

1  **CHAPTER 9**

Special-Use Fibers

2  **ELASTOMERIC FIBERS**

✘ **Elastomers:** A natural or synthetic polymer which, at room temperature, can be stretched repeatedly to at least twice its original length and which, after removal of the tensile load, will immediately and forcibly return to approximately its original length.

✘ **Kinds of stretch**

+Power stretch: holding power with elasticity; fibers with high retractive forces

+Comfort stretch: only elasticity desired

3  **RUBBER**

✘ **Manufactured fiber** in which the fiber-forming substance is comprised of natural or synthetic rubbers.

✘ **Natural rubber:** From plant source.

✘ **Synthetic rubbers:** Synthetic sources.

✘ **Properties of both types similar**

+Excellent elongation & elasticity

+Low tenacity influences end use

+Poor resistance to aging, sunlight, oil, perspiration, oxidizing agents

+Low dyeability, hand, regain

4  **SPANDEX**

✘ **Wet or dry spun** from synthetic polymers.

✘ **Physical structure:** Mono or multifilament; variable sizes.

✘ **Chemical structure:** A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polymer consisting of at least 85% of a segmented polyurethane (also known as *elastane*).

5 6  **SPANDEX**

✘ **Aesthetic:** Seldom used alone; no cover yarn needed.

✘ **Durability:** More durable than rubber; improved tenacity & flex life; similar elongation & elasticity; better resistance to body oils, perspiration, chemicals, aging.

✘ **Comfort:** Low regain; moderate density.

✘ **Care:** Resistant to cleaning chemicals; thermoplastic.

✘ **Uses:** Apparel, industrial, furnishings.

7  **ELASTOESTER**

✘ **Manufactured fiber** in which the fiber-forming substance is a long-chain synthetic polymer consisting of at least 50% by weight of aliphatic polyether and at least 35% by weight of polyester; elongation of 600%.

✘ **Properties:** Low tenacity; lower elasticity compared to other elastomers; superior strength retention in wet heat conditions & after treatment with alkalis; better dyeability & print clarity compared to spandex.

✘ **Uses:** Outerwear & furnishings.

8  **OTHER ELASTOMERICS**

✘ **Elasterell –P**

+An elastic bicomponent polyester; good inherent stretch with excellent recovery; easy care; active sportswear, leisure; known as *multelastester* in Europe.

✘ **Lastol**

+Elastic cross-linked copolymer olefin; superior stretch and recovery; chemically stable; active wear and easy care stretch apparel.

✘

9  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE**

✘ **Aramid**

+Manufactured fiber in which the fiber-forming substance is any long-chain synthetic

polyamide in which at least 85% of the amide linkages are attached directly to two aromatic rings.

10  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗Aramid (cont.)

+Processing: Wet or dry spun & drawn.

+Physical structure: Staple or filament.

+Properties: Exceptional heat and flame resistance & strength; high tenacity & resistance to stretch; resistant to most chemicals; excellent impact & abrasion resistance; regain of 4.5%; usually mass pigmented.

+Uses: Industrial fiber; protective apparel uses.

11  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗Glass

+A manufactured fiber in which the fiber-forming substance is glass (silicon dioxide).

+Process: Melt spun, not drawn.

+Properties: Incombustible; good strength, but low flex abrasion resistance (brittle); low elongation; high density; nonabsorbent.

+Uses: Furnishings and industrial.

✗

12  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗Metal and metallic fibers

+Manufactured fiber composed of metal, plastic-coated metal, metal-coated plastic, or a core completely covered by metal.

+Processing: Laminating or metalizing.

+Types

✗Gold, silver, brass, etc.

✗Aluminum: Often coated with plastic film to minimize tarnishing; may be stiff and inflexible.

✗Stainless steel: Superfine filaments of steel to reduce static potential; strong, stiff, and heavy.

+Uses: Apparel, furnishings, and industrial.

13  **PRODUCTION**

14  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗Novoloid

+Manufactured fiber in which the fiber-forming substance contains at least 35% by weight of cross-linked novolac.

+Properties: Outstanding flame resistance; good resistance to sunlight; inert to most chemicals.

+Uses: Flame-resistant industrial products.

