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"Investigating Seam Strength & Seam Performance with Different SPI on Different Fabrics."

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Abstract: *Seam is a major factor for making a garment. Seam completely depends on the fabric construction, sewing thread. It's important to choose right stitch for selected fabric. This paper investigate the performance of seams constructed with different sewing parameters. The seam quality is defined by appearance and strength. Seams are constructed with different sewing parameters which include the types and sizes of threads, needle sizes and stitch densities for three fabric weight categories. To determine the seam strength with different Fabric type and different SPI. In different fabric different SPI creates different performance. The object is to find out the correct SPI for the particular fabrics. To investigate the puckering effect with different fabrics and different SPI. Three types of fabrics are used for the study. The object is to find out which fabric is suitable for which SPI. So that it is essential to understanding puckering effect.*
Keywords**:** *Stitch, SPI, Seam Puckering & Strength.*

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I. Introduction

Seam is the most important measurable factor for making an apparel. The service of the apparel depends on seam quality. The right choice of seam besides fabric, thread can be increased the quality of apparel. Garments durability most of time depends on seam, thread selection and fabric consideration with cost and quality. Seam quality measured by seam strength, seam appearance and seam puckering. In fashion consumers measured the seam quality by seam appearance and it's durability after wearing. Many types of seams, stitch are applied in garments considered different stitch density (SPI). And seam quality linked with SPI. Practically performance of the seam is different for different garments and it's depend on end use also. The study about seam quality define that it's depend various elements which influences the seam performance. Generally, seam quality measured by manufactures during development and production of garments. Further the quality level of the apparel requires the judgment of seam quality, strength and physical appearance. This paper focuses on the effect of seam and stitch density on seam strength and seam performance of fabric. However several people studied on seam and stitch performance. Nazakat Ali et al studied on Effect of different types of seam, stitch class and stitch density on seam performance [1]. Aaron and Chandrasekaran studied on Influence of stitch density and stitch type on seam properties of garment leathers [2]. Rogale et al studied on Garment seam strength depending on needle size and stitch length [3]. Moustaf andSarhan studied on Interaction between sewing thread size and stitch density and its effects on the seam quality of wool fabrics [4]. Akhter and Khan studied on the effect of stitch types and sewing thread types on seam strength for cotton apparel [5]. Chowdhary & poynor studied on Impact of stitch density on seam strength, seam elongation, and seam efficiency [6]. There is limited documented research on the performance of seam. This study has provided documentation on the influences thread type, stitch density have on seam quality in garments. The aim of this study is to find out the impact of different SPI on seam puckering and seam strength for particular fabric.

II. Literature Review

Seam

In sewing, a seam is the join where two or more layers of fabric, leather, or other materials are held together with stitches. Seams in modern mass-produced apparel, footwear, house hold textiles and sporting goods are sewn by industrial sewing machines.

Classification of seam

Seams are classified according to the type/number of components used. There are eight classes of seams defined as per ISO 4916:1991.

1. Class 1 – Superimposed seam
2. Class 2 – Lapped seam
3. Class 3 – Bound seams

4. Class 4 – Flat seams
5. Class 5 – Decorative/Ornamental stitching
6. Class 6 – Edge finishing/neatening
7. Class 7 – Attaching of separate items
8. Class 8 – Single ply construction

Stitch

Stitch can be defined as, one unit of conformation resulting from one or more strands or loops of thread by intra-looping, inter-looping and interlacing. There are different types of stitch used in garments; those are mentioned in the following:

1. Class-100 (Chain Stitch)
2. Class-200 (Hand Stitch)
3. Class-300 (Lock Stitch)
4. Class-400 (Multi Thread Stitch)
5. Class-500 (Over Edge Stitch)
6. Class-600 (Covering Chain Stitch)

Seam strength

Seam strength is the strength of seam assembly in a garment. It is a function of the strength of the thread used for the seam, type of seam assembly in a garment and type of fabric used, among other factors. Failure of seam assembly can occur either by breaking of sewing thread, tearing of the fabric at the seam, excessive yarn slippage adjacent to the stitches or a combination of the above mentioned conditions.

