

Date 7/21/93  
Amount 3140-3  
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INV 28191

\$1.25

# The Structure of TEXTILE FABRICS

A.W. Koester

**T**here are many methods for making textile fabrics. Some of the oldest fabric structures consist of yarns used to weave, knit, braid, and knot. Newer methods of making fabrics may use fibers, stitching, solutions, foam, or combinations to make textile fabrics. The structure of the fabric determines its characteristics, such as appearance, texture, end uses, performance, and cost. Learning about fabric structure will help you to analyze, understand, and use textile fabrics.

This publication is organized by the material used to make the fabric. The first group of fabrics is made from solutions. Sometimes these are not considered textile fabrics because they are not made with fibers, but because they have some apparel and home furnishings uses they will be described. The second group of fabrics is made directly from fibers. This group includes felt, which is made using an old technique, and nonwovens, which require a modern technique. The third group of fabrics is made from yarns. These are the most widely available fabrics and the most familiar as they are used to make clothing and home furnishings. Within this group are further divisions into the various woven, knitted, knotted, and braided fabrics.

The fourth group of fabrics is called the multicomponent fabrics because they are made from two or more fabrics joined into another fabric structure. Familiar fabrics in this group include quilted, bonded, and laminated fabrics.

The last group of fabrics is called composite fabrics; they are made from one fabric plus fibers, yarns, foams, or films.

## Fabrics made from solutions: Films and foams

Films are solutions poured or forced into warm air or onto a revolving drum. Films are waterproof, low cost, and resistant to soil. They may be stiff, may tear easily, and lack strength unless attached to a fabric as a composite fabric. Films are used for shower curtains, some rain wear, and plastic bags.

Foams are made by adding air bubbles to either a rubber or polyurethane liquid. They are then pressed into a flat structure similar to a film. Foams may be too weak to be used alone. They usually are combined with fabrics for strength and durability—then reclassified as composite fabrics. Some of the leather-like fabrics used in upholstery are examples of foam and fabric composites.

## Fabrics made from fibers

**Felt.** Felt is a matted fabric formed by the interlocking of wool or other hair fibers. Felting is produced by the application of heat, moisture, and pressure to a layered web of tangled wool fibers. Felt does not ravel and does not have a yarn direction or grain. Felt is not durable as a garment fabric, but it is used frequently in decorative projects for home furnishings and individualized clothing.

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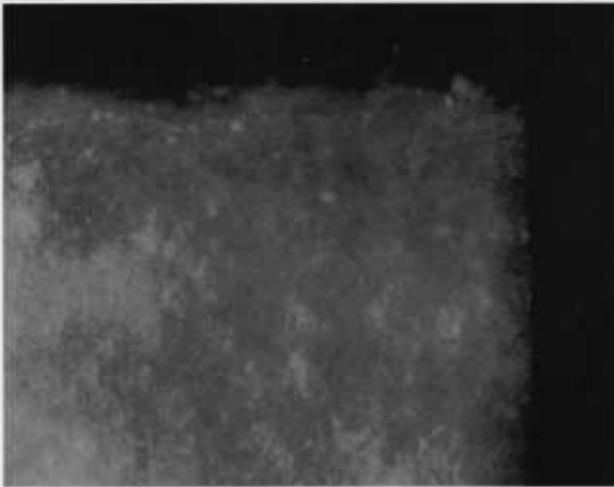
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Revised July 1993



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**Nonwoven fabrics.** Nonwoven fabrics are made from a web of manufactured fibers held together by a resin, heat and pressure, or needle punching with barbed needles. Such fabrics keep their shape and resist wrinkles and shrinkage. Their strength and durability depend on the materials and processes used in their manufacture. Nonwoven fabrics may have no stretch, stretch in one direction, or have limited stretch in any direction. They frequently are used as interfacing fabrics and should be carefully coordinated in weight and stretch with fashion fabrics. Disposable garments are another use for nonwoven fabrics. Nonwoven fabrics of specialized fibers are used for protective garments. They may protect the wearer in dangerous or dirty occupations. Garments of nonwoven fabric may be used to protect environments—such as microelectronic cleanrooms—from contamination by people.

