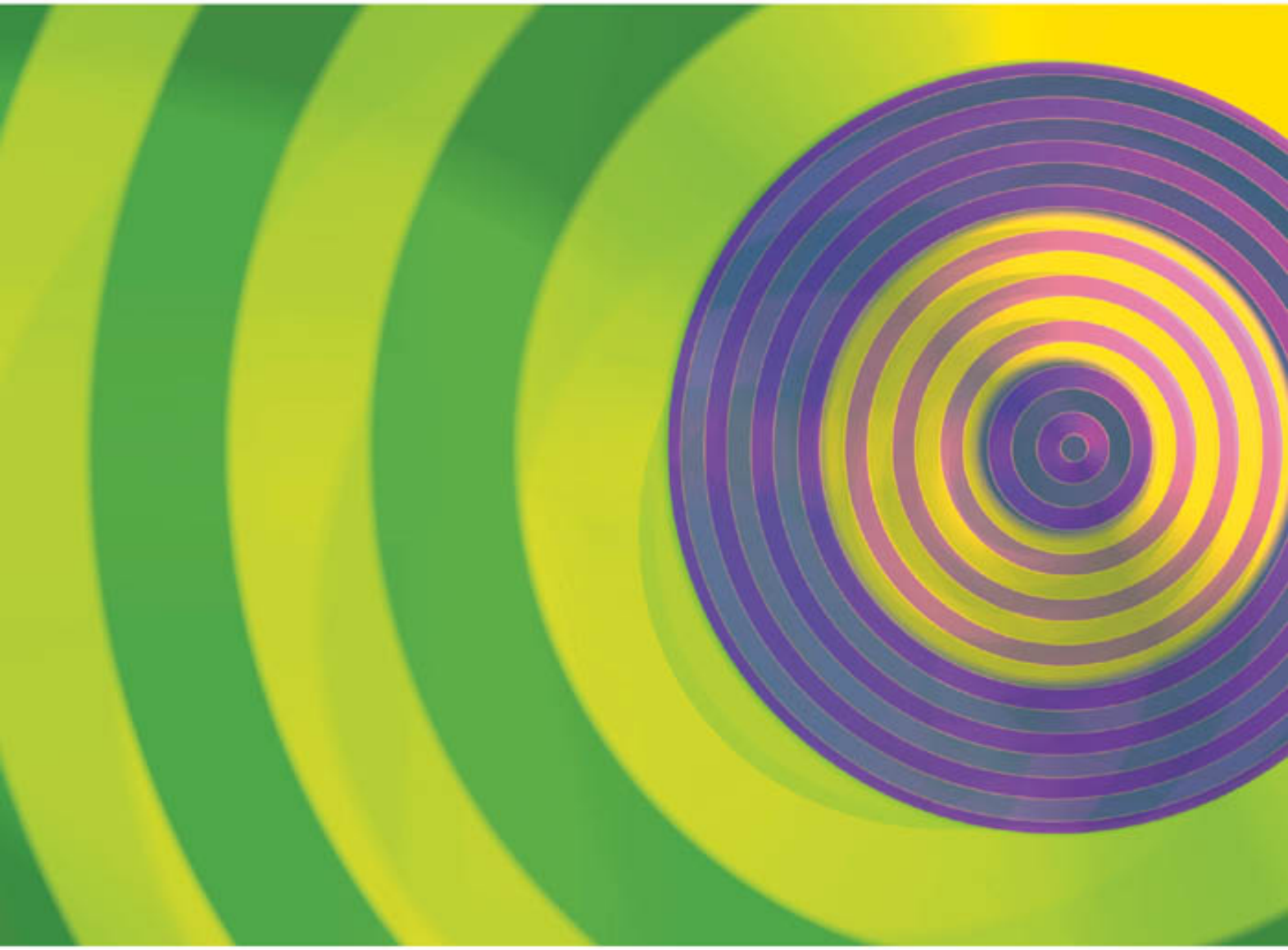
Pearson New International Edition



Fabric Reference

Mary Humphries

Fourth Edition

ALWAYS LEARNING™

PEARSON®

Pearson New International Edition

Fabric Reference

Mary Humphries
Fourth Edition

PEARSON®

Figure 85 (a) Dri-release® and FreshGuard® are registered trademarks of Optimer Performance Fibers. (b) Dri-release® yarns work through blending a synthetic fiber with a small amount of a hydrophilic fiber. (Courtesy of Optimer Performance Fibers)

