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PRELIMINARY REPORT OF PLANTS AND PROCESSES FOR THE DYEING AND FINISHING OF TEXTILES

GEOMET TECHNOLOGIES, INC., GERMANTOWN, MD

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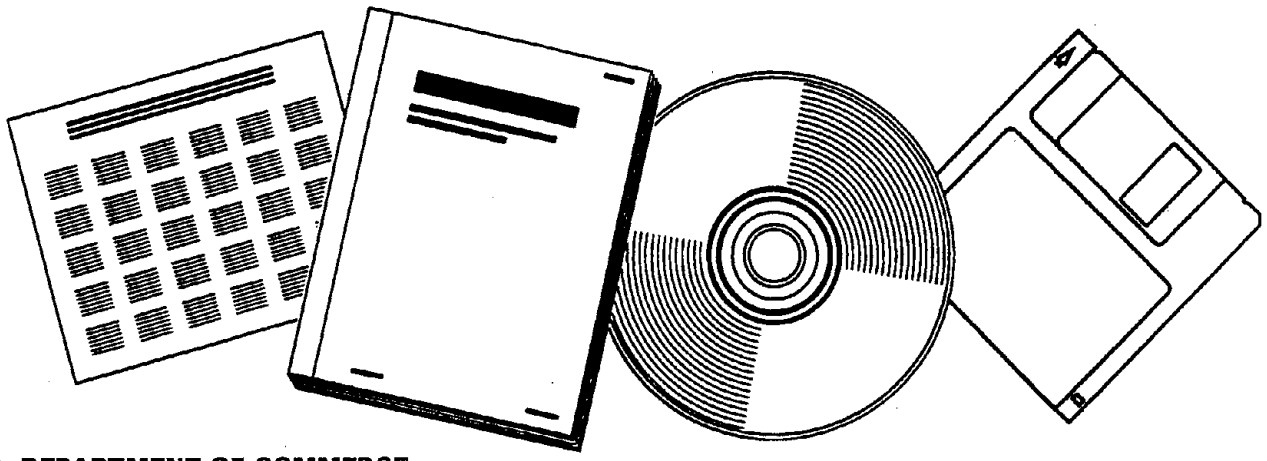

U.S. DEPARTMENT OF COMMERCE
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PRELIMINARY REPORT OF PLANTS AND PROCESSES FOR THE DYEING AND FINISHING OF TEXTILES

GEOMET Technologies, Inc.
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Rockville, Maryland 20852

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16. Abstract (Limit: 200 words) Processes in the dyeing and finishing of textiles during which workers may be exposed to hazardous situations or chemicals were considered. An overview of the textile industry was presented, and dyeing and finishing processes were described. During the preparatory processes fabrics may be subjected to bleaching, singeing, desizing, scouring, degumming, and mercerization. Dyeing processes included stock, top, yarn, piece, cross, and dope. Printing processes discussed included block, roller, discharge, resist, stencil, screen, rotary screen, thermachrome transfer, warp, duplex, photo, batik dyeing, tie dyeing, composition of paste designs, flocking, and spray painting. Finishing processes may be mechanical or chemical. Mechanical processes included shrinking, tentering, crabbing, calendering, schreinering, embossing, moireing, bettling, gigging, shering and sanforizing. Chemical processes discussed included fulling, decating, stiffening, weighting, glazing, parchmentizing, mildew proofing, water repellency, waterproofing, flame proofing, moth proofing, antibacterial finishes, naping, shape retention treatment, crepeing and wrinkles, slip resistance treatment, heat resistance treatment, foam laminating, fabric bonding, and permanent press treatments. Dyeing and finishing occupations were described.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms NIOSH-Publication, NIOSH-Contract, Contract-210-79-0001, Dyeing-industry, Textiles-industry, Occupational-exposure, Worker-safety, Worker-health

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CONTENTS

I. OVERVIEW OF THE TEXTILE INDUSTRY

The Standard Industrial Classification (SIC) group 22 includes textile mill products, commonly known as the textile industry. It is a component of a complex comprised of three interdependent industries: the fiber/textile/apparel complex. This complex, which employs one out of eight Americans, is one the the Nation's largest employers as well as the largest employer of women and minorities in manufacturing.

The fiber/textile/apparel complex can be divided into three major categories, all of which very closely coordinate their activities to satisfy the needs of the consumer. The categories are as follows:

- The fiber industry--includes mainly the manufacture of manmade fibers. It may also include the acquisition of vegetable (cotton) fibers and animal (wool) fibers.
- The textile industry--includes the spinning of the fibers into yarn, the weaving and knitting of yarn to fabric, the manufacture of floor coverings (carpets and rugs) and nonwoven goods, and the dyeing and finishing of textiles. Table I-1 lists the major SIC subgroups of textile mill products.
- The apparel industry--includes the cutting and needle trades. Establishments in this industry are involved in producing clothing

and fabricating products by cutting and sewing purchased woven or knit textile fabrics and related materials.

TABLE I-1

SIC 22: TEXTILE MILL PRODUCTS

SIC Code	Type of Mill	Product
221	Weaving	Broadwoven fabric: cotton
222	"	Broadwoven fabric: manmade fiber and silk
223	"	Broadwoven fabric: wool
224	"	Narrow fabrics and other smallwares: cotton, wool, silk, and manmade fibers
225	Knitting	Knit goods
226	Dyeing	Dyed and finished textiles, except wool fabrics and knit goods
227	Carpet	Floor coverings
228	Yarn	Yarn and thread
229	Miscellaneous	Miscellaneous textile goods (includes nonwoven fabrics, upholstery, lace goods, etc.)

Although the entire fiber/textile/apparel complex is important, only the textile (mill products) component will be addressed because it is here that most of the finishing and dyeing processes take place.

In terms of sales, the textile industry is one of the most important American industries. In 1979 the value of industrial services and shipments of textile mill products was $46.9 billion, 7% more than in the previous year. In the same year, the industry exported $3.027 billion worth of goods while importing $2.19 billion worth. The textile industry (mill products) alone employed 855,900 people in 1979, 752,300 of whom were production workers. Of these production workers, 72,400 (8.1%) were employed in finishing and dyeing operations. Table I-2 lists the total number of plants and employees in each category.

The major animal fiber used today is wool. Although it accounts for only 1% of the textile industry's products, it is nevertheless important in dyeing and finishing because of the relatively large number of workers employed in wool weaving and finishing mills (19,400 in 1972). For a detailed outline of the processes involved in making fabric from wool, see Appendix A, flowchart 1. Commercially grown cotton represents 24% of the fiber used in the textile industry. Like manmade fibers, it passes through various processes. Appendix A, flowchart 2, depicts the processes involved in making fabric from cotton.

In 1979, consumption of fiber was 12.9 billion lb, with manmade fibers (Table I-2) accounting for most of the total (9.802 billion lb, or 75% of total consumption). Cotton consumption was 3.057 billion pounds, or 24% of the total, whereas wool consumption was only 111 million lb, or 1%. Other fibers,

TABLE I-2

1977 CENSUS OF TEXTILE MILLS

SIC Code	Industry Segment	Establishments		Employees (thousands)	
		Total No.	No. with 20 or More Employees	Total No.	No. of Production Workers
2231	Weaving and finishing mills, wool*	157	82	14.7	12.7
225	Knitting mills*				
2251	Women's hosiery, except socks*	199	118	26.5	23.7
2252	Hosiery, NEC**	414	257	32.2	29.1
2253	Knit outerwear mills*	948	548	71.8	61.6
2254	Knit underwear mills*	88	70	23.0	21.5
2257	Circular knit fabric mills*	518	298	50.4	42.8
2258	Warp knit fabric mills*	233	152	23.0	19.3
2259	Knit mills, NEC*	189	48	3.5	3.1
226	Dyeing and finishing textiles, except wool fabrics and knit goods	665	396	72.4	60.1
2261	Finishing plants, cotton	213	99	22.9	19.1
2262	Finishing plants, synthetics	272	184	35.4	28.9
2269	Finishing plants, NEC	180	113	14.1	12.1
2272	Tufted rugs and carpets*	446	248	49.7	39.0
2292	Lace goods*	70	23	2.1	1.8

*Includes dyeing and finishing of textiles

**NEC, Not elsewhere classified

such as glass, mineral, or rubber fiber, are used in the textile industry. However, since these do not constitute a major part of the industry, they will be discussed only to a limited extent.

Fiber to Finished Textiles

After a fiber is acquired or manufactured, it passes through numerous processes before it is sold to the consumer either as thread, yarn, or fabric. The various processes are quite complex, but the finished product justifies the effort.

(a) Textile Fibers

Fibers used in the textile industry are from three main sources: manmade (chemical), vegetable matter (cotton), and animals (wool). Table I-3 gives a complete classification of fibers used in the textile industry and their sources.

Manmade fibers currently account for 75% of the textile market. These fibers are generally of two main types: cellulosic (those made of cellulose) and noncellulosic (those made from chemicals). The cellulosic fibers include common items, such as acetates, and products made from regenerated cellulose, such as rayons. There are four major types of rayon (viscose, cuprammonium, high-wet modulus, and saponified), each with different chemical and physical

TABLE I-3

CLASSIFICATION OF FIBERS

Type	Name	Source or Composition
Natural		
Vegetable	Cotton*	Cotton boll (cellulose)
	Linen	Flax stalk (cellulose)
	Jute	Jute stalk (cellulose)
	Hemp	Hemp or abaca stalk (cellulose)
	Sisal	Agave leaf (cellulose)
	Kapok	Kapok tree (cellulose)
	Ramie	Rhea or China grass (cellulose)
	Coir	Coconut husk (cellulose)
	Pina	Pineapple leaf (cellulose)
Animal	Wool*	Sheep (protein)
	Silk	Silkworm (protein)
	Hair	Hair-bearing animals (protein)
Mineral	Asbestos	Varieties of rock (silicate of magnesium and calcium)
Manmade		
Cellulosic	Rayon*	Cotton linters or wood
	Acetate*	"
	Triacetate*	"
Synthetic long-chain polymers	Nylon*	Polyamide
	Polyester*	Dihydric alcohol and terephthalic acid
	Acrylic*	Acrylonitrile (at least 85%)
	Modacrylic	Acrylonitrile (35-84%)
	Spandex	Polyurethane (at least 85%)
	Olefin	Ethylene or propylene (at least 85%)
	Saran	Vinylidene chloride (at least 80%)
	Vinyon	Vinyl chloride (at least 85%)
	Vinal**	Vinyl alcohol (at least 50%)
	Nytril**	Vinylidene dinitrile (at least 85%)
	Fluorocarbon	Tetrafluoroethylene
	Lastrile	Acrylonitrile (10-50%) and a diene
	Alginate**	Calcium alginate

TABLE I-3 (CONTINUED)

CLASSIFICATION OF FIBERS

Type	Name	Source or Composition
Mineral	Glass Ceramic	Silica sand, limestone, and other minerals Minerals
Metallic	Metal	Aluminum, silver, gold, stainless steel
Rubber	Rubber	Natural or synthetic rubber
Protein	Azlon**	Corn, soybean, etc.

*Indicates major fibers used in the industry

**Not presently in commercial production in United States

properties. In regenerated cellulosic fibers, cellulose is changed chemically into another form and then regenerated into cellulose. Noncellulosic fibers consist of long-chain polymers such as nylons, polyesters, and acrylics.

After the fiber is manufactured, it is spun into yarns and then woven into fabrics. After the yarn is woven, the fabric may pass through various chemical and mechanical treatments known as dyeing and finishing. When fabric is finished, it will either be sold to the consumer or made into apparel. Depending on the item made, the fabric may pass through a postcuring process which can result in creases or other types of finishes. This document will discuss postcuring processes as well as standard finishing and dyeing processes. For a detailed chart of the processes involved in the manufacture of fabrics, see Appendix A, flowchart 3.

In 1979, spun and woolen yarns represented about 30% of all yarns produced for sale; the remaining portion was consumed in affiliated mills. Industry shipments of all yarn mills totaled $4.7 billion, up 8% from the previous year because of strong demand for lightweight blended fabrics. In 1977 there were 529 establisments producing yarns, most located in the South Atlantic region. See Table I-4 for economic profiles of textile mills.

TABLE I-4

ECONOMIC PROFILES OF TEXTILE MILLS, 1979

SIC Code	Type of Mill	Value of Shipments (millions of $)	Establishments		
			Total No. (1977)	No. with 20 or More Employees (1977)	Total No. of Employees (thousands)
2257 2258	Knit fabric	5,747	751	450	67.3
227	Carpet and rug	5,402	590	282	59.9
2281	Yarn (except wool)	4,449	--	--	96.9
2283	Wool yarn	251	--	--	4.3

Broadwoven fabrics (over 12 inches in width) are the principal fabrics produced by weaving mills. Manmade fibers represented over 70% of all broadwoven fabrics produced in 1978. Industry shipments of broadwoven fabrics were expected to reach $14 billion in 1979. In 1977 there were approximately 900

mills producing broadwoven fabrics. These mills employed 270,900 workers (Table I-5 gives production figures for synthetic fibers produced in 1977). In 1979, industry shipments of knit fabrics were valued at $5.5 billion. There were 751 establishments employing 67,300 people. Most of the these establishments are located in the Middle and South Atlantic regions.

TABLE I-5

PRODUCTION OF MANMADE FIBERS, 1977

SIC Code	Description	Total Production (millions of lb)	Value of Shipments (millions of $)
2823	Cellulosic (total)	1,241.1	852.7
28233	Rayon, acetate	NA*	NA
2824	Noncellulosic**	NA	NA
28231	Nylon	2,089.8	1,935.0
28243	Acrylic	695.0	495.8
28244	Polyester	3,385.2	1,916.8

*NA, Not available
**Includes other categories in additions to those given

In 1979, production of rugs and carpets continued to grow steadily. In 1978, production reached a high of 1.0759 billion square yards. Tufted carpets and rugs accounted for 95% of production; woven carpets and rugs accounted for

2%. There were 590 establishments in 1977 employing 59,900 people. Most of these establishments are located in the South Atlantic region.

Dyeing and Finishing

Dyeing and finishing of textiles is sometimes simply called the finishing process. In a broader sense, it can be defined as a chemical or mechanical process applied to cloth or fiber to make it more commercially acceptable. Finishes that enhance the beauty of cloth appeal to the eye; finishes that add weight, body, or warmth appeal to the sense of touch. There are nearly 60 different dyeing and finishing processes using approximately 2,400 different chemicals. Table I-6 lists some of these processes. In this document, dyeing will be considered separately because of its diversity and complexity.

(a) Dyes and Dyeing

Dyeing can be defined as any method of applying color to textiles; thus it also includes printing processes. Textiles may be dyed in several different forms, eg, fiber, sliver, yarn, or fabric. In printing, a pattern or design is imprinted on the fabric in one or more colors, using dyes in the form of a paste. This form of dyeing is quite complex, consisting of approximately 16 different processes. Section II of this report describes the major dyeing processs in detail.

TABLE I-6

DYEING AND FINISHING PROCESSES*

Preparatory Processes	Finishing processes
Bleaching**	Mechanical
Singeing***	
Desizing**	Shrinking
Scouring**	Tentering
Degumming**	Crabbing
Mercerization**	Calendering
	Schreinering
Dyeing and Printing Processes	Embossing
	Moireing
Dyeing	Beetling
	Gigging
Stock	Shearing
Top	Sanforizing
Yarn	
Piece	Chemical
Cross	
Dope	Fulling
	Decating
Printing	Stiffening
	Weighting
Block	Glazing
Roller	Parchmentizing
Discharge	Mildewproofing
Resist	Water repellency
Stencil	Waterproofing
Screen	Flameproofing
Rotary screen	Mothproofing
Thermachrome transfer	Antibacterial finishes
Warp	Napping
Duplex	Shape retention treatment
Photo	Crepeing and wrinkles
Batik dyeing	Slip resistance treatment
Tie dyeing	Heat resistance treatment
Composition of paste designs	Foam laminating
Flocking	Fabric bonding
Spray painting	Permanent press

*The most important processes will be discussed in Section II. For definitions of the terms in this table, see glossary in Appendix B.
**Chemical treatment
***Mechanical treatment

Dyes may be derived from natural sources, as is indigo, or they may be made synthetically, as are the majority of the dyes used in the textile industry as well as in other industries. Synthetic dyes are divided into about 10 classes according to their chemical structures. The structure of dyes is important because fibers have affinities for only certain dyes. Cotton fibers generally cannot be dyed by the same substance as rayon. Table II-12, in Section II, lists the types of dyes used in the textile industry, the fibers that they are used to dye, and their characteristics.

In 1978, total domestic dye production was 251 million lb, for total sales of $733,553,000. Approximately two-thirds of the dyes consumed in the United States are used by the textile industry. Table I-7 lists U.S. production and sales of dyes by class. The textile industry uses 2,000 dyes and 500 dye auxiliaries (aids in dyeing).

TABLE I-7

1978 U.S. PRODUCTION AND SALES OF DYES

BY CLASS OF APPLICATION

Class of Application	Production (thousands of lb)	Sales		
		Quantity (thousands of lb)	Value (thousands of $)	Unit Value/lb* ($)
Acid	39,434	36,658	130,222	3.55
Azoic dyes and components: azoic diazo components, salts (fast color salts)	1,690	1,340	1,806	1.35
Basic	15,357	15,257	67,437	4.42
Direct	28,386	26,816	80,545	3.00
Disperse	44,347	39,721	156,758	3.95
Fiber reactive	5,520	5,292	28,684	5.42
Fluorescent brightening agents	29,933	29,361	49,645	1.69
Food, drug, and cosmetic colors**	6,125	5,968	42,061	7.05
Mordant	376	375	1,665	4.44
Solvent	13,892	10,298	32,630	3.17
Vat	37,752	36,890	102,211	2.77
All other***	27,968	24,735	39,889	1.61
TOTAL	250,780	232,711	733,553	3.15

*Calculated from unrounded figures

**These dyes are not used in the textile industry.

***The data include azoic compositions, azoic coupling components, azoic diazo components (bases), sulfur dyes, and miscellaneous dyes. Statistics for those groups of dyes may not be published separately because publication would disclose information received in confidence.

(b) Finishing

As it comes off the loom, newly made cloth passes through various processes which enhance its appearance and durability. Fabric that comes directly from the loom is referred to collectively as either gray goods or greige goods.

These fabrics will be finished by being subjected to various chemical and mechanical processes which result in a durable and attractive fabric. Finishing in its broadest sense also includes several preparatory processes as well as dyeing and printing. Table I-8 lists the types of chemicals used in finishing.

TABLE I-8

FUNCTIONAL CHEMICAL CLASSES USED IN FINISHING OPERATIONS

Anticreasing agents (antishrinking agents, resins)	Odorant, deodorants
Antifume agents	Oil repellents
Binders	Plasticizers
Biological inhibiting agents	Softeners, handbuilders, antistatic agents
Catalysts	Scrooping agents (antislip, antipill agents)
Delustrants	Water repellents, soil release agents
Desizing agents	Weighting agents, thickeners
	Whiteners (fluorescent)

Finishes can be either permanent or nonpermanent. Generally, a finish is permanent if it is made to withstand a reasonable amount of wear without injury. Examples of permanent finishes are listed in Table I-9. Nonpermanent finishes are those that can either rub off or be washed out. Examples of nonpermanent finishes are sizing, weighting, roller creping, embossing, tentering, and calendering. A detailed discussion of each finishing process is given in Section II.

(c) Machinery Used in the Dyeing and Finishing of Textiles

The machinery used in dyeing and finishing operations is very complex and constitutes a large industry in itself. In 1977, the value of shipments of machinery and parts used in the textile industry was $851 million. The value of new machinery just for dyeing and finishing was $48.1 million, while parts and attachments to existing machinery were valued at $17.5 million.

(d) Production and Employment

The dyeing and finishing industry produced goods that were valued at $6.3 million in 1977 from a total of 665 establishments. The entire industry employed 72,400 people in 1977, or 8.1% of the entire textile industry workforce. Table I-10 shows the quantity of finished goods produced in that year; Table I-11 lists the total number of establishments, number of workers, and value of shipment of finished goods.

TABLE I-9

PERMANENT FINISHES

Cotton	Linen	Rayon
Bleaching	Bleaching	Crease resistant
Cotton/polyester blends	Beetling	Durable press (modified rayons)
Crease resistant	Crease resistant	Dyeing
Durable press (cross-linked cotton)	Dyeing	Moireing (if resin treated and heat set)
Dyeing	Printing	Printing
Glazing	Shrinkage control	Shrinkage control
Mercerizing	Starchless	Starchless
Printing		Water repellent
Shrinkage control		
Starchless		
Trubenizing		
Wash-and-wear		

Silk	Wool	Nylon
Bleaching	Durable press	Durable press (cotton/nylon blends)
Dyeing	Dyeing	Durable press (100% nylon)
Printing	Moth repellent	Embossing (heat set)
	Napping	Moireing
	Printing	Nonstiff
	Shrinkage control	Stiffening (resin)
	Wash-and-wear	

Polyester	Acrylics	Glass Fibers
Durable press	Crease resistant	Crimp setting
Heat set	Durable press	Wrinkle resistant
Moireing	Heat set	
Shape retention	Moireing	
Wrinkle resistant	Permanent press	
	Water repellent	

TABLE I-10

QUANTITY OF FINISHED GOODS FROM

DYEING AND FINISHING MILLS, 1977

Description*	Quantity (millions of yd)
Cotton	1,707.1
White	1,116.5
Solid colors	393.5
Prints	5,732.8
Manmade fibers	

*The dyeing and finishing of wool fabric and knitted goods are included together in the wool-weaving industry (SIC 223) and the knitting industry (SIC 225).