The seam strength dependent on a number of factors including:

- ❖ Type& Weight of the fabric
- ❖ Stitch &seam construction
- ❖ Stitch per inch
- ❖ Tread type and size
- ❖ Stitch balance (thread tensioning)

Lock stitch (301)

For 301 lockstitch seams, we recommend using the same needle thread size as the bobbin thread size in the seam. Why? Because "a chain is only as strong as its weakest link." If a smaller, weaker thread is used in the bobbin, then the seam will only be as strong as the bobbin thread.

Formula for Estimating Seam Strength on Woven Fabrics:

301 Lockstitch - Estimated Seam Strength

= SPI X Thread Strength (lbs.) X 1.5*

* 1.5 is a factor based on the average loop strength ratio of most sewing threads

= 10 SPI X 4.0 lbs. X 1.5 = 60 lb. strength.

SPI Recommendations for Woven's & Knits

Below is a list of garments and the typical number of Stitches per Inch recommended for each of them by A&E:

Table 1.1: SPI Recommendations for Woven's& Knits

Garments	SPI	Comments
Denim Jeans, Jackets, Skirts	7-8	Fewer stitches per inch generally will give a more contrast stitch appearance.
Twill, Pants or Shorts	8-10	More stitches per inch will help minimize seam grinning
Trousers, Dress Pants, Slacks	10-12	On some operations like serge panels, it may be desirable to use a longer stitch length.
Dress Shirt or Blouse	14-20	Using more SPI allows the use of smaller diameter threads that will minimize seam puckering
Casual Shirts, Blouses, Tops	10-14	Using more SPI will give more of a tailored stitch appearance and better seam coverage when surging.
Children's wear	8-10	Usually 8 to 10 SPI is adequate to provide adequate seam strength and at the same time allow for quicker cycle times.
Dresses,	10-12	Due to many of the operations being lockstitch, usually 10 – 12 SPI is

Skirts		required to provide adequate seam strength.
Blind stitch Operations on Slacks, Dresses, Skirts, etc.	3-5	A long stitch length is desirable to minimize the dimple or appearance of the needle penetration on the outside of the garment.
Button sew (4 hole button)	16	Button sew machines are cycle machines with a predetermined number of stitches per cycle.
Buttonhole (1/2" purl or whip stitch)	85-90	Generally sewn vertically– approx. 85- 90 stitches with a lockstitch buttonhole machine.

III. Materials and method

The major portion of the experimental work was carried out in sewing lab of BUFT. However the remaining work and test analysis was conducted in testing lab. The materials used in this research study was based on 100% Cotton Poplin, 100% Cotton Flannel, Fil-A-Fil Oxford Materials and methods for measuring the seam strength and measurement of puckering is experimental.

Raw Materials: Fabrics, sewing thread
Fabrics
For sample A
Composition: 100% Cotton Y/D
Fabric Name: Fil- A- Fil Oxford
Construction: $\frac{50\times32/2}{130\times56}$
Cutable width: 57″

Fig 3.1: Sample A

For sample B
Composition: 100% Cotton
Fabric Name: Poplin
Construction: $\frac{133\times72}{40\times40}$
Cutable width: 57″

Fig 3.2: Sample B

For sample C
Composition: 100% Cotton Y/D
Fabric Name: Flannel (Both side brushed)
Construction: $\frac{76\times64}{21\times21}$
Cutable width: 57″

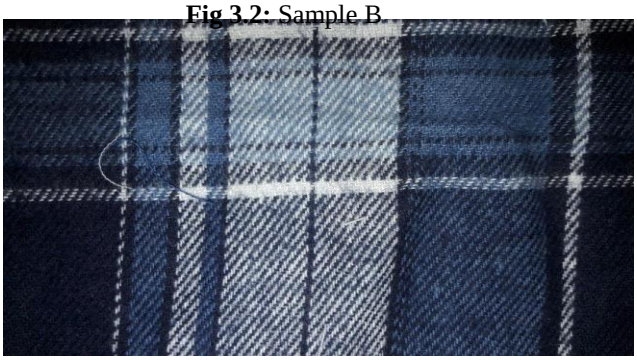


Fig 3.3: Sample C

Sewing Thread:
We used 40/2 100% spun polyester thread in both needle and bobbin.
Composition: 100% Spun Polyester Sewing Thread
Count: 40/2
Cone Length: 4000 Meter