FreshGuard is not a finish, but becomes active on special treatment of the licensed yarns developed by the company, creating a bacteriostatic effect within the fabric that cannot be removed. This makes these fabrics ideal for creation of casual wear, "regular" active sports wear, or garments for extreme activity, such as mountaineering; the fiber blend absorbs and releases moisture (perspiration), while the FreshGuard prevents odor development.

Figure 86 shows the owner of the Lorünser Sport Hotel in Austria, Gebhard Jochum, on this occasion trekking in the Himalayas. The shirt is one of the "Latitude 15" line, made by Americas International Consultants Inc. The face of the fabric is knit with a blend of baby alpaca and silk, with the underlayer a Dri-release blend of hydrophobic and hydrophilic fibers. (Latitude 15 is the latitude at which alpaca live in Peru, where the shirts are made, and the president of the firm is an alpaca farmer.) This shirt is designed to provide a base layer comfortable from below zero, through room temperatures, to scorching heat. One does not have to trek in the high mountains or across desert country to appreciate it, but the wearer here attests that, "The level of comfort it provides in an extreme outdoor environment is amazing."

There is now also a flame resistant Dri-release® FR, developed originally for the U.S. military. The blend has all the advantages outlined for Dri-release, but removed from flame is self-extinguishing, quickly turns to ash, and does not melt or drip—very important for a fabric worn next to or near the skin.

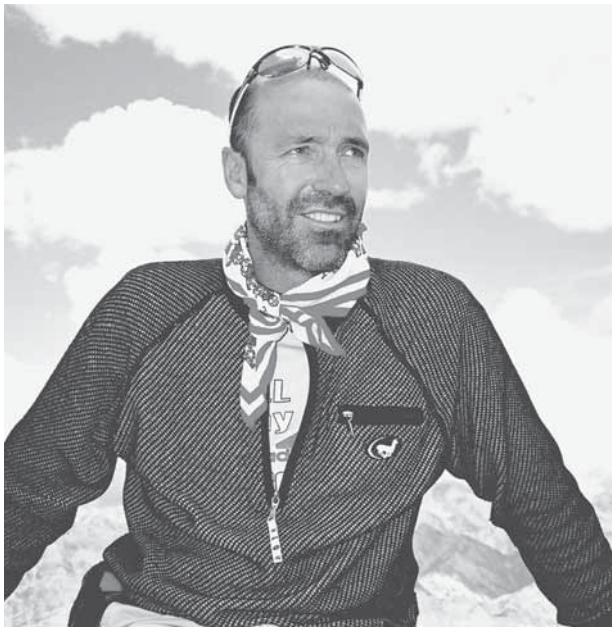


Figure 86 "Latitude 15" shirt keeps Gebhard Jochum comfortable while trekking in the Himalayas. (Courtesy of Gebhard Jochum, Sporthotel Lorünser)

Another branded blend is aimed to be used in all kinds of apparel; this is Merino Coolmax®, a collaboration between Australian Wool Innovation (AWI) and Invista, which owns the Coolmax registered

trademark. This blend also works without any chemical treatment, relying on soft, fine, absorbent Merino wool and the moisture management properties that come with the name Coolmax. It has aimed to be appealing from high performance sportswear, or leisure wear, up to haute couture. Although this is listed here among blends, the name may appear on articles (especially if knitted) where one ply of a yarn is made up of each component, or the Merino wool and Coolmax may be in separate yarn ends plated (plaited) in knitting.