TABLE I-11

1977 CENSUS OF TEXTILE FINISHING PLANTS

SIC Code	Type of Fabric Finished	Value of Shipments (millions of $)	Establishments		Employees (thousands)	
			Total No.	No. with 20 or More Employees	Total No.	No. of Production Workers
2261	Cotton	1,611.3	213	99	22.9	19.1
2262	Manmade	3,109.3	272	184	35.4	28.9
2269	Not elsewhere classified	1,578.3	180	113	14.1	12.1

II. DYEING AND FINISHING PROCESSES

Preparatory Operations

Before fabrics are dyed and finished, there are various preparatory operations. These preparatory processes, as well as the actual dyeing and finishing, are carried out by the converter, who converts the gray goods into finished goods. Figure II-1 is a flow chart of these processes.

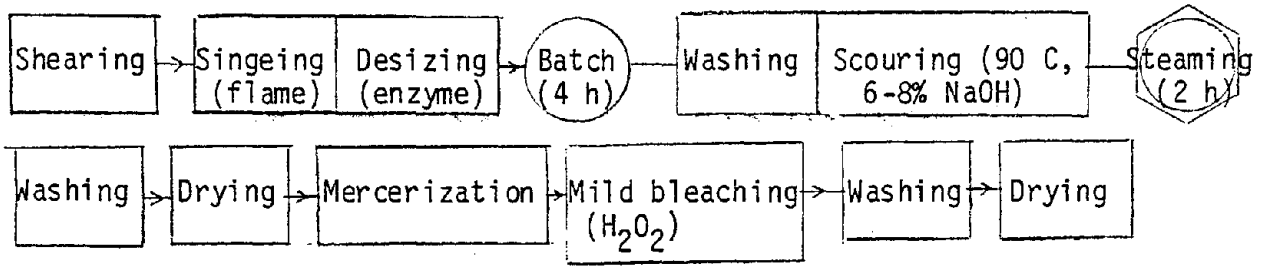
Different fibers usually undergo different treatments depending on the desired effect. For example, degumming is applied to silk and not to cotton because cotton does not have the gummy substance that silk has. Most of the important preparatory processes are described below.

(a) Singeing (Gassing)

Singeing is the treatment of woven fabrics with heat or flame in order to remove surface fibers from the fabrics to produce a smooth finish.

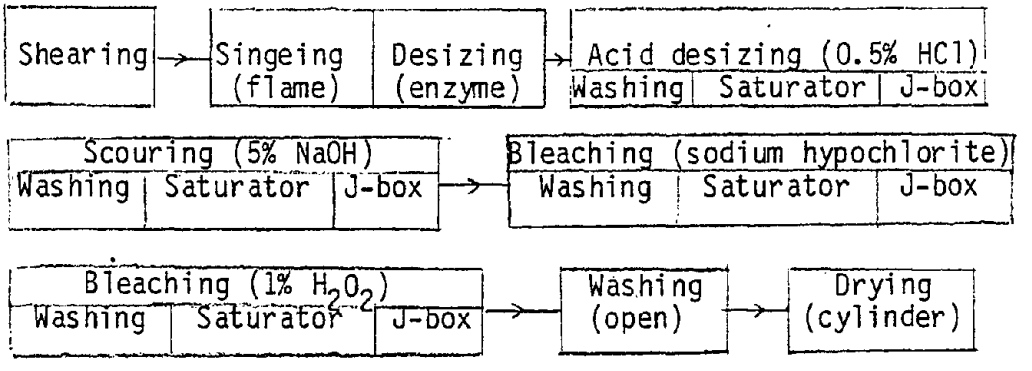
Three types of singeing apparatus are usually used: gas, plate, and roller. Generally, lightweight fabrics are singed on gas singers, whereas for heavy goods the plate and roller singers are used. Before singeing, the goods are brushed off to remove loose dirt and thread. The fabric is then passed through a set of rollers (Figure II-2) and passed over singers.

Open-Width Half Bleach



Fabric ready for dyeing

Rope-Form Full Bleach



Fabric ready for dyeing (light) and finishing

FIGURE II-1. FLOWCHART OF PROCEDURES TO PREPARE FABRIC AND YARN FOR DYEING AND FINISHING

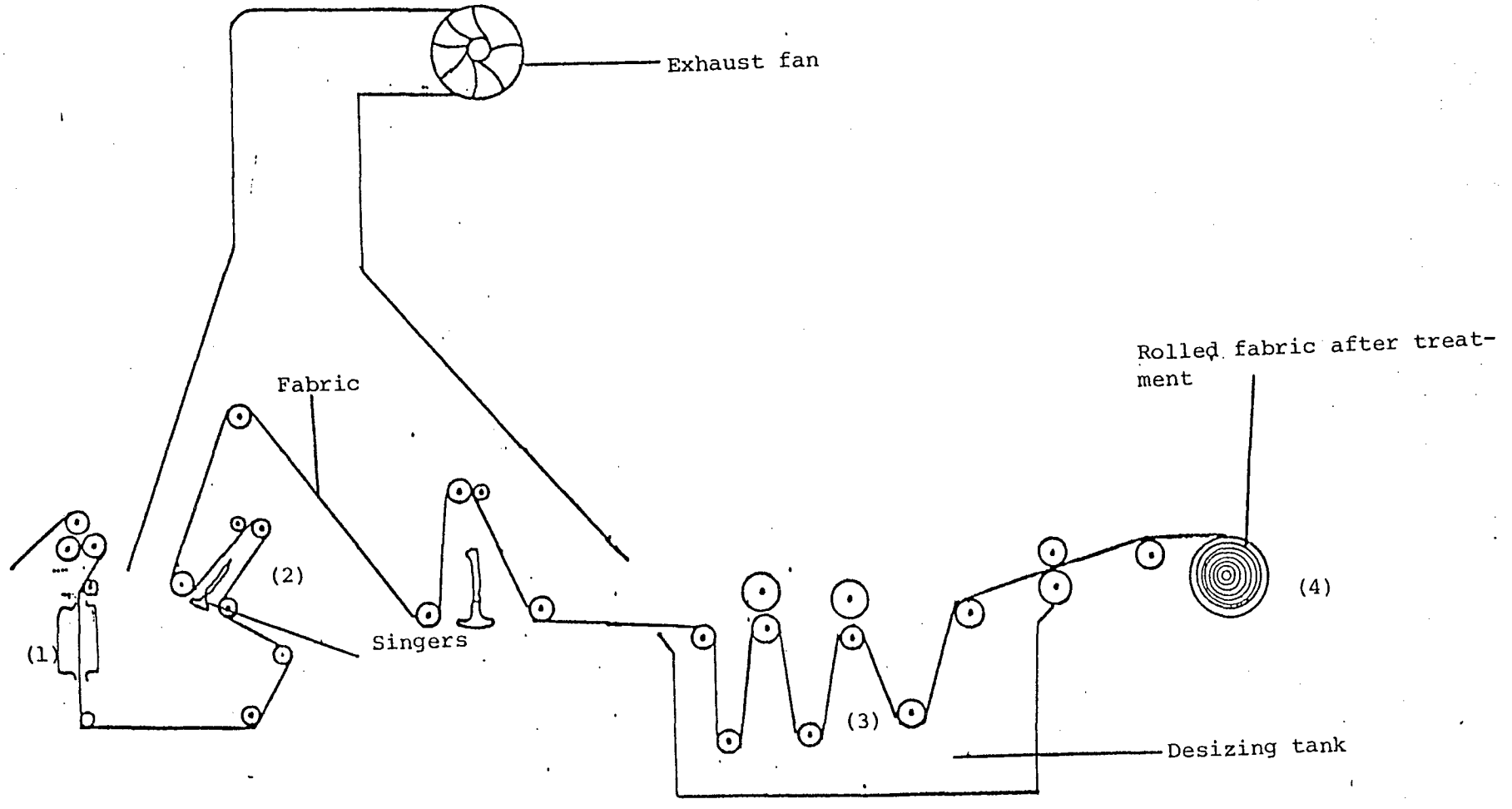


FIGURE II-2. SINGEING AND SIZING APPARATUS. DURING SINGEING, THE FABRIC PASSES THROUGH ROLLERS (1). THEN IT PASSES OVER GAS SINGERS (2) AND INTO THE ACID BATH TO REMOVE SIZING (3). FINALLY, IT PASSES THROUGH OTHER ROLLERS AND IS ROLLED (4).

Immediately after singeing, the cloth is passed through water, dilute sulfuric acid, or starch-solubilizing enzymes to quench any sparks that might result from singeing.

(b) Desizing

Desizing is the removal of starch or other sizing agents that are used to strengthen fibers during processing. Desizing methods involve treating the goods with dilute sulfuric acid or with one of the several liquefying enzymes.

In the acid process, the goods are quenched after singeing in 0.5-0.75% sulfuric acid solution and extracted with water. The fabric remains in steeping boxes for 6 to 8 hours at room temperature and is then thoroughly washed to remove acid and hydrolyzed starch (Figure II-2).

In the enzyme process, a more careful approach is needed because both pH and temperature must be carefully controlled. The most commonly used enzymes are diastases from malt, examples of which are Diastofor and Digestase Special. These enzymes work most efficiently at a pH of 5.0 to 6.5 and at 140-150 F (60-66 C). The cloth is put into a vat containing the enzymes and allowed to sit; then the fabric is washed.

(c) Scouring (Boiling Out)

During scouring, sizing material, dirt, oils, and other substances that adhere to the fibers and fabric during processing are removed. Gener-

ally, for scouring cotton, a strong solution of sodium hydroxide is used; for scouring wool, soap, alkali, or detergents are used. When scouring is done as a finish, it is called piece scouring.

In the scouring process, goods are plaited down through a manhole at the top of a kier in which the liquor (1-2% caustic soda usually mixed with 0.25-0.50% sodium carbonate, sodium silicate, or trisodium phosphate) is continuously drawn off from the bottom and sprayed over the goods at the top. The kier operates under pressure by the injection of steam (up to 3 atm pressure). Kier times range from 2-12 hours, depending on the fabric used. After boiling, the kier liquor is replaced by clear, cold water and the goods are washed several times until cooled.

(d) Mercerization

Mercerization is the treatment of cellulose fibers with sodium hydroxide in order to increase luster, strength, and dye affinity. The process can be carried out before or after the fabric goods are bleached; however, yarns are mercerized before bleaching.

During mercerization, the cloth passes continuously through a caustic saturator containing caustic soda at a temperature of 70-80 F (22-26 C). The excess caustic soda is removed by washing while the goods are held to the desired width on a tenter frame. The washer consist of several boxes containing hot water and dilute acids (Figure II-3).

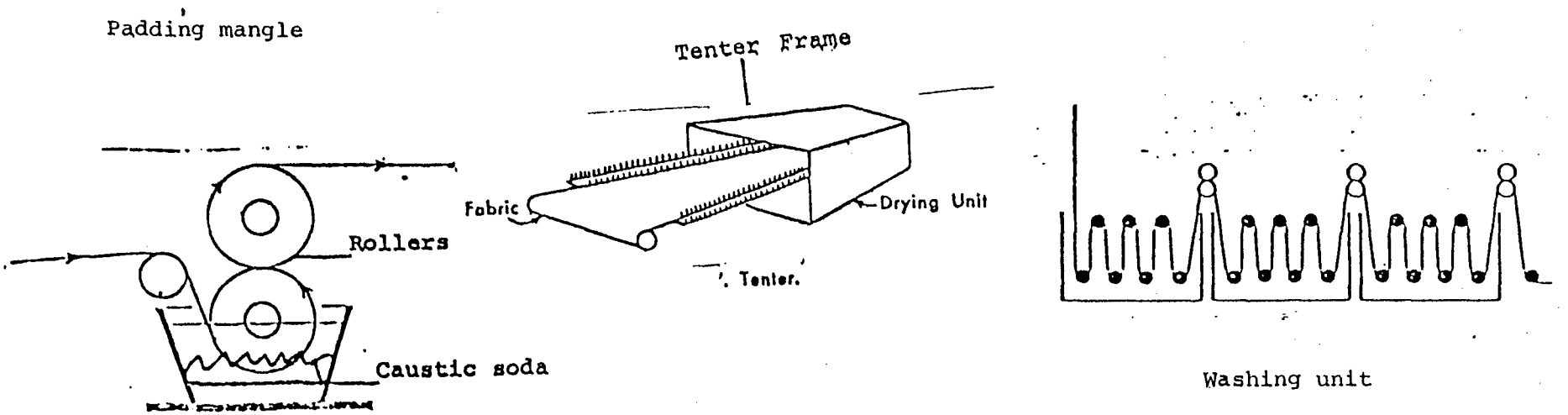


FIGURE II-3. MERCERIZATION PROCESS

In a related process, slack mercerization, fabric is treated so as to allow stretch. In this process, stretch is obtained in the filling direction (width) by holding the length direction under tension while width tension is relaxed. The fabric is then treated with caustic soda for 1 minute. After caustic treatment, the fabric is washed with water (near boiling) and then dried.

The dried fabric will stretch 15-20% in the filling direction, allowing the wearer easy comfort. Material that has been slack mercerized is made into blouses, shirts, and dresses.

(e) Bleaching

Bleaching is the removal of color from fabrics by means of a chemical agent. This process whitens the cloth, which generally comes from the loom a grayish-brown color. Preliminary bleaching is important because if a fabric is not bleached properly during finishing, it could change color due to natural environmental processes (eg, fading from sunlight).

Cotton is generally bleached with chlorine compounds such as sodium hypochlorite and calcium hypochlorite. In addition to chlorine bleaches, hydrogen peroxide is also used. Silk responds well to hydrogen peroxide, whereas wool can be bleached by either hydrogen peroxide or sulfur dioxide gas in the presence of moisture.

During this process, the fabric is saturated in a bleach solution, which may be in large bins. Then the temperature is raised to the level

recommended for the fabric being bleached. After saturating for a period of time in the bleach, the fabric is thoroughly rinsed and dried.

In another process, bleaching may be continuous by using a J-box (Figure II-4) or, in some cases, a series of J-boxes. After going through the J-box, the fabric is washed, scoured, and washed again.

A third bleaching method uses kiers, which are large vessels capable of holding 5 tons of cloth. The goods are boiled for 12 hours under pressure in the kiers, and a 3% solution of caustic soda plus soap and sodium silicate is added. After the 12-hour period, the goods are washed with cold water, pulled out of the kier, washed again, and treated with a weak solution of sulfuric acid to neutralize the alkali. This treatment is called "souring." After another washing, the goods are passed into a 2% sodium hypochlorite solution and piled into bins or J-boxes, where they lie for about an hour. After this last treatment, the cloth is washed through a solution of sulfur dioxide in water, washed again, and allowed to dry for the finishing processes.

Dyeing Processes

After fabrics or yarn have been prepared for finishing, they are dyed by various procedures including printing. For the purposes of this discussion, only the major dyeing processses will be discussed. For information on the other dyeing methods listed in Table I-6, see the glossary in Appendix B.

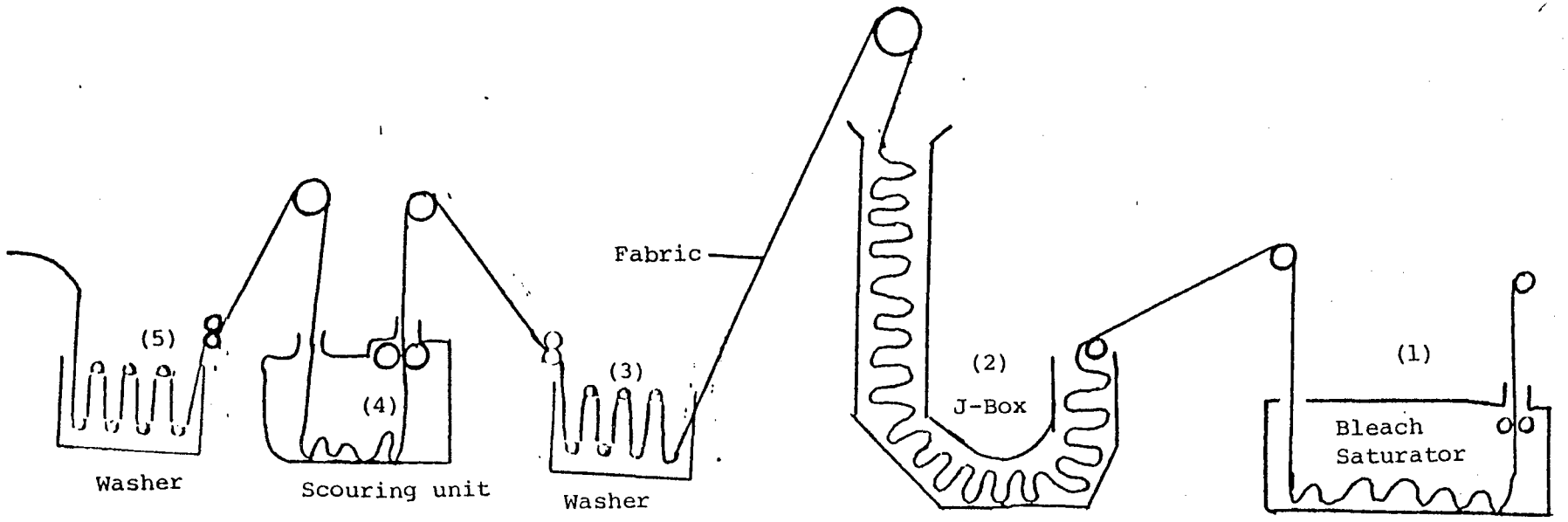


FIGURE II-4 J-BOX UNIT. THE FABRIC PASSES THROUGH THE BLEACH, AT WHICH TIME IT IS SATURATED (1). THEN IT GOES TO THE J-BOX, WHERE IT IS STORED FOR 1 HOUR BEFORE GOING TO THE NEXT PROCESS (2). AFTER LEAVING THE J-BOX, THE FABRIC GOES TO THE WASHING UNIT (3), THEN TO THE SCOURING UNIT (4). AND THEN BACK TO ANOTHER WASHING UNIT (5). THERE ARE ALSO VARIOUS COMBINATIONS OF THIS PROCEDURE.

Approximately 2,500 dyes and dye auxiliaries (agents that help in the dyeing process) are used in the textile industry today. Table II-1 lists the major classifications of dyes as well as their dyeing conditions and the fibers that they are used on. A device called COMIC (acronym of COlorant MIxture Computer) is used by some plants for shade matching, as well as spectrophotometers and colorimeters.

(a) Yarn Dyeing

Yarns are dyed in the form of hanks and packaged eg, cheese, cones etc.

(1) Hank Dyeing

In hank dyeing, hanks of yarns are threaded over poles and suspended over an open dye bath; the hanks are worked so that they are rotated, thus allowing the dye to penetrate all of the yarns. A machine consisting of porcelain rods is used for dyeing rayon yarn. The apparatus consists of a long, shallow trough of dye liquor over which project numerous porcelain rods that carry 2-3 lb of rayon in hanks. The rods rotate so that the hanks are subjected to continuous turning, allowing the dye to penetrate the whole hank of yarns. A variation of this machine is the Hussong machine (Figure II-5). Here the yarn is suspended in a dye bath chamber, and the dye liquor is circulated by a propeller placed in an adjacent chamber. The Hussong machine has automatic controls for controlling the temperature and flowrate of the dye.

