 11 to 243. Washings ranged from 4 to 33, with an average of 15. On the average, a pair of A-gloves was washed once for every 6 wearings, ranging from 1 washing for 2 wearings, to 1 washing for 15 wearings. A-gloves showed that on the majority of the front fingertips, there was slight wear; very few were worn on the back fingertips. Seven pairs out of fifteen were stained. Nine pairs had vertical runs, most of them in the thumb section where the

peak of the thumb joins the upper palm. The two pairs of A-gloves ranking lowest and next to the lowest in the number of wearings, showed the least amount of change in fabric appearance according to visual analysis. Likewise, the pair with the greatest number of washings and wearings, was most completely worn out according to this analysis. There was a highly significant correlation of .705 for all the A-gloves between general wear and the number of washings (Table 6). There was also a highly significant relationship of .713 between the general wear and the number of wearings.

D-gloves were worn an average of 63 times, and a range from 40 to 106 (Table 5). They were washed from 7 to 56 times, or an average of 21. They averaged one washing for each 3 wearings. All D-gloves were worn slightly on all fingertips, both inside and outside, but there were no stains. No palms showed wear. There was no significant correlation between the various factors (Table 6), which might have been due to the extremely small sample of four pairs.

C-gloves were worn an average of 11 times, with a range from 40 to 204 (Table 5). The washings ranged from 3 to 60, with an average of 22. The C-gloves averaged one washing for every 5 wearings. C-gloves, like the D-gloves, were worn on front and back of both right and left fingertips. The side palms were more worn than in either A- or B-gloves. Four pairs of gloves showed stain. The glove ranking first in the total number of wearings showed holes in

many places and great wear over the entire glove surface. On the other hand, the glove worn the least number of times showed the least change in fabric appearance. There was significant correlation of .605 between the number of washings and general wear (Table 6). There was a highly significant relationship of .809 between general wear and the number of wearings.

Worn places appeared to fall in rather well-defined groups. For example, as the amount of wear increased, the worn places were noted first on the right hand, starting with the thumb, and progressing to the forefinger, the third, fourth, and little fingers, and last of all, the side palm and knuckles on the inside of the glove. With further wear, the left hand became worn in the same order, with the thumb showing wear first. A few pairs of gloves were worn to the extent that they could not be used again. These showed wear on the outsides of the gloves as well as on the insides. The photograph (Exhibit 1, Appendix) shows that there was wear at the bends of the fingers, and the glove was distorted until, when it was filled with sand, it promptly took the shape of the human hand.

Wearing appeared to be graded, or to fall into groups which would indicate the degree of wear. If slightly worn, the fabric presented a smooth appearance as differing from the suede-like original fabric; if it was more worn, there was a fuzzy nap; when very worn, there was no nap left; the last stage was when a hole appeared. The three types of

gloves showed wear to be in selected places.

All gloves, with the exception of the B-gloves, showed significant correlation between the number of wearings and general wear as ranked by judges, and between number of washings and general wear. B- and C-gloves showed wear over the entire surface of the gloves, with C-gloves having the most wear on the palms.

Comments by wearers suggested that as the gloves became more worn, it was necessary to wash them more frequently, because they were easily stained by books, purse, or whatever the wearer happened to touch.

Relationship of fit and wear: According to comments of the wearers, most of the wearers of A-gloves objected to the length. Because of the extremely short total length of the gloves, wearers had a tendency to pull the glove at the wrist, and this produced a flare or distorted appearance. Even when the gloves fitted well before washing, they became too small for comfort afterwards. Apparently, if the gloves fitted poorly, the number of wearings was less, as was the case for A₄, the comment of the wearer being that the gloves were too tight, with the result that she wore them only 11 times. This pair ranked lowest in the number of wearings, and next to the lowest in dimensional change. Due to this comparatively low number of wearings, color change, general wear, and dimensional change were less than when a glove was worn a greater number of times. As one example, A₉, which ranked third in the number of wearings, was placed second in

general wear and dimensional change.

D-gloves were objectionable to wearers because the fingers became too small after laundering. Excessive strain on the seams produced many small runs in the fabric along the sides of the fourchettes. Inseams were considered uncomfortable. Most wearers thought the fourchettes became too narrow at the fingertips, therefore not allowing room for the fingers. This could be a fault in the glove cutting, or perhaps the seams were too deep. All wearers of D-gloves disliked the fit, and commented that because of poor fit, they were worn less. This fact is substantiated by the figures showing that D-gloves were worn fewer times, on the average, than any other group. Glove D₅, which was ranked the poorest fitting glove in its group, ranked lowest in the number of wearings, general wear, and dimensional change.

C-gloves were thought to be extremely comfortable, and a single comment that the fingers were too short indicated that this wearer should have been fitted before purchasing her gloves because of her unusually long hand. This dissatisfaction did not interfere with the number of wearings for this particular glove.

In summarizing, C-gloves appear to have been the most satisfactory according to the fit, and it is significant that the average number of wearings was greater than for the other two groups of gloves in which fit was less satisfactory.

Because the gloves having the best fit are receiving

the most wearings and giving the greatest satisfaction, it should be the goal of the consumer and of the manufacturers and salespeople to produce and sell gloves which fit. Because there is so much variation between gloves within a single size group (Table 4), and between the different brands or styles of gloves, it is obvious that the consumer should be fitted in fabric gloves rather than buying by size. That there is no consistency in lengths between the sizes of a given style or between a given size in the different brands of gloves is clearly shown in the size comparison table on total glove length below.

Size Comparisons
Total Length (Average)

Glove	Size			
	6	6 1/2	7	7 1/2
A		8.4"	8.5"	8.4"
B		11.3"	8.5"	13.0"
C	8.7"	11.0"	9.5"	10.3"

Of even greater significance in fit is a comparison of the variations in the circumference measurements of the different sizes and the variations between the different brands of gloves as seen under A, B, and C.

Size Comparisons
Circumference Measurement
for Total Hand (Average)

Glove	Size			
	6	6 1/2	7	7 1/2
A		6.5"	6.3"	7.0"
B		6.3"	7.4"	7.5"
C	6.3"	7.0"	7.0"	7.5"

Table 4
Size Study

Original Length Measurements for the Right Gloves (average)

Size as purchased	No. gloves	Measurements*					
		Total glove	Thumb	Fore-finger	Middle finger	Fourth finger	Little finger
<u>A-Gloves</u>		<u>in.</u>	<u>in.</u>	<u>in.</u>	<u>in.</u>	<u>in.</u>	<u>in.</u>
6 1/2	7	8.4	2.5	2.7	3.0	2.6	2.0
7	7	8.5	2.7	2.7	3.1	2.8	2.8
7 1/2	1	8.4	2.5	2.8	3.3	3.0	2.2
 <u>B-Gloves</u>							
6 1/2	2	11.3	2.3	2.4	2.7	2.6	2.0
7	2	8.5	2.7	2.7	3.1	2.8	2.8
7 1/2	1	13.0	2.6	2.7	3.2	2.8	2.2
 <u>C-Gloves</u>							
6	2	8.7	2.2	2.5	2.9	2.5	2.0
6 1/2	3	11.0	2.2	2.5	2.8	2.6	2.0
7	5	9.3	2.3	2.6	3.0	2.6	2.1
7 1/2	1	10.2	2.8	2.9	2.2	2.9	2.1

Original Circumference Measurements* for the Right Gloves
(average)

<u>A-Gloves</u>							
6 1/2	7	6.5	2.3	2.1	2.4	2.2	2.0
7	7	6.3	2.4	2.0	2.3	2.2	1.9
7 1/2	1	7.0	2.5	2.1	2.4	2.3	2.0
<u>B-Gloves</u>							
6 1/2	2	6.8	2.3	2.1	2.1	2.0	2.0
7	2	7.4	2.6	2.2	2.2	2.3	2.0
7 1/2	1	7.5	2.5	2.3	2.3	2.3	1.9
<u>C-Gloves</u>							
6	2	6.3	2.5	2.0	2.2	2.1	1.9
6 1/2	3	7.0	2.8	2.2	2.3	2.3	2.0
7	5	7.0	2.7	2.4	2.5	2.4	2.1
7 1/2	1	7.5	2.5	2.5	3.0	2.5	2.5

*Two measurements were taken and the mean of these recorded.

It would seem there is no consistent progression, but the fact that A-gloves show lesser dimensional width in size 7 than size 6 1/2 would suggest that brand is less reliable in sizing or cutting than B- and C-gloves.

A study of differences between sizes shows there was no consistency in increase on various fingers or total glove measurements. In various instances, instead of a measurement becoming greater with an increase in the purchased size, it decreased.

This study shows that a consumer cannot rely on her previous experience with a particular size, even within the same brand, because there can be no prediction as to the way a size 7 glove, for example, will fit. It may run smaller than a size 6 1/2. There is no consistency between increase in measurement for size increase within a style group, and there is certainly no relationship between these factors when comparing A-, B-, and C-gloves.

Construction Features Influencing Wear

Seams: There is some relationship between seams and the wear which gloves will receive. This depends on the seam type, and its durability. It was noted that there were many more seam rips with the hand-stitched outseams. Six pairs of A-gloves had seam rips at the front of the thumb section. It is not known if this was caused by the seam itself, or by the strain from the tight fit. In a few cases, there were seam rips between the fingers. C-gloves, also having the hand-stitched outseams, had only one seam rip in

the side wrist section. Because the seams were so similar to the ones in the A group, it is thought that the better fit of these C-gloves helped to keep the seams intact. B-gloves, made with inseams, had only one pair of gloves with a seam rip. Apparently this was due to a pulling of the fabric through the stitches rather than to an actual break. Small vertical runs extended from the seams outward. According to the wearers, the inseams were uncomfortable and extremely bulky.

