Faculty of Engineering

Department of Textile Engineering

"A study on knit fabric faults and their causes"

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“Dedicated to our parents”

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DECLARATION

We hereby declare that the work which is being presented in this thesis entitled, **"A study on knit fabric faults and their causes"** is original work of us, has not been presented for a degree of any other university and all the resource of materials uses for this thesis have been duly acknowledged.

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This is to certify that the above declaration made by the candidates is correct to the best of my knowledge.

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ABSTRACT

This study makes an assessment on finding of knit fabric faults due to changing of Stitch Length. At the beginning, a brief introduction is given with suitable literature review. In this study we have done, **A study on knit fabric faults and their causes.** In Textile industry faults are frequently occurred and stitch length has a direct effect on these faults. For changing the stitch length at same count at three same diametric double jersey knitting machine on same Rib structure we found the effect of stitch length on common Knit fabric faults. Changing of stitch length gradually increases or decreases the amount of some major faults on knit industry such as Hole/Cracks, Loops/Drop stitches, Lycra out, Knots & etc. For this study, we collected different samples of common knit fabric faults & some quality inspection sheet done in 4-point system method from a reputed Textile Industry. Firstly, we analyzed the data from the quality inspection sheets and then we have analyzed how changing of stitch length affects on the increasing or decreasing of majorly occurred faults on grey knit fabric.

CONTENTS

Chapter – 01:
Introduction

1. Introduction

Knitting is one of the important industrial sectors of Bangladesh. The lion share our export oriented RMG is originated from knit fabrics Export means quality; we must ensure 100% quality of our export oriented RMG products. Due to increasing demand for quality knitted fabrics, high quality requirements are today greater since customer has become more aware of "non-quality " problems, in order to avoid fabric rejection , knitting mills have to produce fabrics of high quality ,constantly. Detection of faults during production of knitted fabric with circular knitting machine is crucial for improved quality and productivity any variation to the knitted process needs to be investigated and corrected. The high quality standard can be guaranteed incorporating appropriate quality assurance. Industrial analysis indicate that quality can be improved, and defect cost minimized, by monitoring the circular knitting process.

Fine gauge knitted fabric faults are very different in nature and appearance and are often super imposed. They can be attribute not only to the knitting, but also o the quality of yarns, dyeing and finishing .Some faults can be easily avoided by respecting some fundamental pre-requisites on the circular knitting machine such as the use of positive feeders and the respect of the machine maintenance and cleaning schedule, faults are much more difficult to expect because they are not related to just one cause.

New generation circular knitting machine are conceived with auxiliary equipment that ensure less fabric faults during knitting such as filter creel ,lint removal, thread survey ,oiling and fabric faults detector devices. Fabric faults detector is able to detect holes and dropped stitches but it is sometimes not enough reliable and have to disconnected especially when a structured fabric is knitted because special fabric structures could be confused with faults by the sensor. Other faults cannot be detected during knitting but only after fabric relaxing or finishing such as fabric spirality and color mismatch.

Many researchers have applied computer vision to improve inspection method of human vision in textile products, in most of them, the image of knitted garments had been considered to specify the faults features. Others work aimed to classify defects in knitted fabrics by using image analysis and neutral network algorithm or fuzzy logic. All these methods are not completely reliable because image analysis of knitted fabrics involves difficulties due to the loop structures and yarn hairiness, compare to woven fabrics consisting of neat warp and weft yarns. Knitted fabric faults can also be detected by inspecting yarn input tension and loop but only few types of faults are concerned by these methods.

Human inspection by using knitted fabric inspection machines remains today the most used way to classify faults after knitting. Generally, faults are classified by type and by frequency in the

inspected knitted roll. The inspection assessment permits to appreciate fabric quality. The judgment of fabric quality depend on faults tolerance levels fixed by each knitter and could be in some cases subjective because it is based only on the number of faults on points per 100 yards occupied on grey fabric.

"Our aim of this project is to study on weft knitted fabric faults. To do so we collected some inspection sheet from a reputed industry and classify them in a systematic manner"

Faults in circular knitting production can be caused in various ways and quite a few of them cannot be just related to just one cause. The following explanations are expected to be helpful in trying to locate the cause of these faults easier.

Chapter – 02:
Literature Review

2.1 Knitting

Knitting is a method by which thread or yarn is used to create a cloth. Knitted fabric consists of a number of consecutive rows of loops, called stitches. As each row progresses, a new loop is pulled through an existing loop. The active stitches are held on a needle until another loop can be passed through them. This process eventually results in a fabric, often used for blankets or garments.

2.1.1There are two types of knitting

- Warp knitting
- Weft knitting

In warp knitting, the wales and courses run roughly parallel.

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Fig: Warp knitting

In weft knitting, the entire fabric may be produced from a single yarn, by adding stitches to each wale in turn.

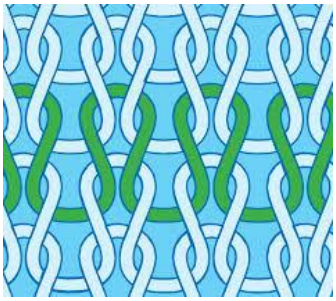


Fig: Weft knitting

2.1.2 Knitting machines:

Knitting machines are mainly two types. They are:

- Weft Knitting Machine.
- Warp Knitting Machine.

Weft knitting machine can be also divided into three types. They are:

i. Flat bar.
ii. Straight bar.
iii. Circular.

Flat bar can be also divided into four types. They are:

1. Flat bet.
2. V-bed.
3. Single bed.
4. Unidirectional.

Straight bar can be also divided into two types. They are:

1. Single needle.
2. Double needle.

Circular can be divided into two types. They are:

1 Revolving cylinder.
2. Circular bearded single jersey.

Revolving cylinder can be also divided into two types. They are:

1. Sinker top open top single jersey.
2. Cylinder and dil.

Circular bearded single jersey can be also divided into two types. They are:

1. Sinker wheel.
2. Loop wheel.

Warp knitting machine can be also divided into two types. They are:

i. Raschel.
ii. Tricot.

2.2 Basic Weft knitted structures:

1. **Plain / Single knit structure.**
2. **Rib structure.**
3. **Purl knit structure.**
4. **Interlock structure**.

2.2.1 Plain knit structure:

Features of plain knit structures:

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.....

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

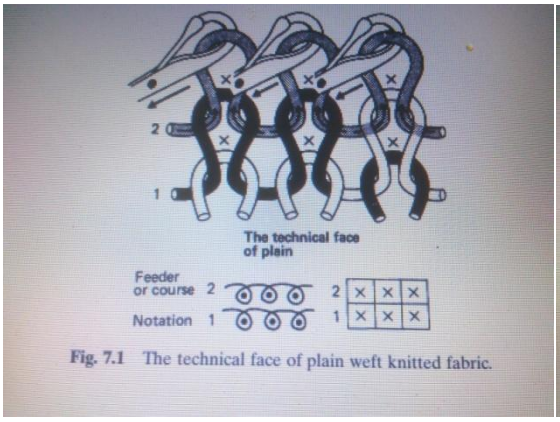


Fig. 7.1 The technical face of plain weft knitted fabric.

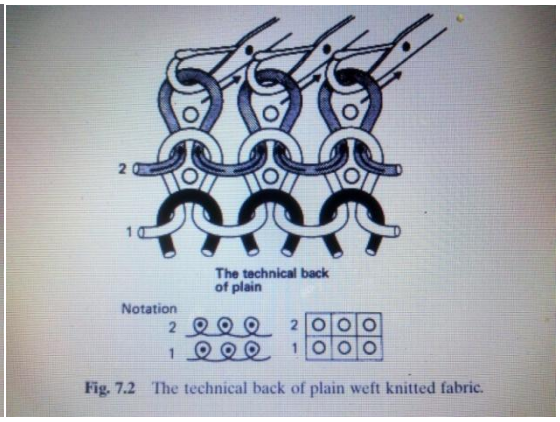


Fig. 7.2 The technical back of plain weft knitted fabric.

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.

2.2.2 Rib structures:

Features of rib structure:

Rib is the second family of knit structures. It's also called double - knit. It's 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------

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

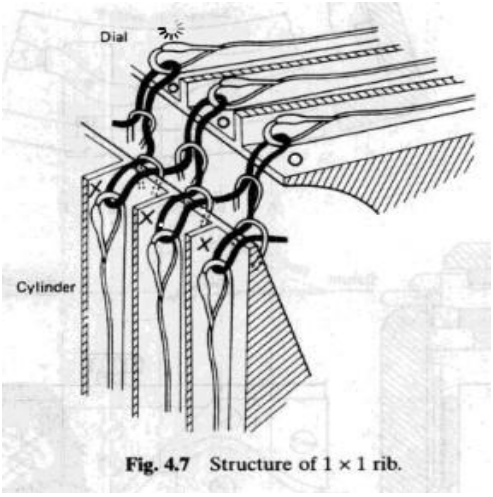


Fig. 4.7 Structure of 1 × 1 rib.

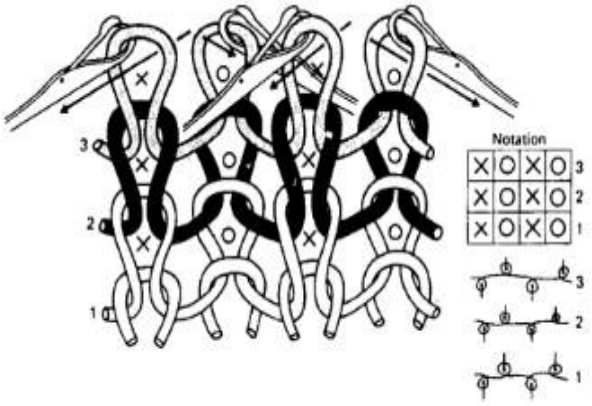


Fig. 4.8 Face and reverse loop wales in 1 × 1 rib.

1x1 Rib is production of by two sets of needles being alternately set or gate between each other. Relaxed 1x1 rib is theoretically twice the thickness and half the width of an equivalent plain fabric, but it haves twice as much width-wise recoverable stretch. In practice, 1x1 rib normally relaxes by approximately 30% compared with it's knitting width.

End Uses:

Rib structures are uses for--Socks, cuffs, waistbands, collars, men's outerwear, knitwear, under wear etc.

2.2.3 Purl knit structures:

Purl knit structures is the third family of knit structures. As with rib structures, it's requires the participation of both needle beds for the production of the loops.

Features of Purl structure:

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

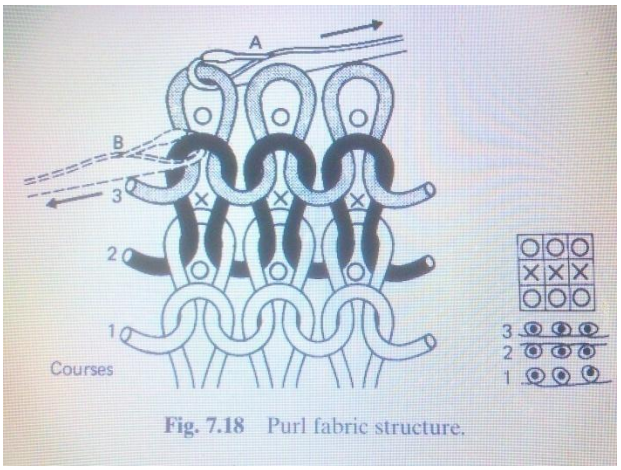


Fig. 7.18 Purl fabric structure.

