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PRODUCTION OF KNIT SHIRT AND COMPARE WITH WOVEN SHIRT IN TERMS OF WEARABILITY

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Abstract: The knitted shirts and woven shirts are available in the market. Some knitted shirts are excellent than woven shirts. Mostly woven shirts are popular in the world. So how to find out better knitted shirts for wear could be done in this work. Selection of fabric in terms of total hand value can be done for knitted fabrics. The testing for bending, drape, and crease recovery can be done for good knitting fabrics. Washing analysis is done for knitted and woven shirts. Overall performance can be deduced which makes more profitable. Knitted shirts production cost is much lower than woven shirts production cost.

Index Terms; Knit shirt, Woven shirt, Production, Total Hand Value, Bending, Drape, Crease recovery

1. Introduction

Knitted garment manufacturing process

A complete product of a knitwear garment has to go through a lot of processes to make a successful production. Nowadays, there is various kind of advanced technological equipment where it does not require any kind of sewing-up.

On the other hand, everything is done by the machine where the traditional process requires a huge number of skilled labor for production. The advanced technology makes the whole process much easier.

In order to complete a whole production, a knitted garment has to make sure of the simple knitting design to the finishing and packing. And this writing will help to understand the entire knitted manufacturing process. So keep reading!

The production process of knitted garment manufacturing

Firstly, the garment manager needs to get a production order from an individual merchandiser. And then the manager informs the production officer about the consumer's choices and requirements.

Afterwards, the production officer informs the technician who is in charge. An in-charge generally knows about the machine if it is running in any productions. Thus the whole process is so lengthy and so much hard work involved with it for production.

So, below are some points mentioned briefly that will make you understand this topic in a much easier way:

- Order confirmation
- Sample fabric
- Analyzing the design
- Pattern grading
- Spreading process
- Cutting process
- Sorting out the fabrics
- Stitching and Sewing up
- Final wash and check
- Packing and Delivery

Order confirmation

The first process in knitted garments is taking the order. Then confirming the color, design, and

so on. This is also a product development window where it assists with pricing, sampling, and information collecting.

Sample fabric

In the process of manufacturing, it is so important to get a sample of the ordered fabric. It will help the manufacturer for a better understanding of what their consumer choice and what they want.

Analyze the design or pattern

Selecting the design and pattern is another complex step. Patterning is the specific design of different parts which is typically drawn in the hard paper and cut according to the shapes. The designer also can draw the pattern manually using the pencil, scale, and paper. And on the basis of this design, the whole production will produce. So making the designs and analyzing the pattern is the topmost important step.

Pattern or design grading

Pattern making and grading is an essential part of this process because there are different kinds of pattern and size, such as XS, S, M, L, XL, XXL. For different types of size, it requires different kinds of patterns. There are also the grading rules to make different sizes pattern. And grading the pattern is so hard if it is done manually. But it can be done so fast and easily too by using some CAD software.

Marker Making

This is such a way that produces the maximum possible garments with the minimum fabrics possible. In this process, all the pattern is arranged to cut in the cutting table. It makes sure that the pattern cut appropriately so that the wastage of the production reduced.

Spreading process

After marker making, the next process is spreading the garments. In this process, the fabric is spread in the table and cutting it as per its length and width. Five to six inches is the maximum height of the stack.

Cutting in shapes

This is an essential step in this process. In this step, the spread fabrics are pinned perfectly with the table and marker paper to avoid the displacement of the fabrics.

Different parts of the garments are cut differently with the cutting machine. Cutting the fabrics can be done very fast and easily by using the Computerized Technique than the manual process.

Sorting out the fabrics

After done with the cutting process, the next step is sorting out and bundling cut the fabric. The part of the garments sorts out the various pieces according to its colors and sizes so the next step can be done properly and systematically.

Printing process

Sometimes the manufacturing requires to do the printing process. Usually, this process is done before the sewing process so that the printing can be done properly and easily.

Assembling the fabrics for Sewing up

Assembling the whole thing is very important in the process of the garment. Because after the assembling process it will go for the sewing section. And anything wrong happens in the assembling part then it will be a major mistake for the whole process. In the sewing section, there are various kinds of sewing machines for different sizes and pieces.

Final wash and checking the quality

After done with all this process, the production will go for a final wash. After that, there are some quality checks, and the quality assurance team will check the quality. They will check the sewing error, measurement faulty, fabric error, print defects, size issues, etc.

If it is possible, then they will try to send them in the rectifying department of the garments to rectify that error. If it's not possible, then they will reject that one.

Ironing and final check

In this section, the garments go for the ironing as per the merchandiser's requirements. And then the Quality assurance team will go for a final check again before going it for the packaging and delivery.

Packing and delivery

After doing the iron and final check, the garments go for the packaging section. In this section, the garments will be packed in some poly bags and finally in the big cartoon with the labels and price tags. Then the whole production is ready for the delivery to its buyers.

The process of the knitted garment manufacturing is not an easy task. It involves a lot of hard works and various types of technological machines. From the above writing, we have seen that the process of knitting garment from the bottom to top.

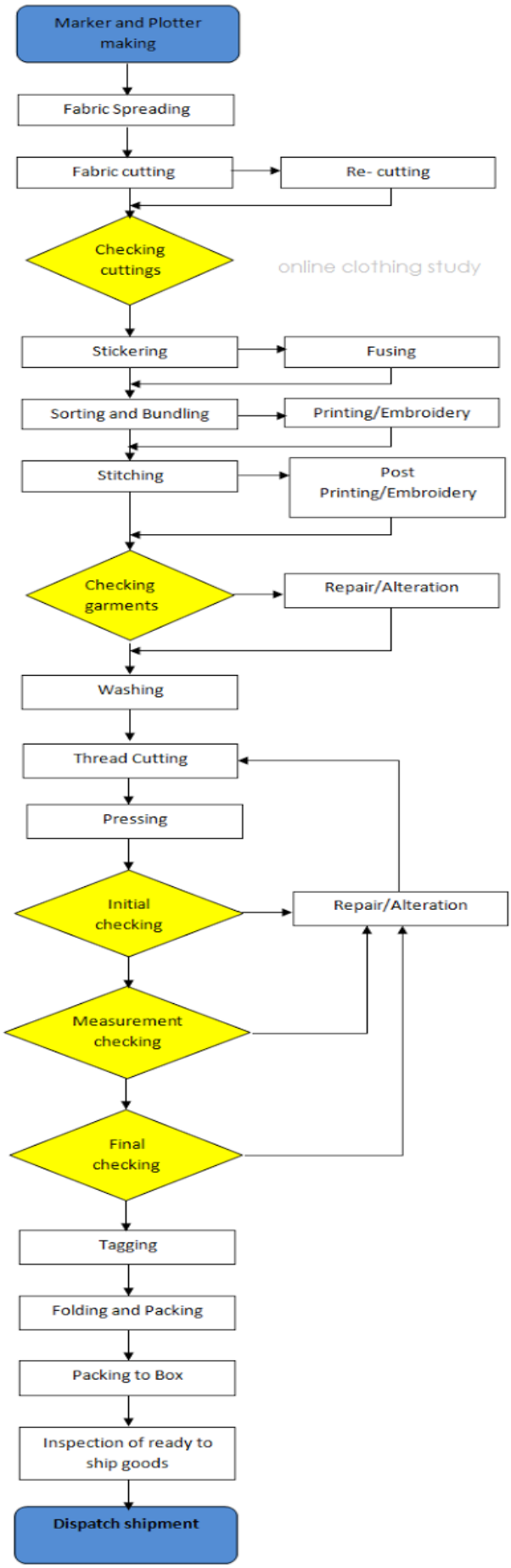
Nowadays, the process gets much more comfortable with the help of technological devices. Thus, it helps to increase the production in the possible less and ensures the reduction of the wastages of fabrics. And hopefully, you have enjoyed the short brief discussion about the knitted garments manufacturing. This is given in reference (1).

Production Process Flow for Woven Garment Manufacturing

If you are new to the garment manufacturing, you may find it difficult how garments are actually made in a factory? After receiving of fabrics, raw materials are passed through various processes before it is ready for shipment to the buyers. Some processes are necessary, where few processes are done based on customer demand and style requirement. A detailed process flow is also important for production planning and Time and action calendar making. A single process flow does not fit for all orders. Like you may need printing or embroidery on the product or you may not. Buyer may ask for washing garments prior to finishing. Sometimes they may not. In this article, I am showing you a process flow that is commonly used for woven products manufacturing. I prefer to show it in a flow chart instead of explaining the same with words.

In the below process flow chart, processes those are shown in the main flow are necessary processes like spreading, cutting, sewing, checking, pressing etc. Processes those are shown side column are done in case it is required. This is given in reference (2).

PRODUCTION PROCESS FLOW CHART



2. Knitted fabric types

Different types of knit fabrics

1. Jersey

Jersey is the most common type of knit fabric. To make this textile, both knit and purl stitching are put together using a single needle. Thus, this fabric is also called the single or plain knit. Among the types of knit fabrics, this one is easy to distinguish because of its unmistakable right and wrong side of fabric.

Jersey knit fabric is a common textile used for making basic T-shirts. It is also perfect for draped garments like dresses and tops. It can come in any fiber, we stock wool, hemp, bamboo, and cotton. We also stock tencel, modal, rayon and a little polyester.

Jersey Knit Fabric Features To Remember:

- lightweight
- not so stretchy unless the material has an amount of spandex in it
- distinct right and wrong side of the fabric
- edges curls up easily when pulled

2. Rib Knit

Rib knit or sometimes called ribbing has raised vertical textured lines. This textile is created using a double bed knitting machine that has two needles with vertical textured lines. This type of knit fabric is also easy to identify because of its vertical ribs. There are 2 basic types of rib knit fabric based on the sequence of knit and purl stitches. The 1×1 rib has a sequence of 1 knit and 1 purl stitch, while the 2×2 rib knit has 2 knit and 2 purl stitches sequence.

Since Rib knit fabric is more stretchy crosswise and lies flat on one side, this fabric is perfect for making turtleneck clothes, bottom edges of sweaters, cuffs, and necklines on clothes. It is also excellent in making mats including rugs and other home furnishings. It can come in any fiber, we stock wool, hemp, bamboo, and cotton. We also stock tencel, modal, rayon and a little polyester.

Rib Knit Fabric Features To Remember

- heavier compared to Jersey
- generally very stretchy among the 3 basic types of knit fabrics, but the 1×1 rib is more stretchy than the 2×2 rib
- almost identical right and wrong side of the fabric
- not so smooth unlike Jersey knit
- edges don't curl up when pulled

3. Interlock Knit

Interlock knit is similar to rib knit. Some experts say it is a variation of ribbing because the fabric is created using 2 needles too. It also looks like 2 layers of single knit piled on top of each other. Thus, this type of knit fabric is also called double-faced rib.