Dyeing Effects

Multicolor effects in dyeing are achieved by blending fibers that take up dyes differently. Most of the major MF fiber generics can be produced in a number of differently dyeing modifications. This means that a fabric could be 100 percent of one fiber generic and still allow this "magic" of what is called *cross dyeing* or *fiber mix dyeing,* or *differential dyeing.* Cross dyeing is used most often for carpets, to allow piece dyeing; this delays decisions on color which, if carpet were made up in fiber- or yarn-dyed colors, could leave warehouses stocked with giant rolls of less popular shades.

Safety and Hygiene (Flame Resistance, Anti-Microbial Action)

Besides the general discussion of using modacrylic fibers for flame resistance (see "Modacrylic"), a selection of blends for flame resistance includes: furnishing fabrics of 80 percent modacrylic, 20 percent polyester; and garments of 80 percent lyocell, 20 percent FR polyester. Odor prevention from bacterial or fungi growth has been noted using at least 30 percent of a bioactive fiber with other fibers in sportswear or underwear.

Improved Performance in Wear and Care

This is one of the notable reasons for blending fibers—part of what may be called *fabric engineering*. We can make up for a disadvantage or weakness in one fiber by picking the right partner. Blending of 10 percent nylon with wool in socks or 20 percent in carpets greatly increases the wear life of the wool. Tilley Endurables travel-wear offers socks of 49 percent olefin, 46 percent nylon, and 5 percent spandex, with an "all-holes-barred" three-year guarantee. However, among ultimate for-strength blends in apparel, one must rank Kevlar® (para-)aramid/cotton for motorcycle outerwear at the top.

For years, cotton has been mixed with wool to give a material that will not felt, mat, or shrink in machine washing and drying, yet will carry some of the warm, comfortable feel and loft of wool.

There is an odd but long-made blend used for long underwear (by Damart of the United Kingdom), knit of 85 percent vinyon blended with 15 percent acrylic. Its trademark name is Thermolactyl—just keep it away from heat, as it is *very* heat sensitive.

Thinsulate™ (by 3M) is often a blend of microfibric olefin and standard polyester (see Figure 82) to give high insulating value (much fiber surface area) in a very thin, light layer of material. A variation, Thinsulate™ Lite Loft™ insulation, gives maximum warmth in sleeping bags with the least weight. The air-laid nonwoven material is a blend of fine (not micro) fibers, with thermal bonding of the fibers to maintain the structure; see Figure 87. Thinsulate™ Flex Insulation, developed for use with stretch fabrics, combines special elastomeric olefin fibers with regular size staple fibers to allow 40 percent stretch in all directions.

Many tests and trials have produced the best blends we have now. This is where the term *engineered blend* is deserved. The manufacturer of such a blend uses a mixture of more than one fiber, not as a sales gimmick but to produce a fabric superior in performance and/or more comfortable and more pleasing.

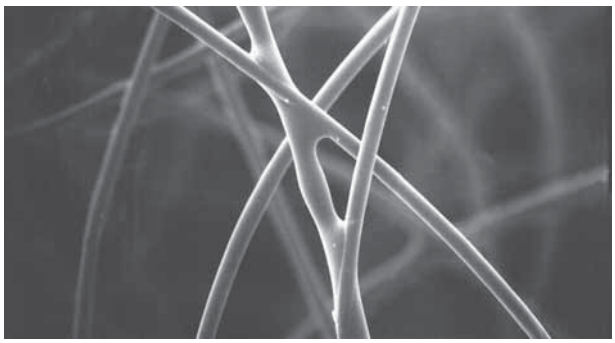


Figure 87 Thinsulate™ Lite Loft™ insulation blends fine fibers in a nonwoven fabric with thermal bonding to maintain the structure for insulation. (Courtesy of 3M)