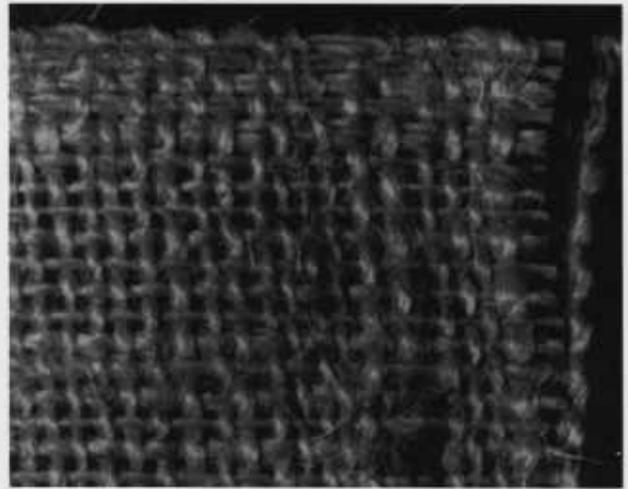


**Fabrics made from yarns:**  
Woven, knitted, stitched knit, knotted,  
and braided

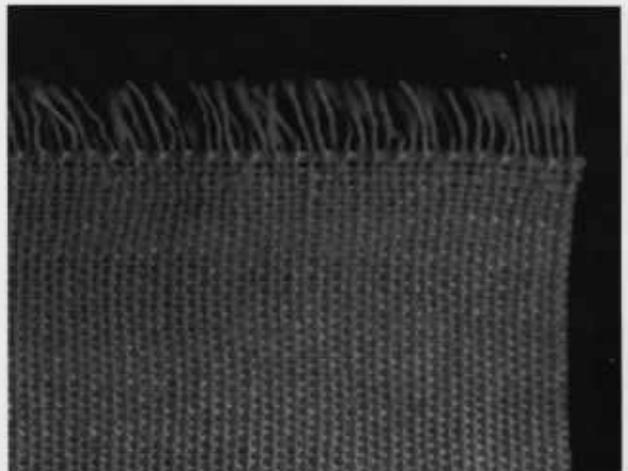
Many different fibers are used to make the yarns for woven, knitted, stitched knit, knotted, and braided fabrics. Some fibers, and the yarns made from them, are more suitable to certain fabric structures than other fibers. The yarn may change the appearance of the fabric depending on the number of parts or plies, the twist, the size, and any special effects that are used. Some fabrics such as crepe, tweed, bouclé, and chenille are named for the yarn used.

**Woven fabrics.** Woven fabrics are made by inserting a crosswise set of yarns at right angles to a lengthwise set

of taut yarns. The crosswise yarns are called weft or filling, and the lengthwise yarns are called warp. Lengthwise yarns are stronger and less flexible than crosswise yarns. Lengthwise yarns extend the entire length of a piece of fabric and may be called the lengthwise grain of the fabric. Crosswise yarns weave from side to side and may be called the cross grain. The lengthwise edges of the fabric are called selvages. In older methods of weaving and in hand weaving, the selvaige is smooth because it is formed by the continuous crosswise yarn carried back and forth across the fabric by the shuttle.

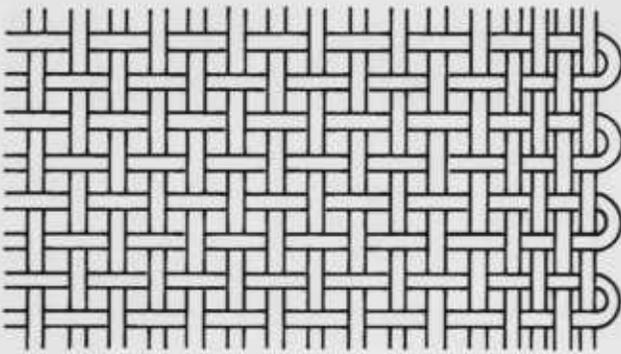


With current shuttleless weaving techniques, the crosswise yarns are inserted individually. They are propelled by air, water, or small lightweight metal grippers. Shuttleless weaving creates fringed selvages.

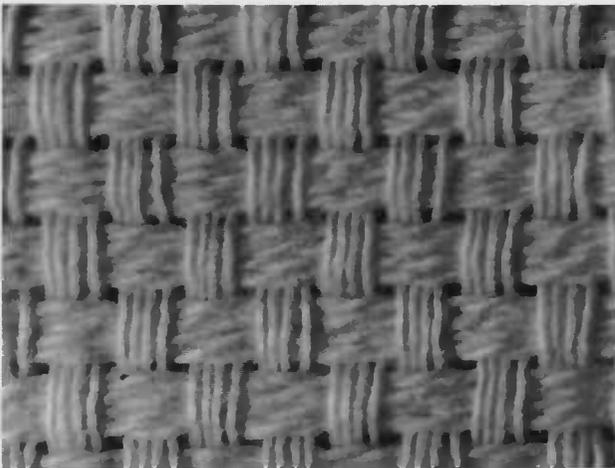


When buying woven fabrics, check that the lengthwise and crosswise yarns are at right angles to each other. Most of today's fabrics have finishes that will not allow you to straighten or square the yarn intersections if they were not squared during manufacturing. The various fibers, yarns, and weave patterns affect the handling and behavior of the fabric.

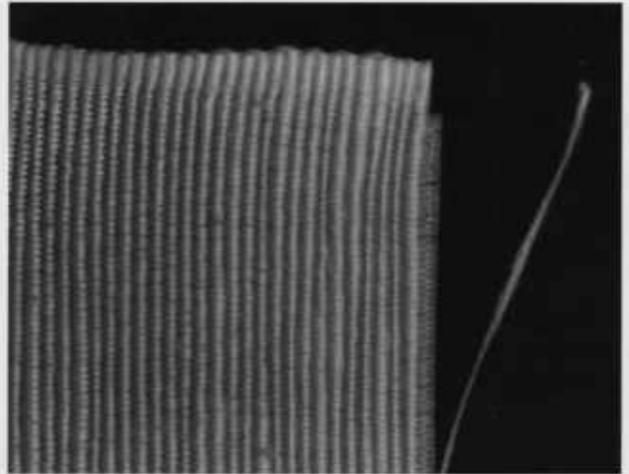
*Plain weave.* The plain weave interlaces the filling (weft) yarns alternately, one over and one under each warp yarn. The plain weave frequently is used because it produces a strong, firm fabric. Lightweight, plain weave fabrics include chiffon, voile, and organdy. Medium-weight, plain weave fabrics include muslin and gingham. Heavyweight, plain weave fabrics include duck, canvas, and burlap.



Variations of the plain weave include *basket* and *rib* weaves. Basket weaves result from two or more warp or filling yarns used side by side as one yarn.