15  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗PBI

+A manufactured fiber in which the fiber-forming substance is a long-chain synthetic aromatic polymer having recurring imidazole groups as an integral part of the polymer chain.

+Processing: Dry spun & drawn.








+Properties: Good tenacity & breaking elongation; mass pigmented; flame resistant; high regain.

+Uses: Heat resistance apparel; furnishings for aircraft, hospitals, & submarines; industrial filters & membranes.

16  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

✗Sulfar

+A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polysulfide in which at least 85% of the sulfide linkages are attached directly to two

- aromatic rings.  
 +Production: Melt spun; drawn.  
 +Properties: Good tenacity and breaking elongation; excellent elasticity & resistance to acids/alkalis; low regain; moderate density.  
 +Uses: Filtration fabrics; papermaking felts, membranes, rubber reinforcement, & electrical insulation.
- 17  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Saran  
 +A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polymer composed of at least 85% by weight of vinylidene chloride units.  
 +Production: Melt spun, hot drawn.  
 +Properties: Good weathering properties, resistant to chemicals, tough, durable; good tenacity; low regain; heavy; does not support combustion.  
 +Uses: Competes with olefin for similar end uses.
- 18  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Vinyon  
 +A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polymer composed of at least 85% by weight of vinyl chloride units.  
 +Properties: Low tenacity; very sensitive to heat; unaffected by moisture; chemically stable; poor conductor of electricity; does not burn.  
 +Uses: Bonding agents for rugs, papers, & fiberweb fabrics & for other industrial products.
- 19  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Vinal  
 +A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polymer composed of at least 50% by weight of vinyl alcohol units and in which the total of the vinyl alcohol units and any one or more of the various acetal units is at least 85% by weight of the fiber.  
 +Properties: Strong fiber, weaker when wet; flame resistant; good resistance to chemicals; mass pigmented.  
 +Uses: Protective apparel and industrial goods.
- 20  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Fluoropolymer  
 +A manufactured fiber containing at least 95% of a long chain polymer synthesized from aliphatic fluorocarbon monomers; polymerized under pressure and heat with catalyst.  
 +Properties: Average tenacity, low elongation, good pliability; heavy; temperature resistant; resistant to chemicals, sunlight, weathering, & aging; low friction coefficient.  
 +Uses: Industrial.
- 21  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Carbon  
 +Heat stabilized, cross-linked polyacrylonitrile.  
 +Properties: High strength; rigid; exceptional heat resistance; moderately heavy; high regain; very low coefficient of thermal expansion; chemically inert; biocompatible.  
 +Uses: Reinforcement fibers in resins & metals; bone-grafts; replacement for asbestos.
- 22  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Melamine  
 +A manufactured fiber in which the fiber-forming substance is a synthetic polymer composed of at least 50% by weight of a cross-linked melamine polymer.  
 +Properties: Moderate strength; 5% regain; low elongation at break; moderately heavy; fair abrasion resistance; good to excellent resistance to most chemicals.  
 +Uses: Low cost competitor for meta-aramid, PBI, sulfar, and polyimide.
- 23  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**  
 ×Polyimide (PI or PEI)

- +Properties: Moderately strong; 20% elongation at break; low regain; moderate specific gravity; good abrasion resistance; good to excellent resistance to most chemicals; moderately high cost.

- +Uses: Filters, protective clothing, fire block seating.

24  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

- ×Polyphenylene Benzobisoxazole (PBO)

- +Properties: Nonflammable; high temperature resistance; good tenacity; 1.5 density; 2% regain; 3.5% breaking elongation.

- +Uses: Reinforcing fiber in resins.

25  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

- ×Ceramic Fibers

- +Properties: Composed of metal oxides, metal carbides, metal nitrides, or other mixtures; high thermal resistance; high strength; rigid.

- +Uses: Reinforcing fibers in resins or other compounds.

26  **FIBERS WITH CHEMICAL, HEAT, OR FIRE RESISTANCE (CONT.)**

- ×Polylactic Acid (PLA)

- +Fermented & melt spun from cornstarch.

- +Properties: Luster, drape, and hand of silk, quick drying, good wrinkle resistance, and good flame and ultraviolet light resistance.

- +Uses: Apparel and industrial applications.