

A COMPARISON OF TWO TYPES OF PERMANENT PRESS  
MEN'S SHIRTS BY LABORATORY TESTING  
AND A CONSUMER SURVEY

by

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## ABSTRACT

Two groups of permanent press shirts were compared and evaluated in this investigation. One group was 100 per cent cotton and the other a blend of 65 per cent Kodel polyester and 35 per cent cotton. Evaluations and comparisons were made by 14 men, each of whom wore one shirt from each group over a period of three months and by three professional home economists who compared and evaluated six shirts which were laundered in the laboratory.

Tests for dimensional stability, colorfastness, comfort, and appearance due to method of laundering showed no appreciable differences in the shirts and between the shirts. However, the collar of the all cotton shirts did shrink an average of 1.6 per cent, which might be excessive if this type of shirt were to be worn with the collar buttoned. Very little difference was found over the period of launderings and between the shirts in the areas of overall appearance, seam appearance, front opening appearance, and collar appearance. These appearances were all generally rated lower than was the fabric appearance. Fabric appearance seemed to be evaluated as the best characteristic.

The outstanding conclusion reached was that the fabric of the shirts is very close to being permanently pressed in the opinion of the observers and the men in the survey. The

construction of the garments is poor, though, causing the appearance of the garments to be unacceptable as advertised by the manufacturer to require "no ironing".

## CHAPTER I

### INTRODUCTION

Much research has been conducted in the last few years on permanent press finishes now being used in ready-made garments and yard goods. This research has mainly been done under controlled conditions in a laboratory situation. Fortess (10) and Stultz (10, 34, 35, 36) have done work with polyester and cotton blends used for permanent press garments; Goldstein and May (11, 12) worked with chemicals to be used on cellulose in the permanent press process; Lee (19, 20) has worked with the synthetic fibers in durable press; and the National Cotton Council (24, 25) is working on improvements of the all cotton permanent press. The investigator chose to conduct a consumer survey using men's shirts and to compare results obtained in the survey with results of laboratory testing.

With the earlier wash-and-wear types of finishes, the fiber used was cotton; however, Lee (19, 20) of DuPont Chemical Corporation and Stultz (34, 35, 36) of Celanese Chemical Company stated that 100 per cent cotton proved unsatisfactory. Because of this, blends of various fibers were used such as cotton and nylon 420, polyester and high-wet modulus rayon, acrylic and high-wet modulus rayon, and polyester and cotton. According to Lee (20) the synthetic fibers are very important in the area of wear life

and wrinkle resistance. They need no chemical treatment, are heat settable, can be shaped and creased in pressing, and keep their shape during subsequent wearing and washing. When blended with cellulose, they help to retain the fabric strength and abrasion resistance which is lost with the cellulose when six to eight per cent resin is applied to the fabric.

Stultz (35) stated that in 1965 the majority of fabrics in the various permanent press programs was polyester and cotton blends. With the polyester present it is possible to chemically treat the cotton with the requisite amount of reactant so that it can be actually stabilized and cross-linked in a garment configuration. The increased use of polyester is shown by statistics in the Textile Organon (8). The use of cotton in men's business and dress shirts increased from 72 million pounds in 1956 to 108.6 million pounds in 1964, an increase of 50.8 per cent. Staple man-made fibers other than rayon or acetate, however, increased from 1.8 million pounds in 1956 to 6.9 million pounds in 1964, an increase of 283 per cent.

It is the purpose of this paper to accept or reject the null hypothesis that there is not a significant difference in the performance of the 100 per cent cotton and the 65 per cent Kodel polyester and 35 per cent cotton blend permanent press shirts after laboratory launderings based on light reflectance. Consumer acceptance of the shirts was evaluated in the laboratory and by a survey. The laboratory evaluations were made for fabric defects, dimensional stability, colorfastness, and acceptability of overall

garment appearance, fabric appearance, seam appearance, front opening appearance, and collar appearance. The consumer survey was based on overall appearance, fabric appearance, seam appearance, front opening appearance, collar appearance, comfort, and colorfastness during the three month period of wear and launderings. Comparisons were made between the laboratory and survey findings.

There are limitations of this study. The survey was conducted for a period of three months. While the shirts were generally worn often during this time, they were just beginning to show signs of wear, and there might have been other significant findings over a longer period of time. The sample of men for the survey was fourteen. A larger sample might have produced different results. Also, the fact that most of the men were at a high educational level might have had some bearing on the results. Only one brand of shirt was tested and only one type of garment used.

## CHAPTER II

### REVIEW OF LITERATURE

#### Wash-and-Wear

Before permanent press finishes were applied to clothing or yardgoods, wash-and-wear was a wanted feature. According to Krumholz (18) a wash-and-wear garment is one which will satisfactorily retain its original neat appearance after repeated wear and laundering with little, if any, touch-up ironings. In addition, the garment must meet the consumer demands for durability, color stability and shrinkage. Wham (41) stated that in 1957 two billion yards of wash-and wear treated cotton cloth were produced and that \$350 million dollars were spent for wash-and-wear men's wear in the same year.

Wash-and-wear proved unsatisfactory, however, and Fynn (9) gave reasons. Excessive shrinkage, attraction of soil, discoloration, failure of all parts of the same garment to keep the same degree of whiteness, odors from finishing agents on the fabric, loss of tensile strength, loss of abrasion resistance, and loss of tear strength were all failures of the earlier wash-and-wear fabrics.

Some improvements and claims were made in the wash-and-wear, but consumers were disappointed and skeptical because the claims did not always prove true. Goldstein (12)

remarked that wash-and-wear cottons had become somewhat of a farce in the minds of the consumers. Fabrics would not hold creases or pleats, seam puckering was a problem, pressing was necessary, and even the garments made of synthetics blended with cellulose behaved very poorly.

### Permanent Press Processes

Before permanent press, all wash-and-wear fabrics were cured in the piece at the mill level. In 1956 Koret of California developed the Koratron process, a deferred cure or post cure process (27, 28), but it was not until 1963 that Koret was ready to market its process. At that time they formed the Koratron Company and filed a patent for the process. Licensed users were to adhere to strict quality control standards. The chemical compound that best met those standards was Perma-fresh 183, developed by Goldstein and May (11).

The Koratron process required expensive new equipment and many innovations in methods of cutting, construction, and pressing. In March of 1964 (26) Levi Strauss and Company purchased a license to use the process; they used it on men's trousers. By November of 1964 Koratron had signed up 60 garment manufacturers and 15 mills, including the 10 largest textile companies in the country.

There are three basic approaches to permanent press; 1) the deferred cure or post cure approach, 2) the pre-cured approach, and 3) textiles engineered with thermosetting fibers.

The deferred cure process patented by Koratron is begun by impregnating the fabric with the appropriate reactant, catalyst, and other finishing agents and then drying it under conditions which minimize curing of the resin. This dried but uncured fabric is "sensitized" cloth. Garments are cut from the sensitized cloth, sewn, and are then pressed to shape. The garments may be cured in a press or in an oven (12, 34).

Another post cure process similar to the Koratron process is Super-Crease by J. P. Stevens and Company (28). This process is based on the use of sulfone chemicals rather than resins. This process eliminates chlorine retention, unpleasant odors, and avoids spontaneous curing of the fabric during storage. The fabric is padded or impregnated with sulfone chemicals which react or crosslink with the cellulose in the presence of water under alkaline conditions. The fabric can also be Sanforized. After the garment is cut, sewn, and pressed, it is cured in ovens either by the batch or continuous method. Stultz (34) stated that, unlike the Koratron treated cloth, the sulfone treated fabric does exhibit a reasonable level of dimensional stability, wash-and-wear performance, and crease angle recovery. This sulfone cloth, as claimed by J. P. Stevens, can be cut on regular patterns whereas Koratron cloth must be over-sized at the waist and inseams.

Dan-Press by Dan River Mills (28, 34) is a deferred cure approach but can be used only on cotton and polyester blends. It can be stored indefinitely without deterioration of the crease-holding properties. A substantial amount of cross-linking resin

is used in the finishing operation, but it is not equivalent to the amount employed in the Koratron process. A very slight oversizing of patterns is suggested on the inseams and waist.

Coneprest by Cone Mills is resin-finished and completely cured in the piece at the mill. If a crease is needed after the garment is finished, the area of the crease is sprayed with a Coneprest solution developed by Cone research. This reactivates the cured state and results in a permanent crease and effective shape retention for the garment.

A pre-cured process announced by Everprest, Incorporated was Sharp/Shape, which is effective with stretch fabrics. It was adopted by Erwin Mills for its Expandra stretch denim, a Sanforized blend of 75 per cent cotton and 25 per cent stretch nylon. The Everprest process (34) does not require an oven curing step, but it does require a two step pressing operation - the regular legging and topping press plus the recommended hot head press procedure.

Never-Press fabrics made by Wamsutta Men's Wear Division require no deferred curing and the garments are guaranteed for normal wear for one year. A combination of fiber engineering and a special resin finish is used and is designed with a particular balance of warp and filling in a blend prescription which permits the setting of durable creases on the pressing machines.

The inherently thermosetting properties in fabric blends of polyester and acrylic fibers are the basis for Burmi-Crease by Burlington Men's Wear (28). No resins or other chemicals are used. The durable crease is achieved on conventional press machines.

#### Problems With Permanent Press

Problems appeared with permanent press as they did with wash-and-wear. Beaumont (2) stated that this was especially true of the all cottons. With each of the new ingredients and processes used, new problems arose. The resin itself causes a destructive loss in the physical properties of the fabric. The loss of tensile and tear strength is accepted as being inevitable.