Beside the seam breaks, another dissatisfaction with the outseams appeared in the form of unravelled seam edges. Both A- and C-gloves showed the seam edges unravelled, in many cases, into the stitching and causing either small runs or an actual opening in the glove. It could be recommended that outseams are not very practical when used on weft knit fabric which is subject to vertical runs.

Hems: Another construction feature which was affected by use of the gloves was the hem. About one-third of the gloves in A- and C-gloves had loose hems, most of them in the front of the gloves. This might have been caused by pulling the glove on the hand improperly. Length of the hem openings ranged from 1/2 inch to 2 inches. There were more loose hems in A-gloves than in C-gloves. Hems in the B-gloves appeared to be very secure.

Cost Related to the Number of Wearings

Cost, as related to the number of wearings, is another

factor to be considered. All gloves used in this study cost \$1.55. The following chart shows how much each pair of gloves cost per wearing. The gloves are arranged in ascending order of cost.

Rank of Gloves in Cost per Wearing

<u>Glove</u>	<u>Cost per wearing</u>	<u>Glove</u>	<u>Cost per wearing</u>	<u>Glove</u>	<u>Cost per wearing</u>
A 3	\$0.006	A 9	\$0.015	B 3	\$0.023
A 6	.007	B 2	.015	C 5	.023
C 9	.007	C10	.015	A11	.036
C 1	.010	A 5	.016	B 5	.036
C 7	.010	C 2	.016	C 4	.036
A 9	.010	C 6	.016	A12	.043
A10	.011	C 8	.017	A 8	.047
A13	.014	A 7	.018	A14	.086
A 2	.015	A 1	.020	A 4	.140

It will be noted that the A-gloves have the widest range of cost, from \$0.006 to \$0.14. The pair of gloves costing the least per wearing was completely worn out, while those costing the most can be worn many more times. The cost per wearing of the B-gloves is \$0.015 to \$0.039, while that for the C-gloves ranged from \$0.007 to \$0.039. See Table 5 for the ranks of the various gloves on factors of cost and number of wearings.

Color Changes

When worn and unworn gloves were compared, a definite color change in all groups was noted (See mounted samples, Exhibit 3, Appendix). Color change was more noticeable in the A-gloves because from the original beige, the color be-

came grey in the most extreme case. D-gloves changed color least. C-gloves remained the same hue, but became lighter in value. It was difficult to know the reason for the color change, because color might have been affected by washing, poor dyes, or the effect of light during wearing.

A-gloves showed a highly significant correlation between color change and the number of washings, with a coefficient of 0.745, also high significance of 0.698 between color and the number of wearings (Table 6). The former shows greater effect.

D-gloves, because of the small sample, showed no mathematical correlation between color change and other factors. However, there was a greater relationship between color and the number of washings than with color and the number of wearings (Table 6).

In C-gloves, there was a highly significant correlation between color change and the number of washings, with a coefficient of 0.754; likewise, with color and the number of wearings, 0.771 (Table 6).

The color change shows a high correlation with the number of washings and also with the number of wearings. Perfect correlation is impossible because other factors enter in. According to visual tests, A-gloves showed the greatest color change and D-gloves, the least change.

Table 6

Coefficients of Correlation
between Variables of Cotton Gloves

A-Gloves 15 pairs			
<u>Variables Correlated</u>	<u>Color</u>	<u>General Wear</u>	<u>Dimensional Change</u>
Number of Washings	<u>0.745¹</u>	<u>0.705</u>	<u>0.605</u>
Number of Wearings	<u>0.692</u>	<u>0.713</u>	<u>0.662</u>

B-Gloves 4 pairs			
<u>Variables Correlated</u>	<u>Color</u>	<u>General Wear</u>	<u>Dimensional Change</u>
Number of Washings	0.829 ²	0.713	0.713
Number of Wearings	0.692	0.829	0.943

C-Gloves 9 pairs			
<u>Variables Correlated</u>	<u>Color⁴</u>	<u>General Wear</u>	<u>Dimensional Change</u>
Number of Washings	<u>0.754³</u>	<u>0.605</u>	0.517
Number of Wearings	<u>0.771</u>	<u>0.809</u>	<u>0.648</u>

¹0.51 is a significant correlation; .641 is a highly significant correlation. All significant correlations are underlined.

²0.95 is a significant correlation; 0.99 is a highly significant correlation.

³0.60 is a significant correlation; 0.73 is a highly significant correlation. All significant correlations are underlined.

⁴Glove 1 is omitted. Original color was unlike that of the other C-gloves.

VI. CONCLUSIONS

The results of this study on cotton knit gloves show that a serviceability test is valuable for demonstrating what happens to gloves during wear. No predictions can be made as to the dimensional change which a pair of gloves will undergo, because gloves even of the same kind (brand and type) shrank varying amounts in length and stretched differently in circumference. However, the variation in length change is less than in circumference.

Gloves of the same marked size differed in actual size within the same brand and among brands. Apparently they are inaccurately cut, and the fabrics are not sufficiently pre-shrunk.

All wearers indicated a preference for gloves long enough to cover the wrist. The A-gloves, "shorties," might have fulfilled this requirement before washing, but certainly did not after washing.

The sueded fabric used in these gloves became .003 to .006 inches thicker on all parts of all gloves during washing, but as the effect of wear became more noticeable, thickness decreased to a figure comparable with the original fabric. Greatest wear occurred on the thumb and forefinger sections.

The gloves were washed on the average of once in every three to six wearings. As the gloves became more worn and the fabric lost color, the gloves soiled more easily and required more frequent washing.

The satisfaction to the wearer and the number of wearings is closely related to the fit of the gloves. In cases of poor fit, gloves were scarcely worn, and the value of the gloves was lost. The pair of gloves worn more frequently cost a negligible amount per wearing.

Construction features have a bearing on the way gloves wear. Dimension and fabric thickness may be unchanged after many months of use, but unravelled seam edges -- unravelled to the extent that an opening occurs in the glove, as was true in A- and C-gloves -- may shorten the life of the glove. Hems, also, must be secure for gloves to give the best results. When wearers put the glove on the hand in a single pulling motion, there is too much strain on the front hem, and hand-stitched hems will probably break.

Color change was difficult to measure objectively except by ranking in relation to a pair of unwashed and unworn gloves. It was evident, however, that much color was lost. The faded and stained fabric found in the gloves receiving the most wear in the one-year period would certainly make them unfit for further wear. The C-gloves appeared to be least changed.

Summarizing the points on which the test gloves were observed statistically or subjectively, for dimensional

change, factors relating to wear, and comments of the wearers, it may be concluded that the C-gloves were most satisfactory and the B-gloves, least satisfactory.

This serviceability study on fabric gloves is a very small part of the research which could be done. Suggested recommendations for continuing the problem are as follows:

1. Further serviceability studies on fabric gloves which would show comparative serviceability of gloves of different price ranges.
2. Further study on hand and glove measurements which might contribute to the development of commercial standards for more accurate and uniform sizing in gloves.
3. Future studies similar in scope or purpose to this study
 - (a) be based on a larger sampling of gloves
 - (b) have a like number of gloves in each classification
 - (c) dark colors in gloves be included
 - (d) a control pair of gloves for each pair in service be submitted to laboratory wear tests for purposes of comparison with wear in use.
4. Further study on knit glove fabric constructions as well as seam construction.

VII. SUMMARY

Thirty-one pairs of beige cotton, double welt knit gloves, of three brand types and costing \$1.55 per pair, were purchased. They were distributed to wearers selected on the bases of their ability to give a comparable amount of wear and to keep accurate records of wearings and washings for a one-year period. This study was carried on to determine what changes occur in gloves during wear which alter their serviceability or satisfaction to the consumer. The latter included the effect of washing and wear on the fit, the color change, and fabric change. A comparison of the satisfaction in service of three brands of gloves within a given price range was made.

1. An analysis of change during wear showed that all gloves shrank a significant amount in length, while they increased in circumference. There was no consistency in the change in various sections of the gloves, but there was some relationship between changes in the same brand type.

2. To a certain extent thickness change shows the effect of wear on gloves. Sections of the gloves which were not subject to friction were all significantly thicker, indicating that shrinkage and napping of the fabric had occurred. Thumbs and forefingers, which received the most

wear, were decreased in thickness from this new amount to a figure more comparable with the original. The outside area of all gloves was significantly thicker than the inside area, which suggests that the inside of the glove is subject to more friction.

3. Worn places on the gloves appeared most frequently on the thumb and extended from the finger sections to the side palm and knuckles, which showed the least wear. B- and C-gloves showed more wear over the entire surface of the gloves, the latter having more wear on the palms.

A-gloves were washed once for every 6 wearings; B-gloves once for every 3 wearings; and C-gloves, once for every 5 wearings. It would be interesting to know if it were the character of the fabric or individual differences among wearers which caused variations between groups. In all groups, wearers commented that as the gloves became more worn through use, the fabric soiled more readily, and launderings had to be more frequent.

4. By studying wearers' comments on fit and the number of times the gloves were worn, it was concluded that the C-gloves were most satisfactory in fit, and B-gloves were least satisfactory in circumference measurement and A-gloves, in length.

It was shown that there is not only variation in dimensional change of gloves during use, but also in glove measurements for a marked size within one style group before the gloves are ever worn. Discrepancies occurring in size

increases were so great that a size marked 7 $1/2$ might measure the same as a size 6 $1/2$.

