
Fabric Science

Fifth Edition

by
Joseph J. Pizzuto

revised by
Arthur Price/Allen C. Cohen

FAIRCHILD PUBLICATIONS

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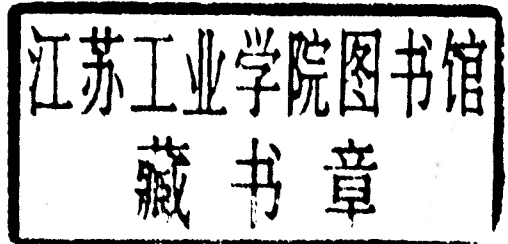
by **Joseph J. Pizzuto**

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A complete textile textbook/workbook
with accompanying fabric samples
to illustrate the text material.

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The greatest emphasis in **Fabric Science** has been placed upon the usage, quality aspects and comparisons of textiles for various end products. Textile manufacturing processes are also included, but are treated only to the degree necessary to compare and comprehend the advantages and shortcomings of the various textile products discussed. Prior knowledge or courses in chemistry or primary textiles is not required for a full comprehension of the text.

The basic concept established by Professor Pizzuto has been continued; that is, the study of textiles must be accompanied with actual working samples in order to achieve a complete understanding of the subject. The book combines full textual material with the advantages of a practical workbook. Most of the topic areas contained in the book are demonstrated by accompanying samples of actual fabrics. The swatches are also the working specimens which are used in conjunction with the assignments at the end of the chapters. Review questions are included which can be used by the reader to check his or her knowledge of the particular chapters covered.

Publication of the book in the ring-binder style of earlier editions has proven to be very popular. The authors have chosen to continue this format which permits the reader to insert new information as it becomes available and so be able to keep this text up to date. This style also facilitates working with the accompanying fabric samples.

The sections of the book dealing with the organization and structure of the multi-faceted textile industry, as well as the way in which textiles are bought and sold before they reach the ultimate consumer, have been included to enable the reader to more fully understand the relationship between the product and the industry in which it is made. The topics of current federal textile laws and regulations and the laboratory testing of textile products (to help assure satisfaction of the product by the ultimate textile consumer) are treated as individual chapters because of their importance resulting from the increasing involvement of government and consumer groups.

Fabric Science, together with its accompanying fabric samples, should constitute the complete textual and fabric aid material required for college-level courses in fundamental textiles. With both authors presently engaged in the teaching of textiles, not only to students at the Fashion Institute of Technology, but also to members of the textile industry through special seminars, the relevancy of the material contained in this book has already been proven. **Fabric Science** has been adopted as a textile text by colleges throughout this country and abroad. The authors are deeply gratified by this response to their work.

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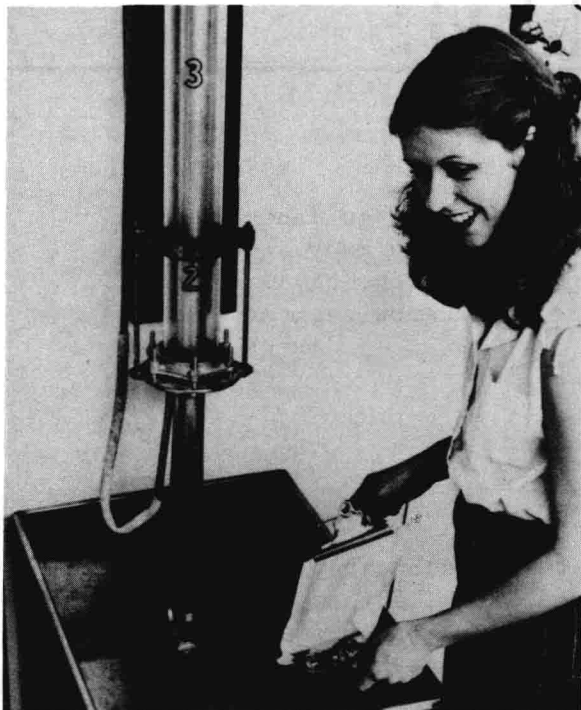
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Highly deserved thanks and acknowledgment are also due to the various textile producers who helped in the selection of the fabrics for the valuable swatch set which accompanies this book.

Knowledge of textiles is important to the careers of the people shown in these photos.



Mark Weithorn.

A textile technician ready to perform a water repellency test.



Robert Machalaba. Courtesy Charter Fabrics, Inc.