Fortess (6, 10) remarked that the first durable press garments made of rather heavy 100 per cent cotton fabrics (about 11 ounces per square yard) immediately showed that with the durable press garments the eight year old claims of wash-and-wear had finally been achieved. Lighter cottons, however, suffered on the edges of cuffs, in fabric strength, in abrasion resistance, and in flex abrasion resistance. Lee (19) stated that to obtain a high level of crease retention, and a true wash-and-wear performance in a garment, a tensile strength loss of 35 per cent to 50 per cent must be accepted on all cotton fabrics. The chemical treatments or cross-linking agents badly degrade the cellulose, halving the elongation and tear strength as well as appreciably reducing abrasion resistance. The tough all cotton construction of approximately 11 ounces in weight usually offsets the inevitable loss of strength, or

the use of a cotton blended with nylon or polyester gives increased strength and resistance to abrasion.

Fortess (10) explained the fact that the man-made fibers are resistant to the cross-linking chemicals needed for the cotton. The man-made fibers inherently possess the wash-and-wear qualities, and especially polyester can be used at an economically attractive blend level. With the use of cotton and man-made fiber blends, lighter weight fabrics can be used with a permanent press finish.

To overcome the shrinkage problem, garments were oversized about one-half size in curing (29, 4, 12, 22). Pre-cured fabrics can be Sanforized. Shrinkage of thread, zippers, tapes, binding, pockets, waistbands, and lining has caused more problems. Those items must be chosen with characteristics which are compatible with those of the fabrics used to make the garment. Doniger (5) also suggested that initial shrinkage can be eliminated by pre-washing certain trim parts in order to achieve shrinkage of all component parts of the garment.

On the cutting table, Cone (4) stated pre-cured cloth lies flat and is easy to cut, while delayed cure cloth wrinkles easily and might be distorted because it is not yet dimensionally stable. In the sewing room, uncured cloth sews easily, although ease of distortion requires some care to avoid puckered seams because of unequal tension in adjoining panels. Doniger (5) stated that to eliminate puckering it is better to cut seams on a slight bias.

Seam puckering presented a large problem, but it was found that seams could be sewn very satisfactorily with a small diameter thread using very fine round-point needles, along with lubrication of the needles and threads (4, 14, 5). Doniger (5) suggested care in the selection of fabrics. Weave, yarn count, and composition of the final finish are important. In general, with denser fabrics, tighter weaves and higher yarn counts, there is greater resistance to needle penetration, passage of the sewing thread, and greater likelihood of puckering. With the very fine needles and modern threads, along with lubrication of the needles and threads, garment manufacturers are able to penetrate fabrics with the least amount of distortion, thereby avoiding as much puckering as possible.

Russo (30) stated that it takes longer to sew garments that are to be labeled 'permanent press'. The tension must be watched because any pucker that appears is a pucker that will remain permanently. Sewing machines must also be slowed down in durable press garments. The rate of production is approximately 75 per cent of normal sewing. Russ Togs' list of instructions (14, 30) given to their foremen specified the type of thread to be used, the stitches per inch, and the size of needles and feed plates. The list also gave instructions on how to control the tension in order to assure uniformity of stitch, how to sew in the zipper, how to blind stitch or hem the garment, and how to press the garment. Lee (20) thought that it was necessary to change seam types and stitch types.

in some cases and this would break tradition. However, shirt manufacturers found that the consumers did not object to construction changes as much as was expected.

With pre-cured fabrics, Doniger (5) stated that the choice of thread is not critical; however, manufacturers must guard against different ratios of shrinkage and subsequent washing, as opposed to the shrinkage of the fabric. A high quality, highly mercerized cotton thread has been found acceptable, and in certain cases, a cotton wrap polyester core thread is desirable. This thread may develop into a problem if the cotton wrapping is not uniform in the winding, free of slugs and mercerized to a satisfactory degree.

Sewing techniques are also important in the construction of garments. Concealed seams as a seam type SSa-1 sometimes tend to show less puckering than a seam type LSc-2, especially if they are sewn with a loose tension. Top stitching should employ the minimum stitches per inch, and stitch types should be chosen which result in a minimum of tension. The type of sewing machine used also should be given considerable thought. In most cases the machines which move with the fabric are desirable. Zig zag stitching and blind stitching are more desirable than stitch type 301. Bobbins should be wound as loosely as possible on the bobbin winder, and friction from the bottom surface of the sewing foot should be minimized.

Pressing is another area which required much care.

Cone (4) stated that the amount needed varies with the choice of the permanent press process used. The delayed cure and vinyl sulfones processes applied to cellulosic fibers probably require shorter press periods because this is sufficient to impart a crease and some smoothness to dried fabrics. The chemical reactions take place later in the oven. The pre-cured processes when applied to re-cured cellulosic or a combination of a thermoplastic and a cellulosic need a longer amount of time, but they have the advantage of not requiring further oven curing. Finishers of piece goods and garments must be alert to avoid oven-curing. A final oven treatment for garments made of pre-cured fabric can be expected to reduce the fabric strength and abrasion performance. Care must also be taken in the final pressing of delayed cured fabrics. After they are cured in the oven, their creases and any other wrinkles or unsmooth parts are permanent. Special redesigned pressing equipment has helped in this task.

Stultz (35) stated that the biggest problem with the permanent press garments is in the garment alterations. Mack (21) explained that wrinkle-resistant finishes on cotton cellulose are generally based on the formation of covalent cross-links. The cross-links impart a rigid structure to the cotton fiber, consequently, crease recovery, dimensional stability, wrinkle resistance, and permanent creasing are associated with this phenomenon. These properties are highly desirable, but create practical difficulties in the manufacturing and alteration of garments. The treatment is designed to

prevent deformations so the cross-links make it impossible to place creases at desirable locations in a finished fabric. This makes adjustments and alterations almost impossible to make in finished garments.

Jay (16) stated that alteration of garments is a consumer need and consumers' needs will be met. Recently consumers have accepted two methods of altering men's pants length which were not acceptable before. To shorten the pants, the cuff is either cut off and sewn on again higher up the leg, or a pleat is sewn in under the cuff making the pants length shorter. Consumers' acceptance of the raw edges or the pleat may indicate that with new products and new ideas, new standards of acceptability in both construction and alterations may be accepted. The consumer might look forward to more varied types of alterations in the permanent and durable press fields. Some procedures that are being tried already are chemical sprays to break down the finish, to allow resewing and still another chemical spray for refinishing, and a small table top oven for re-curing. This might be used in alteration departments of stores.

Another factor, colorfastness in permanent press fabrics seems to be greatly hindered in the curing. Cone (4) stated that dyes are tortured because they are subjected to heat treatments at high temperatures and for long periods of time to cure. This often causes shade changes in different areas of the garment, and since the resin finish embrittles the cotton fiber ends, "dusting" and "crocking" may become problems. Under hot head press treatment the changes are not as drastic. Dyestuff producers commonly agree that the hot head

press method offers less difficulties in dye selection than does any other process now offered to garment manufacturers. If garment manufacturers make known to the fabric source the temperature or curing times to be used, dyestuff problems can be managed and contained.

Since many of the major problems had to do with the all cotton garments, much research was conducted on the cotton to improve its performance. The National Cotton Council (24, 25) listed the significant developments underlying "the resurgence of all cotton durable press". There is now better information on proper curing times and temperatures; polymeric surface treatments and additives improve abrasion resistance; differential cross-linking, in which the two sides of a cotton fabric are treated separately, and sometimes with different finishes, is used to upgrade abrasion resistance; and better abrasion resistance is obtained through mercerizing and the stretching and modification of the fabric construction.

There are also systems involving resin deposition and complete curing under wet conditions, which reportedly yield a four-fold or better increase in abrasion resistance; and grafting of various monomers onto cotton is used to build polymer structures without cross-linking in the fiber, which alleviate the abrasion problem. The double-cure processing, which employs inert occlusion compounds and permits complete curing of the fabric in two stages, permits the use of almost any system of wash-and-wear

chemicals or resins. This is unlike the conventional delayed-cure method which depends on resin stability in the uncured state. There have been new cross-linking chemicals and resins developed which provide a better balance of crease-angle and wash-and-wear rating relative to strength and abrasion resistance.

Although many of these developments have been very helpful, there are problems that remain to be solved. The development of a chemical which will not affect the strength or durability of cotton would be of great help (28). Other problems which researchers are working on are the development of procedures to control shrinkage of garments during the deferred cure processing, the development of chemicals and procedures to eliminate the present discoloration or yellowing of white fabrics treated for deferred cure, the development of chemicals and procedures which will make it possible to alter garments treated for deferred cure, and the elimination of fibrillation in permanent press fabrics. There is also a need for acceptable and rigidly enforced industry-wide standards which would insure a quality permanent press product. The standards would include use of treated fabrics for pocketing, linings, waistbands, zipper tapes, and other components to avoid shoddy inside appearance which has characterized some garments after washing.

#### Laundering of Cotton Textiles

Results of laundering of garments have an influence on consumer satisfaction. Grimes and Werman (13) found that

commercial laundering caused greater shrinkage of cotton broadcloth shirts than laundering by household methods and that hand ironing resulted in greater shrinkage than ironing with a rotary ironer. By none of the methods of laundering was shrinkage more than approximately three-fourths complete after five launderings. Shrinkage of fabric swatches and of shirts were similar, and the broadcloths varied considerably in shrinkage although all were Sanforized. All shrank much more than one per cent.

A study by Shilling and Padget (31) also revealed that the method of laundering does affect wrinkling of wash-and-wear shirts and that the best results were obtained when the shirts were hand-washed at a temperature of  $105^{\circ}$  F. and drip-dried. Fifteen inch wash-and-wear fabric squares and the wash-and-wear shirts showed a similar pattern of wrinkling in laundering. A water temperature of  $140^{\circ}$  F. in laundering caused more wrinkling in the cotton wash-and-wear shirts and fabric squares than water at  $105^{\circ}$  F., and drip-drying. There was also a pattern of wrinkling in the wash-and-wear shirts and fabric squares determined after the first few launderings and in most cases the wrinkling increased after 15 launderings.