When you want to sew pants, skirts, tanks, the best type of knit fabric to use is the interlock fabric. It can come in any fiber, we stock wool, hemp, bamboo, and cotton. We also stock tencel, modal, rayon and a little polyester.

Interlock Knit Fabric Features To Remember

- heavier and thicker than jersey
- not too stretchy compared to Jersey
- reversible type of fabric, there's no right or wrong side of the fabric
- among the 3 basic types of knit fabrics, interlock is more stable.

4. French Terry knit

French Terry fabric is a knitted terry cloth fabric that features loops and soft piles of yarn on one side, (usually the inside of a garment), and a smooth, soft surface on the other side. The result is an absorbent, light-weight, moisture-wicking material that's super comfortable to wear any day of the year. It can come in any fiber, we stock wool, hemp, bamboo, and cotton. We also stock tencel, modal, rayon and a little polyester.

5. Fleece Knits

Fleece Knit Fabric is a durable, warm, and stretch fabric with a thick, deep pile. Fleece Fabric dries quickly, making it perfect for active wear. It can come in any fiber, we stock wool, hemp, bamboo, and cotton. We also stock tencel, modal, rayon and a little polyester.

This is just a beginning to the explanation of knit styles. There are so many, they can have spandex added and that changes the fabric behavior and uses. This is given in reference (3).

Woven fabric types

Different types of weaves in woven fabrics

Textile fabrics are essential material for making clothes, home made-up and other apparel products. Fabrics can be classified into four types according to the fabric weave structure - woven fabric, non-woven fabric, knit fabric and braid. In this post, we will discuss various types of woven fabrics according to the fabric weaves.

What are woven fabrics

Any textiles which are made from the process of weaving are called woven fabrics. Weaving is a method of textile production wherein two distinct set of yarns or threads are interlaced at a right angle to one another to form a fabric or cloth. The longitudinal yarns are called warp and the lateral threads are called weft or filling. Woven fabrics are woven in a loom whose basic function is to hold the warp threads under tension to facilitate the interweaving of the weft threads.

The characteristics of the woven fabric depend a lot on the method in which the yarns are interwoven in. The characteristics of the weave also change depending on the type of the fibre used along with the thickness of the yarn it is woven with. Woven fabrics only stretch diagonally (in bias direction) and usually fray at the edges. Depending on the end use, the fabric weave design is selected for weaving the fabric.

Majority of the woven products are created with one of the three basic weaves: Plain weave, Satin weave, or Twill weave. Some of the most common weave made with the alterations of the above are shown here.

1. Plan weaves

Plain weave, also known as calico, tabby, taffeta as the name suggests is the simplest type of weave where the threads are woven together one after another meaning threads interlaced over one another. It is one of the strongest weaves as the threads are constantly crossing over each other. Its application can be found ranging from heavy and coarse fabric like the canvas to the lightest and finest fabrics like muslins.

2. Matt weave

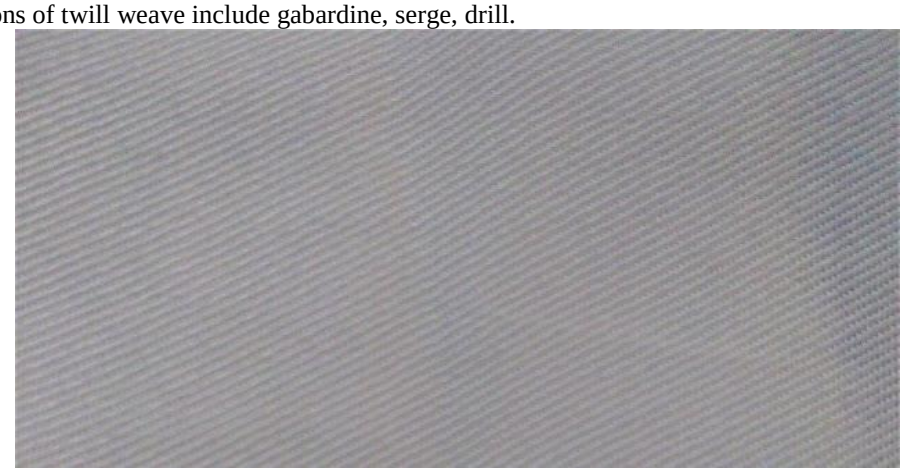
Matt weave is a variation of plain weave with two warp thread passing over two warp thread instead of a single yarn giving a unique checkerboard-like appearance. Matt weave is also known as basket weave. This provides more structure to the fabric. It has great insulating properties and its structure makes the fabric more breathable. It is also naturally resistant to wrinkles.

Example of Matt weave: Oxford fabrics or oxford weave. The Pinpoint weave, Royal Weave are some variations of matt weave. It is mostly used for making casual or sporty cotton shirts, pants and other casual-to-formal garments. Oxford weave is for shirting fabric.

More variations are made from the above with examples like basket weave and monk's cloth, which are made by group of yarns in place of a single yarn in plain weave or by alterations of fine and coarse yarn to make ribbed and corded fabrics with Bedford cord, pique, dimity as warp-ribbed and poplin, rep, grosgrain as weft-ribbed.

3. Twill fabrics

Twill weave is responsible for the diagonal pattern in the fabric. Depending on the technique used in the weave, the diagonal pattern will get different patches. It has lesser binding points compared to plain weave with a higher cloth thickness and mass per unit area. This type of weave is most commonly used for denim fabric and is responsible for two different colours of the fabric in two faces. Some of the alterations of twill weave include gabardine, serge, drill.

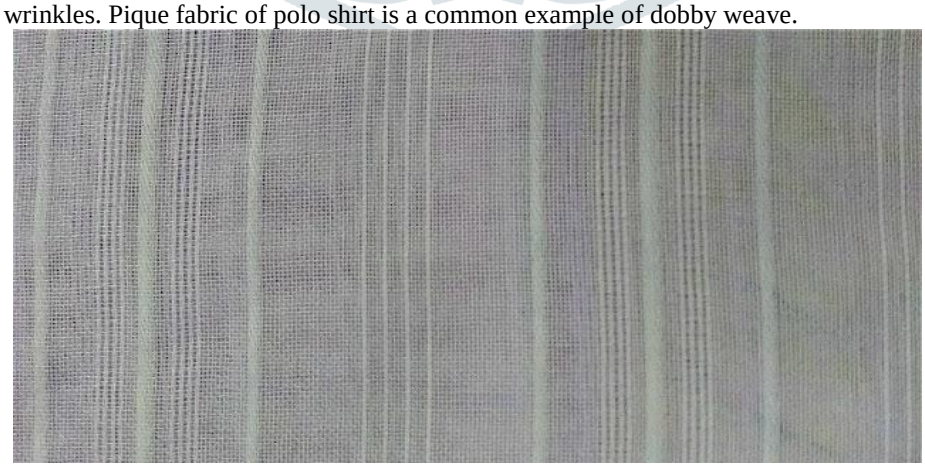


4. Herringbone fabric

Herringbone is a variation of the twill weave. The pattern is called herringbone as it resembles that of the skeleton of herringbone fish. The threads are woven in a way that a herringbone pattern appears on the fabric. Like the twill weave, it also has countless variations, which give different appearances to the fabric. It is most commonly used for suits and outerwear. Woven fabric tapes are commonly used as garment trims.

5. Dobby Weave

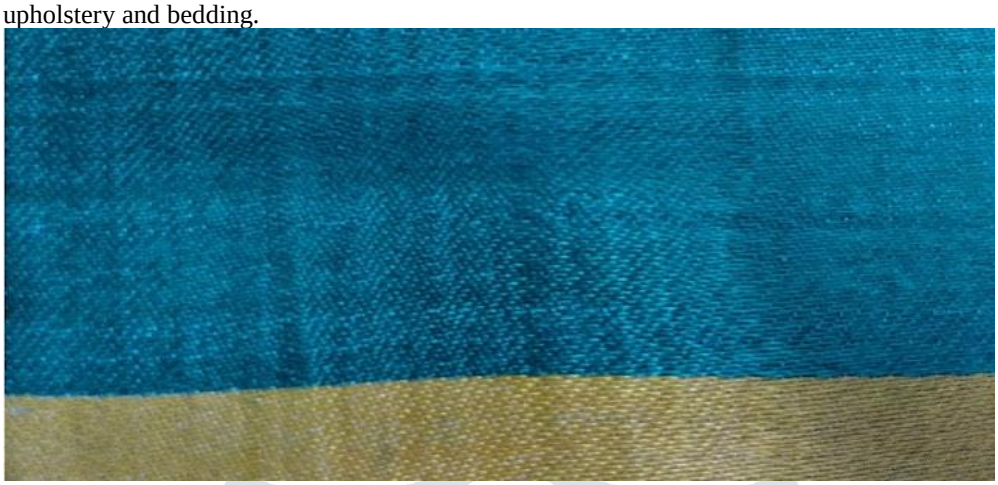
Dobby is usually an advanced design which is used to create a texture in the fabric with a slightly raised design. Dobby weave is the combination of several different thicknesses of yarn and weave technique. The warp and weft may or may not be the same colour. Unlike plain weave, it is less susceptible to wrinkles. Pique fabric of polo shirt is a common example of dobby weave.



6. Satin Fabric

There are many types of satin from cotton satin and polyester satin to silk satin. The satin weave has floating or overshot warp threads on the surface which gives the fabric a shiny surface, which is often associated with exclusive fabrics.

Satin is a type of weave and not a kind of fibre. When the uncrossed threads are in the weft, the weave is called Sateen. It is mostly used for apparel in evening gowns, shirts, wedding dresses, ties etc. along with upholstery and bedding.



7. Pile fabric (Velvet fabric)

In pile fabric, extra sets of warps or fillings are woven over ground yarns of plain or twill weave to form loops. Pile fabrics have been defined as fabrics(s) with a cut or uncut loops which stand up densely on the surface.

Velvet fabric in an example of cut pile. Velvet is known for its soft and smooth surface. It consists of soft threads called pile sticking up out of the fabric. The pile is formed by supplemental yarns that can run both along warp and weft direction. The fabric is woven and then cut apart for the soft pile to emerge. There are many variations of velvet which provide the different look to the surface. Its characteristics depend on the type of yarn used in its manufacturing. Cotton velvet (velveteen) is the strongest and most durable type of velvet.

Velvet fabric

There are even variations for pile fabric with warp-pile fabric like terry, plush and weft-pile like velveteen, corduroy.

Terry weave

8. Jacquard fabrics

The Jacquard loom is a weaving mechanism done in special looms which can control individual warp threads producing fabrics having complicated woven patterns such as brocade, damask, tapestry etc. This is given in reference (4).