End Uses:

Purl structures are uses for---Children's clothing, knitwear, thick and heavy outerwear etc.

2.2.4 Interlock structures:

Interlock is another 1x1 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.

Features of Interlock Structure:

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

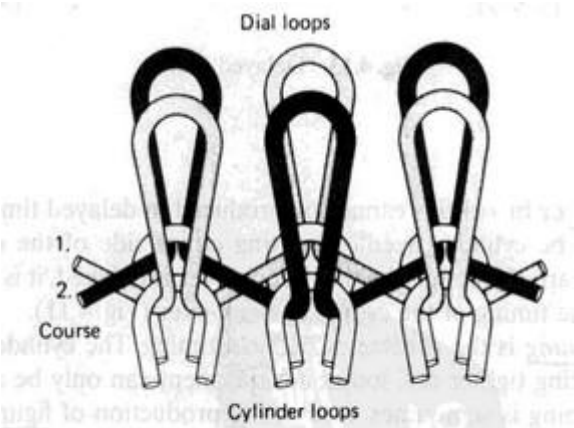


Fig. 4.14 Interlock fabric structure.

0 * 0 *
* 0 * 0

Fig: Interlock structure notation

Interlock relaxes by about 30–40 per cent or more, compared with its knitted width, so that a 30-inch (76 cm) diameter machine will produce a tube of 94-inch (2.4 m) open width which finishes at 60–66 inches (1.5–1.7 m) wide. It is a balanced, smooth, stable structure that lies flat without curl. Like 1x1 rib, it will not unrove from the end knitted first, but it is thicker, heavier and narrower than rib of equivalent gauge, and requires a finer, better, more expensive yarn.

2.2.4 An interlock machine must have the following:

1 Interlock gating, the needles in two beds are being exactly opposite each other so that only one of the two can knit at any feeder.

2 Two separate cam systems in each bed, each controlling half the needles in an alternate sequence, one cam system controlling knitting at one feeder, and the other at the next feeder.

3 Needles set out alternately, one controlled from one cam system, the next from the other; diagonal and not opposite needles in each bed knit together.

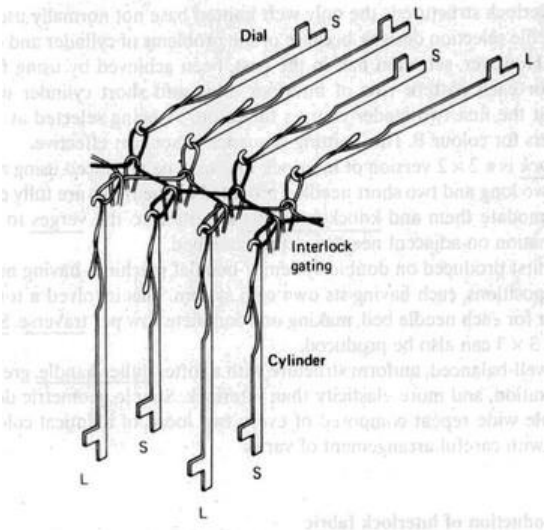


Fig. 4.15 Knitting interlock.

End Uses:

Interlock structures are use for-- Underwear, shirts, suits, trouser suits, sportswear, dresses etc.

2.3.1 Single Jersey Circular Knitting Machine:

Circular knitting machine is widely used throughout the knitting industry to the produce fabric. This machine can be built in almost any reasonable diameter and the small diameter of up to five, which are used for wear. Machine for outerwear and under wear may vary from 12 inch to 60 inch in diameter according to manufactures requirement. This machine can be used either as fabric or for making garments completely with fancy stitch. Latch needles are commonly employed in all modern circular machines because of their simple action and also their ability to process more types of yarns.

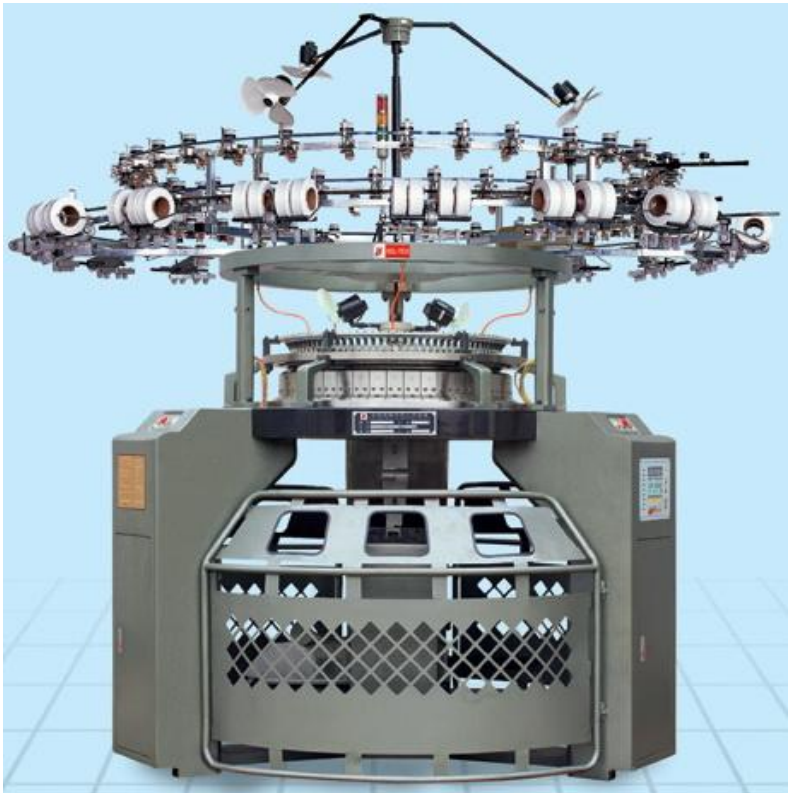


Fig: Circular knitting machine

2.3.2 Important Parts of Circular Knitting Machine:

- **Creel:** Creel is a part of a knitting machine. Hear yarn package are store and ready to feed in the machine.

- **VDQ Pulley:** It is a very important part of the machine. It controls the quality of the product. Altering the position of the tension pulley changes the G.S.M. of the fabric. If pulley moves towards the positive directive then the G.S.M. is decrease. And in the reverse direction G.S.M will increase.

- **Pulley Belt:** It controls the rotation of the MPF wheel.
- **Brush:** Its clean the pulley belt.

- **Tension Disk:** It confronts the tension of the supply yarn.

- **Inlet and Outlet Stop Motion:** It is an important part of the machine. It stops the machine instantly when a yarn is break.

- **Yarn Guide:** Its help the yarn to feed in the feeder.

- **MPF Wheel:** Its control the speed of the MPF. Pulley belt gives motion to the wheel.

- **MPF:** It is Mamenger positive feed. It is also an important part of the machine. It's give positive feed to the machine.
- **Feeder Ring:** It is a ring. Where all feeders are pleased together.

- **Disk Drum:** Use in jacquard machine to produce various types of design.

- **Pattern Wheel:** Pattern Wheels are used in Pai Lung and Auto Stripe machine because of that that help to produce various types of design and stripe.

- **Feeder:** Feeder is help yarn to feed in to the machine.
- **Needle Track:** Where all Needles is placed together in a decent design.
- **Needle:** It is a principal element of the knitting machine. Its help the yarn to create a loop. And by this way fabric are produce. Prior to yarn feeding the needle is raised to clear the old loop from the hook, and received the new loop above it on needle stem. The new loop is then enclosed in the needle hook as the needle starts to descend.
- **Sinker:** It is most important element of the machine. Its help to loop forming, knocking over and holding down the loop.
- **Sinker Ring:** Sinker ring is a ring. Where all sinkers are pleased together.
- **Cam Box:** Where the cam are set horizontally.
- **Cam:** Cam is device s which converts the rotary machine drive in to a suitable reciprocating action for the needles and other elements.
- **Lycra Attachment Device:** Lycra is placed hear. And feeding to the machine.
- **Lycra Stop Motion:** It is one kind of stop motion to stop the machine when the Lycra is break.
- **Cylinder:** Needle track are situated hear.
- **Cylinder Balancer:** It helps the cylinder to set in a proper alignment.
- **Adjustable Fan:** This part removes lint, hairy fibre from yarn and others. To clean the dust by air flow.
- **Expander:** To control the width of the knitted fabric. No distortion of the knitting courses. Even take down tension in the knitting machine. As a result, an even fabric structure is achieved over the entire fabric width. The deformation of the knitted fabric goods can be reduced.

- **Needle Detector:** This part detect the any type of faults of needles.

- **Air Gun Nozzle:** To feed the yarn; sometimes it is used for cleaning purpose.

2.4.1 Knitting Needles

One of the metal or plastic sticks used for knitting is called Knitting needles.

Types of Knitting Needles

- Latch Needle
- Bearded Needle
- Compound Needle

2.4.2 Latch Needle

Latch needle is a part of a knitting machine consisting of a thin shaped with a hook on one end and a pivoting latch that one closes over the hook so that yarn can be drawn through the developing knitting to make a stitch. Fact and fiction envelopes the invention of the latch needle in a similar manner to the bearded needle. Pierre Jeandeau patented the first latch needle (also known as the tumbler needle) in 1806 but there is no evidence of its practical use.

2.4.3 Types of Latch Needle:

Latch Needle is two types. There are:

1. Friction Latch Needle
2. Frictionless Latch Needle.

2.4.4 Properties of Latch Needle:

- Most widely used in weft knitting
- More expensive needle than the bearded needle
- Self acting or loop controlled
- Worked at any angle
- Needle depth determines the loop length
- Variation of the height of reciprocating produces knit, tuck or miss stitch.

