

Knit Structures: Warp Knits

This section describes warp knits, one of two major knit structures. The previous section described filling knit structures. As review, look at the two illustrations below showing a filling knit with yarn loops in the crosswise direction and a warp knit with yarn loops in the lengthwise direction.

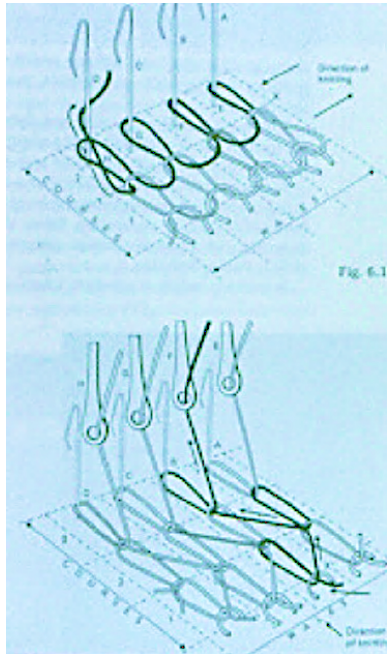


Illustration of knitting machine needles forming a basic filling knit (top) and basic warp knit (bottom). Follow the black yarn loops—the filling knit yarn travels in the crosswise (filling) direction, the warp knit yarn travels in the lengthwise (warp) direction. Note that for the warp knit a “guide bar” carries the yarn to selected needles (moving back and forth) as the fabric is produced and advances.

K. LaBat collection

There are two categories of warp knits: *tricot* and *raschel*.

Tricot warp knit has no specific variations; however, finishes can be used on tricot fabrics to produce an aesthetic effect or texture. Examples include: satin tricot and brushed tricot.

Raschel warp knit variations include:

- raschel lace
- net
- warp sliver (pile)

Tricot warp knit

Think of production warp knit methods like hand crochet processes—both made of chained loops. A basic tricot knit is pictured below. Tricot technical face and technical back look like stacked “V”s. On the technical face, the “V”s appear to be stacked in the lengthwise direction, on the technical back the “V”s appear to be lined up in the crosswise direction. To determine technical face of a tricot knit, pull the cut-edge of the fabric in the crosswise direction. The knit curls to the technical face, much like single filling knit. Warp knit production is different from filling knit production and the knitting machines look different.

A warp knit machine features “warp beams” at the top of the machine. Needles and guide bars line up below the beams. The knitted fabric is rolled on to a fabric beam at the base of the machine. In the warp knitting process, yarn is fed to the needles with a device called a “guide bar” (see illustration). Unlike the carriage in filling knit machines which carries a yarn the full width of the machine; a guide bar travels a limited distance feeding the yarn to selected needles. As the fabric advances the guide bar moves to another needle. Look at the photograph of tricot knit. The yarn forms short “floats” across the fabric. See the video of knit production referenced in the filling knit section: *Textile School via Cotton Incorporated* can be found at: <https://youtu.be/U1bk4ZI0Qvc> Retrieved June 29

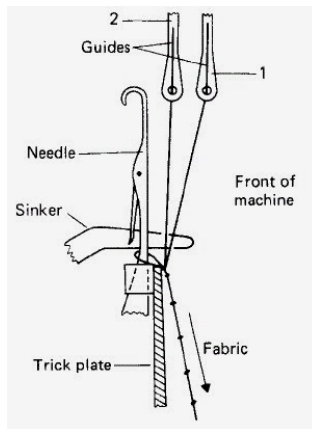
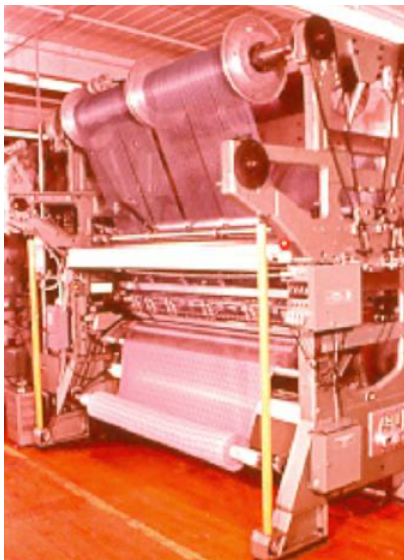


Photo of a warp knit machine.