A fashion coordinator putting colors and textures together for presentation of a new fabric line.



Courtesy Knitting Times Magazine & Doran Textiles Inc.

A textile manufacturing executive examining yarn in a modern spinning plant.



Robert Machalaba. Courtesy C.Q. Corporation.

Textile designer checking the "strike off" of a new design. The designer works closely with the textile printer to assure that accurate color representation of the design is produced.

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INTRODUCTION

Textiles are so much a part of our daily lives that it is not unusual that we take them for granted. The fabrics that clothe us can be considered a part of us, just as the air we breathe and the environment that surrounds us. In fact, textiles have created a stimuli for man's ingeniousness and creativity since before recorded history. By the time civilization reached Ancient Egypt, textiles had reached such an advanced state of technology that the linen used to wrap mummies still remains preserved as textile materials. Through the following centuries textiles played a major role in civilization and world economics. The industrial revolution ushered in the era of modern mass production as the shift from home to factory production began in the textile industry. Textiles are both the most ancient and the most modern of our industries, and are among the magical products of the high-tech world of the late twentieth century.

The versatility of textiles is truly remarkable. While apparel and home furnishings are the best known of the end uses, textiles are also used in an extremely wide range of other products. Examples of these special uses include artificial blood vessels, bulletproof vests, civil engineering earthwork construction, artificial turf, industrial filters, space vehicles, and as structural and reinforcing components in automobiles and aircraft.

To understand the textile industry and how it functions is not an easy task. This industry is a vast complex made up of many segments. Over 25 billion dollars in textile products are sold each year. Together with the apparel industry, there are approximately two million employees, making it one of the larger American industries. Its distribution patterns are complex. The sources of fabric (called the **resources**) vary greatly in size and type, from companies which own many manufacturing plants and have sales in excess of one billion dollars to those which employ only several people.

This first chapter will give the reader a general understanding of the textile industry and how it functions. The balance of the book concentrates on the fabric, its composition and utilization. Both areas are particularly important for those people whose careers will center around the textile industry, apparel manufacturing or retailing.

MAJOR SEGMENTS OF THE TEXTILE INDUSTRY

The textile industry is a group of related industries using many different raw materials and making a great number of products. The following are considered the major production segments of the textile industry. Each is discussed in much more detail later in this book.

A. Fibers

Fibers are the smallest part of the fabric. They are fine hair-like substances, categorized as either **natural** or **man-made**. Cotton, which grows on a plant, and wool, which is shorn from a sheep, are two examples of natural fibers. The man-made fibers are created from chemicals, and include acrylic, nylon and polyester. They are produced by chemical companies, such as E.I. du Pont de Nemours & Company and Monsanto Company.

B. Yarns

Most textile materials contain **yarns**. They are continuous thread-like strands composed of fibers which have been twisted together. (Felt would be an example of a material made directly from fibers but containing no yarns.) There are various types of yarn, from flat and dull to slubby and lustrous. Each one could be made from different fibers. Yarns are used to produce fabrics.

C. Fabric Production

Most fabrics are either **woven** or **knitted**. The companies that make the cloth are called **mills**. Burlington Industries and J. P. Stevens & Company are two of the largest. The range of fabric types and weights is tremendous, fulfilling a variety of consumer demands.

D. Dyeing and Printing

Color is usually applied to fabric by either a **dyeing** or **printing** process. The purpose is to make the fabric more appealing. These operations are performed in **dye plants** or **print plants**, and the companies are called **dye houses** or **print houses**.

E. Finishing

Most fabrics need additional treatments called **finishes** before they can be used. For example, special chemicals are used to make a water-repellent fabric suitable for a raincoat. A special brushing machine is required to make the fuzzy surface found on flannel fabrics. The processes are done in **finishing plants** whose facilities are most often part of dye plants or print plants.

After finished fabric has been produced, it usually will be used by manufacturers to make such items as blouses, drapes, tents or tires. A particular fabric might be used for several different articles, such as a dress, shirt and curtains. Frequently, the same fabric that is shipped to the apparel or home furnishings manufacturer is also sold to a retail store for direct sale to home sewers.