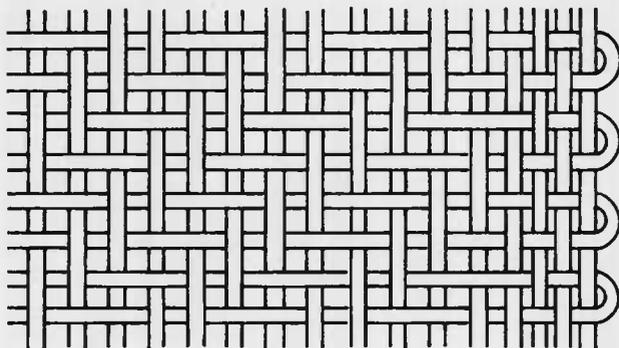
Ribbed or corded fabrics are formed by using warp and filling yarns of different sizes in a plain weave.



Fabrics with small crosswise ribs include broadcloth, poplin, and taffeta. These fabrics usually are the result of using larger crosswise yarns than warp yarns. Shantung has ribs that are irregular as a result of the thick and thin filling yarns. Fabrics with large or more pronounced crosswise ribs include faille, grosgrain, bengaline, and ottoman. These fabrics are the result of fine, closely spaced warp yarns and thicker filling yarns. Dimity has a lengthwise rib that is the result of larger yarns or doubled yarns used lengthwise.

*Twill weaves.* Some weave patterns are the result of varying the number of yarns passed over and under. Twill weaves result from crossing over and under different numbers of yarns. In the simplest form of twill, a crosswise yarn will pass over two and under one lengthwise yarn. The next crosswise yarn also passes over two and under one, with the repeat beginning one yarn further from the edge. This is called a 2 x 1 twill. This pattern or regular progression creates a visible diagonal line that is the identifying characteristic of a twill weave. The numbers used in describing a twill weave tell the number of yarns that cross over and under.

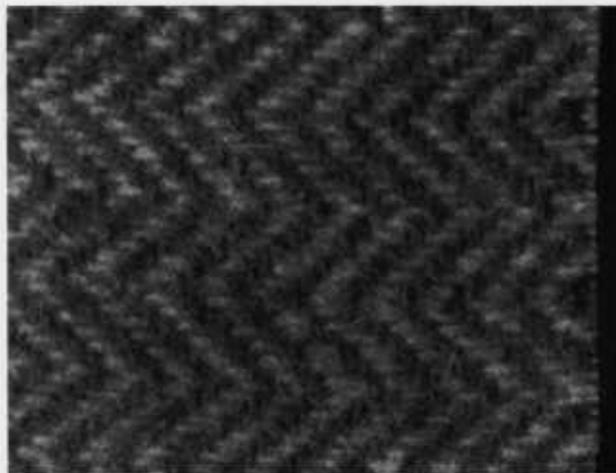
In a solid color fabric, the diagonal twill line is less distinct. In a fabric with warp yarns on one color and another color used for filling yarns, the diagonal effect is more pronounced. Denim is an example of this type of twill.



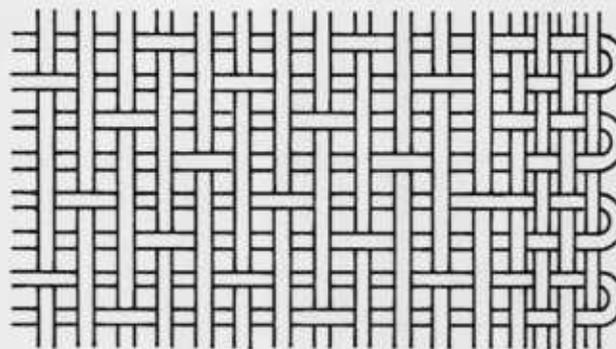
Twill fabrics vary in the pattern of yarns crossed and the angle and direction of the diagonal. Twill fabrics include serge, surah, sharkskin, gabardine, drill, covert, chino, and cavalry. In most twill weaves of wool and wool-like yarns, the diagonal goes from the lower left to the upper right. In cotton and cotton-like yarns, it goes from the lower right to the upper left. This will help you determine the face and back side of the fabric.



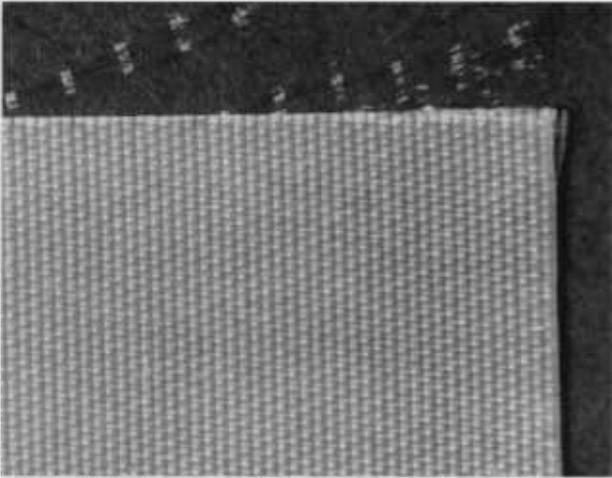
*Herringbone* fabrics have a distinctive appearance where the diagonal line reverses back and forth or right and left. In most twill weaves, the yarns are closely spaced, making strong fabrics that resist soiling and abrasion.



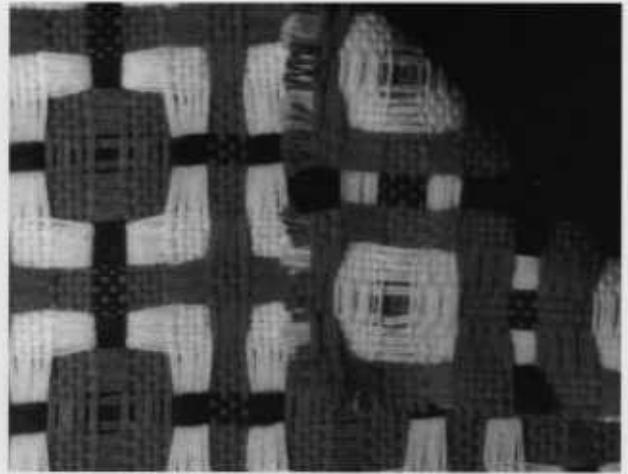
*Satin weave.* A satin weave is made by allowing the yarns in one direction to float over several yarns in the other direction before passing under one yarn. The number of yarns crossed or floated over may range from 4 to 11. The crossing yarns do not pass under the single yarn in a regular progression.



