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THE EFFECT OF SELECTED CLEANSING TREATMENTS  
ON GARMENTS WITH DURABLE PRESS FINISHES

by

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A Thesis Submitted to  
the Faculty of the Graduate School at  
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Approved by

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APPROVAL SHEET

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To Miss Linda Dick and Miss Marilyn Watts for helping with  
the testing.

To Mr. Howard Miller of Lane's Laundry for his technical advice  
on laundry procedure.

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Three tests were used to indicate the effect of the cleaning treatments and the method of applying the finish on the maintenance characteristics of the garments. One test was a visual evaluation of each garment. The remaining tests indicated changes in the physical characteristics of the garments by measuring their tear resistance and wrinkle recovery before treatment and after ten cleaning treatments.

Major emphasis in the visual evaluation was placed on the appearance of the fabric and seams and the sharpness of the creases. These areas were evaluated by rating them according to the standard which they most closely resembled. These standards ranged from Class 5, which represented little or no change in the original smooth appearance, to

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The objectives of this study were to examine the effect of home laundering, commercial laundering and dry cleaning on the maintenance characteristics of durable press finished garments and to determine whether these cleansing treatments or methods of applying the finish differed in their effect on these characteristics.

Thirty garments were purchased representing six durable press finishes. Three of these finishes were applied by the pre-cure method and three, by the deferred cure method. Each of the finishes was represented by five garments alike in appearance, fabric and construction features. This number provided a control for the physical testing, a control for the visual evaluation, and garments to be home laundered, commercial laundered and dry cleaned.

Three tests were used to indicate the effect of the cleansing treatments and the method of applying the finish on the maintenance characteristics of the garments. One test was a visual evaluation of each garment. The remaining tests indicated changes in the physical characteristics of the garments by measuring their tear resistance and wrinkle recovery before treatment and after ten cleansing treatments.

Major emphasis in the visual evaluation was placed on the appearance of the fabric and seams and the sharpness of the creases. These areas were evaluated by rating them according to the standard which they most closely resembled. These standards ranged from Class 5, which represented little or no change in the original smooth appearance, to

Class 1, which represented a marked change in appearance. Ratings of Class 4 or above were considered acceptable to the consumer as needing no pressing, whereas any rating below this point was considered unacceptable as a durable press finished garment, since it would need pressing. Ratings of all garments were made before treatment and at the first, fifth and tenth intervals.

From the data collected in this study, the following conclusions are drawn: (1) none of the garments maintained acceptable ratings for appearance throughout the treatment period; however, various garment areas did maintain acceptable ratings, (2) the cleansing treatments changed the appearance of all of the garments as early as the first interval, (3) the greatest change occurred in the appearance of the garments which were laundered by the commercial procedure, whereas the least change occurred in the appearance of the garments which were dry cleaned, (4) the appearance of the pre-cured garments was changed more by the cleansing treatments than was the appearance of the deferred cure garments, (5) the appearance of the durable press finished garments was affected differently by each cleansing treatment, regardless of the method of applying the finish, and (6) variable results were obtained in the tear resistance and wrinkle recovery of all the treated garments; therefore, no conclusions could be drawn in regard to these characteristics.

20

..... 14

..... 15

..... 16

..... 20

..... 22

..... 24

..... 24

## TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION . . . . .	1
Statement of the Problem . . . . .	1
Importance of the Study . . . . .	2
Limitations of the Study . . . . .	5
Definitions . . . . .	6
Durable press . . . . .	6
Curing . . . . .	6
Pre-cure . . . . .	6
Deferred cure . . . . .	7
Treatment . . . . .	7
Organization of the Study . . . . .	7
II. REVIEW OF LITERATURE . . . . .	8
Basic Principle of Durable Press . . . . .	8
Variations in Application of Finish . . . . .	9
Cotton Fabrics and Durable Press . . . . .	11
Blended Fabrics and Durable Press . . . . .	14
Problems with Durable Press . . . . .	15
Quality Control and Durable Press . . . . .	18
Durable Press and Industry . . . . .	20
The Future of Durable Press . . . . .	22
III. METHODS OF PROCEDURE . . . . .	24
Purchase of Garments Used for Experimentation . . .	24

## TABLE OF CONTENTS

CHAPTER	PAGE
Cleansing Treatments Used . . . . .	25
Home laundering treatment . . . . .	25
Commercial laundering treatment . . . . .	26
Dry cleaning treatment . . . . .	27
Evaluation of Garment Appearance . . . . .	27
Measurement of Selected Physical Characteristics	
of the Garments . . . . .	30
Tear strength . . . . .	30
Wrinkle recovery . . . . .	32
IV. PRESENTATION OF DATA . . . . .	33
Evaluation of the Garments . . . . .	34
Garment areas selected for evaluation . . . . .	34
Ratings given to garments . . . . .	35
Garment 1 . . . . .	36
Garment 2 . . . . .	37
Garment 3 . . . . .	37
Garment 4 . . . . .	40
Garment 5 . . . . .	40
Garment 6 . . . . .	40
Comparison of cleansing treatments . . . . .	44
Home laundering . . . . .	44
Commercial laundering . . . . .	47
Dry cleaning . . . . .	47



## TABLE OF CONTENTS

CHAPTER	PAGE
Change between first and tenth intervals . .	47
Pre-cured vs. deferred cure . . . . .	48
Analysis of the Physical Characteristics of	
Durable Press Garments . . . . .	50
Tear resistance . . . . .	50
Home laundering . . . . .	50
Commercial laundering . . . . .	52
Dry cleaning . . . . .	52
Wrinkle recovery . . . . .	53
Home laundering . . . . .	53
Commercial laundering . . . . .	55
Dry cleaning . . . . .	55
Statistical Analysis of Data . . . . .	56
V. SUMMARY AND CONCLUSIONS . . . . .	59
The Problem . . . . .	59
The Procedure . . . . .	60
Findings Pertaining to the Visual Evaluation	
of the Garments . . . . .	61
Findings Pertaining to the Physical Characteristics	
of the Garments . . . . .	62

TABLE OF CONTENTS

CHAPTER	PAGE
Tear resistance . . . . .	62
Wrinkle recovery . . . . .	64
Conclusions . . . . .	65
Recommendations . . . . .	66
BIBLIOGRAPHY . . . . .	68
APPENDIX A Example of Rating Sheet . . . . .	72
APPENDIX B Percentage Change in Evaluation of Garments at the First, Fifth and Tenth Intervals . . . . .	73
APPENDIX C Example of the Statistical Analysis to Determine the Significance of Differences among Garments, Treatments and Methods of Curing . . . . .	74
I. Increase in Rating after Ten Treatments . . . . .	75
II. Mean Tear Resistance of Samples from Finished Garments; Percentage Change between Untreated and Treated Samples . . . . .	77
III. Mean Wrinkle Recovery of Samples from Finished Garments; Percentage Change between Untreated and Treated Samples . . . . .	78
IV. Statistical Interpretation of the Evaluation of the Samples . . . . .	79
V. Statistical Analysis of the Physical Characteristics of the Samples at the Tenth Interval . . . . .	80

LIST OF TABLES

TABLE	PAGE
I. Garments Used in the Study . . . . .	24
II. Evaluation of Garment 1 . . . . .	38
III. Evaluation of Garment 2 . . . . .	39
IV. Evaluation of Garment 3 . . . . .	41
V. Evaluation of Garment 4 . . . . .	42
VI. Evaluation of Garment 5 . . . . .	43
VII. Evaluation of Garment 6 . . . . .	45
VIII. Garment Evaluation According to Treatment . . . . .	46
IX. Percentage Change in Evaluation after Ten Cleansing Treatments . . . . .	48
X. Decrease in Ratings after Ten Treatments . . . . .	49
XI. Mean Tear Resistance of Durable Press Finished Garments; Percentage Change between Untreated and Treated Garments . . . . .	51
XII. Mean Wrinkle Recovery of Durable Press Finished Garments; Percentage Change between Untreated and Treated Garments . . . . .	54
XIII. Statistical Interpretation of the Evaluation of the Garments . . . . .	58
XIV. Statistical Analysis of the Physical Characteristics of the Garments at the Tenth Interval . . . . .	58

## LIST OF FIGURES

FIGURE	INTRODUCTION	PAGE
1.	Lighting and Viewing Arrangement for Evaluation of the Garments . . . . .	29
2.	Sampling Plan . . . . .	31

fabrics and finishes for consumers interested in devoting less time to the care of their clothes. Although these developments have resulted in considerable improvement of the maintenance characteristics of garments, none have been able to meet the demand of having eliminated pressing after laundering. Encouraged, however, by the reception which consumers gave to the idea that clothes could be laundered and worn without pressing, textile and garment manufacturers have continued to search for a way to impart such characteristics to garments.

The most recent answer is a finish called permanent or durable press. Although garments to which this finish has been applied are becoming increasingly popular, past failures to meet claims have left the consumer skeptical about the appearance of these finished garments following laundering or dry cleaning.

The purpose of this study is to determine whether garments treated with durable press finishes do retain their original, smooth appearance and sharp creases following cleansing treatments. The specific objectives of this study are:

## CHAPTER I

### INTRODUCTION

#### I. STATEMENT OF THE PROBLEM

Textile manufacturers have devoted much research toward producing fabrics and finishes for consumers interested in devoting less time to the care of their clothes. Although these developments have resulted in considerable improvement of the maintenance characteristics of garments, none have been able to meet promotion claims of having eliminated pressing after laundering. Encouraged, however, by the reception which consumers gave to the idea that clothes could be laundered and worn without pressing, textile and garment manufacturers have continued to search for a way to impart such characteristics to garments.

The most recent answer is a finish called permanent or durable press. Although garments to which this finish has been applied are becoming increasingly popular, past failures to meet claims have left the consumer skeptical about the appearance of these finished garments following laundering or dry cleaning.

The purpose of this study is to determine whether garments treated with durable press finishes do retain their original, smooth appearance and sharp creases following cleansing treatments. The specific objectives of this study are:

1. To study the maintenance characteristics of resin-treated garments using those methods available to the consumer.
  - a. To determine the effects of commercial laundering on garments treated with durable press finishes.
  - b. To determine the effects of home laundering on garments treated with durable press finishes.
  - c. To determine the effects of dry cleaning on garments treated with durable press finishes.
2. To compare the effect of these three cleansing treatments on garments treated with various durable press finishes.
3. To determine whether the maintenance characteristics of the garments are affected by the curing process.

## II. IMPORTANCE OF THE STUDY

Although the durable press finish is one of the most recent innovations of textile manufacturers on the market today, the basic concept behind it is well-known.

One of the earliest attempts to set the shape of a fabric was the desire to impart permanent creases and/or a smooth appearance by heat setting synthetic fibers or blends of synthetics and cellulose. A second development in this area was the permanent creasing of wool by chemically modifying the fiber through a process which used thio-glycolic acid and another which used ethanolamine sulphite.<sup>1</sup>

At the same time, a "wash-and-wear" finish was introduced to impart a permanently smooth appearance to fabrics by improving their

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<sup>1</sup>Dr. Dorothy Siegert Lyle, Permanent Press, National Institute of Drycleaning, FF-125 (Silver Spring, Maryland: Bulletin Service, February, 1965).

wrinkle resistance and recovery and their dimensional stability. In this case the fabric was treated with cross-linking chemicals or resins, then dried and cured before the garment was made. When the garments were washed, the seams tended to pucker because of the differential shrinkage of fabric and thread, and creases lost their sharpness because the fabric had been stabilized in a flat state. This was particularly true of resin-treated cottons.

The key to the solution seemed to be in postponing the stabilization of the fabric until after the garment was made. During the mid 50's a women's sportswear house, Koret of California, began experimenting with the manufacturing of garments from 100 per cent cotton fabrics to which cross-linking reactants had been applied and dried, but not cured. After a skirt was made and creased or pleated, it was cured in an oven, thus setting the pleats which remained after many washings and tumble dryings.<sup>2</sup>

"In 1961, Koret was granted U. S. Patent 2,974,432 for its deferred cure process. Later, the Koratron Company was formed to market the process."<sup>3</sup>

Although Koratron provided the initial breakthrough in durable press finishes, the movement did not gain momentum until Levi-Straus

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<sup>2</sup>Fred Fortess, "Durable Press Garments--A Challenge to Industry," Modern Textiles Magazine, XLVII (January, 1966), p. 35.

