WEFT KNITTING

by

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Knitting is a process of manufacturing a fabric by interloping of yarns. Knitting is the second most important method of fabric formation.

Fabric can be formed by hand or machine knitting, but the basic principle remains exactly the same i.e. pulling a new loop through the old loop.
Types of Knitting

- Knitted fabrics
  - Weft Knitting
    - Single jersey
  - Purl
  - Rib
  - Interlock
  - Warp knitting
    - Tricot
    - Raschel
Weft Knitting

- In weft knitting, the loops are formed across width of the fabric.
- Each weft thread is fed, more or less at right angles to the direction in which the fabric is produced.

In this method, the fabric is produced by simple up and down movement of the needles, which is provided by the profile of a cam system. The knitting cams are the devices which convert the rotary machine drive into a suitable reciprocating motion of the needles.
Single Jersey or Plain fabric

- Simplest knit structure.
- Face side smooth and sheen.
- Back side rough and dull.
- Lighter fabric.
- Highly extensible in length and width.
- The fabric has curling problem.
- Laddering is very common in these fabrics.
Purl Fabric

- Both sides of the fabric are similar
- Ravel from both ends
- Twice the thickness of the plain jersey
- Rate of production is low
- Most suitable for children's garments, blankets, shawls, and scarfs etc.
Rib Fabric

- Double Face or Reversible fabric
- Similar cord appearance in each side
- Thicker and heavier fabric
- Lies flat without curl
- Excellent width way elasticity
- Rib fabric can be produced on V-bed machine and footwear machine.
Interlock Fabric

- Both sides of the fabric have an appearance like face side of the single jersey fabric.
- The structure does not curl at edges when laid flat on surface.
- Horizontal and vertical stripes can be produced by using colored yarns.
- The rate of production is low.
Knitting Faults

- Pette
- Patta
- Hole mark
- Loop
- Lycra out/Lycra drop
- Yarn out
- Sinker mark
- Slub
- Oil spot
- Machine setup
- Needle mark/needle break
- Tara/star mark
- Fly dust:
Knitting Faults

- Needle mark/needle break
- Contamination
- Loop
- Pette
End Use Products

End Uses of Jersey Knits
- Sheets
- Sweaters
- T-shirts
- Men’s underwear
- Dresses
- Hosiery

End Uses of Rib Knits
- Collars
- Necklines
- Cuffs
- Bottom edges of sweaters
- Knit hats
- Men’s hosiery

End Uses for Purl Knits
- Infant and children’s wear
- Sweaters
- Scarves

End Uses of Interlock
- Sweat shirts
- Table mat
Classification of weft knitting machine

According to the frame design & needle bed arrangement-
- Circular knitting machine.
- Flat knitting machine

According to the no. of needle bed-
- Single jersey circular knitting machine.
- Double jersey circular knitting machine.

According to the end product of the weft knitting machine-
- Fabric machine.
- Garments machine
Knitting creates multiple loops of yarn, called stitches, in a line or tube. Knitting has multiple active stitches on the needle at one time. Knitted fabric consists of a number of consecutive rows of interlocking loops. As each row progresses, a newly created loop is pulled through one or more loops from the prior row, placed on the gaining needle, and the loops from the prior row are then pulled off the other needle.
Schematic of stockinette stitch, the most basic welt-knit fabric.
Classification of Weft Knitting Machines:

Weft knitting machines can be classified in the following ways:

- On the basis of the number of needle beds
- On the basis of diameter
- On the basis of the nature of driving system
- On the basis of knitted structure
- On the basis of design elements
- On the basis of special products
Classification on the basis of the number of needle beds: The basic element for the knitting machine classification is the needle bed. The needle bed is the main part of a knitting machine and provides the platform for the movement of needles. It has cuts or grooves that provide the direction of movement to the knitting needles. This direction may be up and down or to and fro but could not be the lateral movement. The machine may be called single-bed or double-bed knitting machine on the basis of the number of needle beds. The single-bed knitting machine is also called the single-jersey knitting machine and the double-bed knitting machine is called the double-jersey knitting machine.