Reid (29) found that wash-and-wear cottons are much less susceptible to abrasion when wet than when dry. Therefore, he stated that, in the wash cycle, wash-and-wear cottons can be subjected to practically the same washing conditions as ordinary cottons. For best results the wash-and-wear cottons should be

tumble dried separately from other cottons. They dry at almost the same rate as the untreated cottons, but they retain less water after the spin cycle and, consequently, dry sooner. This rapid drying is a highly desirable characteristic, however, the homemaker must promptly remove wash-and-wear fabrics from the dryer to avoid excessive abrasion.

### Consumer Satisfaction

In 1960 Smith (33) found that women were not impressed by promises, but that they would return to buy wash-and-wear when the performance had been satisfactory. She suggested continued improvement in finishing and more restraint by the industry in promoting wash-and-wear. Now in 1966 Smith (32) finds that, as a rule, the consumer is satisfied with the performance of textile products, however, in the areas of colorfastness and shrinkage, poor performance is apparent and results in consumer returns at the retail level.

New finishes should not add to the consumers' problems. If the new finish exchanges one job for another, there is no advantage to it. Finishers should also strive for maximum uniformity of product. Changes in formulation of the dyeing or chemical treatments from lot to lot is most disturbing to the retailer and his customer.

The consumer, according to Tesi (37), is becoming better educated and is demanding more textile products which have fashion and aesthetic appeal. At the same time, he wants better

quality. The consumer is earning more money and thus has more to spend for textile products if the industry can produce items he wants.

Jeffers (17) agreed that the customers are getting more knowledgeable, more sophisticated, and more discriminating every year. Before, they were willing to accept shirts that were oversized to allow for shrinkage, and they would hope for a good fit after washing. Then preshrunk fabrics were proven and established, and the customers no longer accepted excessive shrinkage. Now permanent press is on the market. Customers may be disappointed at first, possibly even disillusioned, but finally they will be better educated in shopping and will learn what to look for and to expect. Customers want results. Merchandise should look better, wear longer, and require less care.

Hull (15) found that consumers want and demand easy care characteristics of little or no ironing, no starching, no bleaching, and resistance to wrinkling in a growing list of apparel and household products. This is evidenced by the rapid expansion in the production of easy care, woven fabrics since 1955. It is estimated that 600,000 linear yards of cotton fabrics and 700,000 of other easy care, woven fabrics, including cotton blends, were produced in that year. The estimated production of the same fiber-content fabrics in 1962 was 1,900,000 linear yards of cotton and 1,400,000 of other. The estimated total linear yard increase was 2,000,000 linear yards from 1,300,000 in 1955 to 3,300,000 in 1962.

The quality characteristics liked best by housewives who had experience with cotton easy care clothing were ease of washing, no ironing, no starching, durability, resistance to wrinkling, coolness, softness, smoothness, freshness, and appearance after laundering. The characteristics they least-liked were the necessity for even minimum ironing, wrinkling in use, seam puckering, and attraction of lint.

In another survey done on consumer satisfaction with men's shirts (3), it was found that the collar was the most important feature for satisfaction with shirts, and the shirt collar usually determined the wear life of the shirts. Other important factors were appearance, comfort, durability, ease of care, performance while wearing, and performance over time. Fit and fiber of fabric were closely related to comfort, design features of the shirt collars to appearance, and fiber and fabric to durability and ease of care. The men in the survey seemed to desire a higher level of comfort, fit, and appearance in a shirt than of ease of care, and perhaps durability.

## CHAPTER III

### METHOD AND PROCEDURE

#### Shirts

There were two groups of shirts used in this investigation. One group of shirts was 100 per cent cotton, the other group a blend of 65 per cent Kodel polyester and 35 per cent cotton. All of the shirts had a permanent press finish. The Kodel polyester and cotton blend shirts were white batiste with button down or soft collars and a yarn count of warp 101, filling 81. The 100 per cent cotton shirts included broadcloth and oxford cloth. The broadcloth shirts were white, had soft collars and a yarn count of warp 143, filling 62. The oxford cloth ones had button down collars, were white or pastel colors and had a yarn count of warp 93, filling 49. All shirts were short sleeved with tapered sides, and they all had two pockets in front. Seam types and stitch types (39) are listed in Table 1. Thread used for the main seams in the all cotton shirts was all cotton and for the polyester and cotton blend shirts, a blend of polyester and cotton.

#### Survey

The investigator distributed a survey questionnaire (see Appendix A), and seventeen men agreed to participate; however, only fourteen men completed the survey (see Table 2) for

TABLE 1

Seam and Stitch Types Used in the Two Types of Shirts

Location of Seams	100% Cotton Shirts		65% Polyester and 35% Cotton Shirts	
	Seam Type	Stitch Type	Seam Type	Stitch Type
Collar Top Stitch	SSe-2	301	SSe-2	301
Collar to Band	SSq-2	301	SSq-2	301
Collar Band to Neck	LSeg-2	301	LSeg-2	301
Yoke Front	LSeg-2	301	SSa-1	301
Yoke Back	SSa-1	301	SSa-1	301
Sleeve	LSc-2	401	SSa-2	515
Sleeve hem	EFb-1*	301	EFb-1	301
Side Seam	LSc-2	401	SSa-2	515
Hem	EFb-1	301	EFb-1	301

\* One oxford shirt differed in the sleeve hem (EFk-1)

description of participants). A shirt preference and size questionnaire (see Appendix B) was given to them, and they indicated their sizes and preferences of the type of shirt to be used (see Table 3). At this time a leading shirt company was contacted and did agree to supply the shirts for the survey at wholesale cost.

A questionnaire was periodically completed by each of the men in the survey after wearing his two shirts (one 100 per cent cotton and one 65 per cent Kodel polyester and 35 per cent cotton

blend) for three weeks, six weeks, nine weeks, and twelve weeks (see Appendices C and D).

TABLE 2

## Description of the Men in the Consumer Survey

Men	Age	Marital Status	Occupation	Domicile
1.	23	Married	Student (jr.)	Apartment
2.	28	Married	Businessman	Own Home
3.	22	Married	Student (jr.)	Apartment
4.	55	Married	Rancher	Own Home
5.	24	Married	Student (law)	Own Home
6.	46	Married	Teacher	Own Home
7.	30	Married	Student (law)	Own Home
8.	22	Married	Student (sr.)	Apartment
9.	24	Married	Student (law)	Apartment
10.	29	Married	Student (grad.)	Apartment
11.	26	Single	Student (law)	Own Home
12.	23	Single	Student (law)	Own Home
13.	22	Married	Student (sr.)	Rent Home
14.	27	Single	Student (law)	Rent Home
TOTALS	Age Range 22-55 Median Age 25	11 Married 3 Single	11 Students 3 Others	7 Own Homes 2 Rent Homes 5 Rent Apartments

Record sheets (see Appendix E) were filled out telling how often the shirts were worn and laundered. The period of wear and

laundering was from April 25, 1966 to July 16, 1966.

### Laboratory Evaluation

Six shirts were tested in the laboratory. Initially, the shirts were checked for fabric and construction defects according to military specifications (38). During a total of twenty launderings, after each five launderings, the shirts were subjectively evaluated by a panel at the same laundering intervals for 1) overall garment appearance, 2) fabric appearance, 3) seam appearance, 4) appearance of front opening, and 5) collar appearance. (See Appendix F for Observer Score Sheet.)

TABLE 3

Description of the Shirts Evaluated in the Laboratory  
and in the Survey

Shirts	100% Cotton Shirts			65% Polyester, 35% Cotton Shirts	
	Broadcloth Soft Collar White	Oxford Cloth Button Down Collar		Button Down Collar White	Soft Collar White
		Colored	White		
Six Shirts Evaluated in the Laboratory	1	1	1	2	1
Twenty-eight Shirts Evaluated in the Survey	2	8	4	8	6

### Laundrying

The shirts were laundered using a Norge Washer (Model AGW 1540-B) and tumble dryer (Model DEG 1530). Water temperatures in the washer were selected using the shirt manufacturer's recommended temperatures. A low suds commercial detergent was used in the wash, and the water was nine grains hardness. Clean hemmed cotton muslin pieces (36" by 36") were added with the shirts to maintain a constant wash load of approximately four pounds. The water level control was set at Lo, and the washing cycle selected was Wash-and-Wear (Durable), which was the regular cycle with a wash time of seven minutes. The rinse water was cold, the wash speed normal and spin speed slow. The shirts were removed from the washer directly after the final spin cycle and put into the dryer which was set at the Automatic Wash-N-Wear Cycle. This cycle was designed to automatically dry all synthetic and Wash-and-Wear fabrics to the proper degree of dryness. During the last five minutes, the shirts were tumbled without heat to cool them and to reduce wrinkling. The dryer stopped automatically when the shirts were dry. The shirts were immediately removed from the dryer and were hung on hangers.

### Dimensional Stability

To test dimensional stability the shirt specimens were measured initially and after each five launderings. Measurements were taken of the collar from end to end along the neck seam after the collar was smoothed out and flat, the center back length from

the neck seam at the middle of the back to the bottom of the shirt hem, the back width of the shoulder from the sleeve seam to the sleeve seam two inches below the yoke, and the waist from the side seam to the side seam across the back. The waist was located one half way between the last two buttons on the shirt (see Appendix G and H for drawings).

### Colorfastness

To test colorfastness to laundering the entire shirts were used and were laundered as explained previously. The colored shirt was laundered separately from the five white shirts. A multi-fiber sample was basted to the colored shirt and after each five launderings was evaluated with the AATCC color transference chart. The white shirts were evaluated with the use of the AATCC gray scales.