<sup>3</sup>"Permanent Press--The Ultimate in Wash-Wear," American Fabrics, LXVI (Winter, 1964-65), p. 66.

obtained a license from Koratron to use its process in manufacturing heavyweight 100 per cent cotton twill pants. These pants appeared on the market in February, 1964, starting an avalanche in the production of durable press.<sup>4</sup>

Other firms which had been working independently on the same idea were quick to grasp the opportunity before them, and soon the major textile companies were producing durable press finished garments by their own special techniques. Because so many companies had joined the durable press movement, those in the textile industry realized that some type of standards and quality control were necessary to meet to promotion claims that ironing had been eliminated after laundering and to prevent a repetition of the past failures of "wash-and-wear" finishes.

Success of durable press finishes also meant eliminating the problems which arose. One of the major problems was the discovery that the high concentration of resin necessary to impart durable press characteristics to 100 per cent cotton fabrics caused up to 50 per cent reductions in strength and abrasion resistance. Steps to counteract such losses included the blending of synthetic fibers with the cellulosic fiber and the development of variations in the curing technique.<sup>5</sup>

As the durable press movement has gained strength, companies interested in this finish have invested more heavily in the special

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<sup>4</sup>Ibid.

<sup>5</sup>Sydney M. Cone, Jr., "A Long Look at Durable Press as the Newest Extension of Wash-and-Wear," Modern Textiles Magazine, XLVI (August, 1965), p. 39.



equipment necessary to produce a finished garment. They have also begun looking at areas outside the men's and boys' pants industry in which the durable press finish could be applied. The use of durable press finishes has experienced a phenomenal growth since the initial steps were taken by Koratron and Levi-Straus two years ago; however, the key to the success of this movement lies in the extent to which garments with a durable press finish meet the claim of requiring no ironing without presenting any objectionable side effects.

### III. LIMITATIONS OF THE STUDY

Limitations were necessary in selecting garments for use in this study because of the variety of durable press finishes on the market. The following limitations indicate the scope within which this study was conducted:

1. The garments selected for treatment were representative of those available to the consumer in Greensboro, N.C.
2. The garments used represented six durable press finishes.
3. Three of the durable press finishes were applied by the pre-cure method.
4. Three finishes were applied by the deferred cure method.
5. Each finish was represented by five garments alike in appearance, fabric and construction features.

The following tests were selected to give an indication of what the consumer might expect in performance of durable press finished garments:

1. Each finished garment was tested for tear resistance by the use of the Elmendorf Tearing Tester.
2. Each finished garment was tested for wrinkle resistance by the use of the Monsanto Wrinkle Tester.
3. Each finished garment was judged for general appearance before and after a selected number of cleansing treatments.

#### IV. DEFINITIONS

The development of finishes has introduced a new vocabulary to manufacturer and consumer alike. To understand this alteration of fabric properties by the application of chemicals, one must be familiar with the terminology used to describe it. The following are the definitions of terms used throughout this study:

Durable press. Durable press will be used to indicate finishes applied to fabrics which impart to garments "no-iron" characteristics by retaining their original shape throughout their life.

Curing. The application of heat to cross-link the chemicals in the finish applied to the fabric so as to set the shape of the fabric permanently.

Pre-cure. A method of applying durable press finishes in which the fabric is treated with cross-linking chemicals and cured in the flat state before the garment is made. Pressing the garment then sets the fabric in its permanent shape.

Deferred cure. Another method of applying a durable press finish in which the fabric is treated with cross-linking chemicals but is not cured until after the garment has been made.

Treatment. This term indicates the method of cleansing the finished garments. The methods used were home laundering, commercial laundering and dry cleaning.

#### V. ORGANIZATION OF THE STUDY

The remainder of this study is presented in four sections. Chapter II deals with the published material related to the background, manufacturing processes and present status of the development of durable press finishes. Chapter III outlines the methods of procedure for (1) selecting the finishes and garments; (2) applying the cleansing treatments and (3) testing and evaluating the treated garments. Chapter IV presents the results of the data obtained during this study. Chapter V includes the summary, conclusions and recommendations for further study.

## CHAPTER II

### REVIEW OF LITERATURE

#### I. BASIC PRINCIPLE OF DURABLE PRESS

The basic principle of the durable press finish is the cross-linking reaction. Suchecki states:

. . . It occurs when a monomeric resin-forming compound reacts with cellulose at a high temperature in the presence of a catalyst. While chemical bonds are forming between hydroxyl groups of the cellulose molecules, a side polymerizing reaction is also going on. . . .<sup>1</sup>

This cross-linking reaction "locks in" the shape of the fabric so that it will return to that shape after it has been laundered.

Durable press finishes are characterized by the two basic methods of curing the cross-linking resin. The pre-cure method is actually an elaboration of the "wash-and-wear" process. The fabric is impregnated with a cross-linking resin and cured while still in the flat state. It is then made into garments that are pressed on hot head presses which provide a higher temperature than that achieved by conventional presses. Since the cellulosic fibers have already been cured, this method affects the synthetic, thermoplastic fibers by heating them just enough to mold them to the desired shape.

The deferred or post-cure method varies from the pre-cure method in that the fabric is impregnated with the cross-linking resin but not

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<sup>1</sup>Stanley M. Suchecki, "Durable Press," Textile Industries, CXXIX (January, 1965), pp. 122-23.

cured until after the garment has been completed and pressed into the desired shape. Then it is

. . . cured in a baking oven which subjects it to temperatures of 300 to 340 degrees Fahrenheit for anywhere from 4 to 18 minutes, depending on the fabric and the finish. This baking fixes or sets the garment permanently into the shape it was given by sewing and pressing before it entered the oven.<sup>2</sup>

This method deals with the cellulosic content of a fabric since the synthetic fibers are not affected by the resin finish. They are, however, molded by the heat from the pressing and the oven.<sup>3</sup>

## II. VARIATIONS IN APPLICATION OF FINISH

The growth of the durable press movement has led to several variations in the application of this finish. One variation described by Suchecki is the fiber modification process which uses a reactive sulfone as the cross-linking agent.

. . . In the first phase of its application, the sulfone-treated cloth is reacted with caustic soda and potassium bicarbonate in the wet state and after rinsing and drying enters into the "topping" stage. Here an alkaline catalyst and other ingredients are applied, and the fabric dried without curing. Then, the fabric is cut, sewn, pressed, and cured. . . .<sup>4</sup>

Another variation is the high energy or pressure curing process which utilizes the very high temperatures and pressures given off by

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<sup>2</sup>A Definitive Guide to Permanent Press, A Booklet Prepared by the Editors of American Fabrics Magazine in conjunction with the Staff of Celanese Fibers Marketing Company (New York, 1965), p. IV.

<sup>3</sup>Ibid.

<sup>4</sup>Suchecki, op. cit., pp. 128-29.

special pressing equipment. After the garment has been finished on a conventional press to establish the desired shape, it is then pressed on this special equipment at a temperature of 450 degrees Fahrenheit for 15 to 25 seconds, depending on the fiber content. This breaks and reforms the cross-links previously formed on the pre-cured fabric.<sup>5</sup>

Durable press characteristics can also be achieved through the resin-latex or garment treatment process. In this case a conventional resin and a high concentration of a thermoplastic polymer are applied to an unfinished garment. After the excess moisture has been extracted, the garment is shaped by steam pressing and then cured.<sup>6</sup>

The re-cure process is used on garments made from "wash-and-wear" fabrics. After being pressed to the desired shape, the garment is sprayed or sponged with an additional catalyst on those areas where permanent shape is desired. A three-minute press follows which breaks the former cross-links and resets them in the new desired shape.<sup>7</sup>

Two of the newer methods of obtaining durable press characteristics is through fiber blend and fabric construction. The latter is achieved by taking advantage of the heat-setting properties of polyester yarns which are used exclusively in the filling direction. Fiber blends

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<sup>5</sup>Robert L. Stultz, "Review of Durable Press Procedures," American Dyestuff Reporter, LIV (September 13, 1965), p. 85.

<sup>6</sup>Herman B. Goldstein and J. Michael May, "Permanent Press: Finishing and Performance Evaluation," American Dyestuff Reporter, LIV (September 13, 1965), pp. 78-79.

<sup>7</sup>Ibid., p. 78.

deal with the use of two thermoplastic fibers which can be shaped by a hard pressing.<sup>8</sup>

### III. COTTON FABRICS AND DURABLE PRESS

One of the first garments with a durable press finish to appear on the market was the 100 per cent cotton heavyweight twill pants made by the Levi-Straus Company. Although these pants displayed satisfactory durable press characteristics after many launderings, their wear life appeared to have been reduced considerably. An investigation of this problem revealed that the answer lay in the amount of resin used to achieve the durable press characteristics. Whereas a 4 to 6 per cent resin pickup was used in the conventional "wash-and-wear" finish, an increase to a 12 to 14 per cent pickup was necessary for a durable press finish. This higher level of resin caused the cotton fiber to weaken considerably and become very brittle, thereby reducing its strength and abrasion resistance.<sup>9</sup>

The answer to this dilemma was the introduction of synthetic fibers to the durable press movement. Manufacturers found that if they blended a synthetic fiber with cotton in a fabric, the chemical and curing treatments caused only a 10 per cent reduction in fabric

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<sup>8</sup>Stultz, op. cit., p. 85.

<sup>9</sup>Fred Fortess, "Durable Press Garments--A Challenge to Industry," Modern Textiles Magazine, XLVII (January, 1966), p. 35.

strength, whereas an identical 100 per cent cotton fabric suffered losses up to 50 per cent.<sup>10</sup>

Not willing to admit defeat, the cotton industry has experimented extensively to develop a durable press finished garment of 100 per cent cotton which would give satisfactory performance. Some of the results of this experimentation have been significant.

One method is the preferential cross-linking of cotton fibers on the face or back of the fabric, in the center or combinations of these areas. This method was devised to control the cross-linking of the cellulose molecules which causes the reduction in abrasion resistance of the cotton fiber. This control can be achieved by coating one side of the fabric with a solution containing the cross-linking agent and drying it before the solution penetrates to the other side.

A second method is through catalyst inactivation. In this case the fabric is impregnated with a cross-linking resin through the conventional padding method and then treated on either or both sides with the inactivator.<sup>11</sup>

The abrasion resistance of cotton has also been improved by pre-treating the fabric with a graft polymer before the cross-linking resin is applied. The effectiveness of this procedure is attributed to the increased resiliency and extensibility which the grafts confer

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<sup>10</sup>Robert L. Stultz, "The Contribution of Polyester Fiber," Modern Textiles Magazine, XLV (December, 1964), p. 56.

<sup>11</sup>Wilson A. Reeves, Albert S. Cooper, Jr., William G. Sloan and Robert J. Harper, Jr., "All-Cotton Fabrics for Durable Press," Textile Industries, CXXIX (October, 1965), p. 86.



upon the cotton. These characteristics are the results of reduced bonding of hydrogen between cellulose chains and the substitution of ". . . a rather longer and more flexible thermoplastic polymer chain. . . ."12

Another detrimental effect, in addition to the degradation of cotton from the heavier resin applications, is that of the very high temperatures which are used to cure the finished fabrics. One technique that has been proposed to overcome this is to semi-cure the fabric in the flat state and then complete the curing process after the garment has been sewn and pressed to the desired shape. This not only shortens the curing period but also permits less severe curing conditions.<sup>13</sup>

Another technique devised to improve the wear life of cotton is known as the vapor-phase process. Garments of unfinished fabrics are pressed and placed in a closed oven or vapor reactor chamber where they

. . . are exposed to vapors of cellulose cross-linking agents and catalysts which are generated outside the chamber and are introduced by an air or nitrogen stream. After exposure, the chamber is flushed to eliminate unreacted chemicals from the garments.<sup>14</sup>

Some of the advantages which this process offers are as follows:

1. Low-cost chemicals can be used which are not adaptable to pad-dry-cure systems.

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<sup>12</sup>"Two Forums on Permanent Press," Textile Industries, CXXIX (November, 1965), p. 170.

<sup>13</sup>"Permanent Press: New Directions," American Dyestuff Reporter, LIV (October 25, 1965), p. 70.

<sup>14</sup>"Vapor Process for All-Cotton Permanent Press," American Dyestuff Reporter, LV (January 3, 1966), p. 50.

2. Milder curing conditions reduce fiber damage thereby increasing strength and wear resistance.
3. Storage stability is no problem since the fabric is not finished until the garments are placed in the vapor phase oven.<sup>15</sup>

#### IV. BLENDED FABRICS AND DURABLE PRESS

When textile manufacturers were confronted with reduced wear life in durable press finished garments of 100 per cent cotton, they turned to blended fabrics of cellulose and polyester or nylon fibers because of their strength, resilience and abrasion resistance.