FABRIC GLOSSARY

Fabric Glossary *Fabric Name*	*Relationship to Fabric Reference Discussion*
Spun Rayon	Often used with rayon (or with silk) to distinguish a "cottony" fabric from a "silky" material.
Ciré	This thin, shiny fabric with a good deal of water resistance is now usually made in nylon for strength.
Braid	Braid used to stiffen hems or to make light, wide-brimmed hats is today usually made from a coarse monofilament synthetic or a tape-like rayon.
Voile, Filament	The most common, of polyester, is used to make what we call "sheers," for window covering.
Fur-Like	These "fake furs" usually contain modacrylic fibers to lower flammability, but also make use of reaction to heat of acrylics (patent shrinkage) to simulate the "guardhair/underfur" layers of a real fur (see *Acrylic Properties*).
Split-Film Yarn	Olefin most easily forms filaments by this inexpensive process, and these find specialized uses—though not in high fashion fabrics!
"Power" Stretch *vs* Stretch for Comfort, Fit, Ease of Movement	There is a sharp difference between these two kinds of stretch or "give" in fabrics, one of which calls for a specific type of fiber, while the other has many ways to achieve it.
Canvas, Tailor's	To give the stiffening in this interlining, some special forms of MF fibers are substituted for the more expensive, wiry specialty hair fibers.
Color Variable	Some MF modified fibers can give a variable color effect.
Sueded	To feel like real suede, a fabric surface must be made of very fine fibers—what we call "microfibers" today.

REVIEW QUESTIONS 5

1. For a fiber that usually has a round cross section, what is another name for a nonround form? List three results of such a change. What is the best-known trademark name for a nonround fiber (nylon)? What is the difference in appearance when such a fiber is coarse compared to fine?
2. What types of modifications of MF fibers are used to act as stuffing for comforters, pillows, furniture cushions? What types are used to give insulation against heat loss?
3. Define *microfiber* as it is used in textiles today, and give a "benchmark" to illustrate this degree of fineness. What would the term *ultra-microfiber* mean? What term is used for the next degree of fineness in diameter?
4. What is the result in hand and drape of having a very fine fiber? How is the surface of a fabric affected if it is woven of microfiber yarns? What are three main practical advantages of this?
5. What two elements of real suede have to be present in an MF material for it to be very suede-like?
6. How is a fiber changed to reduce tendency to pill?
7. List six additions that can be made to MF fibers while still in liquid form, and an advantage of each.
8. Which is better for drapes, a delustered fiber fabric, or one made with bright fibers, and why?
9. Define a *bicomponent* fiber, and list three ways to accomplish this.
10. Give three advantages gained with each of the following blends, in terms of specific end uses where each would work well (assume 50 percent of each fiber): lyocell/polyester; wool/flax; rayon/olefin; nylon/acrylic; otton/modacrylic.

6 FIBER IDENTIFICATION

The first and most basic information about a fabric is fiber content. Although the way a fabric or garment is made and finished will affect its suitability for different purposes, nothing will counteract the mistake of using a fiber in riding pants, for instance, that cannot withstand abrasion.

Although most fabrics are labeled as to fiber content, there are many occasions when you might wish to determine or confirm this: You may have fabric that was a remnant, a gift, or acquired long ago, with content uncertain. In business, you may simply be unsure of the fiber content you are quoted; however, you cannot depend on your own determination in any legal sense.

For anyone studying the basics of textiles, few demonstrations are more convincing of the real differences between fibers or fabrics that may look and feel similar than a burning test or microscopic examination; these can also show that a relationship does exist between fibers that may look and feel very different!

Fiber identification is a useful skill and can develop into a kind of detective process. With very little equipment, you can at least determine a fiber's general type. Conclusive tests probably have to be made in a laboratory, sometimes with expensive equipment, certainly needing skilled staff.

Fiber Identification Methods

The following is general information on the methods of fiber identification; we will then examine several of them more closely:

1. **Burning test.** A burning test is often the simplest to carry out, as long as precautions are taken with open flame and there is a receptacle for burning or melting material. The test is useful if only a single type of fiber is present in a yarn; if any yarn contains a blend of fibers, the test will reveal only the presence of fibers with very characteristic odors, such as protein and cellulose, or of fibers that melt—but that is good general information. If someone has told you that a fabric is "all silk" and you do not smell burning protein, you know there is no silk at all; however, if you do smell the characteristic odor of burning silk, you do not know whether it is 100 percent silk.