To test color retention by means of light reflectance, a Photometer Model 501-A with a Reflection Density Unit (Model 53) was used. The shirt specimens were tested initially and after each five launderings.

### Wash-and-Wear Appearance

In the subjective tests two methods of lighting were used, the low angle lighting and the overhead lighting. The low angle light was placed 15 inches to the side of the shirt and 10 inches in front of it when the specimen was hung and displayed as shown in the drawing in the Appendix J. The overhead lighting consisted of an

overhead ceiling light of 108 foot candles shining down on the specimen, which was hung on a form as for the low angle.

In testing for overall garment appearance AATCC test method 88A-1964t was used with the following modifications. The garment was hung on a form three feet from the observer. Overhead lighting was used, and the observers were asked to rate the overall garment appearance by the following scale:

- a. Garment is outstanding in appearance.
- b. Garment is good in appearance.
- c. Garment is acceptable in appearance.
- d. Garment does not meet standards of the observer.
- e. Garment is not acceptable.

The three trained observers used were three professional home economists: one a professor of clothing and textiles at the University of Arizona, one a clothing and textiles specialist for the University of Arizona Extension Service, and one a home economics teacher at a junior high school in Tucson, Arizona.

In testing fabric appearance, the AATCC test method 88A-1964t was used with the following modifications. The low angle lighting described previously was used, but instead of a 15" by 15" square of fabric used as a sample, the entire shirt was used. A section of the back of the shirt was shown through a 10" by 10" hole cut in a two by three foot piece of manila tagboard which was hung over the shirt draped on a form (see illustration, Appendix J).

Observers were asked to rate the fabric appearance according to photographs of standards one through five with one being not acceptable and five being outstanding in appearance.

To test seam appearance the AATCC test method 88B-1964t was used with the following modifications. Modifications were the same as for the overall garment appearance except a sleeve was pinned up to the shoulder, and the side seam was exposed between the piece of tagboard draped over the form (see Appendix K). Observers were asked to rate the seam appearance according to photographs of standards one through five with one being not acceptable and five being outstanding in appearance.

The front openings of the shirts were tested by using AATCC test method 88A-1964t with the following modifications. The shirt was hung on a form as it was when evaluating the fabric appearance, but with the front of the shirt forward and the front opening showing through a hole cut in the tagboard four inches wide and fifteen inches long (see Appendix L).

The three observers were asked to rate the front openings by the following scale:

- a. Front opening is outstanding in appearance.
- b. Front opening is good in appearance.
- c. Front opening is acceptable in appearance.
- d. Front opening does not meet standards of the observer.
- e. Front opening is not acceptable.

The collar appearance was tested in the same way as was the front opening with the exception that the opening in the tagboard was in a half-moon shape at the top of the tagboard exposing only the collar (see illustration, Appendix M). The observers were asked to

rate the collar appearance by the following scale:

- a. Collar is outstanding in appearance
- b. Collar is good in appearance.
- c. Collar is acceptable in appearance.
- d. Collar does not meet standards of the observer.
- e. Collar is not acceptable.

#### Analysis of Data

An analysis of variance was completed for the amount of light reflected by the five white shirts used in the laboratory as measured by the reflection densitometer. All other evaluations were subjectively scored. These scores were totaled, averaged, and compared with each other. All of the data were tabulated and illustrated by the use of tables and a figure.

## CHAPTER IV

### RESULTS AND DISCUSSION

#### Fabric and Construction Defects

Military specifications for a man's short sleeve shirt (38) were used as a basis for the evaluation of the fabric and construction defects. Table 4 shows those defects which were found. Major defects seriously affecting the appearance and serviceability of the shirts were 1) parts of all six shirts were cut off grain (especially noticed in the collar and yoke) and 2) a scissor hole was cut in one of the polyester and cotton blend shirts. The oxford cloth shirts showed seam slippage at the corners of the yokes in the back. This probably was caused by the fact that the yokes were cut off grain. Other defects affecting appearance or serviceability, but not seriously, were such things as loose threads, seam puckering, ragged edges on buttonholes, buttonholes not always the same distance from the edge of the shirt, puckers around the neckline, and pockets attached crookedly. One shirt in particular (an all cotton white oxford cloth) had a very poorly hemmed sleeve. As shown in Table 1, the seam type was different from the other oxford cloth shirt and in this case one sleeve hem was twisted and puckered very badly. These defects all appeared to be because of the construction of the garments and not the fabric.

TABLE 4

## Construction Defects Found in the Six Laboratory Shirts

Construction Defects	One Broad-cloth Shirt (Cotton)	Two Oxford Cloth (Cotton)	Three Batiste (Polyester and Cotton)
1. Workmanship damages			M
2. Loose threads	A	AA	AAA
3. Pieces cut off grain	M	MM	MMM
4. Ends of all seams when not caught in other seams or stitching backtacked less than 1/4 inch	A	A	A
5. Thread breaks secured by stitching back of break less than 1/2 inch		A	AA
6. Seams puckered		AA	
7. Broken stitch in one buttonhole			A
8. Ragged edges on button-holes	A	AA	AAA
9. Collar tight at joining to front and yoke, causing puckers or pleats around neckline.	A	AA	AAA
10. Front edge not folded straight with warp line, forming curve	A	AA	AAA
11. Uneven length of front when buttoned (at bottom)		AA	
12. Pockets attached crookedly		AA	AAA

M - Major Defects - When seriously affecting appearance or serviceability.

A - Minor Defects - When affecting appearance or serviceability, but not seriously.

### Dimensional Stability

The laboratory measurements of dimensional stability showed that shrinkage did occur in both the all cotton and the polyester and cotton blend shirts although the largest percentage (1.6 per cent) was in the collar of the all cotton shirt (see Table 5). All other parts of the all cotton and the polyester and cotton blend shirts shrank less than one per cent, although the cotton shirts did shrink more as a whole.

TABLE 5  
Average Shrinkage in Two Types of Shirts

Location of Measurement	Average Per Cent of Shrinkage	
	100% Cotton Shirts	65% Polyester, 35% Cotton Shirts
COLLAR	1.60	0.53
BACK SHOULDER	0.67	0.00
WAIST	0.43	0.17
CENTER BACK LENGTH	0.47	0.13

In the survey all of the men wearing the shirts reported that the collars fit well except in one case in which the collar was too big in the blend shirt. Since the clothing worn in the southwestern United States is usually casual and the weather is quite warm, most of the men in the survey probably wore their shirts without ties and unbuttoned at the top button most of the time. If this were true, the

fit of the collar perhaps would not be as noticeable as in other areas of the country where collars would be buttoned and ties worn.

### Colorfastness

In comparing the multifiber fabric sample with the AATCC color transference chart there seemed to be no change in the color of the shirts. Statistical treatment of the results of tests taken on the five white shirts in the laboratory with the reflection densitometer showed no change in the whiteness with each five launderings at the 5% level of significance (see Table 6). The tabular  $F$  for 4 and 16 degrees of freedom is 3.01 at the .05 probability level. Since the calculated  $F$  for the treatments does not exceed the 5 per cent tabular  $F$ , no significant difference existed between the treatment means. The shirts did show a tendency to decrease in the amount of light reflectance after each five launderings; however, the difference was not visible to the investigator nor to the men in the survey, and statistically it was not significant at the 5 per cent level. There was a significant difference between the shirt means. This was probably due to the fact that the shirts were made of three different fabrics: broadcloth, oxford cloth, and batiste.

TABLE 6

Analysis of Variance for Light Reflectance in Five White  
Permanent Press Shirts

Source of Variation	df	Sum of Squares	Mean Squares	F Value
Treatment (number of launderings)	4	.002400	.000600	2.93
Environment (Shirts)	4	.009967	.002492	12.14*
Experimental Error	16	.003286	.000205	
Determination Error	50	.004337	.000087	
TOTALS	74	.019990		

\* Significant difference at the 5 per cent level.

#### Overall Appearance

Overall appearance seemed largely a matter of personal opinion and varied much among the observers and the men in the survey (see Tables 7 - 9). The observers on the whole evaluated the appearance as worse than did the men, not only in the overall appearance, but in the seam, collar, and front opening appearance (see Figure 1). Generally, the overall appearance was marked very poor and even more so in the cases of the all cotton shirts.

#### Fabric Appearance

Fabric appearance seemed to be the most outstanding characteristic tested in this experiment (see Figure 1). It was the highest rated characteristic tested and the one that was the most consistent, being evaluated at the very good appearance level by the

observers and the men in the survey. Table 8 shows that the range of scores for fabric appearance usually varied no more than one or two points. This evaluation corresponds with the results of the fabric and construction defects evaluation in that the major problem with these shirts appeared to be in the construction of them. The construction of the garments tended to lower the overall appearance of the shirts to an unacceptable level.

### Seam Appearance

Seam appearance was rated very low (2.2) for the Polyester and Cotton Blend Shirts and 2.6 for the cotton shirts in the evaluations of the observers (see Figure 1), however, the men in the survey rated it relatively high (4.1 for the polyester and cotton blend shirts and 3.4 for the cotton shirts - see Figure 1). The inconsistency may be attributed largely to personal opinion and possibly to the fact that different seam types were used on the two types of shirts.

### Front Opening Appearance

Front opening appearance was rated very similarly to the seam appearance although it was rated a bit higher in most cases (see Figure 1). The observers scored the front opening appearance as generally not meeting their standards and the primary reason was that the buttons were sewn on the shirts very tightly causing very noticeable puckers.