5. The types of seams used on gloves have a direct relationship to the amount of service a pair of gloves will give. In B-gloves, the wide inseam was considered very uncomfortable, and that was one reason for wearing the gloves fewer times. The outseams in A- and C-gloves were satisfactory as far as the fit was concerned, but as wear increased, the fabric unravelled along the seam edges until an opening was produced in the glove. Apparently machine-stitched seams were more secure than the hand-stitched ones. Loose seams on the front of A- and C-gloves appear to have been caused by pulling the gloves on the hands.

6. The pair of gloves worn 243 times, at an average cost of \$0.006 per wearing, was unfit for further use. The pair of gloves worn the least number of times cost \$0.14 per wearing. Considering the small amount of change in dimension, color, and general appearance, there are many more wearings possible for this pair. On the whole, the gloves were durable. When the gloves were taken out of service, the average cost per wearing was \$0.017 for C-gloves, \$0.026 for B-gloves, and \$0.033 for A-gloves. These do not necessarily reflect the ultimate cost per wearing, because there are varying numbers of wearings left for many of the gloves.

7. Color change was noted in all three groups of gloves, with significant correlation between color change and the number of washings and wearings. Because other fac-

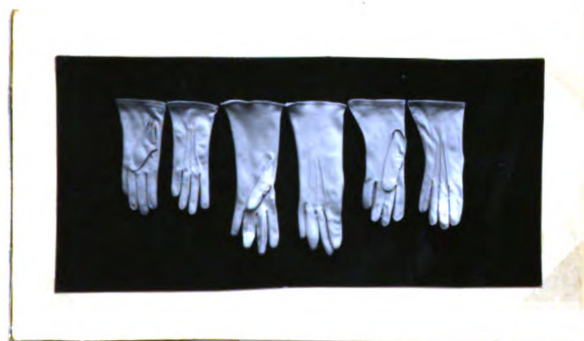
tors, such as dyes and fading by sunlight enter in, the effect of each is ^{unknown}. A-gloves appeared to show greatest color change, while B-gloves were least changed. Because the latter were worn least, the conclusion that B-gloves were best in color retention is not justified.

APPENDIX

Exhibit 1



Showing method of securing circumference measurements. The glove on the left is the original, the one on the right has been worn one year.

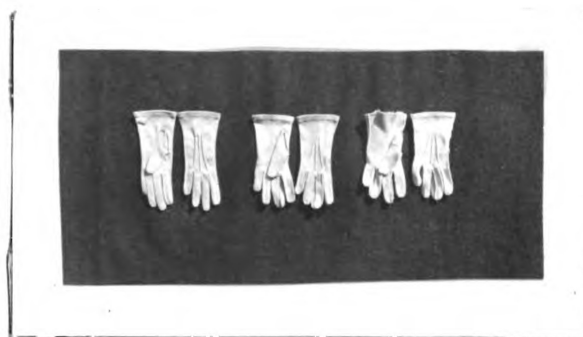


A B C
Gloves
Before wearing

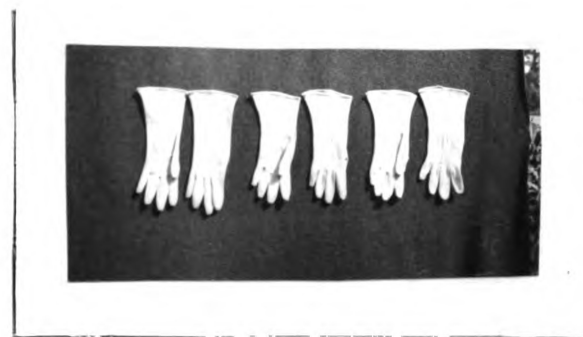


A B C
Gloves
After wearing

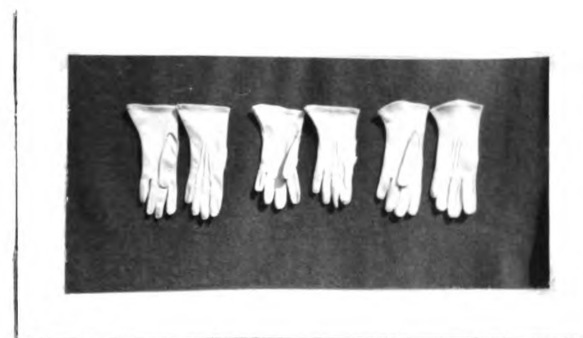
Exhibit 2.



A-gloves



B-gloves



C-gloves

New and Worn Gloves

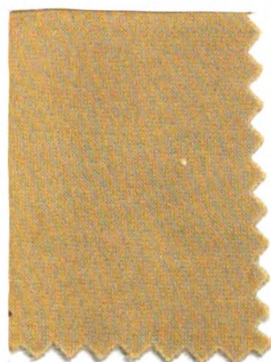
Original glove is on the left, the glove showing average wear in the center, and the one most worn on the right.

Exhibit 3

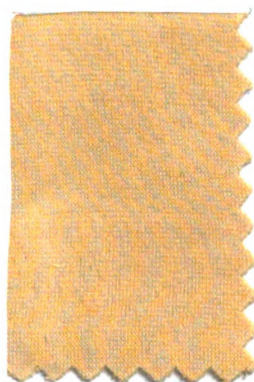
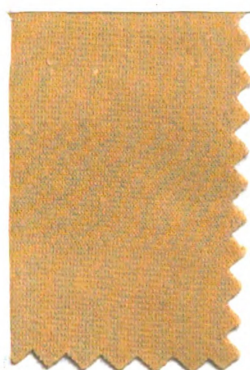
Samples of Glove Fabric

Before Wearing

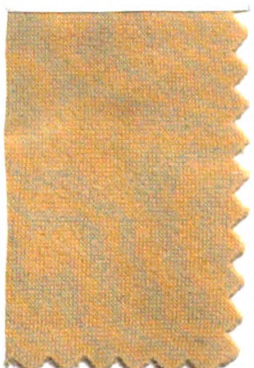
After Wearing



A-Gloves



B-Gloves



C-Gloves

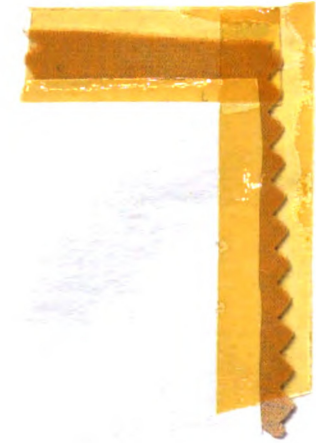
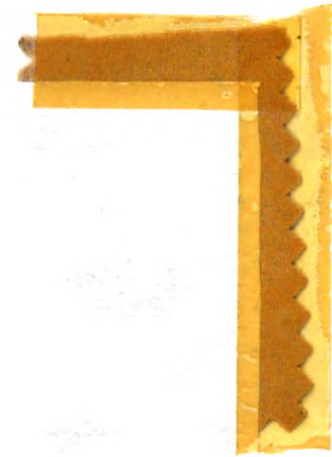
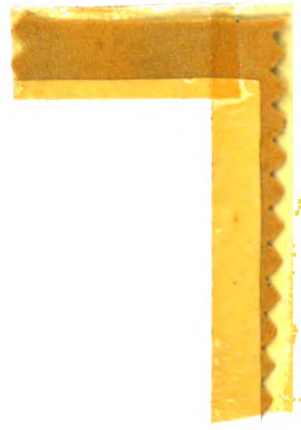
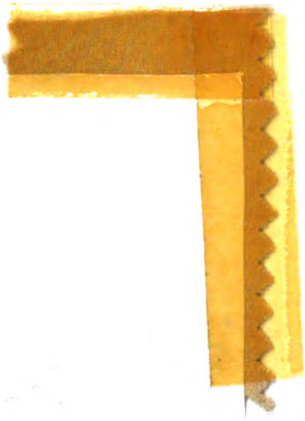


Exhibit 4

318 1/2 Albert Avenue
East Lansing, Michigan
May 26, 1944

You have kindly consented to wear a pair of beige gloves for serviceability tests which I shall use as a basis for my thesis. After wearing them a year, I shall borrow them for a few days to check on their appearance and durability. Your gloves are being mailed today, and should reach you very soon.

I am enclosing a chart in this letter which you will need to check carefully in order that my study be as accurate as possible. Will you mark down each time you wear and wash them? There are laundering directions, too, so that the treatment of all the gloves will be uniform. At the end I have left a place so that you may make any comments you have concerning the way they fit, before and after washing. Another interesting thing to note will be when and where the first signs of wear appear. Whenever you have an idea of what you like or dislike about the gloves, I hope you will write that down.

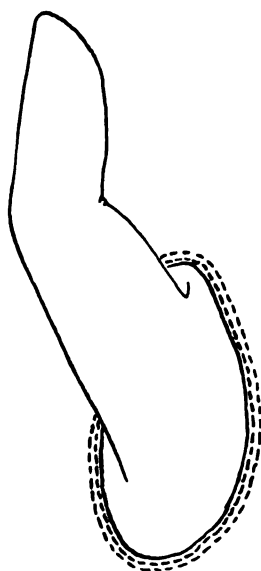
It will be better for the study if you can wear these gloves as often as possible, but feel free to use other gloves which might suit a particular costume. If you should be so unfortunate as to lose them, please let me know at once. The cost of the gloves was \$1.55.

Thank you for your cooperation.