TABLE II-1

CLASSIFICATION OF DYES

Dye Class	Fiber Dyed	Conditions of Dyeing
Direct	Cellulosic: cotton, wool, regenerated protein	Dissolve in water, need sodium chloride (NaCl). Goods enter dye bath cold, warm up slowly to 90 C, and are maintained there for 45 min. Small liquor/goods ratio suggested.
Acid	Wool, regenerated protein, silk, nylon, Orlon, Acrilian Creslan	Dyestuffs are dissolved in H_2SO_4 or formic acid. Glaubers salts ($Na_2SO_4.10H_2O$) are added in proportion to dyestuff. Dyeing is done by adding goods and slowly raising temperature, using high liquor/goods ratio (about 40:1) and adding sodium sulfate to bath to retard action.
Mordant	Wool, Acrilan	Need metallic group, usually chromium, to fix dye to fiber. When using sodium bicarbonate ($NaHCO_3$), mordant is precipitated on fiber before dyeing. If dyestuff is easily oxidized, reducing agent (oxalic acid) is added to dye bath. Mordant is sometimes applied at same time as dye. Sodium chromate is used as mordant in the presence of ammonium sulfate.
Disperse Azo Anthraquinone	Cellulose acetate, nylon, vinyon	Disperse in water if wetting agent such as Turkey red oil is present. Dye by dissolving in fibers, which act as solvents for the dyes. Because fibers dyed by disperse dyes have no reactive groups, they are dyed by this process.
Basic	Regenerated protein, silk, wool	Combine with fibers carrying acid groups; will not dye cellulose unless treated with mordant. Absorb light and fluoresce because intramolecular vibration. Give brilliant colors and are useful for ribbons and party frocks.
Sulfur	Wool, Creslan, cellulose, Zefran	Made by melting organic materials with sulfur and alkaline sulfides. Are applied from a solution of sodium sulfide, which dissolves and reduces dye to more soluble form. Are oxidized to the insoluble form when exposed to the atmosphere. Black colors require 10% dyestuff and no salt; colors require less dyestuff but need 5-15% salt or Glaubers salt. Wetting agent is added to dye bath.

TABLE II-1 (CONTINUED)

CLASSIFICATION OF DYES

Dye Class	Fiber Dyed	Conditions of Dyeing
Azoic	Cotton prints, polyester, Creslan, Nytril, Acrilan	Fiber, yarn, or fabric is impregnated with naphthol; impregnated material is treated with solution of an amine diazotized with nitrous acid. Naphthol couples with the amine, and an insoluble azo color is formed in fiber. After azo color is formed, dyer must wash goods with soap to remove surface color that might cause poor fastness and rubbing.
Vat Anthraquinone Indigoid Sulfide	Cellulose, Zefron, Creslan	Insoluble in water, so they may first be reduced with sodium hydrosulfite to form leuco compounds; are then dissolved in strong alkaline solutions. Fiber is impregnated in the reduced solution and then oxidized by treatment with oxidizing agent or exposure to air. A good soaping removes color and ensures fastness. Anthraquinone dyes are used in strong alkaline solutions; indigoid vat dyes are used in weak alkaline solutions.
Reactive	Cellulosic, synthetic	React with fibers. Dyes used are Procion dyes, which polyamidesare built around cyanuric chloride. When a chlorine atom in the compound is replaced by an amine group, resultant compound has another chlorine atom sufficiently mobile to react with a cellulose hydroxyl group in an alkaline medium of pH 10.5-11.

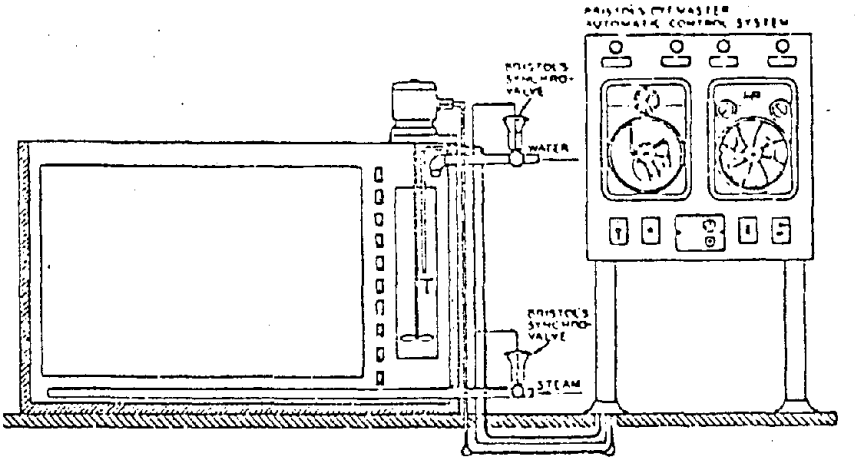


FIGURE II-5. HUSSONG MACHINE

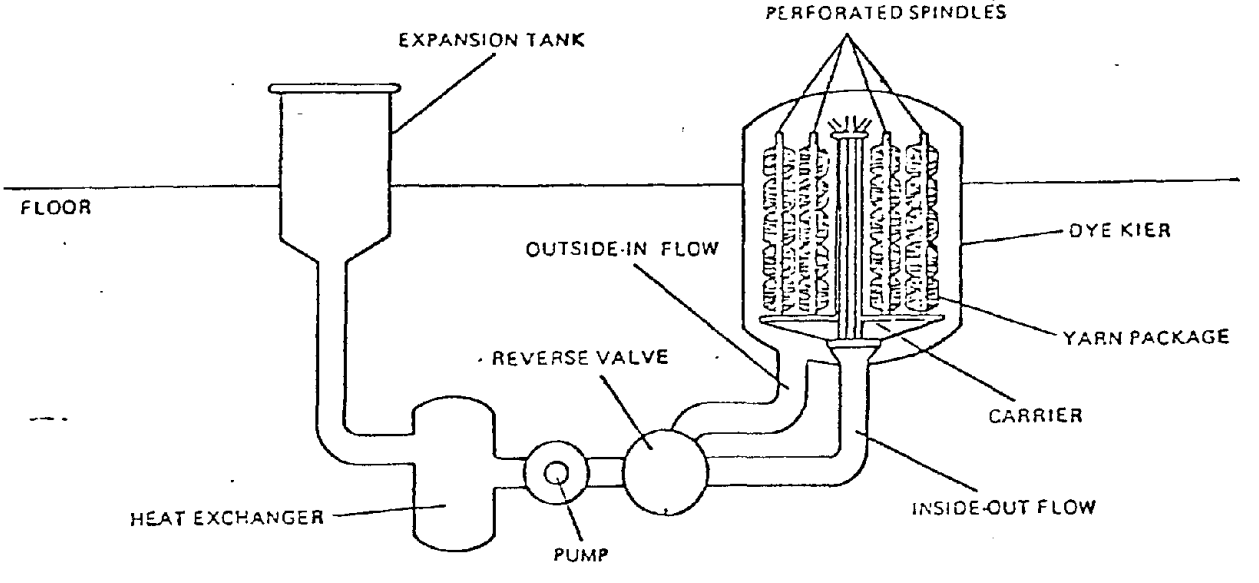


FIGURE II-6. PACKAGE DYEING OF YARNS (COURTESY OF DOW BADISCHE COMPANY)

(2) Pressure Dyeing

Pressure dyeing is used for packages (Figure II-6) as well as for fabrics. This process has three major advantages over simple hank dyeing:

- o There is a lower ratio of dyestuff to other solutes (5:1 rather than 30:1) and therefore lower dyestuff costs.
- o There is very little handling of the yarn and therefore lower labor costs.
- o There is less mechanical damage caused by constant movement of the yarn.

The machine involved, a Longclose pressure dyeing machine, is made of stainless steel and resembles an autoclave. It is fitted with a time/thermostat control which allows dye flow in and out the of the yarns. Yarn is wrapped around a spool and placed on frames, which are placed inside the chamber. The top of the chamber is sealed, and the dyeing process begins. The dyes used must be well dispersed in the liquid medium; otherwise the yarn will filter out various particles of the dyestuff. Yarn packages which are dyed must be loosely wound to allow total penetration of the dyes.

(b) Piece Dyeing

Piece dyeing is the dyeing of fabric after it has been woven or knitted. An advantage of this type of dyeing is that it gives the manufacturer maximum flexibility to meet both large and small demands for a

given shade. Piece dyeing is done with various kinds of equipment and processes as described below:

(1) Jig Dyeing

A jig (Figure II-7) is a machine consisting of two batching rollers with guide rollers over a V-shaped trough filled with dye. The cloth is wound around one of the rollers, drawn downward through steam-heated dye liquor and then wound onto the second roller. About 5,000 yards of cloth can be dyed at one time with this apparatus.

(2) Pad Dyeing

In pad dyeing, the fabric is run through the dye bath in open width and then between squeeze rollers, which force the dye onto the fabric (Figure II-8). With this type of apparatus, cloth can run at a rate of 30-300 yd/min.

(3) Winch, Reel, or Beck Dyeing

Winch dyeing is the oldest form of piece dyeing. The fabric, which is in a loose rope sewn together at the ends, is lifted in and out of the dye bath by a reel (Figure II-9). The fabric is kept immersed in the dye bath; the dye penetrates as the fabric is immersed continuously in a slack condition rather than by pressure. This type of dyeing is used both on lightweight fabrics that cannot withstand the tension of other methods and on heavy goods such as wool.

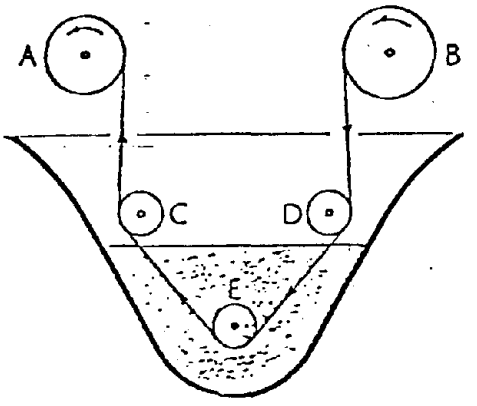


FIGURE II-7. DYE JIG. FABRIC FROM ROLLER B PASSES AROUND GUIDE ROLLERS D, E, AND C, THROUGH THE DYE LIQUOR, AND IS THEN TAKEN UP ON ROLLER A. THE DYE LIQUOR IS STEAM HEATED. THE NUMBER OF TIMES THE FABRIC IS WOUND FROM ONE ROLLER TO ANOTHER IS THE NUMBER OF "ENDS."

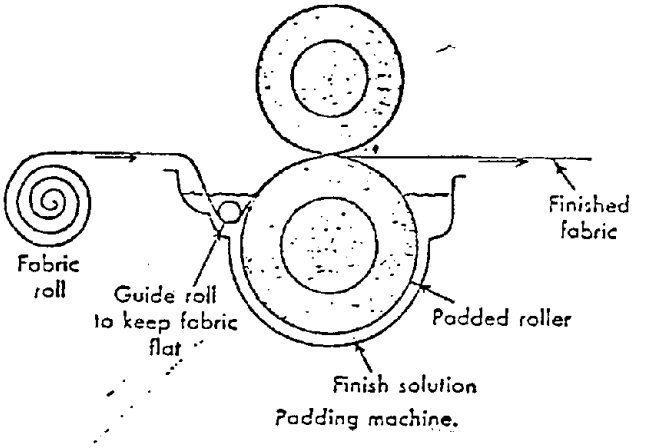


FIGURE II-8. PAD DYEING. THE TWO MAIN ROLLERS ARE UNDER PRESSURE SO THAT THE FABRIC IS SQUEEZED AFTER BEING DIPPED IN THE DYE LIQUOR. THE PRESSURE MUST BE UNIFORM ALONG THE LENGTH OF THE ROLLERS.

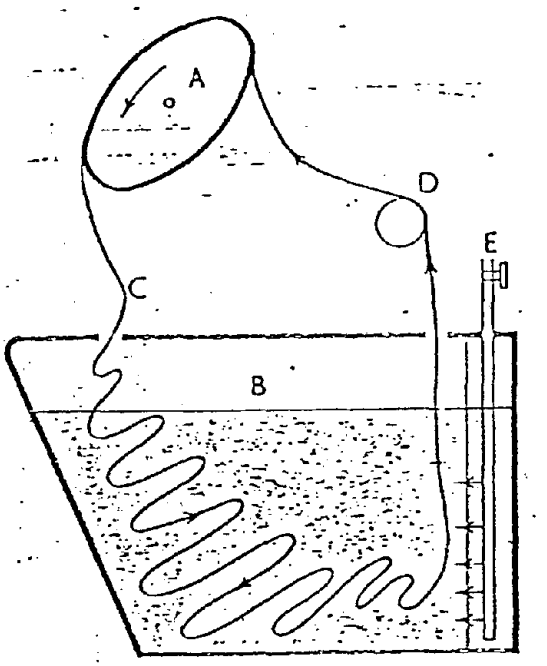


FIGURE II-9. WINCH DYEING. (A) ELLIPTICAL ROLLER; (B) DYE LIQUOR TROUGH; (C) FABRIC; (D) GUIDE ROLLER; (E) STEAM HEATING PIPE. NOTE THAT THE FABRIC PLAITED BY THE ELLIPTICAL ROLLER SPENDS MOST OF THE TIME IN THE LIQUOR--A BIG ADVANTAGE OVER THE JIG. A WINCH IS SUITABLE FOR PLAIN AND CREPE FABRICS. IN SOME CASES IT MAY GIVE "ROPE CREASES" CAUSED BY BUNCHING THE FABRIC IN THE FORM OF A LONG ROPE.

(4) Thermosol Process

In the thermosol process, fabrics are dyed at normal temperatures on regular equipment, dried, and then heat set for 0.5-1 minute at 177 C (350 F).

(5) Baroter

A Baroter is a relatively new device used to dye fabric. This machine, which is intended to dye fabrics at 120 C, consists of four major components: an autoclave-type pressure vessel which encloses the fabric

being dyed, the dyestuff, and the rotor; a 6-foot-diameter rotor on which the fabric is suspended full width in folds on two concentric series of parallel bars; a drive which rotates the rotor at a speed varying from 0.5-6 rpm, usually about 2 rpm; and a sampling device which can be isolated from the main machine so that samples can be removed without loss of pressure. In general, the capacity of the Barotor is 400 lb of fabric.

In the dyeing process, the fabric is looped in a skewed manner so that as the rotor turns (in a counterclockwise direction), the fabric becomes parallel with the liquor (dyes) as it is immersed (Figure II-10).

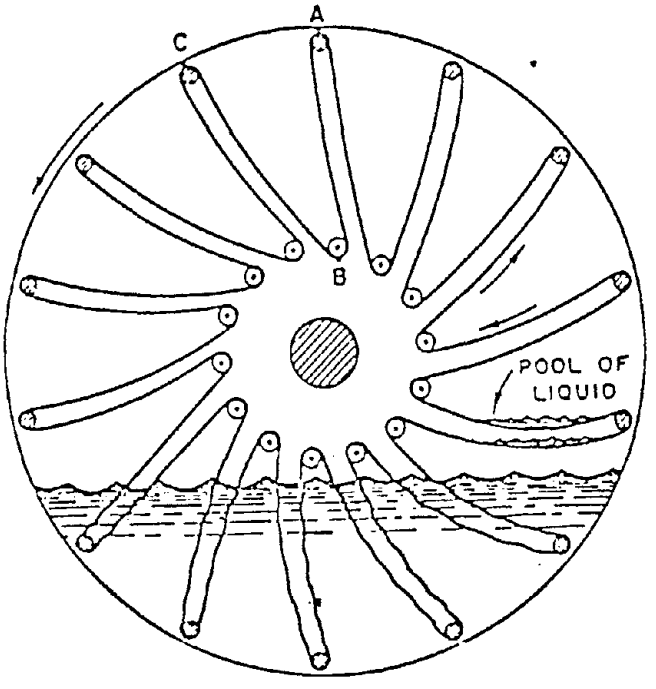


FIGURE II-10. SCHEMATIC CROSS-SECTION OF THE BAROTOR

Since the fabric is loaded slack on the Baroter, each loop carries a liquid pool as it emerges from the dye. The weight of the liquid pool causes sagging of the fabric. This sagging causes some slack to be taken up from the buoyant fabric in the liquor so that the fabric gradually creeps round the rotor. This creeping is a slow process in which 0.25-0.5 inch of fabric is moved during each revolution of the rotor. Without this creeping, the fabric will not be evenly dyed. Before each fabric is loaded onto the rotor, the shrinkage desired should be determined so that an allowance can be made for adequate slack.

(6) Jet Dyeing

A new advancement in dyeing lightweight fabrics is jet dyeing. In this process, dyeing takes place in a closed system in which a fast-moving stream of pressurized dye liquor is carried (Figure II-11). The dye penetrates and dyes the fabric as it passes through the jet. After passing through the jet, the fabric is floated through an enclosed tube where the liquor moves faster than the fabric. This prevents the fabric from touching the side walls of the tube and thus keeps it immersed in the dye bath. Several elbows in the tube create turbulence, which aids in diffusing the dyes and other chemicals. This type of dyeing is useful for very delicate fabrics, since no pressure is applied. In addition, it is economical to operate and allows a high degree of quality control.

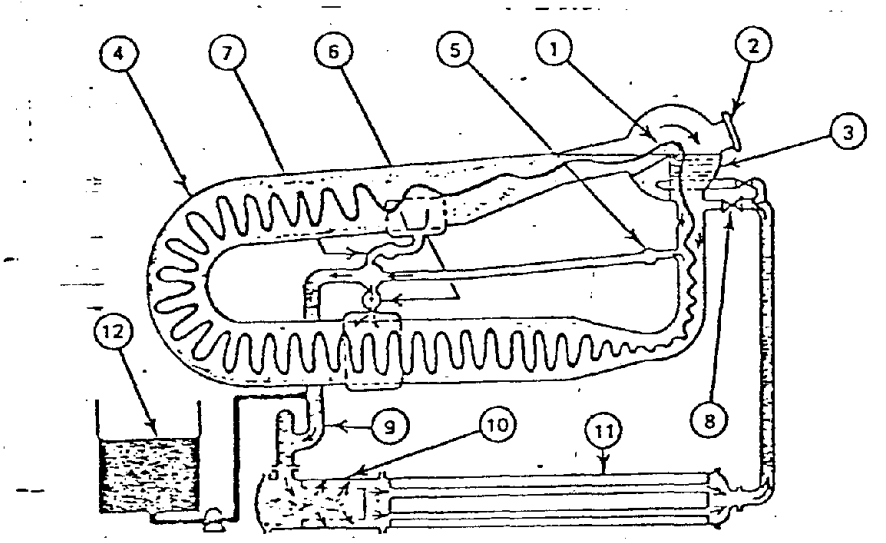


FIGURE II-11. JET DYEING MACHINE. (1) FABRIC GUIDE ROLL; (2) LOADING AND UNLOADING PORT; (3) HEADER TANK; (4) U-TUBE: (5-7) SUCTION CONTROL; (8) DELIVERY CONTROL; (9) MAIN PUMP; (10) FILTER; (11) HEAT EXCHANGER; (12) SERVICE TANK.

(7) Beam Dyeing

In this dyeing process, the fabric is wrapped around a beam and then immersed in a dye bath. Since beam dyeing does not put pressure on the goods as they are being dyed, it is used for lightweight and open-weave fabrics. Bean dyeing uses equipment similar to that described earlier for high-pressure package dyeing.

(8) Vacuum Impregnation

This process is used for dyeing heavyweight fabrics such as corduroy and sateens, which previously had been difficult to dye because

air became trapped inside the fabric. In the vacuum system, the fabric comes in contact with a perforated stainless-steel cylinder. A vacuum pump draws air into the cylinder while dye is being applied, thus allowing thorough penetration of the dye through the fabric.

(c) Printing

Printing is the application of color in a design pattern on a fabric. There are roughly 16 different kinds of printing processes in use today (Table II-2), but there are three major processes will be addressed: roller printing, screen printing, and rotary screen printing.

(1) Roller Printing

Roller printing is a process that results in a beautiful, detailed print characterized by close-fitting colors. It is essentially a roller version of the printing press. It is also an intaglio process because it uses a design engraved on a copper cylinder. In general, there are as many different cylindes as there are colors to be printed.

In the process, furnisher rollers revolve in a trough containing a color (Figure II-12) and then transfer the color onto the engraved roller. A doctor blade scrapes off the excess dye. The cloth that is printed passes between a larger roll and an engraved copper cylinder. Underneath the cloth are two other cloths: a rubberized blanket, which gives the cloth a good dyable surface, and a gray cloth for backing, which absorbs the dye.