2.4.5 Different Parts of Latch Needle:

There are six main parts of latch needle with short info are given below:

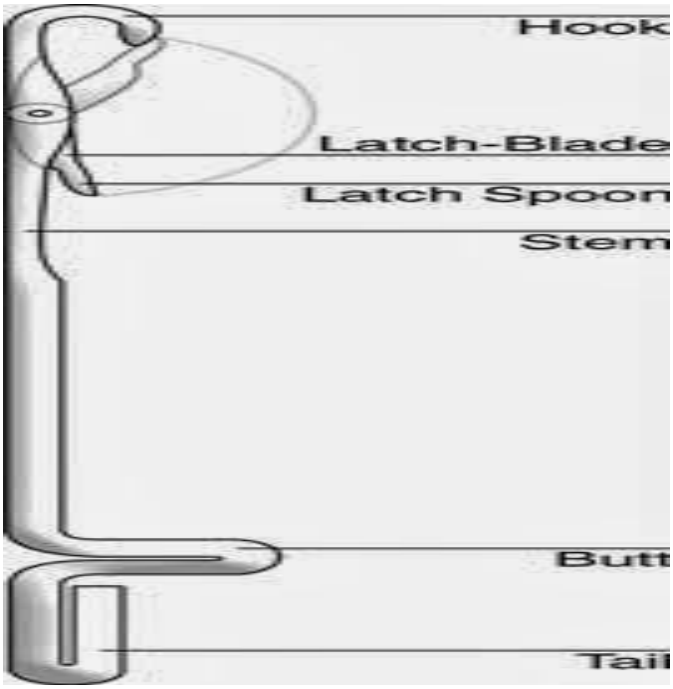


Photo: Different Parts of Latch Needle

1. **Hook:** The hook is used to catch a thread and form loops
2. **Latch blade:** This latch blade locates the latch in the needle.
3. **Latch spoon:** The latch spoon is an extension of blade and bridges the gap between the hook and stem.
4. **Stem:** The stem of latch needle carries the loop in the clearing on rest position.
5. **Butt:** Butt of latch needle enables the needle to be reciprocated.
6. **Tail:** The tail is an extension below the butt giving additional supp9ort to the needle and keeping the needle in its trick

2.4.6 Without those latch needle parts are also:

1. **Rivet:** The rivet which may be plain or threaded. This has been dispensed with on most plated metal needles by pinching n the slot walls to retain the latch blades.

2. **Slot or Saw Cut:** This slot receives the latch blade.

3. **Cheeks or Slot Walls:** It is either punched or riveted to fulcrum the latch blade.

2.4.7 Main Features of the Latch Needle:

The latch needle has nine main features which is given below;

1. The hook, which draws and retains the new loop.

2. The slot or saw cut, which receives the latch-blade (not illustrated).

3. The cheeks or slot walls, which are either punched or riveted to fulcrum the latch blade (not illustrated).

4. The rivet, which may be plain or threaded. This has been dispensed with on most plate metal needles, by pinching in the slot walls to retain the latch blade.

5. The latch-blade, which locates the latch in the needle.

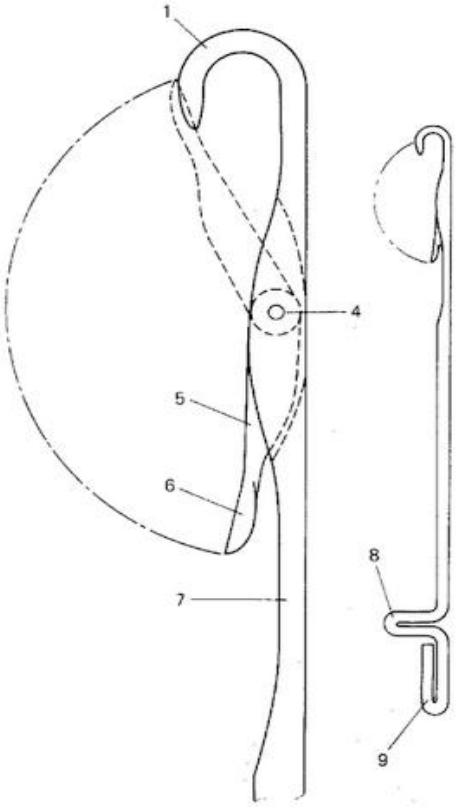


Fig: Main features of the latch needle

6. The latch spoon, which is an extension of the blade, and bridges the gap between the hook and the stem covering the hook when closed, as shown in broken lines.

7. The stem, which carries the loop in the clearing or rest position.

8. The butt, which enables the needle to be reciprocated when contacted by cam profiles on either side of it, forming a track. Double-ended purl type needles have a hook at each end; whilst one hook knits, the inactive hook is controlled as a butt by a cam-reciprocated element called a slider.

9. The tail, which is an extension below the butt, giving additional support to the needle and keeping the needle in its trick.

2.4.8 Knitting Action of the Latch Needle:

The position of a latch needle as it passes through the cam system, completing one knitting cycle or course as it moves up and in its trick or slot.

1. **The rest position:**

   The head of the needle hook is level with the top of the verge of the trick. The loop formed at the previous feeder is in the closed hook. It is prevented from rising as the needle rises, by holding-down sinkers or web holders that move forward between the needles to hold down the sinker loops.

2. **Latch opening:**

   As the needle butt passes up the incline of the clearing cam, the old loop, which is held down by the sinker, slides inside the hook and contacts the latch, turning and opening it.

3. **Clearing height.:**

   When the needle reaches the top of the cam, the old loop is cleared from the hook and latch spoon on to the stem. At this point the feeder guide plate acts as a guard to prevent the latch from closing the empty hook.

4. **Yarn feeding and latch closing:**

   The needle starts to descend the stitch cam so that its latch is below the verge, with the old loop moving under it. At this point the new yarn is fed through a hole in the feeder guide to the descending needle hook, as there is no danger of the yarn being fed below the latch. The old loop contacts the underside of the latch, causing it to close on to the hook.

5. **Knocking-over and loop length formation:**

   As the head of the needle descends below the top of the trick, the old loop slides off the needle and the new loop is drawn through it. The continued descent of the needle draws the loop length, which is approximately twice the distance the head of the needle descends, below the surface of the sinker or trick-plate supporting the sinker loop. The distance is determined by the depth setting of the stitch cam, which can be adjusted.

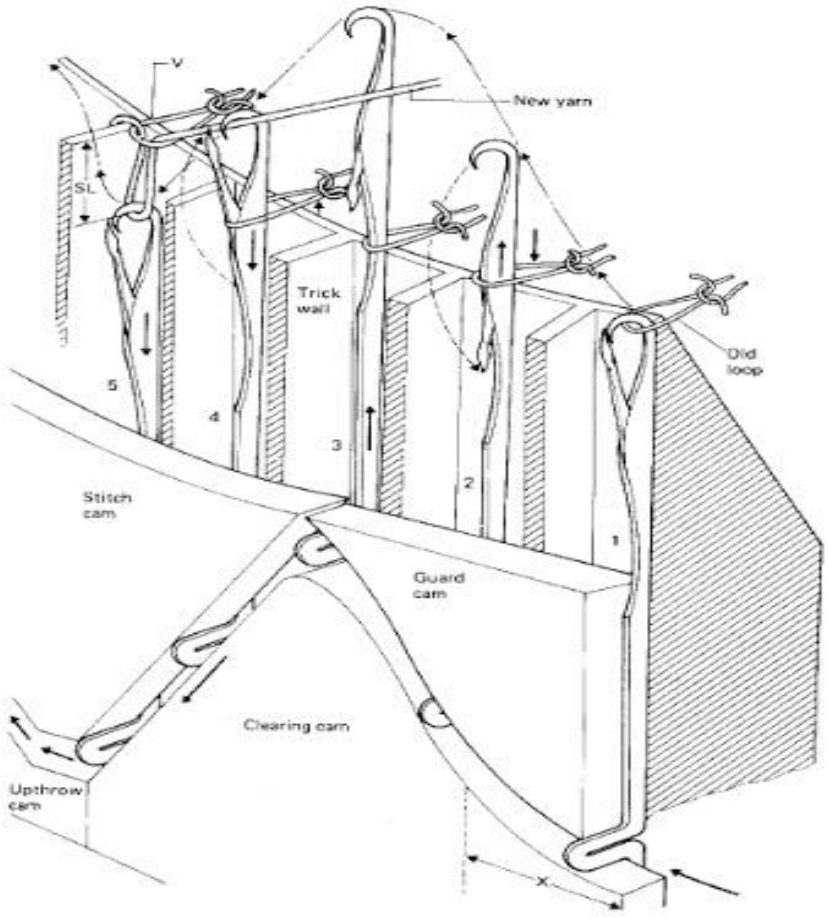


Fig: Knitting action of the latch needle

The rest position actually occurs between positions 1 and 2, when the open needle hook just protrudes above the needle trick verge. In this position, a feeder would be passed without the needle receiving a new loop and the old loop would not be cast off, so that a float stitch would be produced. The tucking in the hook position occurs between positions 2 and 3, when the needle can receive the new yarn but the old loop has not been cleared from the open latch.

The latch needle used on the Stoll CMS V-bed flat machine has a spring-loaded latch so that it fully opens and fully closes. Also, the latch spoon does not project beyond the needle head. Loops thus slide easily over the hook and latch, the yarn is less likely to be split, and there is greater security for the knitted loops.

2.4.9 Advantages of Latch Needle:

The latch needle has the major advantage of being self-acting or loop-controlled, so that individual movement and control of the needle enables stitch selection to be achieved. It is ideally suited for use with computer-controlled electronic selection devices. For that reason, it is the most widely used needle in weft knitting and is sometimes termed the 'automatic' needle (provided there are loops on the needle).

2.4.10 Application of Latch Needle:

Latch needle are widely used in –

1. Double Cylinder Machine,
2. Flat Bar Machine,
3. Single Jersey Circular Knitting Machine,
4. Double Jersey Circular Knitting Machine.

2.5.1 Common faults in knit fabric

Normally the following faults occur in knitting:

1. Holes / Cracks
2. Loop / Drop stitches
3. Cloth fall-out
4. Snagging
5. Tuck or Double stitches
6. Bunching-up
7. Vertical stripes
8. Horizontal stripes
9. Soil stripes
10. Color fly
11. Distorted stitches

2.5.2 Common faults in knit fabric, their causes & remedies

1. **Holes / Cracks:** In daily terminology there is usually no difference between cracks and holes. It can however be started that holes are the result of cracks or yarn breakages. During loop formation the yarn had already broken in the region of the needle hook. Depending on the knitted structure, yarn count, machine gauge, course density, the holes have different sizes.

   Causes:

   1. Relation between cylinder & dial loop not correct; yarn feeder badly set.
   2. Weak places in yarn, which break during loop formation.
   3. If the yarn count is not correct on regarding structure, gauge, course & density.
   4. Badly knot or splicing.
   5. Yarn feeder badly set.

   Remedies:

   1. Yarn strength must be sufficient to withstand the stretch as well as uniform.
   2. Use proper count of yarn.
   3. Correctly set of yarn feeder.
   4. Knot should be given properly.

2. **Loop / Drop stitches:** Drop stitches are the result of a defective needle. They also occur when a yarn is not properly fed during loop formation, i.e. not properly laid in the needle hooks.

   Causes:
   1. Badly set yarn feeder.
   2. Yarn feeder wrongly threaded-in.
   3. Dial loop length not properly related to cylinder loop length; the loop jumps out of the needle hook.
   4. Bad take-up.
   5. Very bad material.
   6. Insufficient yarn tension.

   Remedies:

   1. Needle should be straight & well.
   2. Proper feeding of yarn during loop formation.
   3. Correct take-up of the fabric & correct fabric tension.
   4. Yarn tension should be properly.