TABLE 7

Average and Median Scores on the 100 Per Cent Cotton  
and the 65 Per Cent Polyester and 35 Per Cent Cotton Blend  
Shirts in Five Areas of Evaluation

MEN	100% Cotton Shirts							65% Polyester 35% Cotton Shirts						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
1.	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.3	4.0	4.0	4.1	4.0
2.	3.5	4.0	3.3	4.3	4.5	3.9	4.0	3.8	4.3	3.3	3.8	2.5	3.5	3.8
3.	2.0	4.0	2.8	3.0	5.0	3.4	3.0	2.8	5.0	4.0	4.0	5.0	4.2	4.0
4.	3.0	4.0	3.0	3.0	4.3	3.5	3.0	4.0	5.0	4.0	4.0	4.8	4.4	4.0
5.	2.5	4.3	3.0	3.8	4.8	3.7	3.8	3.0	5.0	4.0	4.0	5.0	4.2	4.0
6.	2.0	2.3	2.0	3.5	3.8	2.7	2.3	4.0	4.8	3.8	4.8	4.8	4.4	4.8
7.	1.0	4.3	3.3	1.8	4.3	2.9	3.3	1.8	4.8	5.0	3.0	4.8	3.9	4.8
8.	2.0	3.8	3.0	4.3	4.3	3.5	3.8	2.0	3.8	3.0	4.3	4.3	3.5	3.8
9.	3.3	3.8	4.0	4.5	4.8	4.1	4.0	3.5	4.5	4.3	4.5	4.5	4.3	4.5
10.	1.3	4.5	3.3	4.0	4.0	3.4	4.0	1.8	4.5	4.0	4.8	4.0	3.8	4.0
11.	4.3	4.0	4.3	4.5	5.0	4.4	4.3	4.0	3.8	4.0	4.5	4.0	4.1	4.0
12.	4.0	4.0	4.8	3.5	4.3	4.1	4.0	4.8	5.0	5.0	4.0	4.5	4.7	4.8
13.	1.3	4.3	3.8	4.3	4.3	3.6	4.3	2.0	3.8	4.5	3.3	3.0	3.3	3.3
14.	3.0	4.0	3.0	4.0	3.8	3.6	3.8	3.8	3.5	4.0	4.0	3.8	3.8	3.8

## OBSERVERS

1.	2.3	4.0	3.2	2.8	3.0	3.1	3.0	3.0	3.9	2.8	3.0	4.0	3.3	3.0
2.	1.3	4.1	2.4	1.9	1.8	2.7	1.9	2.2	4.5	2.0	2.2	2.5	2.7	2.2
3.	2.2	4.0	2.2	2.8	2.6	2.8	2.6	2.6	4.1	1.8	2.7	2.4	2.7	2.6

A - Overall Appearance  
B - Fabric Appearance  
C - Seam Appearance

D - Front Opening Appearance  
E - Collar Appearance  
F - Total Average  
G - Median

TABLE 8

Ranges of Scores on the 100 Per Cent Cotton and the 65 Per Cent Polyester and 35 Per Cent Cotton Man's Shirt  
in Five Areas of Evaluation

MEN	100% Cotton Shirts					65% Polyester, 35% Cotton Shirts				
	A	B	C	D	E	A	B	C	D	E
1.	4	4	4	4	4	4	4	4-5	4	4
2.	2-4	4	3-4	4-5	4-5	2-5	4-5	3-5	3-4	2-4
3.	2	4	2-3	3	5	2-3	5	4	4	5
4.	3	4	3	3	4-5	4	5	4	4	4-5
5.	2-3	4-5	3	3-4	4-5	2-4	5	4	4	5
6.	1-3	1-4	2	2-4	2-5	4	4-5	3-4	4-5	4-5
7.	1	4-5	3-4	1-4	4-5	1-2	4-5	5	1-4	4-5
8.	2	3-4	2-3	4-5	3-5	2	3-4	2-4	4-5	3-5
9.	2-4	2-5	4	4-5	4-5	2-4	4-5	4-5	3-5	4-5
10.	1-2	4-5	3-4	4	4	1-2	4-5	4	4-5	4
11.	4-5	4	4-5	4-5	5	4	3-4	4	4-5	4
12.	4	4	4-5	3-4	4-5	4-5	5	5	3-5	4-5
13.	1-2	4-5	3-4	4-5	4-5	2	3-4	4-5	3-4	3
14.	2-4	4	3	4	3-4	3-4	3-4	4	4	3-4
OBSERVERS										
1.	2-3	3-5	2-4	2-4	2-4	2-4	3-4	2-4	3	3-5
2.	1-2	3-5	1-4	1-2	1-3	2-3	4-5	1-5	2-3	2-4
3.	1-3	4	2-3	1-4	1-4	1-4	4-5	1-3	1-4	1-4

A - Overall Appearance

B - Fabric Appearance

C - Seam Appearance

D - Front Opening Appearance

E - Collar Appearance

TABLE 9

Overall Averages, Medians, and Ranges of the Scores  
of the Observers and the Men in the Survey

	100% Cotton Shirts					65% Polyester, 35% Cotton Shirts				
	A	B	C	D	E	A	B	C	D	E
Averages:										
Observers	1.9	4.0	2.6	2.5	2.5	2.6	4.2	2.2	2.6	3.0
Men	2.7	4.0	3.4	3.8	4.4	3.2	4.4	4.1	4.1	4.2
Medians:										
Observers	2.2	4.0	2.4	2.8	2.6	2.6	4.1	2.0	2.7	2.5
Men	2.8	4.0	3.3	4.0	4.3	3.7	4.5	4.0	4.0	4.4
Ranges:										
Observers	1-3	3-5	1-4	1-4	1-4	1-4	3-5	1-5	1-4	1-5
Men	1-5	1-5	2-5	1-5	2-5	1-5	3-5	2-5	1-5	2-5

A - Overall Appearance  
B - Fabric Appearance  
C - Seam Appearance  
D - Front Opening Appearance  
E - Collar Appearance

### Collar Appearance

The collar appearance evaluation differed most noticeably between the observers in the laboratory and the men in the survey in the all cotton shirt (see Figure 1). The observers scored the collar appearance low and not much different from the seam and front opening appearance while the men in the survey scored it as equal to and higher than the fabric appearance. Differences between the collar in the all cotton and the polyester and cotton blend shirts were very slight in the survey evaluated shirts, but differed more noticeably in the laboratory evaluation. The polyester and cotton blend shirt collar was rated higher than was the collar in the all cotton shirts. Ranges did vary quite noticeably in both the laboratory and the survey evaluations (see Tables 8 and 9).

Again personal opinion is probably the cause of the great difference in evaluation. The observers in the laboratory were all professional home economists and appeared to have been more critical than were the men in the survey. Especially in the evaluation of the collar, puckering caused by the top stitching and by the fact that the collar was tight at the joining to the front and yoke lowered the score in the opinion of the observers in the laboratory, while the men in the survey failed to mention this or consider it in the evaluation of the collars. This difference in evaluation may have been due to the fact that the men in the survey probably were wearing their shirts unbuttoned at the top most of the time.

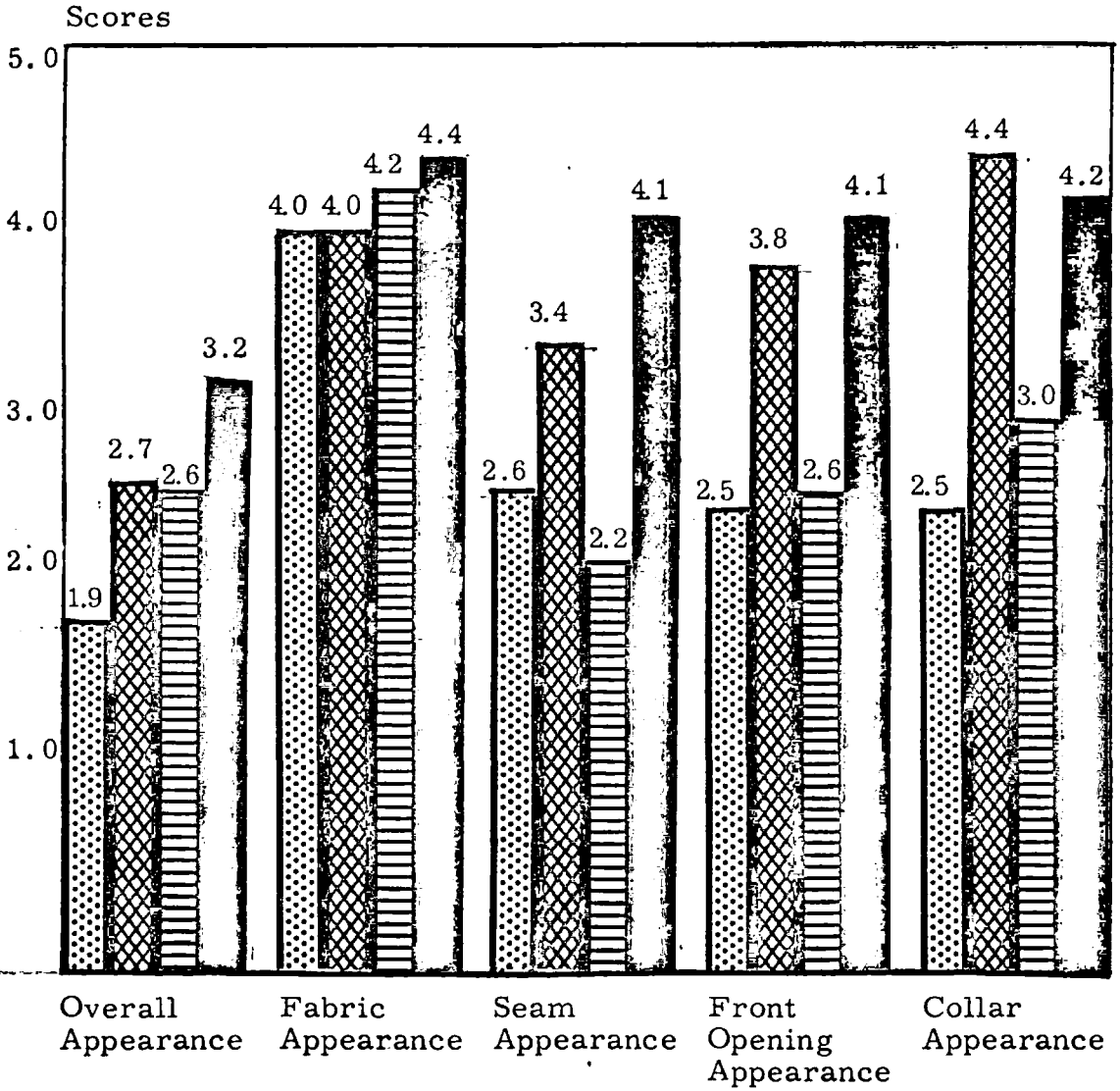






Figure 1. Scores of the Shirts in Five Areas by the Observers and the Men in the Consumer Survey.