Fig 3.4: sewing thread

Machine
Sewing Machine, Testing Machine
Sewing Machine:
Sewing Machine: Single Needle Lock Stitch Machine- 301
Brand Name: DURKOPP ADLER
Origin: Germany
Needle Size: 0.14
SPM: 4000-450

Fig 3.5: Sewing M/C

Methods
Preparation of Sample for seam puckering:

At first, we clean the sewing machine surface. Threading according to threading guide. Filling bobbin case with the same thread as we used in needle. Length of the sample is 15 inch and width is 10 inch. We sew these fabrics in three different SPI (8, 10, and 12) in three types of fabrics- 100% Cotton Poplin, 100% Cotton Y/D Flannel, Fil-A- Fil Oxford to determine the seam strength and to measure puckering effect.

Measurement of Puckering:

For judging seam appearance so many standards are available in market but nowadays AATCC standard 88B is the most commonly practiced today. In AATCC method seam appearance is classified into five grades. In grading systems the grade 1 refers to worst fabric which is heavily puckered and grade 5 refers smooth fabric with little pucker or no pucker at all. Sample fabrics are sewn as per as standard procedures and the appearance of seam is compared with standard reference specimens. The grade of fabric is the grade of the reference specimen which matches most nearly to sample fabric specimen. The subjective evolution method outlined above though simple and easy to perform, has shortcoming such as subjective, human bias towards a particular color or pattern, higher evaluation time, inconsistency among judges and need for training. Thus evaluation based on subjective techniques is not reliable [2].

Determination of Seam Strength:
Method: ISO 13935-2
Sample size: 15×10 cm
Unit: Newton
Machine: Electromechanical Testing Machine
M/C Model: 5ST
Origin: U.S.A

Fig 3.6: Electromechanical Testing Machine

Sampling:

Select samples either in accordance with the procedure laid down in the material specification for the fabric or as agreed between the interested parties. In the absence of an appropriate material specification, the example of a suitable sampling procedure given in Annex A can be used. An example of a suitable pattern for cutting test specimens from the laboratory sample is given in Annex B. Avoid test specimens with folded or creased areas, selvedges, and areas not representative of the fabric.

Testing Procedure:

Gauge length

Set the gauge length of the tensile-testing machine to 100 mm or, if agreed, to 75 mm, to within ±1 mm.

Rate of extension

Set the rate of extension of the tensile-testing machine to 50 mm/min.

Mounting of test specimens

Clamp a test specimen centrally so that its longitudinal center line passes through the center point of the front edges of the jaws and becomes perpendicular to the edges of the jaws to have the line drawn on the test specimen coincide with one edge of the jaws. After closing the upper jaw, avoid pretension when adjusting the specimen along the guide line in the lower jaw so that the fabric hangs under its own weight when the lower clamp is closed.

Operation

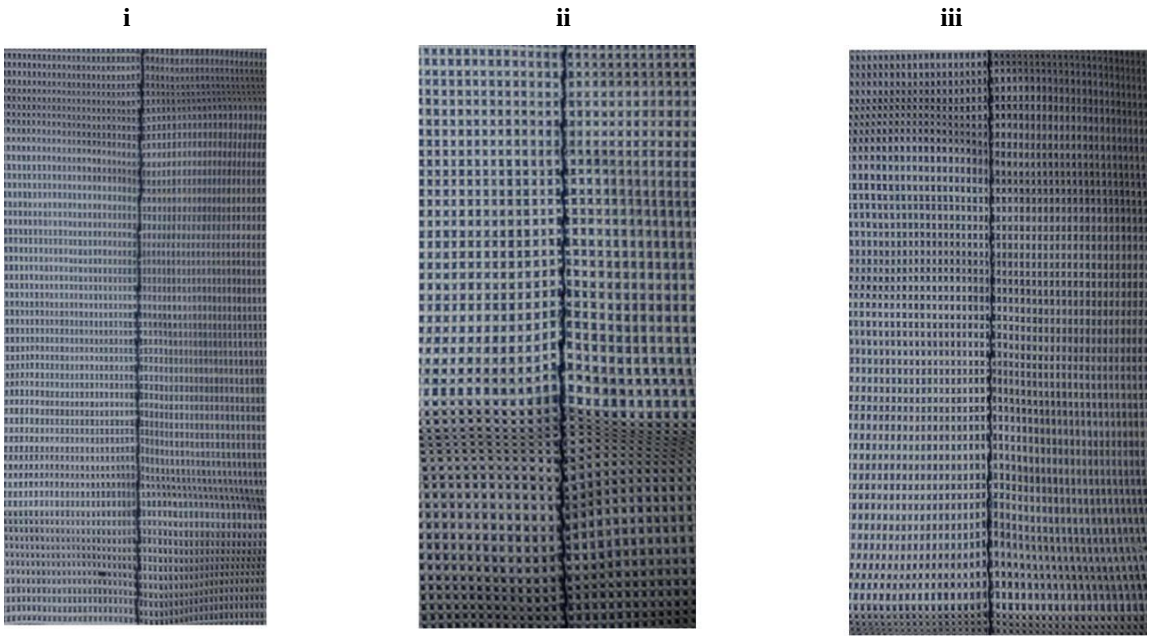
Engage the device for recording the maximum force. Put the movable clamp in motion and extend the test specimen to the point of rupture. Record the maximum force in Newton. Perform the test at least on five test specimens of each fabric direction. Record any break which occurs within 5 mm of the clamping line of jaws and report the result as a jaw break. At the end of the five tests, examine the results obtained. If any of the jaw break results falls above the lowest "normal" break result, then it can be included. If any of the jaw break results