TABLE II-2

DECORATION OF FABRICS BY PRINTING AND DYEING

Type of Decoration	Hand Method	Machine Method
Block printing	Design carved on blocks; dye applied to block; block pressed on fabric	Similar blocks pressed on fabric by machine; design tends to be more regular
Roller printing		Design etched on roller; companion roller transmits dye to etched roller, which transmits it to fabric
Discharge printing		Bleached goods first dyed; chemical bleach printed on fabric; color discharged
Resist printing		Resist paste put on fabric; fabric dyed; paste removed
Stencil printing	Design cut in stencil; color applied over stencil	
Screen printing	Design sketched or photographed on sheet silk, nylon, Dacron, vinyon, or metal screen; background of design opaqued; color applied to screen as stencil and forced through screen	Similar screens; up to 20 set in electronically controlled machine that regulates speed of opertion, amount of dye forced through each screen, fabric movement
Rotary screen printing		Cylindrical seamless metal screen; dye paste forced through screen as it rotates on moving fabric
Thermocrome transfer printing		Thermoplastic ink designs transferred by heat and pressure from paper to fabric
Warp printing		Engraved rollers print design only on warp yarns; fabric then woven, using white or neutral filling yarn
Duplex printing		Design printed back to back on both sides of fabric; gives effect of woven pattern
Photo printing	Photographs printed on sensitized fabric	

TABLE II-2 (CONTINUED)

DECORATION OF FABRICS BY PRINTING AND DYEING

Type of Decoration	Hand Method	Machine Method
Batik dyeing	Design put on fabric; wax deposited on background of design; fabric dyed; wax removed	
Tie dyeing	Fabric knotted or tied in parts with string; dipped into dye; fabric untied	
Composition or paste designs		Lacquer figures or colored paste glued or baked on surface of fabric
Flocking		Very short, usually colored fibers adhered to fabric in design effect, conforming to pattern of adhesive applied with roller
Spray painting	Mechanized airbrush applies surface coating	

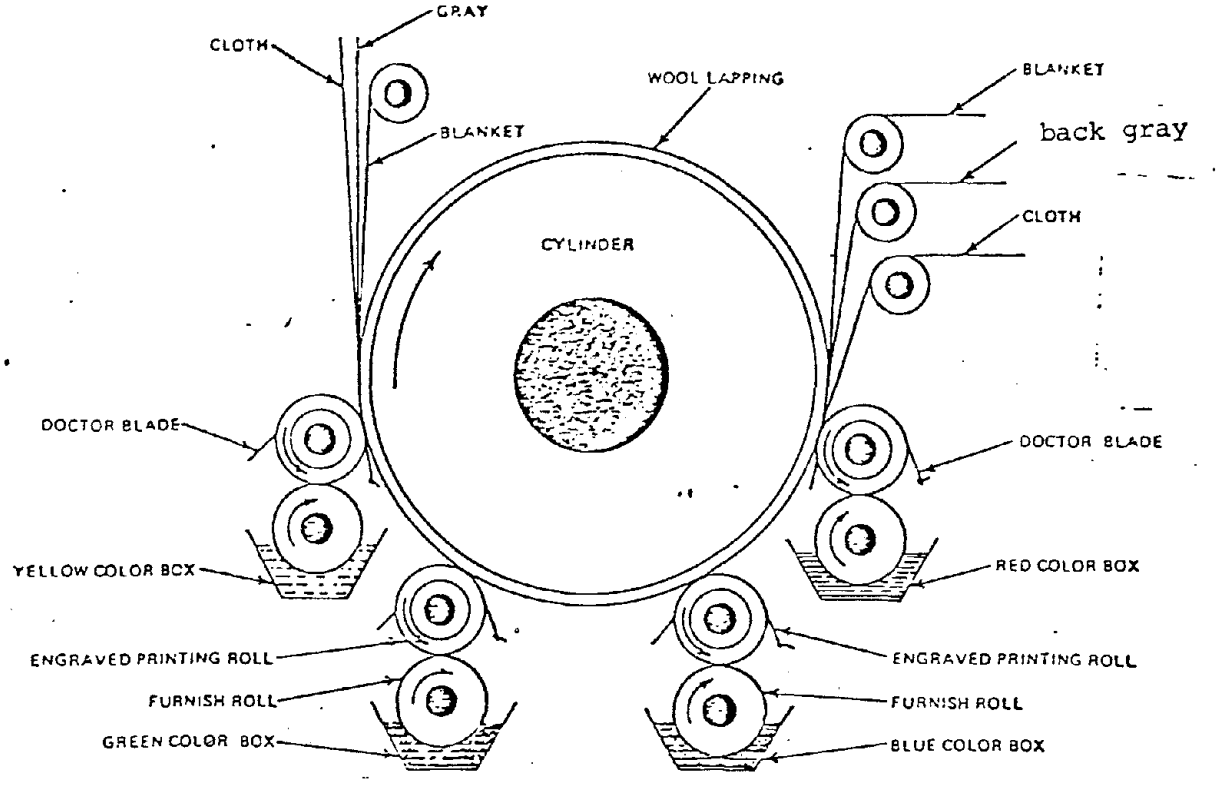


FIGURE II-12. ROLLER PRINTING MACHINE

Knitted and rayon fabrics are lightly coated on the back with gum sizing, which prevents them from stretching or swelling as they pass through the printing apparatus.

After being printed, the cloth is dried and steamed; it may also be treated to set the dye.

(2) Screen Printing

Screen printing has the advantage of producing brighter, cleaner shades than does roller printing. In this process, a fabric is printed by being passed under a dye-covered screen. Previously this method of printing was referred to as silk screen printing because the screens were made of silk. Now, however, the screen may be made of nylon, metal, or other materials. Screen printing is used extensively for designs whose circumference is larger that that of the rolls used in roller printing. In this method, the artist's design is copied on a screen for each color to be printed. There may be up to 20 screens, each with a different-colored design. After the design is drawn, lacquer or another impermeable substance is applied to all parts of the screen that are not part of the design. In a more modern method, the design may be photographed; then a negative is used for each sensitized screen to opaque or block out areas that are not part of the colored design.

After the design is made, the screen is fitted onto a wooden or metal frame. The fabric to be printed is pinned or pasted to a long flat table covered with a thick felt pad, an oil cloth, and a cotton cloth. The oil

cloth protects the felt pad, and the cotton cloth takes up the excess dye from the fabric. The cotton cloth must be changed periodically.

The screen with the design is set over the fabric by brackets, and the printing paste (dye) is poured onto the screen. The paste is forced through the screen by rubber-edged squeegees. The frame, which contains the screen, is placed over the next section of fabric, and the whole process is repeated (Figure II-13). In many cases the machines used are automatic and require only one operator, thus allowing more fabric to be printed at a lower cost. In general, screen printing is done commercially for small yardages (500-5,000 yards at a time).

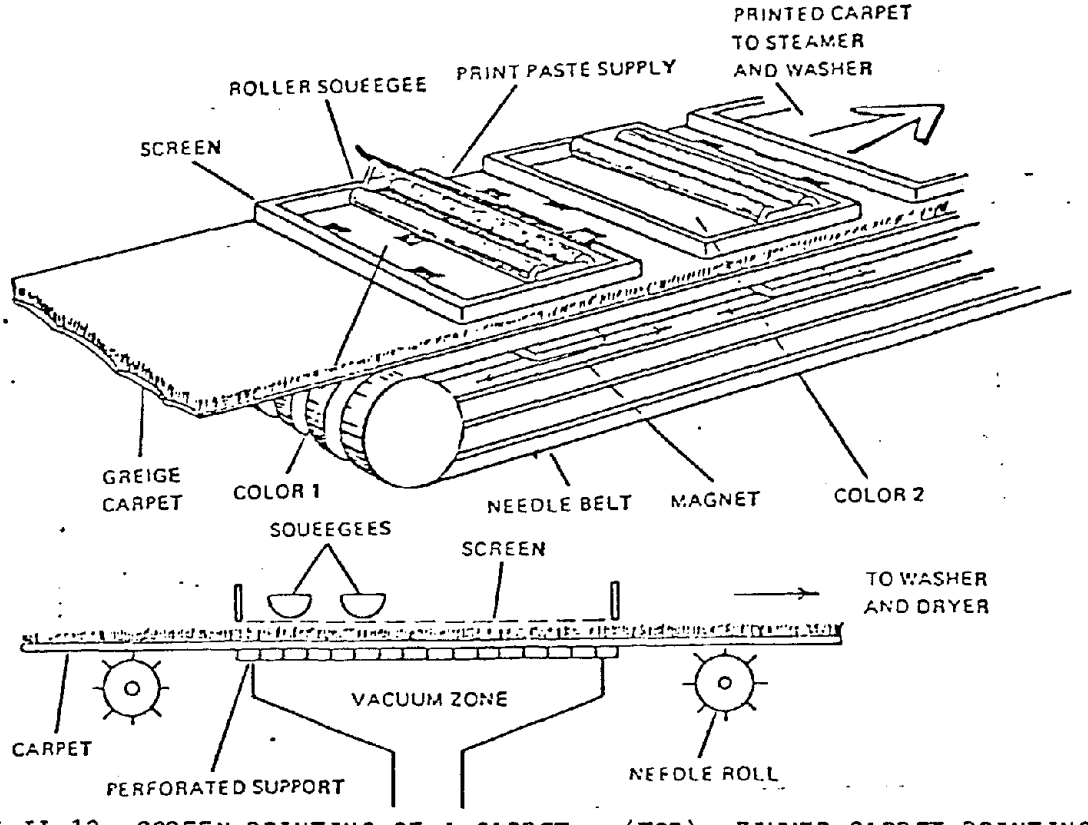


FIGURE II-13. SCREEN PRINTING OF A CARPET. (TOP) ZIMMER CARPET-PRINTING MACHINE LAYS DOWN EACH COLOR SEPARATELY FROM PRINTING PASTE APPLIED BY MEANS OF TWO MAGNETIC ROLLER SQUEEGEES. PRESSURE IS CONTROLLED BY SELECTING HEAVY OR LIGHT SQUEEGEES AND BY VARYING THE CURRENT GOING TO THE ELECTROMAGNET. ENDLESS BELTS FITTED WITH NEEDLES ASSURE A POSITIVE DRIVE FOR GOOD REGISTER. (BOTTOM) THE BDA SCREEN PRINTER USES A SERIES OF SCREENS, ONE FOR EACH COLOR; THE BASIC UNIT IS SKETCHED.

(3) Rotary Screen Printing

Rotary screen printing, developed in the Netherlands, is a recent modification that evolved from regular screen printing. In this method, prints of highly intricate design, with shades of up to 12 colors, can be obtained with a high degree of accuracy, sharpness, and detail.

The fabric being printed is fed under constant tension into the printer part of the machine (Figure II-14). The back of the fabric is coated with an adhesive that causes it to adhere to a horizontal conveyor printing blanket. Here the fabric passes under seamless rotating screens onto which printing paste (dye) is automatically fed from pressure tanks; a squeegee in each screen forces the paste through the screen and onto the fabric. The fabric can be printed at a rate of up to 85 yd/min.

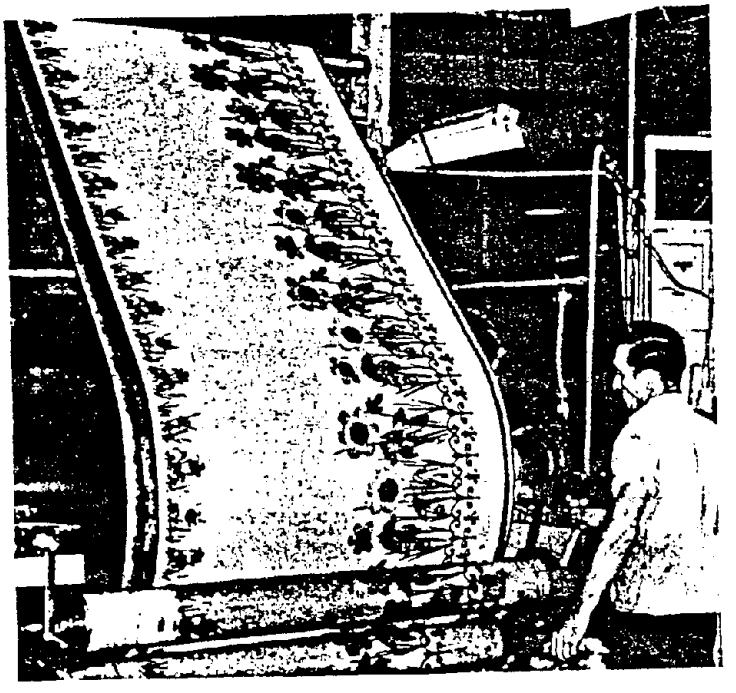


FIGURE II-14. ROTARY SCREEN PRINTING IN OPERATION (COURTSEY OF TEXTILE WORLD)

(d) Finishing Processes

For maximum durability, fabric must be finished properly. Finishing procedures are varied and complex, involving many processes that add luster, strength, permanent press, creases, pleats, water repellency, flame retardancy, and other qualities. Finishing may be accomplished both by mechanical and chemical means.

(1) Mechanical Processes

(A) Calendering

In calendering, fabrics are passed between rollers with the application of heat and pressure. Calenders may have two, three, five, or seven rollers. This process can give glaze, smoothness, embossments, or luster to fabric. Slightly different calender machines are used for the different effects.

A simple calender (Figure II-15), which gives a smooth finish to fabric, corresponds in function to the simple iron used in the home. In this process, a damp fabric is passed through a calender in which one roller is heated. The fabric is pressed between the heated roller and another roller. The fabric comes out smooth and may have a sheen.

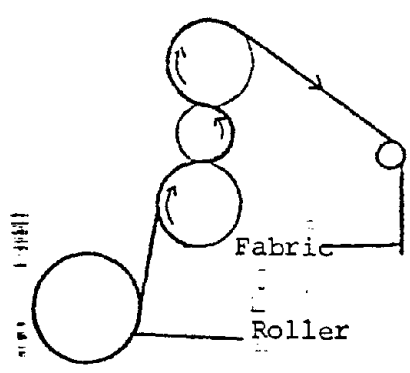


FIGURE II-15. CALENDER MACHINE

A friction calender is used to give a highly glazed surface to the cloth. In this process, the cloth is passed through a finishing solution (possibly a resin) and then partially dried. The cloth is then threaded through a calender in which the speed of a metal roller is greater than the speed of the cloth. The speeding rollers polish the cloth's surface. The other metal roller may be hot, which results in a highly glazed cloth.

A Schreiner calender produces a deep-seated luster rather than a shine by breaking up the reflectance of light rays. It also flattens the yarn. The Schreiner calender has a roller that is engraved with 200-300 fine diagonal lines that are invisible to the unaided eye. The cloth is threaded into the calender and run through it as in the simple calender.

Embossing calenders produce either flat or raised designs on fabrics. The embossing calender consists of two rollers; one is a solid paper rollers exactly twice the size of the other roller, which is hollow. The hollow roller is heated by a gas flame (Figure II-16). In this process, the cloth is threaded into the calender and passes over the engraved roller, which adds the embossment.

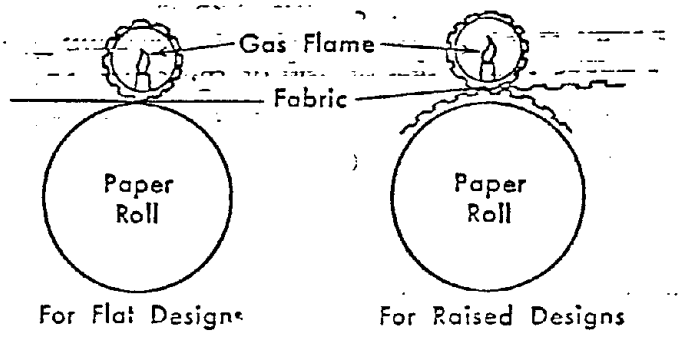


FIGURE II-16. EMBOSSING ROLLS

There are calendering procedures of less importance, such as moireing, in which a watermark design is applied to a fabric.

(B) Sanforization

Sanforization is a mechanical process whereby residual or service shrinkage is reduced to a minimum. This method produces a fabric that is guaranteed to have shrinkage of not more than 1% in either the warp or filling when it is washed.

In the process, the fabric to be sanforized is washed by standard procedures (ASTM or other approved methods), and shrinkage is determined. The fabric then passes over a smooth cylinder to remove wrinkles and is fed into a chamber. The fabric is dampened by steam or water to relax the yarns. After the fabric is dampened, it goes through a tenter frame. As the cloth passes through the frame, it is rippled by being pulled first on one side then the other while being subjected to steam. The sideways pull releases the tension on the warp yarn, which relaxes the crinkle. This results in lengthwise shrinking to the predetermined value. Pulling on the filling yarns, which are wet, causes the filling to straighten and stretch slightly. The width dimension can then be brought to the predetermined measurement as shown by the pretests.

The fabric then passes over additional cylindrical rolls to flatten the cloth, and the cloth goes to a belt-shrinking machine. Here it adheres to the outer surface of a heavy blanket that passes over the surface of a revolving drum. The blanket and the fabric are turned over as they enter

and pass into the drum. The blanket surface contracts and the filling yarns are compressed, which aids in shrinking. After this procedure the fabric is labeled "Sanforized."

(2) Chemical Processes

(A) Permanent Press

Perhaps the greatest achievement in finishing processes is permanent press, a treatment that saves millions of hours in ironing and pressing each day. Permanent press finishing is used mainly on cellulosic fibers or blends of cellulose with other fibers. In the process, chemicals called cross-linking agents are used to link the two chains of a cellulose molecule together. There are some permanent finishing processes, used mainly on synthetic fabric, that require only heat setting.

Chemicals other than the cross-linking agents are also used: wetting agents, softening agents, fulling agents, and catalysts. Table II-3 lists some cross-linking agents and catalysts used in the industry.

Permanent press finishes can be cured (totally finished) either before (precure) or after (postcure) the fabric is made into a garment. In precure finishing, the fabric is impregnated with a cross-linking agent, preferably a resin, and the fabric is dried (Figure II-17). In postcure finishing, the fabric is shipped to a garment manufacturer and made into a garment, heated in an oven at a relatively high temperature, and then prepared for the consumer (Figure II-18).

TABLE II-3

CROSS-LINKING AGENTS AND CATALYSTS

Cross-Linking Agents (for Cotton)	Catalysts
Imidazolidone	Tartaric acid
Dimethyl urea	Oxalic acid
Methoxymethyl melamine	Ammonium chloride
Trimethylol hexahydrotriazinones	Ammonium sulfate
Dimethoxymethyl melamine	Ammonium phosphate
Dimethylol ethylene urea	Organic amine salts
Dimethylol propylene urea	Zinc salts
Dimethylol dihydroxyethylene urea	Magnesium salts
Dimethylol-5-hydroxypropylene urea	
Tetramethylol acetylene diurea	
Dimethoxymethyl uron	
Dimethylol carbamates	
Dimethylol alkanediol diurethane	
Epichlorhydrin	
1,3-Dichloropropanol-2	
Formaldehyde	
Methylene glycol	

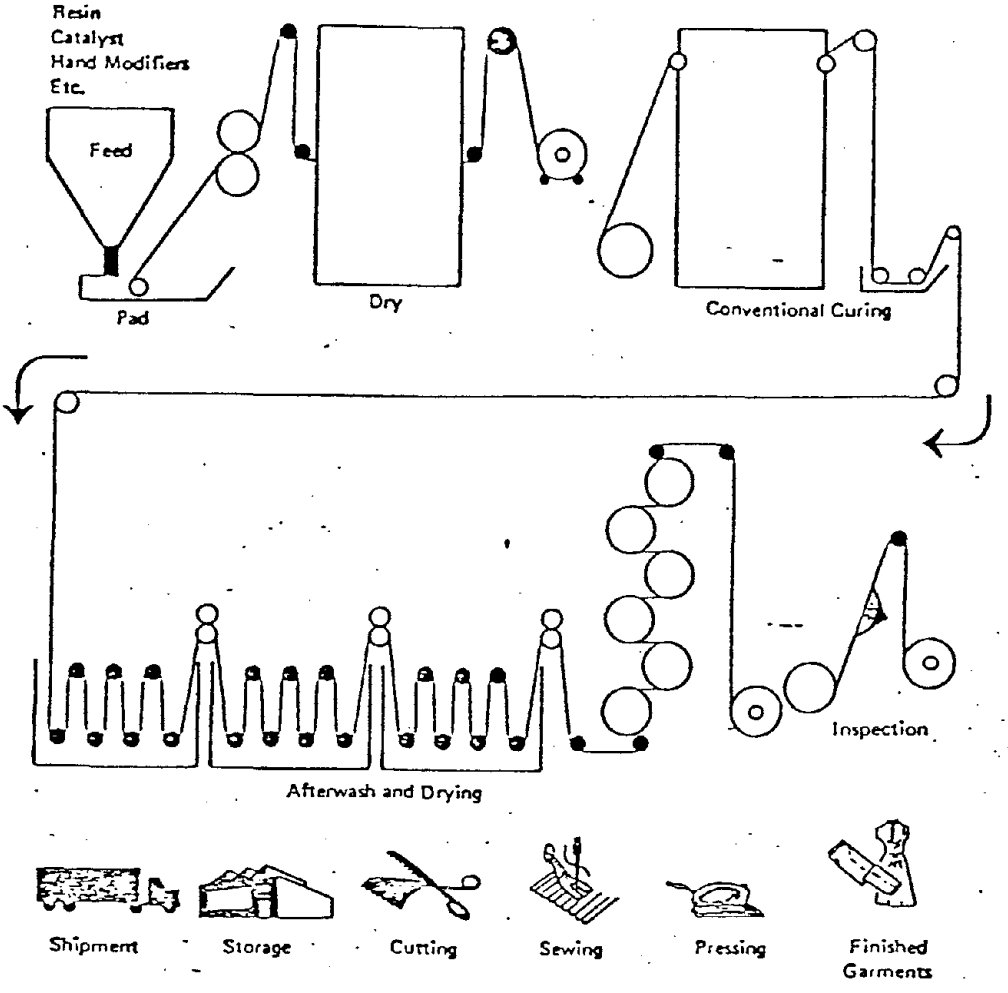


FIGURE II-17. PRECURE OPERATING PROCEDURES

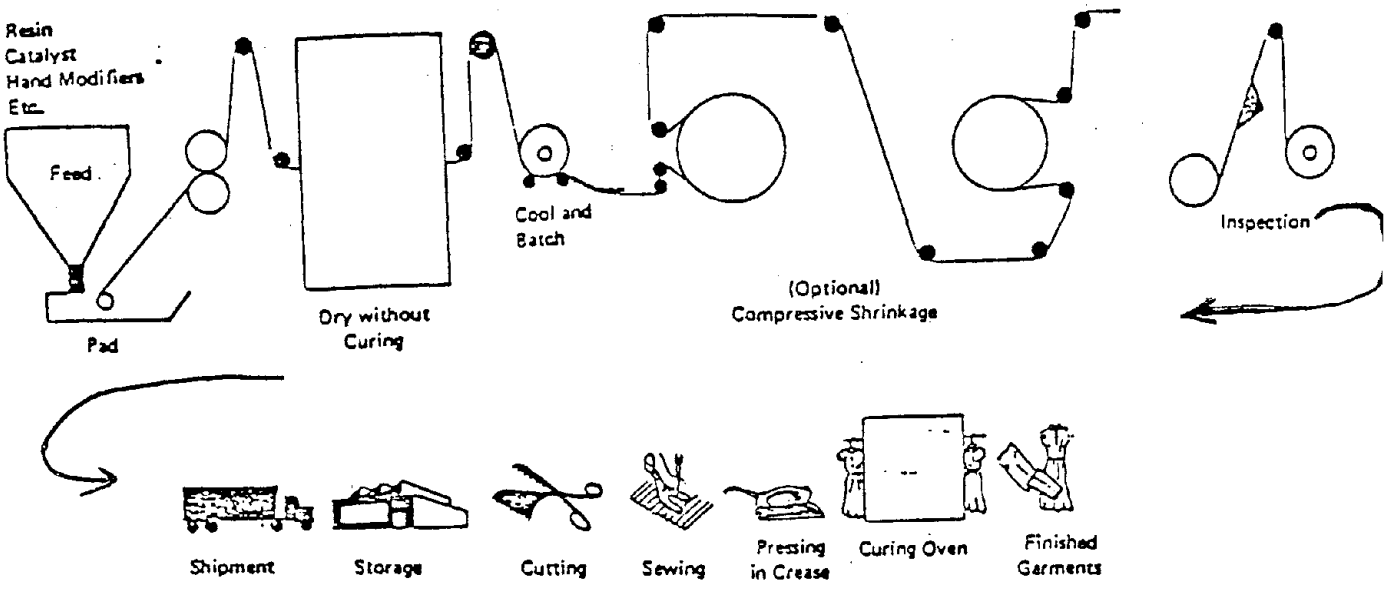


FIGURE II-18. POSTCURE OPERATING PROCEDURES

There are various patented processes on the market today for permanent press finishing processes including Koratron, Sta-prest, Super-crease, Dan-Press, Coneprest, and Sharp/Shape. Since many of these processes are similar, only the Koratron process will be discussed in detail.