Illustration of a needle & guide bar mechanism. One latch needle and two guide bars.

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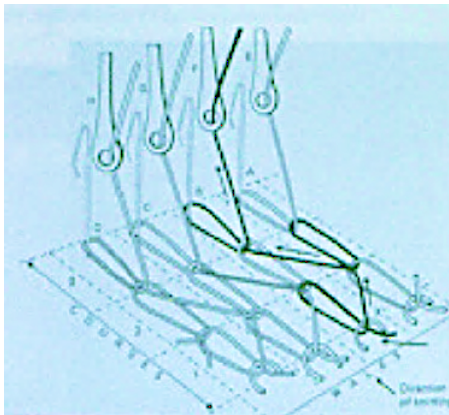


Illustration of tricot knit production. Black yarn illustrates how the yarn travels back and forth from one needle to the adjacent needle while the fabric advances.

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Tricot knit, nylon filament yarns. Top photo: technical back. Bottom photo: technical front.

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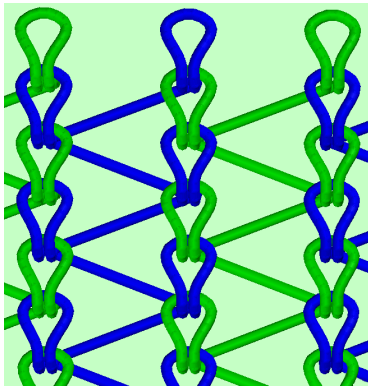


Diagram of a tricot warp knit. Note the yarns travel in the warp direction and the rows interlace.

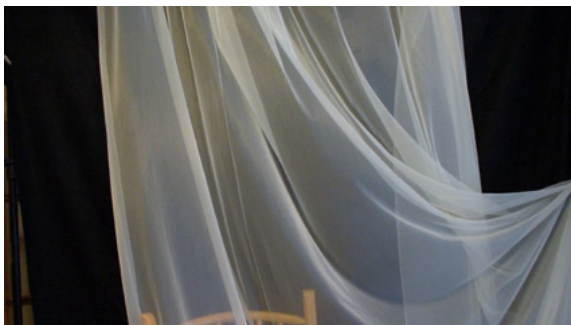
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Tricot fabric is often made with nylon or polyester filament yarns. Typical tricot applications include lingerie and athletic apparel. Tricot can be produced in sheer to opaque fabrics and used in combinations for design effects. The *Vanity Fair* nightgown pictured below uses an opaque under gown with an over-lay gown of sheer fabric. Sheerness variations can be produced by varying yarn “denier”. Denier is a measure of linear density and thickness of continuous filament yarns. At the simplest, the smaller the denier number the finer and thinner the yarn. For example you might see tricot labeled as 40 denier or 15 denier with 40 denier more opaque than 15 denier.

Tricot provides some stretch with stability—stretch can be enhanced by adding elastomeric yarns like spandex. Elastomeric yarns can be fed with a guide bar to selected needles while stable filament yarns are fed to other needles. Various combinations of elastomeric yarns and filament yarns can provide desired product performance.



Example of 15 denier nylon tricot.

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Tricot (nylon) nightgown. Vanity Fair, circa 1960. Panels of sheer bright pink, light green, & light pink over pale pink tricot under gown. See the link for more views. Goldstein Gallery Collection

<https://goldsteincollection.rediscoverysoftware.com/mDetail.aspx?rID=2015.036.030&db=objects&dir=GOLDSTEIN>

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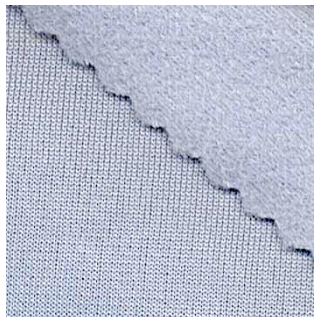
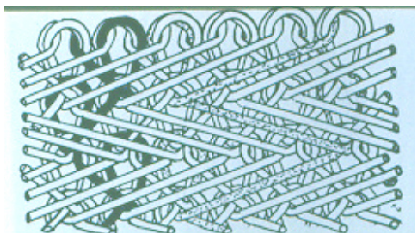


Bathing Suit, 80% nylon and 20% spandex. Gottex, 1980-1989. See the link for more views. Goldstein Gallery Collection

<https://goldsteincollection.rediscoverysoftware.com/mDetail.aspx?rID=2014.016.015&db=objects&dir=GOLDSTEIN>

Retrieved July 12, 2026.

