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AERONAUTICAL SYSTEMS DIV WRIGHT-PATTERSON AFB OHIO

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NEW STANDARD FOR BLUE AIR FORCE POLYESTER/WOOL UNIFORM FABRIC.(U)

MAR 78 R HARLAN, J H ROSS

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**NEW STANDARD FOR BLUE AIR FORCE
POLYESTER/WOOL UNIFORM FABRIC**

*DIRECTORATE OF EQUIPMENT ENGINEERING
CLOTHING DIVISION*

MARCH 1978

TECHNICAL REPORT ASD-TR-78-4
Final Report for Period January 1976 - December 1977

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The recent development and approval of a 100% texturized polyester serge, for optional uniforms, in a darker shade of blue (1578) resulted in a visual difference between this new fabric and the Blue 1549 shade used in the 55% polyester/45% wool tropical fabric used in the issue Class A Air Force uniform. At the request of the Air Force Uniform Board a new standard was developed for the polyester/wool fabric in Blue Shade 1578. | | | |

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In addition a set of eight shade tolerances were established for use in determining acceptability when the new shade goes into production.

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FOREWORD

This program was accomplished as a result of a request from the Air Force Uniform Board, HQ USAF. Mr. Roy Harlan was the project officer. The shade development was carried out by the Burlington Menswear Division of Burlington Industries under the supervision of Mr. Charles Watts.

The development program was planned and directed by the Clothing Division (ASD/ENEU), Directorate of Equipment Engineering, Deputy of Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio.

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SECTION I

INTRODUCTION

The fabric used in Air Force Class A uniforms is a tropical weave (plain) composed of 55% polyester and 45% wool. The construction characteristics and mechanical and colorfastness requirements are described in specification MIL-C-21115, Type III, Class 3. The fabric, developed prior to 1960, has undergone a color metamorphosis since originally put into use. The first documented shade (color) development was Blue 1084⁽¹⁾ completed in 1964. In 1968, a new shade, Blue 1549, was developed⁽²⁾. In both cases, shade tolerances were developed to assist quality control personnel in their inspection and acceptance of the fabrics and to insure consistency of shade from piece to piece, and lot to lot.

A major shortcoming of the Blue Shade 1549 in the polyester/wool blend has been the tendency for "frosting" with wear and age. "Frosting" is a term used to describe fabrics whose appearance is similar to early morning frost on a grass lawn⁽³⁾. It is a term used to describe the appearance of abraded synthetic and synthetic/natural fiber blends. It may be the result of differential wear, as in multi-component blends in which the fibers do not match in shade, or due to variation in or incomplete penetration of the dyestuffs.

In the 1970's, the Air Force chose, as an optional fabric, one woven of 100% texturized polyester continuous filament yarns which was piece dyed. The color chosen was labeled Blue 1578. It was a darker shade of blue than the 1549 shade and, in combination with a serge weave, resulted in a Class A uniform with superior appearance to the uniform made of the polyester/wool in the Blue 1549 shade.

The Air Force, in December 1975, approved the development of a new dye formulation for the polyester/wool fabric used in "issue" uniforms. The objective was to achieve a blue shade that matched the Blue Shade 1578 of the 100% texturized polyester optional fabric. A program was initiated with Burlington Industries to develop the standard color and eight shade tolerances for use by the Defense Personnel Support Center (DPSC) in conducting acceptance evaluation.

This report describes the development of the new shade standard and tolerances. One late change imposed was that the dye formulation must not contain vat dyes, since they have been reported as potentially carcinogenic and are no longer being produced in the United States.

SECTION II

MATERIALS

The Air Force uses a single weight fabric for its Class A uniforms, allowing all-year use of the uniform. The fabric is described in specification MIL-C-21115, Type III, Class 3 and is a blend of polyester and wool fibers. The process, for dyeing and blending the fibers, spinning the yarn, weaving, and finishing the fabric, detailed by others⁽³⁾, is reasonably standard from mill to mill. The fibers are dyed before initiation of the yarn manufacturing process to insure attaining a homogeneous blend of fibers and color.