3. **Cloth fall-out:** cloth fall-out is an area consisting of drop stitches lying side by side. They can occur either when a yarn is laid-out or when its breaks without any immediate connection.

   Causes:
   1. If the yarn is not stitched by several needles line adjacent to one another.
   2. It can occur, if many adjacent needles produce the drop stitches.

   Remedies:

   1. Make sure all the latches of needle are closed with feeding yarn after a drop stitch.

4. **Snagging:** Snagging occurs almost without exception only while processing continuous filament yarns. Besides the specific sensitivity of these yarns, main cause mechanical strain during knitting or subsequent processes.

Causes:

1. Mainly occur while processing filament yarn.

Remedies:

1. Using yarn with a coarser single filament count, lesser crimp elasticity and higher twist.
2. During knitting on mechanical influences, caused by rough surfaces on yarn guide elements, yarn feeders, needles, fabric take-up etc.

5. **Tuck or Double stitches:** Tuck or double stitches occur due to badly knitted or non-knitted loops. They are unintentional tuck loops or floats, also showing up as thick places or small beads in the fabric.

Causes:

1. Insufficient sliding ability of yarn.
2. Needle clearance, if adjustable, is too small.
3. The dial is set too high.
4. Coarse density is not set correctly.
5. The loops are too tight e.g. with interlock.
6. Insufficient fabric take-up.

Remedies:

1. Fabric take-up must be adjusted.
2. The coarse density must be set correctly**.**

6. **Bunching-up:** Visible knots in the fabric are referred to as bunching-up. They appear as beads and turn up irregularly in the fabric.

Causes:

1. It is influenced by fabric take-up.

Remedies:

1. Fabric take-up should function properly.

7. **Vertical stripes:** vertical stripes can be observed as longitudinal gaps in the fabric. The space between adjacent wales is irregular and the closed appearance of the fabric is broken up in an unsightly manner.

   Causes:

   1. More finer yarn for the machine gauge.
   2. Stitch size (course density) is not correct.
   3. Needle are bent or damaged.
   4. Needle from different suppliers.

   Remedies:

   1. Yarn count should be selected as machine gauge.
   2. Stitch size should be correct.
   3. Selection of needle properly.

8. **Horizontal Stripes:** Horizontal stripes are caused by unevenness in the courses; theyu traverse horizontally and repeat themselves regularly or irregularly.

   Causes:

   1. Irregularities of the yarn.
   2. Feeder stripes can be caused by replacing yarn package.
   3. Uneven yarn tension & its fluctuation.
   4. Improper setting of stitch size.
   5. Improper take-up can also cause horizontal stripe.

   Remedies:

   1. The machine must be mounted horizontally.
   2. Needle dial & cylinder must be exactly centered towards one another.
   3. Yarn tension & stitch should be controlled uniformly.
   4. Yarns of same lot should be used.

9. **Soil Stripes:** Soil stripes can appear both in the direction of wales as well as courses.

Causes:

1. Defective oiling or greasing.
2. Sudden machine stoppage.
3. At the time of defective needle replacing.

Remedies:

1. Consciously oiling or greasing.
2. Being aware of needle changing.

10. **Color Fly**: Color fly consist of single fibres, bunches of fibres or yarns pieces in fabric and is very difficult to remove.

Causes:

1. Hairs with natural dark color present in raw wool.
2. Fly coming from various processing stages during spinning.

Remedies:

1. Should be careful of fly coming at the time of spinning.
2. Certain of hairs with natural dark color are unavoidable & must be tolerated.

11. **Distorted Stitches:** Distorted stitches lead to a very unsettled fabric appearance. They are most disturbing in single-color yarded goods. The fabric appearance is skitter.

Causes:

1. Bad knitting machine setting.
2. Unequal coulier depths between dial & cylinder needles.

Remedies:

1. Machine should set correctly by skilled person
2. Maintain equal coulier depths between dial & cylinder needles.

2.6.1 Fabric Quality Inspection

Inspection in reference to the apparel industry can be defined as the visual examination or review of fabrics & accessories. It is an important aspect followed prior to garment manufacturing to avoid rejects due to fabric quality and facing with unexpected loss in manufacturing.

The quality of a final garment depends on the quality of a fabric when it is received as a roll. Even the most outstanding manufacturing methods cannot compensate for defective materials. Normally, we inspect 10% of the rolls we receive and evaluate them based on a four-point system. This way, we can avoid fabric related quality problems before it is put into production. Normally four systems are used for inspection of finished garments.

1. 4 point system
2. 10 point system
3. Graniteville "78" system.
4. Dallas system.

But among them four point system is widely used. Now a short description of 4 point inspection system is given below.

2.6.2 Four Point System

The 4-point system, also called the American Apparel Manufacturers (AAMA) point grading system for determining fabric quality, is widely used by producers of apparel fabrics and is endorsed by the AAMA as well as the ASQC (American Society or Quality Control).

The 4-point system assigns 1, 2, 3 and 4 penalty points according to the size and significance of the defect. No more than 4 penalty points can be assigned for any single defect. Defect can be in either length or width direction, the system remains the same. Only major defects are considered. No penalty points are assigned to minor defects.

In this system, one should inspect at least 10 per cent of the total rolls in the shipment and make sure to select at least one roll of each color way. Fabric defects are assigned points based on the following:

Size of defect	Penalty
3 inches or less	1 points
Over 3, but not over 6	2 points
Over 6, but nor over 9	3 points
Over 9, inches	4 points

Total defect points / 100 square yards of fabric are calculated and the acceptance criteria are generally not more than 40-penalty points. Fabric rolls containing more than 40-points are considered as rejected.

2.6.3 The formula to calculate points per 100 square yards

$$= \frac{\text{Total points scored in the roll x 100 x 36}}{\text{Fabric width in inches x Total yards inspected}}$$

2.6.4 General Inspection Procedures

- Fabric inspection is done in suitable and safe environment with enough ventilation and proper lighting.
- Fabric passing through the frame must be between 45 - 60 degree angles to inspector and must be done on appropriate Cool White light 2 F96 fluorescent bulbs above viewing area. Back light can be used as and when needed.
- Fabric speed on inspection machine must not be more than 15 yards per minute.
- Textiles like knits must be evaluated for weight against standard approved weight.
- Fabric width must be checked from selvage to selvage against standard.
- All defects must be flagged during inspection
- The length of each roll inspected must be compared to length as mentioned on supplier ticketed tag and any deviation must be documented and reported to mill for additional replacement to avoid shortage.
- If yarn dyed or printed fabrics are being inspected the repeat measurement must be done from beginning, middle and end of selected rolls.
- No penalty points are recorded or assigned for minor defects. Only major defects are considered.

- Major knitted fabric defects like as mixed yarn, yarn variation, needle line, barre, slub, hole & press off if found in a finished fabric than it will be classified as a second rated fabric.

2.6.5 Acceptable calculation for Grey fabric inspection

Points Parameter	Grade
Up to 40 points	A
41 – 60 Points	B
61 – 80 Points	C
Above 80	Rejected

2.6.6 Example

Total Linear points = 28

Total Length of the roll = 105 yards

Width of the roll = 90 inches

Calculation:

$$= \frac{\text{Total points scored in the roll x 100 x 36}}{\text{Fabric width in inches x Total yards inspected}}$$

$$= \frac{28 \text{ x } 100 \text{ x } 36}{90 \text{ x } 105}$$

= 10.667%

Results: Satisfactory Roll (Acceptable)

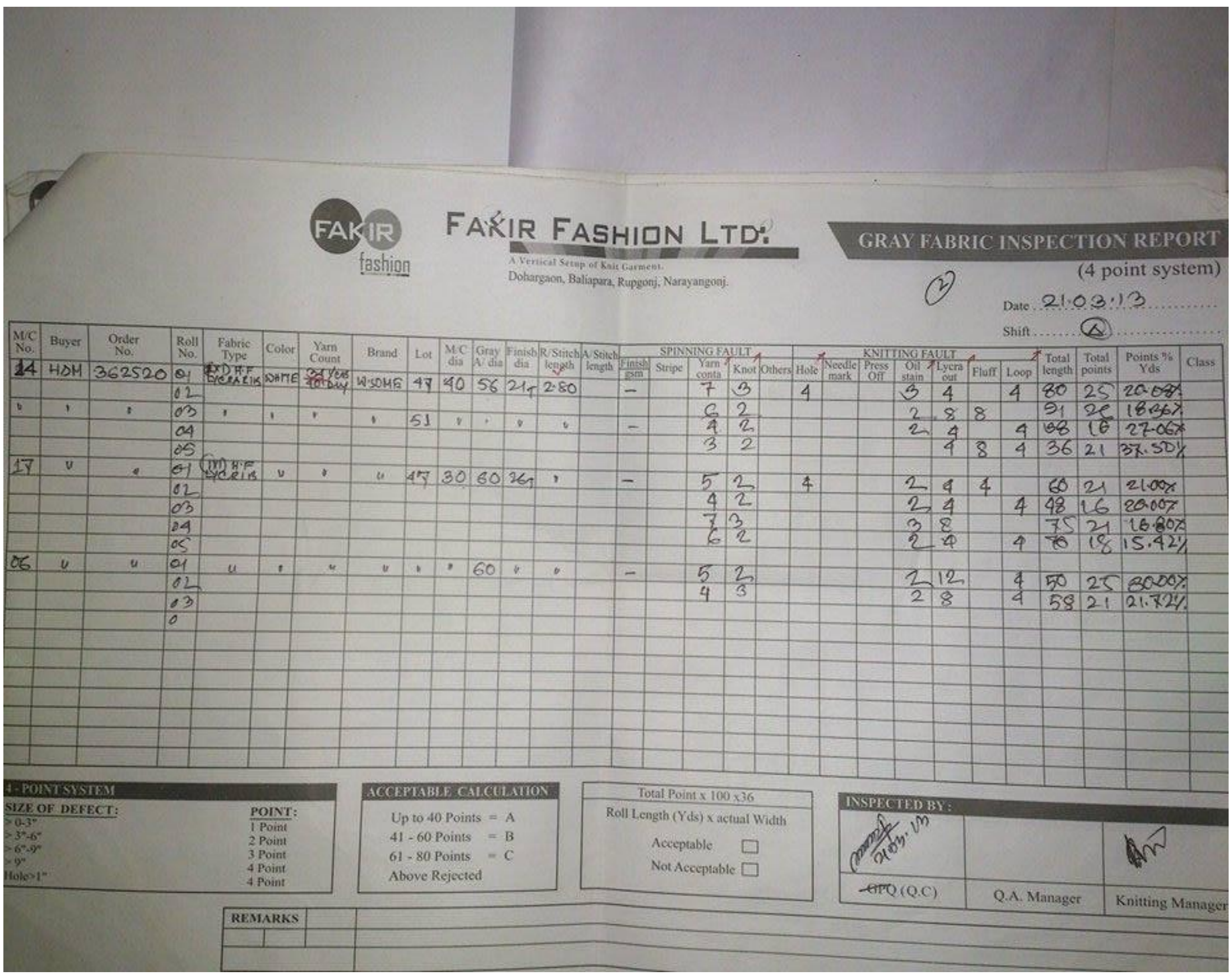
Chapter – 03:
Data Collection

3. Data Collection:

We inspected some grey fabric rolls at the inspection machine in the factory. Then we collected some inspection sheet of fabric faults from the quality inspection zone in the factory. These sheets are of same diameter machine. Then we analyzed the number of fault variation at different stitch length. These are analyzed also on points per 100 yards system.