Finishes to selected yarn floats on the tricot technical back are used to produce appearance and tactile effects. Brushed tricot or napped tricot (sometimes called velour) is produced by breaking and brushing floats on the technical back of a tricot fabric—giving a soft, fuzzy surface to one side of the fabric. A smooth shiny surface can be produced by flattening and smoothing the thermoplastic yarn floats on the technical back of a tricot fabric producing a satin-like appearance and feel.



Brushed tricot.

Illustration of floats that are brushed to provide texture.

Fabric swatch—technical face at bottom, technical (brushed) back at top



Satin tricot swatch. Long horizontal yarns--“V”s (technical back) are flattened with a hot roller, providing a smooth surface.

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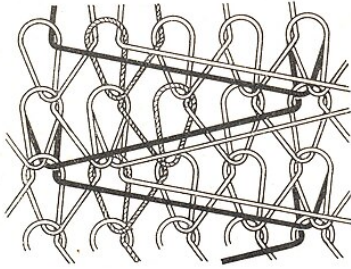


Diagram of warp knitted 4-needle satin loop structure. Heat calendar would be applied to flatten the black yarn.

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<https://upload.wikimedia.org/wikipedia/commons/c/c1/Satin.jpg>

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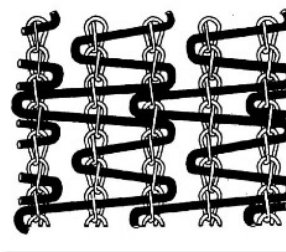
Tricot Characteristics:

- more stretch in crosswise direction compared to length direction.
- when stretched in cross direction, “curls” to technical face (vertical “V” side)

Tricot applications: lingerie, linings, backings to stabilize wovens and knits.

Raschel warp knit

Raschel warp knits, like tricot, are formed with vertical yarn loops (illustration). Raschel knitting methods produce stable, open-structured fabrics ranging from fine nets and lace to sturdy industrial fabrics. Compared to tricot Raschel knits tend to be firmer, slightly rougher and have more texture. The mechanism illustration below shows one type of guide bar and needle configuration with three guide bars each carrying a different yarn to one of the needles.



Raschel knit illustration. Note black yarn warp floats and vertical chain loops that intertwine.

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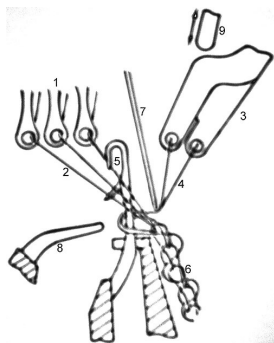


Diagram of Raschel knitting machine with 3 guide bars.

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Laces and nets:

Raschel knitting machines are used to make open fabrics like nets and laces. Machine knitted laces are less expensive than hand-made lace which is the old traditional method of making lace. There are many types of hand-made laces—fascinating processes that you might want to delve into.



Raschel lace swatch, technical face (left) and technical back (right).

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Raschel nets vary from fine net, like *tulle* used in bridal veils, to industrial nets used by fisherman. *Crinoline* is a crisp stiff fabric often made with Raschel knitting techniques. *Crinoline* can also be a garment name—an under skirt that is used to provide volume to an overskirt. A crinoline garment is sometimes called a “can-can” for the high-energy dance that gained notoriety in Paris cabarets in the mid-1830’s. Crinolines were worn under “poodle skirts”, popular in the 1950’s, to fill out the bell shape of the skirt.

The illustration below shows the diagram for a yarn looping around selected knitting needles. The fabric swatch is an industrial net with arrows indicating the direction of the yarn chains as they separate and merge.

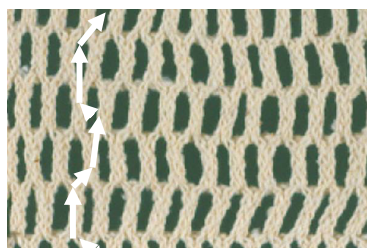
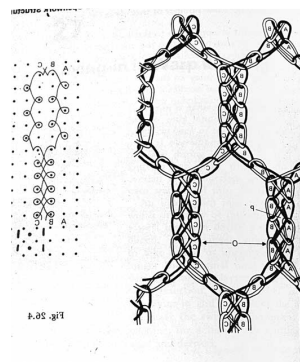


Illustration of Raschel net structure, warp direction loops forming chains that intertwine and separate (left).