Barcode weave

3. Comparison of Knitted & Woven garments

The Difference Between Woven & Knitted Fabric

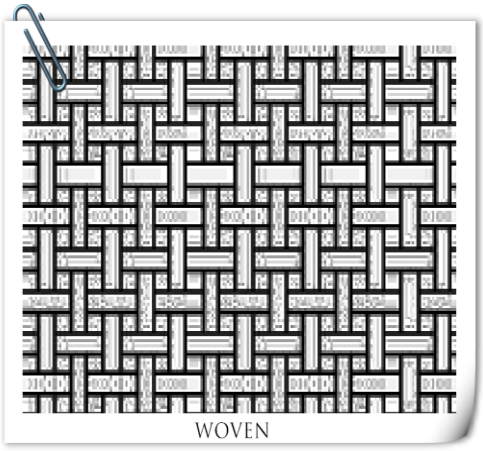
When you go to a clothing store, do you notice the difference between shirts and T-shirts? When you touch them, you might feel that T-shirts are softer than shirts while shirts look more in shape, even when their material are both 100% cotton. The differences are mainly due to the fabric types they use: shirts are made from woven fabrics while T-shirts from knitting fabrics.

Woven Fabric

Structure: Multiple yarns comprise a woven fabric, crossing each other at right angles to form the grain. See the figure for an example.

Features: More in shape with dimensional stability

Applications: Shirts, Pants, Jackets, Bags, Tablecloth etc.



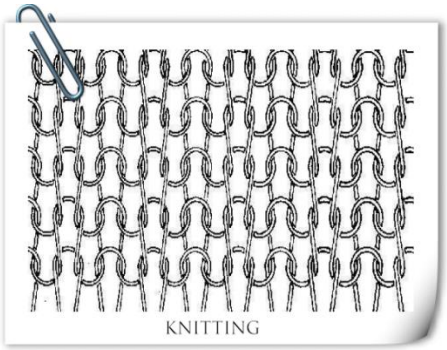
Knitting Fabric

Structure: A knit fabric is made up of a single yarn, looped continuously to produce a braided look.The figure shows the example.

Features: High elasticity & soft.

Applications: T-shirts, Polo shirt, Sweater, Swimsuit, Socks, Scarf

This is given in reference (5).



Knit vs Woven Fabric: What Is The Difference?

It's tempting to pick fabric for your next sewing project based on how the material looks or feels. Appearance and texture can help you select a fabric for sure, but you also need to consider how each type of fabric is made. For example, when you compare knit vs woven fabric, what is the difference?

The main difference between knit and woven fabric is that knit fabric uses a single looped yarn construction, while woven fabric contains a structure of crossed yarns. Knit fabric has a braided, sweater-like look on close examination. Woven fabric displays the over-under pattern of warp and weft yarns.

In this article, you will find out how a knit and a woven fabric gets made. You will learn the key differences between these types of material. Finally, you will discover examples of each type of fabric, as well!

Knit vs Woven Fabric: Key Points

Though all fabric has either a knit or woven construction, these two types of material can have very different characteristics. Check out this chart to get a quick overview of the nine key characteristics of knit and woven materials.

	Knit Fabric	Woven Fabric
Stretch	Very stretchy because of the open, interlocked thread structure.	Does not stretch except on the bias.
Strength	Can stretch out easily and does not have a lot of strength.	Quite tough because of the over-under weave of crisscrossing thread structure.
Durability	Does not fray easily but can pill and stretch out, making it less durable.	Many types of woven fabric have a lot of durability and can withstand many washes without pilling or stretching out.
Breathability	Typically much more breathable due to open looped thread structure.	Less breathable than knitted material.
Softness	Knit fabric almost always feels soft and flexible.	Depends on the type of material. Some woven fabric feels soft to the touch, but most has a coarse texture than knit material.
Comfort	Very comfortable, soft, and form-fitting Often used for clothing that drapes or hugs the body.	Less comfortable and often used in more structured garments.
Wrinkle Resistance	Excellent wrinkle resistance and does not easily hold a crease.	Crease easily and not wrinkle-resistant.
Ease of Care	Usually washable but can wear out quickly.	Sometimes requires special care but typically lasts a long time without pilling.
Common Uses	T-shirts, sweatshirts, sportswear, leggings, socks, underwear, swimsuits.	Shirts, jackets, pants, dresses, skirts.

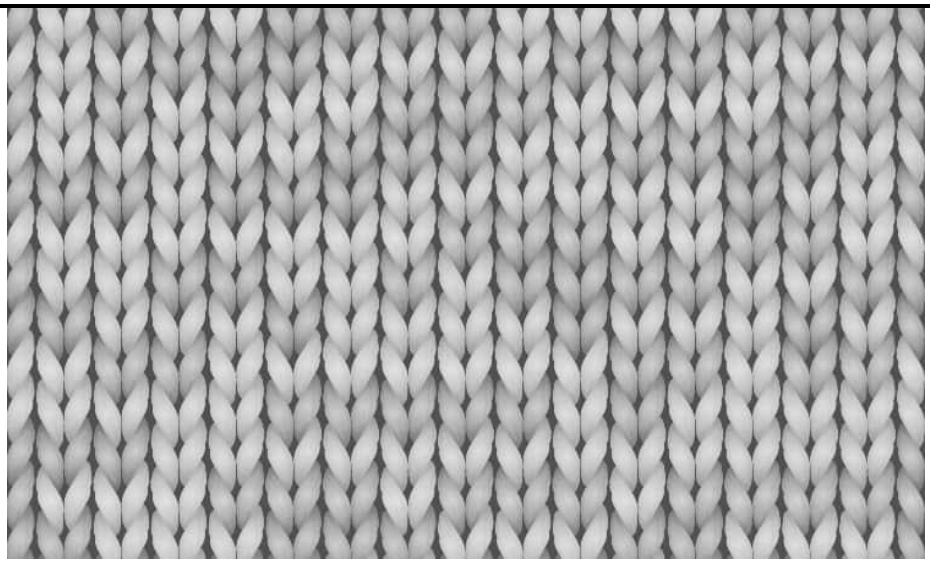
What is Knit Fabric?

Knit fabrics use interlocking loops made out of one long yarn to form a smooth, slightly stretchy kind of material. Knit fabric factories use giant knitting machines that employ the same process as hand-held knitting needles, just on a larger scale.

If you look closely at any knit fabric, you will see tiny links of thread that look like many small braids. Under a microscope, these tiny links would look just like the knitted loops of yarn in your favorite sweater!

Technically, knit fabrics can have two slightly different types of construction. Warp-knit fabric has vertical loops, meaning that those tiny braid-like chains run up and down the fabric. Weft-knit fabric has horizontal loops and looks more like the tiny braids that go across the fabric.

Knitting has existed for thousands of years. No one knows its exact origins, but historians have proved that many ancient cultures used a knitting process to make warm clothing!



But the kind of knit fabric you see in t-shirts today has quite recent origins. In 1916, Coco Chanel famously wore a jersey knit pullover. At the time, the knit fabric still had some similarities to more traditional hand-knitted sweaters and was typically made out of wool.

However, due to Coco's massive influence, women all over the world soon wanted a jersey knit garment of their own. Machine-made jersey knit dresses, pullovers, shirts, and jackets quickly became all the rage.

Then the 1950s saw the emergence of double-knit synthetics like polyester. These aided the vibrant fashion trends of the 1960s and 70s. The cheaper cost of synthetic materials also made knit fabric much more popular in this era.

Today, knit material like jersey knit is used in a lot of athletic and leisurewear. Probably every t-shirt and sweatshirt you own features knit fabric! Leggings, tank tops, sports bras, and many other stretchy garments also use knit fabric.

What is Woven Fabric?

Woven fabric features two sets of threads that cross over and under each other to form a pattern. Factories use large looms set with vertical threads called warp threads and horizontal threads called weft threads to create the structure of this material.

If you look at a piece of woven fabric up close, its structure looks kind of like the over-under pattern in a straw basket.

Woven textiles have existed for thousands and thousands of years. Ancient civilizations wove plant-based fibers like flax almost all the way back at the beginning of human history!

Today, you can find woven fabric made out of pretty much any type of fiber. This ranges from things you might expect, like cotton and wool, to modern textiles such as polyester and rayon. You can even find specialized woven fabric like vinyl, which is made out of stone filaments!

But not all woven fabric uses the same weaving pattern. While the type of material used does make a difference, it is often the weaving pattern that truly characterizes a type of fabric.

Different kinds of fabric like tulle, satin, and poplin are all defined by the kind of weaving pattern used. For example, polyester woven in a satin weave pattern will have a shimmery, silky surface. Polyester woven in a plain weave will have a dull, more textured surface.

Three main weaving patterns shape all woven textiles, though these do have several variations as well.

Plain weave uses that basic over-under structure and looks like many tiny squares up close. Your cotton bedsheets may use this weaving pattern, as do fabrics such as chiffon and organza.

A satin weave uses a special technique that places clumps of weft threads passing over one warp thread at a time. Putting more threads on the surface of the fabric creates that classic, shimmery, smooth texture.

Twill weave has a distinctive V-shaped pattern of threads. Wool woven in a herringbone twill pattern shows up prominently in wool suits and jackets.

What is The Difference Between Knit and Woven Fabric?

The difference between knit and woven fabrics is that knit fabric uses looped thread construction and woven fabric is made out of two sets of threads crossed over each other.

Fabric can contain any type of fiber, from synthetics like polyester to ancient textiles like silk and linen. But no matter what kind of material goes into the fabric, all cloth goes through one or the other of these two types of cloth construction.

Aside from the distinctive thread structure, you can use several other easy tests to tell the difference between a knit or woven piece of material. First, knit fabric stretches far more than woven fabric. Second, knit material also does not hold a wrinkle easily if you pinch it between your fingers, and woven fabric will crease.

Of course, each method of fabric construction has distinctive characteristics.

Stretch

Knit fabric stretches much more than woven fabric. The loops of thread in knit fabric make it flexible and perfect for form-fitting attire. It can stretch horizontally and vertically, though it can also stretch out and become skewed when not cared for properly.

Woven fabric does not have a lot of elasticity in it. It does not stretch much vertically or horizontally, though it can stretch a little on the diagonal. For this reason, fashion designers will sometimes cut woven material "on the bias" or at a diagonal to give this type of fabric more of a form-fitting drape.

Woven material typically has more of a structure to it than knit material. Clothes made out of woven material typically require closures like zippers or buttons, as they will not easily expand to go over your head or up your legs otherwise!

Strength

The strength of any fabric depends largely on the type of fiber it contains, but the woven fabric does have greater strength than a knit fabric made out of the same kind of material.