In the Koratron process, fabric is impregnated with imidazolidone and dried at a relatively low temperature to avoid a chemical reaction that would set the finish. Then the goods are shipped to a garment manufacturing plant. After garments are made, they are put on a conveyor and passed through an oven heated to 160 C (320 F). Passing through the oven sets the cure, which results in a permanent shape, pleats, or creases.

(B) Flameproofing (Flame Retarding)*

A flameproofing or flame-retardant material decreases the flammability of a combustible fiber, polymer, or fabric. Flameproofing involves many chemicals and various processes. Chemicals used in flameproofing include tetrakis(hydroxymethyl)phosphonium compounds and derivatives; N-methylol dimethylphosphonopropionamide; chlorinated paraffins plus antimony trioxide; and borax and boric acid. Synthetic fibers such as modacrylics, however, are naturally flameproof and need no chemical treatment.

In one type of process, the chemical is applied by padding squeezed on the fabric by a padding machine, dried, and cured. Drying involves passing the treated fabric through a dryer but retaining some moisture. Curing involves passing the treated fabric through a hot oven for a short time, thus allowing the chemical to set properly.

In another process, the fabric is saturated with a soluble salt and then immersed in a second solution, which reacts with the saturated salt to render it insoluble. For acetates, nylons, and acrylic fibers, an emulsified clear liquid is applied in a dye bath and then the fiber is treated in the usual fashion to allow curing.

*Other terms indicating flame-retardant properties are flame resistance, self-extinguishing material, flame retardancy, and thermally stable material. See glossary in Appendix B for definitions.

In a newer process, used on nylon and Dacron polyester, a plastisol is coated on the fibers and bonded with an adhesive. This special coating imparts a good fire-retardant finish.

(C) Water Repellency

Water-repellent finishes resist absorption and penetration of water for a limited period of time. After that time, however, water will penetrate. Most water-repellent fabrics are porous, whereas waterproof fabrics are nonporous.

Chemicals used for water repellency in nondurable finishing are based on paraffin wax and aluminum and zirconium salts. In the process using these chemicals, an emulsion is applied to the fabric by simple padding. After the emulsion has penetrated, the fabric is dried.

For durable finishes, different chemicals are used. To impart water repellency to cotton, linen, and viscose rayon, a pyridinium compound is applied. This compound permeates the fiber and becomes part of it.

Durable finishing operations consists of five major steps:

1. The fabrics are impregnated by padding in the presence of a buffer and polymerizing agent.
2. The fabric is dried so that 5-10% moisture is retained.
3. The fabric is cured by passing through a temperature of 160-232 C (320-450 F) for up to 3 minutes and then cooled.

4. After cooling, the fabric is washed to remove acidic material and other water-soluble constituents. Washing is accomplished by passing the cured fabric through a continuous washer containing a solution of alkali and wetting agent in the first washer box and running water in the other washer boxes.
5. After washing, the fabric is dried by various standard methods.

(D) Waterproofing

For a fabric to be truly waterproofed, it must be completely sealed with a substance that is insoluble in water. Today most waterproofed fabrics are cotton and nylon. The chemicals used are usually vinyl resins because they do not oxidize or crack as readily as other substances such as rubber.

One process, the Koroseal process, makes fabric impervious to agents such as water, wind, mildew, and moths. In this process, plasticized polyvinyl chloride is coated on the surface of the fabric; this treatment results in a tough, stretchable plastic coating.

(E) Mothproofing

Wool products are sometimes mothproofed by impregnating the yarn with various chemicals. Dieldrin, a well-known insecticide, is sometimes applied to wool in the dyeing process as well as in other wet

processes. Here the material is absorbed onto the fabric. In a newer development, antimetabolites are coated onto wool fibers, which makes them virtually useless to moth larvae as food.

III. TEXTILE DYEING AND FINISHING OCCUPATIONS

According to the Occupational Outlook Handbook of the U.S. Department of Labor, about one-half of all employees in the textile industry work in mills that weave or knit fabrics to be made into clothing or household furnishings. Another one-third of the employees produce knit goods for use in making stockings and underwear, and most of the remaining employees work in mills that color or put patterns on cloth or that manufacture carpets and other products such as thread, lace, and cord for tires.

Although textile plants are found in almost every State, they are concentrated in a broad arc stretching from New England through the Southeastern United States into Texas. Because of several economic advantages in the Southeast, such as cheaper steam and electric power, lower labor costs, and geographic accessibility to cotton, the South dominates the Northeast in most sectors of the industry.

Although most of the plants are small, about 90% of all textile workers are employed in plants having 100 workers or more. The 1980 U.S. Industrial Outlook estimates total employment during 1979 as about 856,000. Of this total, 72,500, or 8.1%, were employed in dyeing and finishing occupations.

Dyeing and finishing processes usually take place after the yarn has been woven or knitted. The operations may take place on the premises where the fabrics are woven or may be done by independent businesses. Selected

dyeing and finishing occupations as listed in the Dictionary of Occupational Titles are described in detail in Appendix C. A few of the major categories are briefly described below.

Bleach range operators are involved in operations preparatory to dyeing and finishing processes. They tend machines that bleach, wash, and dry greige cloth. Dye weighers mix the dyes and chemicals to be used in the subsequent dyeing processes. Dye range operators run the machines that dye and dry the cloth. In the dyeing process, fabric is immersed in a solution of dyestuff. Printing procedures differ in that a pattern or design is imprinted on the fabric by using dyes in paste form. Screen printers mount screens on rotary screen printing machines, fill the machines with dyes, and tend them as they print. Cloth printers set up and operate printing roller machines to print designs on cloth and other materials such as fiberglass, felt, and oilcloth.

In addition to dyeing and printing, finishing often involves treating fabric to prevent excessive shrinkage, to add strength, or to give a silky luster. Calender operators tend machines that impart luster and finish to cloth or felt by pressure of cold or steam-heated rolls. Cloth-finishing range operators tend ranges that apply size, water-repellent, wrinkle-resistant, or other chemical finishes to cloth, stretch cloth to a specified width, and dry finished cloth.

Each step in the finishing process provides jobs for textile machine operatives and general maintenance workers. The operative jobs, which comprise most of the occupations of the textile industry, can be learned on

the job. Other occupations, such as textile designers, technicians, and engineers, require additional training and special skills. A small number of jobs are held by workers trained in such professional fields.

In 1976, the average hourly wage of production workers in textile dyeing and finishing was $3.82. The lowest rate was in the Southeast, probably because of the relatively high employment of women and the lack of unionization for the industry in this region. Less than 20% of the textile workers were unionized, compared with as many as 90% in other regions of the United States.

Although most textile employees work with or near machinery, the accident rate for the industry is slightly lower than the average for all manufacturing industries. However, some workers are subjected to noise from machinery. Also, lint-laden air and poor lighting are problems in some older plants.

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SIC 2231	Weaving and finishing mills, wool
SIC 2251	Women's hosiery, except socks
SIC 2252	Hosiery, NEC
SIC 2253	Knit outerwear mills

SIC 2254 Knit underwear mills
SIC 2257 Circular knit fabric mills
SIC 2258 Warp knit fabric mills
SIC 2259 Knit mills, NEC
SIC 2261 Finishing plants, cotton
SIC 2262 Finishing plants, manmade fibers
SIC 2269 Finishing plants, NEC
SIC 2272 Tufted rugs and carpets
SIC 2292 Lace goods
SIC 2299 Textile goods, NEC
SIC 3552 Textile machinery

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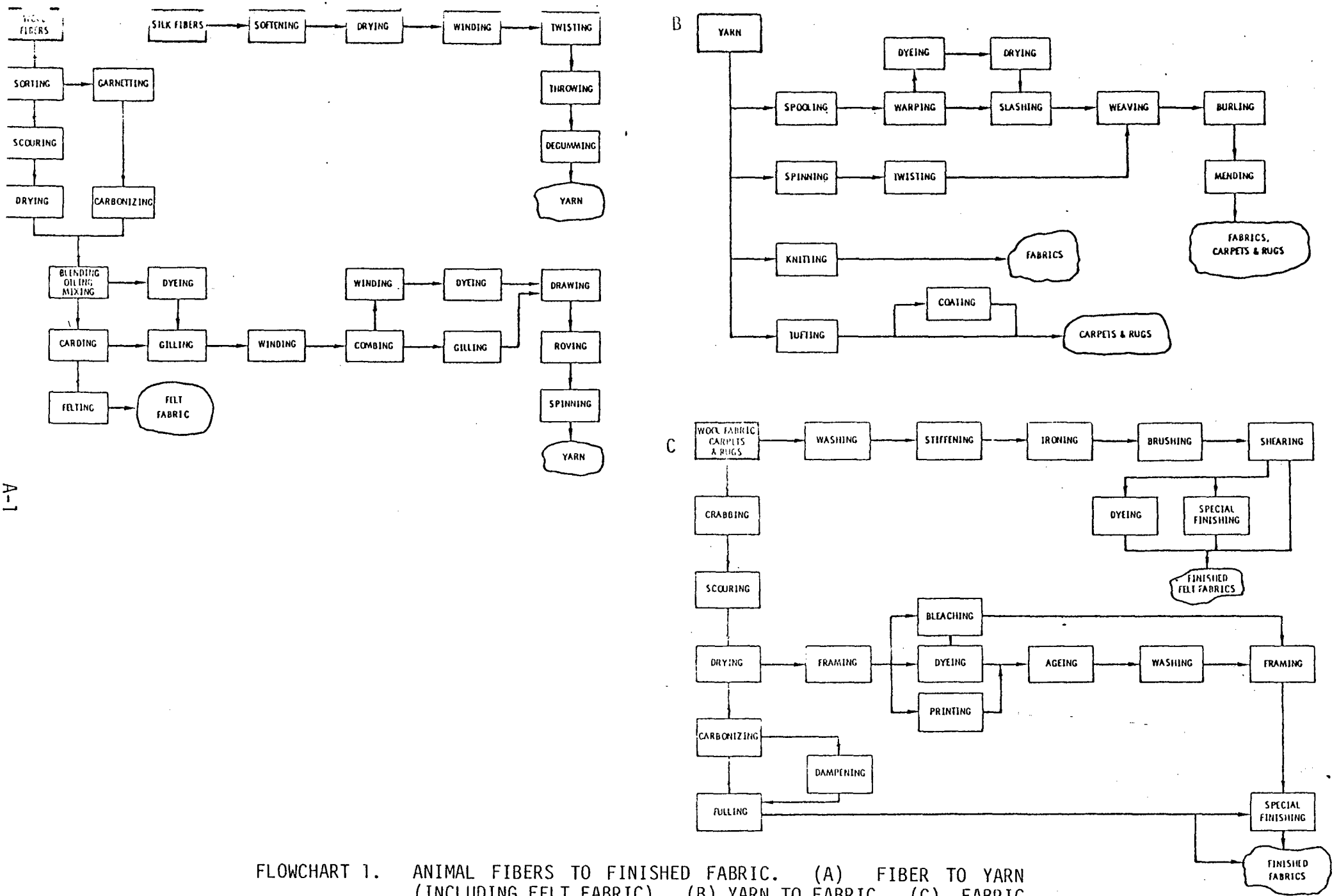
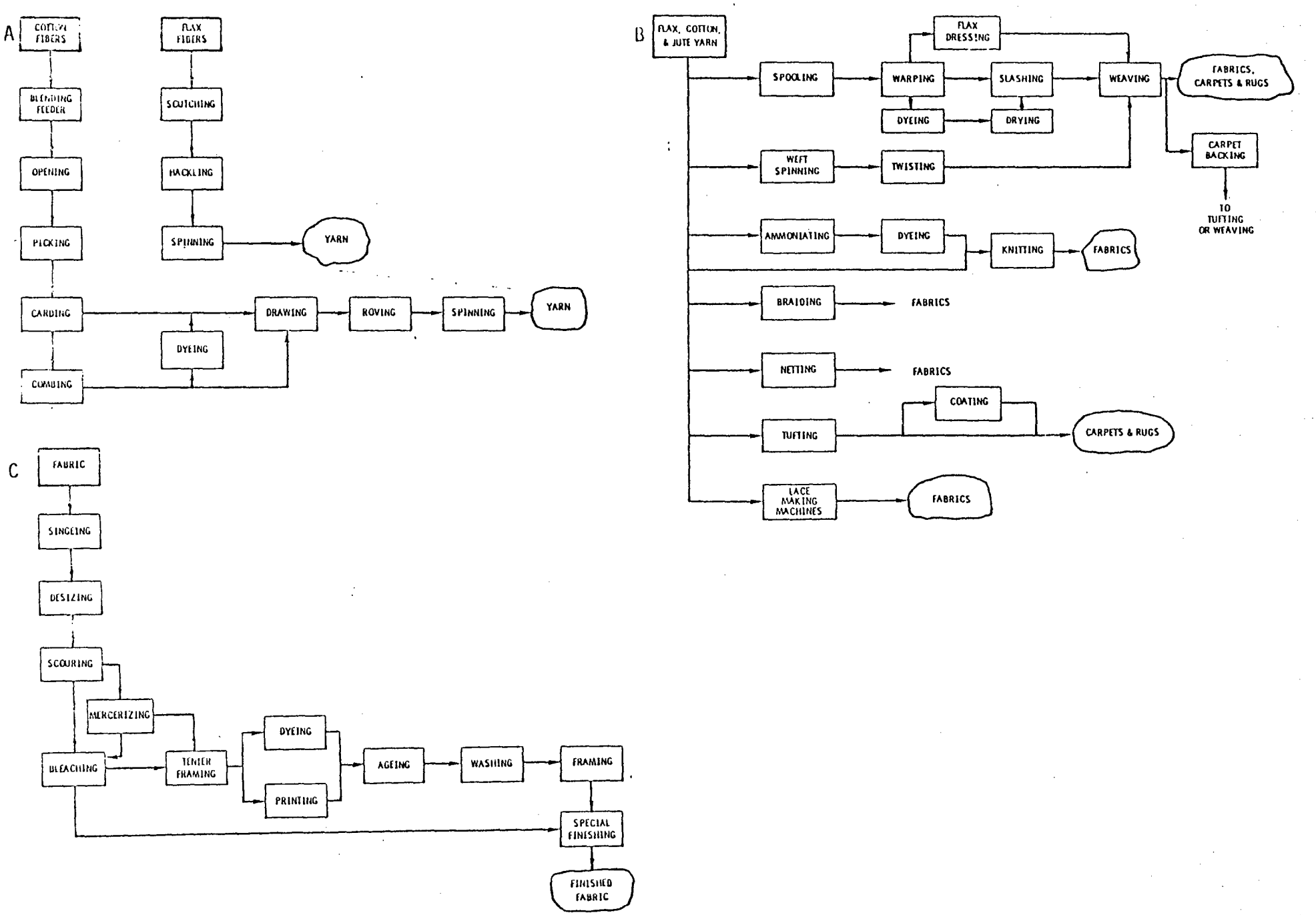
APPENDIX A

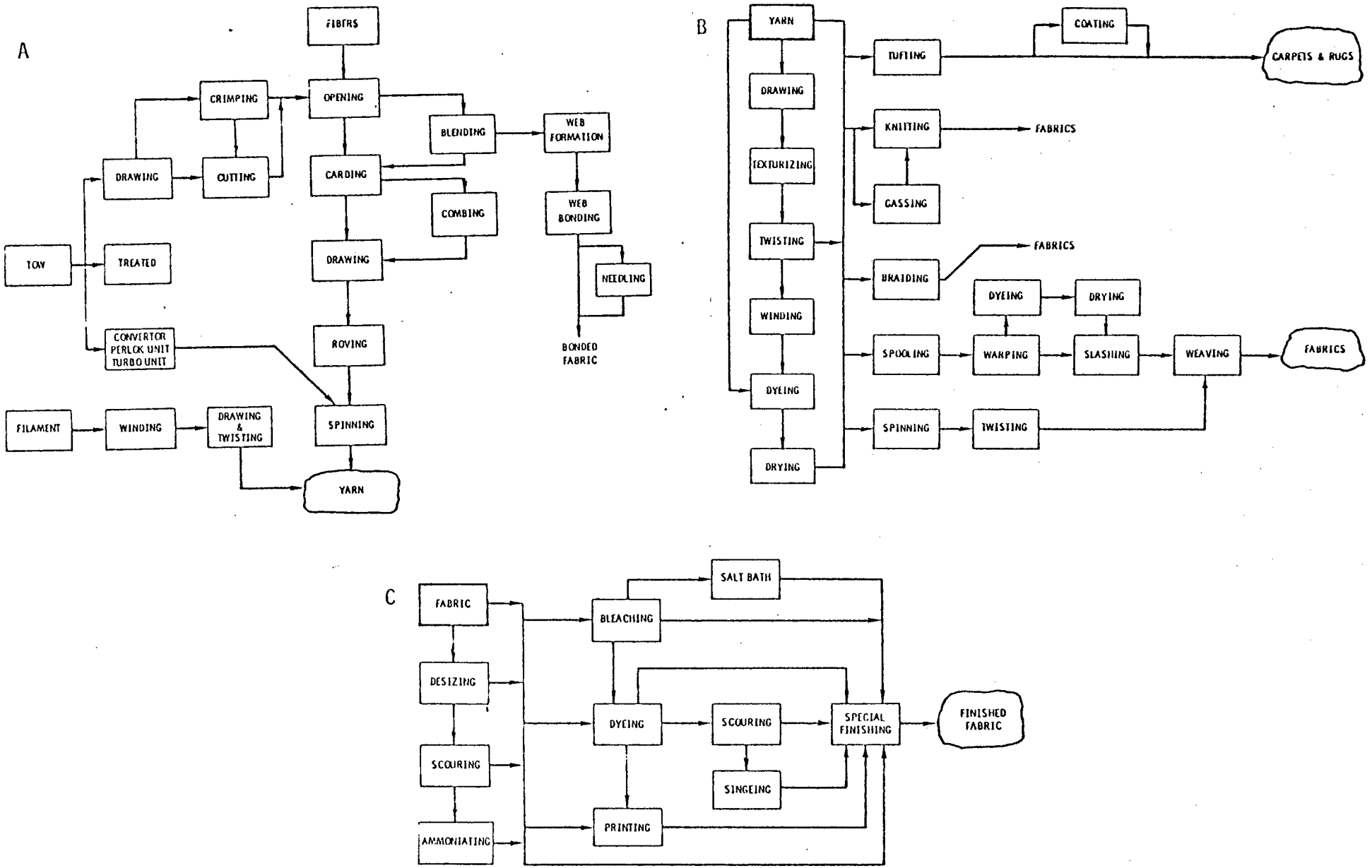
FLOWCHARTS



FLOWCHART 1. ANIMAL FIBERS TO FINISHED FABRIC. (A) FIBER TO YARN (INCLUDING FELT FABRIC). (B) YARN TO FABRIC. (C) FABRIC TO FINISHED FABRIC.