falls below the lowest "normal" break result, then it shall be excluded and further tests should be carried out to obtain five "normal" results falls below the lowest "normal" break result, then it shall be excluded and further tests should be carried out to obtain five "normal" breaks. If all the results are jaw breaks, or if five "normal" breaks cannot be obtained, then the individual results shall be reported without the coefficient of variation or confidence limits. Jaw break results shall be indicated as such in the report, and the results discussed between the interested parties.

IV. Results & Discussion

Effect of SPI on Puckering for Sample A:

Effect of SPI on puckering for sample A is done on 100% Cotton Y/D Fil-A-Fil Oxford.



SPI 8 SPI10 SPI 12

Fig 4.1: Effect of SPI

Seam Appearance Variation due to SPI for Sample (A):

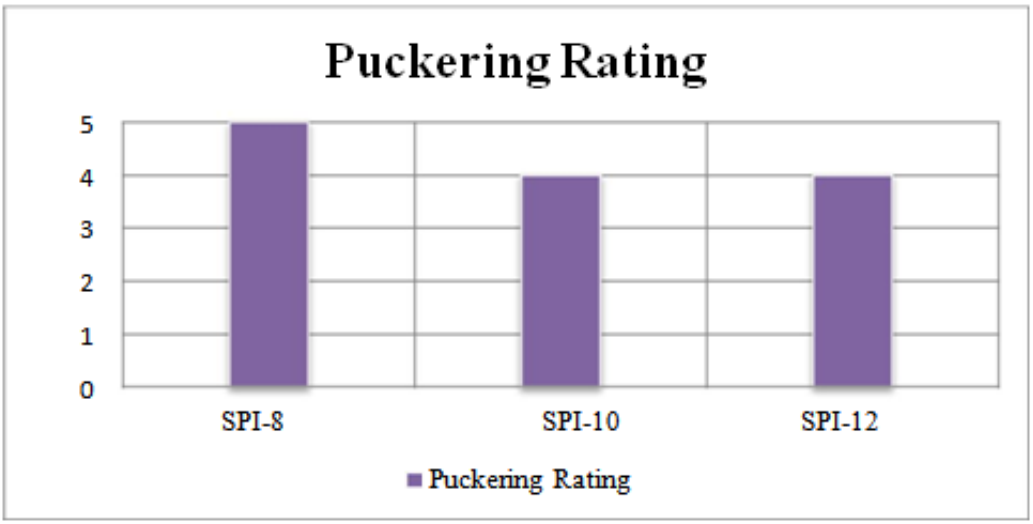


Figure (4.2): Seam Appearance Variation for Sample A

According to AATCC method, seam appearance is classified into five grades. Grade1 refers to worst fabric which is heavily puckered and grade 5 refers to smooth fabric with little pucker or no pucker at all. Thus, grade 5 is referred to sample A. grade 4 is referred to sample B and C.