Woven fabric has the tensile strength of all those crossed threads to give it shape and strengthen it. Knit fabric can pretty easily stretch out.

On the other hand, a knit fabric does not fray as easily as woven fabric.

Durability

Woven fabrics typically have much greater durability than knit fabric. You may find this surprising; after all, t-shirts and many of your toughest clothes are made out of knit material! But woven fabric can hold its shape and resist pilling after heavy use and lots of washing, whereas knit material will eventually stretch out, pill, and lose its nice appearance.

Generally speaking it's a lot easier to damage a knit material than to damage a woven material. Of course, this does depend somewhat on the type of material used–a woven silk fabric requires special dry cleaning, for example, while your average cotton knit can go straight in the washer!

But overall, woven material will hold up better over time than knit fabric.

Breathability

Knit material offers more breathability than woven material. The looped thread construction offers lots of pathways for air to flow through. Woven material does have some microscopic spaces between the crossed threads, but it tends to form more of a barrier between you and the air.

Many other factors determine breathability as well. Finer threads usually offer more breathability in both knit and woven materials. The tightness of the knit or weave also impacts the breathability of the material in question.

On top of that, the material itself impacts breathability as well. For example, cotton will feel very breathable in either a knit or a woven structure. Polyester, on the other hand, will feel less breathable because it does not have porous fibers.

Softness

Knit fabric almost always feels soft due to its giving and stretch structure. Woven materials often have more of a firm or even coarse texture.

Now, that does not mean woven material never feels soft! Ringspun cotton woven in a tight satin weave will have a soft, almost lustrous surface. But Ringspun cotton knitted into jersey knit for at-shirt will feel cushiony and gentle to the touch.

Again, the softness largely depends on the type of material used. But it's safe to say that knit material pretty much always feels soft, and woven material does not always feel soft!

Comfort

Generally, a knit fabric will feel more comfortable than woven fabric. Knit fabric has a forgiving, form-fitting, drapey quality that wins it a lot of points for comfort! Woven fabric can also feel quite comfortable depending on the type of material used and the style of the garment.

The softness of knit fabric also makes them super comfortable. Most of your comfy at-home attire, like t-shirts, baggy hoodies, and cozy sweats, are made out of knit materials.

Wrinkle-Resistant

Knit material wins the wrinkle-resistant contest, hands down! The looped structure and flexibility of this kind of material prevent it from creasing easily. On the other hand, woven fabric can catch and hold a crease quite stubbornly in many cases.

As a fun fact for you, fabric wrinkles because heat and moisture impact the hydrogen bonds inside the material. This allows the fibers to change shape a bit, creating creases in the material.

Ease of Care

The ease of care for both knit and woven fabrics depends on what kind of material they contain. That said, both types of fabric construction offer some pros and cons in terms of care.

Knits will not wrinkle easily and don't require ironing. Woven material, on the other hand, will not pill or stretch out as easily in the wash. It does often need ironing, though, because it creases so easily.

Common Uses

Both woven and knit materials have many popular uses in clothing.

Though knit fabric has only existed for about a century, it has rapidly become a staple of many modern wardrobes. T-shirts use knit material, as do bathing suits, socks, underwear, and pretty much all stretchy sportswear like leggings or tank tops.

Of course, you can also find pretty much any kind of clothing made out of woven fabric. Dresses, shirts, skirts, pants, suits, ad much more feature woven fabric. People have worn woven textiles for thousands and thousands of years!

Garments made out of woven material typically have more of a structure and include several different pieces of material sewed together to fit the body's shape.

Also, it usually costs more to make woven material than knit material. The lower cost of knit fabric no doubt adds to the popularity of leisurewear today! This is given in reference (6).

4. Problems in knitted garments

23 Fabric Defects to Look Out for During Fabric Inspection

As a garment importer touring your supplier's factory, you likely have one thing on your mind: the anticipation of customer satisfaction as they buy an item from your product line.

But there's a problem.

The "quality" fabric from your supplier doesn't meet your standards. In fact, it has a lot of problems. Fabric inspection reveals countless defects ranging from drop stitches to color shading variation.

The scale of defects makes it clear the garment manufacturer will have to cut around the issues to use the fabric, wasting material in the process.

Where do these kinds of fabric defects come from? And how can you prevent them from negatively impacting fabric quality (**related**: How MMI Textiles Improved Fabric Quality to Retain Key Customers [case study])?

The 4-point system is the industry standard for evaluating fabric quality in the inspection industry. This system **assigns penalty points to a roll of fabric according to defect size, quality and significance**.

But you must understand the different types of fabric defects to look for before you can use the 4-point system. Read on or click the links below to jump to different sections to learn more about each of these fabric defects.

1. Horizontal lines
2. Shade variation
3. Dirt/stains
4. Uneven dyeing
5. Drop stitches
6. Misprinting
7. Crease marks
8. Barre
9. Neps/knots
10. Abrasion marks
11. Splicing
12. Holes
13. Defective selvage
14. Snags
15. Thick place/thin place
16. Bowing and skewing
17. Needle lines
18. Coarse pick
19. Coarse end
20. Broken pick
21. Broken end
22. Missing end
23. Filling bar. This is given in reference (7).

5. Problems in woven garments

Woven Fabric Defects

In the **textile** industry, woven fabric is produced by interlacing warp and weft yarn. Faulty **woven fabrics** hamper the total **quality** of woven garments such as **shirts**, pants, **trousers**, jackets, etc. As a textile engineer, you should know about the major woven fabric faults produced during woven **fabric** manufacturing. As its importance, this article has shown those woven **fabric faults**.

Major Defects Found in Woven Fabrics:

Various types of faults found in woven fabrics have mentioned below:

1. Bad selvage
2. Broken ends or warp
3. Broken picks or weft
4. Loose warp
5. Loose weft or snarl
6. Double-end
7. Tight end
8. The float of warp
9. Wrong end color
10. Miss pick
11. Double pick
12. Weft bar
13. Ball

14. Hole
15. Oil spot
16. Tails out
17. Temple mark
18. Reed mark
19. Slub
20. A thick and thin place.

This is given in reference (8).

6. Production of knitted shirts & its costs

Garments Costing Method for Knitted T-Shirt (Buying Costing)

In the garments sector, a business is totally standing on the profit of garments costing. There are so many in knit garments merchandising who still don't know the proper garments costing method for a T-Shirt. As its importance on garments profit, today I will discuss the easiest costing method for a knitted T-Shirt.

Method of Garments Costing for the knitted T-Shirt

At first, a **knit garment merchandiser** should confirm the following matters before going to the knitted T-shirt costing:

1. Yarn Price
2. Knitting and Washing Cost
3. Dyeing Cost
4. Printing cost
5. Cost of Making (CM)
6. Accessories Cost
7. Commercial Cost
8. Others Cost

The second duty is to calculate fabric consumption and costs.

- Generally, we calculate the grey **fabric consumption**.
- After completing grey fabric consumption and costing, all the required fabric processing costs (knitting+ washing cost, dyeing cost) should be added with grey fabric cost. After that, we can achieve the actual fabric cost.
- Then finally all the other necessary costs should be added with the actual fabric cost to achieve the total cost of a garment.

An example of knitted T-Shirt costing is given in the following for removing all confusion about the above discussion.

Example

Suppose, The buyer "VF Asia Ltd. " provided you the following measurement chart of a knitted printed T-Shirt order by mentioning the order quantity and fabric GSM.

1. Fabric is 100% cotton single jersey, and fabric GSM is 140
2. The order quantity is 15000pc.

Then calculate the garments costing (on FOB) per pcs for the order.

	Actual	**Allowance**	**Measurement with Allowance**
Body Length	85cm	6cm	91cm
Sleeve Length	50cm	6cm	56cm
1/2 Chest Width	70cm	6cm	76cm

Solution:

Given that,
Fabric GSM- 140,
Body length with allowance- 91cm
Sleeve length with allowance – 56cm
½ Chest widths with allowance – 76cm
Let,
Yarn Price per kg- $4.00
Knitting and Washing Cost per kg- $1.20
Dyeing Cost per kg- $2.00
Printing Cost per dozen- $5.00
Accessories Cost per dozen- 2.00
Now, we have to calculate the **fabric consumption** for the above order.

Fabric Consumption

All the measurements are applied in the following formula-

Fabric consumption per dozen, (All measurement in cm),

$$\frac{(\text{Body length} + \text{Sleeve length} + \text{Allowance}) \times (1/2\ \text{Chest width} + \text{Allowance}) \times 2 \times \text{GSM} \times 12}{10000000} + \text{Wastage\% (in kg)}$$

$$\frac{(91 + 56) \times 76 \times 2 \times 140 \times 12}{10000000} + 10\%\ \text{(in kg)}$$

= 3.754 + 10% (in kg)
= 4.13kg per dozen.

So, grey fabrics needed per dozen garments are 4.13kg.

As yarn price per kg is $4.00 then, grey fabric cost per dozen is (4.13kg × $4.00) = $16.52
After, adding all the fabric processing costs (Knitting+ Washing Cost, Dyeing Cost) with grey fabrics cost, the actual fabric cost will be determined.

So,
Actual fabric cost = Total Grey fabric cost + {{(knitting cost + washing cost) + dyeing cost} × 4.13kg] per dozen
= $16.52 + {($1.20 + $2.00) ×4.13} per dozen
= $29.74 per dozen.

So, the actual fabric cost per dozen is……. $29.74 …… (A)
Printing Cost per dozen…… $5.00 …….. (B)
Accessories Cost per dozen……..…$ 2.00 …… (C)
Cost of making (CM)……. $5.00 …… (D)
Commercial cost ……. $0.50 ……. (E)
Others cost …… $0.30 …… (F)

Now, by adding A, B, C, D, E, and F, we will get the total FOB cost of the garments per dozen.

Total FOB cost per dozen = (A +B + C + D+ E + F)
= $ (29.74 + 5.00 + 2.00 + 5.00 + 0.50 + 0.30)
= $42.54 per dozen.
So, the total FOB cost per dozen stands at-$42.54
In buying house costing, profit% for the buying house (here-15%) should be added with total FOB cost per dozen.

So,
Total FOB cost per dozen with profit% stands at ($42.54 + 15%) = $48.92
Now, total FOB cost per pcs clothing is ($48.92 / 12) = $4.08

So, in the view of buying house costing (FOB) per pcs garment is $4.08. This is given in reference (9).

7. Production of woven shirts & its costs

Method of Garments Costing for Woven Long Sleeve Shirt (Factory Costing)

At the starting of a woven shirt costing, a woven garments merchandiser should confirm the following matters

1. Fabric Cost,
2. Printing Cost,
3. Embroidery Cost,
4. Cost of Making (CM),
5. Washing Cost,
6. Accessories Cost,
7. Commercial Cost,
8. Others Cost.