Weft knitting machines can also be categorized on the basis of the shape of the knitting machine. If the shape of the needle bed is circular, then it is called the circular knitting machine, and if the shape of the needle bed is flat, then it is called the flat-bed knitting machine. Flat-bed machines may be horizontal or slightly inclined at an angle of 90–105°. The single circular knitting machine consists of a single cylinder, which is inclined in the vertical direction.
Classification on the basis of diameter:
The diameter of the knitting machine determines the linear width of knitted fabrics. So, the machine diameter has direct relation with the fabric linear width. On the basis of diameter, knitting machines can be classified into three categories:

- Small-diameter knitting machine (diameter ranges from 3 to 6 inches)
- Medium-diameter knitting machine (diameter ranges from 8 to 22 inches)
- Large-diameter knitting machine (diameter ranges from 24 to 40 inches)

Small-diameter machines are used for hosiery products, medium-diameter machines are used for body size fabrics, and large-diameter machines are used for the production of open width fabric similar to the one produced on flat knitting machines.
Classification on the basis of the nature of driving systems:

The driving mechanism is also a base for the classification of knitting machines. On the basis of the nature of driving mechanism, knitting machines can be divided into two categories:

- Hand-driven knitting machine
- Power-driven knitting machine

Both these types of knitting machines are considered under the list of flat knitting machines.
Classification on the basis of knitted structures:

Knitting machines can be categorized on the basis of knitted structures. There are four basic knitted structures, that is, single jersey, rib, interlock, and purl. The single-jersey fabric is made on single knit machines while other three structures are developed on double knit machines.
Classification on the basis of design elements:

Sometimes, extra design elements are also attached on the knitting machines for the sake of designing, and these machines are named after design elements. For example, Pattern wheel knitting machine

- Jacquard knitting machine
- Multitrack knitting machine
- Intarsia knitting machine
- Knitting machine with \textit{CAD} and CAM
Classification on the basis of special products:

An end product is also a base for the classification of knitting machines. Knitting machines are named on the basis of products obtained from that machine. Examples include socks knitting machine, terry knitting machine, gloves knitting machine, sliver knitting machine, and fleece knitting.
Name of the knitted structures:
Those basic / primary structures are...........
Plain / Single knit structure.
Rib structure.
Purl knit structure.
Interlock structure.

How can we identify the plain knit structure fabrics:
Plain knit structure is the simplest and most basic structure. It's also called single knit structure. It's produced by the needles of one set of needle with all the loops intermeshed in the same direction. We can identify the plain knit structure fabrics as following properties...

• The fabric is unbalanced and different appearance on face and back side. V shapes on face and Arcs on back.
• Lengthwise extensibility of the fabric is moderate (10-20%). and widthwise extensibility is high (30-50%).
• The fabric extensibility area is moderate to high.
• The fabric is thicker and warmer than plain woven made from same yarn.
• The plain knit structure can be easily unravelled from the edge which was knitted last. Unroving either end.
• The fabric has tendency to curl.
Notation of plain knit structure:

* * * *
* * * *
* * * *
* * * *
* * * *

Face loop

0 0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0

Back loop

End Uses:
Plain knit structures are used for basic T-shirt (men's and ladies), Under garments, men's vest, ladies hosiery, fully fashioned knit wear etc.
How can we identify Rib structures fabrics:

Rib is the second family of knit structures. It's also called double-knit. It requires two sets of needles operating in between each other so that wales of face stitches and wales of back stitches are knitted on each side of the fabric. We can identify the Rib structure fabrics as following properties------

- Same appearance in both sides of rib fabric. Like face of plain.
- Lengthwise extensibility of the fabric is moderate and widthwise extensibility is very high (50-100%).
- The fabric extensibility area is high.
- The fabric is much thicker and warmer than plain woven.
- Rib structures can be unravelled from the edge knitted last. Unroving only form end knitted last.
- No tendency to curl.

