Technical Fabrics – Warp Knitted

Comparison of warp and weft knits

**Weft knits**
- Course-wise/horizontal loop formation
- Needles knit sequentially in knitting cycle
- Yarn supply usually in the form of cones on creels
- Less number of yarns involved in knitting
- Mostly staple yarns are used; but filaments may also be used

**Warp knits**
- Wale-wise/vertical loop formation
- Needles knit all together in a knitting cycle
- Yarn supply usually in the form of beams
- Larger no. of yarns involved in knitting
- Mostly filament yarns are used; but staple may also be used
Comparison of warp and weft knits

**Weft knits**
- Less preparatory processes
- Less varieties of structure possible
- Low production
- High stretchability in both directions; comparatively higher in width direction
- Lower dimensional stability
- Cheaper machines

**Warp knits**
- More preparatory processes
- More varieties of structures possible
- High production
- Low stretchability in both directions; comparatively higher in width direction
- Higher dimensional stability
- Expensive machines

Different elements and zones of warp knitting machine
### Warp-knitting machines

#### Tricot machines
- Bearded or compound needles are commonly used
- Sinkers control the fabric throughout the knitting cycle
- Less number of warp beams and guide bars (2 to 8)

#### Raschel machines
- Latch needles commonly used but compound may also be used
- Sinkers only ensure that the fabric stays down when the needle rise
- More number of warp beams and guide bars (2 to 78)

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### Warp-knitting machines

#### Tricot machines
- Warp beams are positioned at the back
- Gauge is defined as needles per one inch
- Machines are made in finer gauges (28-40 needles/inch)
- Preferably used to produce fine fabrics with high stitch densities

#### Raschel machines
- Warp beams are positioned at the top
- Gauge is defined as needles per two inch
- Machines are made in courser gauges (24-64 needles per two inch)
- Preferably used to produce rather coarser structures with low stitch densities
## Warp-knitting machines

### Tricot machines
- Mechanical design allows less accessibility on the machine
- Angle between needle and fabric take-down is about 90
- Knitting tension is lower
- Machines are wider

### Raschel machines
- Mechanical design allows more accessibility on the machine
- Angle between needle and fabric take-down is about 160
- Knitting tension is higher
- Machines are narrower

## Warp-knitting machines

### Tricot machines
- Machine speed is high (up to 3500 courses per min.)
- Comparatively simple structures are produced
- Machines are mainly suitable for filament yarns

### Raschel machines
- Machine speed is lower (up to 2000 courses per min.)
- Simple to complex structures can be produced
- Machines are mainly suitable for spun yarns
Product range of warp knitting machines

<table>
<thead>
<tr>
<th>Type of machine</th>
<th>Product range</th>
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<tr>
<td>Trocit</td>
<td>Single Needle Bar: Lingerie, shirts, ladies’ and gents’ outerwear, leisurewear, sportswear, swimwear, car seat covers, upholstery, bed linen, toweling, lining, nets, foot wear fabrics, technical fabrics, medical textiles. Double Needle Bar: Double faced or simplex fabrics, dress wear fabrics, technical textiles</td>
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<tr>
<td>Raschel</td>
<td>Single Needle Bar: Curtains, curtain laces, foundation garments, nets, fishing nets, sports nets, power nets, table cloths, bed covers, elastic bandages, cleaning cloths, upholstery, ladies’ underwear, velvets, fruit and vegetable bags, carry bags, geo-textiles, medical textiles. Double Needle Bar: Pile &amp; plush fabrics, carpets, tubular fabrics and sacks, seamless shaped stockings and garments, nightwear and knitwear, string vest, scarf, medical textiles, artificial turf etc.</td>
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Basic structure of warp knitting machine

Similar to that of a weaving machine, especially in the yarn supply system from warp beams (1) and the fabric batching via the take-up (3). The fabric is produced, however, by intermeshing loops in the knitting elements (2) rather than interlacing warps and wefts as in a weaving machine.
Warp Knitting Motion Types

Features of a typical warp knitting machine in standard configuration (RS series):

- sturdy construction
- up to 6 guide bars (6 warp-beam unwinding points) for flexibility of structures, end product, and fabric design
- up to 40 needles per inch for open or very dense structures
- up to 6.60 m working width
- up to 2,000 courses per minute

Karl_Mayer
**Elastic structures**

For a structure to be stretchable it should be designed with:
1 - open fabric construction
2 - short underlaps.

The structure illustrated herein is the most basic one. It is called **tricot stitch** or 1 and 1 (1 needle underlap and 1 needle overlap).

To increase the lengthwise strength, a specific stitch construction is used (pillar stitch).
To increase the widthwise stability, the underlaps are lengthened (e.g. satin stitch).

A dimensionally stable structure is achieved by combining these two types of stitch construction (e.g. pillar - satin).
Open structures

One way to produce an open structure is to knit unconnected pillars continuously while a connecting underlap by horizontal yarns is produced only every few courses.

