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Effect of the Seam Efficiency and Puckering on Denim Sewability

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ABSTRACT

Sewability is an important one of effective parameters on garments quality.
Sewability of a fabric depends on the difference of fabric weight and mechanical properties such as properties of seams and preparing the sewing machine. This paper investigates the sewability of denim fabrics stitched with lockstitch.301 in 3 levels of density and different weights with super imposed seem to know about, Do, stitch, seam efficiency and seam pucker effect on denim sewability?
Researcher had used the experimental method where that by using three different weights of denim with sewing thread - core spun - and the researcher used super imposed seam with a sewing machine which produces lockstitch No.301 (one needle and one sewing thread) according to British and American federal standard for Seams and stitches. Three levels of stitch density were used as following: - 4 - 7 - 10 s.p.cm. Studying their effect of all on the sewability, there are some effective elements such as: Seam efficiency, puckering, weight of fabric, sewing thread, needle, seam type, stitch density and sewing machine.
In this research the researcher used three different weight of denim, core spun threads, superimposed seam and lockstitch no.301.
The samples were sewing in three different directions such as , Warp direction - weft direction - 45 degree angle for measuring seam puckering seam strength - fabric strength and seam efficiency.
Finally, the researcher found that there is relationship between sewability of denim and seam pucker.
The more you increased seam pucker the less sewability. However, relation between sewability of denim and seam efficiency is Positive relationship.
KEYWORDS: Sewability, denim, Seam strength, seam efficiency, seam pucker.

1. INTRODUCTION AND PROBLEM

The clothing manufacturer contents of a variable of products in fashion world, different styles of garments, mass production and manufacturing environment, so, the technology of clothing manufacture need to increased demands turn and quick reply and feedback.

The relationship between the raw material properties, sewing performance and seam quality becomes very important.

There are many elements, impact on garments quality such as: fabrics, sewing threads, needles, sewing machine and there are some elements such as sewability, the fabric and sewing thread are considerable the basic material of garments manufacture.

In the first, the designers of garments are interested in the basic material properties for getting high quality of seam.

The Bayer is mainly interested in some properties of apparel such as appearance, wearability and comfort of the garment. Correct selection of basic material help us to getting comfortable wear to the wearer additional also helps in smooth sewing operation working and manufacturing of garments.

May be that process and lead to high quality garment without defect.

In this research it is studying some different factors which effect on the denim sewability such as weight – stitch-puckering – seam strength. Researcher used the experimental method in the research, using three different weights of fabrics denim with sewing thread - core spun - and he used super imposed seam with a sewing machine which produces lockstitch No. 301 in category British standard for Seams and stitches. Three levels of stitch density were used as following: - 4-7-10 s /cm.

The samples were sewing in three different directions as following:-

Warp direction - weft direction - 45 degree angle for measuring seam, puckering, seam strength, fabric strength and seam efficiency. It is important to comprise some previous studies review of researches in the field of fabric

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sewability and mechanical properties of denim and apparel where F.Fathy Saied et, al[4] said that, the idea of using the objective measurement of properties to predict fabric performance is not new.

1.1 testing of fabrics

Measurements used to predict some aspects of fabric performance for many years. Recently, techniques developed to measure the Mechanical properties of fabrics and used these measurements to quantify handle1 and predict performance in both garment manufacture and its appearance 2.

In experimental work part on the topical measurement of mechanical properties for fabric dates back to the 1930s as mentioned Pierc [1].

We can predict for fabric interpretation in apparel manufacturing from properties of mechanical .In the 1960s was first tested by Lindberg research teams extensively.

Many properties of fabric associated with performance were identified by these teams in apparel industry.

We can include some properties such as extensibility, bending, shear and fabric weight. To fully describe tensile, shear or bending behavior of fabric are required several measurements.

Those measurements are used to describe resistance to deformation as mentioned Skelton [2].

For various purposes the fabric Objective Measurement can be used, such as:, fabric quality ,evaluation of the formability of fabrics and the appearance of finished apparel, creation of specific techniques to enable the making-up industry to choose fabrics, as well as for quality and process control as mentioned Mahar, Pestle [3].

The study of Saied et al [4] was its reseats as follow:-

Test FAST system results recorded almost the same values in the both fabric structures, exception in the case of weft count 20/1 in the two fabric structures.

FAST meter tends to provide higher values of twill weave than plain weave.