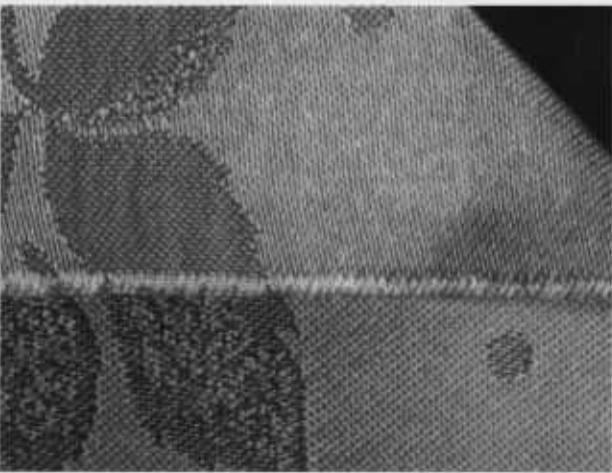
If the warp yarns form the floats, the fabric is called satin. When the filling yarns float, the fabric is called *sateen*. Most satin fabrics are made of continuous filament yarn and are lustrous. Sateen fabrics usually are made of spun yarns. Satin weave fabrics are smooth and resist soiling, but snag easily and do not resist abrasion.



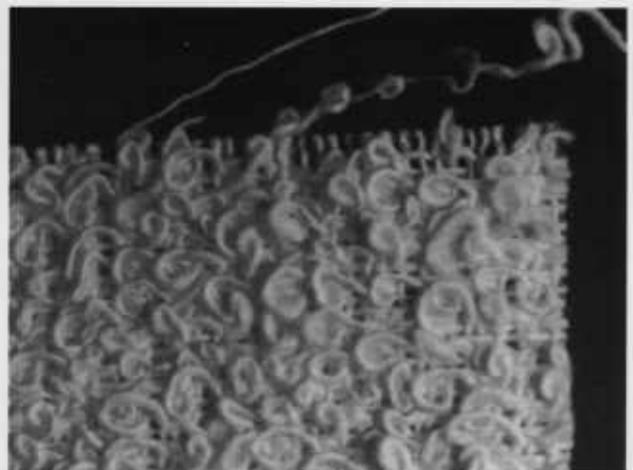
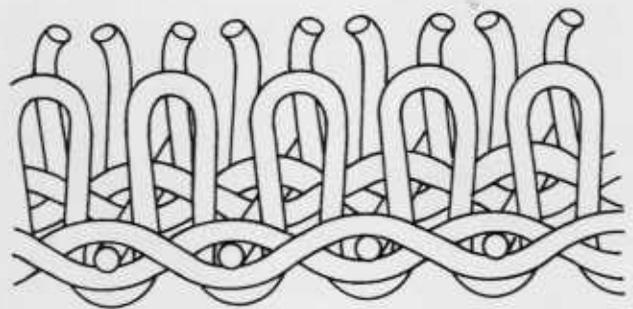
*Jacquard.* A Jacquard weave is a combination of plain, twill, and satin weaves. It is formed by controlling each warp yarn individually. The result is a patterned fabric with the design formed by a mixture of weave patterns. Some examples of Jacquard pattern fabrics are brocade, brocatelle, and damask.

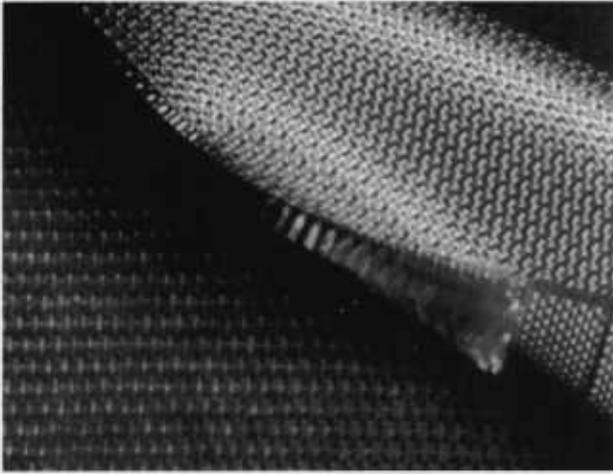


*Pile.* Pile fabrics are three-dimensional fabrics. They may be constructed by weaving, knitting, tufting, or stitchthrough. Woven pile fabrics have cut or uncut loops that stand up on the surface. In addition to the lengthwise and crosswise yarns, a third set of yarns forms the pile. Woven pile fabrics include terry, corduroy, velvet, and velveteen.



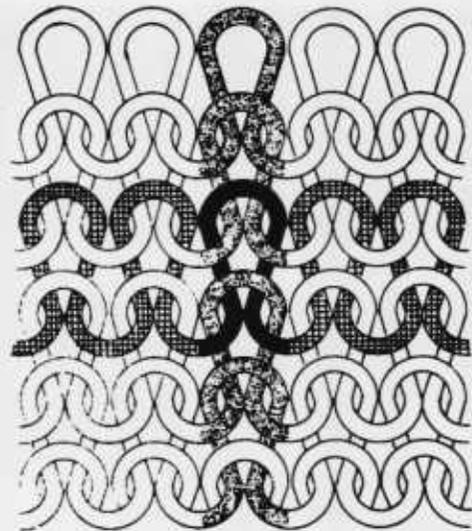
*Dobby.* A doobby weave is similar to a Jacquard but it is a smaller repeated pattern, usually a geometric. Dobby weaving also is the result of controlling the warp yarns individually. Some doobby weave fabrics include pique, bird's eye, and waffle cloth.