Our collected sheets are given below by scanning:

3.1 Data Inspection Sheet at Stitch Length 2.80 mm:



FAKIR fashion

FAKIR FASHION LTD.

A Vertical Setup of Knit Garment.

Dohargaon, Baliapara, Rupgonj, Narayangonj.

GRAY FABRIC INSPECTION REPORT

(4 point system)

Date 21.03.13

Shift A

M/C No.	Buyer	Order No.	Roll No.	Fabric Type	Color	Yarn Count	Brand	Lot	M/C dia	Gray A/ dia	Finish dia	R/Stitch length	A/Stitch length	Finish gsm	Stripe	Yarn conta	Knot	Others	Hole	Needle mark	Press Off	Oil stain	Lycra out	Fluff	Loop	Total length	Total points	Points % Yds	Class
14	HDM	362520	01	H.F LYCRA RIB	WHITE	[illegible]	W.SOME	47	40	56	21	2.80		–		7	3		4			3	4		4	80	25	20.08%	
			02													6	2					2	8	8		91	26	18.36%	
"	"	"	03	"	"	"	"	51	"	"	"	"		–		4	2					2	4		4	68	16	27.06%	
			04													3	2						4	8	4	36	21	37.50%	
			05																										
17	"	"	01	(1X1) H.F LYCRA RIB	"	"	"	47	30	60	26	"		–		5	2		4			2	4	4		60	21	21.00%	
			02													4	2					2	4		4	48	16	20.00%	
			03													7	3					3	8			75	21	16.80%	
			04													6	2					2	4		4	70	18	15.42%	
			05																										
06	"	"	01	"	"	"	"	"	"	60	"	"		–		5	2					2	12		4	50	25	30.00%	
			02													4	3					2	8		4	58	21	21.72%	
			03																										
			0																										

4 - POINT SYSTEM

SIZE OF DEFECT:	POINT:
> 0-3"	1 Point
> 3"-6"	2 Point
> 6"-9"	3 Point
> 9"	4 Point
Hole>1"	4 Point

ACCEPTABLE CALCULATION

Up to 40 Points = A
41 - 60 Points = B
61 - 80 Points = C
Above Rejected

Total Point x 100 x36 / Roll Length (Yds) x actual Width

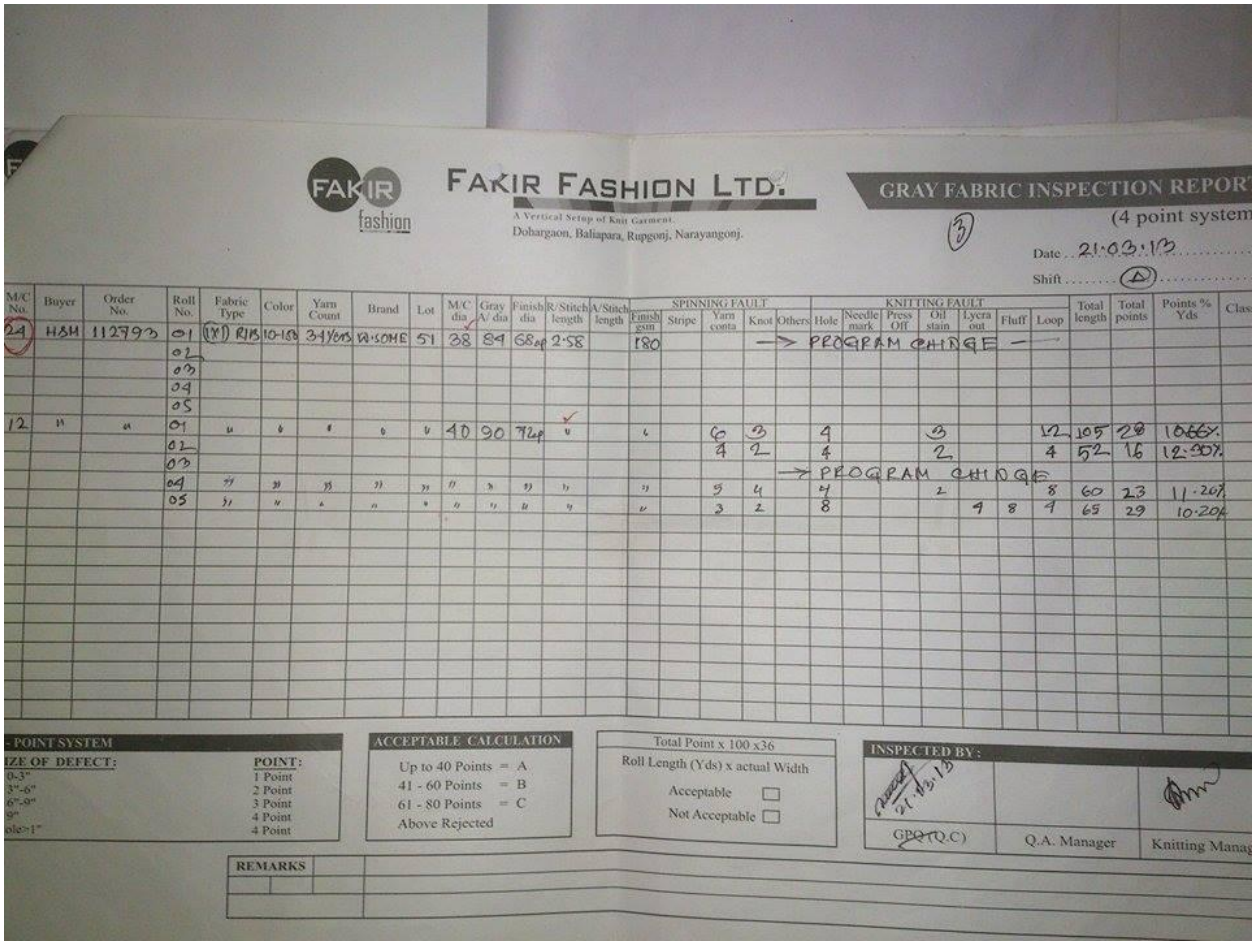
Acceptable ☐
Not Acceptable ☐

INSPECTED BY:

GPQ (Q.C) | Q.A. Manager | Knitting Manager

REMARKS

3.2 Data Inspection Sheet at Stitch Length 2.58 mm:



FAKIR fashion

FAKIR FASHION LTD.

A Vertical Setup of Knit Garment.
Dohargaon, Baliapara, Rupgonj, Narayangonj.

GRAY FABRIC INSPECTION REPORT

(4 point system)

Date .. 21.03.13

Shift .. A

M/C No.	Buyer	Order No.	Roll No.	Fabric Type	Color	Yarn Count	Brand	Lot	M/C dia	Gray A/ dia	Finish dia	R/Stitch length	A/Stitch length	SPINNING FAULT: Finish gsm	Stripe	Yarn conta	Knot	Others	KNITTING FAULT: Hole	Needle mark	Press Off	Oil stain	Lycra out	Fluff	Loop	Total length	Total points	Points % Yds	Clas
24	H&H	112793	01	(1X1) RIB	10-18	34Yons	RASOME	51	38	84	68cp	2.58		180				→ PROGRAM CHINGE →											
			02																										
			03																										
			04																										
			05																										
12	"	"	01	"	"	"	"	"	40	90	72cp	✓	"	"		6	3		4			3			12	105	28	1066%	
			02													4	2		4			2			4	52	16	12.30%	
			03																→ PROGRAM CHINGE										
			04	"	"	"	"	"	"	"	"	"	"	"		5	4		4			2			8	60	23	11.20%	
			05	"	"	"	"	"	"	"	"	"	"	"		3	2		8					4	8	4	65	29	10.20%	

- POINT SYSTEM

SIZE OF DEFECT:	POINT:
0-3"	1 Point
3"-6"	2 Point
6"-9"	3 Point
9"	4 Point
ole>1"	4 Point

ACCEPTABLE CALCULATION

Up to 40 Points = A
41 - 60 Points = B
61 - 80 Points = C
Above Rejected

Total Point x 100 x36
Roll Length (Yds) x actual Width

Acceptable ☐
Not Acceptable ☐

INSPECTED BY :

21.03.13

GP(Q.C) | Q.A. Manager | Knitting Manag

REMARKS

3.3 Data Inspection Sheet at Stitch Length 2.65 mm:

FAKIR fashion

FAKIR FASHION LTD.

A Vertical Setup of Knit Garment

Dobargaon, Balupara, Rupgonj, Narayangonj.

GRAY FABRIC INSPECTION REP

(4 point sy

Date 21.03.13

Shift A

M/C No.	Buyer	Order No.	Roll No.	Fabric Type	Color	Yarn Count	Brand	Lot	M/C dia	Gray A/ dia	Finish dia	R/Stitch length	A/Stitch length	SPINNING FAULT				KNITTING FAULT								Total length	Total points	Points % Yds
														Finish gsm	Stripe	Yarn conta	Knot	Others	Hole	Needle mark	Press Off	Oil stain	Lycra out	Fluff	Loop			
13	H&M	59318	01	(1x1) RIB		34/2	WISONE	51	36	822	68	2.65		170		6	3	Patta	16			3			4	71	8.2	10.78
			02													7	2		4			2		4		65	13	12.83
			03													8	3					3			4	80	18	9.87
			04																									
			05																									
25	"	"	01	"	"	"	"	"	34	78	64	"	"	"		7	3		4			3		4		114	21	16.87
			02													9	3					3			4	102	18	8.14
			03													7	2		8			2				102	19	8.59
			04													5	3		4			2			4	92	18	15.98
			05																									
34	"	"	01	"	"	"	"	"	"	98	"	"	"	"		6	4		4			4		4		115	22	8.82
			02													9	3					3				111	19	5.40
			03													6	3		4			2			4	80	19	10.76
			04													6	3		9			3			4	85	20	10.85
			05																									

4 - POINT SYSTEM

SIZE OF DEFECT:	POINT:
> 0-3"	1 Point
> 3"-6"	2 Point
> 6"-9"	3 Point
> 9"	4 Point
Hole>1"	4 Point

ACCEPTABLE CALCULATION

Up to 40 Points = A

41 - 60 Points = B

61 - 80 Points = C

Above Rejected

Total Point x 100 x36

Roll Length (Yds) x actual Width

Acceptable ☐

Not Acceptable ☐

INSPECTED BY:

~~CPO~~ (Q.C)	Q.A. Manager	Knitting

REMARKS

Knitting Incharge / Q.A Incharge

Knitting Manager / Q.A

Chapter - 04:
Table & Graphs

4.1 Table: Machine no 14: 1X1 Rib, 34/1 & 2.8 mm stitch length:

Roll No	Yarn Contamination	Oil Stain	Hole	Knot	Lycra out	Fluff	Loop	Length (yards)
1	7	3	4	3	4	0	4	80
2	6	2	0	2	8	8	0	91
3	4	2	0	2	4	0	4	38
4	3	0	0	2	4	8	4	36
Total points	20	7	4	9	20	16	12	245
Total points/ 100 yards	5.24781	1.83673	1.04956	2.3615	5.24781	4.19825	3.14868	

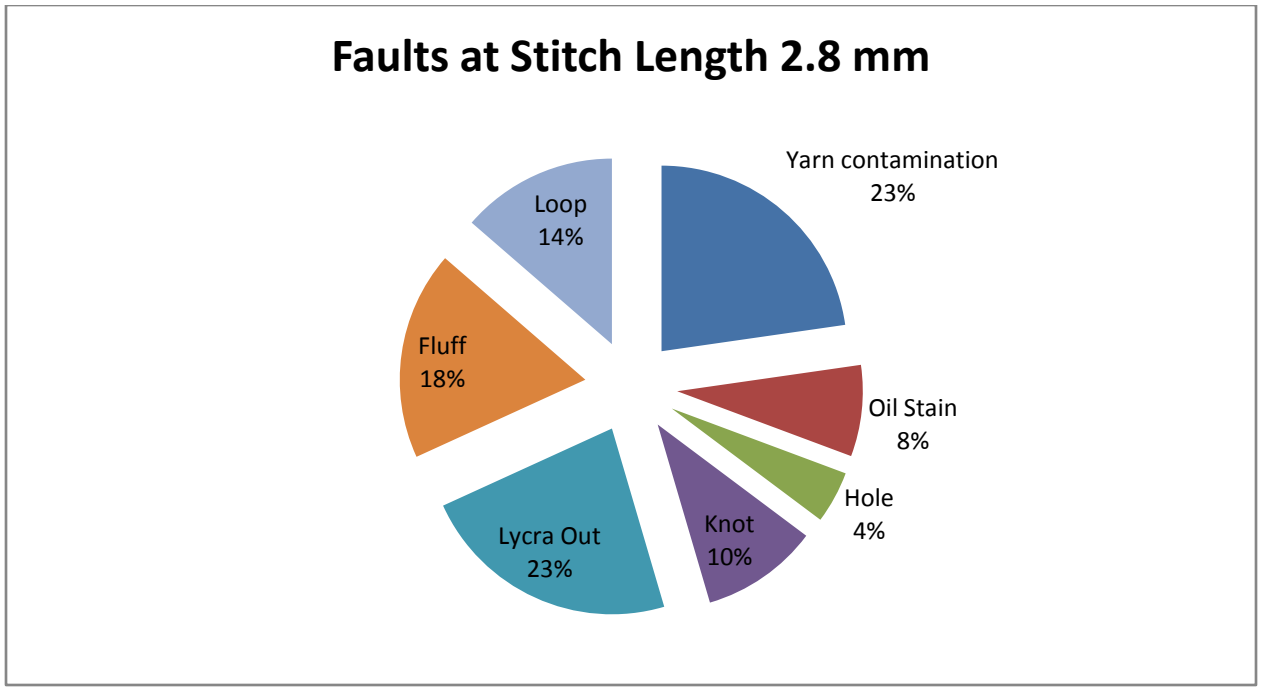


Diagram 4.1: Pie Chart diagram of fabric faults at stitch length 2.8 mm

From the above chart we can see that at stitch length 2.8 mm:

- Yarn contamination & Lycra out is occupied 23%
- Fluff is occupied 18%
- Loop is occupied 14%
- Knot is occupied 10%
- Oil stain is occupied 8%
- Hole is occupied 4% of the total points.

4.2 Table Machine No12: 1X1 Rib, 34/1 & 2.58 mm stitch length:

Roll No.	Yarn Contamination	Oil Stain	Hole	Knot	Lycra out	Fluff	Loop	Length (yards)
1	6	3	4	3	0	0	12	105
2	4	2	4	2	0	0	4	52
3	5	2	4	4	0	0	8	60
4	3	0	8	2	4	8	4	65
Total	18	7	20	11	4	8	28	282
Total points/ 100 yards	2.55319	0.99290	2.83687	1.56028	0.56737	1.13475	3.97163	

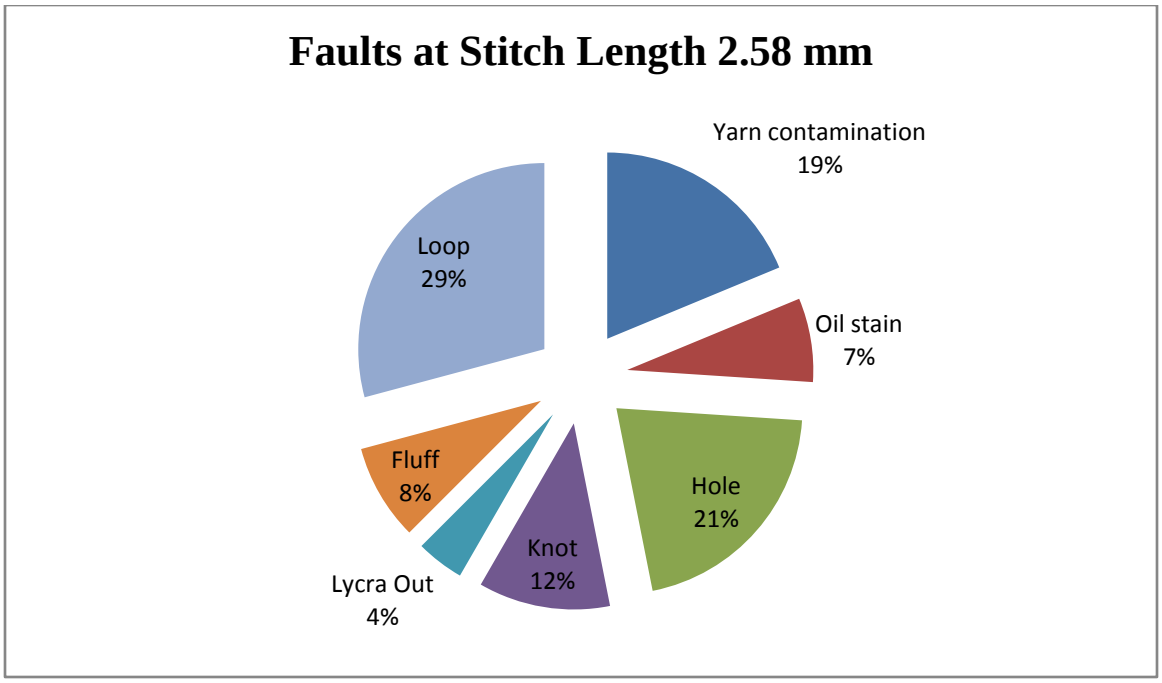


Diagram 4.2: Pie Chart diagram of fabric faults at stitch length 2.58 mm.

From the above chart we can see that at stitch length 2.58 mm:

- Loop is occupied 29%
- Hole is occupied 21%
- Yarn contamination is occupied 19%
- Knot is occupied 12%
- Fluff is occupied 8%
- Oil stain is occupied 7%
- Lycra out is occupied 4% of the total points.

4.3 Table Machine no 12: 1X1 Rib, 34/1 & 2.65 mm stitch length:

Roll No.	Yarn Contamination	Oil Stain	Hole	Knot	Lycra Out	Fluff	Loop	Length (yards)
1	7	3	4	3	4	4	0	114
2	8	3	0	3	0	0	4	102
3	7	2	8	2	0	0	0	102
4	5	2	4	3	0	0	4	52
	27	10	16	11	4	4	8	370
Total Points/100 Yards	3.203	1.186	1.898	1.305	0.474	0.474	0.949	

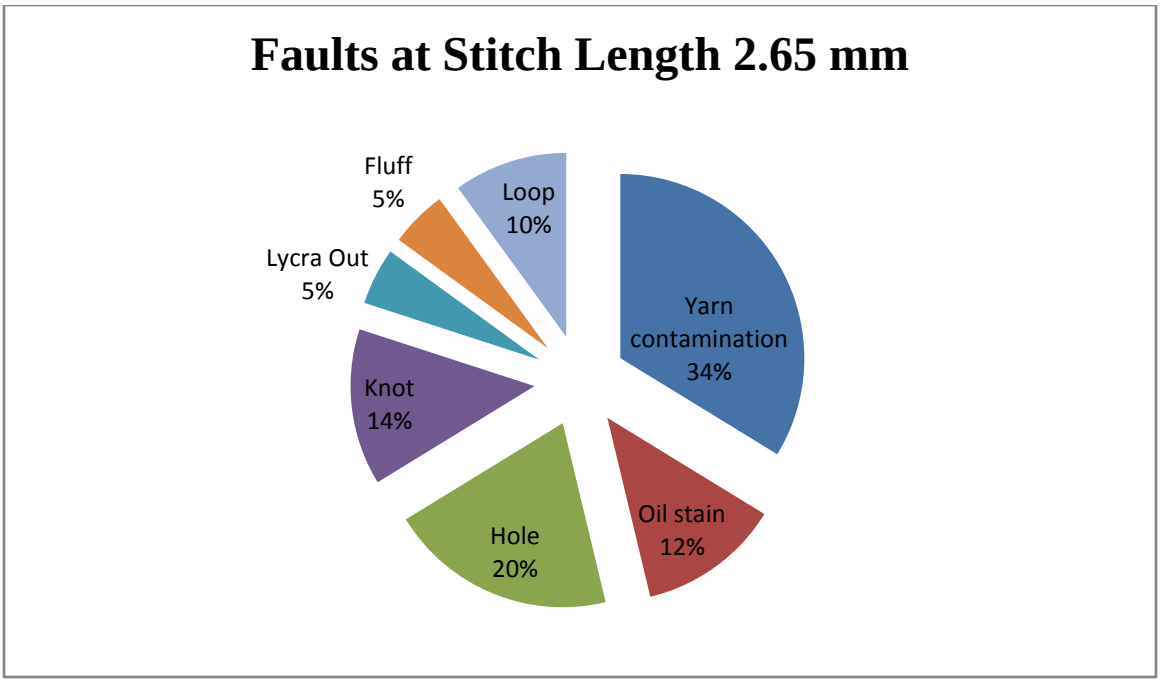


Diagram 4.3: Pie Chart diagram of fabric faults at stitch length 2.65 mm

From the above chart we can see that at stitch length 2.65mm:

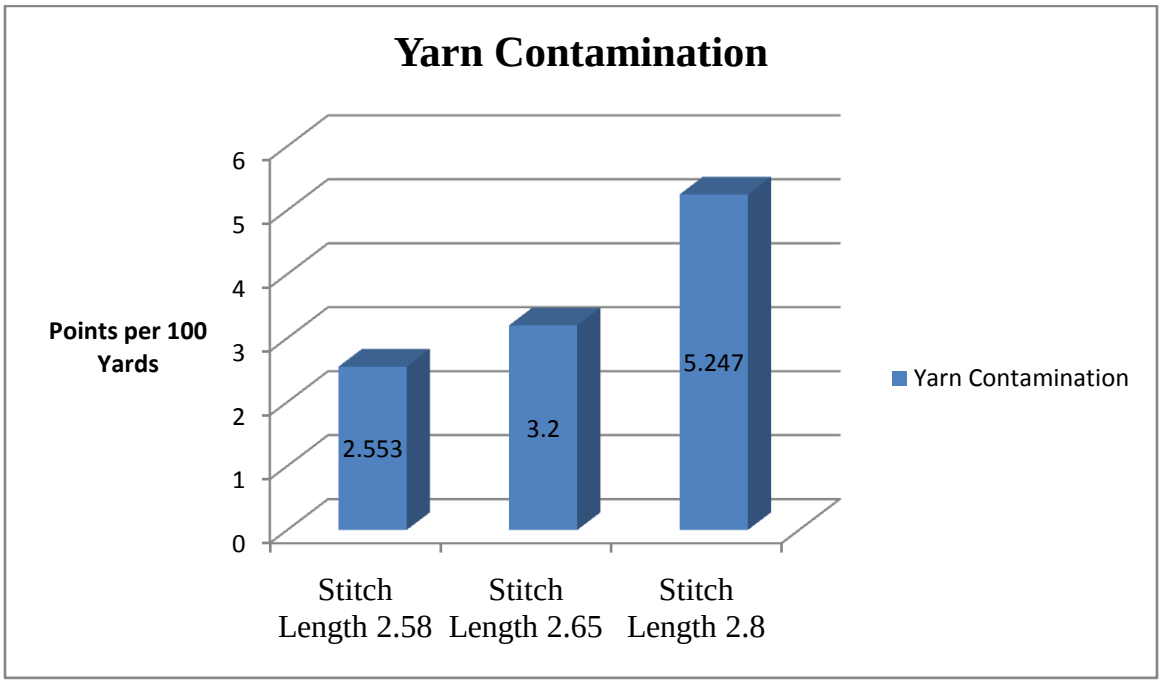
- Yarn contamination occupied 34%
- Hole occupied 20%
- Oil Stain occupied 12%
- Knot occupied 14%
- Loop occupied 10%
- Fluff & Lycra out occupied 5% of the total points.

4.4 By averaging the three data table of different stitch length

Stitch Length	Yarn Contamination	Oil Stain	Hole	Knot	Lycra out	Fluff	Loop
2.58	2.553	0.99	2.83	1.56	0.56	1.134	3.97
2.65	3.2	1.18	1.89	1.3	0.47	0.47	0.94
2.8	5.247	1.83	1.049	2.361	5.247	4.198	3.148

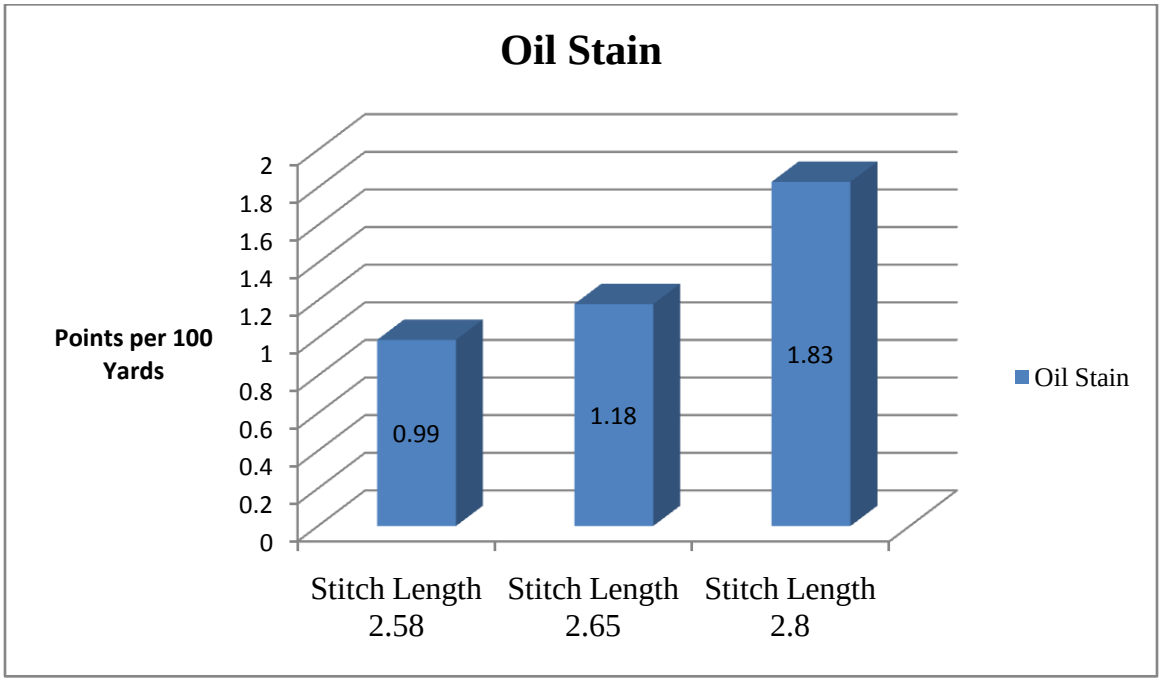
4.5 Graphs of the fabric faults found on the average data table:

4.5.1 Yarn Contamination



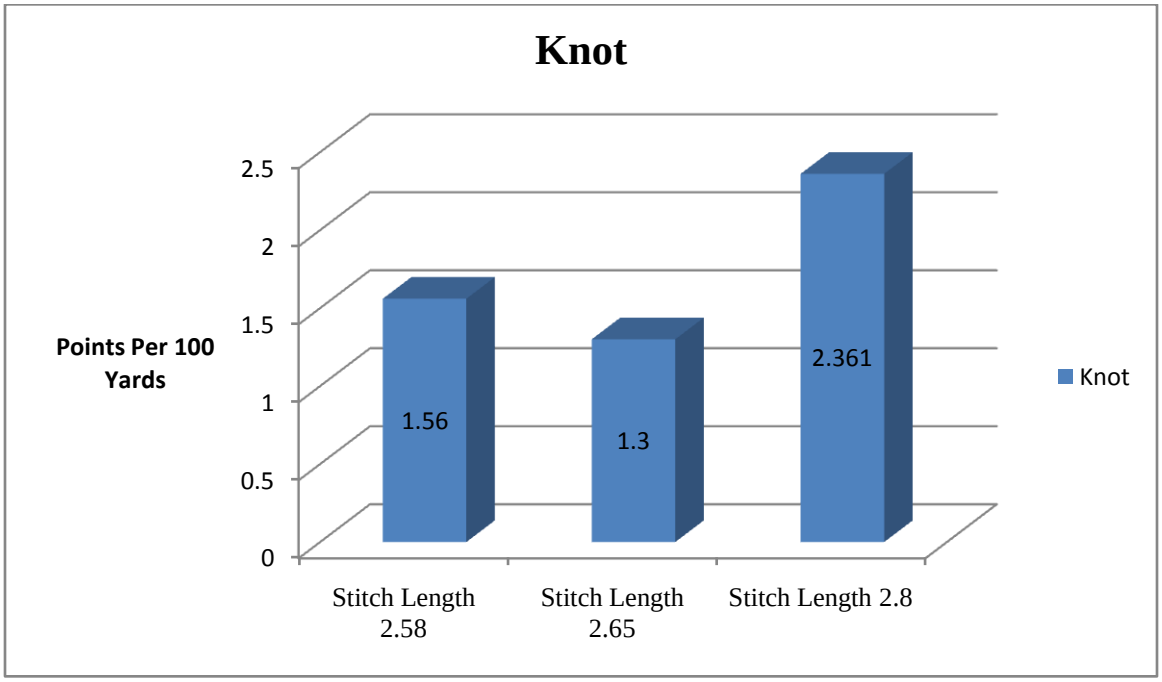
- From the above chart, we can see that the yarn contamination has increased with the increase of stitch length.

4.5.2 Oil Stain



- From the above chart, we can see that oil stain has increased with the increase of stitch length.

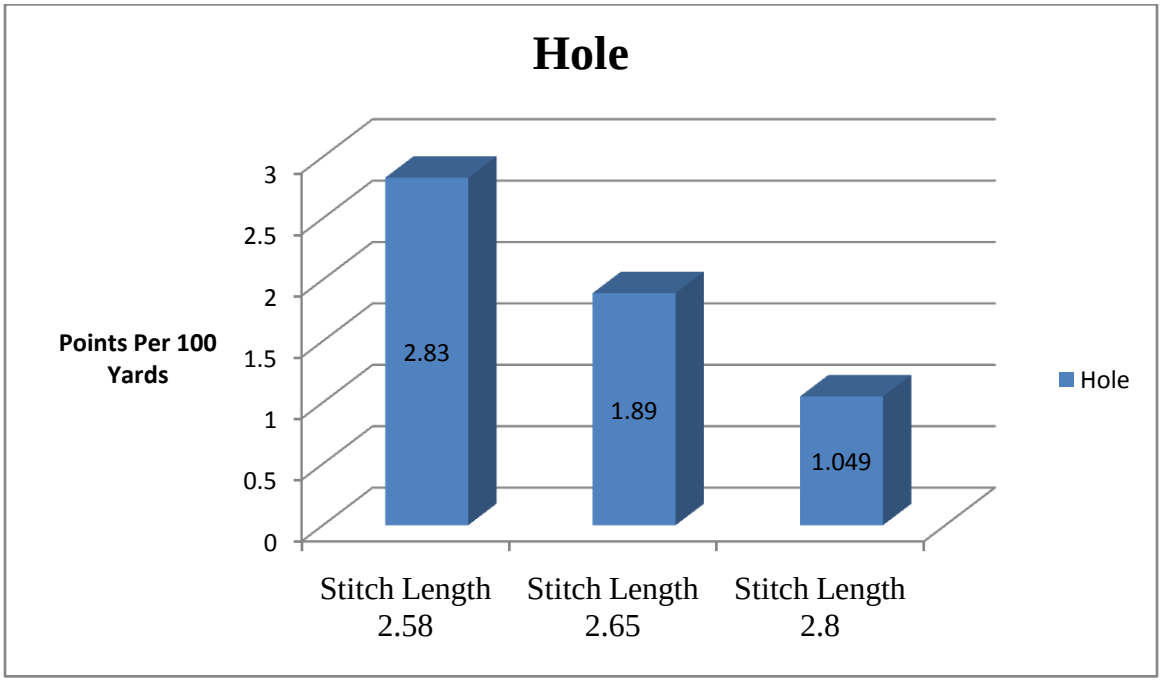
4.5.3 Knot



- From the above chart, we can see that the knots have increased with the increase of stitch length.