FLOWCHART 2. VEGETABLE FIBERS (COTTON) TO FINISHED FABRIC. (A) FIBER TO YARN. (B) YARN TO FABRIC. (C) FABRIC TO FINISHED FABRIC.



FLOWCHART 3. MANMADE FIBERS TO FINISHED FABRIC. (A) FILAMENT, FIBERS, AND TOW TO YARN (INCLUDING BONDED FABRICS). (B) YARN TO FABRIC. (C) FABRIC TO FINISHED FABRIC.

APPENDIX B

GLOSSARY

GLOSSARY

Acetate dye. See Disperse dyes.

Acid dye. A type of dye used on wool and other animal fibers. When used on cotton or linen, a mordant is required. It has poor color resistance to washing. A special method of application is required for acrylic fibers of Orlon 42. Dynel modacrylic fibers may be colored in light shades.

Airbrushing. Blowing color on a fabric with a mechanized air brush.

Alizarin dye. A vegetable dye originally obtained from the madder root, now produced synthetically. It is best used on wool but can be used on cotton, particularly in madder prints.

Aniline dye. A term generally applied to any synthetic, organic dye. Any dye that is derived from aniline.

Antibacterial finishes. Chemical antiseptic finishes that impart a self-sterilizing quality to a fabric. Appearance and feel of the fabric are unchanged, and no chemical odor remains.

Azoic dye. See Naphthol dye.

Basic dye. A type of dye that will dye wool and silk directly without a mordant. It can be used on cotton with a mordant.

Batik. A kind of resist dyeing in which parts of a fabric are coated with wax to resist the dye. It is usually done by hand but can be imitated by machine.

Carding. A hand or machine process for separating fibers to make them into a web of randomly aligned fibers.

Chrome dye. See Mordant.

Cireing. Wax or a similar compound is added to silk and rayon followed by hot calendering. This results in a supergloss almost metallic in appearance.

Crepeing. A process using special crepe yarns to produce a pebbly or crinkled surface.

Crocking. Rubbing off of a fabric's color.

Crock meter. A standard device for testing a fabric's fastness to crocking.

Cross dyeing. A combination of stock dyeing or yarn dyeing with subsequent piece dyeing. Produces varied effects.

Degumming (of silk thread). The removal of sericin from silk fibers.

Developed dye. A type of dye in which one color may be changed by use of a developer. The intensity of the color and the fastness of the dyestuff may be changed by this treatment.

Dip dyeing. A process of piece dyeing hosiery or other knitted goods after construction.

Direct dye. A type of dye with an affinity for most fibers. It has poor resistance to washing.

Direct printing. Application of color by passing the cloth over a series of rollers engraved with the designs. Developed direct dyes have good resistance to washing.

Discharge printing. A method by which the cloth is piece dyed first and then the color is discharged or bleached in spots, leaving white designs.

Disperse dyes. Dispersions of colors or pigments in water. They were originally known as acetate dyes. At present these dyes are also used to color the new synthetic fibers.

Dope dyed. See Solution dyed.

Duplex print. Method of printing a fabric on the face and then on the back.

Dyed in raw stock. See Raw-stock dyeing.

Dyeing. A process of coloring fibers, yarns, or fabrics with either natural or synthetic dyes.

Fabric bonding. A technique that uses specially developed adhesives that effect a permanent bond between two fabrics.

Fade-Ometer. A standard laboratory device for testing a fabric's fastness to sunlight.

Fast dyes. Those dyes that are fast for the purpose for which the fabric is intended.

Fiber dye. See Raw-stock dyeing.

Filling yarns. Yarns that are woven between the warp yarns on a loom. See Warp yarns.

Flameproofing. Chemical treatment to retard flammability of textile fabrics. 1. A flame-resistant material is one that exhibits lower flammability than other well-known materials under identical, carefully specified conditions of testing. 2. A self-extinguishing material is one which, when ignited at the bottom edge in a vertical position, does not continue to burn after the source of ignition is

removed. 3. A flame-retardant material decreases the flammability of a combustible polymer, fiber, or fabric to which it is added. 4. A thermally stable material is one that has a high decomposition temperature, and is thus inherently flame resistant because of its chemical structure.

Fluorescent whitening agent. An agent that imparts a brighter white color that gives the impression of fluorescing.

Foam laminating. Application of a solid foam to woven and knitted fabrics.

Fugitive dye. Those colors that are not fast to such elements as light, washing, perspiration, and crocking.

Glazing. Application of starch, glue, mucilage, or shellac followed by friction calendering to obtain a stiff polished or glazed surface. This process makes the fabric resistant to dust and spots and minimizes shrinkage.

Gray goods. See Greige goods.

Greige goods. Goods that come directly off the loom without prior treatment.

Hand-blocked print. Fabrics printed by hand with blocks made of wood or linoleum.

Indigo. A type of dyestuff originally obtained from the indigo plant, now produced synthetically. Blues are brilliant. It has good colorfastness to washing and to light.

Ingrain. A knitted or woven fabric made of yarns dyed before knitting or weaving.

Jig dyeing. Passing the cloth through a jig dyeing machine (a large tube holding dye). It is used particularly for dark, direct dyes.

Kier. Large steel vessels that hold about 5 tons of cloth used in bleaching processes.

Launder-Ometer. A standard laboratory device for testing a fabric's fastness to washing.

Madder. See Alizarin dye.

Mildewproofing. Chemical processes that remove moisture from susceptible fabrics to prevent the growth of fungus that can stain, cause odor, and eventually deteriorate the fabric.

Mordant. A substance that acts as a binder for the dye. A mordant has an affinity for both the dyestuff and the fabric.

Naphthol dye. Insoluble azoic dyes formed on the fiber by impregnation of the cotton fabric with beta-naphthol that has been dissolved in caustic soda and then immersed in a basic dye. It is used primarily on cotton and gives brilliant scarlet and red at relatively low cost.

Pad dyeing. A process of first passing the cloth through a trough containing dye, then squeezing it between heavy rolls to remove excess dye.

Permanent press. A chemical process that gives fabric a shape-retentive finish (requiring little or no ironing). It is used on cotton and cotton-blend fabrics as well as wool and wool-nylon blends.

Photographic printing. Application of a photographic image to a fabric.

Piece dyeing. A fabric dyed after weaving, knitting, or other method of construction.

Pigment dyes. Dye emulsion made with certain kinds of fine synthetic pigment in a solution of synthetic resins in an organic solvent; water is stirred in with a high-speed mixer. Often applied by pad dyeing. Good colorfastness to light, washing, acids, and alkalies. When resin binder is ineffective, dye may crock or have poor resistance to washing.

Printing. Methods of stamping colored figures on cloth.

Raw-stock dyeing. Dyeing of fibers before spinning into yarn. It is synonymous with fiber dyed.

Resist dyeing. Application of substances to a cloth to resist dyeing; the cloth is immersed in dye, and the "resist" is then removed. See Batik.

Roller printing. See Direct printing.

Sanforizing. A standardized method of compressive shrinkage whereby the fabric is deliberately shortened in both width and length, resulting in a tighter and closer weave and consequently, a higher thread count. This process reduces the residual shrinkage in cotton and linen to not more than 1%.

Screen printing. Background of design painted on screen first. Dye is printed on exposed portions of fabric.

Shape retentive. Chemical finishes added to fabrics to increase their resilience and ability to retain their shape.

Shearing. Shearing is done by a cylindrilcal machine having rotating spiral blades that level surface irregularities caused by the plucking action of the teasels in the napping process.

Shrinking. A preparatory finishing process, such as immersion in cold water, followed by hot water, steaming, or a chemical treatment that minimizes subsequent shrinking.

Sizing. A temporary stiffening process usually involving immersion of the fabric in a starch solution.

Slip resistance. The deposition of resin at the points of interlacing weaving so that warp yarns do not slip along the filling yarns.

Slub dyed. Sliver dyed or printed.

Solution dyed. Manmade fibers dyed in the spinning solution.

Space-dyed yarns. Those yarns that have been dipped in dye or spotted in various places along the yarn.

Spun dyed. See Solution dyed.

Stencil printing. A type of resist printing where portions of the design are covered with metal or wood so the covered parts do not take dye.

Stiffening. Permanent stiffening effects can be achieved by chemical processes that change the cellular structure of the fiber.

Stock dyeing. Textile fiber dyed in a loose condition before it is spun. This is done by putting it in large vats and circulating dye liquor through the mass of fiber at elevated temperatures.

Sulfur dye. A dye derived from chemicals containing sulfur. It is used mostly for vegetable fibers. It has fair resistance to washing and poor resistance to sunlight.

Tie dyeing. A type of resist printing in which pieces of string are tied around bunches of cloth, or the fabric is stitched where dye is to be resisted.

Top dyeing. Top is wool that has been combed to take out the short fibers and then delivered from the combs in a ropelike form about 1.25 inches thick. The top is wound on perforated spools, and the dye liquor is circulated through it.

Vat dyed. This process uses an insoluble dye made soluble in its application. It is then put on the fiber and is oxidized to its original insoluble form. Excellent colorfastness to washing and sunlight.

Warp printing. Printing of warp yarns with the design before weaving. A hazy grayed effect is produced.

Warp yarn. Yarns placed lengthwise on a loom. See Filling yarns.

Waterproofing. A process that completely seals the fabric so that it is insoluble in water.

Water repellency. A quality that makes the fabric resist absorption and penetration of water for a given period of time, depending on the length of exposure and force of the water.

Weighting. Increasing the weight and body of the fabric by immersing it in a solution containing metallic salts.

Yarn dyed. Yarns are dyed before the fabric is constructed.

APPENDIX C

OCCUPATIONS

550.585-018 CHEMICAL MIXER (textile) compounder.

Tends equipment that mixes chemicals for use in bleaching, cleaning, desizing, latexing, mercerizing, and finishing canvas goods, carpets and rugs, felt goods, and textile yarns and fabrics: Weighs or measures quantities of ingredients, such as peroxide, silica, caustic, solvents, emulsions, resins, starches, and detergents, following formula and pours them into mixing tank. Turns valves to admit water into tank up to mark on tank wall. Starts mixer and allows solution to mix for specified period of time. Turns valve to transfer solution from mixing tank to storage tank. Tests solutions in storage tanks with hydrometer, viscosimeter, or by *titration* to detect variations from standards and adds appropriate ingredients to restore solution to standard strength. Records test results, batches of solutions mixed, and chemicals used in each batch for production and inventory purposes. May inject steam into solution to dissolve ingredients or cook solution to specified consistency. May be designated according to solution mixed as ACID-BATH MIXER (textile); AMMONIA-SOLUTION PREPARER (textile); CAUSTIC MIXER (textile); GUM MIXER (textile); LATEX COMPOUNDER (textile); SIZE MAKER (textile); SOAP MIXER (textile); WATERPROOFING MIXER (textile).

550.684-014 DYE WEIGHER (any ind.) chemical weigher; color weigher; drug-room clerk; dye maker; dyer assistant.

Mixes dyes and chemicals for use in dyeing products, such as fabrics, hosiery, and yarns: Weighs out quantities of powdered or liquid dyes and chemicals, following formula sheet. Pours dyes and chemicals into pail or mixing tank and turns valve to admit water into tank or pail up to mark on container wall. Stirs ingredients with paddle and injects steam into solution to dissolve dye. Dumps contents of pail into supply tank or turns valves to transfer dye solution from mixing tank to supply tanks in dye room. Inventories dyes and chemicals and notifies DYER, SUPERVISOR (any ind.) as supplies are needed. May be designated according to dye mixed as INDIGO MIXER (textile).

580.585-010 TENTER-FRAME OPERATOR (textile) cloth stretcher; drier tender; drying-machine tender; framing-machine tender; hot-frame tender; open-tenter operator; pin-tenter operator; steam-frame operator; stretcher; tentering-machine operator.

Tends *tenter frame* that stretches cloth in width, removes wrinkles, and dries cloth after processes, such as dyeing or finishing: Trucks folded cloth to feed-end of machine or mounts roll of cloth at *scray*, using hoist. Sews cloth end to *leader* in machine, using sewing machine. Turns wheel to adjust clips or pins to stretch cloth to specified width. Moves lever to control speed of cloth through drying cabinet, to *swinging attachment*. Measures width of cloth emerging from machine, using yardstick. Records yardage clock readings. May replace full trucks with empty ones and ravel seams to separate truck loads of cloth. May tend tenter frame equipped with weft-straightening attachment.

581.685-026 DRYING-MACHINE OPERATOR, PACKAGE YARNS (textile) drier operator; kier drier; oven-drier tender; package drier; port drier.

Tends machines that dry packages of dyed or bleached yarn by any of following methods: (1) Removes yarn packages from yarn stand and places them on drying-oven rack. Sets temperature control gages according to specifications and pushes rack of yarn into drying oven. (2) Positions loaded yarn stand removed from dyeing machine over hot-air port, using power hoist. Sets controls to direct air through holes in yarn stand to dry yarn. (3) Loads stand of yarn into kier, using power hoist. Closes lid and tightens bolts, using wrench. Sets controls to circulate hot air through yarn. Removes dried yarn from drying machine, inspects packages for dyeing defects, and packs packages in cases for storage or shipment. May fasten case with metal band and truck case to warehouse.

581.685-054 SKEIN-YARN DRIER (textile) drying-machine operator; steam-drier operator; yarn-dry-room worker.

Tends machine that dries skeins of yarn: Turns valves to set temperature of drying cabinet according to specifications. Starts fans to circulate heat in drying cabinet. Places yarn skeins on conveyor that conveys yarn through cabinet, hangs skeins on drying rack and pushes rack into drying cabinet, or loops skeins over poles and places poles on conveyor that conveys yarn through cabinet. Removes dried skeins of yarn from conveyor, racks, or poles. Shakes tangled skeins of yarn before and after drying to straighten skeins.

582.582-010 DYE-RANGE OPERATOR, CLOTH (textile) cloth dyer dye feeder; dyeing-machine feeder; dye-range feeder; front tender.

Operates feed-end of *range* to dye and dry cloth in open widt Trucks folded cloth to feed-end of machine or pushes roll of cloth on brackets at *scray*. Sews cloth end to *leader* in machine, using portab sewing machine. Turns handwheel to adjust cloth guides. Turns valv to admit dye to dye pad from mixing tank. Sets thermostats to contr temperature of dye in padder and hot air in drying box. Star machines, observes control panel, and turns knobs to synchronize i dividual motor speeds. Reads yardage clock and records production, l numbers, and running time. Turns valve to drain used dye from d pad. Cleans padder and steambox with water hose. May mix dyes [DY WEIGHER (any ind.)] and add chemicals to dye bath. May b designated according to dye used as INDIGO-VAT TENDER, CLOT (textile).

582.585-010 AGER OPERATOR (textile)

Tends machine that passes printed or dyed cloth through steam an chemical fumes to develop and fix colors: Measures out and mixe chemicals with water in tank. Trucks cloth to feed-end of ager. Sew end of cloth to *leader* in machine, using portable sewing machine. Ob serves cloth entering machine to detect defects, such as holes an grease spots. Examines cloth emerging from machine to detect unever or incorrect color shade and color runs indicating incorrect adjustmen of steam and chemical flow. Turns valves to make adjustments. Pull cloth having imperfections over edge of truck for later removal anc ravels seams to separate lots. Marks aged cloth and records production. Stops machine, cools interior with water, and enters ager to rethread cloth that has torn out. May tear out patch of defective cloth for inspection by CLOTH PRINTER (any ind.). May tend machine using steam only and be known as ENDLESS-STEAMER TENDER (textile).

582.665-010 CYLINDER BATCHER (textile)

Tends machine that draws cloth through softening solution and winds cloth onto perforated cylinder to prepare cloth for dyeing: Threads cloth from supply truck through softening bath, guides, and rollers to takeup cylinder or sews cloth to *leader* in machine, using portable sewing machine. Presses button to start machine and observes cloth for defects. Cuts out flaws and sews ends together by hand or with sewing machine. Removes full cylinder from machine, using chain hoist. Records yardage cloth reading onto work ticket. May tend *tenter frame* in tanden with cylinder batcher.

582.665-014 DYE-REEL OPERATOR (textile) beck tender; cloth dyer; dye-beck-reel operator; dye-tub operator; dye-winch operator; piece-dyeing-machine tender; piece-dye worker; vat tender.

Tends machine that bleaches or dyes cloth in *rope form:* Hangs cut of cloth over reel above beck (dye tub). Sews ends of cloth together to form endless rope from each cut of cloth, using portable sewing machine. Sets gages to control automatic cycle of washing, dyeing, and rinsing as instructed by DYER, SUPERVISOR (any ind.). Notifies DYE WEIGHER (any ind.) to release chemicals and dyes to dye tub. Cuts sample from cloth when dyeing cycle is near end and submits sample to DYER, SUPERVISOR (any ind.) to determine if color meets specifications. Ravels seams connecting cloth ends after rinsing is completed. Starts reel to pull cloth out of dye tub. Guides cloth into truck. May unwind cloth from roll by machine so that cuts of cloth may be separated for dyeing [ROLLING-DOWN-MACHINE OPERATOR (knit goods; textile)]. May be designated according to type of cloth dyed as KNIT-TUBING DYER (textile).

582.665-018 JIGGER (textile) jig operator.

Tends dye jig that passes cloth from one roll to another through va of dye or other solution to scour, bleach, or dye cloth: Mounts roll o cloth on machine, using power hoist. Passes cloth under guide roller in tank to *takeup roll*. Turns valve to fill tank with water and pour specified quantity of dye into tank or notifies DYE-WEIGHER HELPER (any ind.) to release dye solution to dye machine. Sets thermostat to control steam for heating solution. Adds chemicals as instructed by DYER, SUPERVISOR (any ind.). Starts machine that passes cloth through dye bath or chemical solution, reversing direction of cloth until it has passed through solution specified number of times. Opens valve to drain solution from machine. Fills machine with water and rinses surplus dye from cloth by passing cloth through water as in dyeing. Doffs roll of cloth from dye jig, using power hoist. May weigh and mix dyes.

582.685-014 BEAM-DYER OPERATOR (textile) cylinder dyer.
Tends machine that scours and dyes cloth wound on perforated *beam I:* Loads beam of cloth onto machine carriage, using electric hoist. Pushes carriage into dyeing chamber and bolts door. Places sample spool of material in miniature pressure chamber to obtain swatches for inspection. May tend open-top vat and be designated as BEAM DYER, RECESSED VAT (textile).

582.685-018 BLEACH-RANGE OPERATOR (textile)
Tends feed-end of *range* that bleaches, washes, and dries *greige* cloth preparatory to printing, dyeing, or finishing: Pulls cloth from overhead carrier, positions truck of folded cloth at feed-end of machine, or mounts roll of cloth onto brackets at *scray*. Sews cloth end to *leader* in range, using portable sewing machine. Presses button or turns handwheel to set width guide according to width of cloth. Turns valves to control level of chemicals in mangle, washboxes, and peroxide saturator. Turns knobs to adjust pressure on squeeze rollers and to set speed of range as specified for various cloth styles. Observes cloth entering machine to detect bad seams or flaws that might cause tear-outs. Stops range and seams cloth to correct flaws. May thread cloth through range when leader not left in range.

82.685-030 CLOTH-WASHER OPERATOR (textile) washing-machine operator.
Tends machines that wash or treat cloth with chemicals preparatory o or after processes, such as bleaching, dyeing, printing, and finishing: ushes truck of cloth into feeding position or mounts roll of cloth on haft at feed-end of machine. Sews end of cloth to *leader* in machine, sing portable sewing machine. Turns valves to admit water, detergents, austic, acids, steam, or other chemicals into washing tanks according specifications. Starts machine and observes flow of cloth through achine to detect tears in cloth. Stops machine, disentangles tear-outs, nd knots selvages of torn cloth by hand. Tests solutions in washing anks by *titration* or using litmus paper or hydrometer. Adds water, detergents, or chemicals to washing tanks to dilute or strengthen solutions s indicated by tests. May be designated according to chemicals used washing tanks as ACID-WASHER OPERATOR (textile); APHTHOL-SOAPING-MACHINE OPERATOR (textile); according o objective of washing as CLOTH NEUTRALIZER (textile); or according to type of cloth as BACK-GREY-CLOTH WASHER (textile). lay tend machines, consisting of series of tanks, that process cloth in pen-width or *rope form*. Important variables may be indicated by trade ames of machines used.