Claude M. Lee of E. I. de Pont De Nemours & Co., Inc., reported that polyester blends of 65 per cent or more with cotton or rayon have indicated an excellent balance of properties which would result in the greatest consumer satisfaction. ". . . Laboratory data show that the abrasion resistance, tear and grab strength after chemical treatment and curing are significantly higher than in the lower percentage blends. . . ." <sup>16</sup>

Nylon in its staple form is used with cotton for blended yarns and in its filament form for stretch fabrics. In this case Mr. Lee stated that extensive testing programs have revealed that a minimum of 15 per cent staple nylon is necessary in both warp and filling directions in fabrics of  $8\frac{1}{2}$  ounces or more. A higher percentage is necessary

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<sup>15</sup>Ibid.

<sup>16</sup>Claude M. Lee, "Synthetic Fibers in Durable Press," American Dyestuff Reporter, LV (January 17, 1966), p. 40.

to strengthen lighter weight fabrics. Stretch fabrics made of a nylon blend show improved abrasion resistance which has been attributed to "give" in the fabric while being worn and washed.<sup>17</sup>

#### V. PROBLEMS WITH DURABLE PRESS

The introduction of a new finish usually presents certain problems which must be overcome before manufacturers and consumers consider the performance of the finish completely satisfactory. Durable press finishes are no exception. Some of the initial problems which arose with the advent of these finishes have been overcome; others have not.

One which was solved was the yellowing of white fabrics in curing and laundering. This has been eliminated by using only certain resins.<sup>18</sup>

The formaldehyde odor from the thermosetting resins has also been brought under control. This has been done by washing pre-cured fabrics after curing and by developing new chemical compounds such as imidazolidone and the sulfones for the deferred cure garments.<sup>19</sup>

Shrinkage, particularly in the warp direction, has been handled by oversizing the garments. This applies only to deferred cure garments which cannot be stabilized through the sanforizing process as

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<sup>17</sup>Ibid.

<sup>18</sup>"Permanent Press--A Progress Report," American Fabrics, LXVII (Spring, 1965), p. 60.

<sup>19</sup>A Definitive Guide to Permanent Press, op. cit., p. VIII.

pre-cured fabrics can. Cutters must be very careful to cut adjoining sections in the same direction to control differential shrinkage, and the manufacturer must select findings (thread, zippers, bindings, pocket linings and such) with similar shrinkage characteristics.<sup>20</sup>

One of the earliest problems confronting manufacturers was the spontaneous curing which occurred during the deferred cure process. The sensitized fabric would spontaneously cure itself during storage before being made into garments. Improvement of the chemicals used has brought this under control, and fabrics can now be stored for a year or more without any ill effects.<sup>21</sup>

Durable press finished garments are difficult, if not impossible, to alter. This is particularly true of those with a high cellulosic content. To shorten pants with cuffs, for example, the cuff must be removed, the leg shortened and then the cuff is resewn into place. This is one problem which has yet to be solved.<sup>22</sup>

Another which still plagues manufacturers is damage due to chlorine retention. This occurs through an interaction of chlorine with the resin which may weaken the fiber or cause discoloration.<sup>23</sup>

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<sup>20</sup>Sydney M. Cone, Jr., "A Long Look at Durable Press as the Newest Extension of Wash-and-Wear," Modern Textiles Magazine, XLVI (August, 1965), pp. 42-43.

<sup>21</sup>A Definitive Guide to Permanent Press, loc. cit.

<sup>22</sup>Cone, op. cit., p. 43.

<sup>23</sup>Warren L. Beaumont, "The Delayed Cure Process," American Dyestuff Reporter, LIV (September 13, 1965), p. 87.

Some problems which have arisen in the durable press movement are unique to the clothing manufacturer. The main difficulty has been with seam appearance. Although this existed with "wash-and-wear," it became much more significant with durable press finishes. Because these finishes appreciably improved the fabric appearance of laundered garments, manufacturers had to produce seams that looked equally as good. This meant a change in the type of seams used, such as the substitution of the safety stitch for the double-felled seam in men's shirts. Lee has indicated other changes as follows:

. . . They have had to use sewing thread of Dacron polyester, fewer stitches per inch, changed setting and sewing conditions. In many cases, they have had to equip their machines with new fine-toothed feed dogs, small-hole throat plates and even to go to new type sewing machines that control the fabric better during sewing. . . .<sup>24</sup>

Manufacturers found that the solution of one problem often presented others with which they had to contend. An excellent example of this was the introduction of synthetic fibers to the durable press movement. These fibers were successful in counteracting the strength loss of cellulose fibers; however, they added a few problems of their own.

One was the discovery that dyes originally used on polyester fibers could not withstand the extreme temperatures for the longer periods of time necessary to cure the finish. Their reaction to these curing conditions was to sublime or migrate to the resin which coated

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<sup>24</sup>Lee, op. cit., p. 41.

the polyester fiber. The dye was absorbed by the resin and then washed off the first time the garment was laundered, causing a change in shade.

Manufacturers found that heat alone could also change the color of a fabric or sensitize the dye to light, causing it to fade later when it is exposed to light. Progress has been made toward eliminating these problems by developing more durable dyes and carefully screening existing dyes to find those which will withstand the extreme curing conditions.<sup>25</sup>

Another problem arose in cross dyeing cotton-polyester blends. At the creases and other heavy wear areas, the cotton and its color were worn away more rapidly than the polyester. The predominance of the polyester color presented an objectionable appearance which has been counteracted by using three colors in the fabric--a dark, medium and light shade--thereby reducing the contrast in color due to the preferential wearing.<sup>26</sup>

## VI. QUALITY CONTROL AND DURABLE PRESS

The key to the failure of the "wash-and-wear" finishes was the fact that they did not live up to the claims of manufacturers that ironing had been eliminated. With the advent of the durable press finishes these manufacturers were well aware that the success of these finishes depended on maintaining high performance standards and rigid quality control.

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<sup>25</sup> Ibid., p. 40.

<sup>26</sup> Ibid.

Koratron was the company which again made the initial move. When it began to license other manufacturers to use its patented process, the company ". . . established a quality control program at both the mill and garment maker level to assure good performance of the garments produced and sold to the consumer."<sup>27</sup>

Fabric suppliers and finishers were required to submit a one-yard cut from every 20,000 yards run. Among the tests to which this sample is subjected are crease retention, wrinkle recovery, fabric smoothness, tensile strength, tear strength, abrasion resistance and dimensional stability.

Garment manufacturers must submit two garments for each style and fabric they are planning to use in actual production. Each is evaluated after having been washed and dried five times. The areas checked include general appearance, seams, zipper and creases.<sup>28</sup>

Koratron, however, is not the only company which is concerned with quality control. Lee expressed this concern as follows:

A matter of great concern to the industry today is how to maintain high standards of performance for the durable press clothing being produced and sold. Historically, in any new development in this industry, there are many people who will take short cuts. There is no doubt about there being a need for acceptable industry standards for durable press and the industry is responding and trying to establish performance standards.<sup>29</sup>

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<sup>27</sup>Dr. Dorothy Siegert Lyle, Permanent Press, National Institute of Drycleaning, FF-125 (Silver Spring, Maryland: Bulletin Service, February, 1965).

<sup>28</sup>Louis Hochstaeder, "The Story of One Permanent Press Finish," Modern Textiles Magazine, XLV (December, 1964), p. 60.

<sup>29</sup>Lee, op. cit., p. 41.

Manufacturers had guides, however, with which to work. E. James Stavrakas of J. C. Penney Merchandise Testing Center stated this very aptly:

The value of the time and efforts of hundreds of men and women expended on the various research committees of the American Association of Textile Chemists and Colorists has never been more apparent to me than it has in the past year. It is a serious question in my mind whether we would have dared enter as quickly and in depth into this new world of products without having the test methods and photographic standards developed over the years by the wash-wear committee of AATCC. Despite their limitations, they provide an invaluable basis for communicating our needs and requirements in an intelligible manner.<sup>30</sup>

The superior performance of durable press finished garments has necessitated the revision of the "wash-and-wear" standards which this organization formulated for seam puckering, fabric smoothness and crease retention. Not only is the AATCC "wash-and-wear" committee working on these revisions, but its members are enlisting the aid of all those working with durable press finished garments by encouraging them to share the methods they have devised for their own use and to report the problems they have encountered with existing standards.<sup>31</sup>

## VII. DURABLE PRESS AND INDUSTRY

A unique distinction of the durable press movement is the fact that it has united all aspects of the textile and clothing industries into a co-ordinated effort to produce a truly successful "no-iron" garment. This has affected the roles of manufacturers and meant

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<sup>30</sup>E. James Stavrakas, "Permanent Press: A Merchant's View," Textile Industries, CXXIX (June, 1965), p. 121.

<sup>31</sup>Ibid.



expanded responsibilities for many of them. For example, Lee reported that the garment manufacturer

. . . has had to become a quality control expert in all steps of the process including curing of the garment. He has needed to learn new techniques and procedures and establish new standards. He has had to retrain and reorient operators in new ways of doing things. . . . He has had to be meticulous in cutting and sewing and finally in finishing [pressing] the garment.<sup>32</sup>

The garment manufacturer has also been faced with a considerable increase in investment due to the new equipment that must be purchased to produce a durable press finished garment. This increase is particularly true in the pressing area. John Milholland of Troutman Industries reported:

. . . Pressing cost is much greater than ever before. In fact, in my particular company's case the capital investment for additional pressing equipment and floor space for it was three times the investment for an oven and its floor space.<sup>33</sup>

Lee indicated why clothing manufacturers have made this increased investment:

You may ask, why does the clothing manufacturer go to the trouble? The answer is competition and profit. The durable press garments have been enthusiastically received, generally at a higher retail price, and everyone is trying to get into the act.<sup>34</sup>

Manufacturers of pressing equipment have also been affected because of the critical role pressing plays in this movement. They have

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<sup>32</sup>Lee, op. cit., p. 40.

<sup>33</sup>John Milholland, "The Cutter Aspect of Permanent Crease and Permanent Press Processing," American Dyestuff Reporter, LIV (September 13, 1965), pp. 97-98.

<sup>34</sup>Lee, op. cit. p. 41.

had to develop new machines which will produce temperatures up to 450 degrees Fahrenheit, a 175-degree increase over the older, conventional pressers. They have had to increase the pressure which these machines produce and provide very accurate timing devices and controls to give the manufacturer the precision he needs to produce quality garments.<sup>35</sup>

Suppliers of garment components or findings found themselves in a crucial position which meant they had to develop components with characteristics similar to the garments in which they were used. Lee reported that ". . . thread has had to be super-stabilized, zippers have to be made to have shrinkage characteristics similar to fabric used. . . ." <sup>36</sup>

#### VIII. THE FUTURE OF DURABLE PRESS

The first durable press finishes introduced to the consumer were applied to men's work pants. Since that initial introduction, durable press finishes have been used on casual slacks for men and boys, as well as dress and sport shirts for both. Austin L. Cable, president of Cable Raincoat Company, is reported by Stavrakas as indicating a possible trend of the durable press movement in the future:

Citing as an example a man's suit, retailing at \$100, which requires laborious insertions of inner-facings, taping, shoulder pads, etc., which cost the consumer about \$15, he [Cable] said that a comparable tailoring effect could be built into the garment through the permanent press techniques which imparts a memory, and thus permanent contours as well.<sup>37</sup>

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<sup>35</sup>Cone, op. cit., p. 42.

<sup>36</sup>Lee, op. cit., p. 41.

<sup>37</sup>Stavrakas, op. cit., p. 169.

Not only can consumers expect to see durable press finishes applied to men's summer suits and sports jackets, but also work uniforms, men's pajamas and underwear, sportswear, infants' and children's wear, blouses, dresses, skirts and rainwear. Indications are that the application of durable press finishes will not stop there, for there is speculation that sheets, tablecloths, napkins, slipcovers, draperies and handkerchiefs will soon be included.<sup>38</sup>

Since this article was published, durable press finishes have been applied to a number of the above items which are now available to the consumer. This fact provides proof of the phenomenal rate of growth which the durable press movement has experienced. As the problems confronting industries today are solved, the consumer can expect to find these finishes being applied to an even wider range of wearing apparel and household items.

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<sup>38</sup>"Permanent Press--A Progress Report," American Fabrics, LXVII (Spring, 1965), pp. 62-63.

## CHAPTER III

### METHODS OF PROCEDURE

#### I. PURCHASE OF GARMENTS USED FOR EXPERIMENTATION

A survey was conducted in local department stores to determine the durable press finishes available to the consumer. On the basis of this information, a total of thirty garments was purchased representing six durable press finishes. In order to compare the effectiveness of the six finishes as influenced by the curing process, three of the finishes selected were applied by the pre-cure method and three by the deferred cure method. The garments selected are listed in Table I.