Important tips

- The next duty is to calculate fabric consumption and costs.
- Then finally all the other necessary costs should be added with the fabric cost to achieve the total cost of a garment.

Now, I will present an example of Woven Shirt costing in the following. I hope, all the confusion will be cleared from the above discussion.

Example:

Suppose, The buyer "Bangla Apparel" forwards a "woven long sleeve shirt" item order to you with the following specification.

Fabric width- 60”

Follow the below measurement chart:

	Actual Length	Allowance	Measurement with Allowance
Body Length from HSP	64cm	6cm	70cm
½ Chest	40cm	6cm	46cm
Sleeve Length	30cm	6cm	36cm
Armhole (Straight)	15cm	5cm	20cm
Collar Length	38cm	4cm	42cm
Collar Width	6cm	2cm	8cm
Cuff Length	10cm	3cm	13cm
Cuff Width	2.5cm	0.5cm	3cm
Collar Band Length	28cm	3cm	31cm
Collar Band Width	2cm	2cm	4cm
Pocket Length	13cm	2cm	15cm
Pocket Width	9cm	1cm	10cm
Yoke Length	42cm	4cm	46cm
Yoke Height	11cm	3cm	14cm

Now, calculate the garments costing (on FOB) for the above order.

Solution:

Fabric width – 60”

(Here, the given fabric width is 60”, during sewing, we cannot use the edge of a fabric. So, all time we must exclude 1” from the given fabric width. So, now the fabric width is 60-1 = 59”)

Wastage – 10%

Let,

1. Fabric Cost per yds- $3.50
2. Printing Cost per dozen- $1.6
3. Embroidery Cost per dozen- $4.00
4. Accessories Cost per dozen- $1.80
5. Washing Cost per pcs- $1.00 so, washing cost per dozen is – ($1.00 × 12) = $12.00

Now, we have to calculate the fabric consumption for this order.

1. Fabric consumption for the Body Parts (Body + Chest)

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Body Length from HSP} + \text{Allowance}) \times (1/2\ \text{Chest} + \text{Allowance}) \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{70 \times 46 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 5.64yds per dozen..... (A)

So, fabric consumption for the Body Parts (Body + Chest) is 5.64 yds per dozen.

(Note: 2.54 used to convert into inch from cm and 36 used to convert into yds from inch).

2. Fabric consumption for the Sleeve

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Sleeve Length} + \text{Allowance}) \times (\text{Arm hole straight} + \text{Allowance}) \times 2 \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{36 \times 20 \times 2 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 2.52yds per dozen..... (B)

So, fabric consumption for the sleeve is 2.52 yds per dozen.

3. Fabric consumption for the Collar

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Collar Length} + \text{Allowance}) \times (\text{Collar Width} + \text{Allowance}) \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{42 \times 8 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 0.59yds per dozen..... (C)

So, fabric consumption for the Collar is 0.59yds per dozen.

4. Fabric consumption for the Cuff

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Cuff Length} + \text{Allowance}) \times (\text{Cuff Width} + \text{Allowance}) \times 2 \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{13 \times 3 \times 2 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 0.14yds per dozen..... (D)

So, fabric consumption for the Cuff is 0.14yds per dozen.

5. Fabric consumption for the Collar Band

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Collar Band Length} + \text{Allowance}) \times (\text{Collar Band Width} + \text{Allowance}) \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{31 \times 4 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 0.22yds per dozen..... (E)

So, fabric consumption for the Collar Band is 0.22yds per dozen.

6. Fabric consumption for the Pocket

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Pocket Length} + \text{Allowance}) \times (\text{Pocket Width} + \text{Allowance}) \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{15 \times 10 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 0.26yds per dozen.. (F)

So, fabric consumption for the Pocket is 0.26yds per dozen.

7. Fabric consumption for the Yoke

Here, we will apply the following formula (per dozen),

$$= \frac{(\text{Yoke Length} + \text{Allowance}) \times (\text{Yoke Height} + \text{Allowance}) \times 2 \times 12}{\text{Fabric Width} \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

$$= \frac{46 \times 14 \times 2 \times 12}{59 \times 36 \times 2.54 \times 2.54} \text{ (In yds)}$$

= 1.13yds per dozen.. (G)

So, fabric consumption for the Yoke is 1.13yds per dozen.

Now,

By adding A, B, C, D, E, F, and G we will get the total fabric consumption per dozen for the order. Here also, we add the fabric wastage%

Total fabric consumption with wastage% for the woven long sleeve shirt is-

= {(A + B + C + D + E + F + G) + Wastage %}

= {(5.64 + 2.52 + 0.59 + 0.14 + 0.22 + 0.26 + 1.13) + 10%}

= (10.5 + 10%) per dozen.

= 11.55yds per dozen.

So, total fabric consumption for the woven long sleeve shirt is 11.55yds per dozen.

As fabric cost per yds is $3.50 then, the total fabric cost per dozen is (11.55yds × $3.50) = $40.43

Now,

By adding all the following costs with fabric cost, we will get the total FOB cost of garments per dozen.

Fabric cost per dozen ……………………… $40.43 ………………………………. (H)
Printing Cost per dozen …………………..$1.60 ……………………………………… (I)
Embroidery Cost per dozen ……………… $4.00 ……………………………………… (J)
Accessories Cost per dozen ……………..$1.80 ……………………………………… (K)
Washing cost per dozen ………………… $12.00……………………………………… (L)
Cost of making (CM) per dozen……… $15.00 …………………………………….. (M)
Commercial cost …………………… $0.60 …………………………………….. (N)
Others cost ………………………… $0.20 ……………………………….. (O)

So,

Total FOB cost per dozen = (H + I + J + K + L+ M + N + O)

= $ (40.43 + 1.60 + 4.00 + 1.80 + 12.00 + 15.00 + 0.60 + 0.20)

= $75.63 per dozen.

In the case of the factory, we received the order from a buying hose (Here, we got the order from Bangla Apparel Buying House), so we have to pay 10%commission to them for that order.

So, in this situation, total FOB cost per dozen stands at-

= $75.63 per dozen + 10% commission

= $83.19 per dozen.

In factory costing, profit% for the factory (here-15%) should be added with total FOB cost per dozen.

So,
Total FOB cost per dozen with profit% stands at ($83.19 + 15%) = $95.67
Now, total FOB cost per pcs is ($95.67 / 12) = $7.97
So, the factory cost (FOB) per pcs garment is $7.97. This is given in reference (10).

8. Testing of various knitted fabrics

1. Analysis of single jersey fabric

Courses/inch = 45
Wales/inch = 29
Crimped length = 2.6cm
Extended length = 6.1cm
Crimp% = ((6.1-2.6)/2.6)x100 =135%
Stitch length = 6.1/2.5 = 0.244 cm or 2.44 mm
Count of yarn = 30^s
GSM = (45x29x(0.244/2.54)x100x100x453.6)/(40x2.54x840x2.54x36)
= 73 g/m^2

2. Analysis of blue colour fabric (Fleece)

Courses/inch = 38
Wales/inch = 26
Crimped length = 2.6cm
Extended length = 7.4cm
Crimp% = ((7.4-2.6)/2.6)x100 =185%
Stitch length = 7.4/2.5 = 0.296 cm or 2.96 mm
Count of yarn = 30^s
GSM = (38x26x(0.296/2.54)x100x100x453.6)/(30x2.54x840x2.54x36)
=89 g/m^2

Structure
Blue colour = Ground yarn
White colour = Fleece yarn
Fleece yarn = 6nos
Repeat
6 blue
1- Back side
2- Front
3- Back side
4- Front
5- Back side
6- Front

3. Analysis of single pique

Courses/inch = 48
Wales/inch = 25
Crimped length = 2.5cm
Extended length = 5.5cm
Crimp% = ((5.5-2.5)/2.5)x100 =120%
Stitch length = 5.5/2.5 = 0.22 cm or 2.2 mm
Count of yarn = 30^s
GSM = (48x25x(0.22/2.54)x100x100x453.6)/(30x2.54x840x2.54x36)
=81 g/m^2

4. Analysis of 1x1 Rib fabric

Courses/inch = 45
Wales/inch = 30
Crimped length = 3.5cm
Extended length = 5.8cm
Crimp% = ((5.8-3.5)/3.5)x100 =66%
Stitch length = 5.8/2.5 = 0.232 cm or 2.32 mm
Count of yarn = 30^s
GSM = (45x30x(0.232/2.54)x100x100x453.6)/(30x2.54x840x2.54x36)
=96 g/m^2

5. Analysis of half cardigan fabric

Courses/inch = 58
Wales/inch = 28
Crimped length = 2.6cm
Extended length = 7.6cm
Crimp% = ((7.6-2.6)/2.6)x100 =192%
Stitch length = 7.6/25 = 0.304 cm or 3.04 mm
Count of yarn = 30^s
GSM = (58x28x(0.304/2.54)x100x100x453.6)/(20x2.54x840x2.54x36)
=226 g/m^2

6. Analysis of interlock fabric

Courses/inch = 33
Wales/inch = 43
Crimped length = 2 cm
Extended length = 9cm
Crimp% = ((9-2)/2.5)x100 =350%
Stitch length = 9/25 = 0.36 cm or 3.6 mm
Count of yarn = 40^s
GSM = (33x43x(0.36/2.54)x100x100x453.6)/(30x2.54x840x2.54x36)
=156 g/m^2

7. Analysis of fleece fabric

Courses/inch = 49
Wales/inch = 27
Crimped length = 2.8cm
Extended length = 6.5cm
Crimp% = ((6.5-2.8)/2.8)x100 =132%
Stitch length = 6.5/25 = 0.26 cm or 2.6 mm
Count of yarn = 20^s
GSM = (49x27x(0.26/2.54)x100x100x453.6)/(30x2.54x840x2.54x36)
=105 g/m^2
Structure fleece 1:1 fleece

8. Analysis of 1x2 Rib fabric (Double Jersey Rib)

Courses/inch = 42
Wales/inch = 48
Crimped length = 2.5cm
Extended length = 9cm
Crimp% = ((9-2.5)/2.5)x100 =260%
Stitch length = 9/50 = 0.18 cm or 1.8 mm
Count of yarn = 35^s
GSM = (42x48x(0.18/2.54)x100x100x453.6)/(350x2.54x840x2.54x36)
=95 g/m^2

9. Analysis of single jersey horizontal stripe fabric

Courses/inch = 31
Wales/inch = 29
Crimped length = 4.2cm
Extended length = 12.4cm
Crimp% = ((12.4-4.2)/4.2)x100 =195%
Stitch length = 12.4/50 = 0.248 cm or 2.48 mm
Count of yarn = 40^s
GSM = (31x29x(0.248/2.54)x100x100x453.6)/(40x2.54x840x2.54x36)
=51 g/m^2