The specification requirements are spelled out in Table 1. In addition to the requirements listed, the wool used must be 64's U.S. Standard or finer, and the polyester must be a 3 denier semi-dull staple fiber (3 inch minimum) made from polyethylene glycol terephthalate. The finished fabric must have colorfastness to wet drycleaning, crocking, perspiration, and light equal to or better than the standard sample. The fabric must show no more pilling than the standard sample.

The yarn manufacturing process is shown in Figure 1. The fabric description and loom set-up is shown in Table 2. The final dye formulation for each fiber component is shown in Table 3. The fabric finishing process is shown in Figure 2.

SECTION III

DISCUSSION

The program goals included processing the fiber, yarn, etc., using standard production procedures to insure that future procurements of large yardage would be carried out with a minimum of difficulty. The scouring and combing of the wool fibers were conducted by the contractor at their Clarksville, VA facility. The fiber (stock) dyeing, both wool and polyester, was accomplished at the Raeford, NC plant as was the fiber blending, yarn manufacturing, and weaving. The greige goods were returned to the Clarksville facility for finishing and laboratory evaluation.

The contract called for the delivery of 360 yards of the standard shade and 40 yards each of eight tolerances to the Air Force. The program was completed with a minimum of problems. A specimen of the Blue Shade 1578 standard in 100% texturized polyester serge was provided to the contractor for matching purposes. Approximately 20 specimens were prepared and, after finishing, submitted to the Clothing Division for shade evaluation. After the standard was selected, the shade tolerances were selected, some from the original 20 and the remainder from additional specimens which were prepared with slight variations in the dye formulation.

The only problem that had to be resolved was the requirement that all vat dyes be eliminated from the dye formulation due to OSHA reports that these dyes were potentially toxic/carcinogenic. Indigosal Vat Blue O, one of the dye components, had been used in past years in Air Force blue shades. Because of the OSHA reports, U.S. manufacturers of this class of dyestuffs had already begun to drop production. The new blue color was obtained using other blue dyes (Table 3).

The new standard shade delivered (360 yards) is described in Table 4, with specification requirements shown for comparison purposes. The sample that was accepted had a rating of 5.0 when tested for colorfastness to crocking, perspiration, and wet drycleaning. Light fastness rated 4.0 as did pilling and wrinkle recovery. These ratings were obtained using standard test methods specified by AATCC and FED-STD-191.

In previous laboratory studies⁽³⁾ it had been found that this specification fabric had superior abrasion when made using Dacron^R T-54 polyester as compared to T-64 or T-35, the latter being used as the polyester component of the new standard shade. A wear test of six fabrics woven to meet the requirements of MIL-C-21115, Type III, Class 3, is presently being analyzed and, when complete, a decision will be made whether to require a specific polyester type in this fabric construction.

SECTION IV

CONCLUSIONS

The objective, a new Blue Shade 1578 for MIL-C-21115, Type III, Class 3 fabric, was achieved using commercial manufacturing processes and equipment. The required yardage of the specification fabric in the new shade and eight shade tolerances were delivered to the Air Force Clothing Division.

Quantities of the new standard shade and tolerances have been provided to the Defense Personnel Support Center, Defense Logistics Agency for use in current and future procurements of the 55% polyester/45% wool specification fabric.

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2. Technical Report ASD-TR-68-15, "Development of Shade Standards and Shade Tolerances in Blue 1549 Wool/Polyester Cloth, Stock Dyed Conforming to Type III, of Specification MIL-C-21115B," J. P. Stevens Co., Inc., June 1968
3. Technical Report AFML-TR-75-98, "Development of Polyester/Wool Uniform Fabric with Improved Durability and Appearance," Georgia Institute of Technology, August 1975