**Notation of rib structures:**

```
* 0 * 0

* 0 * 0

* 0 * 0

1*1 Rib structure
```

End Uses:

Rib structures are uses for--Socks, cuffs, waistbands, collars, men's outerwear, knitwear, under wear etc.
How can we identify purl knit structures fabric:

Purl knit structures is the third family of knit structures. As with rib structures, it requires the participation of both needle beds for the production of the loops. We can identify the Purl structures fabric as following properties:

- Same appearance on both sides. Like back of plain.
- Lengthwise extensibility is very high and widthwise extensibility is high.
- The fabric extensibility area is very high.
- Very much thicker and warmer than plain woven.
- Unroving either end.
- No tendency to curl.

Notation of purl knit structure:

```
0 0 0
* * *
```

```
0 0 0
```

1*1 purl knit

End Uses:
Purl structures are uses for---Children's clothing, knitwear, thick and heavy outerwear etc.
How can we identify the interlock structures fabric:
Interlock is another 1*1 rib variant structure which is produced on specially designed machines. Those machines possess two sets of needles (short and long needles) in both cylinder and dial and at least two feeders. We can identify the interlock structure fabric as following properties---

- Same appearance on both sides, like face of plain.
- Lengthwise extensibility is moderate and widthwise extensibility is moderate.
- Extensibility area is moderate.
- Very much thicker and warmer than plain woven.
- Unroving only from end knitted last.
- No tendency to curl.

Notation of interlock structure:

* 0 * 0

0 * 0 *

Interlock structure

End Uses:
Interlock structures are use for-- Underwear, shirts, suits, trouser suits, sportswear, dresses etc.
Classification of weft knitting machine

- According to the frame design & needle bed arrangement:
  - Circular knitting machine
  - Flat knitting machine
Classification of weft knitting machine

- According to the no. of needle bed.
  - Single jersey circular knitting machine.
  - Double jersey circular knitting machine.
Features of single jersey circular knitting machine

- Single jersey circular knitting machine has normally rotating (clockwise)
- Cylindrical one set of needle bed.
- Generally latch needles are used.
- Generally machine gauge is 24. It can be 10 to 36.
Features of rib circular knitting machine:

- In rib circular knitting machine, there are two sets of needles. One set of needles are mounted on a vertical cylinder & other set of needles are mounted on horizontal dial.

- Generally needle gauge is 18.
Features of interlock circular knitting machine

- In interlock circular knitting machine, there are two needle beds. One set of needles are mounted on a vertical cylinder & other set of needles are mounted on horizontal dial.
- The dial needles are face to face between the cylinder needles.
- Generally needle gauge is 20.
Main parts of knitting machine & their functions

- Needle:
  Needle is a tiny hocked elements used for loop formation.
  Needle used for knitting are three types.

- Functions:
  - To feed the yarn.
  - Loop formation.
  - To hold the old loop.
Main parts of knitting machine & their functions

Cam (knit, tuck, miss): Each needle action is obtained by means of cams acting on the needle butt.

There are three types of cam. (knit, tuck, miss)

Functions:
✓ Help to produce knit, tuck & miss loop.
Main parts of knitting machine &
their functions

- **Sinker**

- Sinker is a thin metal plate which is placed at right angle between the adjoining needles.
- Sinker is used in single jersey circular knitting machine.

- **Functions:**
  - Loop formation.
  - Holding down.
Main parts of knitting machine & their functions

- **Dial**
  - Dial is a upper steel needle bed used in double knit machine.
  - Dial is used in double jersey (rib or interlock) circular knitting machine
Main parts of knitting machine & their functions

- **VDQ (Variable diameter for quality) pulley**
  - To control the GSM.
  - It gives motion to the positive feeder

- **Toothed belt**
  - To transfer the motion from VDQ pulley to positive feeder

- **Motor**
  - To produce the motion to the machine.