TABLE I  
GARMENTS USED IN THE STUDY

Garment	Fiber Content	Weave
GROUP I		
<u>Pre-Cured Finish</u>		
1. Men's dress shirt	65% Polyester/35% Cotton	Plain
2. Boys' trousers	50% Acrylic/50% Polyester	Twill
3. Ladies' slacks	40% Polyester/30% Cotton/20% Rayon/ 10% Nylon	Plain
GROUP II		
<u>Deferred Cure Finish</u>		
4. Boys' sport shirt	50% Polyester/50% Cotton	Plain
5. Men's trousers	85% Cotton/15% Nylon	Twill
6. Men's trousers	50% Polyester/50% Cotton	Twill

Each finish was represented by five garments identical in appearance, fabric and construction features. This number provided for the following treatments and were coded accordingly:

- A. Control I: garment receiving no cleansing treatment to be used in the sampling for physical testing as a comparison for the cleansed garments.
- B. Control II: garment receiving no cleansing treatment to be retained for visual comparison of the appearance of various garment parts at the conclusion of the study.
- C. Home Laundering: garment to be laundered by home laundering procedure.
- D. Commercial Laundering: garment to be laundered by commercial laundering procedure.
- E. Dry Cleaning: garment to be laundered by dry cleaning procedure.

## II. CLEANSING TREATMENTS USED

The cleansing treatments used were selected as those the consumer would most likely use. Because of the "no-iron" characteristics of these garments, pressing after the cleansing treatment would have defeated the purpose of the study.

Home laundering treatment. The method used in the home laundering treatment was based on the procedure recommended by the AATCC Technical Manual with slight adaptations for the type of equipment available.<sup>1</sup> A four-pound load was used which consisted of one garment for each

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<sup>1</sup>1965 Technical Manual of the American Association of Textile Chemists and Colorists (New York: Howes Publishing Company, September, 1965), XLI, p. B-100.

durable press finish. The washing process was carried out in a Philco CE734 Duomatic on the setting specified for "wash-and-wear" garments. A full water level was used at a temperature of  $105 \pm 5$  degrees Fahrenheit. To obtain a good running suds, one-fourth cup of a low sudsing detergent was added. The garments were dried in a twenty-pound capacity commercial type tumble dryer.

The major steps in the procedure were as follows:

1. A ten-minute wash period at  $105 \pm 5$  degrees Fahrenheit.
2. A sixteen-minute rinse period which included a cold spray rinse and two cold deep rinses.
3. An extraction period.
4. A thirty-minute tumble drying period.

Commercial laundering treatment. The method used in the commercial laundering treatment was based on the procedure used by a local laundry and specifications in the AATCC Technical Manual. Slight adaptations were made for the type of equipment available. A ten-pound load was designated as the minimum load. Garments representing each of the six durable press finishes weighed four pounds; therefore, six pounds of additional fabric were added according to the specifications in the AATCC Technical Manual.<sup>2</sup> A controlled temperature of  $140 \pm 5$  degrees Fahrenheit and a water level of seven inches were used in a small-sized, cylindrical washer with a reversing wash wheel. An agitator speed of 43 rpm was used. Thirty grams of a laundry detergent were added to produce a good running suds. No sour was used, and neutralization of the detergent was not necessary. Bleaching was not

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<sup>2</sup>Ibid.

required for the garments treated. After the moisture had been extracted, the garments were placed in a twenty-pound capacity commercial type tumble dryer.

The procedure used was as follows:

1. A seven-minute wash period at  $140 \pm 5$  degrees Fahrenheit and a water level of seven inches.
2. Three five-minute rinses at the same temperature and water level.
3. A three-minute extraction period.
4. A thirty-minute tumble drying period.

Dry cleaning treatment. An RCA Whirlpool coin-operated dry cleaning machine was used at a local laundramat. The four-pound load consisted of one garment for each of the six durable press finishes. Perchloroethylene was the solvent used in the cleansing process.

The major steps in the procedure were:

1. A ten-minute wash period.
2. A five-minute extraction period.
3. A fifteen-minute tumble drying and deodorizing period.

### III. EVALUATION OF GARMENT APPEARANCE

Garment appearance was rated by evaluating the fabric, seams and creases of the garment according to procedures set forth in the AATCC Technical Manual. Comparisons of these various parts of the garment were made with their respective photographic standards, and a numerical rating was given corresponding to the rating of the standard which it most closely resembled. An evaluation scale from Class 5 to Class 1 was used to indicate any change in appearance. A rating of Class 5 represented little or no change in the original smooth appearance,

whereas a Class 1 rating represented a marked change in appearance corresponding to Standard 1. Each garment was placed on a hanger and conditioned at  $70 \pm 2$  degrees Fahrenheit and  $65 \pm 2$  per cent relative humidity for at least three hours before the evaluation was made. This evaluation was made after the zero, first, fifth and tenth cleansing treatments by the researcher.

All observations were made from a distance of four feet from the viewing board. Each garment was hung on the board vertically and centered at a height of five feet. The photographic standards were placed on each side of the garment to facilitate the comparative rating. An overhead fluorescent light was the only light source used in the evaluation of the fabric and seams. For the evaluation of the creases, an additional light source was placed six feet to the side of the viewing board at the five-foot level. A diagram of the lighting and viewing arrangement for the evaluation of the garments is pictured in Figure 1 on page 29.

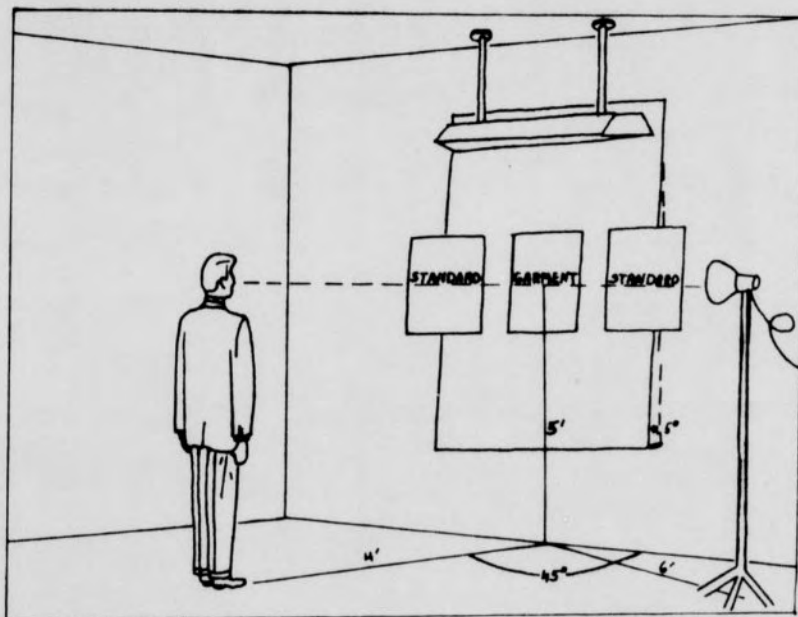
A rating of the surface appearance of the fabric was made after comparing it with five photographic standards representing varying degrees of smoothness. This evaluation was made according to the specifications of AATCC Tentative Test Method 88A-1964T.<sup>3</sup>

The seams of the garments were rated after comparing them with five photographic standards for either single needle or double needle

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<sup>3</sup>1965 Technical Manual of the American Association of Textile Chemists and Colorists, op. cit., pp. B-99-103.





\*Adaptation of Figure 1, 1965 Technical Manual of the American Association of Textile Chemists and Colorists (New York: Howes Publishing Company, September, 1965), XLI, pp. B-105.

FIGURE 1

LIGHTING AND VIEWING ARRANGEMENT FOR  
EVALUATION OF THE GARMENTS

seams. The procedure used conformed to the specifications set forth in AATCC Tentative Test Method 88B-1964T.<sup>4</sup>

A rating of the sharpness of the creases on the pants' legs was made after comparing them with five photographic standards according to the procedure specified in AATCC Tentative Test Method 88C-1964T.<sup>5</sup>

#### IV. MEASUREMENT OF SELECTED PHYSICAL CHARACTERISTICS OF THE GARMENTS

The performance of the garments before and after the cleansing treatments was indicated by measuring the tear resistance and wrinkle recovery of the fabric. These tests were selected because they seemed to be the most indicative of changes in the strength or wrinkle resistance of the finished garments. The procedures used for both tests were based on approved methods of textile analysis for items of this type. A diagram of the sampling plan for these tests is indicated in Figure 2 on page 31.

Tear strength. The Elmendorf Tear Tester was used to indicate any deterioration in the strength of the fabric according to the procedure specified by ASTM Standard D1424-63.<sup>6</sup> This method measures the average force required to continue a tear started by a cut in the fabric

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<sup>4</sup>Ibid., pp. B-103-4.

<sup>5</sup>Ibid., pp. B-104-5.

<sup>6</sup>1965 Book of ASTM Standards (Philadelphia: American Society for Testing Materials, October, 1965), XXIV, pp. 435-39.

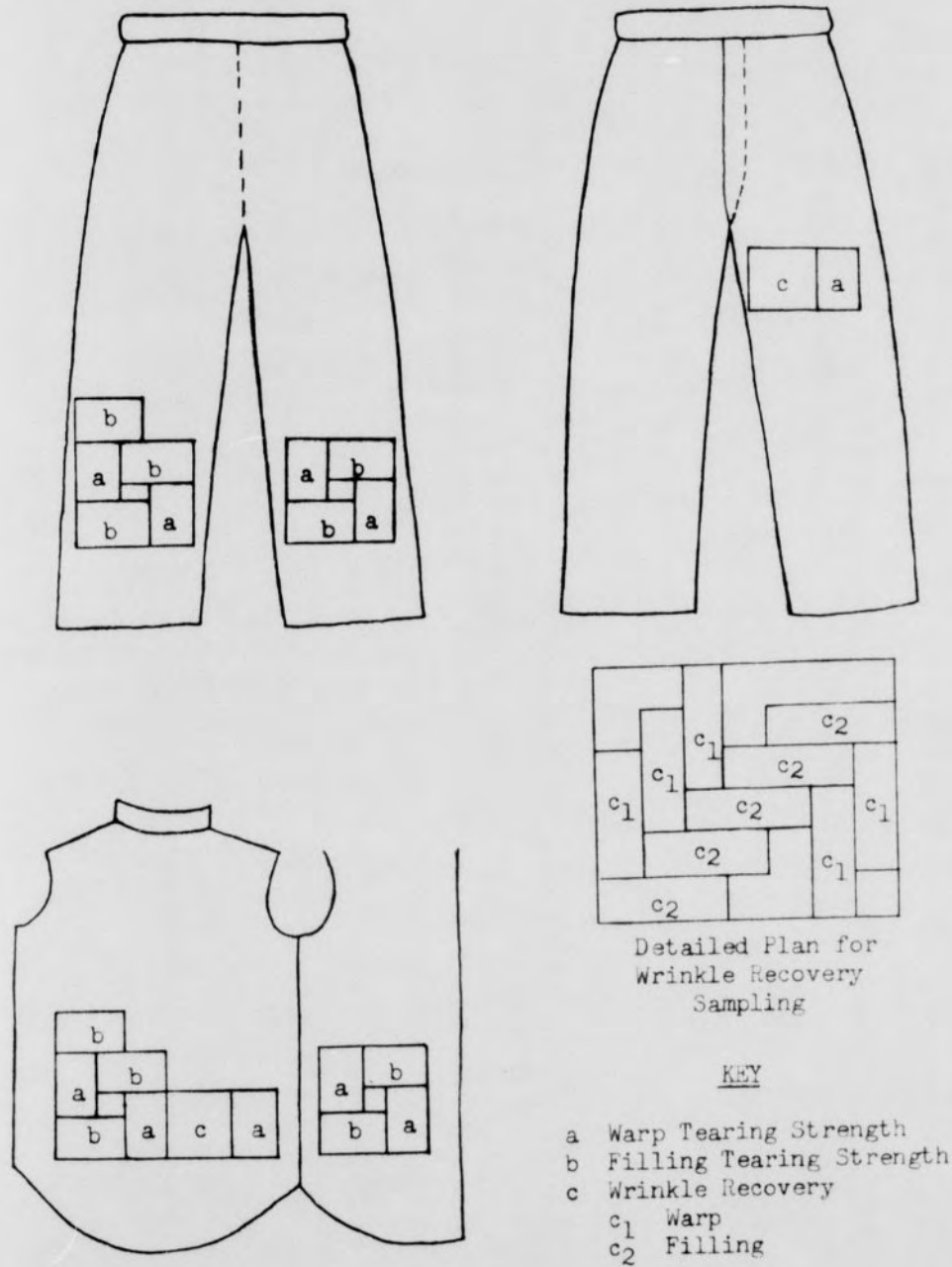


FIGURE 2  
 SAMPLING PLAN

sample. A total of ten specimens was taken from each durable press finished garment. Five of the samples were cut so that the tear direction was perpendicular to the warp yarns and five were cut with the tear direction perpendicular to the filling yarns. These samples were conditioned twenty-four hours prior to testing at  $65 \pm 2$  per cent relative humidity and  $70 \pm 2$  degrees Fahrenheit.