- It can see that needle penetrations force increase for sample no 2 (fabric weft count 20/1, 25 pick/cm) than others, that due to structure plain, density of weft at (weft &warp) direction.

1.2 The denim fabric

The denim fabric is one of most famous cotton fabric in the industrial world especially jeans garments manufacturing. Denim is a strong cotton warp-faced twill textile in which hugging warp and weft yarns to make the fabric.

Often, the warp threads are dyed, but the weft threads are not dyed that in the most indigo denim.

We can notice that the jeans garments' color inside is white while the out color is blue.

It an important that there are some factors effects on apparel quality such as: the sewability.

Fig.*no.1 Seam puckers of denim*

1.3 The sewability

The sewability meaning in English Dictionary" the ability to be sewn or stitched".

We can say that "the sewability is main factor of sewing quality of garments and make it without defects".

1.4 Seam strength

The Strength is considered one of the mechanical properties of woven fabrics. The manufacturers are using the stitches to make seams help determine the functional and aesthetic performance of apparel.

The relationship between directly Strong stitches and seam strength is positive.

The strength of the seam can be found within the seam type and seam.

The overall construction of the garment depends on some elements such as: The location and type of seam and must be suitable.

We can determine +the quality of manufactured products by the tensile testing machine (Brown et al) [5].

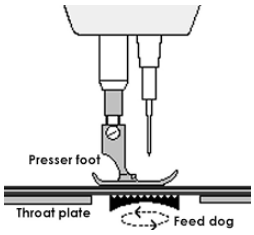

Fig.No.2 sewing machine feed dog

We can calculate the sewability by using the following equation:-

Seam Strength = Break load (N) / Stitch density ……..... **1**

1.5. The efficiency of seam

The seam efficiency depends on the ratio between seam strength and fabrics strength while it is necessary to calculate the experiments with seams involved.

we can calculate seam efficiency by using the following equation :

Seam Efficiency = Fabric Strength with Seam / Fabric Strength without Seam ……..……..……2

Or, Seam Efficiency% = Seam Strength / Fabric Strength x100……..……...3

Breaking strength of fabrics is different according to different fabrics .

fiber structure and morphology play main action of a fabric properties and performance.

The molecular orientation and crystallinity of fibers will contribute to the fabric strength.

The machine acts as a force and produces the breaking load of a fabric, the load at which the fabric breaks as Courtney[6] mentioned.

1.6 Seam puckering

Seam puckering meaning that is problem in sewn fabric with sewing threads , needle and setting sewing machine while it indicate to the gathering of a seam during sewing, after sewing, or after laundering, causing bad appearance of seam .

You can notice that Seam puckering is more found in woven fabrics than knits; and it is memorable on tightly woven fabrics.

Behera[7] told that sewability is an important factor which decides the quality of seam and which is influenced by many factors such as properties of sewing threads and fabrics, processes of needle penetration, stitch formation, sewing thread tension, fabric feeding, seam construction and various technological parameters in sewing process.

The quality of seam is determined by measuring needle penetration force, needle cutting index and seam mechanical properties.

Cheng [8] said that in this work different woven fabric structures were selected to study the seam strength, slippage and puckering. By using the Instron Tensile Testing Machine (Constant-Rate-Elongation-Type), the type of seam failure and the average load of seam strength were obtained.

By using the AATCC standard set of pucker levels, the grade of seam pucker was also measured. In addition, as Cheng's [8] mentioned that are Different fabrics are sewn into garments in the apparel industry. The performance and appearance of seams form an important component of the quality of the finished product.

Similarly, the quality of sewn apparel depends on different factors such as: slippage, seam strength, puckering and yarn severance.

All these factors combined together contribute to sewability, which is considered to be one of the most important aspects of apparel industry. His paper[8] present work attempts to investigate the fabric weight of selected woven fabrics on seam performance and appearance.

Three types of garment seam tests, including seam strength, seam slippage and seam puckering would be investigated. Moreover, the influences of different combinations of fabric weight, fabric thickness, fabric weave and seam direction (warp and weft) on seam performance and appearance would also be studied.