-  100% Cotton, Evaluated by Observers' Laboratory
-  100% Cotton, Evaluated by Men in Survey
-  65% Polyester and 35% Cotton Blend, Evaluated by Observers in Laboratory
-  65% Polyester and 35% Cotton Blend, Evaluated by Men in Survey

Another factor which lowered the score in the opinion of the observers was the apparent shrinkage of the collar which was unequal to the shrinkage of the interfacing causing folds in the interfacing and affecting the collar appearance.

### Comfort

Over the twelve-week period of the survey the all cotton shirts were worn an average of 126 hours per person and the polyester and cotton blend shirts an average of 117 hours per person (see Table 10). The cotton shirts were laundered an average of 11 times during that period and the shirts got approximately 11.8 hours of wear between launderings. The polyester and cotton blend shirts were laundered an average of 10.2 times during the period and they got approximately 11.4 hours of wear between launderings.

Although the comfort of the two types of shirts was evaluated almost identically by the men in the survey (nine men evaluated both shirts as very comfortable, and five evaluated them as comfortable), most of them did wear the all cotton shirts for a longer period of time and in some cases much more often. The total number of hours the shirts were worn during each laundering period (see Table 11) showed a tendency to decrease with each period. The polyester and cotton blend shirts decreased in hours of wear at a much faster rate than

TABLE 10

Total Number of Hours the Two Types of Shirts were Worn and  
Laundered by Each of the Men in the Survey

MEN	100% Cotton Shirts				65% Polyester, 35% Cotton Shirts			
	A	B	C	D	A	B	C	D
1.	111.5	20	8	13.9	119.5	21	10	12.0
2.	42	5	5	8.4	62	9	7	8.9
3.	127.5	17	12	10.5	59	12	8	7.4
4.	90	15	12	7.5	62	12	8	7.8
5.	166	19	10	16.6	134	20	10	13.4
6.	201	20	18	11.2	211.75	26	18	11.8
7.	164	15	14	11.7	153	12	13	11.8
8.	111	15	9	12.3	84	11	9	9.3
9.	139.5	20	10	14.0	170.5	25	10	17.1
10.	99	16	9	11.0	83	15	9	9.2
11.	144.5	15	15	9.7	81.5	10	10	8.2
12.	136	10	10	13.6	190	16	12	15.8
13.	114	14	13	8.8	103	15	12	8.6
14.	121	10	9	13.4	124	9	7	18.1
Totals	1767	211	154	162.6	1637.25	213	143	159.4
Average	126.2	15	11	11.6	116.9	15	10.2	11.4
Median	132	15	10	11.4	111.3	13.5	10	10.5
Range	42	5	5	7.5	59	9	7	7.4
	to	to	to	to	to	to	to	to
	201	20	18	16.6	211.75	26	18	18.1

A - Hours Shirts were Worn

B - Times Shirts were Worn

C - Times Shirts were Laundered

D - Hours Shirts were Worn Between Laundering

did the all cotton shirts. These results may indicate a preference on the part of the men for the all cotton shirts. In a few cases there were complaints that the all cotton collar was a bit scratchy when worn with a tie and before it was laundered, but one man remarked that the all cotton shirt had a more airy feeling and that it was a better shirt in his estimation for the Tucson climate. Again personal opinion varied.

TABLE 11

Number of Hours the Two Types of Shirts Were Worn During  
Each Three Week Period of the Consumer Survey

SHIRTS	Three Weeks	Six Weeks	Nine Weeks	Twelve Weeks
100% Cotton	472.0	444.5	447.0	403.3
65% Polyester and 35% Cotton	527.0	404.5	382.0	323.75

It might be noted that the temperature in Tucson (40) during the period of this survey increased continually from a total average of 67.6 degrees in April to 87.6 degrees in July (See Table 12). The average maximum temperature increased from 85.4 degrees in April to 103.3 degrees in July, and the average relative humidity at 11 A.M. from 20 per cent in April to 36 per cent in July. This was also accompanied by an increase of precipitation. This increase in temperature, humidity and precipitation over the period of the survey may help to explain why the number of hours the polyester and cotton shirts were worn decreased. The shirts probably became more uncomfortable as the temperature and moisture increased.

TABLE 12

Temperature, Relative Humidity, and Precipitation Readings  
in Tucson, Arizona, During the Months of April, May  
June and July, 1966

	April	May	June	July
Temperatures				
Total Averages (°F.)	67.6	76.6	83.7	87.6
Average Maximums (°F.)	85.4	94.6	102.2	103.3
Average Minimums (°F.)	49.8	58.2	65.1	71.9
Relative Humidity				
Averages (per cent)				
5 A. M.	45	42	37	62
11 A. M.	20	20	20	36
5 P. M.	15	14	14	31
11 P. M.	33	29	25	52
Precipitation (Inches)	0.86	0.13	0.09	1.78

Laundering

Of the fourteen men completing the survey, two laundered their shirts at a commercial establishment, six at a laundromat, and six at home (see Table 13). Of those doing the shirts at a laundromat or at home eight of the men tumble-dried their shirts, three line-dried them and one drip-dried his. There seemed to be no noticeable difference in the evaluations of the men caused by the method of laundering or drying. Seven of the men did light pressing of the shirts before they could be worn, and four dampened and ironed them (see Table 13). One man felt that the shirts were satisfactory without touch-up ironing, although after nine weeks of wear he did remark that the shirts were losing the ability to look fresh after a washing and that he might start having them ironed. This man did launder his shirts at home and did line-dry them.

Several of the men in the survey remarked that, in their opinions, the shirts were not permanent press. One man felt so strongly this way that he stopped wearing his shirts after six weeks. Pressing was definitely needed, especially on the seams and pockets. Several of the observers and men in the survey remarked that the fabric seemed almost satisfactory, but the construction of the garments was so poor that pressing was required.

TABLE 13

## Method of Laundering and Ironing of Shirts by Men in the Consumer Survey

Laundering Method	Commercial Establishment	Laundromat		Home Laundered		
		Light Pressing	Dampened and Ironed	No Iron	Light Pressing	Dampened and Ironed
Ironing Method	Did not know					
Marital Status						
Married Men	1	3	1	--	3	3
Single Men	1	--	--	1	1	--
Domicile						
Own Home	1	1	--	1	2	2
Rent House or Apartment	1	2	1	--	2	1
Occupation						
Student	1	3	1	1	3	2
Other	1	--	--	--	1	1
Age						
22 - 30	2	3	1	1	3	2
46 and 55	--	--	--	--	1	1

## CHAPTER V

### CONCLUSION

Fabric appearance seemed to be the most outstanding characteristic evaluated in this study. It was consistently rated the highest in the laboratory and the consumer survey. Initial observations for defects showed that defects in the shirts were due to the construction of the garments and not the fabric. Overall appearance, seam appearance, front opening appearance, and collar appearance all seemed to be largely a matter of personal opinion although they were generally rated much lower than the fabric due to construction defects.

In the laboratory evaluations, shrinkage did occur in the shirts at less than 1 per cent except in the collar of the 100 per cent cotton shirts, in which the average amount of shrinkage was 1.6 per cent. Therefore, shrinkage may be noticeable in the collar of the 100 per cent cotton shirt if worn buttoned. The color of the shirts did not change visibly and results of the reflection densitometer tests of the shirts showed no significant change in color based on the analysis of variance.

The consumer survey showed that comfort of the shirts appeared to be largely a matter of personal opinion. No matter how the shirts were laundered or dried, there seemed to be no noticeable differences in the evaluations. The shrinkage

of the collars was not noticeable, but this might be due to the more casual wear of clothing in the southwest where collars are usually unbuttoned.

From results obtained through the consumer survey and laboratory testing conducted on these permanent press shirts, one outstanding conclusion reached is that the fabric is very close to being permanently pressed in the opinion of the observers and the men in the survey. The construction of the garments, however, is so poor that the shirts pucker and wrinkle along all stitching lines making their appearance unacceptable without at least touch-up pressing.

APPENDIX A

Consumer Survey of Satisfaction With and Comparison  
of Two Permanent Press Shirts

I. Participants in the survey

- a. Would be asked to wear two specific shirts as often as possible during a period of three months.
- b. Would be asked to keep a record of how often the shirts were worn and how they were laundered for the period of time of the survey.
- c. Would be asked to comment on comfort, fit, appearance, wear, etc., of the shirts.

II. Would you be willing to participate in this survey if you were asked to buy two specific shirts at retail prices?

YES

NO

Would you be willing to participate if you were asked to buy the shirts at wholesale or discount prices?

YES

NO

Would you be willing to participate if the shirts were provided?

YES

NO

Name \_\_\_\_\_

Address \_\_\_\_\_

Phone \_\_\_\_\_

Will you be in Tucson through April, 1966?

YES

NO

Thank you for your help.



APPENDIX C

NAME \_\_\_\_\_ DATE \_\_\_\_\_

PART II: Laundering of the shirts  
 (For each question please  
 check (\*) choice for Shirt A  
 and for Shirt B.)