Wrinkle recovery. Determination of the wrinkle recovery of the fabrics was obtained by measuring the recovery angle of specimens after they had been creased and compressed under controlled conditions. This test was performed on the Monsanto Wrinkle Recovery Tester according to the specifications of AATCC Tentative Test Method 66-1959.<sup>7</sup> Five samples were cut with the lengthwise portion of the sample in the warp direction and five samples with the lengthwise portion in the filling direction. These samples were conditioned prior to testing at  $65 \pm 2$  per cent relative humidity and  $70 \pm 2$  degrees Fahrenheit.

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<sup>7</sup>1965 Technical Manual of the American Association of Textile Chemists and Colorists, op. cit., pp. B-151-52.

## CHAPTER IV

### PRESENTATION OF DATA

This chapter presents the data obtained in examining the performance of garments treated with durable press finishes. The data was collected with the following major objectives in mind:

1. To study the maintenance characteristics of durable press finished garments using home laundering, commercial laundering and dry cleaning methods.
2. To compare the effect of these three cleansing treatments on the maintenance characteristics of the garments.
3. To determine whether the maintenance characteristics of the garments are affected by the curing process.

The garments used in this study were selected from local department stores in Greensboro, North Carolina. Thirty garments were purchased representing six durable press finishes. Three of these finishes were applied by the pre-cure method and three applied by the deferred cure method. Each finish was represented by five garments which were alike in appearance, fabric and construction features. This number provided for a control in the testing of physical characteristics, a control in the evaluation of appearance and a garment for the home laundering, commercial laundering and dry cleaning treatments.

Because the two methods of applying the finish were to be compared rather than the garments, the six finishes selected were not represented by identical garments. They consisted of two pairs of men's trousers, one pair of boys' trousers, a men's dress shirt, a boys' long-sleeved sport shirt and a pair of ladies' slacks.

## I. EVALUATION OF THE GARMENTS

### Garment Areas Selected for Evaluation

Evaluation of the appearance of durable press finished garments is of great concern to manufacturers, yet there is a lack of uniformity in their standards and evaluation procedures. Each company tends to set its own standard of acceptability and focuses attention upon those areas of the garment which it feels are most important. Since little information is available to serve as a guide concerning those areas of the garment which are indicative of good performance, all areas considered important to the consumer were examined and evaluated.

In the examination of each durable press finished garment, major emphasis was placed on (1) the appearance of the fabric, (2) the appearance of the seams and (3) the sharpness of the creases. Evaluations of the areas were made by comparing them with their respective photographic standards and rating them according to the standard which they most closely resembled. These standards ranged from Class 5, which represented little or no change in the original smooth appearance, to Class 1, which represented a marked change in appearance. An area with either a Class 4 or 5 rating was selected as that which would be accepted by the consumer as needing no pressing. Any area rated below a Class 4 was considered unacceptable as a durable press finished garment, since it would need pressing.

One rating sheet was devised which listed all the areas to be considered in the evaluation; however, only those areas which were

applicable to each garment were evaluated. (Appendix A is an example of this rating sheet.) The specific areas evaluated on the shirts were the fabric in both the front and back, the side seams, front pocket and sleeve seams. The areas evaluated on the men's and boys' trousers were the fabric of the upper part of the front and back of the garment, the side seams, inseams, seams on the front and back pockets, waistband seam in the front and back, the fly seam and both creases on the front and back of the legs. The areas evaluated on the ladies' slacks were fabric of the upper part of the front and back of the garment, the side seams, inseams, waistband seam in the front and back, the side zipper seam and both creases on the front and back of the legs.

Because so many areas were rated on each garment, the mean of all ratings will be used in discussing the garments at each interval. In comparing the treatments and the methods of applying the finish, percentages will be used based on the mean of all ratings carried to the nearest tenth. This percentage indicated more vividly the variations which occurred.

#### Ratings Given to Garments

Since one aim of this study was to evaluate the "no-iron" characteristics of garments with durable press finishes, no attempt was made to press these garments before the testing began. Any wrinkles on the garments when purchased were not removed and, therefore, influenced the rating of the garments at the "0" or untreated interval and the rating of those garments held as a control for the visual evaluation.

The evaluations were also influenced by the colors of the garments. The color combination in the plaid of the boys' sport shirt, the black of the ladies' slacks and the dark green of the boys' trousers tended to mask the shadows of the wrinkles which were considered in making the evaluations.

At the untreated interval, Garments 2, 4 and 5 had a mean rating of Class 4. The appearance of these garments was considered acceptable to the consumer without pressing. At the tenth interval none of the garments had mean ratings which were considered to have met the claim that garments with durable press finishes do not have to be pressed. This was not true of specific garment areas, however, for several of them did maintain an acceptable rating throughout a cleansing treatment.

Garment 1. At no time did the overall evaluation of Garment 1, the man's dress shirt, meet acceptable standards for durable press finished garments. This garment merited a "high" rating of Class 3 at the untreated interval. With one exception Class 2 ratings were given following each cleansing treatment at each interval. The garment which was laundered by commercial methods was ranked as Class 1 after the tenth interval.

Class 4 ratings were given to several areas of the untreated garment, notably a front pocket seam and fabric appearance. The lowest ratings were given to the two seam areas evaluated. The highest rating for the side seams was a Class 3 given to the untreated garments, and the lowest given to the same area at the tenth interval was a Class 1.



The sleeve seams received ratings of Class 2 and Class 1 at these same intervals of treatment. The above information is given in Table II.

Garment 2. Before the cleansing treatments were applied, the boys' trousers were ranked as Class 4 and considered acceptable to the consumer as not requiring pressing. Only the garment receiving the home laundering treatment maintained this rating at the first interval. The ratings for the trousers which received the other two treatments dropped below this standard to a Class 3 which was maintained throughout the remaining intervals, regardless of the cleansing treatment.

Some of the areas, however, did not drop below a Class 4 or 5 rating even after the tenth interval. This was true of the front and back waistband seams, some of the side seams, inseams, pocket seams and fabric appearance. The areas receiving the lowest ratings were the front and back creases. Before treatment a Class 4 rating was given to the creases on the front and back of the garment to be home laundered; however, after the fifth interval most of the creases on all three of the trousers were rated Class 1. The above information is given in Table III on page 39.

Garment 3. The ladies' slacks received overall ratings which were below the acceptable rating of Class 4 or 5 at each evaluation interval, regardless of the cleansing treatment. With the exception of the Class 2 rating of the slacks laundered ten times by the commercial procedure, all the garments received Class 3 ratings both before and after treatment. The above information is given in Table IV.

TABLE II  
EVALUATION OF GARMENT 1  
(MEN'S DRESS SHIRT)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	3	3	3	2	2	2	1	2	1	1	1	2
Side seam - left	3	2	2	2	1	2	1	3	2	1	2	3
Front pocket	4	3	3	2	2	2	2	2	2	2	1	2
Appearance - front	3	3	4	3	1	2	4	2	3	3	2	3
Appearance - back	4	3	4	3	2	3	3	2	3	3	2	3
Sleeve - right	2	2	1	1	1	1	1	2	1	2	1	1
Sleeve - left	2	2	1	1	2	1	1	2	1	1	1	1
<b>Total</b>	<b>21</b>	<b>18</b>	<b>18</b>	<b>14</b>	<b>11</b>	<b>13</b>	<b>13</b>	<b>15</b>	<b>13</b>	<b>13</b>	<b>10</b>	<b>15</b>
<b>Mean</b>	<b>3.0</b>	<b>2.6</b>	<b>2.6</b>	<b>2.0</b>	<b>1.6</b>	<b>1.9</b>	<b>1.9</b>	<b>2.1</b>	<b>1.9</b>	<b>1.9</b>	<b>1.4</b>	<b>2.1</b>
<b>Garment Rating</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>

TABLE III  
EVALUATION OF GARMENT 2  
(BOYS' TROUSERS)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	4	4	4	4	4	3	3	4	3	3	4	4
Side seam - left	4	4	4	4	4	3	3	4	4	3	4	4
Inseam - right	5	5	5	4	4	5	4	4	4	3	4	4
Inseam - left	5	5	4	4	5	4	4	4	4	4	4	4
Front pocket - right	4	5	5	4	3	4	3	3	4	3	2	4
Front pocket - left	5	5	5	4	4	4	4	4	4	4	3	4
Back pocket - right	5	5	4	3	2	3	2	3	3	2	2	3
Back pocket - left	5	4	4	4	3	4	3	4	4	3	3	4
Fly	4	4	4	4	4	4	3	4	4	2	3	4
Front crease - right	4	3	3	4	2	2	2	2	1	1	1	1
Front crease - left	4	3	2	4	2	2	1	2	1	1	1	1
Back crease - right	4	3	2	3	2	2	1	1	1	1	1	1
Back crease - left	4	4	3	4	2	2	1	1	2	2	2	1
Appearance - front	4	5	4	4	2	3	5	3	4	5	2	5
Appearance - back	4	4	4	4	1	3	4	3	4	5	2	5
Waistband - front	5	5	5	5	4	4	4	4	5	4	4	4
Waistband - back	5	5	5	5	4	4	4	5	5	4	5	5
Total	75	73	67	68	52	56	51	55	57	50	47	58
Mean	4.4	4.3	3.9	4.0	3.1	3.3	3.0	3.2	3.4	2.9	2.8	3.4
Garment Rating	4	4	4	4	3	3	3	3	3	3	3	3

Garment 4. The boys' sport shirt had a Class 4 rating before treatment, but dropped below this standard to a Class 3 rating after the cleansing treatments at each interval except the tenth. In this case the garment which had been home laundered ten times received a Class 2 rating.

This garment received some acceptable ratings in all areas except the sleeves. These received an initial rating of Class 3 at the "0" or untreated interval, dropping to a Class 2 after the tenth interval. The above information is given in Table V on page 42.

Garment 5. Acceptable ratings of Class 4 were given to all the men's trousers at the "0" or untreated interval, to those receiving the home laundering and commercial laundering treatments at the first interval and to the trousers receiving the dry cleaning treatment at the fifth interval. Class 3 ratings were given to all the remaining garments.

Although each area of the garment received a number of Class 4 and 5 ratings, the inseams and fly seams were the only areas which generally maintained an acceptable rating throughout each treatment period. The lowest ratings were received by the front pocket seams at the tenth interval, especially those on the garment given the commercial laundering treatment. The above information is given in Table VI on page 43.

Garment 6. Only once did the overall evaluation of the men's trousers meet the acceptable standards set up for durable press garments.