82.685-046 DESIZING-MACHINE OPERATOR, HEAD-END (textile) desizing-pad operator; malter operator.
Tends feed-end of *range* that removes size from cloth to increase affinity of cloth for dye: Weighs out desizing agent and mixes agent with water in mixing tank, following formula. Turns valves to transfer solution from mixing tank to desizing tubs and to control steam for heating olution. Positions truck of cloth at feed-end of machine, or mounts loth roll onto brackets at *scray*. Sews cloth end to *leader* in machine, sing portable sewing machine. Observes flow of cloth through machine o detect flaws, such as holes and torn selvages. Cuts out flaws, using cissors, and sews cloth ends together. Turns knob to adjust cloth uides and speed of range to accommodate changes in styles of cloth.

582.685-090 JET-DYEING-MACHINE TENDER (textile)
Tends machine that dyes cloth under pressure: Turns valves to admit water, steam, and chemicals into compartments to specified level. Sews ends of cloth together to form endless rope of cloth, using portable sewing machine. Presses button to activate suction device that draws cloth over machine reel into compartments. Presses button to start automatic washing, dyeing, and rinsing cycles, and observes control panel for faulty machine operation. Reports malfunctions to maintenance personnel. Starts reel to pull cloth from machine at end of processing cycles.

582.685-098 OPEN-DEVELOPER OPERATOR (textile)
Tends open-developer machine that develops dye in dyed or printed cloth, removes excess color from cloth, and wets cloth before soaping process: Threads end of roll of cloth through machine rolls. Turns steam valves to heat machine tank and opens valves to admit specified chemicals into tank and to start water spray. Turns handwheels to close wringer rolls and starts machine. Straightens wrinkles in cloth as cloth enters machine. Sews end of new roll of cloth to end in machine during processing, using portable sewing machine. Drains tank of machine after cloth is processed. May mix chemicals in storage tank to develop desired color of cloth.

582.685-102 PACKAGE-DYEING-MACHINE OPERATOR (textile) beam dyer; bleacher; dyeing-machine tender; package dyer.
Tends machine that dyes or bleaches yarn wound on perforat *beams I, tubes I,* or spring coils: Loads package stand or beam of ya into machine, using power hoist. Closes lid and tightens lid bolts w wrench. Mixes preweighed dye or bleach with water in pail or overfl tank, stirring with paddle. Turns valves to control steam and water flo Sets controls to pump dye or bleach into machine that automatica processes and rinses yarn at specified temperature and pressure. Ad chemicals during dyeing or bleaching cycle as specified. May lo packages of yarn onto perforated spindles of stand and unload machi [DYE-STAND LOADER (textile)]. May weigh dyes according to f mula. May tend machine to bleach yarn and be designated as YAR BLEACHING-MACHINE OPERATOR (textile). May tend machine dye raw fibers or *tops* and be designated as RAW-STOCK-DYEIN MACHINE TENDER (textile); or TOP-DYEING-MACHINE TENDI (textile).

582.685-106 PADDING-MACHINE OPERATOR (textile) dye-padder operator.
Tends padding machine that saturates cloth with dye preparatory further processing: Positions handtruck of cloth at feed-end of machi or mounts roll of cloth on machine, using power hoist, and threa cloth through rollers, or sews supply end to *leader* in machine, usi portable sewing machine. Sets air pressure gage to control pressure squeeze roll and temperature gage to control temperature of dye. No fies DYE-WEIGHER HELPER (any ind.) to release dye to overfl tank. Turns valves to fill padding tank with dye. Starts machine to pa cloth through dye, between squeeze rolls and onto *takeup roll*. Doffs r of cloth from machine, or may feed cloth to set of *drying cans*. C sample of cloth for inspection by DYER, SUPERVISOR (any ind May weigh and mix dye and chemicals.

582.685-158 WARP-DYEING-VAT TENDER (textile) continuous-ya dyeing-machine operator; long-chain-dyeing-machine operator.
Tends machine that washes, bleaches, dyes, rinses, and dries wa yarn in *rope form:* Weighs chemicals and dyes, according to formu and dumps ingredients into mixing tank. Turns valves to admit ste and water into tank, and stirs solution with paddle. Turns valves release dye mixture into vats. Sets *drying can* thermostat at temperatu specified for count of yarn to be dried. Mounts *ball warps* on rack front of machine, using hoist. Ties yarn to *leader* to thread machi Observes yarn passing through units of machine to detect yarn brea or tangles. Stops machine and untangles snarled yarns or ties brok ends. Compares sample of yarn with standard to determine if dyei meets specifications, and notifies DYE WEIGHER (any ind.) if speci cations are not met. Observes level of liquid in vats and adjusts liqu flow to maintain specified level. May be designated according to d used as INDIGO-VAT TENDER, WARP (textile) or according process as WARP-BLEACHING-VAT TENDER (textile); WAR SCOURING-VAT TENDER (textile).

582.686-014 DYE-REEL-OPERATOR HELPER (textile) dye-room helper; laborer, wash-and-dye house.
Assists DYE-REEL OPERATOR (textile) to bleach or dye cloth, pe forming any combination of following tasks: Mounts cloth rolls c brackets and feeds end of cloth through *swing-folding attachment* machine that unwinds cloth into handtruck. Hangs end of cloth ov winding reel in dye beck (tub) and sews ends together to make contin ous loop, using portable sewing machine. Ravels connecting seams aft rinsing and guides cloth over doffing reel into handtruck. Turns valv to drain, rinse, and fill tanks with water. Carries chemicals, such dyes, bleaches, and scouring agents, from mixing room to dye hou and pours chemicals into beck. Conveys cloth between department using handtruck. Performs other duties as described under HELPE (any ind.).

583.685-026 CALENDER OPERATOR (felt goods; tex. bag; textile) calender tender; roll-calender tender.
Tends machine that imparts luster and finish to cloth or felt by pre sure of cold or steam-heated rolls: Places roll of cloth or felt c brackets of machine, using hoist, and threads end of cloth between ro lers and onto takeup *beam I*. Pulls lever to lower rollers and apply pre sure to cloth. Turns screws to position brush that cleans nap of fe goods. Turns dial to set temperature gage according to specification f style of cloth. Turns handwheel to adjust entering guides according width of cloth and to regulate tension of cloth. May raise rollers allow seams or clips to pass. May sew end of new cloth to *leader* clot May tend *calender* fed directly from another machine or from han truck.

584.685-058 YARN-MERCERIZER OPERATOR (textile) II
mercerizer; mercerizer-machine operator.

Tends *range* that mercerizes and dries yarn in warp form: Pours caustic soda, acids, and softeners into mixing tanks, according to formula. Turns valves to allow solutions to flow into mercerizing, neutralizing, and finishing vats. Mounts balls of warp yarn in *creel*, using hoist or lift, and aid of YARN-MERCERIZER-OPERATOR HELPER (textile). Ties ends of warp to *leader*, starts machine and observes movement of warp through baths to detect breaks or tangles. Pulls broken yarn from vat, using hook, and ties ends. Tests caustic solution, using hydrometer, and adds water or caustic to restore solution to prescribed strength. Adjusts controls to regulate water and drier temperature and speed at which yarn passes through machine, according to yarn type. May tend discharge end of drier and observe yarn passing through *swing-folding attachment* into handtruck, boxes, or cans. May oil and make minor adjustments and repairs to machine.

589.130-010 CLOTH FINISHER (carpet & rug; textile) finishing supervisor.

Supervises and coordinates activities of workers engaged in finishing cloth, carpets, rugs, and other fabrics: Schedules finishing of cloth or carpeting according to color, width, and type of finish, to maintain efficient operation. Selects standard formulas that meet customer specifications or uses knowledge of finish ingredients and application methods to develop new formulas. Writes mixing instructions for use by CHEMICAL MIXER (textile). Writes work orders for supervisors indicating specified finish, style, and yardage of cloth or carpeting to be processed. Examines cloth or carpeting to verify that finish meets specifications. Inventories and orders chemicals and supplies from purchasing department. Trains workers in setup, repair, and operation of *ranges*, machines, and equipment. Performs other duties as described under SUPERVISOR (any ind.). May be designated according to department supervised or process involved as CARPET-FINISHING SUPERVISOR (carpet & rug); CLOTH-BLEACHING SUPERVISOR (textile); CLOTH-BRUSHING-AND-SUEDING SUPERVISOR (textile); CLOTH-LAMINATING SUPERVISOR (textile); CLOTH-MERCERIZING SUPERVISOR (textile); CLOTH-NAPPING SUPERVISOR (textile); CLOTH-SHEARING SUPERVISOR (textile); CLOTH-SHRINKING SUPERVISOR (textile).

589.562-010 CLOTH-FINISHING-RANGE OPERATOR, CHIEF (textile) finishing range supervisor; range operator.

Controls *range* consisting of units, such as chemical or dye pads, washboxes, steamboxes, *J-boxes*, *tenter frames*, *curing ovens*, and *drying cans* to desize, bleach, dye, or finish cloth and other textile goods: Lines up cloth to be processed according to priority, style, and width. Gives directions to CLOTH FEEDER (textile); CLOTH-FINISHING-RANGE TENDER (textile); and BACK TENDER (textile) engaged in tending range units to insure that desizing, bleaching, dyeing, or other finishing processes conform to specifications. Tests chemical solutions by *titration* or with hydrometer to detect variation in strength and notifies mixing department to add required quantity of chemicals or water according to test results and specifications. Observes control panel and equipment to detect faulty operation and adjusts controls to synchronize motor-driven rollers. Records test results, style numbers, and yardage of cloth processed. May inspect cloth. May be designated according to process controlled as CLOTH-BLEACHING-RANGE OPERATOR, CHIEF (textile); CLOTH-DESIZING-RANGE OPERATOR, CHIEF (textile); CLOTH-DYEING-RANGE OPERATOR, CHIEF (textile).

589.662-010 SCOURING-TRAIN OPERATOR (carpet & rug; textile) scouring-machine operator.

Operates scouring train (series of tanks or bowls) to wash, rinse, and dry raw wool preparatory to dyeing or carding: Turns valves to start continuous flow of water, detergent, and acid into bowls. Reads thermometer and turns steam valves to heat wash and rinse solutions to specified operating temperature. Starts machine that feeds raw wool from hopper into washbowl and activates rakes that move wool through bowls to squeeze rolls and rinse bowl. Patrols scouring train to detect choke-up at squeeze rolls and removes jammed fibers by hand. Observes sudsing in washbowls and turns valve to increase or decrease concentration of detergent. Tests acidity of solution in finishing bowl by *titration*. Turns valve to control flow of acid to maintain specified concentration. Starts fans that circulate hot air in drier. Feels wool delivered from drier and adjusts thermostatic control if wool is not dry. Drains and cleans machine. May feed raw wool into scouring machine hopper. May direct activities of team workers and be designated SCOURING-TRAIN OPERATOR, CHIEF (carpet & rug; textile).

589.665-014 CLOTH-FINISHING-RANGE OPERATOR (textile) backfiller; finishing-range operator; starcher-and-tenter-range feeder; treater.

Tends feed-end of *range* that applies size, starch, water-repeller wrinkle resistant, or other chemical finishes to cloth, stretches cloth specified width, and dries finished cloth: Positions truck of folded clo at feed-end of machine or inserts rod through cloth roll and pushes rc onto brackets. Sews cloth end to *leader* in machine, using portable se ing machine. Turns valve to permit flow of *finish* to trough under ma gle. Turns handwheels and knobs to control temperature of *drying ca* and movement of cloth through range, and to adjust width and tensic guides. Observes cloth entering machine to detect flaws, such as hol and torn selvages. Cuts out flaws, using scissors. When back-filling clo with starch, positions *doctor* at specified angle to scrape excess starc from cloth. Cleans and greases machines. May be designated accordir to type of finish applied as BACK SIZER (textile); WATERPROOI ING-MACHINE OPERATOR (textile).

589.685-026 CLOTH-FINISHING-RANGE TENDER (textile)

Tends intermediate units of cloth or other textile goods desizing, bleaching, dyeing, or finishing *ranges*, such as washboxes, *tenter frame*, *drying cans*, and *curing ovens:* Turns valves to admit steam, water, and chemicals to washboxes and chemical troughs. Patrols area between entry and terminal units to detect faulty operation of equipment. Turns knobs to adjust temperature in drying and curing units and to regulate speed of motor-driven rollers, according to specifications. Reports grease spots, holes, and tears in cloth to operator of range. Disentangles tear-outs, rethreads unit, and sews torn cloth, using portable sewing machine. May mix chemicals or dyes. May test strength of chemical solutions by *titration* or with hydrometer. May be designated according to process as CLOTH-BLEACHING-RANGE TENDER (textile); CLOTH-DESIZING-RANGE TENDER (textile); CLOTH-DYEING-RANGE TENDER (textile); TIRE-FABRIC-IMPREGNATING-RANGE TENDER (tex. prod., n.e.c.).

589.685-058 FOLDING-MACHINE OPERATOR (knit goods; textile) dry folder, cloth; folder operator; layer-up.

Tends machine that smooths and folds knitted tubing as tubing unwinds from rolls: Puts roll of tubing on turning rod of machine. Threads end of tubing over supporting rolls of machine, through steam rolls, and through feed rolls which pull tubing over spreader and through steam rolls. Turns crank to adjust height of folding table located under rolls. Starts machine and observes as tubing travels through rolls which move back and forth on carriage and deposit tubing in folds onto table. Removes folded tubing from table and places tubing in boxes. May weigh tubing and record weight.

589.685-074 PLEATER (textile) bin piler; plaiter.

Tends machine that guides cloth in *rope form* into storage bins or processing tanks in pleat-like folds to prevent tangling during subsequent removal: Threads cloth through *poteyes*, over rollers, through sleeve of pleating mechanism, and into bin or tank. Starts machine and turns knob to adjust pleating device so that cloth piles in even layers. May guide cloth with wooden stick or by hand. May sew ends of cloth together, using portable sewing machine. May be designated according to process as SOUR-BLEACHING PLEATER (textile).

589.685-086 ROLLING-DOWN-MACHINE OPERATOR (knit goods; textile) pleating-machine operator; swing-folding-machine operator.

Tends machine that unwinds cloth from rolls and discharges it into loose or folded form to facilitate further processing: Inserts metal rod through roll of cloth and lifts cloth into feeding position. Sews end of cloth roll to cloth in machine, using portable sewing machine. Positions truck under delivery roller or *swing-folding attachment* and starts machine. Pushes loaded trucks from area. May observe cloth to detect defective seams and resew seams to prevent raveling.

589.685-090 SCUTCHER TENDER (textile) cloth opener, hand.

Tends machine that opens cloth to full width after cloth is processed in *rope form:* Sews end of cloth to *leader*, using portable sewing machine, or threads cloth through guides and rollers, over beaters that revolve against direction of cloth to to cause cloth to open and over scrimp rail that stretches and smooths cloth. Starts machine and observes cloth passing over beaters to insure cloth is opened to full width.

583.685-086 PRESS OPERATOR (textile)

Tends machine that steams and presses wrinkles from woolen cloth: Starts press and manually guides cloth into machine and under weighted cylinder which steams material and presses out wrinkles. Turns handwheel to adjust cylinder pressure according to type of cloth processed. Sews end of new material to end of material in press, using sewing machine. Cleans and oils pressing machine.

583.686-030 PRESS FEEDER (knit goods; textile) roller-presser operator.

Positions cloth or knitted garments on belt conveyor of machine that presses garments through heated rollers to smooth out wrinkles, dry, or preshrink articles. May inspect one side of garment to detect holes and lay defective garment on table for MENDER, KNIT GOODS (garment; knit goods).

584.382-010 COATING-MACHINE OPERATOR (coated fabrics) saturator.

Operates machine to coat cloth, paper, or other sheet material used in production of artificial leather and other coated fabrics: Installs uncoated sheeting roll on machine brackets, using hoist, or threads sheeting from *calender machine* through coating machine rollers onto *takeup roll*. Operates sewing machine to join uncoated roll to end of processed roll, and cuts material at seam after seam passes through coating and drying units. Adjusts *doctor* blade or roller clearance to produce coating of specified thickness. Starts machine when dryer temperature reaches specified setting. Turns valves to control flow of coating solution onto sheeting, or applies solution to fabric surface, using dipper and bucket. Observes process to prevent slippage of sheeting from width guides and turns valves and moves machine controls to correct such defects as streaks, wrinkles, and turned edges in material being processed. Applies gummed tape to repair holes or tears in sheeting. May be designated according to type of coating applied as DULL-COAT-MILL OPERATOR (coated fabrics); FINISH-COAT-MILL OPERATOR (coated fabrics); FIRST-COAT OPERATOR (coated fabrics). May remove coated rolls from machine, using hoist.

584.562-010 COATING-MACHINE OPERATOR (carpet & rug; felt goods) roll-coating-machine operator.

Operates machine to coat rolls of woven fiber rugs or felt padding with vinyl or other coatings to prolong life of fiber and retard soiling: Dumps specified amounts of coating ingredients into vat and starts mixer. Turns valve to transfer coating to machine reservoir. Observes thermometers and adjusts electrical controls to maintain specified temperatures in bath and drying compartments. Threads fiber rug material through machine or sews end of new roll to end of preceding roll in machine. Pushes switch to start machine that moves material through coating bath and drying compartments onto rewind roller. Cleans machine and equipment, using water, solvents, brushes, scrapers, and chisel. Prepares production report on rugs coated. May operate machine equipped with automatic sprays to coat rugs or padding.

584.665-010 COATER HELPER (textile)

Assists COATER (textile) in applying rubber or pyroxylin coating to fabric, such as carpeting and upholstery material, and to dry coating: Starts pump to admit solution to trough. Observes cloth to detect faulty coating and covers missed spots, using brush. Turns dials to control temperature of *curing oven* and movement of cloth through *range*, and to adjust *tenter frame* guides. Works as member of team to operate and clean range. Assists in removing full rolls from range. May tend intermediate range units that apply backing to carpeting and be designated as LAMINATING-MACHINE-OPERATOR HELPER (textile).

584.682-010 COATER (textile)

Operates *range* consisting of units, such as troughs, pickup roller, *curing oven*, and *tenter frame*, to apply rubber or pyroxylin coating to fabrics, such as carpeting or upholstery material, and to dry coating: Sews end of cloth to *leader* in machine, using portable sewing machine or threads end of fabric through rolls of machine. Starts pump to admit solution into trough. Watches for skewed cloth and pushes buttons to control speed of rollers that hold back or advance selvages to straighten cloth. Measures cloth emerging from tenter frame to determine if cloth has been stretched and dried to specified width. Turns handwheel to adjust distance between tenter chains. Turns switches to regulate speed of machine and temperature of drying cabinet and turns setscrew to set *doctor* blade for various cloth styles. Tests viscosity of solution with viscosimeter and adds solvent, rubber, or pyroxylin to bring solution to specified viscosity. Doffs trucks of dry cloth at *swing-folding attachment*. May operate machine equipped with condenser to recover evaporated solvent. May operate range to apply backing to carpeting.

584.682-014 LAMINATING-MACHINE OPERATOR (knit goods; textile) combining-machine operator.

Operates *range* to laminate materials, such as cloth, carpeting, felt and foam rubber: Mounts roll of felt or foam rubber on machine brackets. Pushes truck of cloth into feeding position. Sews cloth and felt or foam rubber to *leader* using portable sewing machine, or threads layers of materials through range unit guides and rollers. Turns dials and handwheels to adjust blade that spreads predetermined quantity of adhesive onto cloth, regulate heat lamps and speed of laminating rollers, or to adjust *tenter frame* according to width of materials. Turns valve to admit steam into *drying cans* or steam pipes and starts range. Alines cloth entering machine and observes fabrics to detect wrinkles and holes. Patches holes with masking tape and smooths wrinkles by hand. May apply adhesive to material with trowel or dipper. May work as member of team to guide cloth into range.

584.685-014 CLOTH-MERCERIZER OPERATOR (textile) lusterer; mercerizer; mercerizer-machine operator; mercerizing-range controller.

Tends machine that adds silk-like luster to cotton cloth and increases strength and affinity of cloth for dyes: Mounts roll of cloth on machine or pulls supply cloth from handtruck or overhead *poteyes* and sews end to *leader* in machine, using portable sewing machine. Turns valve to admit caustic into vats and handwheel to adjust *tenter frame* clips to maintain tension on cloth and prevent shrinkage as cloth passes through soapy-water spray. Sets thermostat to control temperature of caustic bath. Starts machine and observes flow of cloth through machine units to detect holes in cloth and torn selvages. Cuts out defects, using scissors, and seams ends of cloth. Turns knobs on control panel to synchronize motor speeds of machine units. Adds soap to wash bath as suds are depleted.