- **Sensor**
  - To identify the breakage of yarn.
Knit Schematics
Weft or filling knits are constructed from one yarn that is fed into knitting machine needles in a horizontal direction. The circular knitting machine creates a spiral effect as it produces a fabric in tabular form. Because of this spiral characteristic, it is often difficult to have the wales and courses of the knit fabric form a perfect 90-degree angle match.

Knitted fabrics are produced by two general methods – **warp knitting**, and **weft knitting**, and each method produces a variety of types of knitted fabrics.
<table>
<thead>
<tr>
<th>Knitted Fabric Knits</th>
<th>Specialized Weft Knits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weft Knits</td>
<td></td>
</tr>
<tr>
<td>Single Knits</td>
<td>Intarsia</td>
</tr>
<tr>
<td>Single Jersey</td>
<td>Jacquard Jerseys</td>
</tr>
<tr>
<td>Lacoste</td>
<td>Knitted Terry</td>
</tr>
<tr>
<td>Double Knits</td>
<td>Knitted Velour</td>
</tr>
<tr>
<td>Rib Knit</td>
<td>Sliver Knit</td>
</tr>
<tr>
<td>Purl Knit</td>
<td>Fleece</td>
</tr>
<tr>
<td>Interlock Knit</td>
<td>French Terry</td>
</tr>
<tr>
<td>Cable Fabric</td>
<td></td>
</tr>
<tr>
<td>Bird’s Eye</td>
<td>Warp Knits</td>
</tr>
<tr>
<td>Cardigans</td>
<td>Tricot</td>
</tr>
<tr>
<td>Milano Ribs</td>
<td>Raschel</td>
</tr>
<tr>
<td>Pointelle</td>
<td></td>
</tr>
</tbody>
</table>
Either a circular or a flat-bed knitting machine can be used to make weft knits. Four basic stitches are used in the weft of filling knits.

- Jersey stitch/plain knit
- Purl stitch
- Rib stitch
- Interlock stitch (both for single and double knits)
Flat or Jersey Knit Fabric

Flat or Jersey Knit fabrics have visible flat vertical lines on the front and dominant horizontal ribs on the back of the fabric. The flat or jersey knit stitch is used frequently, it is fast, inexpensive, and can be varied to produce fancy patterned fabrics. A major disadvantage of regular flat knits is their tendency to “run” if a yarn is broken. The flat or jersey stitch can be varied by using different yarns or double-looped stitches of different lengths to make terry, velour, and plush fabrics. This stitch is also used in making nylon hosiery, men’s underwear, and t-shirts.
Purl Knit Fabric

Purl Knit Fabrics look the same on both sides of the fabric. Many attractive patterns and designs can be created with the purl stitch. It is often used in the manufacture of bulky sweaters and children’s clothing. The production speed is generally slow with Purl knits.

Purl Knit is made by knitting yarn as alternate knit and purl stitch in one wale of the fabric. The fabric has alternate courses of knit stitch and purl stitch. The fabric is reversible and identical on both sides of the fabric. The fabric does not curl and lies flat. It is more stretchable in length direction.
Rib Stitch Knit Fabric

Rib Stitch Knits have stitches drawn to both sides of the fabric, which produces columns of wales on both the front and back of the fabric. Rib stitch produces fabrics that have excellent elasticity. Rib knits are used for the “ribbing” which is usually found at the lower edges of sweaters, on sleeve cuffs, and at necklines. The Rib-knit fabric is made by knitting yarn as alternate knit stitch and purl stitch in one course of the fabric. The fabric has alternate wales of knit and purl stitches. It is reversible fabric, as they look identical on both sides of the fabric. They may be made with both flat and circular knitting machines.
Cardigans

Cardigans are a variation of Rib Knit with half Cardigan and Full Cardigan varieties. The fabric has specific patterns of tuck stitches. These produce a raised effect and hence, cardigans are a thicker fabric.