TABLE IV  
EVALUATION OF GARMENT 3  
(LADIES' SLACKS)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	3	3	3	4	3	3	2	3	3	1	1	1
Side seam - left	4	4	4	3	3	3	3	3	3	3	1	1
Inseam - right	4	4	5	4	3	4	4	4	4	4	4	5
Inseam - left	4	5	5	3	4	4	3	4	3	3	4	4
Zipper	3	4	3	1	1	2	1	1	1	1	1	1
Front crease - right	3	3	3	4	3	3	3	2	2	2	2	2
Front crease - left	2	3	2	3	3	2	2	3	2	2	2	2
Back crease - right	3	2	3	3	3	2	2	2	2	2	2	2
Back crease - left	3	2	2	3	3	3	2	3	2	2	2	2
Appearance - front	4	3	4	4	2	2	4	2	3	4	3	3
Appearance - back	3	3	2	4	2	2	4	2	3	4	3	3
Waistband - front	3	3	3	3	3	3	2	3	3	2	2	3
Waistband - back	5	4	4	4	4	4	3	4	4	3	4	3
<b>Total</b>	<b>44</b>	<b>43</b>	<b>43</b>	<b>43</b>	<b>37</b>	<b>37</b>	<b>35</b>	<b>36</b>	<b>35</b>	<b>33</b>	<b>31</b>	<b>32</b>
<b>Mean</b>	<b>3.4</b>	<b>3.3</b>	<b>3.3</b>	<b>3.3</b>	<b>2.8</b>	<b>2.8</b>	<b>2.7</b>	<b>2.8</b>	<b>2.7</b>	<b>2.5</b>	<b>2.4</b>	<b>2.5</b>
<b>Garment Rating</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>

TABLE V  
EVALUATION OF GARMENT 4  
(BOYS' SPORT SHIRT)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	4	5	5	2	3	3	2	3	2	1	3	3
Side seam - left	4	5	4	2	3	3	3	3	2	1	2	3
Front pocket	4	4	4	2	3	4	3	4	4	2	4	4
Appearance - front	4	4	5	5	3	3	5	4	3	4	4	5
Appearance - back	4	4	4	3	3	3	4	4	4	4	3	4
Sleeve - right	3	3	3	2	3	2	2	2	2	2	2	2
Sleeve - left	3	2	3	2	3	2	2	3	2	2	3	3
Total	26	27	28	18	21	20	21	23	19	16	21	24
Mean	3.7	3.9	4.0	2.6	3.0	2.9	3.0	3.3	2.7	2.3	3.0	3.4
Garment Rating	4	4	4	3	3	3	3	3	3	2	3	3

TABLE VI

EVALUATION OF GARMENT 5  
(MEN'S TROUSERS)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	3	4	4	4	4	3	3	4	4	3	4	4
Side seam - left	3	5	4	3	4	4	3	4	3	1	3	3
Inseam - right	5	5	5	5	5	5	4	4	4	4	4	4
Inseam - left	5	5	5	4	5	5	4	5	5	3	4	5
Front pocket - right	3	4	4	2	3	4	1	1	3	2	1	3
Front pocket - left	4	4	4	2	3	4	2	2	4	2	1	2
Back pocket - right	5	5	4	4	4	3	3	3	3	4	3	3
Back pocket - left	4	4	4	4	3	3	4	3	4	4	3	4
Fly	5	5	4	4	4	4	4	4	4	3	4	4
Front crease - right	4	4	3	3	3	3	3	3	4	3	3	4
Front crease - left	4	3	3	4	3	3	3	3	3	3	2	3
Back crease - right	4	2	3	3	2	3	3	3	4	3	2	3
Back crease - left	4	3	4	3	3	3	3	3	3	3	2	4
Appearance - front	3	3	3	4	4	3	3	4	4	3	3	4
Appearance - back	3	3	3	4	4	3	4	4	3	3	3	3
Waistband - front	3	4	2	3	3	3	3	3	3	2	3	3
Waistband - back	4	3	2	4	4	2	3	3	3	3	3	2
Total	66	66	61	60	61	58	53	56	61	49	48	58
Mean	3.9	3.9	3.6	3.5	3.6	3.4	3.1	3.3	3.6	2.9	2.8	3.4
Garment Rating	4	4	4	4	4	3	3	3	4	3	3	3

In this case a Class 4 rating was given at the "0" or untreated interval to the garment designated to receive the commercial laundering treatment.

Class 4 ratings, however, appeared throughout the treatment period for all areas. These were received more frequently by the in-seams, fly seam and fabric appearance. The pocket seams tended to receive the lowest ratings throughout the treatment period, although those of the garment receiving the dry cleaning treatment were given several acceptable ratings of Class 4. The above information is given in Table VII.

#### Comparison of Cleansing Treatments

Comparison of the treatments was made by using the mean of the garment evaluations expressed to the nearest tenth. This figure illustrated more vividly the differences which occurred. This information is summarized in Table VIII on page 46.

Home laundering. The garments receiving the home laundering treatment reacted in different ways. The ratings of Garments 1, 2, 3 and 5 dropped progressively from the evaluation of the untreated garments to the evaluation of the garments at the tenth interval. The ratings of Garments 4 and 6, on the other hand, dropped after the evaluation at the "0" or untreated interval, rose at the fifth interval to a level lower than the initial rating and dropped again at the tenth interval.



TABLE VII  
EVALUATION OF GARMENT 6  
(MEN'S TROUSERS)

	0			1			5			10		
	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning	Home Laundering	Commercial Laundering	Dry Cleaning
Side seam - right	4	3	3	4	2	3	4	4	3	3	2	3
Side seam - left	4	4	2	4	3	2	3	4	2	3	3	2
Inseam - right	4	4	3	4	4	2	4	4	3	4	3	2
Inseam - left	4	4	2	4	4	3	5	4	3	4	3	3
Front pocket - right	3	3	2	2	1	2	1	1	2	1	1	2
Front pocket - left	2	4	4	2	3	4	1	3	3	1	3	4
Back pocket - right	2	4	1	1	1	1	2	1	1	2	2	1
Back pocket - left	2	2	4	2	3	4	2	3	3	2	3	3
Fly	4	4	1	4	4	3	4	4	4	4	3	4
Front crease - right	3	3	4	4	3	3	4	3	3	4	3	4
Front crease - left	3	3	3	3	3	3	3	3	3	3	3	3
Back crease - right	3	3	4	3	3	3	3	3	3	3	3	3
Back crease - left	4	3	3	3	3	3	4	3	4	3	3	4
Appearance - front	3	4	4	3	2	4	3	3	4	2	3	4
Appearance - back	3	4	4	4	2	4	4	3	4	4	3	3
Waistband - front	3	3	3	1	2	3	2	2	3	3	2	3
Waistband - back	4	4	4	2	2	2	3	3	3	2	3	4
<b>Total</b>	<b>55</b>	<b>59</b>	<b>51</b>	<b>50</b>	<b>45</b>	<b>49</b>	<b>52</b>	<b>51</b>	<b>51</b>	<b>48</b>	<b>46</b>	<b>52</b>
<b>Mean</b>	<b>3.2</b>	<b>3.5</b>	<b>3.0</b>	<b>2.9</b>	<b>2.6</b>	<b>2.9</b>	<b>3.1</b>	<b>3.0</b>	<b>3.0</b>	<b>2.8</b>	<b>2.7</b>	<b>3.1</b>
<b>Garment Rating</b>	<b>3</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

TABLE VIII  
GARMENT EVALUATIONS ACCORDING TO TREATMENT

<u>PRE-CURED</u>												
Garment	<u>Home Laundering</u>				<u>Commercial Laundering</u>				<u>Dry Cleaning</u>			
	<u>0</u>	<u>1</u>	<u>5</u>	<u>10</u>	<u>0</u>	<u>1</u>	<u>5</u>	<u>10</u>	<u>0</u>	<u>1</u>	<u>5</u>	<u>10</u>
1	3.0	2.0	1.9	1.9	2.6	1.6	2.1	1.4	2.6	1.9	1.9	2.1
2	4.4	4.0	3.0	2.9	4.3	3.1	3.2	2.8	3.9	3.3	3.4	3.4
3	3.4	3.3	2.7	2.5	3.3	2.8	2.8	2.4	3.3	2.8	2.7	2.5
<b>Total</b>	<b>10.8</b>	<b>9.3</b>	<b>7.6</b>	<b>7.3</b>	<b>10.2</b>	<b>7.5</b>	<b>8.1</b>	<b>6.6</b>	<b>9.8</b>	<b>8.0</b>	<b>8.0</b>	<b>8.0</b>
<b>Mean</b>	<b>3.6</b>	<b>3.1</b>	<b>2.5</b>	<b>2.4</b>	<b>3.4</b>	<b>2.5</b>	<b>2.7</b>	<b>2.2</b>	<b>3.3</b>	<b>2.7</b>	<b>2.7</b>	<b>2.7</b>
 <u>DEFERRED CURE</u>												
Garment												
4	3.7	2.6	3.0	2.3	3.9	3.0	3.3	3.0	4.0	2.9	2.7	3.4
5	3.9	3.5	3.1	2.9	3.9	3.6	3.3	2.8	3.6	3.4	3.6	3.4
6	3.2	2.9	3.1	2.8	3.5	2.6	3.0	2.7	3.0	2.9	3.0	3.1
<b>Total</b>	<b>10.8</b>	<b>9.0</b>	<b>9.2</b>	<b>8.0</b>	<b>11.3</b>	<b>9.2</b>	<b>9.6</b>	<b>8.5</b>	<b>10.6</b>	<b>9.2</b>	<b>9.3</b>	<b>9.9</b>
<b>Mean</b>	<b>3.6</b>	<b>3.0</b>	<b>3.1</b>	<b>2.7</b>	<b>3.8</b>	<b>3.1</b>	<b>3.2</b>	<b>2.8</b>	<b>3.5</b>	<b>3.1</b>	<b>3.1</b>	<b>3.3</b>

Commercial laundering. Garments receiving the commercial laundering treatment showed the same varied reaction. The ratings of Garments 3 and 5 dropped progressively from the untreated to the tenth interval, whereas Garments 1, 2, 4 and 6 dropped at the first interval, rose at the fifth to a level lower than the initial rating and dropped again at the tenth interval.

Dry cleaning. The reaction of garments receiving the dry cleaning treatment was even more varied. The rating of Garment 3 dropped progressively after the initial evaluation at the zero interval, whereas the rating of Garment 5 dropped at the first interval, rose at the fifth to a level lower than the initial rating and dropped again at the tenth interval. The ratings of Garments 1, 2, 4 and 6, however, dropped after the evaluation at the untreated interval and then rose again to a level lower than the first rating.

Change between first and tenth intervals. The effect of the treatments on the appearance of the garments has been expressed as the percentage change between the evaluation of the untreated garments and the evaluation of the treated garments at the tenth interval. These percentages are given in Table IX. (The percentage change at the first, fifth and tenth intervals are given in Appendix B.)

With the exception of Garment 4, the boys' sport shirt, the greatest change in appearance occurred on the garments which received the commercial laundering treatment. In the case of Garment 4, the home

laundering treatment resulted in the greatest change. The least change occurred on the garments which received the dry cleaning treatment.

TABLE IX  
PERCENTAGE CHANGE IN EVALUATION AFTER  
TEN CLEANSING TREATMENTS

Garment	Home Laundering	Commercial Laundering	Dry Cleaning
1	-37	-46	-19
2	-34	-35	-13
3	-26	-27	-24
4	-38	-23	-15
5	-26	-28	- 6
6	-13	-23	+ 3

#### Pre-Cured Vs. Deferred Cure

The mean ratings of the pre-cured and deferred cure garments have been averaged to facilitate the comparison of these two methods of application. These ratings have been averaged at each interval for each cleansing treatment applied to the garments. The evaluations of Garments 1 to 3 comprised the average for the pre-cured garments, whereas the evaluations of Garments 4 to 6 represented the deferred cure garments. The means of these evaluations are shown in Table VIII on page 46.

The evaluation of the pre-cured garments receiving the home laundering treatment dropped progressively after the untreated interval. The evaluation of the deferred cure garments, on the other hand, dropped at the first interval, rose at the fifth interval to a lower level than the initial rating and dropped again at the tenth interval. In the

commercial laundering treatment the evaluations of both the pre-cured and deferred cure garments dropped at the first interval, rose at the fifth interval to a lower level than the initial rating and dropped again at the tenth interval.

The reactions of the pre-cured garments and deferred cure garments were not the same in the dry cleaning treatment. The evaluation of the pre-cured garments dropped at the first interval and remained constant through the tenth interval. The evaluations of the deferred cure garments dropped at the first interval, remained the same at the fifth and then rose at the tenth interval to a level lower than the initial rating.

The effect of the treatments on the two methods of applying the finish has been expressed as the percentage change between the evaluation of each method at the untreated interval and the evaluation at the tenth interval. These percentages are given in Table X.

TABLE X  
PERCENTAGE DECREASE IN RATINGS AFTER TEN TREATMENTS

Treatment	Pre-Cured	Deferred Cure
Home Laundering	33	25
Commercial Laundering	35	26
Dry Cleaning	18	6

The evaluations of the pre-cured garments were affected more by each cleansing treatment than those of the deferred cure garments. The

evaluations for both the pre-cured and deferred cure garments were affected most by the commercial laundering treatment; however, the difference between this treatment and the home laundering treatment was small. The evaluations of the garments were affected least by the dry cleaning treatment.

## II. ANALYSIS OF THE PHYSICAL CHARACTERISTICS OF DURABLE PRESS GARMENTS

The physical characteristics of durable press finished garments which were considered pertinent to this study were tear resistance and wrinkle recovery. Ten samples were taken from the untreated garment for each test and from the garments which had been home laundered, commercial laundered and dry cleaned ten times. Five of the samples tested the warp yarns and five, the filling yarns. The mean of each set was recorded as the tear resistance and wrinkle recovery.

### Tear Resistance

The tear resistance of the untreated and treated garments are presented in Table XI. This table also indicates the percentage change in tear resistance between the untreated garment and each of the treated ones.