584.685-042 MANGLE TENDER (textile) cloth presser; mangler.

Tends mangle that wets-out cloth or applies finishing chemicals, such as size starch, synthetic resins, or cellulose derivatives to cloth: Positions trucks of cloth at feed-end of machine and threads cloth through guides, under immersion roll, and through expander attachment and squeeze rolls, or sews end of cloth to *leader* in machine, using portable sewing machine. Turns valve to admit water, starch, or finishing solution to trough of mangle. Turns handwheel to set pressure of squeeze rollers according to thickness of cloth. Observes flow of cloth through mangle to detect holes and torn selvages. Cuts flaws from cloth, using scissors, and sews ends of cloth together. May tend machine arranged in tandem with *drying cans*, *tenter frame* or *curing oven*. May be designated according to fluid used in trough as STARCH-MANGLE TENDER (textile); WATER-MANGLE TENDER (textile).

584.685-054 YARN-MERCERIZER OPERATOR (textile) I mercerizer; mercerizer-machine operator; skein-mercerizing-machine operator.

Tends machine that mercerizes yarn in skein form: Shakes skeins of yarn to remove tangles and loads skeins on roller arms of machine. Starts machine that puts yarn under tension, passes skeins through caustic solution, and rinses skeins. Tests caustic solution, using hydrometer, and adds soda or water to maintain uniform strength specified. Removes skeins from mercerizer and hangs skeins on rack over tank for neutralizing. Turns valves to start spray of water and neutralizing solution. Tests neutralization, using litmus paper. May weigh and mix caustic and neutralizing solutions according to formula. May extract moisture from yarn [EXTRACTOR OPERATOR (textile)] and dry yarn in steam chamber [SKEIN-YARN DRIER (textile)].

589.686-010 BACK TENDER (textile) cloth drier; desizing-machine offbearer; desizing-machine operator, rear-end; drying-machine receiver; drying-machine tender; frame catcher; swing tender; take-away attendant; tentering-machine offbearer; tentering-machine rear-end operator; tenter-machine tailer.

Offbears from delivery end of *range* or machine that dyes, finishes, washes, treats, or dries cloth or other textile goods: Observes as cloth winds onto rolls or passes through *swing-folding attachment* into trucks and notifies supervisor of obvious flaws. Measures cloth with ruler and feels cloth discharging from *drying cans* or *tenter frame* to verify that cloth meets specifications for width and dryness. Moves lever to lower blade that cuts cloth at seams or ravels seams connecting lengths to remove cloth from machine. Pushes roll of cloth onto platform or lifts roll from machine brackets, using hoist. Places *tube I* on winding shaft and starts cloth winding on tube. Replaces filled truck at swing-folding attachment with empty truck to receive folded cloth. May wrap cloth roll with burlap. May regulate heat of drying cans and flow of water into washboxes by turning valves. May be designated according to type of machine as CLOTH-BLEACHING-RANGE BACK-TENDER (textile); CLOTH-FINISHING-RANGE BACK-TENDER (textile); CLOTH-WASHER BACK-TENDER (textile); DRYING-MACHINE BACK-TENDER (knit goods; textile); DYEING-MACHINE BACK-TENDER (textile); TENTER-FRAME BACK-TENDER (textile). Additional Titles: CLOTH-MERCERIZER BACK-TENDER (textile); DESIZING-MACHINE BACK-TENDER (textile); DRY-CANS BACK-TENDER (textile); MANGLE BACK-TENDER (textile); MANGLE CATCHER (textile); SINGER BACK-TENDER (textile); SOAPING-MACHINE BACK-TENDER (textile); TIRE-FABRIC-IMPREGNATING-RANGE BACK-TENDER (tex. prod., n.e.c.); WHITE-WASHER PILER (textile).

589.686-014 CLOTH FEEDER (textile) range feeder.

Feeds cloth into any of various textile finishing machines: Alines trucks or rolls of cloth to be processed through machine according to priority, style, and width. Positions truck of cloth at feed end of machine or mounts roll of cloth onto brackets at *scray*. Sews end of cloth to *leader*, using portable sewing machine. Straightens cloth as it enters machine. May assist machine operator to thread cloth through machine. May be designated according to machine fed as FINISHING-RANGE FEEDER (textile); MERCERIZING-RANGE FEEDER (textile); TENTER-FRAME FEEDER (textile).

652.382-010 CLOTH PRINTER (any ind.) printer; printing-machine operator.

Sets up and operates machine to print designs on materials, such as cloth, fiberglass, plastics sheeting, coated felt, or oilcloth: Turns handwheel to set pressure on *printing rollers*, according to specifications. Turns screws to aline register marks on printing rollers with register marks on machine, using allen wrench. Sharpens *doctor*, using file and oilstone, and verifies evenness of blade, using straightedge. Alines doctor against printing roller, using handtools. Dips color from tubs into color boxes to supply printing rollers. Scans cloth leaving machine for printing defects, such as smudges, variations in color shades, and designs that are out of register (alinement). Realines printing rollers and adjusts position of *blanket* or back-grey cloth to absorb excess color from printing rollers. Records yardage of cloth printed. Coordinates printing activities with workers who feed and doff machine and aid in setting up and cleaning machine. May notify COLORIST (profess. & kin.) when color shade varies from specifications. May mix own colors. May mount printing rollers on machine for change of pattern [PRINTING-ROLLER HANDLER (textile)]. May position knives specified distance from edge of plastics material to trim excess material from edges. When printing samples of new patterns and novelty designs is designated as NOVELTY-PRINTING-MACHINE OPERATOR (textile) or PROOFING-MACHINE OPERATOR (print. & pub.). May set up and operate cloth printing machine utilizing caustic soda paste instead of color paste to print designs on cloth which shrink to form *plisse*, and be designated PLISSE-MACHINE OPERATOR (textile).

652.385-010 PRINTING-ROLLER HANDLER (textile) copper-roller handler, printing; mandrel-press hand.

Mounts *printing rollers* on cloth printing machine for change of pattern: Inserts mandrel through *printing shell* and positions shell on hydraulic jack, using hoist. Starts jack that presses mandrel into shell to assemble completed roller. Removes used rollers from printing machine and lifts new rollers into position with aid of other workers, using hoist. Removes printing shells from mandrel, using hydraulic jack. Moves used rollers to warehouse for cleaning and storage, using handtruck.

652.582-014 ROTARY-SCREEN-PRINTING-MACHINE OPERATOR (textile) roller printer.

Operates rotary screen-printing machine to print designs on textiles: Mounts screen-printing rollers in specified sequence on machine. Turns knob to set machine speed and adjust pressure of rollers, according to type of design and cloth being printed. Turns valves that automatically admit printing paste into rollers. Starts machine and conveyor belt that carries textile articles under printing rollers. Inspects article being printed to detect colors out of register (alinement). Turns knob to adjust position of rollers so that each color is printed in allotted spaces in design. Removes foreign matter from rollers to prevent irregular flow of printing paste.

652.682-018 SCREEN-PRINTING-MACHINE OPERATOR (textile) automatic-silk-screen printer.

Operates automatic screen-printing machine to print multicolor designs on textiles: Mounts screens in specified sequence on machine. Pours printing paste onto screens or fills automatic feed pan. Turns knob to set machine speed and adjusts swing and pressure of squeegees, using handtools, according to type of design and cloth being printed. Starts machine and conveyor belt that carries textile articles under screens. Inspects articles being printed to detect colors out of register (alinement). Turns screws to adjust position of screens so that each color is printed in alloted spaces in design. Removes foreign matter from screens to prevent irregular flow of printing paste. Tapes holes in coated portion of screen if leak develops.

652.686-010 CLOTH-PRINTER HELPER (any ind.)

Feeds and offbears machine that prints cloth: Pushes roll of cloth from handtruck onto rack at back of *scray*. Sews end of cloth roll to preceding cut of cloth, using sewing machine. Starts feeding rollers that unwind cloth into scray. Positions handtruck beneath *swing-folding attachment* and packs cloth into truck with hands. Tears cloth or ravels seam when truck is filled. May feed and offbear cloth printing machine that utilizes caustic soda instead of color paste to shrink cloth to form plisse and be designated PLISSE- MACHINE OPERATOR HELPER (textile).

652.686-022 LOADER-UNLOADER, SCREEN-PRINTING MACHINE (textile)

Feeds or offbears automatic screen-printing machine that prints designs on textile products, such as towels, sheets, and pilloweases: Positions articles on conveyor belt of machine, following marks on conveyor. Removes printed articles from conveyor at discharge end of machine and places articles over wire, on racks, or on perforated conveyor belt that carries articles through drier. Cleans printing screens, using solvent, water, and rags.

652.686-038 SCREEN-PRINTING-MACHINE-OPERATOR HELPER (textile)

Performs variety of duties to assist automatic screen-printing machine operator in printing multicolored patterns on textiles: Turns thumbscrews and loosens and tightens bolts, using wrench, to remove, replace, adjust, or aline screens in bed of screen printing machine as instructed by machine operator. Pushes new roll of cloth into feed brackets and alines end of new cloth with end of cloth in machine and sews ends together, using portable sewing machine. Carries stacks of cloth articles, such as towels, washcloths, and bathmats from storage boxes, and stacks articles on shelf for use by workers feeding machine that prints precut cloth articles. Observes operation of printing machine to detect flaws in printing, such as blurs, smears, and color out of register (alinement), and reports problem detected to machine operator. Pours printing paste onto screen as required. Loads and unloads handtrucks, and trucks printing screens and drums of printing paste to and from storage areas.

979.684-030 SCREEN PRINTER (textile) silk-screen printer.

Prints designs on textiles, such as cloth, towels, bath cloths, sheets, and pillowcases, using screen and squeegee: Sets register guides along edge of printing table at intervals specified for pattern repeat. Pours color paste onto screen and positions screen against guides over cloth. Draws squeegee across screen to press color paste through open portion of screen and print design. Repeats process with different screen for each color in design. Washes screens with water or solvent to remove color paste.

APPENDIX D

SELECTED DYEING AND FINISHING ESTABLISHMENTS

SELECTED DYEING AND FINISHING ESTABLISHMENTS

Alba-Waldensian, Inc.
201 St. Germain Ave. S.W.
P.O. Box 100
Valdese, NC 28690
704-874-2191

Allied Textile Printers Corporation
1 Van Houten St.
P.O. Box 2548
Paterson, NJ 07505
201-523-2500

Arnold Print Works, Inc.
Columbia St.
Adams, MA 01220
413-743-2600

Arosa Knitting Corporation
12845 N.W. 45th Ave.
Opa-Locke, FL 33054
305-685-5053

Avondale Mills
Sylacauga, AL 35150
205-245-5221

Beacon Piece Dye & Finishing Company
Mill & Front St.
P.O. Box 30
Beacon, NY 12508
914-831-1300

Bemis Company, Inc.
800 Northstar Center, Box 95
Minneapolis, MN 55402
612-340-6162

Bernard Screen Printing Corporation
2300 Marcus Ave.
New Hyde Park, NY 11043
516-437-4800

Berven Rug Mills, Inc.
2600 Ventura Ave.
Fresno, CA 93721
209-233-7363

Burlington Industries, Inc.
3330 W. Friendly Ave.
P.O. Box 21207
Greensboro, NC 27420
919-379-2000

Cal Pacific Dyeing & Finishing Corporation
505 E. Gardena Blvd.
Gardena, CA 90247
213-770-1121

Cannon Mills Company
P.O. Box 107
Kannapolis, NC 28081
704-933-1221

Cantan Textile Mills, Inc.
71 Main St.
P.O. Box 827
Canton, GA 30114
404-479-2141

Champion Products, Inc.
115 College Ave.
Rochester, NY 14607
716-271-2235

Clearwater Finishing Company
Subdivision of United Merchants & Manufacturers, Inc.
Clearwater, SC 29822
803-593-2521

Collins & Aikman Corporation
210 Madison Ave.
New York, NY 10016
212-953-4100

Cone Mills, Corporation
1201 Maple St.
Greensboro, NC 27405
919-379-6220

Dan River, Inc.
Danville Division
P.O. Box 261
Danville, VA 24541
804-799-7000

Dixie Yarns, Inc.
1100 Watkins St.
Chattanooga, TN 37401
615-698-2501

Duro Finishing Corporation
110 Chace St.
Fall River, MA 02724
617-675-0101

Dyersburg Fabrics, Inc.
E. Phillips St.
Dyersburg, TN 38024
901-285-2323

Fabricsamerica Corporation
Fulton Fabrics Division
170 Blvd. S.E.
Atlanta, GA 30312
404-688-1111

Foxfire Industries, Inc.
1907 Crutchfield St.
P.O. Box 5007
Chattanooga, TN 37406
615-698-4022

Glen Raven Mills, Inc.
Glen Raven, NC 27215
919-227-6211

Graniteville Company
Graniteville, SC 29829
803-663-7231

Groves Thread Company, Inc.
N. Grover St.
Gastonia, NC 28052
704-865-1231

Norwich Mills
Subsidiary of Champion Products, Inc.
96 E. Main
Norwich, NY 13815
607-334-3206

Potomac Dyeing and Finishing Corporation
367 E. Franklin
Hagerstown, MD 21740
301-733-5260

Quality Mills, Inc.
Highway 52
P.O. Box 1107
Mt. Airy, NC 27030
919-786-6124

Reeves Brothers, Inc.
Time & Life Bldg.
New York, NY 10020
212-333-4200

Riegel Textile Corporation
P.O. Box 329
Ware Shoals, SC 29692
803-456-7411

Russell Corporation
Alexander City, AL 35010
205-234-4251

Southern Silk Mills
Spring City, TN 37381
615-365-5163

Springs Mills, Inc.
Fort Mill, SC 29715
803-547-2901

Standard-Coosa-Thatcher Company
Chattanooga, TN 37401
615-622-3131

Stevens, J.P. & Company, Inc.
Stevens Tower
1185 Avenue of the Americas
New York, NY 10036
212-575-2000

Hanes Dye & Finishing Company
Buxton St.
Winston-Salem, NC 27102
919-725-1391

Laughlin Textile Mills, Inc.
P.O. Box 100
Waterford, NY 12188
518-237-6700-1

Lowenstein, M. & Sons
1430 Broadway
New York, NY 10018
212-560-5000

Lyman Printing & Finishing Company
An Affiliate of M. Lowenstein & Sons
Lyman, SC 29365
803-439-3081

Malden Mills, Inc.
46 Stafford St.
Lawrence, MA 01840
617-685-6341

Munsingwear, Inc.
718 Glenwood Ave.
Minneapolis, MN 55405
612-340-4700

Narrow Fabric Company, The
Division of Wyomissing Corporation
7th & Reading Aves.
P.O. Box 742
Reading, PA 19603
215-376-2891

Neisco Industries, Inc.
Old Grover Rd.
P.O. Box 632
Kings Mountain, NC 28086
704-739-5421

North Carolina Finishing Company
Division of Fieldcrest Mills, Inc.
Box 1100
Salesbury, NC 28144
704-636-3541

Thomaston Mills, Inc.
115 E. Main
P.O. Box 311
Thomaston, GA 30286
404-647-7131

Threads-Incorporated
Bessemer City Rd.
P.O. Box 759
Gastonia, NC 28052
704-867-7271

Transco Textile Industries, Ltd.
P.O. Drawer 10026
1660 Dixon Airline Rd.
Augusta, GA 30903
404-793-0000

United Dyeing & Finishing Company
Division of Fair-Tex Mills, Inc.
2645 Mitchell Ave.
Allentown, PA 18103
215-797-5680

United Merchants & Manufacturers, Inc.
1407 Broadway
New York, NY 10018
212-564-6000

Westpoint-Pepperell, Inc.
W. Tenth Street at Fourth Avenue
P.O. Box 71
West Point, GA 31833
404-645-1111

Westpoint Pepperell, Apparel Fabrics Division
111 W. 40th St.
P.O. Box 80
New York, NY 10018
212-354-9150

Wilmington Finishing Company
P.O. Box 471
Wilmington, DE 19899
302-654-5311

APPENDIX E

ASSOCIATIONS AND UNIONS

TRADE ASSOCIATIONS

American Dye Manufacturers Institute
630 Third Avenue
New York, NY 10017
Ernest S. Meyers, Executive Director
(212) 953-9000

American Printed Fabrics Council
1040 Avenue of the Americas
New York, NY 10018
J. Walter Kaine, Executive Director
(212) 840-7660

American Textile Manufacturing Institute, Inc.
Suite 300
1101 Connecticut Avenue, N.W.
Washington, DC 20036
W. Ray Shockley, Executive Vice President
(202) 862-0500

Association of Flock Processors
27 East 20th Street
New York, NY 10003
Harold Swiss, Administrator
(212) 228-3929

Canvas Products Associated International
600 Endicott Building
St. Paul, MN 55101
Robert C. Mead, Executive Vice President
(612) 222-2508

Color Association of the U.S., Inc.
242 East 19th Street
New York, NY 10003
Midge Wilson, Executive Director
(212) 929-8026

Durene Association of America
350 Fifth Avenue
New York, NY 10001
Robert T. Barnes, Managing Director
(212) 564-0936

International Silk Association
299 Madison Avenue
New York, NY 10017
Grace Baller, Executive Vice President
(212) 490-0084

International Society of Industrial Yarn Manufacturers
Box 1278
Gostona, NC 28052
B. R. Farmer, President
(704) 865-9531

Knitgoods Dyers and Processors Association
51 Chambers Street
New York, NY 10007
Harold Korzenik, Counsel
(212) 962-1183

Knitted Textile Association
51 Madison Avenue
New York, NY 10010
Gordon F. Graham, Administrative Secretary
(212) 683-7520

Man-Made Fiber Producers Association
1150 17th Street, N.W.
Washington, DC 20036
Charles W. Jones, President
(202) 296-6508

Master Textile Printers Association
60 Glen Avenue
Glen Rock, NJ 07452
Louis L. Croland, Executive Vice President
(201) 444-5110

National Textile Processors Guild
51 Chambers Street
New York, NY 10007
Harold Korzenik, Secretary-Counsel
(212) 962-1183

Silk and Rayon Printers and Dyers Association of America, Inc.
150 Hinchman Avenue
Wayne, NJ 07470
Kenneth G. Monaghan, Executive Secretary
(201) 271-6400

Textile Converters Assocation
1450 Broadway
New York, NY 10018
Jacob P. Rosenbaum, Executive Director
(212) 354-1373

Textile Distributors Association
1040 Avenue of the Americas
New York, NY 10018
J. Walter Kaine, Executive Director
(212) 398-0600

Textile Information Users Council
Box 7793
Greensboro, NC 27407
D. L. Ball, Committee Member
(919) 379-2613

Textile Printers and Dyers Labor Relations Institute
150 Hinchman Avenue
Wayne, NJ 07470
Walter J. Stryker, Secretary
(201) 942-7000

LABOR UNIONS

Amalgamated Clothing and Textile Workers Union
770 Broadway
New York, NY 10003
Murray H. Finley, President
(212) 255-7800

Textile Foreman's Guild
300 Lafayette Avenue
Hawthorne, NJ 07506
LeRoy Toci, President
(201) 423-3079

United Textile Workers of America
420 Common Street
Lawrence MA 01840
Francis Schaufenbil, President
(617) 686-2901

American Association for Textile Technology
1040 Avenue of the Americas
New York, NY 10018
Karan Koopman Stone, Administrative Manager
(212) 354-5188

American Association of Textiles Chemists and Colorists
Box 12215
Research Triangle Park, NC 27709
William Martin, Executive Director
(919) 549-8141

American Transfer Printing Institute
51 Madison Avenue
New York, NY 10010
Lance Walsky, Executive Director
(212) 683-7520

Institute of Textile Technology
Box 391
Charlottesville, VA 22902
C. G. Tewksbury, President
(804) 296-5511

National Association of Textile Supervisors
44 Betwood Street
Albany, NY 12209
Arthur C. Mullen, Executive Secretary and Treasurer
(518) 482-6658

National Council for Textile Education
Box 391
Charlottesville, VA 22902
Dr. Robert A. Barnhardt, President
(804) 296-5511

Southern Textile Association
335 Ridgecrest Road
Cary, NC 27511
(919) 467-7189

Textile Quality Control Association
Box 76501
Atlanta, GA 30328
L. Howard Olson, Secretary-Treasurer
(404) 252-9037

Textile Research Institute
Box 625
Princeton, NJ 08540
Henry J. Jansen, Secretary-Treasurer
(609) 924-3150

Textile Resource and Research Center
Valentine Museum
1015 East Clay Street
Richmond, VA 23219
Jean Du Val Kane, Director
(804) 679-0711

Textured Yarn Association of America
Box 1013
Monroe, NC 28110
Norman R. Cohen, Executive Secretary
(704) 283-4923

Wool Bureau
360 Lexington Avenue
New York, NY 10017
Felix J. Colangelo, President
(212) 986-6222

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