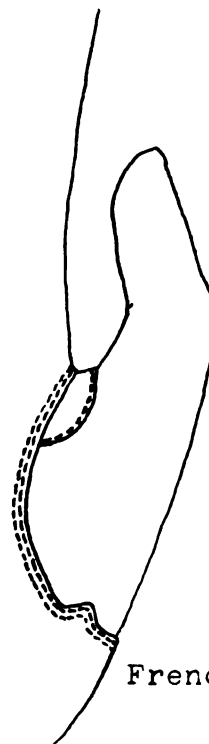
Sincerely yours,

Ruth H. Heitz

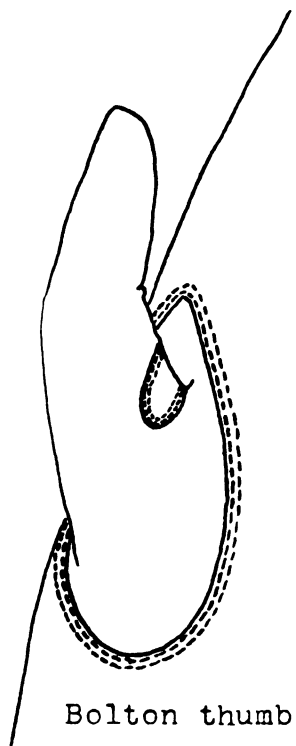
Figure 2
Common Types of Thumbs (5)



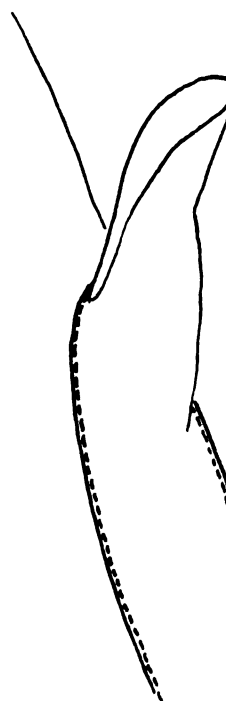
Set-in thumb



French thumb



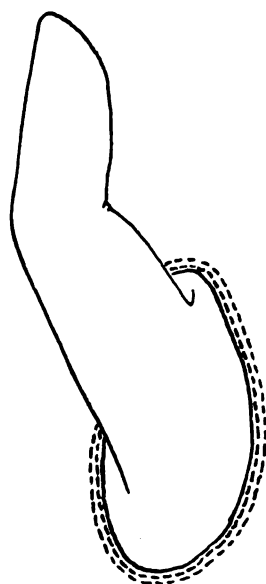
Bolton thumb



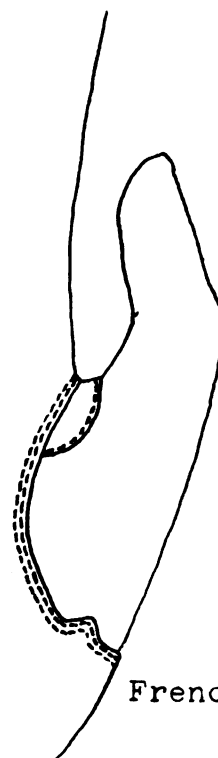
Inserted
thumb

Figure 2

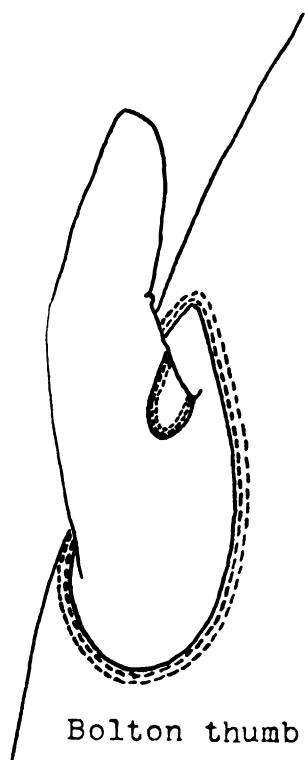
Common Types of Thumbs (5)



Set-in thumb



French thumb



Bolton thumb

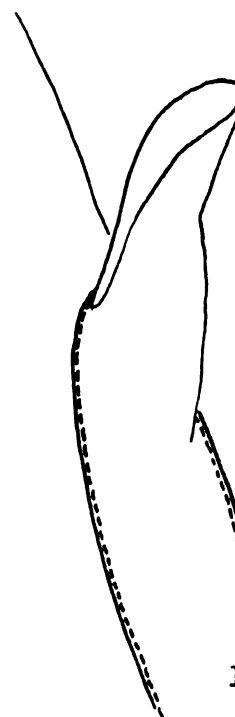
Inserted
thumb

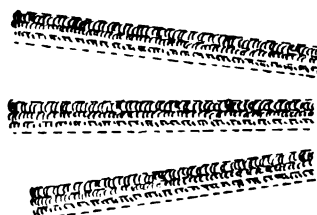
Figure 3

Styles of Points Used on Gloves (1)

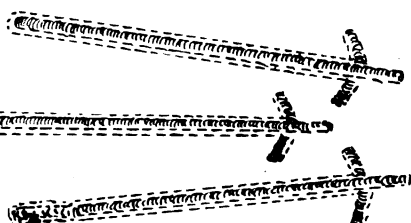
Plain Single
Draw



Four needle
stitchings
flat



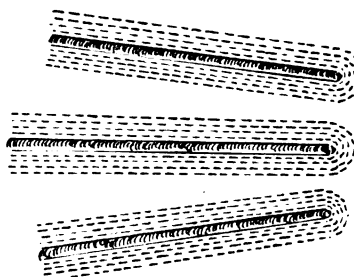
Single Draw
two needle
stitches,
spear point



Double Draw
two needle
stitches



Single Draw
four needle
stitches



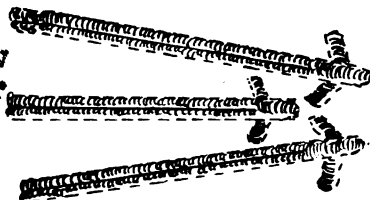
Five rows
embroidery



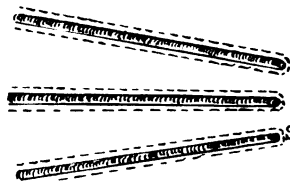
Single Draw
two rows
embroidery



Double Draw
full spear



Single Draw
one needle
stitch



Single Draw
two rows
silk stitching

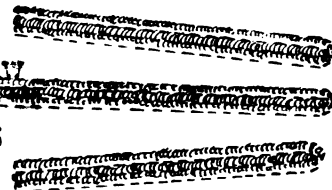


Chart 1

WASHING DIRECTIONS

Wash frequently so gloves will not be too badly soiled
 Prepare suds, almost cool, with any pure white flake soap
 Rinse two or three times in almost cool water
 Knead between folds of a turkish towel to remove excess moisture
 Blow into gloves to put them in shape
 Dry at room temperature away from direct heat or sunlight
 Work between hands to soften and stretch to shape just before entirely dry.

DATA

Date first hole appeared: _____ Which glove.....
 Due to wear.... _____ Location on
 Accident _____ glove _____
 Broken seam: _____
 Type of mend used: _____

COMMENTS

Fit

Excellent _____ Good _____ Fair _____ Poor _____

Reasons:

Other comments:

65

(mark below, X for wearing, O for washing)

Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
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This image shows a full page of blank graph paper. The grid consists of 20 columns and 20 rows of squares, formed by thin black lines on a white background. There are no markings, text, or drawings on the paper.

Table 7

Glove Length Measurements Before and After Wearing

A- Gloves	Right Total Length			Left Total Length		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	8.4	7.7	-0.7	8.4	7.6	-0.8
2	8.3	7.9	-0.4	8.6	8.1	-0.5
3	8.6	7.2	-1.4	8.6	7.8	-0.8
4	8.3	8.1	-0.2	8.5	8.4	-0.1
5	8.7	8.0	-0.7	8.7	8.0	-0.7
6	8.4	7.2	-1.2	8.5	7.5	-1.0
7	8.6	8.1	-0.5	8.6	8.1	-0.5
8	8.1	7.8	-0.3	8.1	7.7	-0.4
9	8.3	7.6	-0.7	8.5	7.7	-0.8
10	8.6	7.8	-0.8	8.5	7.8	-0.7
11	8.3	7.8	-0.5	8.3	7.4	-0.9
12	8.7	8.3	-0.4	8.7	8.4	-0.3
13	8.4	7.7	-0.7	8.4	7.9	-0.5
14	8.5	7.6	-0.9	8.5	7.5	-1.0
16	8.2	7.8	-0.4	8.6	7.7	-0.9
B- Gloves						
1	13.0	10.9	-2.1	13.0	10.5	-2.5
2	11.4	11.1	-0.3	11.4	11.0	-0.4
3	11.5	10.8	-0.7	11.5	10.5	-1.0
5	11.3	10.8	-0.5	11.3	10.8	-0.5
C- Gloves						
1	8.7	8.3	-0.4	9.1	8.3	-0.7
2	11.2	10.3	-0.9	11.3	10.4	-0.9
4	10.8	10.5	-0.3	10.6	10.4	-0.2
5	9.5	8.8	-0.7	9.4	8.7	-0.7
6	9.5	8.8	-0.7	9.5	8.6	-0.9
7	9.3	8.7	-0.6	9.2	8.7	-0.5
8	9.1	8.5	-0.6	9.4	8.7	-0.7
9	10.2	9.9	-0.3	10.2	9.5	-0.7
10	9.2	8.6	-0.6	9.2	8.5	-0.7