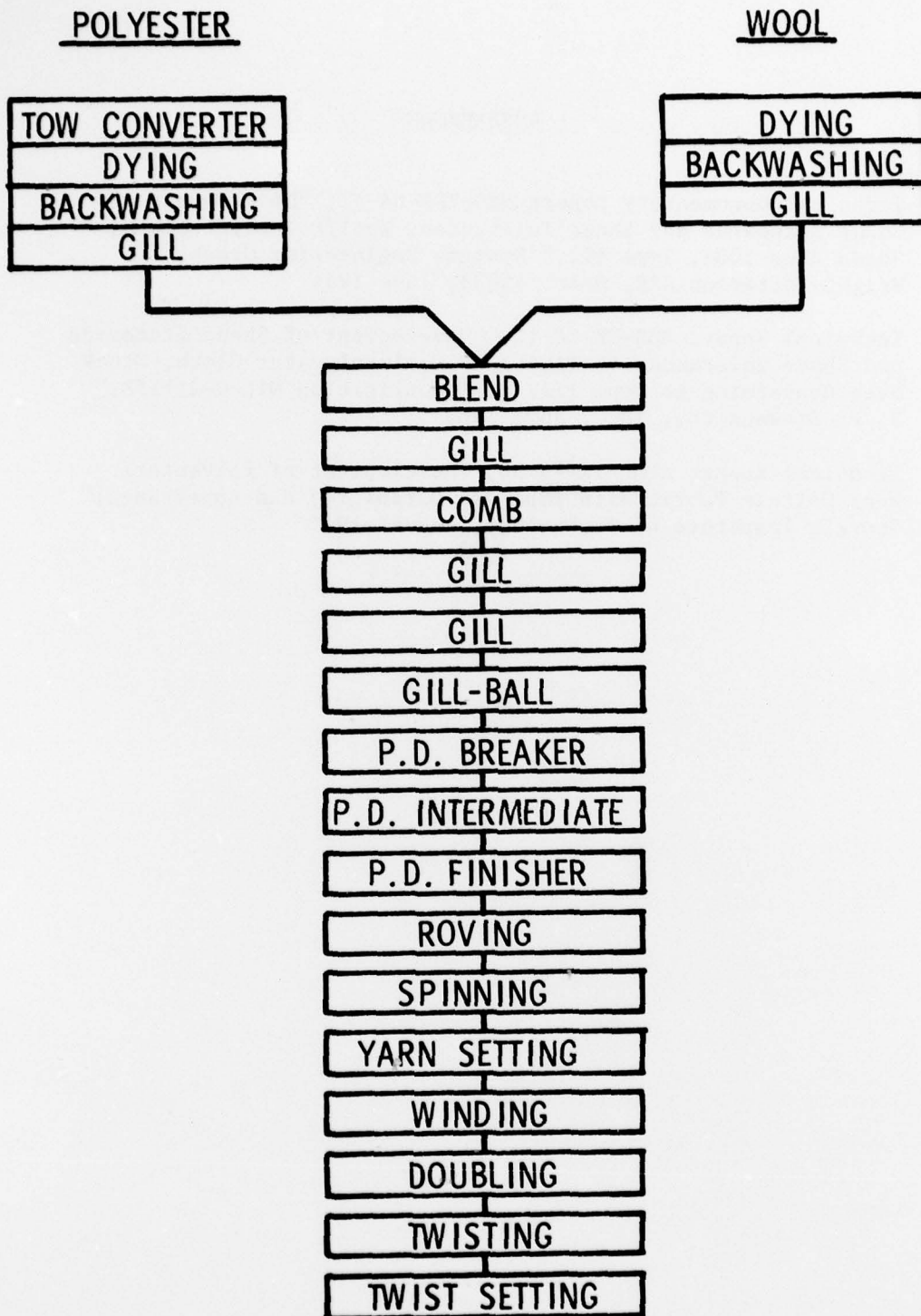


FIGURE 1 YARN MANUFACTURING PROCESS

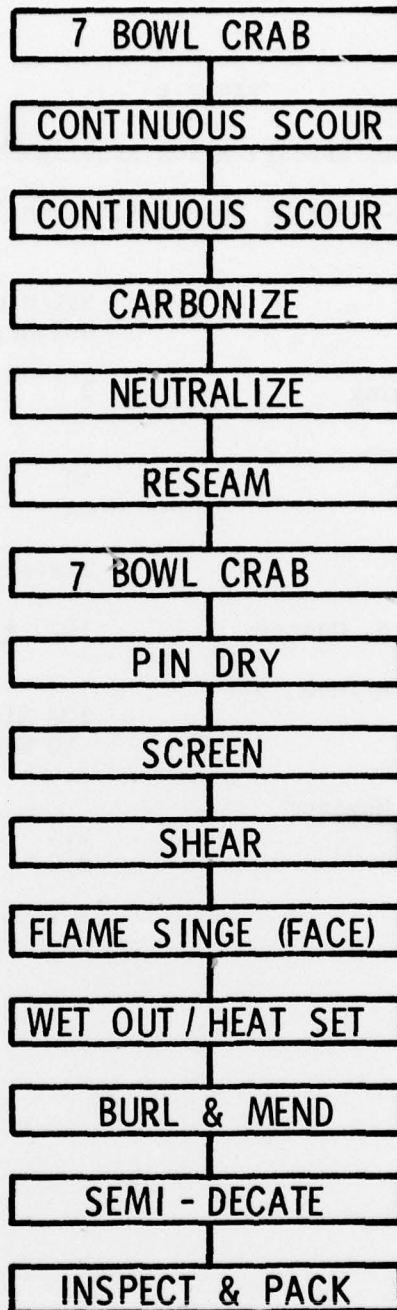


FIGURE 2 FABRIC FINISHING STEPS (BATCH)

TABLE 1
FABRIC SPECIFICATION REQUIREMENTS
MIL-C-21115, Type III, Class 3

| | |
|--------------------------------|------------------|
| Yarn Fiber Content | |
| Polyester | 55% Min - 60 Max |
| Wool | 40% Min |
| Yarn Ply, Warp & Filling | 2 |
| Yarns Per Inch, Minimum | |
| Warp | 50 |
| Filling | 44 |
| Weave | Plain |
| Weight Per Linear Yard, Ounces | 10.0 ± 0.5 |
| Breaking Strength, Lbs/Inch | |
| Warp | 100 Min |
| Filling | 80 Min |
| Shrinkage, Per Cent, Maximum | |
| Warp | 2.5 |
| Filling | 2.0 |
| PH | 5.5 - 8.5 |

TABLE 2
WEAVING SET - UP

| LOOM TYPE | SULZER |
|------------------------------|---------------|
| Yarns Per Inch | |
| Warp | 47 |
| Filling | 45 |
| Ends Per Dent | 2 / 2 |
| Reed Width, Inches | 66-1/2 |
| Greige Weight, Ounces | 11.43 |
| Weave | Plain |

TABLE 3
DYE COMPONENTS

| | |
