

# Fabrics: Manufactured Fibers

**M**ANUFACTURED FIBERS are produced from organic elements: petroleum, coal, and natural gas. Synthetic fibers include nylon, rayon, Kevlar®, spandex, and acrylic. Synthetics continue to mimic the positive characteristics and hand (how the fabric feels) of natural fibers. Synthetics also blend well with natural fibers. Blended fabrics can take the best of natural fabrics and the best of synthetics to create even more desirable fabric properties and characteristics.



## Objective:



Describe the characteristics and surface finishes of manufactured fibers and fabrics.

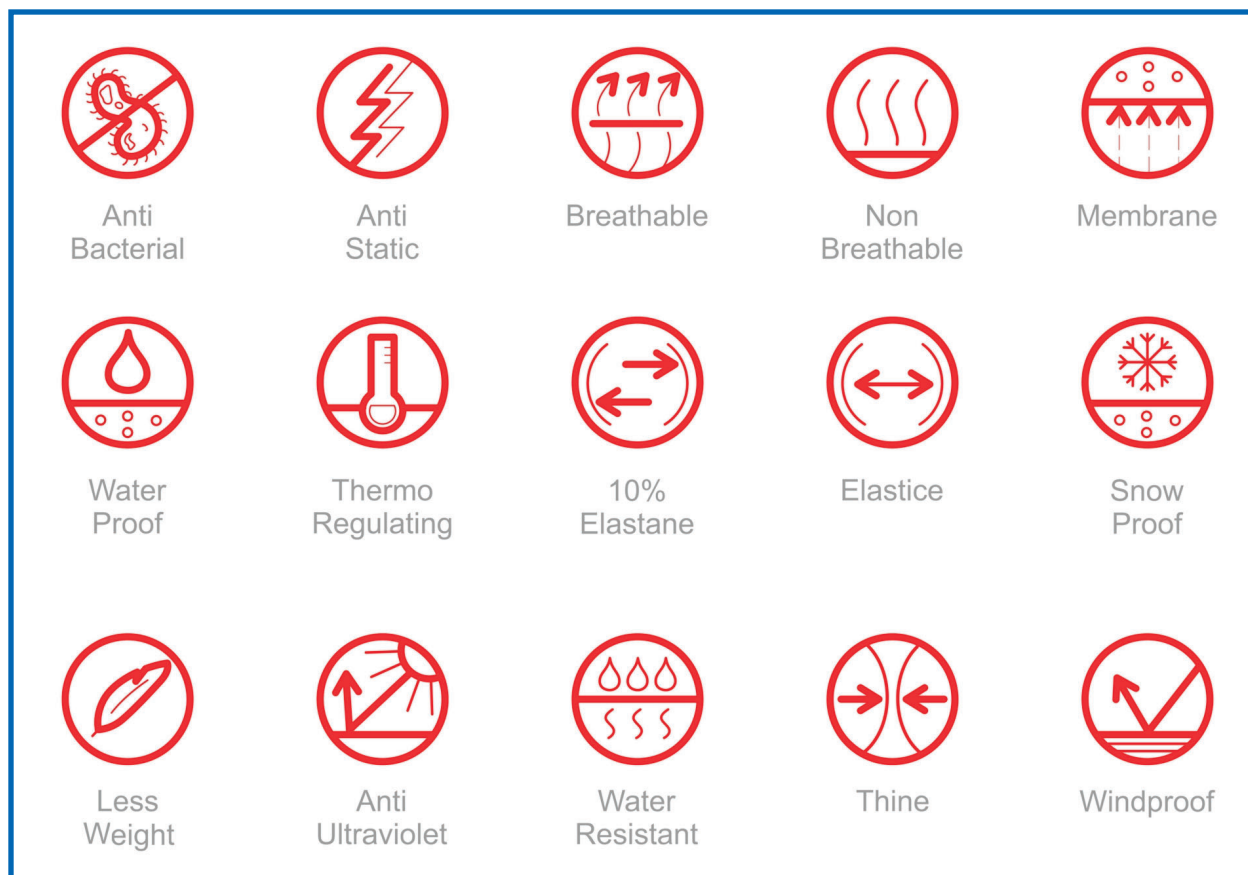
## Key Terms:



|                   |                      |               |
|-------------------|----------------------|---------------|
| acetate           | geotextiles          | nylon         |
| acrylic           | generic name         | olefin        |
| antistatic        | glazing              | polyester     |
| brushing          | hand                 | polymer       |
| calendaring       | Kevlar®              | rayon         |
| cellulosic fibers | manufactured fibers  | sizing        |
| crease resistant  | mercerization        | spandex       |
| embossing         | microfiber           | stone washing |
| fabric finish     | napping              | synthetic     |
| flame retardant   | noncellulosic fibers | trade name    |

## Manufactured Fiber Fabrics

Manufactured fibers are used for a wide variety of products: garments, upholstery, fire protection, tires, pond liners, landscaping, road building, and outdoor carpets and furniture. Military uses are the reason chemical engineers developed many of these synthetic fibers and fabrics. Manufactured fibers are produced from organic elements such as petroleum, coal, wood



**FIGURE 1.** Fiber properties and characteristics make synthetic fabrics desirable. Which garments in your wardrobe display the fabric properties shown here?

pulp, paper, natural gas, and plastics. Many manufactured fibers mimic today's natural fiber fabric characteristics and hand.

## MANUFACTURED FIBERS AND FABRIC TYPES

**Manufactured fibers** are **synthetic** (man-made) filaments (and fabrics) produced by scientists in a lab. Today, manufactured fibers are used in many garments and have many more industrial uses. Synthetic fabrics are often a blend of natural and manufactured fibers making it possible to combine (engineer) the best characteristics of each fiber to create a fabric with specific properties. Technology is being infused in some of these manufactured fibers to keep us warmer and to register heart rates.

- ◆ Most recently manufactured fibers repel rather than absorb water, dry quickly, and have minimal shrinkage when laundered. Manufactured fibers tend to wrinkle less than natural fiber fabrics. Manufactured fibers create fabrics that are made into clothing, furnishings, household items, and industrial items. Each generic manufactured fiber has unique properties that are constantly modified to improve performance and care.

- ◆ There are two major categories of manufactured fibers: cellulosic and non-cellulosic.
  - **Cellulosic fibers** are made from wood pulp and produce the following textiles: rayon, lyocell, (trade name Tencel), acetate, and triacetate. Cellulosic fibers require a minimal number of chemical stages during production.
  - **Noncellulosic fibers** are synthetics made from carbon, hydrogen, nitrogen, and oxygen molecules. These molecules form **polymers** ('poly' means many and 'mer' means unit) are large molecules composed of many repeating monomers.
  - All manufactured fibers have two names: a generic name and a trade name. A **generic name** is a common name for a group of similar fibers. A **trade name** is the name the manufacturer uses. For example:
    - Aramid is the generic name for the trade names Kevlar® and Nomex.
    - Nylon is the generic name for the trade names Anso, Antron, and Zafra.
    - Polyester is the generic name for the trade names Dacron, Fortrel, and Trevira.
    - Spandex is the generic name for the trade name Lycra.



FIGURE 2. Work out wear is often made of Lycra spandex.

## Acetate

**Acetate** is a synthetic fiber produced from cellulose (wood fibers). These fibers are made into fabrics that produce dresses, dress clothes, upholstery, and drapes. Acetate's fabric characteristics are:

- ◆ Soft
- ◆ Resists shrinking
- ◆ Dries quickly
- ◆ Wrinkles
- ◆ Melts under heat
- ◆ Poor (low) abrasion resistance

## Acrylic

**Acrylic** is a synthetic fiber made from natural gas and petroleum. These fibers are made into fabrics that produce garments, blankets, carpets, and upholstery. Acrylic's fabric characteristics are:

- ◆ Soft

- ◆ Warm
- ◆ Wool-like feel
- ◆ Wrinkle resistant
- ◆ Pills
- ◆ Heat sensitive (burns easily due to air pockets in the fabric)

## Kevlar®

**Kevlar®** is a strong and heat resistant synthetic fiber related to aramids that was developed by chemist Stephanie Kwolek at Du Pont in 1965. These fibers are made into fabrics that produce fire, police, and military uniforms and equipment, personal protection (bulletproof vests and helmets), shoes, audio equipment, vehicle brakes, frying pans, cables and ropes, smartphones, wind turbines, and cycle tires. Kevlar's® fabric characteristics are:

- ◆ Strong and impact resistant
- ◆ Heat resistant
- ◆ Absorbs moisture quickly (which makes it sensitive to its environment)
- ◆ Light and thin
- ◆ Difficult to cut, sand, or machine



**FIGURE 3.** Kevlar® is a strong and heat resistant synthetic fiber that is used in fire protection and military uniforms. These mountain climbing shoes are also made of Kevlar®.

## Microfiber

**Microfiber** is a synthetic strand made from a polyolefin finer than one denier (a diameter less than 10 mm). Microfiber uses include garments, upholstery, industrial filters, and cleaning products. Microfiber fabric characteristics are:

- ◆ Tightly woven

- ◆ Stains wipe off easily
- ◆ Dries quickly
- ◆ Shrink on first washing
- ◆ Expensive

## Nylon

**Nylon** is a synthetic polyamide fiber made from petroleum. It was the first completely synthetic fiber developed. By combining two sets of molecules, nylon is produced. Nylon's uses include lingerie, pantyhose, swimwear, tires, tents, and carpets. Nylon's fabric characteristics are:

- ◆ Strong
- ◆ Resilient
- ◆ Lustrous
- ◆ Retains its shape
- ◆ Heat sensitive
- ◆ Low moisture absorbency

## Olefin

**Olefin** is a synthetic fiber made from a polyolefin (e.g., polypropylene). Olefin's uses include active wear apparel, rope, indoor-outdoor carpets, lawn furniture, and upholstery. Olefin's fabric characteristics are:

- ◆ Strong
- ◆ Lightweight
- ◆ Quick drying
- ◆ Abrasion resistant
- ◆ Sensitive to heat and light
- ◆ Low absorption rate

## Polyester

**Polyester** is a synthetic polymer fiber made from coal, air, water, and petroleum. Polyester is created when a chemical reaction takes place between an acid and alcohol. Polyester uses include many garments (pants, shirts, hats, parkas), linens (tablecloths and comforters), upholstery, and drapes. Polyester's fabric characteristics are:

- ◆ Excellent wrinkle resistance
- ◆ Dries quickly



- ◆ Blends well with other fibers
- ◆ Retains creases
- ◆ Melts and burns at the same time
- ◆ Absorbs soils and stains
- ◆ Low absorption rates

## Rayon

**Rayon** is a synthetic fiber manufactured from regenerated cellulose plant fiber. Rayon fabric uses include garments, upholstery, and drapes. Rayon's fabric characteristics are:

- ◆ Soft (sometimes called
- ◆ High moisture absorbency
- ◆ Drapes well
- ◆ Feel and texture of silk (often called artificial silk)
- ◆ Wrinkles
- ◆ Shrinks
- ◆ Burns rapidly

## Spandex

**Spandex** is a synthetic fiber that is very elastic. Because it is produced from a polymer chain, it can be stretched repeatedly without breaking: almost 500 percent of its length. The unique network of spandex fibers causes them to recover length and strength over time. Spandex uses include sportswear and is blended with other fabrics to add elasticity. Spandex's fabric characteristics include:

- ◆ Great elasticity
- ◆ Strong and durable
- ◆ Damaged by bleach



**FIGURE 4.** Spandex is a synthetic fiber that is very elastic. The unique network of spandex fibers causes them to recover length and strength over time. This bicyclist is wearing Spandex shorts and shirt.