Table 8

Glove Length Measurements Before and After Wearing

A- Gloves	Right Thumb			Left Thumb		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.5	2.4	-0.1	2.5	2.3	-0.2
2	2.7	2.5	-0.2	2.8	2.4	-0.4
3	2.8	2.2	-0.6	2.9	2.4	-0.5
4	2.6	2.5	-0.1	2.6	2.4	-0.2
5	2.7	2.4	-0.3	2.6	2.2	-0.4
6	2.6	2.3	-0.3	2.6	2.3	-0.3
7	2.7	2.6	-0.1	2.6	2.5	-0.1
8	2.3	2.1	-0.2	2.4	2.3	-0.1
9	2.4	2.3	-0.1	2.4	2.2	-0.2
10	2.6	2.1	-0.5	2.6	2.2	-0.4
11	2.5	2.1	-0.4	2.5	2.3	-0.2
12	2.5	2.2	-0.3	2.5	2.3	-0.2
13	2.5	2.2	-0.3	2.5	2.2	-0.3
14	2.5	2.3	-0.2	2.5	2.2	-0.3
16	2.6	2.3	-0.3	2.5	2.2	-0.3
B- Gloves						
1	2.6	2.0	-0.6	2.6	2.1	-0.5
2	2.5	2.1	-0.4	2.5	2.0	-0.5
3	2.3	2.1	-0.2	2.4	2.4	0.0
5	2.3	2.1	-0.2	2.3	2.1	-0.2
C- Gloves						
1	2.2	2.0	-0.2	2.0	1.9	-0.1
2	2.2	2.0	-0.2	2.2	2.1	-0.1
4	2.2	2.0	-0.2	2.1	2.0	-0.1
5	2.3	2.2	-0.1	2.3	2.0	-0.3
6	2.4	2.2	-0.2	2.3	2.1	-0.2
7	2.2	2.2	0.0	2.1	2.2	0.1
8	2.2	2.1	-0.1	2.3	2.0	-0.3
9	2.3	2.6	0.3	2.3	2.5	0.2
10	2.3	2.0	-0.3	2.2	2.0	-0.2

Table 9

Glove Length Measurements Before and After Wearing

A- Gloves	Right Forefinger			Left Forefinger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.8	2.6	-0.2	2.9	2.6	-0.3
2	2.8	2.6	-0.2	2.8	2.6	-0.2
3	2.8	2.5	-0.3	2.8	2.4	-0.4
4	2.7	2.5	-0.2	2.8	2.5	-0.3
5	2.8	2.4	-0.4	2.8	2.5	-0.3
6	2.8	2.4	-0.4	2.7	2.3	-0.4
7	2.8	2.5	-0.3	2.9	2.6	-0.3
8	2.5	2.4	-0.1	2.5	2.3	-0.2
9	2.5	2.5	0.0	2.6	2.5	-0.1
10	2.6	2.4	-0.2	2.6	2.4	-0.2
11	2.7	2.4	-0.3	2.6	2.4	-0.2
12	2.7	2.5	-0.2	2.7	2.5	-0.2
13	2.6	2.5	-0.1	2.6	2.4	-0.1
14	2.7	2.5	-0.2	2.6	2.4	-0.2
16	2.9	2.5	-0.4	2.8	2.4	-0.4
B- Gloves						
1	3.2	2.9	-0.3	3.2	2.8	-0.4
2	3.0	3.0	0.0	3.0	2.9	-0.1
3	3.0	2.8	-0.2	3.0	2.8	-0.2
5	2.7	2.6	-0.1	2.8	2.7	-0.1
C- Gloves						
1	2.9	2.5	-0.4	2.9	2.7	-0.2
2	2.8	2.6	-0.2	2.8	2.6	-0.2
4	2.8	2.8	0.0	2.8	2.6	-0.2
5	3.0	2.7	-0.3	3.0	2.8	-0.2
6	3.0	2.8	-0.2	3.0	2.7	-0.3
7	3.0	2.8	-0.2	2.9	2.8	-0.1
8	2.9	2.7	-0.2	3.0	2.9	-0.1
9	3.2	3.0	-0.2	3.2	3.0	-0.2
10	3.0	2.8	-0.2	2.9	2.7	-0.2

Table 10

Glove Length Measurements Before and After Wearing

A- Gloves	Right Middle finger			Left Middle finger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	3.3	2.9	-0.4	3.3	2.9	-0.4
2	3.0	2.9	-0.1	3.1	3.0	-0.1
3	3.1	2.7	-0.4	3.1	2.8	-0.3
4	3.0	2.8	-0.2	3.1	2.9	-0.2
5	3.1	3.0	-0.1	3.1	2.7	-0.4
6	3.0	2.7	-0.3	3.0	2.7	-0.3
7	3.2	2.9	-0.3	3.2	3.0	-0.2
8	2.9	2.7	-0.2	2.9	2.6	-0.3
9	3.0	2.7	-0.3	3.0	2.7	-0.3
10	3.0	2.6	-0.4	3.0	2.6	-0.4
11	3.0	2.8	-0.2	3.0	2.8	-0.2
12	3.0	2.9	-0.1	3.0	2.8	-0.2
13	3.0	2.6	-0.4	3.0	2.7	-0.3
14	3.0	2.6	-0.4	3.0	2.7	-0.3
16	3.1	2.7	-0.4	3.1	2.7	-0.4

B- Gloves						
1	3.2	2.9	-0.3	3.2	2.8	-0.4
2	3.0	3.0	0.0	3.0	2.9	-0.1
3	3.0	2.8	-0.2	3.1	2.8	-0.3
5	2.7	2.6	-0.1	2.8	2.7	-0.1

C- Gloves						
1	2.9	2.5	-0.4	2.9	2.7	-0.2
2	2.8	2.6	-0.2	2.8	2.6	-0.2
4	2.8	2.8	0.0	2.8	2.6	-0.2
5	3.0	2.7	-0.3	3.0	2.8	-0.2
6	3.0	2.8	-0.2	3.0	2.7	-0.3
7	3.0	2.8	-0.2	2.9	2.8	-0.1
8	2.9	2.7	-0.2	3.0	2.9	-0.1
9	3.2	3.0	-0.2	3.2	3.0	-0.2
10	3.0	2.8	-0.2	2.9	2.7	-0.2

Table 11

Glove Length Measurements Before and After Wearing

A- Gloves	Right Fourth finger			Left Fourth finger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	3.0	2.6	-0.4	3.0	2.6	-0.4
2	2.7	2.5	-0.2	2.8	2.7	-0.1
3	2.8	2.5	-0.3	2.8	2.5	-0.3
4	2.8	2.6	-0.2	2.8	2.7	-0.1
5	2.8	2.5	-0.3	2.8	2.5	-0.3
6	2.7	2.5	-0.2	2.7	2.4	-0.3
7	2.7	2.4	-0.3	2.8	2.5	-0.3
8	2.5	2.4	-0.1	2.5	2.3	-0.2
9	2.7	2.4	-0.3	2.7	2.4	-0.3
10	2.7	2.4	-0.3	2.7	2.4	-0.3
11	2.6	2.4	-0.2	2.6	2.4	-0.2
12	2.6	2.5	-0.1	2.6	2.5	-0.1
13	2.6	2.5	-0.1	2.6	2.4	-0.2
14	2.6	2.5	-0.1	2.6	2.5	-0.1
16	2.8	2.5	-0.3	2.7	2.6	-0.1
B- Gloves						
1	2.8	2.4	-0.4	2.8	2.4	-0.4
2	2.7	2.3	-0.4	2.6	2.6	0.0
3	2.7	2.5	-0.2	2.7	2.6	-0.1
5	2.6	2.4	-0.2	2.5	2.4	-0.1
C- Gloves						
1	2.5	2.3	-0.2	2.5	2.4	-0.1
2	2.5	2.3	-0.2	2.8	2.3	-0.5
4	2.6	2.5	-0.1	2.5	2.4	-0.1
5	2.6	2.5	-0.1	2.6	2.6	0.0
6	2.6	2.4	-0.2	2.7	2.4	-0.3
7	2.6	2.4	-0.2	2.6	2.4	-0.2
8	2.5	2.3	-0.2	2.6	2.5	-0.1
9	2.9	2.7	-0.2	2.8	2.7	-0.1
10	2.6	2.5	-0.1	2.6	2.4	-0.2

Table 12

Glove Length Measurements Before and After Wearing

A- Gloves	Right Little finger			Left Little finger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.2	1.9	-0.3	2.2	2.0	-0.2
2	2.1	2.0	-0.1	2.1	2.0	-0.1
3	2.1	1.8	-0.3	2.1	1.9	-0.2
4	2.1	2.0	-0.1	2.1	2.0	-0.1
5	2.1	1.9	-0.2	2.1	1.9	-0.2
6	2.1	1.9	-0.2	2.1	1.9	-0.2
7	2.1	2.0	-0.1	2.1	2.0	-0.1
8	2.0	1.9	-0.1	1.9	1.8	-0.1
9	2.0	1.9	-0.1	2.0	1.9	-0.1
10	2.0	1.8	-0.2	2.0	1.9	-0.1
11	2.1	1.8	-0.3	2.1	1.9	-0.2
12	2.0	1.9	-0.1	2.0	2.0	0.0
13	2.0	1.9	-0.1	2.0	1.9	-0.1
14	2.0	1.9	-0.1	2.0	1.9	-0.1
15	2.1	2.0	-0.1	2.1	2.0	-0.1
B- Gloves						
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
1	2.2	1.8	-0.4	2.3	2.0	-0.3
2	2.1	2.0	-0.1	2.1	2.0	-0.1
3	2.0	1.8	-0.2	2.1	2.0	-0.1
5	2.0	2.0	0.0	2.0	1.9	-0.1
C- Gloves						
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
1	2.0	1.9	-0.1	2.1	1.9	-0.2
2	2.0	1.9	-0.1	2.0	1.9	-0.1
4	2.0	2.0	0.0	2.0	2.0	0.0
5	2.0	2.0	0.0	2.1	2.0	-0.1
6	2.1	2.0	-0.1	2.1	2.0	-0.1
7	2.1	2.0	-0.1	2.1	2.0	-0.1
8	2.0	2.0	0.0	2.1	2.0	-0.1
9	2.1	2.0	-0.1	2.1	2.0	-0.1
10	2.1	1.9	-0.2	2.1	1.9	-0.2