Half Cardigan

The Half Cardigan is made of one course of all knit on both needle beds and second course of all knit on front needles and all tuck on back needles. The tuck loops present in the fabric reduce the stretch in width direction. It is not reversible fabric. They are generally coarsely knitted and used for making pullovers and sweaters.

Full Cardigan

The Full Cardigan is made of a repeat of one course of all knit on front needles and all tuck on back needles, the second course of all tuck on front needles and all knit on back needles. Full Cardigan looks identical on both sides. Excessive tuck loops make the fabric bulky and thick. It is usually knitted in coarser gauge and widely used in making sweaters and fashion garments. Cardigans are usually made of Wool or Acrylic.
Milano Ribs
Milano Ribs are a variant of Rib Knit with half Milano and full Milano variations. The fabric has specific patterns of knitting and misses.

Half Milano
Half Milano is made of a repeat of one course of all knit on both needle beds and second course of all knit on front needles only. It has an unbalanced structure. It is usually knitted coarse gauge and widely used for making sweaters.

Full Milano
Full Milano is made of a repeat of one course of all knit on both needle beds, the second course of all knit on front needles only and the third course of all knit on back needles only. Full Milano is finely knitted fabric and has better coverage. It has greater dimensional stability than half Milano rib. It is widely used as suiting fabrics.
Interlock Stitch Knit Fabric

Interlock stitch Knits are variations of rib stitch knits. The front and back of interlocks are the same. These fabrics are usually heavier and thicker than regular rib knit fabrics unless used with finer yarns. The interlocking of stitches prevents runs and produces apparel fabrics that do not ravel or curl at the edges.
Double Knit Fabric

Double Knits are made from the interlock stitches and its variations. The process involves the use of two pairs of needles set at an angle to each other. Fibers that the generally used to make double knits are polyester and wool. Double knits are weft knitted fabrics made with two sets of needle beds. The fabric structure is more stable and compact. The fabrics do not curl at the edges and do not ravel. They may be made with interesting designs and textures. One or two yarns are used to knit one course in the fabric.
Warp Knitted Fabric

Warp knitted fabrics are made in a special knitting machine with yarns from warp beam. Unlike weft knits, they are knitted from multiple yarns, with yarns forming loops in adjacent wales. The fabric may be identified with a pick glass. The face side of the fabric has slightly inclined vertical knitting loops whereas the backside of the fabric has inclined horizontal floats. They do not ravel. Warp knit fabrics are constructed with yarn loops formed in a vertical or warp direction. All the yarns used for a width of a warp knit are placed parallel to each other in a manner similar to the placement of yarns in weaving. The fabrics that are made of great quality with the technique are generally made with Tricot and Raschel knits.
Tricot Knit Fabric
Tricot knits are made almost exclusively from filament yarns because uniform diameter and high quality are essential yarn characteristics for use with the very high-speed tricot knitting machines. Fabrics constructed by the tricot knitting machine are usually plain or have a simple geometric design. The front surface of the fabric has clearly defined vertical wales, and the back surface has crosswise courses.
Raschel Knit Fabric
Raschel knits are produced from spun or filament yarns of different weights and types. Most raschel knits can be identified by their intricate designs, the open-space look of crochet or lace, and an almost three-dimensional surface effect design.
Cable Knit Fabric

Cable fabric is a double knit fabric made by the special loop transfer technique. The wales in the fabric have a rope-like appearance, where plaits are based on the transfer of loops with adjacent wales. The fabric has an interesting surface texture like braids as the loops cross each other. It is widely used as sweater fabric.
Bird’s Eye Knit Fabric