MARKET PLANNING FOR APPAREL

Each segment of the textile industry must plan well ahead of the next retail selling season. Unless schedules are maintained and deadlines met by the fiber producers, fabric mills and other textile companies, garments will not be able to be shipped when the retail stores are ready to buy. The time problem is especially acute in the textile industry since there are so many operations that must be performed before finished fabric is made. A delay in any of the operations will extend the fiber-to-fabric time period. The following indicates the scheduling usually involved:

It takes almost a year from the time a **fiber supplier** starts delivering fibers for yarn manufacturing until the completed garment is ready for sale in the retail store. The fiber shipments stop about four months before the start of the retail season.

The **yarn manufacturers** begin delivering their yarns to the mills about nine months before the garments are to be sold in the retail stores and stop about two months before.

The **finished fabrics** start to be shipped to the garment manufacturer about six months before and continue to be sold into the retail selling season.

Some **apparel manufacturers** start cutting fabrics four months before the season and many continue to cut after the season has begun.

There are two main retail selling seasons for apparel. They are **Fall** and **Spring**. The former starts about August first and the latter begins about February first. The other seasons include **Summer** and **Holiday**.

The textile and apparel industries are working toward reducing the time periods mentioned above in order to respond more quickly to changes in the marketplace. One method is the use of electronics to link textile mills, apparel manufacturers and retail stores for faster interchange of sales, delivery and inventory information. Other methods include shorter production runs, the use of the latest technology for faster textile and apparel production, as well as the use of computers by designers as a time saving device.

GENERAL FIELDS OF TEXTILE PRODUCTS

The textile products industry is segmented into three large groupings. Most companies specialize in one of these areas: apparel, home furnishings or industrial. The end use consumption of fibers in the United States is approximately 35 percent apparel, 35 percent home furnishings, and 30 percent industrial and miscellaneous consumer-type products.

During the past ten years total fiber consumption in the industrial sector has steadily grown. (Apparel uses have declined, while home furnishings have remained relatively static.) Many are unaware of the importance and potential of this industry segment. This is partly because industrial fabrics frequently comprise components of other products and are never seen in their end use applications. It also takes a long time to prove fabric performance requirements and yarn acceptance for the material (two to five years is not uncommon). In addition, this market has traditionally been a slow-to-change, conservative business.

While the following list is not complete, it does indicate representative classifications for fabric end uses:

A. Apparel

Women's Wear, Men's Wear, Girls' Wear, Boys' Wear and Infants' Wear

1. Sportswear
 - a. Tops - Blouses, Shirts
 - b. Bottoms - Slacks, Shorts, Skirts
2. Swimwear and Beach Wear
3. Dresses
 - a. Casual
 - b. Evening Wear
4. Intimate Apparel
 - a. Undergarments
 - b. Sleepwear
 - c. Robes
 - d. Loungewear
5. Maternity Wear
6. Outerwear
 - a. Sweaters
 - b. Jackets
 - c. Rainwear
7. Coats and Suits
8. Accessories
 - a. Scarves
 - b. Handkerchieves
 - c. Belts
 - d. Gloves
 - e. Handbags
 - f. Ties
9. Miscellaneous
 - a. Hosiery
 - b. Hats
 - c. Umbrellas
 - d. Athletic Uniforms

B. Home Furnishings

1. Furniture
 - a. Upholstery
 - b. Slip Covers
2. Hangings
 - a. Drapes
 - b. Curtains
3. Domestic
 - a. Sheets
 - b. Pillow Cases
 - c. Bedspreads
 - d. Blankets
 - e. Mattresses
4. Linens
 - a. Table Cloths
 - b. Napkins
 - c. Towels and Wash Cloths
5. Floor Coverings
 - a. Carpets
 - b. Rugs
 - c. Padding
6. Miscellaneous
 - a. Lamp Shades
 - b. Throw Pillows

C. Industrial

1. Used in Manufacturing Plants
 - a. Conveyor Belting
 - b. Printer's Blankets
 - c. Tapes
 - d. Filters
2. Outdoor
 - a. Furniture
 - b. Awnings
 - c. Tents
 - d. Boat Sails
3. Footwear
 - a. Sneakers
 - b. Soft Shoes
4. Transportation (Automobiles, etc.)
 - a. Flooring
 - b. Tires
 - c. Interior
5. Miscellaneous
 - a. Laundry Bags
 - b. Aprons
 - c. Luggage
 - d. Flags
 - e. Hoses

FABRIC RESOURCES

Primary Sources of Fabric

A **primary source** of fabric is a company that makes or creates the material. The firms in this category are mills and converters. Some of the mills produce woven fabrics exclusively, others make only knit fabrics, while some of the giant mills manufacture both.