## Geotextiles

**Geotextiles** are permeable fabrics which, when used in association with soil, have the ability to separate, filter, protect and drain. Geotextiles are made from polypropylene and are woven, needle punched, or heat bonded for use in contact with soil. Silpaulin is an example of



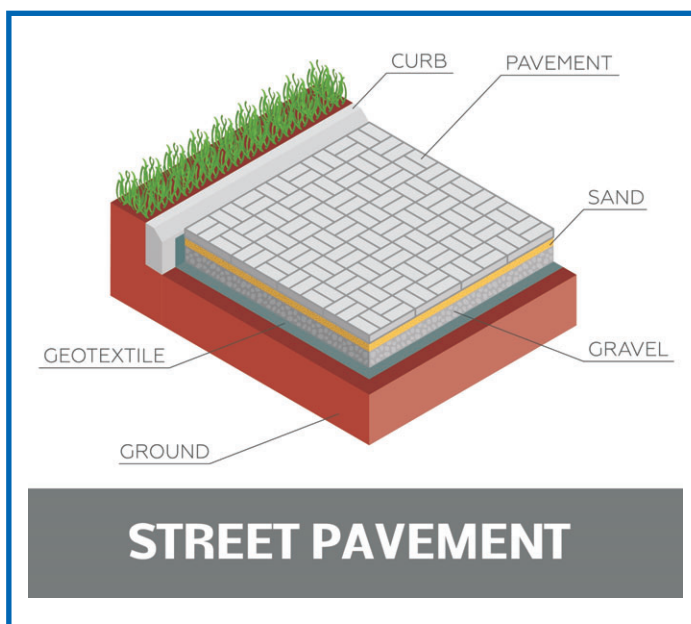
## DIGGING DEEPER...

### UNCOVERING ADDITIONAL FACTS: More Synthetic Fibers and Fabrics

The manufactured fibers in this unit are a short list of synthetic textiles. Research other manufactured fabrics such as modacrylic, azlon, nylril, saran, vinyon, etc. Conduct research about a fiber (and/or a blended fabric) and write a summary of what the synthetic fiber is made from and its characteristics, uses, appearance, and care. Also include the date the textile fiber was developed. You can also search for categories: synthetic upholstery fabrics, military fabrics, etc.

a fabric used in pond liners. Companies that produce and/or supply geotextiles include: GlobalSpec, TerraTex, BPM, and MMI Textiles. Geotextiles are used in the civil engineering (road construction) and outdoor furniture industries. Geotextile fabric characteristics include:

- ◆ Permeable (moisture passes through)
- ◆ Mildew resistant
- ◆ Water repellent
- ◆ Abrasion resistance
- ◆ Bursting strength (and other physical, mechanical, hydraulic, degradation and endurance properties)



**FIGURE 5.** Geotextiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, protect and drain. What are other uses for geotextiles?

## FABRIC FINISHES

A **fabric finish** is a chemical treatment of a textile to improve the texture and **hand** (how the fabric feels) and the fabric's performance (e.g., water resistant, insect repellent, etc.). Many finishes have the added advantage of improving the comfort of the fabric, too. These finishes can make a favorite pair of jeans more comfortable, make a wedding dress have a beautiful sheen, or create a work uniform that needs little ironing.

### 11 Common Fabric Finishes

1. An **antistatic** finish reduces the fabric's dryness by absorbing small amounts of moisture from the air to eliminate static electricity.
2. A **brushing** finish naps the fabric and makes appear and feel less severe.