Bird’s eye is a double knit fabric with a combination of tuck stitches along with knitting stitches. The tuck stitch creates interesting eyelet or hole effect on the fabric surface resembling a bird’s eye. The fabric usually made of multi-colored threads creating scrambling effect. The fabric may be made with designs having eyelets. They are a popular clothing fabric, especially women’s wear.
Pointelle Knit Fabric
Pointelle is a type of double knit fabric. The fabric has patterned miss stitches. The fabric has looked like lace, with holes made by these transferred stitches. The feminine look of the fabric makes it ideal for women’s tops and kids wear.
Intarsia Knit Fabric
Intarsia is patterned single knit fabric. It is made of knitting multi-colored yarns. The fabric has the same course knitted in different colors with different yarns. It has colored designs as blocks distributed in different color backgrounds. The patterns look identical on both the face and backside of the fabric. There are no floats found on the backside of the fabric. It is typically used to make shirts, blouses, and sweaters.
Jacquard Knit Fabric

Jacquard Jerseys are single jersey fabrics made of Circular Knitting machines using Jacquard mechanism. They are the simplest method of making patterned fabrics. They are produced with interesting patterns, which may have any of the following:

• Combinations of stitches, or
• Combinations of yarn types in terms of color textures etc.

Jacquard fabrics have different colored loops made of different threads in the same course. Floats are an inherent feature of single jersey jacquards. They are widely used in the sweater industry.
Knitted Terry Fabric

Knitted Terry is pile jersey fabric made with a special attachment in regular circular knitting machines similar to woven fabrics. The fabric has loops on the fabric surface. The fabric is made of two sets of yarns, in which one set of yarn makes the pile, while the other set of yarn makes the base fabric. Knit terry is softer, more flexible and is more comfortable than woven terry fabrics. However, they are not firm and durable as woven terry. Owing to its softness and absorbency, it is widely used in beachwear, towels, bathrobes etc.
**French Terry Fabric**

French Terry It is a type of Weft Insertion Jersey. The piles on the fabric are not napped and the technical back of the fabric is used as face side. French Terry has loops or piles on one side only. The piles of the French Terry are much shorter when compared to usual Terry. The fabric has excellent stretch and gives fleece like a handle. These features make the fabric more comfortable hence, they are popularly used in clothing, especially infants and kids. French Terry is widely used in sportswear, jogging suits and workout suits owing to its absorbency and stretch.
Knitted Velour Fabric
Knitted Velour are Pile jersey fabrics having soft protruding fibers on the fabric surface. Like knit terry, they are also made of an additional set of yarns making pile loops on the fabric surface. However, in Velour, these pile loops are sheared evenly and brushed. It may be dyed and generally available with solid colors. They are used in luxurious apparels like jackets, blouses, dresses etc.
Sliver Knit Fabric

The Sliver Knit is Pile jersey fabric. Unlike Velour fabric, Sliver knit fabric is characterized by a longer pile on the fabric surface. It is made of special circular knitting machines in which the surface fibers imitating fur are attached to the fabric, by means of knitting sliver along with base yarn making the fabric. Sliver knit fabrics have longer and denser piles on the fabric surface than other pile jerseys. Animal printed sliver knit fabrics are popularly used as imitation fur fabrics. They are more popular than fur as they are light, more stretchable and do not require special care for storage. They are widely used in making jackets and coats.
Fleece Knit Fabric

Fleece is a type of weft insertion jersey. Weft insertion fabrics are weft knitted fabrics in which an additional yarn is inserted for each course. These additional yarns are not knit, rather they are held by the loops in each course of the fabric. The inserted yarn may be decorative or functional like stretch yarn. It provides stability, cover, and comfort. The insertion yarn is usually coarser than the base yarn. When the insertion yarn forming piles are sheared and napped, it is called Fleece. They are usually made of Cotton, Cotton/Polyester, Wool, and Acrylic. End Uses include jackets, dresses, sportswear, and sweaters.
THANK YOU