The additional yarns on the surface give pile fabrics durability. However, they need extra care in pressing to avoid flattening the pile. Pile fabrics may be pressed with the right side against self fabric or a needle board. Some fake fur fabrics can be pressed only with the fingers. The pile or nap visible on pile fabrics affects the direction of the layout of pattern pieces on the fabric. Patterns usually include layout instructions for cutting the pattern pieces in one direction, “with the nap.” Short pile fabrics should be cut with the nap going upward on the body to give a visually deeper color. Long pile fabrics should have the nap running downward on the body.

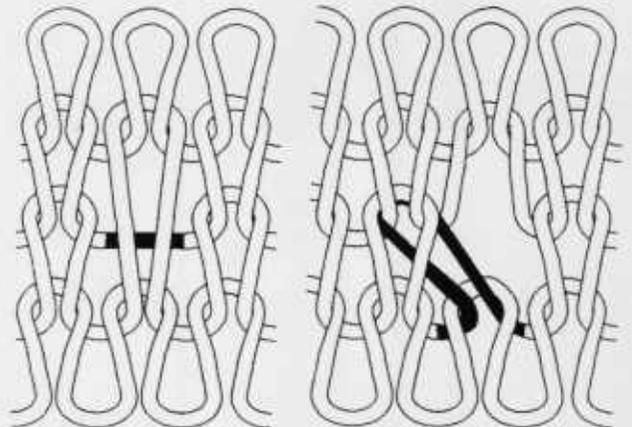
**Knitted fabrics.** Knitted fabrics are produced by interlooping yarns into each other. Each loop is called a stitch. There are two main categories of knitting—*weft* knitting and *warp* knitting.



Single knit

-  = Knit loop or stitch
-  = Row or course
-  = Wale

*Weft knitting.* Weft knitting is similar to hand knitting. The yarn moves horizontally across the fabric and loops are made one at a time. The fabric is constructed in horizontal rows of knit loops, or courses. Rows of stitches are added on top of each other. Each vertical line of loops is called a wale. If a stitch is dropped or cut, the loops forming the wale unloop. This creates a run or ladder. All weft knits except double knits can ladder. Variations in the loop of the weft knit stitch create different surface textures. Some of the variations are called *purl*, *transfer*, *spread*, *miss or float*, *tuck*, and *cross*.

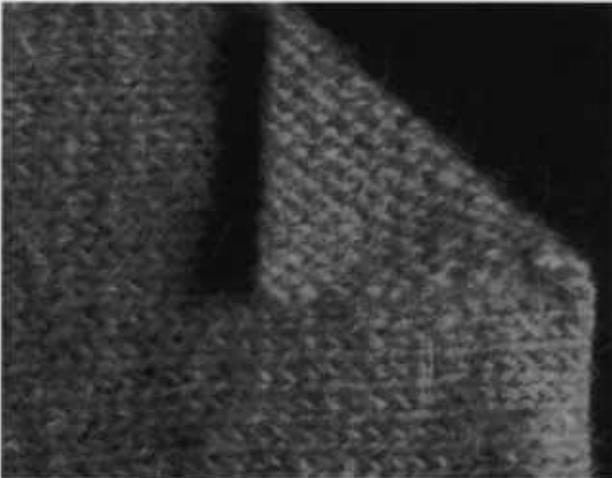


Miss or float

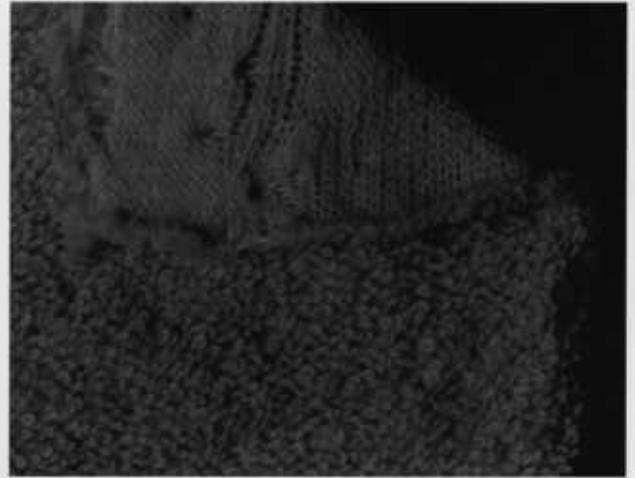
Transfer

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Single knit or *jersey knit* has knit loops facing only one side of the fabric. It is a stretchy fabric with each side having a different appearance. The face shows the V of the knit loop, while the back shows the horizontal part of the loop. Single knits can run or ladder easily, especially if smooth filament yarns are used. Single knits also readily curl to the face side at a cut edge, making sewing difficult. Single knits have greater stretch in the crosswise direction; however, they lack the stretch recovery of some of the other knits. Therefore, single knit fabrics should be checked for both stretch and recovery. Single knit fabrics generally are used in casual semifitted clothing. Coordinate single knits with clothing patterns designed for knits on the basis of the amount of stretch.