3. **Calendaring** is a finish process in which fabric is passed between two heated rollers to produce surface effects or textures such as high luster, glazing, embossing, etc.
4. A **crease resistant** (or CRF) finish adds a resin to the fabric to reduce wrinkling.
5. **Embossing** is part of the calendaring process in which the rollers are carved to raise the surface of the fabric and engraving the fabric with a design.
6. A **flame retardant** finish reduces flaming and burning in fabrics.
7. **Glazing** is applying a resin during calendaring to produce a high polish.
8. **Mercerization** is a textile finishing treatment for cellulose fabrics and yarns, in which fibers and fabrics are treated with caustic soda or lye prior to dyeing to add strength, improve dye uptake and tear strength, and add luster.
9. **Napping** is a finish that uses rotating wire brushes to raise the short fiber ends of the staple yarns of the fabric.
10. **Sizing** is a finish that adds starches or resins to the fabric to add more body.
11. **Stone washing** is the addition of pumice stones (often wiped with oxidizing bleach) to the laundering process to produce a worn and faded look to a fabric.

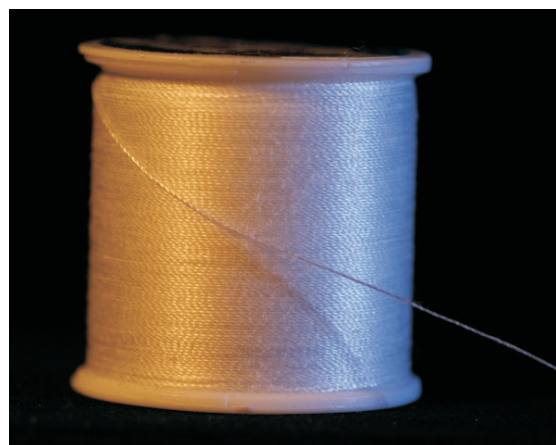


FIGURE 6. The two-ply cotton mercerized thread shown here has a polyester core and a nice luster. (Image courtesy Wikipedia at [https://commons.wikimedia.org/wiki/File:Spool\\_of\\_white\\_thread.jpg](https://commons.wikimedia.org/wiki/File:Spool_of_white_thread.jpg))



FIGURE 7. These volcanic pumice stones are used for stone washing. Stone washing is a finish done to jeans. Do you have a pair?

## Summary:



Manufactured fibers are synthetic (man-made) filaments (and fabrics) produced by scientists in a lab and used for a wide variety of products: garments, upholstery, fire



protection, tires, pond liners, landscaping, road building, and outdoor carpets and furniture. Military uses are the reason chemical engineers developed many of these synthetic fibers and fabrics. Many synthetic fabrics mimic today's natural fiber fabric characteristics and hand.

All manufactured fibers have two names: a generic name and a trade name. A generic name is a common name for a group of similar fibers. Synthetic fabric types include acetate, Kevlar®, nylon, polyester, and spandex. A trade name is the name the manufacturer uses. A fabric finish is a chemical treatment of a textile to improve the texture and hand (how the fabric feels) and the fabric's performance (e.g., resistant, repellent, etc.). Fabric finishes include brushing, calendaring, napping, and stone washing.

### Checking Your Knowledge:



1. List five manufactured fibers.
2. Describe five characteristics of synthetic fabrics.
3. List and briefly describe two fabric finishes.
4. What are the advantages of blending fibers to create new fabrics?
5. How has spandex changed sportswear?

### Expanding Your Knowledge:



Choose one of the fabric finishes in this unit. Go through magazines, advertisements, or online to search for five garments/items including carpets, drapes, furniture upholstery, table coverings, tents, etc. that use this finish. Print out a picture of each of the five garments and write a brief explanation about how this finish positively impacted the product or garment.

### Web Links:



#### Fabric Calendaring Process

<http://www.youtube.com/watch?v=jUz5YK-9NAY>

#### Performance Finishes

<https://fashion-history.lovetoknow.com/fashion-clothing-industry/performance-finishes>

#### Rayon

<http://www.madehow.com/Volume-1/Rayon.html>

#### A Short History of Manufactured Fibers

<http://gpktt.weebly.com/a-short-history-of-manufactured-fibers.html>

#### Woven Geotextiles

<https://www.erosionpollution.com/woven-geotextiles.html>