   Discussion in detail of this procedure follows, with results of typical burning tests on various fibers.
2. **Microscopic examination.** A lengthwise (longitudinal) view of fibers is easy to get and very helpful. A cross section of fibers may sometimes be needed for positive identification, but is much more demanding to prepare. You do not need an expensive microscope; a child's or hobby type will do well, as fibers reveal most of their significant appearance at a magnification of 100 times (100) or even less, and mounts made in water give a good, undistorted view, although they do dry up quickly. Detailed discussion of this procedure follows.
3. **Staining test.** A stain test provides a useful cross-check in identifying fibers, as long as they are not already too dark a color, either naturally or from having been dyed. The identification (ID) stain will have a mixture of dyestuffs in it that gives different colors on different fiber types—a variation of cross-dyeing. When microscopic examination is made of a sample that has already been stained, both appearance and color contribute information. For example, a number of major fiber groups are round in cross section and so appear structureless in lengthwise view—like a rod. Use of an ID stain, especially if a piece of multifiber cloth is included, often helps greatly to distinguish among these groups. Testing laboratories regularly use such multifiber cloth, woven with 5 cm or 10 cm repeats of a variety of fibers in strips. The makeup of a 13-fiber cloth and a result with one ID stain mixture are shown in Figure 88.
4. **Solubility or chemical test.** This kind of test is needed when an unknown is very dark in color, when two or more fibers are present in a blend (which makes a burning test inconclusive), when fibers have very little visible structure, and in general, as a conclusive cross-check to burning or stain tests or microscopic examination.

   One of the few specific chemicals readily available is nail polish remover, which, although it is not acetone, will affect only acetate or triacetate at room temperature. Most other chemicals needed in fiber identification are hazardous and used only in laboratories. However, a chart later in this section shows some key fiber solubilities.

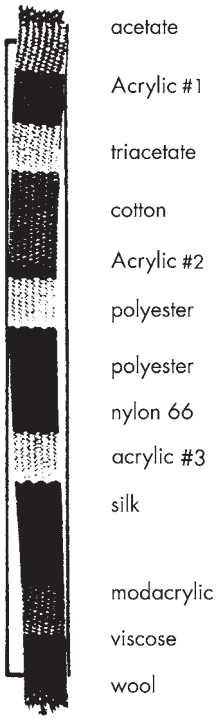


Figure 88 A 13-fiber multifiber cloth stained with an identification stain, made up to give different colors on different fiber types.

5. **Fiber density, infrared spectrophotometry, gas chromatography.** These are all positive identifying tests, but are very specialized. Near-infrared (NIR) spectrophotometry has provided a quick identification of fibers in textiles intended for recycling.[29] DNA "fiber profiling" has been developed by the British Textile Technology Group to distinguish among animal fibers, such as cashmere and yak.[30]
6. **Fiber melting point.** This is a specialized method with significant drawbacks for identification. Many synthetic fibers give a range of melting point figures, or may decompose before their melting point is reached. The copper block method commonly used indicates a softening point which may not be close enough to the melting point.

Textile Flammability

This topic touches far more than just fiber identification, so before proceeding with specific information on burning tests, we should consider fire safety as it relates to textiles. Fabrics are all around us—in clothing and household furnishings; in whatever transport we use; in schools, offices, theaters. Concern that dangerously flammable textile products should not be allowed on the market has led to increasing legislation in this area in a number of countries. In the United States, the original Flammable Fabrics Act (1953) was amended in 1967 to outlaw highly flammable fabrics for interiors as well as apparel. Since 1973, under the Consumer Products Safety Act, an independent agency, the Consumer Product Safety Commission, creates and enforces the rules for textiles (as well as other products). Standards in effect can be found in parts of Title 16 of the Code of Federal Regulations, Subchapter D—Flammable Fabrics Act Regulation in: part 1610, clothing textiles general; 1611, vinyl plastic film in apparel; 1615, children's sleepwear, sizes 0 through 6X; 1616, children's sleepwear sizes 7 through 14; 1630, 1631, carpets and rugs, small and large; 1632, mattresses, mattress pads. In Canada similar regulations exist under the Hazardous Products Act (1969), through Consumer Product Safety, under Health Canada's Product Safety Programme. The standards in both countries establish a base level of safety for consumer apparel, with special standards for items such as children's sleepwear, and also for carpets and mattresses.