- The reason behind this is, as the stitch length increases the tension of feed yarn also increases. For the increased tension on yarn, it breaks and knot is given.

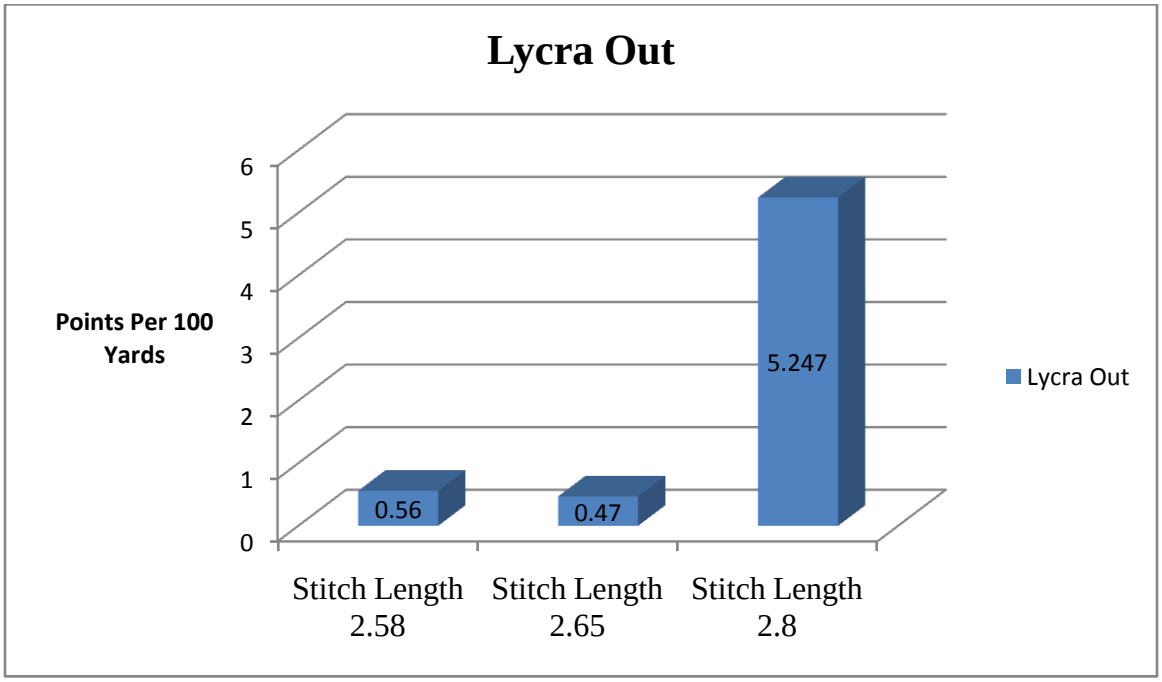
4.5.4 Hole



- From the above chart, we can see that the hole / cracks have increased with the decrease of stitch length.

- If the tension on yarn increases then stitch length decreases. For the increased tension on yarn, it breaks more in case of decreased stitch length during knitting.

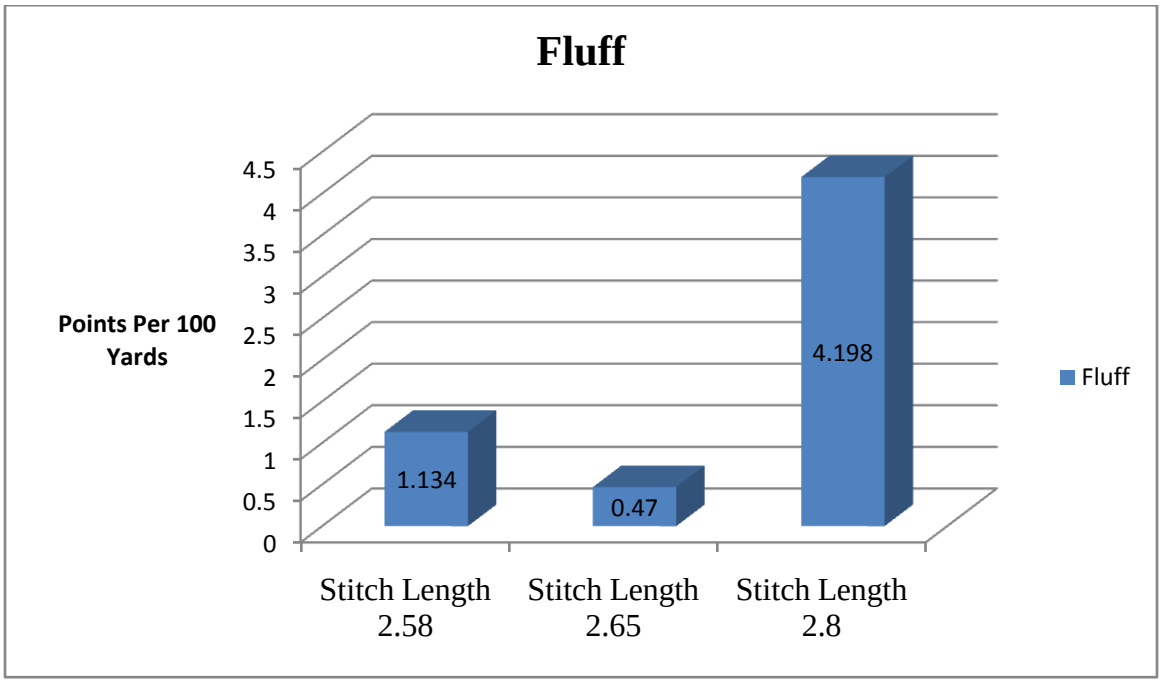
4.5.5 Lycra Out



- From the above chart, we can see that the Lycra out is more increased with the increase of stitch length.

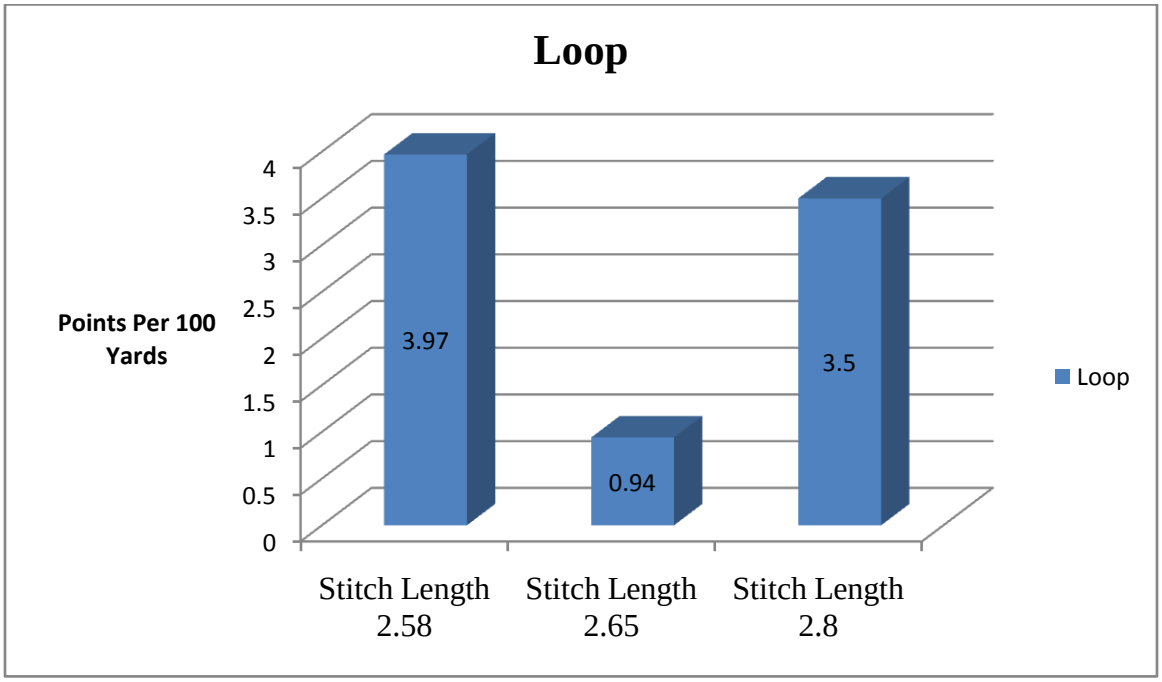
- Lycra out is on a tolerable condition on lower stitch length.

4.5.6 Fluff



- From the above chart, we can see that the Fluff is more increased with the increase of stitch length.
- The fault fluff remains reasonable condition on lower stitch length.

4.5.7 Loop



- From the above chart, we can see that when the stitch length decreases then the fault Loop is increasing.
- When the stitch length is on medium level then loop is occurred less.

Chapter – 05:
Decisions

5. Decisions

By analyzing the data table and chart we can come to the following decisions

- Hole / cracks have increased with the decrease of stitch length.
- Knots have increased with the increase of stitch length from 2.58 mm to 2.8 mm. But at 2.65 mm the fault is minimum.
- When the stitch length increased from 2.58 mm to 2.8 mm then the fault Loop / drop stitches increases. But at stitch 2.65 mm the fault is minimum.
- When the stitch length increased from 2.58 mm to 2.8 mm then the fault fluff increases. But at stitch 2.65 mm the fault is minimum.
- When the stitch length increased from 2.58 mm to 2.8 mm then the fault Lycra out stitches increases. But at stitch 2.65 mm the fault is minimum.
- Yarn contamination has increased with the increase of stitch length.
- Oil stain has increased with the increase of stitch length.
- We can see that knots, loop/ drop stitches, fluff, lycra-out has occurred minimum at the stitch length 2.65 mm.

Chapter -06:
Further Study

5. Further Study

- Whether the knitted fabric faults increases or decreases with the changing of yarn count.
- Whether the knitted fabric faults increases or decreases with the changing of yarn TPI.
- Whether the knitted fabric faults increases or decreases with the changing of gauge.
- Whether the knitted fabric faults increases or decreases with the changing of Machine diameter.

Chapter – 07:
Conclusion

7. Conclusion

Faults found in knitted fabric mainly originated from three separate aspects e.g. (i) Faults due to yarn, (ii) faults occur during knitting and (iii) faults occur due to environment.

In order to ensure quality of knitted fabric one must ensure coordination of all the three aspects mentioned above.

We believe that our work will help the people working in the knitting industry to identify the source of detected faults & proposes specific solutions for these faults causes. So knitters can take necessary remedial steps to overcome the faults.

8. References:

1. Knitting Technology, by David j. spencer.

2. Circular Knitting, by Lyer C, Mammel B, Schach W.

3. Fabric Inspection System using 4- point system, by Tti inspections (Pvt.) Ltd.

4. Knitting Fundamentals, Machines, structures & Developments, by N. Anbumani.

5. Textilelearner.blogspot.com/