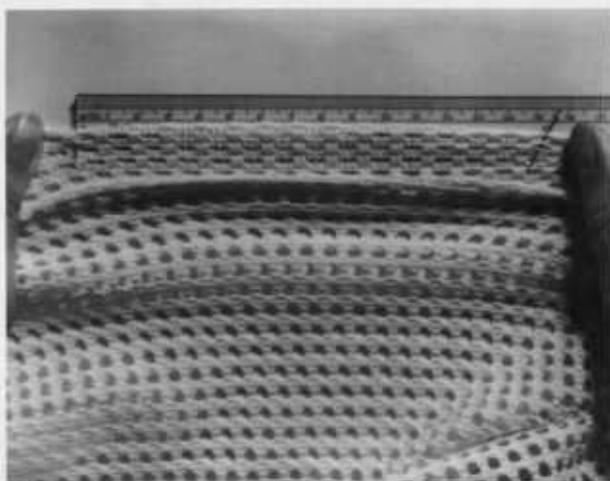
Knitted *pile* fabrics are made by feeding two yarns or a yarn and a bundle of fiber into the machine together. They are knitted so that one yarn appears on the face and one on the back of the fabric. The yarn forming the pile is pulled to the surface and cut or left uncut. Knitted pile fabrics include velour, fleece, and fake fur.



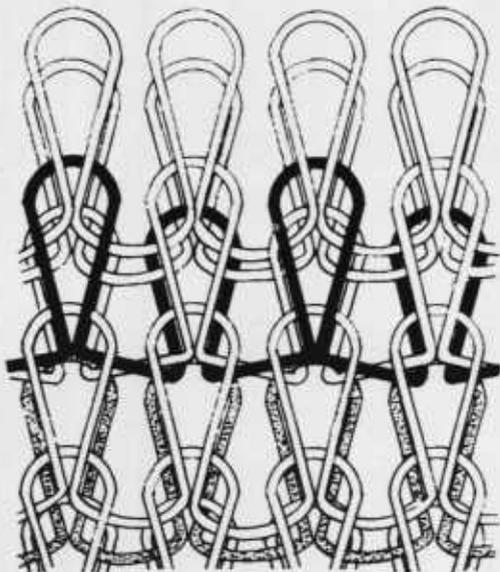
*Rib knit* fabrics have lengthwise wales that alternate to face opposite sides of the fabric. The fabric has a similar appearance on each side. In hand knitting, rib knits are the result of alternating knit and purl stitches.



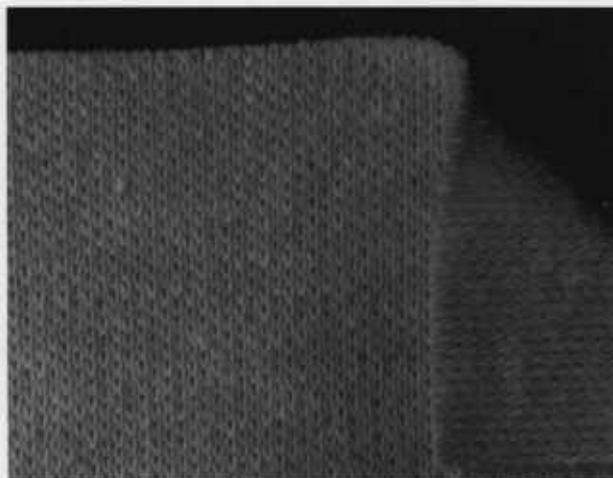
The stretchability of a rib knit fabric depends on the number of knit loops that face each direction. Rib knit fabrics are bulkier but have better recovery from cross-wise stretch than other weft knits. Rib knits are used at the edges of sweaters such as the cuffs, neckline, and lower edge. The amount of stretch in a rib knit is determined by using a stretch gauge. A stretch gauge is found on sewing patterns for stretch knits. This ability to stretch and recover influences the fit and the construction of the garment.



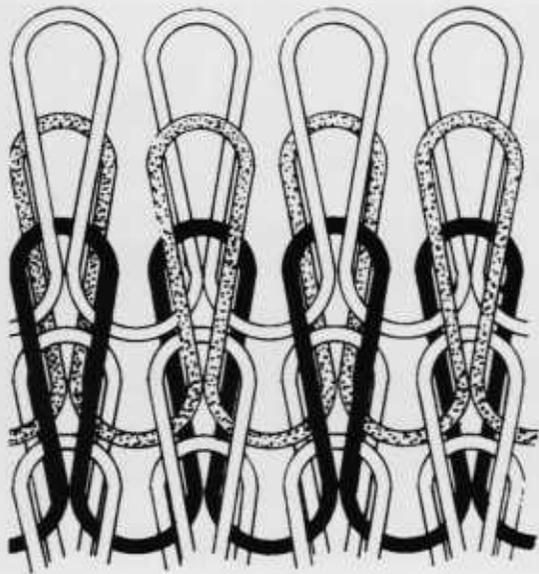
*Double knit* fabrics are weft knits. They are produced by machines with two sets of needles and yarns. Double knits are variations of the rib stitch, so they may look similar on both sides of the fabric.



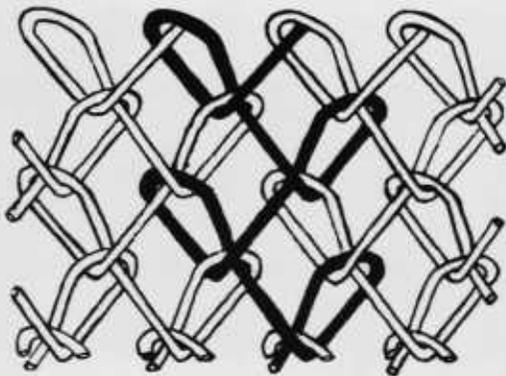
Double knits are run-resistant, firmer, less stretchy, and more stable than single knits but are as bulky as or bulkier than rib knits. Double knits provide more insulation because of the double set of yarns and the air pockets formed between the yarns. Double knits may be used with clothing patterns suitable for woven fabrics rather than patterns intended for stretchy knits. The stretch and recovery of a double knit should be compared to the stretch gauge found on some patterns. There are many variations of double knit structures including pique, Ponte di Roma, blister stitch, crepe stitch, and Jacquard or patterned knit.