Home laundering. All garments, except Garment 1, showed a variation in the warp tear resistance of the untreated garment and its home laundered counterpart. Garments 2, 3 and 5 showed increased tear resistance when compared with their untreated counterparts, whereas Garments

TABLE XI

MEAN TEAR RESISTANCE OF DURABLE PRESS FINISHED GARMENTS  
(Expressed in Grams)

PRE-CURED Garment	Original		Home Laundrying		Commercial Laundrying		Dry Cleaning	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
1	1920	1360	1920	1260	1725	1580	2340	1580
2	3640	2900	3800	3020	3280	2900	4680	3820
3	1920	--	2680	--	2660	--	2540	--
Mean	2493	2130	2800	2140	2555	2240	3187	2700
<u>DEFERRED CURE</u>								
Garment								
4	2140	1700	2040	1760	2360	1880	2200	2100
5	3000	2480	3360	3160	2920	2620	3160	2940
6	4520	3020	4500	3260	4080	3080	4240	3380
Mean	3220	2400	3300	2727	3120	2527	3200	2807

PERCENTAGE CHANGE BETWEEN UNTREATED AND TREATED GARMENTS

<u>PRE-CURED</u>								
Garment								
1	----	----	0.0	- 7.4	-10.2	+16.2	+21.9	+16.2
2	----	----	+ 4.4	+ 4.1	- 9.9	0.0	+28.6	+31.7
3	----	----	+39.6	--	+38.5	--	+32.3	--
<u>DEFERRED CURE</u>								
Garment								
4	----	----	- 4.7	+ 3.5	+10.3	+10.6	+ 2.8	+23.5
5	----	----	+12.0	+27.4	- 2.7	+ 5.6	+ 5.3	+18.5
6	----	----	- 0.4	+ 7.9	- 9.7	+ 2.0	- 6.2	+11.9

4 and 6 showed a decrease. The percentage change ranged from an increase of 40 per cent for Garment 3 to a decrease of 5 per cent for Garment 4.

Only Garment 3 failed to show a variation in the filling tear resistance of the untreated garment and its home laundered counterpart. In this case the filling yarns were too strong for the equipment used; therefore, no data was available for its tear resistance. Garments 2, 4, 5 and 6 showed an increase in tear resistance, whereas Garment 1 showed a decrease. Garment 5 had the largest percentage increase which was 27 per cent, whereas Garment 1 had the largest percentage decrease, a 7 per cent change.

Commercial laundering. All garments showed a variation in the warp tear resistance of the untreated garment and its commercial laundered counterpart. Garments 3 and 4 were the only ones showing an increase, whereas Garments 1, 2, 5 and 6 all showed a decrease. The percentage change in tear resistance ranged from an increase of 38 per cent for Garment 3 to a decrease of 10 per cent for Garments 1, 2 and 6.

Only Garment 2 did not show a variation in the filling tear resistance of the untreated garment and its commercial laundered counterpart. No data was available for Garment 3. The remaining garments--1, 4, 5 and 6--all showed an increase in tear resistance with a high of 16 per cent for Garment 1 and a low of 2 per cent for Garment 6.

Dry cleaning. All garments showed a variation in the warp tear resistance of the untreated garment and its dry cleaned counterpart. Garment 6 was the only one showing a decrease, whereas Garments 1, 2, 3,



4 and 5 all showed an increase. The percentage change in tear resistance ranged from an increase of 32 per cent for Garment 3 to a 6 per cent decrease for Garment 6.

Garment 3 was the only one in which no variation occurred in filling tear resistance of the untreated garment and its dry cleaned counterpart. In this case no data was available because of the strength of the filling yarns. The remaining garments all showed increased tear resistance with a high of 32 per cent for Garment 2 and a low of 12 per cent for Garment 6.

#### Wrinkle Recovery

The wrinkle recovery of the treated and untreated garments is presented in Table XII. This table also indicates the percentage change in wrinkle recovery between the untreated garment and each of the treated garments.

Home laundering. All garments showed a variation in the warp wrinkle recovery of the untreated garment and its home laundered counterpart. Only Garment 3 showed an increase in wrinkle recovery, whereas Garments 1, 2, 4, 5 and 6 all showed decreases. The percentage change in warp wrinkle recovery ranged from an increase of 17 per cent for Garment 3 to a decrease of 19 per cent for Garment 4.

Only Garment 1 did not show a variation in the filling wrinkle recovery of the untreated garment and its home laundered counterpart. Garments 3 and 6 showed an increase, whereas Garments 2, 4 and 5 showed a decrease. Garment 3 had the highest increase in filling wrinkle

TABLE XII

MEAN WRINKLE RECOVERY OF DURABLE PRESS FINISHED GARMENTS  
(Expressed in Degrees)

PRE-CURED Garment	Original		Home Laundering		Commercial Laundering		Dry Cleaning	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
1	149	147	148	147	143	147	151	155
2	157	159	156	158	162	159	160	160
3	134	126	157	151	135	142	133	146
Mean	147	144	154	152	147	149	148	154

DEFERRED CURE

Garment	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
4	158	156	128	140	155	151	156	157
5	167	151	158	142	150	139	158	143
6	163	154	150	160	150	162	144	165
Mean	163	154	145	147	152	151	153	155

## PERCENTAGE CHANGE BETWEEN UNTREATED AND TREATED GARMENTS

PRE-CURED

Garment	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
1	---	---	- 0.7	0.0	- 4.0	0.0	+ 1.3	+ 5.4
2	---	---	- 0.6	- 0.6	+ 3.2	0.0	+ 1.9	+ 0.6
3	---	---	+17.2	+19.8	+ 0.7	+12.7	- 0.7	+15.9

DEFERRED CURE

Garment	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
4	---	---	-19.0	-10.3	- 1.9	- 3.2	- 1.3	+ 0.6
5	---	---	- 5.4	- 6.0	-10.2	- 7.9	- 5.4	- 5.3
6	---	---	- 8.0	+ 3.9	- 8.0	+ 5.2	-11.7	+ 7.1

recovery, a 20 per cent change, and Garment 4 had the largest decrease, a 10 per cent change.

Commercial laundering. All garments showed a variation in the warp wrinkle recovery of the untreated garment and its commercial laundered counterpart. Garments 2 and 3 showed an increase, but Garments 1, 4, 5 and 6 showed decreases. The percentage change in warp wrinkle recovery ranged from an increase of 3 per cent for Garment 2 to a decrease of 10 per cent for Garment 5.

Garments 1 and 2 are the only ones which did not show a variation in the filling wrinkle recovery of the untreated garment and its commercial laundered counterpart. Garments 3 and 6 showed an increase; however, Garments 4 and 5 showed a decrease. The largest increase was the 13 per cent change of Garment 3, whereas the largest decrease was the 8 per cent change of Garment 5.

Dry cleaning. All garments showed a variation in the warp wrinkle recovery of the untreated garment and its dry cleaned counterpart. Garments 1 and 2 were the only ones which showed an increase, whereas Garments 3, 4, 5 and 6 showed a decrease. The percentage change in warp wrinkle recovery ranged from an increase of 2 per cent for Garment 2 to a decrease of 12 per cent for Garment 6.

All garments showed a variation in the filling wrinkle recovery of the untreated garment and its dry cleaned counterpart. Only Garment 5 showed a decrease, whereas Garments 1, 2, 3, 4 and 6 showed increases. The largest percentage increase in filling wrinkle recovery was the 16

per cent change in Garment 3; the lowest was the 17 per cent change of Garments 2 and 4. The decrease in Garment 5 was 5 per cent.

### III. STATISTICAL ANALYSIS OF DATA

The data collected in the evaluation of the garments and in testing their tear resistance and wrinkle recovery were subjected to an analysis of variance. The visual evaluations of the garments, the tear resistance tests and the wrinkle recovery tests were analyzed in terms of the differences among the garments, the curing methods and the treatments. An example of this analysis is shown in Appendix C.

The  $F$  value obtained from the evaluations of the garments was found to be highly significant at the untreated, first, fifth and tenth intervals. The same was true of the evaluations of the pre-cured garments at all four intervals. In the case of the deferred cure garments, however, the differences which occurred were highly significant at only the untreated or "0" interval. The differences which occurred between garments in the comparison of the method of applying the finish were highly significant at the fifth and tenth intervals. There was no significant difference among the treatments at any of the four intervals. This statistical interpretation of the evaluation of the garments is given in Table XIII.

The differences which occurred in the testing of wrinkle recovery were highly significant among the garments tested and among the pre-cured garments for the filling yarns only. On the other hand, analysis of the

tear resistance data of the warp yarns revealed highly significant differences among the garments tested as well as among the pre-cured and deferred cure garments.

The same analysis of variance used above was not applicable to the data for the tear resistance of the filling yarns due to the fact that the filling yarns of Garment 3 were too strong for the equipment used; therefore, no data was available for the wrinkle recovery of the filling yarns. The statistical analysis of the physical characteristics of the garments is given in Table XIV.

STATISTICAL ANALYSIS OF THE PHYSICAL CHARACTERISTICS  
OF THE GARMENTS OF THE FIBRE GROUP

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Type of Yarn	Warp		Filling	
	Pre-cured	Deferred	Pre-cured	Deferred
Garment 1	10	10	10	10
Garment 2	10	10	10	10
Garment 3	10	10	10	10
Garment 4	10	10	10	10
Garment 5	10	10	10	10

Significant at the 5% level  
Significant at the 1% level

TABLE XIII  
 STATISTICAL INTERPRETATION OF THE EVALUATION OF THE GARMENTS

	Intervals			
	0	1	5	10
Garments	**	**	**	**
Pre-Cured	**	**	**	**
Deferred Cure	**	*	NS	NS
Pre-Cured Vs. Deferred Cure	*	NS	**	**
Treatments	NS	NS	NS	*

\*\* significant at the .01 level  
 \* significant at the .05 level  
 NS not significant

TABLE XIV  
 STATISTICAL ANALYSIS OF THE PHYSICAL CHARACTERISTICS  
 OF THE GARMENTS AT THE TENTH INTERVAL

Source of Variation	Wrinkle	Wrinkle	Tear Re-	Tear Re-
	<u>Recovery</u> Warp	<u>Recovery</u> Filling	<u>sistance</u> Warp	<u>sistance</u> Filling
Garments	NS	**	**	
Pre-Cured	NS	*	**	
Deferred Cure	NS	**	**	Complete data not available
Pre-Cured Vs. Deferred Cure	NS	NS	*	
Treatments	NS	NS	NS	

\*\* significant at the .01 level  
 \* significant at the .05 level  
 NS not significant

## CHAPTER V

### SUMMARY AND CONCLUSIONS

#### I. THE PROBLEM

Durable press finished garments are manufacturers' most recent attempt to satisfy consumers interested in spending less time in the care of their clothes. In the two years since their introduction, these finishes have become increasingly popular; however, past failures to meet claims that ironing had been eliminated have left the consumer dubious about the appearance of these garments following laundering or dry cleaning.

The objectives of this study were to study the effect of selected cleansing treatments on the maintenance characteristics of durable press finished garments and to determine whether the cleansing treatments or methods of applying the finish differed in their effect on these characteristics. The objectives were pursued in terms of the following questions:

1. Is there a change in the visual appearance of durable press finished garments after being home laundered, commercial laundered or dry cleaned?
2. Is there a difference in the tear resistance of durable press finished garments after being home laundered, commercial laundered or dry cleaned?
3. Is there a difference in the wrinkle recovery of durable press finished garments after being home laundered, commercial laundered or dry cleaned?
4. Is there a difference between the maintenance characteristics of garments with durable press finishes applied by the pre-cured method and those with finishes applied by the deferred cure method?

5. Is there a difference among the maintenance characteristics of garments with durable press finishes applied by the pre-cured method?
6. Is there a difference among the maintenance characteristics of garments with durable press finishes applied by the deferred cure method?

## II. PROCEDURE

Following a survey in local department stores, thirty garments were purchased representing six durable press finishes. Three of these finishes were applied by the pre-cure method and three, by the deferred cure method. Each of the finishes was represented by five garments alike in appearance, fabric and construction features. This number provided a control for the physical testing, a control for the visual evaluation and garments to be home laundered, commercial laundered and dry cleaned.

Three tests were used to indicate the effect of the cleansing treatments and the method of applying the finish on the maintenance characteristics of the garments. One test was a visual evaluation of each garment. The remaining tests indicated changes in the physical characteristics of the garments by measuring their tear resistance and wrinkle recovery before treatment and after ten cleansing treatments.

Major emphasis in the visual evaluation was placed on the appearance of the fabric and seams and the sharpness of the creases. These areas were evaluated by rating them according to the standard which they most closely resembled. These standards ranged from Class 5, which represented little or no change in the original smooth appearance, to



Class 1, which represented a marked change in appearance. Ratings of Class 4 or above were considered acceptable to the consumer as needing no pressing, whereas any rating below this point was considered unacceptable as a durable press finished garment, since it would need pressing. Ratings of all garments were made before treatment and at the first, fifth and tenth intervals.