Table 13

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Total hand			Left Total hand		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	7.0	7.2	0.2	6.8	7.1	0.3
2	6.5	6.6	0.1	6.1	6.1	0.0
3	6.0	6.8	0.8	6.5	7.0	0.7
4	6.2	6.5	0.3	6.2	6.5	0.3
5	6.5	6.8	0.3	6.5	6.6	0.1
6	6.2	6.8	0.6	6.3	6.3	0.0
7	6.5	6.3	-0.2	6.4	6.4	0.0
8	6.5	6.5	0.0	6.5	6.5	0.0
9	6.5	6.3	-0.2	6.4	6.1	-0.3
10	6.5	6.0	-0.5	6.4	6.1	-0.3
11	6.5	6.5	0.0	6.5	6.4	-0.1
12	6.4	6.3	-0.1	6.4	6.3	-0.1
13	6.4	6.1	-0.3	6.4	6.2	-0.2
14	6.3	6.5	0.2	6.2	6.6	0.4
16	6.5	6.5	0.0	6.5	6.6	0.1

B- Gloves						
1	8.0	8.2	0.2	8.0	7.6	-0.4
2	7.5	7.7	0.2	7.5	8.0	0.5
3	7.2	8.0	0.8	7.1	7.6	0.5
5	6.8	7.3	0.5	6.8	7.0	0.2

C- Gloves						
1	6.3	6.6	0.3	6.3	6.2	-0.1
2	6.8	7.5	0.7	6.9	7.5	0.6
4	7.2	7.4	0.2	7.1	7.4	0.3
5	7.1	7.7	0.6	7.0	7.5	0.5
6	7.2	7.6	0.4	7.1	7.7	0.6
7	6.9	7.2	0.3	6.9	7.5	0.6
8	6.9	7.4	0.5	7.0	7.3	0.3
9	7.5	7.7	0.2	7.5	7.3	-0.2
10	7.0	7.7	0.7	7.0	7.6	0.6

Table 14

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Thumb			Left Thumb		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.5	2.9	0.42	2.5	2.9	0.4
2	2.5	2.8	0.3	2.5	2.7	0.2
3	2.3	2.5	0.2	2.5	2.6	0.1
4	2.4	2.7	0.3	2.4	2.6	0.2
5	2.5	2.6	0.1	2.5	2.7	0.2
6	2.2	2.5	0.3	2.2	2.5	0.3
7	2.4	2.7	0.3	2.3	2.8	0.5
8	2.4	2.4	0.0	2.4	2.6	0.2
9	2.5	2.5	0.0	2.5	2.6	0.1
10	2.2	2.5	0.3	2.2	2.6	0.4
11	2.2	2.5	0.3	2.2	2.6	0.4
12	2.0	2.5	0.5	2.1	2.5	0.4
13	2.3	2.3	0.0	2.3	2.5	0.2
14	2.1	2.6	0.5	2.0	2.6	0.6
16	2.6	2.5	0.1	2.5	2.5	0.0
B- Gloves						
1	2.5	2.8	0.3	2.5	3.0	0.5
2	2.5	2.5	0.0	2.5	2.9	0.4
3	2.7	3.0	0.3	2.6	2.9	0.3
5	2.8	2.5	0.3	2.8	2.5	0.3
C- Gloves						
1	2.5	2.4	-0.1	2.5	2.7	0.2
2	2.8	2.8	0.0	2.9	3.0	0.1
4	2.8	3.1	0.3	2.9	2.9	0.0
5	2.8	3.0	0.2	2.7	3.1	0.4
6	2.8	3.0	0.2	2.8	2.8	0.0
7	2.3	2.8	0.5	2.3	2.8	0.5
8	2.7	2.8	0.1	2.8	3.0	0.2
9	2.5	2.7	0.2	2.5	3.1	0.6
10	2.7	3.0	0.3	2.7	2.7	0.0

Table 15

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Forefinger			Left Forefinger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.1	2.5	0.4	2.0	2.5	0.5
2	2.2	2.2	0.0	1.9	2.2	0.3
3	1.8	2.3	0.5	1.8	2.5	0.7
4	1.9	2.3	0.4	1.9	2.2	0.3
5	2.0	2.3	0.3	2.0	2.2	0.2
6	2.0	2.3	0.3	2.0	2.5	0.5
7	2.0	2.1	0.1	2.0	2.0	0.0
8	2.0	2.2	0.2	2.0	2.0	0.0
9	2.0	2.2	0.2	1.9	2.3	0.4
10	2.0	2.3	0.3	1.9	2.1	0.2
11	2.0	2.2	0.2	1.9	2.1	0.2
12	2.0	2.3	0.3	2.0	2.2	0.2
13	2.1	2.1	0.0	2.1	2.2	0.1
14	2.0	2.2	0.2	2.0	2.4	0.4
16	2.3	2.1	-0.2	2.2	2.2	0.0

B- Gloves						
1	2.3	2.5	0.2	2.2	2.6	0.4
2	2.3	2.4	0.1	2.3	2.2	-0.1
3	2.1	2.4	0.3	2.0	2.7	0.7
5	2.1	2.1	0.0	2.0	2.2	0.2

C- Gloves						
1	2.0	2.0	0.0	2.0	2.2	0.2
2	2.3	2.5	0.2	2.3	2.5	0.2
4	2.1	2.6	0.5	2.0	2.4	0.4
5	2.4	2.6	0.2	2.3	2.8	0.5
6	2.2	2.9	0.7	2.1	2.8	0.7
7	2.4	2.4	0.0	2.3	2.6	0.3
8	2.5	2.6	0.1	2.5	2.6	0.1
9	2.5	2.5	0.0	2.5	2.7	0.2
10	2.4	2.7	0.3	2.3	2.2	-0.1

Table 16

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Middle finger			Left Middle finger		
	Before	After	Change	Before	After	Change
	wearing	wearing		wearing	wearing	
	in.	in.	in.	in.	in.	in.
1	2.4	2.8	0.4	2.2	2.9	0.7
2	2.5	2.7	0.2	2.5	2.6	0.1
3	2.0	2.7	0.7	2.1	2.6	0.5
4	2.3	2.7	0.4	2.2	2.5	0.3
5	2.4	2.7	0.3	2.3	2.7	0.4
6	2.2	2.5	0.3	2.2	2.6	0.4
7	2.3	2.4	0.1	2.3	2.6	0.3
8	2.5	2.5	0.0	2.5	2.5	0.0
9	2.4	2.6	0.2	2.4	2.6	0.2
10	2.3	2.5	0.2	2.4	2.5	0.1
11	2.5	2.5	0.0	2.5	2.6	0.1
12	2.3	2.6	0.3	2.4	2.4	0.0
13	2.3	2.5	0.2	2.3	2.5	0.2
14	2.4	2.5	0.1	2.4	2.6	0.2
15	2.6	2.5	-0.1	2.7	2.5	-0.2
B- Gloves						
1	2.4	2.6	0.2	2.3	2.5	0.2
2	2.3	2.1	-0.2	2.3	2.3	0.0
3	2.1	2.5	0.4	2.1	2.8	0.7
5	2.1	2.0	-0.1	2.1	2.2	0.1
C- Gloves						
1	2.2	2.1	-0.1	2.2	2.3	0.1
2	2.5	2.5	0.0	2.5	2.5	0.0
4	2.1	2.5	0.4	2.1	2.6	0.5
5	2.5	2.8	0.3	2.5	2.8	0.3
6	2.3	2.9	0.6	2.3	2.9	0.6
7	2.6	2.5	-0.1	2.5	2.6	0.1
8	2.7	2.5	-0.2	2.7	2.7	0.0
9	3.0	2.5	-0.5	3.1	3.2	0.1
10	2.5	2.8	0.3	2.5	2.4	-0.1

Table 17

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Fourth finger			Left Fourth finger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.3	2.7	0.4	2.2	2.7	0.5
2	2.4	2.5	0.1	2.4	2.5	0.1
3	2.0	2.6	0.6	2.1	2.5	0.4
4	2.1	2.6	0.5	2.1	2.5	0.4
5	2.3	2.6	0.3	2.3	2.5	0.2
6	2.2	2.4	0.2	2.2	2.4	0.2
7	2.1	2.4	0.3	2.1	2.5	0.4
8	2.1	2.3	0.2	2.1	2.1	0.0
9	2.1	2.5	0.4	2.1	2.5	0.4
10	2.1	2.5	0.4	2.0	2.5	0.5
11	2.2	2.4	0.2	2.2	2.4	0.2
12	2.1	2.5	0.4	2.1	2.3	0.2
13	2.2	2.4	0.2	2.2	2.4	0.2
14	2.2	2.4	0.2	2.1	2.4	0.3
16	2.3	2.4	0.1	2.2	2.3	0.1
B- Gloves						
1	2.3	2.6	0.3	2.3	2.4	0.1
2	2.3	2.4	0.1	2.2	2.3	0.1
3	2.2	2.3	0.1	2.2	2.6	0.4
5	2.0	2.1	0.1	2.0	2.0	0.0
C- Gloves						
1	2.1	2.0	-0.1	2.2	2.3	0.1
2	2.5	2.4	0.1	2.5	2.4	0.1
4	2.0	2.4	0.4	2.1	2.4	0.3
5	2.4	2.6	0.2	2.4	2.6	0.2
6	2.3	2.6	0.3	2.3	2.7	0.4
7	2.5	2.5	0.0	2.5	2.4	-0.1
8	2.5	2.5	0.0	2.5	2.7	0.2
9	2.5	2.5	0.0	2.5	2.6	0.1
10	2.4	2.5	0.1	2.4	2.3	-0.1