A common type of double knit is the *interlock*. This is a rib knit made with a double set of yarns giving a smooth surface on both sides. Because interlocks have a smooth surface, they frequently have printed designs. Interlocks are less stretchy than single rib knits but more stretchy than other double knits. They can run or ladder in one direction. Interlock knits should be compared to a stretch gauge for clothing pattern coordination.

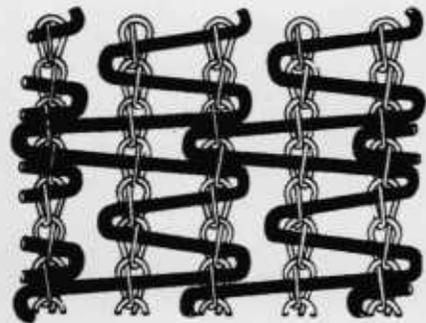


**Warp knitting.** Warp knitting uses many more yarns than weft knitting. Each lengthwise warp yarn feeds to an individual machine needle and follows a vertical and alternating diagonal pattern through the fabric length. From one to four sets of yarns are prepared on beams or bars indicating the number of yarns each needle forms into each stitch. The diagonal movement may form open or closed loops. The diagonal pattern may alternate between adjacent stitches or may move diagonally across the back of several stitches.

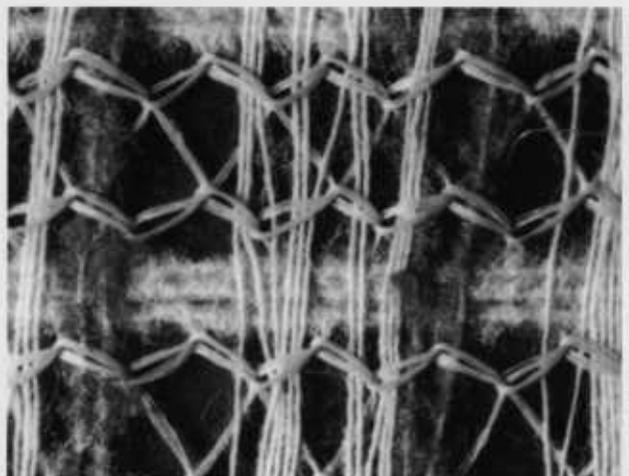


Warp knits can vary in the number of yarns, the vertical or alternating diagonal direction of the yarns, and open or closed loops. These variations affect the elasticity, firmness, stability, and designs of warp knit fabrics.

*Tricot and raschel* are two common types of warp knitting. Tricot is made with one to four sets of yarns, but usually two sets. It has fine vertical wales of knit stitches on the face and a fine horizontal herringbone rib on the back side. Raschel is a versatile type of warp knit producing fabric ranging from laces to nets and tulle to heavy suitings.

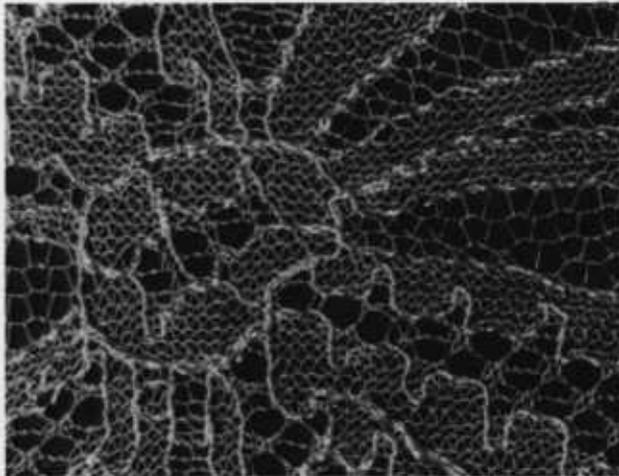


**Stitch knit.** Stitch knit fabrics are also called stitch bonded, stitchthrough, or Malimo (a brand of machine used in the manufacturing process). Stitch knit fabrics are made with weft yarns, stitching yarns, and sometimes warp yarns. The stitching needles and yarn may move in a vertical direction, forming a chain stitch to hold the weft yarns together. They also may move in an alternating diagonal direction to hold weft and warp yarns in place. Some fabrics are used for apparel, but the primary uses are for home furnishings, towels and dishcloths, and industrial fabrics.

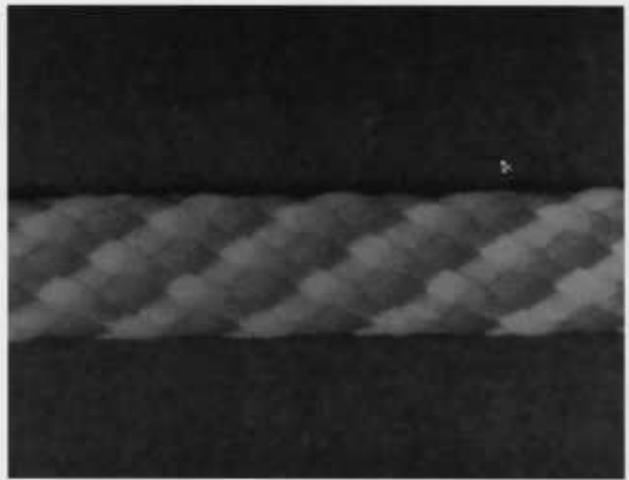


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**Lace.** Lace is the twisting, intertwining, and sometimes knotting of threads around each other to form a mesh of holes and pattern. Lace ranges from simple nets to complex floral patterns and from narrow-width trims to dress-width yardage. Lace yardage may have a one-way design, which requires purchasing additional fabric and following the pattern layout for a napped fabric. Patterns for garments of lace should have only a few minimum darts and design details. In better quality lace garments, the pattern will be matched. Special use may be made of the lace design as part of the garment style. When laces were made by hand, they were delicate fabrics requiring special handling and garment construction. Most of today's laces are made on raschel knit frames or special machines.