### III. FINDINGS PERTAINING TO THE VISUAL EVALUATION OF THE GARMENTS

Although Garments 2, 4 and 5 received an acceptable rating of Class 4 at the untreated or "0" interval, none of the treated garments received an acceptable rating at the tenth interval. This is not true, however, of various garment areas which did maintain acceptable ratings throughout the treatment period.

The reaction of the garment areas to the cleansing treatments varied. While some of the ratings dropped progressively after the untreated interval, other dropped at the first interval, rose at the fifth interval and dropped again at the tenth interval. Another reaction which occurred among the ratings of the garments receiving the dry cleaning treatment was a drop after the evaluation at the untreated interval and a rise in the ratings at subsequent intervals.

Although the home laundering treatment had the greatest effect on the appearance of Garment 4, the commercial laundering treatment had the greatest effect on all the remaining garments. The dry cleaning treatment had the least effect on all of the garments.

The ratings of the garments according to the method of applying the finish showed variations similar to the individual garment ratings. The ratings of the pre-cured garments which received the home laundering treatment dropped progressively following the untreated interval. The ratings of the deferred cure garments receiving the home laundering and commercial laundering treatments, as well as the ratings of the pre-cured garments receiving the commercial laundering treatments, dropped at the first interval, rose at the fifth interval and dropped again at the tenth interval. The ratings of the pre-cured garments receiving the dry cleaning treatment dropped at the first interval and remained constant through the tenth interval. The ratings of the deferred cure garments dropped at the first interval, remained the same at the fifth interval and then rose at the tenth interval.

According to the percentage change in ratings at the first, fifth and tenth intervals, the pre-cured garments were generally affected more by all the treatments than the deferred cure garments. The commercial laundering treatment had the greatest effect on all the garments and the dry cleaning treatment, the least effect.

#### IV. FINDINGS PERTAINING TO THE PHYSICAL CHARACTERISTICS OF THE GARMENTS

##### Tear Resistance

All the garments showed either increased or decreased tear resistance except in the case of the warp yarns of Garment 1 receiving the home laundering treatment, the filling yarns of Garment 2 receiving the

commercial laundering treatment and the filling yarns of Garment 3 in all three treatments. The latter instance resulted from filling yarns which were too strong for the equipment used; therefore, no data was available.

Among the garments receiving the home laundering treatment, an increase in tear resistance occurred in the warp yarns of Garments 2, 3 and 5 and in the filling yarns of Garments 2, 4, 5 and 6. A decrease occurred in the warp yarns of Garments 4 and 6 and the filling yarns of Garment 1.

In the case of the commercial laundering treatment, an increase in tear resistance occurred in the warp yarns of Garments 3 and 4 and the filling yarns of Garments 1, 4, 5 and 6. The tear resistance of the filling yarns of Garment 2 did not change. Only the warp yarns of Garments 1, 2, 5 and 6 showed a decrease in tear resistance.

After the dry cleaning treatment Garments 1, 2, 3, 4 and 5 showed an increase in warp tear resistance, and Garments 1, 2, 4, 5 and 6 showed an increase in the filling yarns. Only the warp yarns of Garment 6 showed a decrease in tear resistance.

The largest increase in tear resistance among the garments receiving the home laundering treatment was the 39.6 per cent change in the warp yarns of Garment 3. The largest decrease was the 7.4 per cent change in the filling yarns of Garment 1.

The largest increase in tear resistance among the garments receiving the commercial laundering treatment was the 38.5 per cent change of

the warp yarns of Garment 3. The largest decrease was the 10.2 per cent change in the warp yarns of Garment 1.

Among the garments receiving the dry cleaning treatment, the largest increase in tear resistance occurred in the warp yarns of Garment 3. The only decrease was the 6.2 per cent change which occurred in the warp yarns of Garment 6.

#### Wrinkle Recovery

All garments showed either increased or decreased wrinkle recovery except the filling yarns of Garment 1 receiving the home laundering treatment and Garments 1 and 2 receiving the commercial laundering treatment.

Garment 3 showed the only increase in wrinkle recovery among the warp samples of garments receiving the home laundering treatment. Garments 1, 2, 4, 5 and 6 showed a decrease. The increase was a 17.2 per cent change, whereas the largest decrease was 8 per cent.

The filling samples of Garments 3 and 6 were the only ones that showed increased wrinkle recovery. Garments 2, 4 and 5 showed decreases, whereas Garment 1 showed no change. The largest increase was the 19.8 per cent change in Garment 3, and the largest decrease was the 10.3 per cent change in Garment 4.

Among these garments receiving the commercial laundering treatment, Garments 2 and 3 showed increases in the wrinkle recovery of the warp samples. Garments 1, 4, 5 and 6, on the other hand, showed decreases. Garment 2 had the largest increase in wrinkle recovery, a 3.2 per cent

change, and Garment 5 showed the largest decrease, a 10.2 per cent change.

There was no change in the wrinkle recovery of the filling yarns of Garments 1 and 2; however, Garments 3 and 6 showed an increase and Garments 4 and 5, a decrease. The largest increase was the 12.7 per cent change of Garment 3, and the largest decrease was the 7.9 per cent change of Garment 5.

The increase in the wrinkle recovery of the warp samples from garments receiving the dry cleaning treatment occurred in Garments 1 and 2; the decrease, in Garments 3, 4, 5 and 6. The largest increase was the 1.9 per cent change in Garment 2, whereas the largest decrease was the 11.7 per cent change of Garment 6.

Among the filling samples, Garments 1, 2, 3, 4 and 6 showed increased wrinkle recovery. Only Garment 5 showed a decrease, a 5.3 per cent change. The largest increase was the 15.9 per cent change in Garment 3.

## V. CONCLUSIONS

From the data collected in this study of durable press finished garments, the following conclusions are drawn:

1. None of the garments maintained acceptable ratings for appearance throughout the treatment period; however, various garment areas did maintain acceptable ratings.
2. The cleansing treatments used in this study (home laundering, commercial laundering and dry cleaning) changed the appearance of all of the garments as early as the first interval.

3. The greatest change occurred in the appearance of the garments which were laundered by the commercial procedure, whereas the least change occurred in the appearance of the garments which were dry cleaned.
4. The appearance of the pre-cured garments was changed more by the cleansing treatments than was the appearance of the deferred cure garments.
5. The appearance of the durable press finished garments was affected differently by each cleansing treatment, regardless of the method of applying the finish.
6. Variable results were obtained in the tear resistance and wrinkle recovery of all the treated garments. Because of this variability in garment performance, no conclusions could be drawn in regard to these characteristics.

#### VI. RECOMMENDATIONS

Further investigation of durable press finished garments would be desirable for more conclusive evidence regarding the effect of cleansing treatments on their maintenance characteristics. Specific areas suggested for investigation are:

1. The development of an improved method of evaluating garment areas rather than the same areas detached from the garment on which the present standards are based.
2. The effect of wear and cleansing treatments on the maintenance characteristics of durable press finished garments.
3. The abrasion resistance of durable press finished garments which have been worn and cleansed or just cleansed.
4. The effect of commercial methods of laundering and dry cleaning on the strength of durable press finished garments.
5. The appearance of garment seams in relation to the kind of fabric, thread and stitching characteristics used.

6. The effect of cleansing treatments on garments which have been pressed prior to treatment, so that all areas receive the same acceptable rating.
7. Further examination of the wrinkle recovery and tear resistance of durable press finished garments in relation to the weave, thread count, weight and dimensional stability of the fabric.

BIBLIOGRAPHY



## BIBLIOGRAPHY

### A. BOOKS

1965 Book of ASTM Standards. Volume XXIV. Philadelphia: American Society for Testing Materials, October, 1965.

1965 Technical Manual of the American Association of Textile Chemists and Colorists. Volume XLI. New York: Howes Publishing Company, September, 1965.

### B. BULLETINS

A Definitive Guide to Permanent Press. Prepared by the Editors of American Fabrics Magazine in conjunction with the Staff of Celanese Fibers Marketing Company, New York, 1965.

Lyle, Dr. Dorothy Siegert. Permanent Press, National Institute of Drycleaning, FF-125. Silver Spring, Maryland: Bulletin Service, February, 1965.

### C. PERIODICALS

Beaumont, Warren L. "The Delayed Cure Process," American Dyestuff Reporter, LIV (September 13, 1965), 86-88.

Cone, Sydney M., Jr. "A Long Look at Durable Press as the Newest Extension of Wash-and-Wear," Modern Textiles Magazine, XLVI (August, 1965), 39-43, 69.

Fortess, Fred. "Durable Press Garments--A Challenge to Industry," Modern Textiles Magazine, XLVII (January, 1966), 34-36.

Goldstein, Herman B., and J. Michael May. "Permanent Press: Finishing and Performance Evaluation," American Dyestuff Reporter, LIV (September 13, 1965), 78-83.

Hochstaedter, Louis. "The Story of One Permanent Press Finish," Modern Textiles Magazine, XLV (December, 1964), 59-60.

Lee, Claude M. "Synthetic Fibers in Durable Press," American Dyestuff Reporter, LV (January 17, 1966), 39-41.

- Milholland, John. "The Cutter Aspect of Permanent Crease and Permanent Press Processing," American Dyestuff Reporter, LIV (September 13, 1965), 97-98.
- "Permanent Press--A Progress Report," American Fabrics, LXVII (Spring 1965) 55-66.
- "Permanent Press: New Directions," American Dyestuff Reporter, LIV (October 25, 1965), 68-74.
- "Permanent Press--The Ultimate in Wash-Wear," American Fabrics, LXVI (Winter, 1964-65), 61-76.
- Reeves, Wilson A., Albert S. Cooper, Jr., William G. Sloan and Robert J. Harper, Jr. "All-Cotton Fabrics for Durable Press," Textile Industries, CXXIX (October, 1965), 74-88, 103.
- Stavrakas, E. James. "Permanent Press: A Merchant's View," Textile Industries, CXXIX (June, 1965), 116-125.
- Stultz, Robert L. "The Contribution of Polyester Fiber," Modern Textiles Magazine, XLV (December, 1964), 55-57.
- \_\_\_\_\_. "Review of Durable Press Procedures," American Dyestuff Reporter, LIV (September 13, 1965), 84-85.
- Suchecky, Stanley M. "Durable Press," Textile Industries, CXXIX (January, 1965), 121-135.
- "Two Forums of Permanent Press," Textile Industries, CXXIX (November, 1965), 166-179, 184.
- "Vapor Process for All-Cotton Permanent Press," American Dyestuff Reporter, LV (January 3, 1966), 50.

APPENDIX



## APPENDIX B

PERCENTAGE CHANGE IN EVALUATION OF GARMENTS  
AT THE FIRST, FIFTH AND TENTH INTERVALS

Garment	Home Laundering			Commercial Laundering			Dry Cleaning		
	<u>1</u>	<u>5</u>	<u>10</u>	<u>1</u>	<u>5</u>	<u>10</u>	<u>1</u>	<u>5</u>	<u>10</u>
1	-33.3	-36.7	-36.7	-38.5	-19.2	-46.2	-26.9	-26.9	-19.2
2	- 9.1	-31.8	-34.1	-27.9	-25.6	-34.9	-15.4	-12.8	-12.8
3	- 2.9	-20.6	-26.5	-15.2	-15.2	-27.3	-15.2	-18.2	-24.2
4	-29.7	-18.9	-37.8	-23.1	-15.4	-23.1	-27.5	-32.5	-15.0
5	-10.2	-20.5	-25.6	- 7.7	-15.4	-28.2	- 5.6	0.0	- 5.6
6	- 9.3	- 3.1	-12.5	-25.7	-14.3	-22.9	- 3.3	0.0	+ 3.3

APPENDIX C

EXAMPLE OF THE STATISTICAL ANALYSIS TO DETERMINE THE SIGNIFICANCE  
OF DIFFERENCES AMONG GARMENTS, TREATMENTS AND METHODS OF CURING  
(EVALUATION OF UNTREATED GARMENTS)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Garments	5	4.1933	0.8387	25.04**
Pre-Cured	2	3.2623	1.6312	48.69**
Deferred Cure	2	0.7267	0.3634	10.85**
Pre-Cured Vs. Deferred Cure	1	0.2044	0.2044	6.10*
Treatments	2	0.1479	0.0740	2.21
Garment x Treatment (error)	10	0.3350	0.0335	
Total	17	4.6762		

\*\* significant at the .01 level

\* significant at the .05 level