10. Knitted denim

Courses/inch = 64
Wales/inch = 36
Crimp % white = (0.85-0.5)/ (0.5) x 100 = 70%
Blue = (0.6-0.5)/ (0.5) x 100 = 20%
Stitch length white = 1.35 mm
Blue = 0.95 mm
Count = 203
GSM = (64x36x(1.25/25.4) x 453 x 100 x 100) / (2.54x2.54x20x36x840)
= 132 g/m2
Structure = Twill

.	X	X	X	**Single Jersey**
X	X	X	.	**. Blue Colour**
X	X	.	X	**X White Colour**
X	.	X	X	

9. Washing of knitted & woven shirts & compared to socks

Washings
L - Length W - Width

	0		1		2		3		4		5	
	L	W	L	W	L	W	L	W	L	W	L	W
1. Woven Shirt												
Front	74.5	34	75	35	74.5	33.5	74.5	34.5	74	34	75	33.5
Back	79	64	82	65	81.5	64	81	65	82	66	81	65
Sleeve	62.5	58 (29x2)	63.5	58 (29x2)	64.5	58 (29x2)	64	57 (29x2)	64.5	58 (29x2)	63.5	58 (29x2)
2. Knitted												

Front	69.5	30	71	31	72	30.5	71	32	70	33	71	33
Back	64	68	64.5	69	64	66	65	64	63	68	64.5	69
Sleeve	49	50 (25x2)	51	54 (27x2)	50.5	50 (25x2)	49.5	50 (25x2)	49	49 (24.5x2)	50.5	50 (25x2)
3. Socks												
Ribwelt	3	12	3	12	3	12	3	11.5	2.5	11.5	3	12
Calf or leg	18	12	18	12	18	12	17	12	17.5	12	18	12
Foot	18	11	18	11	18	11	17	11	16	11	16	11

10.Wearability parameters for garments

NUMERI

a) A mixed feeling come from smooth, limber and soft feeling. Its typical feeling is given by the fabric woven by cashmere fibre. Experts express this feeling by their professional words which means "the softness come from fine and high quality wool fibres".

b) Flexibility, smoothness, touch of smooth bending and springy property in bending.

SHARI

a) "Shari-shari" feeling. This "shari-shari" is the crisp and sharp sound which is made by rubbing the surface of the fabric with itself when the surface is lightly rough and lightly hard just as dry sand. This shari feeling brings us a cool feeling and this feeling is brought by hard and strongly twisted yarn. For example, woolen plush fabric usually possesses this feeling strongly.

b) Mainly surface touch. All kinds of the hardness of fabric promote this feeling.

KOSHI

a) and b) A stiff feeling from bending property and springy property promotes its feeling. High density fabrics made by springy and elastic yarn usually possess this feeling strongly.

HARI

Anti-drape stiffness, no matter whether the fabric is springy or not. This word means "Spread".

FUKURAMI

a) Feeling come from a bulky, rich and well formed feeling

b) Springy property in compression and thickness accompanied with warm feeling.

The experts from different companies had not discussed each other about these definitions before organizing committee but they had almost common understanding about the hand, and there was not so much difference in their conception and understanding about these expressions.

Primary hand expressions and their definitions

Men's winter suit fabric		
Hand		
Japanese	**English**	
KOSHI	Stiffness	A feeling related with bending stiffness. Springy property promotes this feeling. The fabric having compact weaving density and woven by springy and elastic yarn makes this feeling strong
NUMERI	Smoothness	A mixed feeling come from smooth, limber and soft feeling. The fabric woven from cashimere fiber gives this feeling strongly
FUKURAMI	Fullness and softness	A feeling come from bulky, rich and well formed feeling. Springy property in compression and thickness accompanied with warm feeling are closely related with this feeling. (FUKURAMI means "Swelling")
Men's summer suit fabric		
KOSHI	Stiffness	
SHARI	Crispness	A feeling come from crisp and rough surface of fabric. This feeling is brought by hard and strongly twisted yarn. This feeling brings us a cool feeling. (This word means a crisp, dry and sharp sound arisen by that the fabric is rubbed with itself)
HARI*	Anti-drape stiffness	Anti-drape stiffness, no matter whether the fabric is springy or not. (This word means "spreading")
FUKURAMI*	Fullness and softness	
* These are recently added to the primary hand group for the summer men's suit fabric		

Primary hand expressions and their definitions

Women's medium thick fabric		
Hand		
Japanese	**English**	
KOSHI	Stiffness	A feeling related with bending stiffness. Springy property promotes this feeling. The fabric having compact weaving density and woven by springy and elastic yarn makes this feeling strong
NUMERI	Smoothness	A mixed feeling come from smooth, limber and soft feeling. The fabric woven from cashimere fiber gives this feeling strongly
FUKURAMI	Fullness and softness	A feeling come from bulky, rich and well formed feeling. Springy property in compression and thickness accompanied with warm feeling are closely related with this feeling. (FUKURAMI means "Swelling")
SOFUTOSA*	Soft feeling	Soft feeling, a mixed feeling of bulky, flexible and smooth feelings
* This is not a primary hand. This expression was added as a semi-primary hand because that this feeling was important for ladies dress fabric		
Women's thin-dresst fabric		
KOSHI	Stiffness	
SHARI	Crispness	A feeling come from crisp and rough surface of fabric. This feeling is brought by hard and strongly twisted yarn. This feeling brings us a cool feeling. (This word means a crisp, dry and sharp sound arisen by that the fabric is rubbed with itself)
HARI	Anti-drape stiffness	Anti-drape stiffness, no matter whether the fabric is springy or not. (This word means "spreading")
FUKURAMI	Fullness and softness	
KISHMI	Scooping feeling	Scooping feeling. A kind of silk fabric possesses this feeling strongly
SHINAYKASA*	Flexibility with soft feeling	Soft, flexible and smooth feeling
* These is not a primary hand but semi-primary hand. This hand is added because of its importance at the evaluation of the ladies thin fabrics		

This is given in reference (11).

11.Testing by experts of knitted & woven shirts and knitted fabrics

Winter (35, 35, 30)

Ex.No	1	2	3	4	5	6	7	8	9	Knitted denim
KOSHI	25	20	30	35	35	25	25	25	30	30
NUMERI	30	30	20	25	20	20	20	20	30	25
FUKURAMI	30	30	25	30	30	30	30	30	30	30

Ex.No	1	2	3	4	5	6	7	8	9	Knitted denim
KOSHI	7.1	5.7	8.6	10	10	7.1	7.1	7.1	8.6	8.6
NUMERI	8.6	8.6	5.7	7.1	5.7	5.7	5.7	5.7	8.6	7.1
FUKURAMI	10	10	8.3	10	10	10	10	10	10	10

Winter

Koshi (Maximum) = 35 Stiffness
Numeri (Maximum) = 35 Smoothness
Fukurami (Maximum) = 30 Fullness & Softness
=100

Total Hand Value (THV) $= (-1.2293 + 0.5904Y_1 - 0.0441Y_1^2 - 0.1210Y_2 + 0.0517\,Y_2^2 + 0.6317\,Y_3 - 0.0506\,Y_3^2)$

	1	2	3	4	5	6	7	8	9	10
THV	4.8	4.74	3.46	3.3	2.5	3.0	3.0	3.0	3.6	3.6

Summer (30, 35, 10, 25)

Ex.No	1	2	3	4	5	6	7	8	9	Knitted denim
KOSHI	15	15	25	25	25	15	15	25	20	20
SHARI	20	20	30	20	15	30	30	30	20	20
FUKURAMI	10	5	5	10	10	10	10	10	10	10
HARI	25	20	20	15	25	20	20	20	20	20

Ex.No	1	2	3	4	5	6	7	8	9	Knitted denim
KOSHI	5.0	5.0	8.3	8.3	8.3	5.0	5.0	8.3	6.7	6.7
SHARI	5.7	5.7	8.5	5.7	4.3	8.5	8.5	8.5	5.7	5.7
FUKURAMI	10	5.0	5.0	10	10	10	10	10	10	10
HARI	10	8.0	8.0	6.0	10	8.0	8.0	8.0	8.0	8.0

Summer

Koshi (Maximum) = 35 Stiffness
Shari (Maximum) = 35 Crispness
Fukurami (Maximum) = 10 Fullness & Softness
Hari (Maximum) = 25 Anti-drape stiffness
=100

Total Hand Value (THV) = $(-1.3788 - 0.0004Y_1 - 0.0006Y_1^2 + 0.7501Y_2 - 0.0361\ Y_2^2 + 0.5190Y_3 - 0.0369\ Y_3^2 + 0.2555Y_4 - 0.0352\ Y_4^2)$

THV
Excellent – 5; Good – 4; Average – 3; Below Average – 2; Poor – 1; Out of use – 0;

	1	2	3	4	5	6	7	8	9	10
THV	2.1	3.2	3.9	3.5	1.75	3.7	3.7	3.7	3.0	3.0

Winter		
	Woven Shirt	Knitted Shirt
KOSHI 35%	20	15
NUMERI 35%	30	25
FUKURAMI 30%	25	20
Summer		
	Woven Shirt	Knitted Shirt
KOSHI 30%	20	15
SHARI 35%	30	25
FUKURAMI 10%	10	10
HARI 25%	20	20

Winter		
	Woven Shirt	Knitted Shirt
KOSHI	5.7	4.3
NUMERI	8.6	7.1
FUKURAMI	8.3	6.7
THV	5.24	4.2
Summer		
	Woven Shirt	Knitted Shirt
KOSHI	6.7	0.5
SHARI	8.6	7.1
FUKURAMI	10.0	10.0
HARI	0.8	0.8
THV	4.1	3.8

12.Testing of knitted denim for bending, drape, crease recovery

Bending Length Maximum C = 8cm
Bending Length Minmum = 0cm
Flexural rigidity G Max = $W_2C^3 \times 10^3$ mgcm (Reference (13))
W_2 – Weight gm/cm^2
300 GSM = 300/10000 = 0.03 gm/cm^2
C = 8cm
FR Max = $0.03 \times 8^3 \times 10^3 = 15360$ mgcm
FR Min = 0 mgcm
Bending Modulus Maximum = $732G/g_1^3 = (12 \times G \times 10^{-6})/g_2^3$ kg/cm^2
g_1 – Thickness in thousand
g_2 – Thickness in cm
Maximum Thickness = 0.064 x 2 = 0.128cm

d inches = $1/(28\sqrt{2}) = 0.025$
Max d cm = 0.064 cm
Min Thickness = 0.0083 x 2 = 0.0166
Bending Modulus = $(12 \times 15360 \times 10^{-6}) / 0.468^3 = 1.8$ kg/cm^2
Min B M = 0
Flexural rigidity for G 5cm = $0.015 \times 5^3 \times 10^3$
(Lengthwise course) = 1875 mgcm
Flexural rigidity for 3.5cm = $0.015 \times 3.5^3 \times 10^3$