**Braided.** Braided fabrics are yarns interlaced diagonally into narrow fabrics. They are stretchy and easily shaped. Because of these qualities, they are used for shoelaces and belts.



## Multicomponent fabrics

Multicomponent fabrics have two or more fabrics joined.

**Quilted fabrics.** Quilted fabrics are two layers of fabric with a layer of fiber in between. The layer of fiber may be cotton or wool batting, down, or manufactured fiberfill. Traditionally, the layers have been connected by hand or machine stitching. Newer techniques use manufactured fiberfill with heat or chemical adhesives to hold the layers together.



**Bonded fabrics.** Bonded fabrics are two fabrics joined by an adhesive. The thickness of the bonded fabrics is not significantly changed by the adhesive. Laminated fabrics are a layer of fabric joined to another material such as a foam. Sometimes a tricot lining is added on the back side of the foam. Fabrics may be bonded or laminated to improve performance by increasing warmth, reducing cost, improving handling, or reducing shrinkage. The quality of a bonded or laminated fabric depends on durable attachment and careful placement of both fabrics with the grain. Consider their use and purpose before selecting laminated fabrics, and look for an even and thorough lamination. These fabrics should be coordinated with sewing patterns requiring simple styling and a loose fit.



Fabric—fabric



Fabric—foam



Fabric—foam—fabric

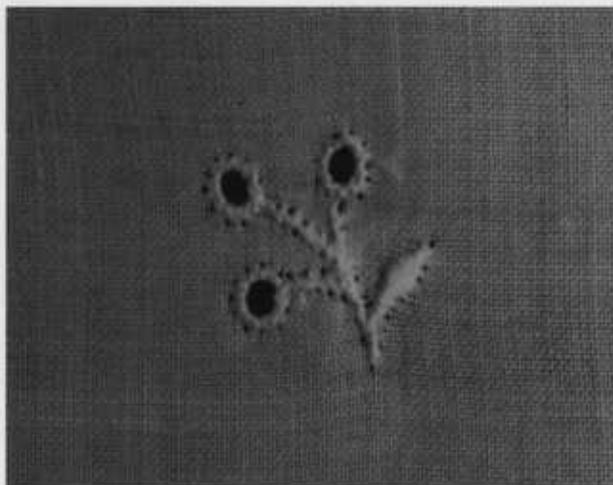
## Composite fabrics

Composite fabrics are made of one fabric plus fibers, yarns, films, or foams added.

**Flocked fabrics.** Short pieces of fiber may be forced onto a fabric surface and held by an adhesive or by electronic bonding. These fabrics are called flocked. They may have all-over flocking to resemble a suede leather, or may have the flocking in a pattern such as polka dots. Flocked fabrics are used in apparel and upholstery.

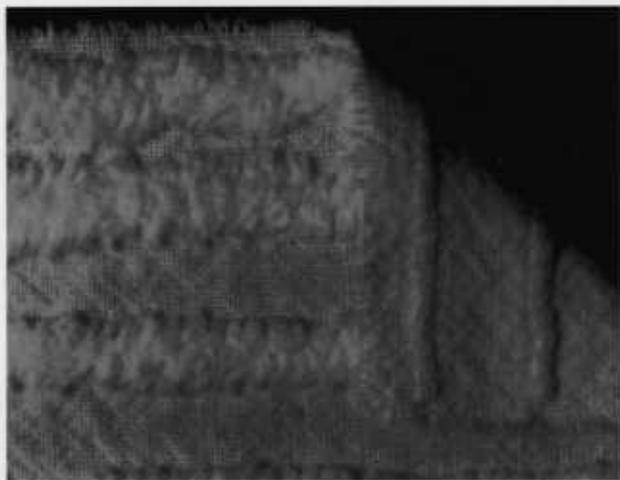


**Embroidered fabrics.** Yarns may be attached to fabrics by stitching to create embroidered fabrics. Eyelet is one example of an embroidered fabric. Another example is applique, in which decorative fabric pieces are stitched to a base fabric.



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**Tufted fabrics.** Tufted fabrics are composite pile fabrics. Many yarns may be forced through a backing fabric by needles to form tufted fabrics. The tufts may be cut or remain looped on the face of the fabric. A coating or a backing fabric usually is used on the reverse side to protect the inserted loops. This prevents them from being pulled out. This is a less expensive method for making pile fabrics. Tufting frequently is used to make carpeting, upholstery, coat linings, and bedspreads.



**Supported films.** The films or foams described in the first group of fabrics may be combined with fabrics. These are described as supported films.

**Coated fabrics.** Coated fabrics have a woven or knitted base cloth to which a coating is applied. The coating may be applied to the right or the wrong side of the fabric. Examples of a coating applied to the right side are vinyl coated raincoat or tablecloth fabrics. Some outdoor wear fabrics have a water-resistant finish applied to the wrong side of the fabrics.

When selecting composite fabrics, consider each fabric as if it were not combined. In addition, look at the method of combining. Fabrics should be on-grain, smooth, and even.



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