Flammability of furnishings fabrics is also of great concern. The Upholstered Furniture Action Council has drawn up voluntary standards for upholstered furniture. There are many fire regulations governing acceptable levels for components of public buildings, such as hospitals and schools. Students in interior design should realize that professionals are expected to know and meet standards of safety set for contract work for their project and area, not only in the fabrics they choose, but to meet local fire codes in wallcoverings as well—if designers are certified, the responsibility is with them. A contractor can give the information on what class of fire rating is needed, and the designer should get a certificate from any fabric supplier stating that the fabric meets these ratings. If a fire were to occur and the proper materials had not been used, the designer could be held responsible.

So far as choosing apparel and fabric for domestic use, we should be aware of fire hazards in general, and this is an important focus of the general discussion of flammability that follows.

Burning Behavior

Flame retardancy is measured by the amount of oxygen needed to support combustion (Limiting Oxygen Index or LOI[31]); fibers with an LOI greater than 25 are said to be flame resistant or retardant, that is, there must be at least 25 percent oxygen present for them to burn. Glass, for instance, will not burn even in an atmosphere of 100 percent oxygen. Glass is also very resistant to heat, but other fibers may be flame resistant yet heat sensitive, such as the modacrylics.

Fiber Type and Fire Safety

Just as fiber behavior is basic to wear, ease of care, or comfort of our textile articles, so it is to their relative flammability. However, at this point we should note that what follows is a description of the relative flammability of **fibers without modifications**. Many MF fibers are available also in a flame resistant or retardant form, with the trademark name often followed by the letters FR (see "Additions to Manufactured Fibers before Spinning" earlier in this Section). Flame retardant finishes can be given to natural and MF fibers.

The following lists, then, describe behavior in flame and removed from it, by fibers not given any flame retardant modification or finish:

Most Flammable

- Cellulosic fibers (such as cotton, flax, viscose, lyocell). Once alight, these burn readily and so can "propagate" flame to other fabrics; can leave glowing embers.

Intermediate

- Acetate, triacetate. These melt as they burn; burn more readily than the groups listed next.
- Nylon, polyester, olefin (polypropylene), acrylic, spandex. These do not catch fire (ignite) readily; once ignited, burn and most melt; tend to drip (especially nylon); the drops tend to carry the flame away, so the fabric self-extinguishes in some situations.

Less Flammable

- Protein (wool, silk). These do not ignite easily; burn slowly; tend to self-extinguish, except in very dry air or with very open fabric.

Flame Resistant (LOI greater than 25)

Will not continue to burn when the source of ignition is removed (self-extinguishing).

- Modacrylic, saran, vinyon. These melt; modacrylic does not drip.
- Aramid. These do not melt but char; tend to self-extinguish; give little smoke.
- Certain modifications. Some MF fibers are given flame resistance by agents put in before the fiber is spun.

Flameproof (Nonflammable)

- Novoloid, polybenzimidazole (PBI). These will not burn; do not melt; char, but stay intact.
- Inorganic fibers (asbestos, glass, metal, etc.). These will not burn; can melt, but at temperatures so high they do not figure in textile fire safety!

Fabric Construction and Fire Safety

The way the fabric is constructed is another very important factor in fire safety:

- Lighter-weight fabrics, especially light, sheer, or open fabrics, burn faster than heavier fabrics (of equivalent fiber types).
- Fabrics with a raised surface burn faster than smooth fabrics.
- Open, porous fabrics or those with a more sparse pile burn faster than those with yarns packed closely together.

Garment Design and Construction and Fire Safety

The style and construction of a garment affects flammability:

- Loose-fitting garments, with flaring skirts or sleeves, with gathers, ruffles, trim like lace, anything with a lot of air incorporated with it, will ignite more readily and burn faster than closely fitting, virtually untrimmed articles. This means that flowing, at-home garments should be worn with care around the kitchen stove or barbecue.
- Thread may be more flammable than garment fabric, so an article can burn preferentially at the seams.