|----------------------------------|--------|
| <u>POLYESTER: Dispersed Dyes</u> | |
| Eastman Polyester Blue BLF-C | 2.79% |
| X Resolin Rubine BR | 0.44% |
| Samaron Yellow 6GSL | 0.127% |
| | |
| <u>WOOL: Reactive Dyes</u> | |
| Lanasol Blue 3G | 0.43% |
| Lanasol Blue 3R | 2.18% |
| Lanasol Red 6G | 0.56% |
| Lanasol Yellow 4G | 0.31% |

TABLE 4
FINAL FABRIC PROPERTIES

| PROPERTIES | SPECIFICATION REQUIREMENTS | TEST DATA |
|--|----------------------------|--------------------------------|
| Fiber Content, Per Cent Polyester Wool (Min) | 55-60 40 | 56 44 |
| Polyester Type, Denier & Staple Length | 3.0 : 3.0 | T-35, 3.0 : 3-1/2 |
| Yarn Size, Ply, Twist Warp Filling | 2 Ply 2 Ply | 2/32.8, 14 oz 2/32.8, 13 oz |
| Yarns Per Inch Warp Filling | 50 Min 44 Min | 50 44 |
| Weave | Plain | Plain |
| Breaking Strength, Lbs/Inch Warp Filling | 100 Min 80 Min | 145 122 |
| Shrinkage, Per Cent Warp Filling | 2.5 Max 2.0 Max | 1.5 0.9 |
| PH | 5.5 - 8.5 | 7.0 |
| Weight, Per Linear Yard | 10.0 ± 0.5 | 10.5 |