Shirt A 100% Cotton	Shirt B Cotton and Kodel
---------------------------	--------------------------------

- |  | 1. | 2. | 3. | 1. | 2. | 3. |
|--|----|----|----|----|----|----|
| 1. How did you launder the Shirts?<br>a. Commercial Establishment<br>b. Laundromat<br>c. Home Laundering<br>d. Done by another person in their home<br>e. Other _____                                    | a. | b. | c. | a. | b. | c. |
| 2. Was bleach used on the shirts?<br>a. Yes<br>b. No<br>c. Don't know  | a. | b. | c. | a. | b. | c. |
| 3. What equipment was used (if you know)<br>Washing<br>a. Automatic Washer (top loading)<br>b. Automatic Washer (front loading)<br>c. Conventional Washer (wringer type)<br>d. By Hand<br>e. Other _____ | a. | b. | c. | a. | b. | c. |
| 4. Drying<br>a. Tumble Dried<br>b. Line Dried<br>c. Drip Dried   | a. | b. | c. | a. | b. | c. |
| 5. Did you touch up the shirts with an<br>iron or have it done?<br>a. No<br>b. Yes, pressed lightly<br>c. Yes, dampened and ironed<br>d. Other _____   | a. | b. | c. | a. | b. | c. |
| 6. Were any repairs necessary in the last<br>three weeks? If so, what were they?<br>a. Yes _____<br>b. No  | a. | b. |    | a. | b. |    |

Other comments on laundering and care of the shirts:

\* 1. Always                      2. Frequently                      3. Occasionally

APPENDIX D

NAME \_\_\_\_\_ DATE \_\_\_\_\_

PART III: Satisfaction with Shirts

COMFORT

Shirt A  
100%  
Cotton

Shirt B  
Cotton  
and Kodel

1. Are the shirts comfortable to wear (fit, etc.)?
  - a. Very comfortable
  - b. Comfortable
  - c. Uncomfortable
  
2. Does the collar fit well?
  - a. Yes
  - b. No, too big
  - c. No, too small
  - d. Fits well, but uncomfortable
  - e. Other \_\_\_\_\_

a.		
b.		
c.		

a.		
b.		
c.		
d.		
e.		

Comments on Comfort:

APPEARANCE

3. If you were to rate your shirts on the overall garment appearance after they have been freshly washed and dried, which category would you put them in? (not pressed or ironed)
  - a. Garment is outstanding in appearance
  - b. Garment is good in appearance
  - c. Garment is acceptable in appearance
  - d. Garment does not meet standards of the wearer
  - e. Garment is not acceptable

a.		
b.		
c.		
d.		
e.		

4. If you were to rate your shirts on the fabric appearance, which category would you put them in?
  - a. Fabric is outstanding in Appearance
  - b. Fabric is good in appearance
  - c. Fabric is acceptable in appearance

a.		
b.		
c.		

## APPENDIX D (Continued)

	Shirt A.	Shirt B
d. Fabric does not meet standards of the wearer		
e. Fabric is not acceptable		
5. If you were to rate the front openings of your shirts (buttoned up), which category would you choose?		
a. Front opening is outstanding in appearance		
b. Front opening is good in appearance		
c. Front opening is acceptable in appearance		
d. Front opening does not meet standards of the wearer		
e. Front opening is not acceptable		
6. If you were to rate your shirts on the collar appearance, which category would you choose?		
a. Collar is outstanding in appearance		
b. Collar is good in appearance		
c. Collar is acceptable in appearance		
d. Collar does not meet standards of the wearer		
e. Collar is not acceptable		
7. If you were to rate your shirts on the appearance of the seams, which category would you choose?		
a. Very smooth appearance		
b. Very light puckering		
c. Definite puckering		
d. Very noticeable puckers		
e. Excessive puckering		
8. Rate the colorfastness or graying in the case of white shirts.		
a. Colors and white stayed bright		
b. Colors and white changed a little (may have)		
c. Questionable color change		
d. Very noticeable color change		
e. Excessive change in color		

Other comments on appearance of shirts:



APPENDIX F

Observer Score Sheet

Observer \_\_\_\_\_

Shirt No. \_\_\_\_\_

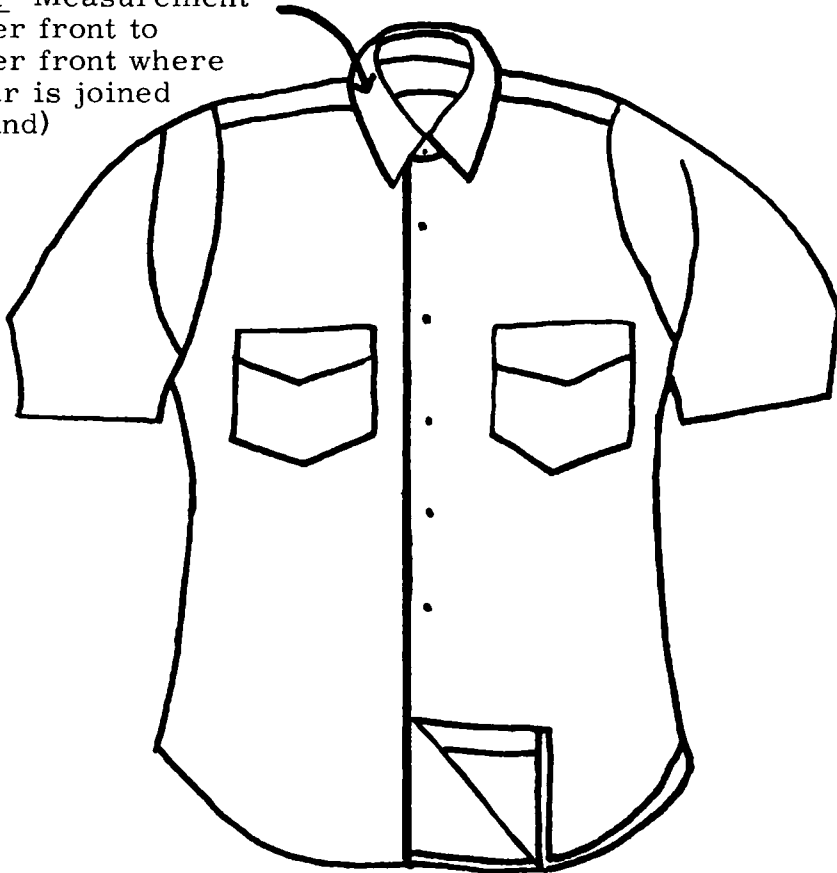
Please check one for each test.

1. Overall garment appearance  
 a. Garment is outstanding in appearance  
 b. Garment is good in appearance  
 c. Garment is acceptable in appearance  
 d. Garment does not meet standards of the observer  
 e. Garment is not acceptable in appearance
  
2. Fabric appearance  
 a. Negligible or no change as shown in Standard 5  
 b. A change in appearance equivalent to Standard 4  
 c. A change in appearance equivalent to Standard 3  
 d. A change in appearance equivalent to Standard 2  
 e. A change in appearance equivalent to standard 1
  
3. Seam appearance  
 a. Seam appearance equivalent to Standard 5  
 b. Seam appearance equivalent to Standard 4  
 c. Seam appearance equivalent to Standard 3  
 d. Seam appearance equivalent to Standard 2  
 e. Seam appearance equivalent to Standard 1
  
4. Appearance of front opening  
 a. Front opening is outstanding in appearance  
 b. Front opening is good in appearance  
 c. Front opening is acceptable in appearance  
 d. Front opening does not meet standards of the observer  
 e. Front opening is not acceptable
  
5. Collar appearance  
 a. Collar is outstanding in appearance  
 b. Collar is good in appearance  
 c. Collar is acceptable in appearance  
 d. Collar does not meet standards of the observer  
 e. Collar is not acceptable in appearance

APPENDIX G

Diagram of Shirt Front Showing Measurement for Shrinkage

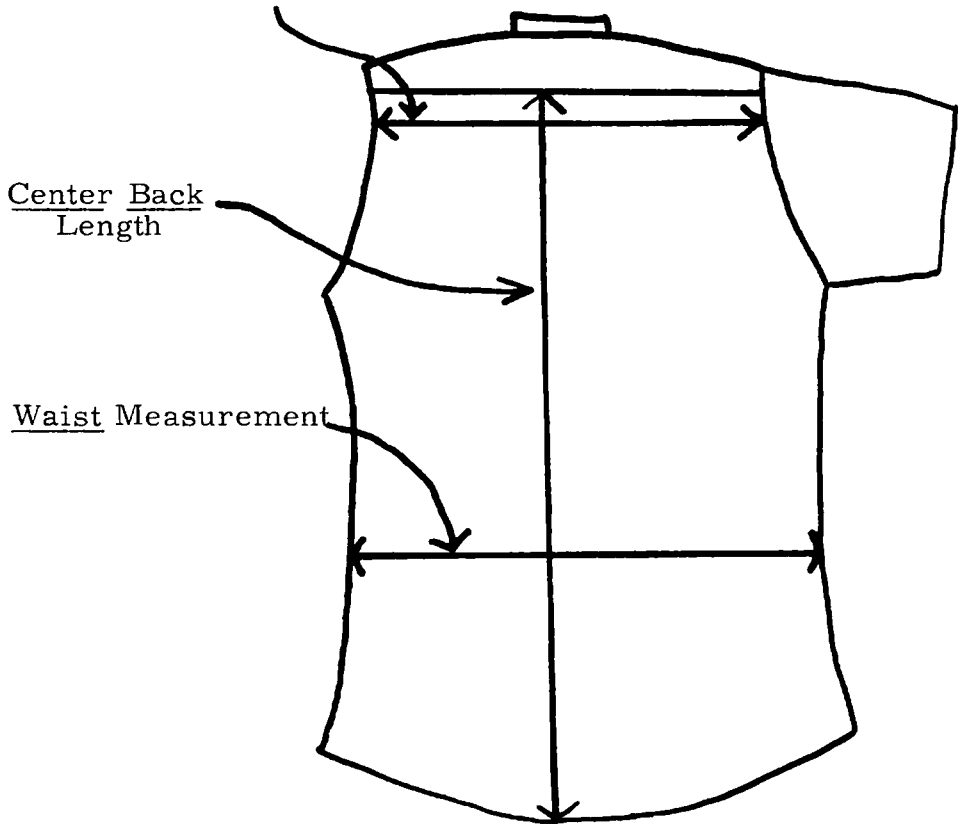
Collar Measurement  
(center front to  
center front where  
collar is joined  
to band)