(Lengthwise wales) = 643.125 mgcm
Bending Modulus 5cm B L
(Lengthwise course) = $(12 \times 1875 \times 10^{-6}) / 0.468^3 = 0.22$ kg/cm^2
Bending Modulus 3.5cm B L
(Lengthwise wales) = $(12 \times 643.125 \times 10^{-6}) / 0.468^3 = 0.0753$ kg/cm^2

Drape Co-efficient
Drape co-efficient max F = $(A_s - A_d) / (A_D - A_d)$
A_D – Area of specimen = 30cm 12”
A_d – Area of supporting disc = 6” 15cm
A_s – Actual projected area of the specimen A_s
Maximum D.C.F = (30-15) / (30-15) = 1
Minimum D.C.F = (15-15) / (30-15) = 0
Actual area of specimen (Back)= 509.5cm^2
Actual area of specimen (Front)= 20 x 23 = 460 cm^2
D.C.F back = (509.5 – 176.625) / (706.5 – 176.625) = 0.6282
A_D = 706.5
A_d = 176.25
D.C.F front = (460 – 176.625) / (706.5 – 176.625) = 0.5348

Crease recovery
1. Course – Face – 70^0
   2” wales – 1” – Back – 210^0
2. 2”Wales – Face - 29^0
   Course 1” – Back - 120^0

13. Characteristics of knitted fabrics

Characteristics and properties of rib structure

- Rib fabrics are double-faced structures as well as balanced structures.
- Both face loops and back loops are visible on both the sides of the fabric, and fabric has identical appearance on face and at back.
- Fabric surface is vertically corrugated or ribbed.
- Fabric is much thicker, usually double, than single jersey fabric.
- Fabric surface is rough or harsh in feel.
- Fabric does not curl at the free edges.
- Fabric can easily be unroved from the end last knitted.
- Fabric has good extensibility in length direction, but the width-wise extensibility and the recovery are much higher than single jersey fabric.
- Needles in the two beds are not face to face but needles in one bed are in between the needles of the other bed so that they do not touch while raised for clearing.

Full cardigan

- For a full cardigan or polka rib, the first course is knitted with face, and tuck loop on second course with a tuck, followed by a reverse loop. It is a therefore a balanced structure.
- End Uses
- Rib fabric is suitable for collars, handcuffs, waistbands, warm outerwear, underwear, socks and swimwear.
- Interlock Structure

Characteristics and properties of interlock structure

- Fabrics are dimensionally stable, heavy and costly.
- Machines have two beds. Machines may be flat or circular, but generally circular.
- Minimum two yarns are needed to produce a fabric.
- Fabric has double faced as well as very stable structure.
- Fabric surface is smooth.
- Fabric is equally thicker to rib but much more compact.
- Fabric neither curls nor ladders.
- End uses
- Interlock fabrics are suitable for underwear, trouser suits, shirts and sportswear.
- Derivatives of interlock structure
- Eight lock,
- Single pique,
- Ponte- di-Roma,

- Ottoman rib,
- Bourrelet,
- Texi pique,
- Pin tuck,
- Purl Structure

Characteristics and properties of purl structure

- Alternative courses are made of all face loops and all back loops. As a result, each wale is made of face loop and back loop in an alternative order.
- Fabric has horizontal corrugation or rib appearance on the surfaces, i.e. opposite to rib fabric.
- Fabric is reversible in appearance and has soft handle.
- Fabric has very high extensibility in length direction, making it suitable for kidswear.
- Fabric does not curl at the edges because of alternate face and back loop courses.
- Fabric thickness is theoretically double to that of a plain knit.
- End Uses
- Purl fabric is suitable for children's clothing, knitwear, heavy outerwear, golf sweaters and sportswear.

Characteristics and properties of single jersey

- Plain jersey is produced by a single set of needles, drawing the loops away from the technical back and towards the technical face side of the fabric.
- The technical face is smooth, with the side limbs of the needle loops having the appearance of columns of Vs in the wales.
- On the technical back, the heads of the needle loops and the bases of the sinker loops form columns of interlocking semi-circles.
- The single jersey is a weft knitted fabric formed with face knit stitches on the face side, and back knit stitches on the rear.
- The fabric has good extensibility in both length and a width direction, but width-wise extensibility is usually much higher than length-wise extensibility.
- The fabric curls at the free edges on flat surface-towards the front at the upper and lower edges, and towards the back at left and right edges.
- The fabric shrinks in width/circumference, and the extent of shrinkage is about in the range of 25-40 per cent.
- The fabric thickness is approximately twice the diameter of the yarn used.
- Properties like rigidity, air permeability, bursting strength and GSM of the fabric change with change in loop length.
- Yarn /course can be unroved from start and end of knitting.
- 2.2. End uses
- Plain knit structures are used for basic t-shirts (men's and ladies), undergarments , men's vests, ladies' hosiery, fully fashioned knitwear, etc.
- Derivatives of plain knit (Single Jersey)
- Structural modifications are used to a great extent in designing plain knit structures by modifying the order of knitting. The plain knit structures can be modified with the following alternatives:
- Knit and float,
- Knit and tuck,
- Knit, float and tuck.
- Tuck loop
- If -while rising -the needle reaches such a height that the old loop is not cleared but needle hook can catch a new yarn during the downward movement, then the old loop is not cast off but retained in the hook and a new loop too is formed. This situation is called tucking, and the new loop is called tuck loop. The tuck loop tends to be wider than equivalent plain loop, and it can be used to increase the width of the fabric. But during tucking, the held loop is stretched as a result when the same is cast off and allowed to relax; it shrinks more, causing more shrinkage of the fabric in the length direction. It makes the fabric more compact and offers better dimensional stability and shape retention.

Characteristics of the tuck stitch

- The tuck stitch exhibits two free arms that spread away from the concerned wale line. The neighbouring wale lines would therefore be pushed away from their normal location in the resultant fabric. This results in localised openings on the two sides of a tuck stitch and in reduction in number of wales per unit length. Effectively the resultant fabric becomes more porous and wider. Tuck stitch makes the fabric wider, more porous and thicker.
- Float loop (Miss loop)
- If -while rising-the needle reaches such a height that neither the old loop can be cleared nor the needle hook catch new yarn during downward movement, then the old loop is not cast off but retained in the hook as well, as no new loop is formed. This situation is called floating. The yarn passes under the needle and remains straight between the neighbouring loops. The straight yarn connecting the two nearest loops knitted from is called float or miss loop. Float stitches also reduce the width-wise elasticity and improves the dimensional stability.

Characteristics of the float stitch

- Imparts additional rigidity to the fabric along the course direction.
- The pull in the adjacent wale lines close together, tending to make the fabric narrower.
- The float also tends to make the fabric appear thinner at the affected zones.
- A float is, however, a loose yarn segment on the technical back side of a single jersey fabric and is therefore prone to snagging caused by any sharp object or abrasive surface.
- Float stitch makes the fabric narrower, thinner due to minimum yarn used in construction and more rigid in the course direction.
- Fabric is flimsy and less rigid compared to others.
- Less extensible than either knitted or tucked structure.
- 2x2 Rib structure (Double jersey)
- Derivatives of rib structure
- Half cardigan,
- Milano rib,
- French pique,
- Swiss pique.
- Half cardigan
- In half cardigan or royal rib on one course, a 1x1 rib is produced, and on another course a tuck loop and a reverse loop are produced. It is therefore an unbalanced structure.

This is given in reference (12).

14. Different types of knit shirts

Different types of knit shirts are T-shirts (cotton knitted), single jersey, rib, double sided cloth, beads, double beads. Mercerized cotton T-shirt are used for silky lustre.

Yarn mercerized & fabric mercerized double mercerized fabric is also used. Super high count such as 120^s can also be used. Pure cotton jersey, polyester cotton single & double sided, pure cotton, polyester-cotton hexagonal, four corner mesh, herringbone pattern, composite rib and stripe mesh are other types of T-shirts. Low elastic polyester yarns, special shaped polyester yarns, nylon yarns, cotton yarns, wool yarns are used. Plain stitches, variable plain stitches, ribbed plain stitches, double ribbed plain stitches, jacquard stitches, wool loop weave are used for T-shirts. Single jersey (lycra jersey, spandex jersey) T-shirt fabric is also available. Pique polo shirt with cotton, blended cotton or chemical fibre is available. Lacoste polo shirt is also available. Honey comb T-shirt is available. Interlock T-shirt is also available. 1x1 rib, 2x2 rib, 2x3 rib fabric is also used for collar & cuffs of T-shirts. Dobby/mini jacquard rib fabrics are also used. Jacquard knit fabrics is also used. Sweater knit fabric is also available. 100% cotton, long staple cotton, organic cotton, pima, supima cotton (US), c/p blends 60/40, 80/20, p/c 65/35, T/c 70/30, polyester, rayon, modal fibre, bamboo fibre, nylon, mulberry silk, linen fibre, spandex/lycra stretch are used to produce T-shirt. Various sizes of women's knitwear are XS, S, M, L, XL, XXL, XXXL with bust sizes 32, 34, 36, 38, 40, 45.5, 48 inches respectively. For Men's knitwear sizes are S, M, L, XL, XXL, XXXL with chest size 38, 41, 43, 45.5, 48, 50 inches respectively. For children's wear 3-4 age, 5-6, 7-8 age group with chest 13, 14, 15 inches respectively.