Table 18

Glove Circumference Measurements Before and After Wearing

A- Gloves	Right Little finger			Left Little finger		
	Before wearing	After wearing	Change	Before wearing	After wearing	Change
	in.	in.	in.	in.	in.	in.
1	2.0	2.3	0.3	2.0	2.2	0.2
2	1.9	2.0	0.1	2.0	2.1	0.1
3	1.8	2.2	0.4	2.0	2.1	0.1
4	1.9	2.0	0.1	1.9	2.0	0.1
5	2.0	2.2	0.2	1.9	2.2	0.3
6	2.0	2.1	0.1	2.0	2.2	0.2
7	1.9	2.2	0.3	2.0	2.0	0.0
8	1.9	2.1	0.2	1.9	1.9	0.0
9	1.9	2.5	0.6	2.0	2.5	0.5
10	2.0	2.0	0.0	2.0	2.1	0.1
11	2.0	2.0	0.0	2.0	2.0	0.0
12	2.0	2.1	0.1	1.9	2.0	0.0
13	2.0	2.0	0.0	2.0	2.0	0.0
14	2.0	2.0	0.0	1.9	2.0	0.1
16	2.1	2.1	0.0	2.0	2.0	0.0
B- Gloves						
1	2.0	2.2	0.2	2.0	2.0	0.0
2	1.9	2.0	0.1	1.9	2.2	0.3
3	2.0	1.8	-0.2	2.0	2.0	0.0
5	2.0	2.0	0.0	2.0	1.6	-0.4
C- Gloves						
1	1.9	2.0	0.1	2.0	2.1	0.1
2	2.0	2.5	0.5	2.0	2.0	0.0
4	2.0	2.0	0.0	2.0	2.0	0.0
5	2.1	2.3	0.2	2.1	2.3	0.2
6	2.1	2.0	-0.1	2.1	2.2	0.1
7	2.0	2.0	0.0	2.0	2.2	0.2
8	2.1	2.0	-0.1	2.0	2.1	0.1
9	2.5	2.4	-0.1	2.5	2.1	-0.4
10	2.0	2.2	0.2	2.0	2.0	0.0

Table 19

Glove Thickness Measurements Before and After Wearing

A-Gloves		Right Index fingertip			Left Index fingertip		
		Before	After	Change	Before	After	Change
		wearing	wearing		wearing	wearing	
		in.	in.	in.	in.	in.	in.
1	inside	0.025	0.028	0.003	0.025	0.028	0.003
	outside	.025	.028	.003	.025	.031	.006
2	inside	.025	.029	.004	.025	.029	.004
	outside	.025	.029	.004	.025	.030	.005
3	inside	.025	.027	.002	.025	.027	.002
	outside	.025	.027	.002	.025	.027	.002
4	inside	.025	.030	.005	.025	.029	.004
	outside	.025	.031	.006	.025	.030	.005
5	inside	.025	.031	.006	.026	.031	.005
	outside	.025	.031	.006	.026	.032	.006
6	inside	.025	.029	.004	.025	.031	.006
	outside	.025	.032	.007	.025	.032	.007
7	inside	.026	.031	.005	.026	.029	.003
	outside	.025	.031	.006	.025	.031	.006
8	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.031	.006	.025	.032	.007
9	inside	.024	.027	.003	.025	.031	.006
	outside	.024	.031	.007	.025	.031	.006
10	inside	.025	.028	.003	.025	.028	.003
	outside	.025	.031	.006	.025	.031	.006
11	inside	.026	.030	.004	.026	.030	.004
	outside	.025	.032	.007	.025	.032	.007
12	inside	.025	.029	.004	.025	.030	.005
	outside	.025	.030	.005	.025	.031	.006
13	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.031	.006	.025	.031	.006
14	inside	.026	.030	.004	.025	.031	.006
	outside	.026	.030	.004	.025	.031	.006
16	inside	.026	.030	.004	.026	.030	.004
	outside	.026	.032	.006	.026	.030	.004
<u>B-Gloves</u>							
1	inside	.026	.022	.004	.026	.029	.003
	outside	.026	.026	.000	.026	.029	.003
2	inside	.026	.026	.000	.026	.025	-.001
	outside	.026	.029	.003	.026	.027	.001
3	inside	.029	.026	.003	.029	.027	-.002
	outside	.029	.027	-.002	.029	.029	.000
4	inside	.026	.027	.001	.026	.027	.001
	outside	.026	.028	.002	.026	.028	.002

Table 19 (cont.)

G-Gloves		Right Index fingertip			Left Index fingertip		
		Before wearing	After wearing	Change	Before wearing	After wearing	Change
		in.	in.	in.	in.	in.	in.
1	inside	(omitted because of duplex construction)					
	outside						
2	inside	0.039	0.034	0.005	0.030	0.035	0.005
	outside	.039	.036	.003	.030	.032	.002
4	inside	.039	.038	.001	.029	.030	.001
	outside	.038	.034	.004	.029	.032	.003
5	inside	.039	.032	.007	.027	.030	.003
	outside	.039	.031	.008	.027	.031	.004
6	inside	.037	.034	-.003	.027	.034	-.007
	outside	.037	.031	.006	.027	.030	.003
7	inside	.027	.027	.000	.027	.026	-.001
	outside	.027	.033	.006	.027	.030	.003
8	inside	.027	.024	-.003	.026	.025	-.001
	outside	.027	.029	.002	.026	.030	.004
9	inside	.030	.030	.000	.030	.029	-.001
	outside	.030	.034	.004	.030	.031	.001
10	inside	.026	.029	.003	.025	.029	.004
	outside	.026	.035	.009	.025	.031	.006

Table 20

Glove Thickness Measurements Before and After Wearing

		Right Middle fingertip			Left Middle fingertip		
A-Gloves		Before wearing	After wearing	Change	Before wearing	After wearing	Change
		in.	in.	in.	in.	in.	in.
1	inside	0.026	0.029	0.003	0.025	0.029	0.004
	outside	.025	.028	.003	.024	.031	.007
2	inside	.025	.028	.003	.024	.029	.005
	outside	.025	.029	.004	.024	.029	.005
3	inside	.025	.027	.002	.025	.027	.002
	outside	.025	.029	.004	.025	.029	.004
4	inside	.025	.032	.007	.025	.029	.004
	outside	.025	.032	.007	.025	.029	.004
5	inside	.026	.029	.003	.026	.031	.005
	outside	.026	.032	.006	.026	.032	.006
6	inside	.025	.029	.004	.025	.031	.006
	outside	.025	.031	.006	.025	.032	.007
7	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.030	.005	.025	.030	.005
8	inside	.024	.030	.007	.025	.031	.006
	outside	.024	.032	.008	.025	.032	.007
9	inside	.024	.027	.003	.025	.031	.006
	outside	.024	.031	.007	.025	.031	.006
10	inside	.025	.029	.004	.025	.030	.005
	outside	.025	.030	.005	.025	.031	.006
11	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.032	.007	.025	.032	.007
12	inside	.026	.030	.004	.025	.030	.005
	outside	.026	.030	.004	.025	.031	.006
13	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.032	.007	.025	.032	.007
14	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.031	.006	.025	.031	.006
16	inside	.026	.029	.003	.026	.031	.005
	outside	.026	.032	.006	.026	.032	.006
B-Gloves							
1	inside	.026	.023	-.003	.026	.029	.003
	outside	.026	.026	.000	.026	.029	.003
2	inside	.026	.026	.000	.026	.026	.000
	outside	.026	.027	.001	.026	.027	.001
3	inside	.026	.025	-.001	.025	.027	.002
	outside	.026	.027	.001	.025	.027	.002
5	inside	.024	.029	.005	.026	.028	.002
	outside	.024	.028	.004	.026	.028	.002

Table 20 (cont.)

<u>C-Gloves</u>		Right Middle Fingertip			Left Middle Fingertip		
		Before	After	Change	Before	After	Change
		wearing in.	wearing in.	in.	wearing in.	wearing in.	in.
1	inside	(Omitted because of duplex construction)					
	outside						
2	inside	0.029	0.075	0.046	0.023	0.059	0.036
	outside	.029	.027	.002	.023	.033	.010
4	inside	.027	.032	.005	.023	.030	.007
	outside	.027	.031	.004	.023	.031	.008
5	inside	.023	.030	.007	.027	.032	.005
	outside	.023	.032	.009	.027	.032	.005
6	inside	.026	.023	-.003	.027	.023	-.004
	outside	.026	.030	.004	.027	.030	.003
7	inside	.026	.029	.003	.025	.029	.004
	outside	.026	.030	.004	.025	.030	.005
8	inside	.026	.024	-.002	.025	.027	.002
	outside	.026	.029	.003	.025	.031	.006
9	inside	.032	.032	.000	.031	.031	.000
	outside	.032	.033	.001	.031	.032	.001
10	inside	.025	.023	-.002	.025	.021	-.004
	outside	.025	.032	.007	.025	.035	.010