Effect of SPI on Strength for Sample A (Strength variation due to SPI for Sample A):

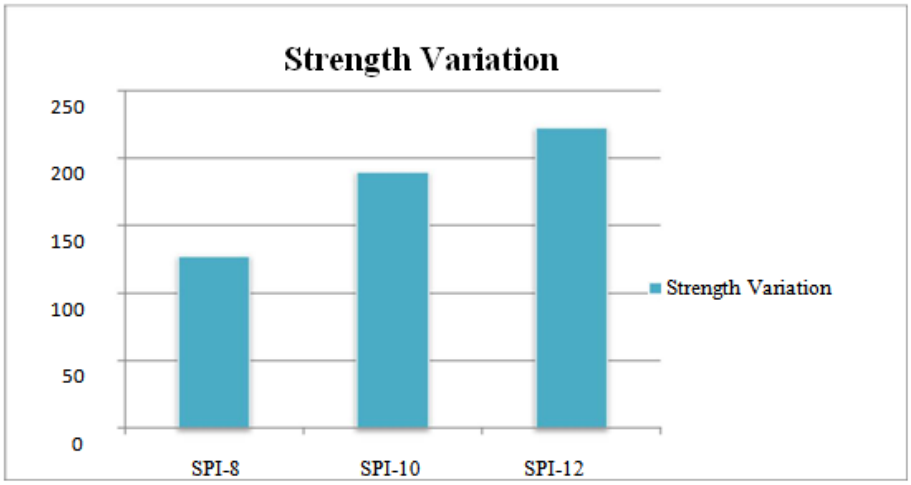


Figure (4.3): Strength Variation for Sample A

According to the above figure strength of seam increase when SPI of seam increase. Because the unit of seam, increasing within an inch. For this the force of strength shared in large amount of stitch. So, we can say when SPI increases in seam, and then the strength of seam also increased.

Effect of SPI on Puckering for Sample B:
Effect of SPI on puckering for sample B is done in 100% Cotton Poplin.

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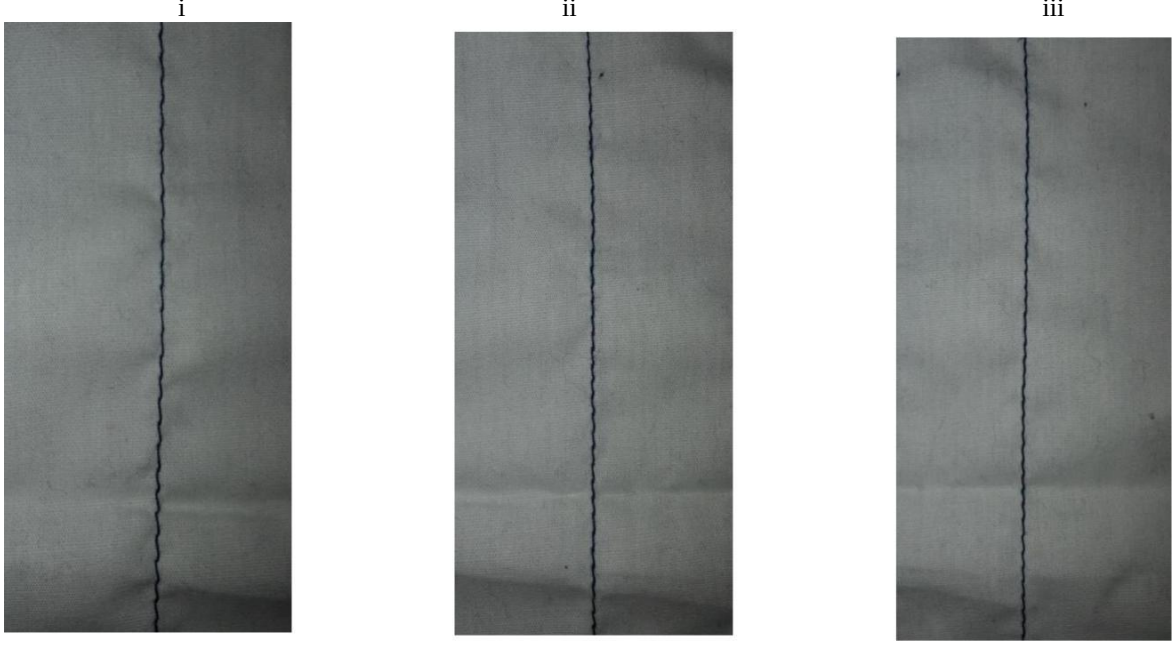