Cheng's [8] results are in 2/1 twill fabric, the seam strength is directly proportional to the fabric weight in both the warp and weft directions. This means the heavier the fabric, the higher the seam strength. In addition, the seam strength of the fabric in the warp direction is higher than that in the weft except for the fabric weighed 250g/m2 In 3/1 denim fabric, the seam strength is also directly proportional to the seam strength in both the warp and weft directions. This means the heavier the fabric, the higher the seam strength. In addition, the seam strength of the fabric in the warp direction is also greater than that in the weft except for the fabric weighed 302g/m2 Cheng [8].

PAMUK et al [9] presented an experimental study of sewability of lining fabrics. In this study, he divided six types of linings fabrics, to three groups by considering composition, yarn count, weft and warp density, were examined by using L&M sewability tester at the same conditions.

He said that when weft and warp densities are high, it has seen that the porosity of the fabric decreases, fabric becomes denser, more yarns are either broken or separated by the sewing needle, so the needle penetration force increases. It can be said that there is a significant influence of density on sewability properties of lining fabrics. Sewing needle penetration force of lining fabrics are affected by the fabric density in both directions and yarn count.

The high penetration force of the fabric shows that the fabric has a high resistance to sewing. So for lining selection, this property should be taken into consideration.

Öndoğan [10] said that the term sewability can be defined as the ability and the ease with which the two-Dimensional fabric components can be qualitatively and quantitatively be seamed together to the three-Dimension apparel [10].

However, Nayak [11] told about the Sewability is considered to be one of the most important aspects of garments area. It is expected that Good sewability make garments without defects and can make fabric producing pucker-free garments [11].

In ready- made garments, sewing defect is a always recurring event and is the major cause of Bayer's complaint [11]. The needle penetrating through the fabric caused Seam damage and can create severe sewability problems as Guarda [12] mentioned.

Mandal, et al[13] said that It is one of reasons of essential for apparel manufacturer for prediction is Knowledge of the relation between sewing thread for mechanical properties and seam quality for prediction of sewing thread mechanical properties, as related to the required properties of high seam quality.

Garments maker can decision to select optimal for sewing threads By defining the relation between seam qualities and sewing thread mechanical properties, in garments industry.

1.7 Sewing threads and quality of seam

A big set of sewing threads is used in garments manufacturing.

The most of the sewing threads are made from cotton and polyester fiber which are used by the garments manufacturers. West [14].

There are natural such as linen and silk and Synthetic fiber fibers are used in making Sewing threads, for example acrylic, viscose and nylon additional polyester are also used in garments manufacturing Taylor,[15].

The most of threads are made from core spun yarns, spun or continuous filament.

Each type of sewing thread has special properties, which are prime instrumental factor for quality of seam.

When we use sewing machine in high speed, thread is subjected to complex kinematic and dynamic conditions.

In such conditions the thread is subjected to shear, compressive, bending, tensile, friction and surface stresses Ukponmwan,et al[16].

Bending and friction are the important ones for quality of seam. Among these stresses acting on the thread Sundaresan, Salhotra [17].

Such dangerous sewing conditions may decrease the first strength of sewing thread by as much as 60%, in turn, reduces the serviceability of the seam , Munden, Dorkin, [18].

The reduction in sewing threads strength which is a function of the dynamic strain exerted on the thread is mainly caused by sewing thread properties.

Thus the studies of the sewing thread properties are vital for improving seam appearance and seam serviceability.

The drop-feed mechanism in sewing machines is considerable one of the common reasons for ply slippage universally which is used for garments manufacture as Khana [19] said.

1.8 Seam Pucker test: -

The tested seam is allowed to be vertically hanged under its own weight and compared with a photographic standard. Each seam is compared ranging from level **1** (bad pucker) to level 5 (no pucker) according to AATCC tentative test method 88B as Stylios [20] mentioned.

1.9 Seam strength and elongation:

the extreme force may be expressed by seam strength by Newton scale to cause a seam specimen to rupture.

the elasticity of seam and flexibility may be are evaluated by using Seam extension

.

Seam extension is outlined as the ratio of the extended length after loading to the original length of the seam.

we can measured seam extension by using the following formula:

SE = EL / OL x100.

Where, SE= Seam Elongation %.

EL= Extended length.

OL = original length.

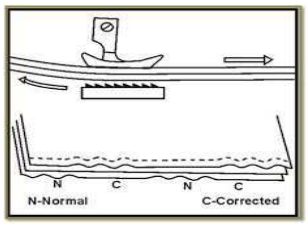

Fig.No.4Seam puckering shape

By using ASTM standard we can evaluated seam elongation was measured.