In the primary fabric market, most sales are based on contracts with shipments to be made months later. The converters and mills work closely with their customers' designers and merchandisers to create designs and working samples. Sales of fabric either in inventory or about to be ready for sale (called **spot** or **nearly goods**) also occur, but on a much smaller scale. Usually, very small orders will not be taken, this being the function of the jobber. (See page 8.)

Mill

The **mill** is a company that owns textile machinery and makes fabric. Most textile mills are located in the southeastern portion of the United States, with a large percentage in North Carolina and South Carolina. The corporate headquarters for the major mills are concentrated in New York City.

The large textile mills are vertically integrated. They not only make the fabric, but also produce their own yarn and perform the finishing processes required after the fabric has been completed. However, they do not make their own fibers.

The mills sell their finished fabrics to various customers. The converter, discussed in the next section, is a major buyer. Garment and home furnishings manufacturers use fabrics in making their products. Jobbers, who help dispose of excess or surplus merchandise for the mill, are another customer. Large retail stores, which in turn sell to the home sewer, also buy from the mills.

Most of the staple fabrics are sold by the mills. A **staple fabric** is one which is produced continuously each year with no change in construction or finish, and includes poplin, taffeta, tricot and sheeting. There are, however, many **fancy or novelty fabrics** also offered for sale by the mills.

The following are some of the major textile mills:

- A. Burlington Industries, Inc.
- B. J. P. Stevens & Co., Inc.
- C. Milliken & Company
- D. United Merchants and Manufacturers, Inc.
- E. West-Point Pepperell, Inc.
- F. Fieldcrest Cannon Inc.
- G. Springs Industries, Inc.
- H. Cone Mills Corporation
- I. Dan River, Inc.
- J. Collins & Aikman Corporation



FIGURE 1-1. Modern textile mill. Notice the single level structure for increased efficiency.

Courtesy Burlington Industries, Inc.

Converter

The **converter** is an individual or organization that buys **greige** (or **grey**) goods (unfinished fabric), usually from mills, has the fabric dyed or printed and finished by other companies, and then sells the finished fabric. All aspects of the fabric, including construction, design, color and finish, are determined by the converter. The converters are much smaller than the large textile mills.

There are three basic types of converting organizations, all of which overlap. The **true** or **straight** converting company buys only greige goods and has a contractual relationship with the mill or the finisher used. The **converter-jobber** company is like the true converter, except that it also buys some yardage of finished fabric when the need arises. The **integrated converter** is part of a large vertical mill and produces and finishes fabric in its own plants or goes to other sources for necessary greige goods and finishing operations. Most of the true converters and converter-jobbers are located in New York City.

The converters sell their finished fabrics to the same customers as the mills (garment and home furnishings manufacturers, jobbers and retail stores). Occasionally, one converter will buy from another. If, for example, he is unable to buy sufficient fabric from the mills to cover a very large order, the converter will buy additional fabric elsewhere.

The strength of the true converter and converter-jobber is that they are not restricted by machinery that they own and so must use. They have great flexibility and are more likely to pioneer new fabrics and designs than the integrated converter or the textile mill.

The following are some major nonintegrated converting companies:

- A. Charter Fabrics, Inc.
- B. Concord Fabrics, Inc.
- C. Max Kahn Curtain Corporation
- D. Pressman-Gutman Company, Inc.
- E. Reliable Textile Company, Inc.
- F. Richloom Fabrics Corporation
- G. Shirley Fabrics Corporation

Importer

Many textile fabrics (and yarns) are made overseas and then imported into the United States. Since about 1980 the volume of textile imports has risen dramatically and today accounts for a large percent of the fabrics used domestically. While the greatest amount of textiles and textile products comes from the Far East, they are also received from many other parts of the world.

The textile importing companies are of two types. The **direct importer** buys fabric or manufactured textile products (e.g., clothing or soft luggage) from a foreign mill or other supplier and brings it into the United States. It is then sold to an American apparel manufacturer or other customer. The other type, the **import mill**, is a foreign company that owns textile machinery and makes the fabric (or yarns) that is then exported to the United States. These companies operate like an American mill in the selling of their fabrics and in obtaining orders. Two of the largest import mills are Sunkyoung International, Inc. (South Korea) and Teijin America, Inc. (Japan).