SPI 8 **SPI 10** **SPI 12**

Fig 4.4: Effect of SP

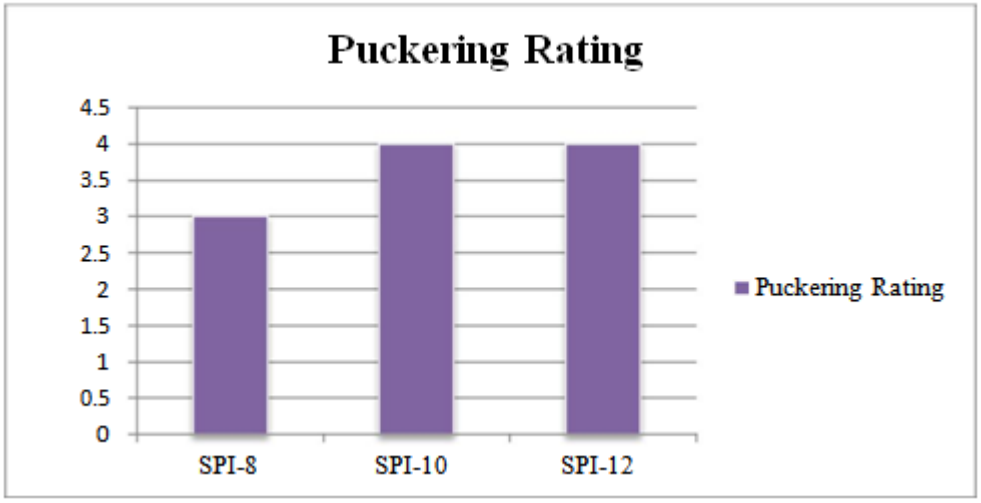

Figure (4.5): Seam Appearance Variation for Sample B

Effect of SPI on Strength for Sample B:
Strength variation due to SPI for Sample (B):

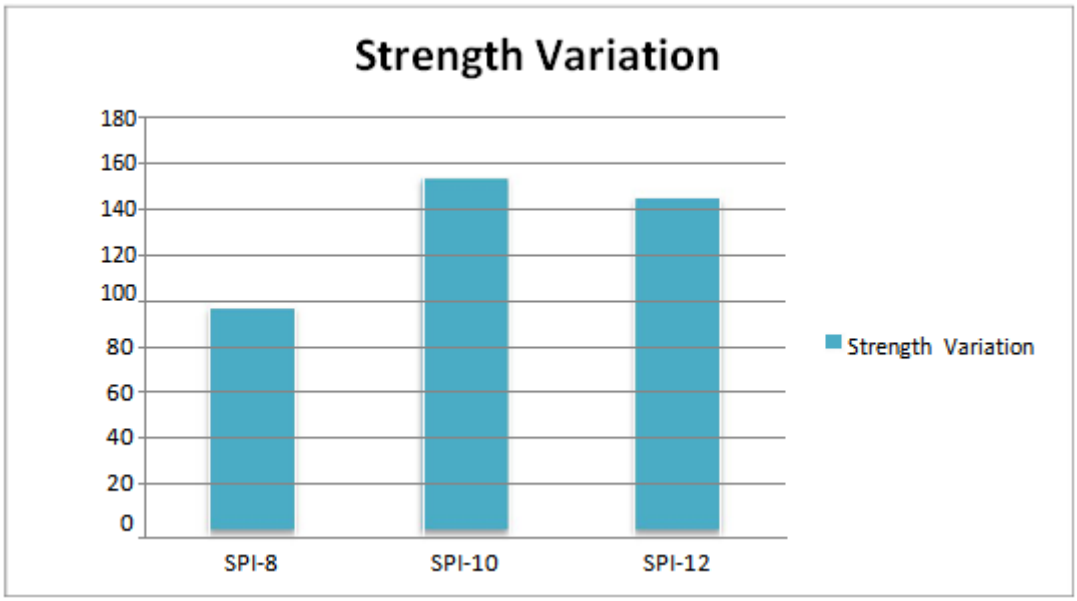

Figure (4.6): Strength Variation for Sample B

According to the above figure strength of seam increase when SPI of seam increase. Because the unit of seam, increasing within an inch. For this the force of strength shared in large amount of stitch. But, we find in 100% cotton poplin fabric when SPI increase 10 to 12 the strength of seam decreases. So, we can say the seam strength, not only depends on SPI but also depends on fabric construction.