15. Result

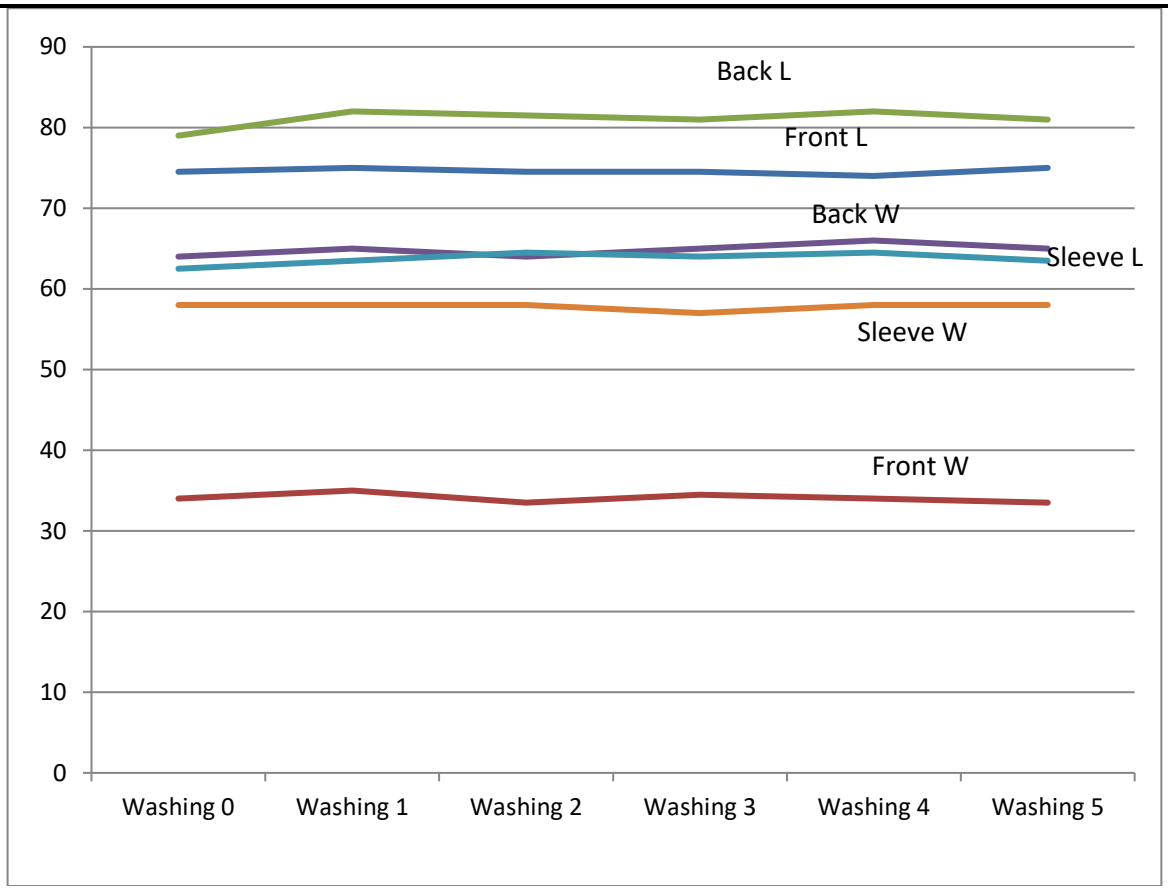
The knitted garment manufacturing process and woven garment manufacturing process was given here. The different fabric types used for knitted and woven garments are presented. Comparison of woven & knitted garments is given here. The problems with knitted & woven garments are collected. The production of knitted and woven shirts cost is given here. Testing of various knitted fabrics are done in laboratory & presented. Washing of knitted and woven shirts and compared to socks is given here. The wearability parameters were collected from literature. Testing by experts of knitted and woven shirts and knitted fabrics are done in laboratory.

Testing of knitted denim for bending, drape & crease recovery & washing are done in laboratory. Characteristics of knitted fabrics is studied. Different types of knit shirts are presented.

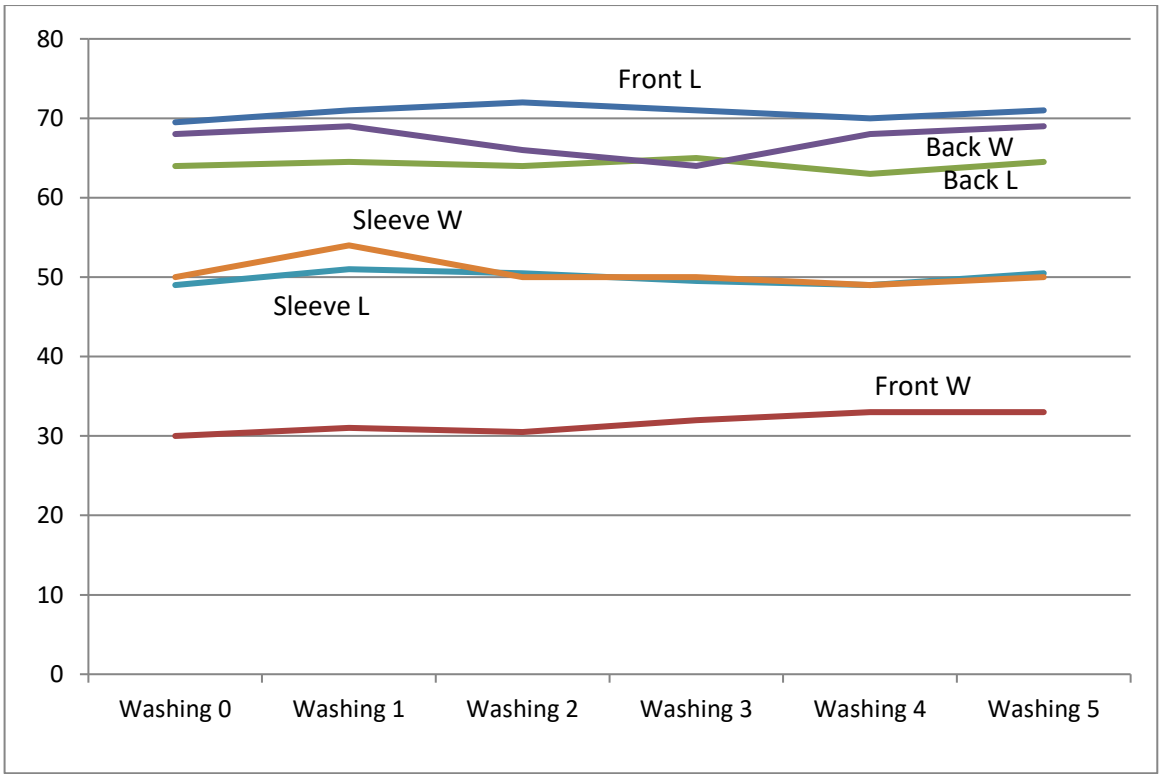
16. Discussions

The discussions can be done with the various laboratory works done.

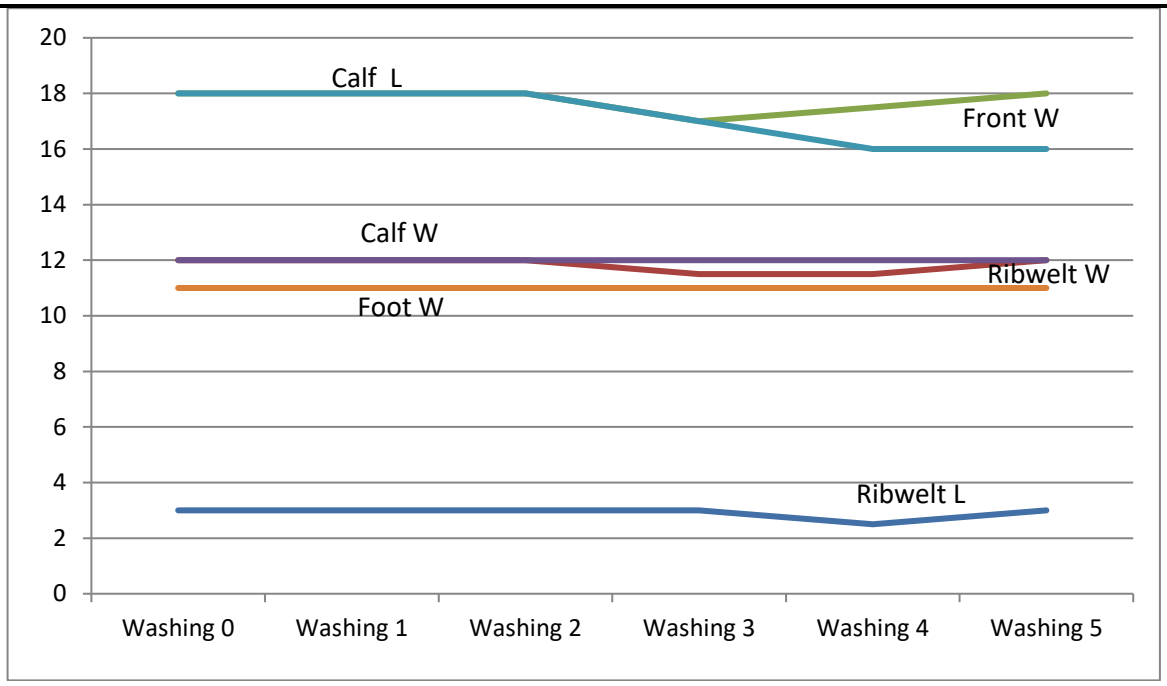
Graphs, woven shirt, knitted shirt, socks.



Graph: Woven Shirt



Graph: Knitted



Graph: Socks

Washing is an important property in determining the wearability. From the experiments the woven shirt front dimensional change is 1cm in lengthwise, 1.5cm widthwise. For back the change is 3cm lengthwise and 2cm widthwise. For sleeve the change is 2cm lengthwise and 1cm widthwise. This change is significant.

For knitted shirt front the dimensional change is 2.5cm lengthwise and 3cm widthwise. For back the change is 2cm lengthwise and 5cm widthwise. For sleeve the change is 2cm lengthwise and 4cm widthwise.

For socks there is no change in dimension. This data shows woven fabrics are better than knitted fabric, but with introduction of spandex knitted fabric also exhibits good dimensional stability.

The production of knitted shirts is cheaper than woven shirts. Knitted shirts cost $4.08 while woven shirts costs $7.97.

The wearability parameters of fabrics are analyzed using the experts and total hand value is calculated. The selection of knitted fabrics can be done with THV values. THV above 3.5 is good and samples 1, 2, 9, 10 can be used for knitted shirts purposes for winter garments. For summer garments sample 3, 4, 6, 7, 8 can be used for knitted shirts purposes. The THV of woven shirt and knitted shirts after stitching is analyzed. For woven shirt THV is excellent and for Knitted shirt it is good. This is for winter garment. The THV of woven shirt is goodand knitted shirt is also good & it can be used for summer garments. This method can be used for variety of fabrics and with different fibre types, yarn types and suitable fabrics can be used for garment purposes.

The bending property of knitted denim is good. The bending length is good. The flexural rigidity is found to be poor. Bending modulus is also found to be poor. So knitted fabrics bending property can be improved by spandex fibre introduction.

The drape co-efficient is found to be good. Only curling is seen coursewise. This can be improved by spandex fibre contented yarn. The crease recovery is poor. This can be improved by spandex fibre introduction.

17. Conclusions

The suitable knitted fabric selection can be done with various tests like bending, crease recovery, drape, washing, total hand value. After finding out convenient knitted fabric, the knitted shirts can be manufactured. The knitted shirts production cost is lesser than woven shirts production cost which is a perfect advantage.

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19. Acknowledgement

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