Industrial net swatch (right).

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Crinoline petticoat, Munsingwear 1950-1959. Nylon crinoline with ruffled skirt and elastic waist cincher. See the link for more views. Goldstein Gallery Collection

<https://goldsteincollection.rediscoverysoftware.com/mDetail.aspx?rID=1981.151.002&db=objects&dir=GOLDSTEIN>

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Raschel knitting can be used to make “power net” for foundation garments and athletic wear. One bar carries spandex yarn providing stretch while other bars carry filament yarns for stability and strength.

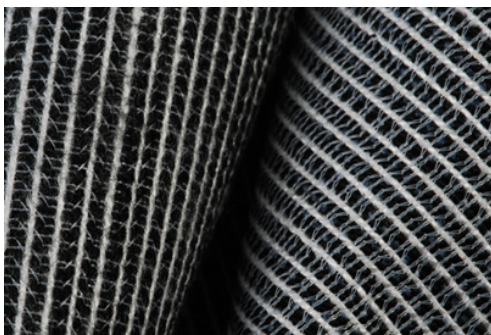


Foundation garment. Spanx. 2011. 87% nylon, 13% lycra. Synthetic peach brown girdle, extends from below bust to mid-thigh, bifurcated with functional opening under crotch. See the link for more views.

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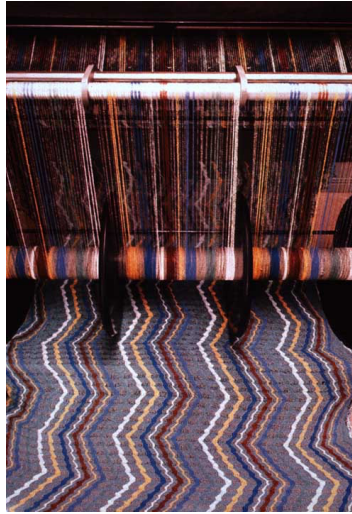
Insertion warp knits are used as interfacing in apparel. The knit structure makes the fabric pliable and can be made in very light-weight forms. A stabilizing yarn is “inserted” into the knit in the warp or filling direction to reduce stretch.



Insertion knit interfacing swatch.

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Milanese warp knit uses the characteristic zig-zag floats in various colors to make a “lightening bolt” pattern.



Milanese knit fabric being produced on a Raschel warp knit machine.

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Raschel warp knit fabric applications:

- Apparel: lingerie, athletic wear, patterned hosiery, lace trims
- Interior fabrics: sheer curtains, upholstery
- Industrial: shade tarps, cargo netting, produce bags

Sliver warp knit

Raschel knit machines can be used to produce fabrics with a pile surface. The pile surface tends to be longer than tricot sliver knits can be used for “faux fur”. The versatility of the knitting process and equipment has been used to produce outdoor carpet and stadium carpet. Astro-turf™ was developed for its first use in the Houston Astrodome in 1966.

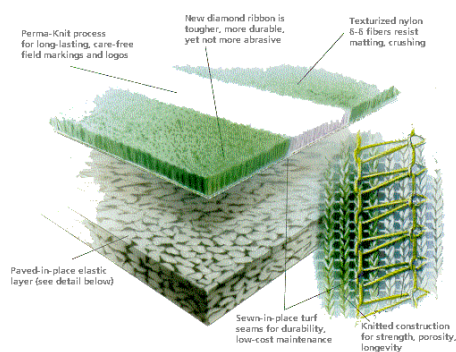


Illustration of stadium carpet. Pile on surface, knit structure, laminated to foam surface.

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Characteristics of Raschel Warp Knits:

- many product variations

Differences between tricot and raschel knits (all other variables equal):

- tricot lighter and thinner
- tricot more stable
- raschel more patterns possible:
 - bigger open structures
 - fine to chunky nets
 - lace pattern motifs
 - multiple colors in various patterns

Warp knits are formed with yarn loops that travel in the lengthwise (warp direction). Many types of production warp knits are produced.

Next Section on *Non-woven structures*.