Effect of SPI on Puckering for Sample C:
Effect of SPI on puckering for sample C is done in 100% Cotton Y/D Flannel.

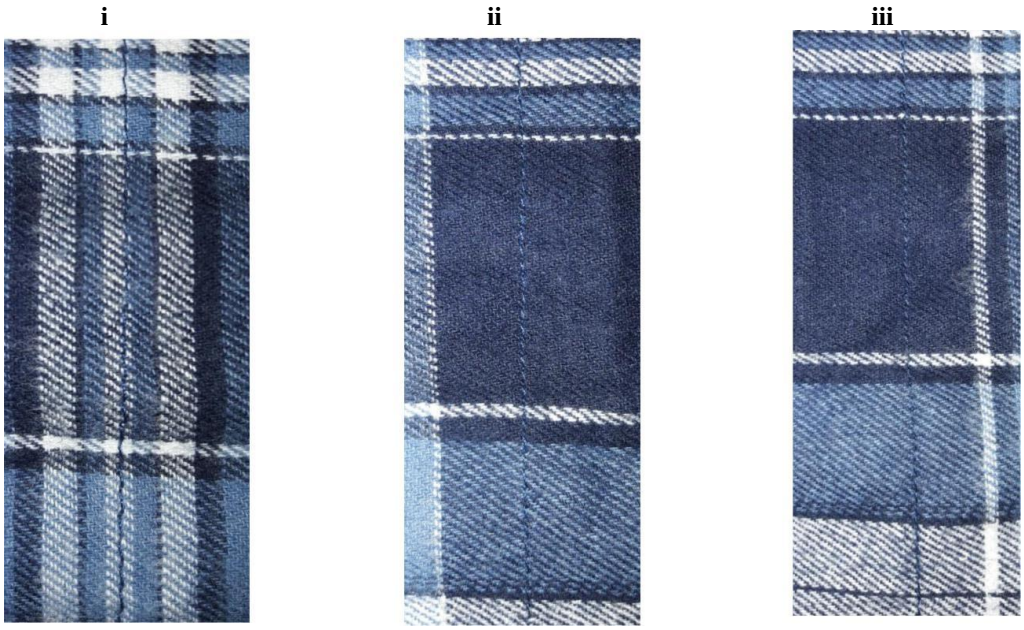

Fig 4.7: Effect of SPI

Seam Appearance Variation due to SPI for Sample (C):

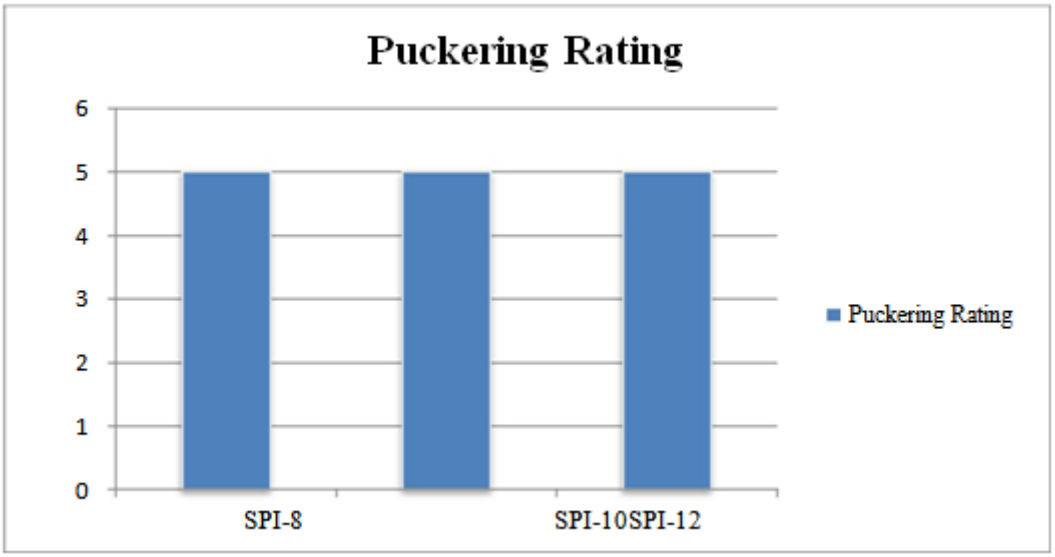

Figure (4.8): Seam Appearance Variation for Sample C

According to AATCC method, seam appearance is classified into five grades. Grade1 refers to worst fabric which is heavily puckered and grade 5 refers to smooth fabric with little pucker or no pucker at all. Thus, grade 5 is referred to sample A, B and C.