APPENDIX H

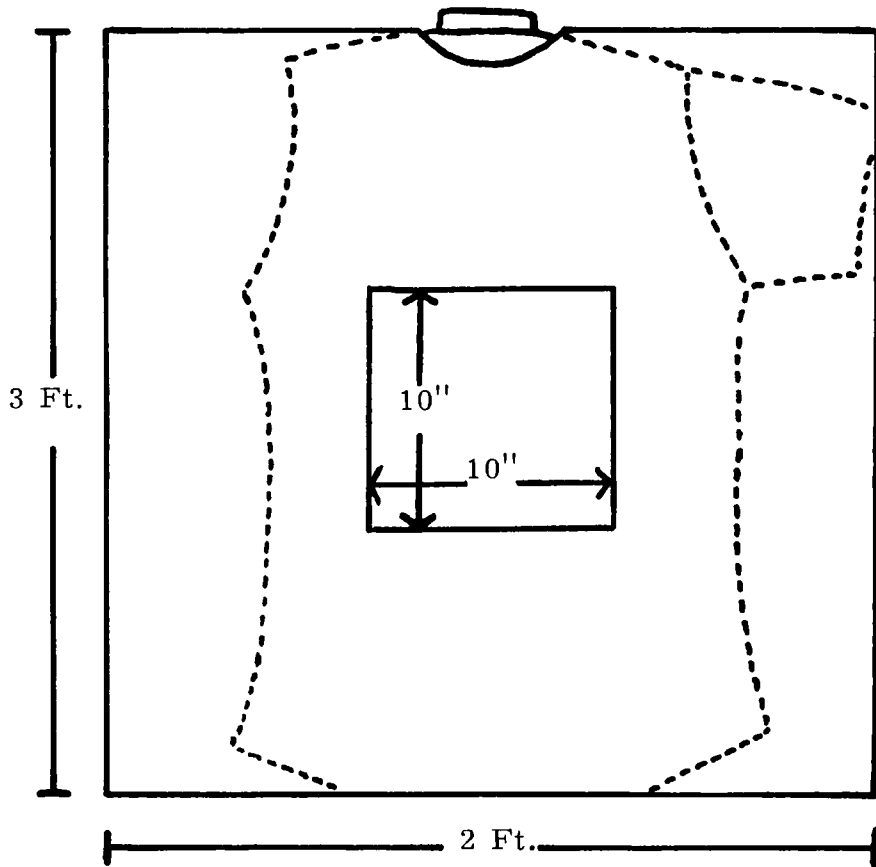
Diagram of Shirt Back Showing Measurement for Shrinkage

Back Shoulder Measurement  
(2 inches below the yoke)



APPENDIX J

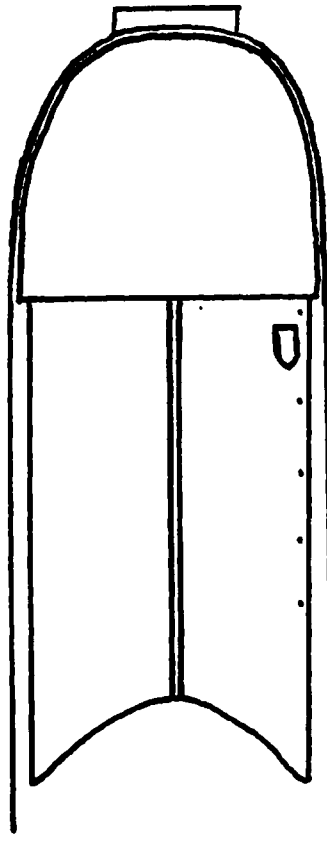
Evaluation of Fabric Appearance



SHIRT BACK

APPENDIX K

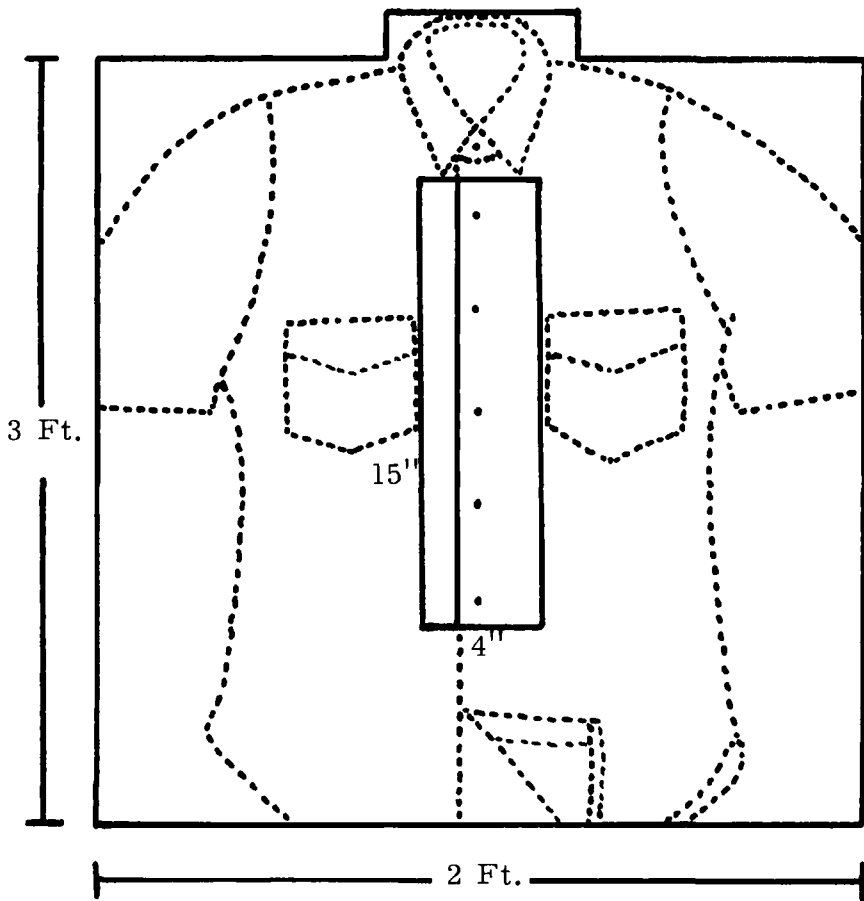
Evaluation of Seam Appearance



SIDE VIEW

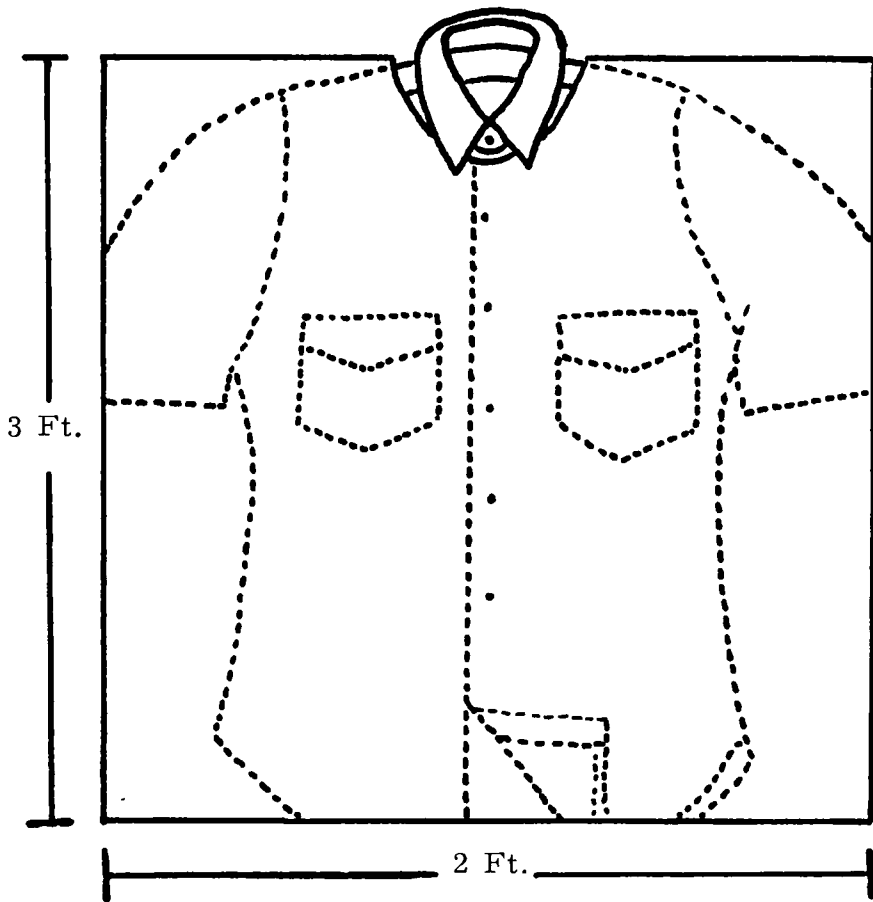
APPENDIX L

Evaluation of Front Opening



APPENDIX M

Evaluation of Collar Appearance



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