This open polyethylene net is used to wrap pallet packing units, stacks of crates for safer shipment or as illustrated to stabilise round bales of hay or straw in the field.

The structure shown in the illustration is used as shading net and can be produced in various shade grades.
Another way to produce an open structure is to form loops continuously on the same needle and to interlace them laterally at certain intervals.

The net is used to protect persons and buildings. Fishnets are other possible end-uses.

**Closed structures**
Can be produced by:

- Decreasing loop size
- Using heavier/thicker yarn
- Using underlaps
- Or using more guide bars
Mono-axial structures

When combining filler yarns and weft inlays one with another, bi-axial structures with reinforcement in directions 0° and 90° can be produced.

Geogrid structures are main applications of biaxially reinforced fabrics.

The fabric is designed to take force in two directions (0° and 90°). For this can be used rovings of glass, high tenacity polyester, aramid or carbon as pillar threads and weft threads. These fabrics are used for reinforced composites. Considering the orientation of the force taking yarns (0°, 90°) this fabric is comparable to a woven fabric. However, there is the advantage that yarns are directly oriented and lie absolutely straight in the fabric.

There is no loss of tenacity as in the wovens due to its crimp effect.

Bi-axial structures
Multiaxial structures

A multi-axial multi-ply fabric demonstrating the two diagonal yarn sets in addition to the bi-axial yarn sets created by the midlapping guide bar (warp or ST-yarn) and the magazine weft insertion system (weft).

Applications are: inflatable bodies, such as airships, inflatable boats, inflatable life rafts, rescue tents, gas membranes, V-belts, flexible roofing membranes etc.

MULTIAXIAL
High-tech knitting machine with several weft insertion systems for the production of multiaxial multiply and composite fabrics

Shipbuilding:
sailor yachts, fast patrol boats, passenger ships, lifeboats

Power engineering
rotor blades for wind power plants,

Sports and leisure time:
tennis rackets, skis, snowboards, surfboards, sports boats

Plant engineering:
pumping and piping systems, container building

Aerospace industry:
antennas, parabolic reflector mirrors, pressure vessels, satellite structures

Medical sector:
orthopedical applications, prostheses for arms and legs, medical appliances

Automotive industry:
ca body parts, bumpers, reinforcement parts, leaf and coil springs

Airplane construction:
tail plane parts, wings, rotor blades, brake disks, tanks

Machine building:
fast moving parts
Advantages of directionally oriented structures

Unlike the arrangement in a woven structure, the yarns in warp-knitted directionally oriented structures are running absolutely straight and in parallel. This brings about the following advantages:
• Direct introduction of forces into reinforcement yarns, no structural elongation
• Simple calculation of fabric properties in accordance with the end-use intended
• Any yarn type can be processed – from low-twist soft staple yarns up to high tenacity filament yarns
• Excellent tear and tear propagation resistance.

Production of composite fabrics by warp knitting

• The key idea behind the production of composite fabrics is to combine several materials of partly opposite properties to create a single membrane that performs essentially much better than one of its constituents alone.
• Raschel machines allow simple and highly-efficient production of composite fabrics in one operation only.

Fields of application
- Geotextiles for road construction,
- railway construction,
- slope and bank reinforcements,
- laminating substrates
- agricultural textiles
Fiber reinforced light weight concrete

Spacer Fabrics

- A *spacer fabric is a double-faced fabric knitted on a double needle bar machine*.
- The distance between the two surfaces is retained after compression by the resilience of the pile yarn.

The principal advantages are:
- BREATHABILITY
- INSULATION
- COMPRESSION STRENGTH
- DURABILITY
Advantages of Warp-knitted weft-insertion geotextiles as compared to woven geotextiles

• Strength-for-strength, they are lighter than woven geotextiles using the same yarn.
• Knitted geotextiles have exceptional tear strength.
• Knitted geotextiles can incorporate an additional fabric to form a true composite geotextile, the fabric being simply knitted-in.

The advantages of warp knitted nets

• Warp knitted nets have knot-free joints giving greater strength and lower weights;
• Fabric density is easily adjustable and can be adjusted to the requirements of sunlight
• Different sizes and shapes of net openings can be produced.
• They are dimensionally stable
Circular warp knitting

• Tubular, seamless, extensible nets for fishnet patterned stockings, fruit sacks, and medical support bandages can be knitted on simple, small-diameter circular warp knitting machines.

POPULAR WARP KNIT STRUCTURES
Locknit Structure

Sharkskin Structure
Queenscord structure

Velvet structure
TO SEE SOME WARP KNITTED EXAMPLE PRODUCTS, VISIT:

http://www.karlmayer.com
http://www.liba.de
http://www.baltex.co.uk
http://www.warpknitting4u.com/