Effect of SPI on Strength for Sample C:
Strength variation due to SPI for Sample (C):

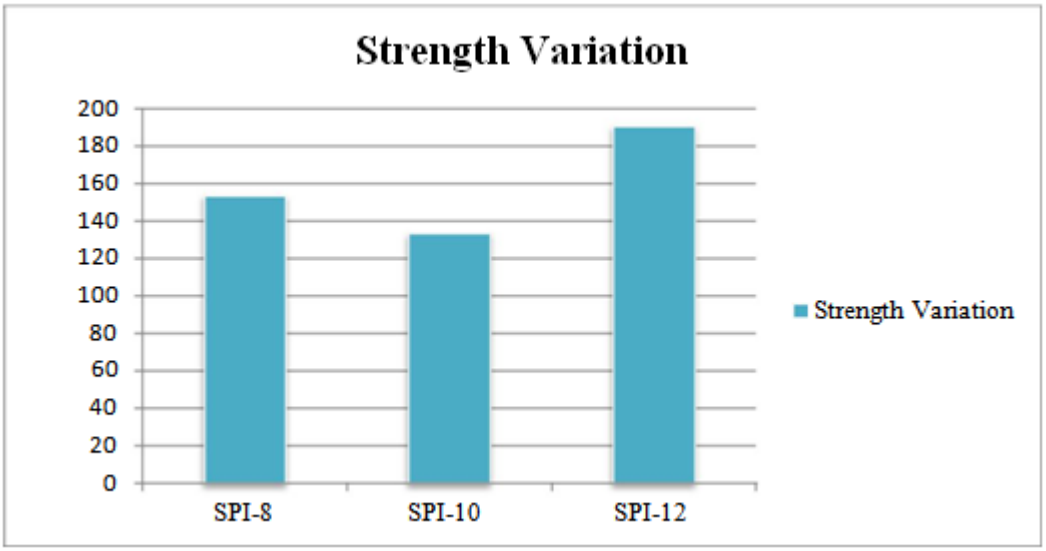

Figure (4.9): Strength Variation for Sample C

According to the above figure strength of seam increase when SPI of seam increase. Because the unit of seam, increasing within an inch. For this the force of strength shared in large amount of stitch. But, we find in 100% cotton flannel fabric when SPI increase 8 to 10 the strength of seam decreases. So, we can say the seam strength, not only depends on SPI but also depends on fabric construction.

V. Conclusion

It was found from experimental results that with increase in the stitch density the strength of the seam was also increase but up to some extent, after that the strength of seam decreased, Because increase in the stitch density after certain level may rapture the fabric. Further it was also found that different seams impact in a different way on the strength under different SPI.Seam quality is subjected to seam strength, strength efficiency, puckering and appearance. Consumers evaluate seam quality mainly based on the seam appearance and its durability after wear and care procedures. Various types of seams, stitches can be applied on finished fabrics (garments) with different stitch density (SPI) having diverse effects on seam strength, quality in general and performance in particular. The probability of seam performance for different fabric is also different. As a result, analysis of seam performance can provide a more significant study of various elements influence the seam performance. The study was carried out on different commercial fabrics for making comparison on seam strength and seam puckering based on changing SPI values. Different commercial fabrics Fil- A- Fil Oxford, Poplin, and Flannel was used under three different SPI (SPI-8, SPI-10, and SPI-12). In this study seam puckering is determined through AATCC method and seam strength is measured through ISO 13935-2 method by Electromechanical Testing Machine. The results showed that, the overall seam performance is influenced by different factors. It was concluded from this research that, as SPI was increased, the seam strength was also increased and decreased when SPI was reduced vice-versa.

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