Table 21

Glove Thickness Measurements Before and After Wearing

A-Gloves		Right Side palm			Left Side palm		
		Before wearing	After wearing	Change	Before wearing	After wearing	Change
		in.	in.	in.	in.	in.	in.
1	inside	0.026	0.031	0.005	0.025	0.033	0.008
	outside	.026	.030	.004	.025	.033	.008
2	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.032	.007	.025	.032	.007
3	inside	.025	.030	.005	.025	.029	.004
	outside	.025	.031	.006	.025	.031	.006
4	inside	.024	.030	.006	.025	.030	.005
	outside	.024	.030	.006	.025	.030	.005
5	inside	.025	.031	.006	.025	.032	.007
	outside	.025	.032	.007	.025	.032	.007
6	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.032	.007	.025	.032	.007
7	inside	.026	.030	.004	.025	.031	.006
	outside	.026	.031	.005	.025	.032	.007
8	inside	.025	.030	.005	.024	.030	.006
	outside	.025	.031	.006	.024	.032	.008
9	inside	.025	.030	.005	.025	.031	.006
	outside	.025	.031	.006	.025	.032	.007
10	inside	.024	.030	.006	.024	.030	.006
	outside	.024	.031	.007	.024	.032	.008
11	inside	.025	.032	.007	.025	.032	.007
	outside	.025	.032	.007	.025	.033	.008
12	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.030	.005	.025	.031	.006
13	inside	.025	.030	.005	.025	.032	.007
	outside	.025	.031	.006	.025	.032	.007
14	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.032	.007	.025	.031	.006
16	inside	.026	.031	.005	.025	.031	.006
	outside	.026	.032	.006	.025	.032	.007
B-Gloves							
1	inside	.026	.029	.003	.025	.030	.005
	outside	.026	.030	.004	.025	.030	.005
2	inside	.026	.030	.004	.026	.030	.004
	outside	.026	.030	.004	.026	.030	.004
3	inside	.026	.032	.006	.026	.030	.004
	outside	.026	.032	.006	.026	.031	.005
5	inside	.024	.029	.005	.026	.029	.003
	outside	.024	.030	.006	.026	.031	.005

Table 21 (cont.)

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G-Gloves		Right Side palm			Left Side palm		
		Before wearing in.	After wearing in.	Change in.	Before wearing in.	After wearing in.	Change in.
1	inside	(Omitted because of duplex construction)					
	outside						
2	inside	0.023	0.051	0.023	0.023	0.052	0.004
	outside	.023	.052	.004	.023	.053	.005
4	inside	.023	.051	.003	.023	.052	.003
	outside	.023	.053	.005	.023	.053	.004
5	inside	.027	.051	.004	.023	.051	.003
	outside	.027	.051	.004	.023	.052	.004
6	inside	.027	.029	.002	.027	.029	.002
	outside	.027	.032	.005	.027	.033	.006
7	inside	.025	.029	.004	.026	.032	.006
	outside	.025	.051	.006	.026	.051	.003
8	inside	.027	.029	.002	.026	.051	.005
	outside	.027	.051	.004	.025	.050	.005
9	inside	.051	.055	.004	.050	.051	.001
	outside	.051	.055	.004	.050	.056	.006
10	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.051	.006	.025	.050	.005

Glove Thickness Measurements Before and After Wearing

A-Gloves		Right Thumb			Left Thumb		
		Before wearing	After wearing	Change	Before wearing	After wearing	Change
		in.	in.	in.	in.	in.	in.
1	inside	0.025	0.028	0.003	0.025	0.030	0.005
	outside	.025	.033	.008	.025	.031	.006
2	inside	.025	.029	.004	.025	.030	.005
	outside	.025	.030	.005	.025	.031	.006
3	inside	.025	.026	.001	.026	.029	.003
	outside	.025	.026	.001	.026	.030	.004
4	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.029	.004	.025	.030	.005
5	inside	.025	.031	.006	.026	.031	.005
	outside	.025	.032	.007	.026	.031	.005
6	inside	.025	.032	.007	.025	.031	.006
	outside	.025	.032	.007	.025	.032	.007
7	inside	.026	.030	.004	.025	.031	.006
	outside	.026	.031	.005	.025	.032	.007
8	inside	.026	.032	.006	.025	.031	.006
	outside	.026	.032	.006	.025	.032	.007
9	inside	.026	.028	.002	.026	.030	.004
	outside	.026	.029	.003	.026	.031	.005
10	inside	.025	.029	.004	.025	.029	.004
	outside	.025	.031	.006	.025	.031	.006
11	inside	.024	.030	.006	.025	.031	.006
	outside	.024	.031	.007	.025	.033	.008
12	inside	.026	.031	.005	.026	.031	.005
	outside	.026	.031	.005	.026	.031	.005
13	inside	.025	.028	.003	.024	.029	.005
	outside	.025	.028	.003	.024	.032	.008
14	inside	.025	.030	.005	.025	.027	.002
	outside	.025	.032	.007	.025	.030	.005
16	inside	.025	.029	.004	.025	.029	.004
	outside	.025	.032	.007	.025	.032	.007
B-Gloves							
1	inside	.026	.027	.001	.026	.025	-.001
	outside	.026	.024	-.002	.026	.026	.000
2	inside	.025	.025	.000	.026	.027	.001
	outside	.025	.027	.002	.026	.023	.002
3	inside	.026	.024	-.002	.026	.026	.000
	outside	.026	.026	.000	.026	.029	.003
5	inside	.025	.028	.003	.025	.028	.003
	outside	.025	.028	.003	.025	.030	.005

Table 22 (cont.)

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C-Gloves	Right Thumb			Left Thumb		
	Before wearing in.	After wearing in.	Change in.	Before wearing in.	After wearing in.	Change in.
1 inside	(Omitted because of duplex construction)					
outside						
2 inside	0.023	0.032	0.004	0.023	0.030	0.002
outside	.023	.034	.006	.023	.037	.005
4 inside	.027	.026	-.001	.027	.029	.002
outside	.027	.032	.005	.027	.030	.005
5 inside	.027	.032	.005	.027	.030	.005
outside	.027	.032	.005	.027	.033	.006
6 inside	.027	.026	-.001	.027	.027	.000
outside	.027	.026	-.001	.027	.027	.000
7 inside	.027	.026	.001	.027	.027	.000
outside	.027	.030	.003	.027	.030	.003
8 inside	.026	.024	-.002	.026	.023	.002
outside	.026	.025	.002	.026	.032	.006
9 inside	.021	.021	.000	.022	.022	.000
outside	.021	.025	.004	.022	.027	.005
10 inside	.025	.027	.002	.025	.030	.005
outside	.025	.030	.005	.025	.032	.007

Table 23

Glove Thickness Measurements Before and After Hearing

A-Gloves		Right Knuckles			Left Knuckles		
		Before wearing	After wearing	Change	Before wearing	After wearing	Change
		in.	in.	in.	in.	in.	in.
1	inside	0.026	0.031	0.005	0.026	0.032	0.006
	outside	.026	.031	.005	.026	.032	.006
2	inside	.025	.030	.005	.025	.031	.006
	outside	.025	.030	.005	.025	.031	.006
3	inside	.025	.027	.002	.026	.028	.002
	outside	.025	.027	.002	.026	.028	.002
4	inside	.026	.030	.004	.025	.030	.005
	outside	.026	.030	.004	.025	.030	.005
5	inside	.026	.030	.004	.026	.031	.005
	outside	.026	.030	.004	.026	.031	.005
6	inside	.026	.029	.003	.026	.030	.004
	outside	.026	.029	.003	.026	.030	.004
7	inside	.026	.030	.004	.026	.031	.005
	outside	.026	.030	.004	.026	.031	.005
8	inside	.025	.029	.004	.025	.033	.008
	outside	.025	.029	.004	.025	.033	.008
9	inside	.026	.030	.004	.026	.030	.004
	outside	.026	.030	.004	.026	.030	.004
10	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.030	.005	.025	.030	.005
11	inside	.025	.031	.006	.025	.031	.006
	outside	.025	.031	.006	.025	.031	.006
12	inside	.025	.030	.005	.025	.030	.005
	outside	.025	.030	.005	.025	.030	.005
13	inside	.025	.031	.006	.025	.030	.005
	outside	.025	.031	.006	.025	.030	.005
14	inside	.025	.029	.004	.025	.029	.004
	outside	.025	.029	.004	.026	.029	.003
16	inside	.026	.030	.004	.026	.031	.005
	outside	.026	.030	.004	.026	.031	.005
B-Gloves							
1	inside	.026	.027	.001	.026	.030	.004
	outside	.026	.027	.001	.026	.030	.004
2	inside	.026	.031	.005	.026	.030	.004
	outside	.026	.031	.005	.026	.030	.004
3	inside	.026	.030	.004	.026	.030	.004
	outside	.026	.030	.004	.026	.030	.004
5	inside	.025	.031	.006	.025	.030	.005
	outside	.025	.031	.006	.025	.030	.005

Table 23 (cont.)

J-Glows		Right Channels			Left Channels		
		Before wearing in. in.	After wearing in. in.	Change in. in.	Before wearing in. in.	After wearing in. in.	Change in. in.
1	inside	(Omitted because of duplex construction)					
	outside						
2	inside	0.020	0.029	0.009	0.020	0.025	0.004
	outside	.020	.029	.009	.020	.025	.004
4	inside	.023	.030	.007	.023	.028	.004
	outside	.023	.030	.007	.023	.028	.004
5	inside	.023	.030	.007	.027	.032	.005
	outside	.023	.030	.007	.027	.032	.005
6	inside	.027	.039	.012	.027	.039	.012
	outside	.027	.039	.012	.027	.039	.012
7	inside	.027	.030	.003	.027	.031	.004
	outside	.027	.030	.003	.027	.031	.004
8	inside	.027	.023	.004	.026	.022	.002
	outside	.027	.023	.004	.026	.023	.002
9	inside	.022	.022	.001	.021	.024	.003
	outside	.022	.025	.001	.021	.024	.003
10	inside	.026	.020	.004	.026	.020	.004
	outside	.026	.021	.005	.026	.021	.005

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