By using an Instron Tensile Tester we can measure the tensile strength of the woven fabrics, the seam strength and elongation, accordance to model 4411.

The ASTM D 5034 was used to determine the fabric tensile strength and ASTM D 1683-04 was used to determine the seam strength and elongation.

1.10 efficiency of Seam:

We can use Seam efficiency to measure the strength (durability) along the seam line.

Durability is defined as necessary to satisfactory seam's functional performance, and efficient seams are assumed to be more durable than weak ones.

Efficiency of Seam (%) = Seam strength /Fabric strength × 100.

Based on ASTM standard D 1683-04 to measure the efficiency of Seam.

Because of ASTM standard is an international standard so the evaluation of seam efficiency is well accepted by the garments manufacture.

1.11 puckering of seam:

In (AL-Sarhan)[21] 's study ,tell us about that thickness strain method as evaluation for puckering of sea which was used.

We can calculate puckering of seam by measuring the difference between fabric and thickness of seam under constant compressive load by using the following formula.

Seam puckering (%) = ts - 2t /2t × 100.

Where, ts= seam thickness, t= fabric thickness.

To a large degree this method is used for evaluating puckering of seam because it is well referred and can give more accurate than any other method.

(AL Sarhan)[21] See that this method is less time consuming than other methods and is easy to calculate [21].

2.1 Experimental work

The researcher used three different weights of Denim cotton fabric such as:

1. First weight =330 g/m^2.
2. Second weight =395 g/m^2.
3. Third weight =450 g/m^2.

And he had sewn by lock stitch sewing machine with one speed but in different density as following:

4 s.p.cm, 7 s.p.cm, 10 s.p.cm.

In three directions as following:

- Warp.
- Weft.
- Angle 45^0.

With superimposed seam and core spun threads.

All that to test following:

1. Seam pucker.
2. Seam Strength.
3. Seam Efficiency.

2.2 Properties of tested raw materials

Three different weights fabrics cotton denim were used.

Table (I) provides the Technical specifications of the fabrics used in the research, (As stated in the technical specifications of Gulf denim Company

Table 1, Fabric Specifications

Fabric code	Weave	Weight of Fabric-g/m^2	Thickness Of Fabric mm	Fabric sett (threads per cm)		Yarn count Tex		Fiber Type
				warp	Weft	warp	weft	
1	1/3-Denim	330	0.79	70	42	9	9	100% cotton
2	1/3 –Denim	395	0.83	67	39	9	6.5	100% cotton
3	1/3- Denim	450	0.87	67	41	6.5	6.5	100% cotton

2.3 Experimentation

The seam strength tests were performed with reference to ASTM D434-95: "Standard Test Method for Resistance to Slippage of Yarns in Woven Fabrics using a Standard Seam"[22].

The Instron Model 1026 Tensile Testing Machine was used to measure the seam strength and seam slippage. It was equipped with jaws suitable for grab test. To achieve uniform and equal tension, the auxiliary clamps were attached to the machine at 3 inch (7.5mm) apart.

The seam puckering test was performed with reference to AATCC 88B-1975 (R1978):

All the specimens were conditioned under the standard atmosphere (20 ± 2°C and 65 ± 2% relative humidity) for at least 24 hours before testing.

Table 2 Seam Strength, fabric Strength and Seam efficiency Tests Results

Weave structure	Seam Direction	Weight of Fabric- g/m²	Thickness Of Fabric mm	Type of Seam	Average load of Seam strength –kg	Average load of fabric strength – kg	Seam Efficiency%
1/3 Denim	Warp	332	0.77	Super Imposed Seam-1	25. 8	39	%66.1
		395	0.83	Super Imposed Seam-1	28.6	44	%65
		456	0.88	Super Imposed Seam-1	30.1	43.1	%69.3
1/3 Denim	Weft	332	0.77	Super Imposed Seam-1	24.7	45.5	%54.2
		395	0.83	Super Imposed Seam-1	26	55.6	%46.7
		456	0.88	Super Imposed Seam-1	29.1	75.8	%38.3
1/3 Denim	45^0	332	0.77	Super Imposed Seam-1	28	58	%48.2
		395	0.83	Super Imposed Seam-1	30.6	45	%68
		456	0.88	Super Imposed Seam-1	31.4	64	%49

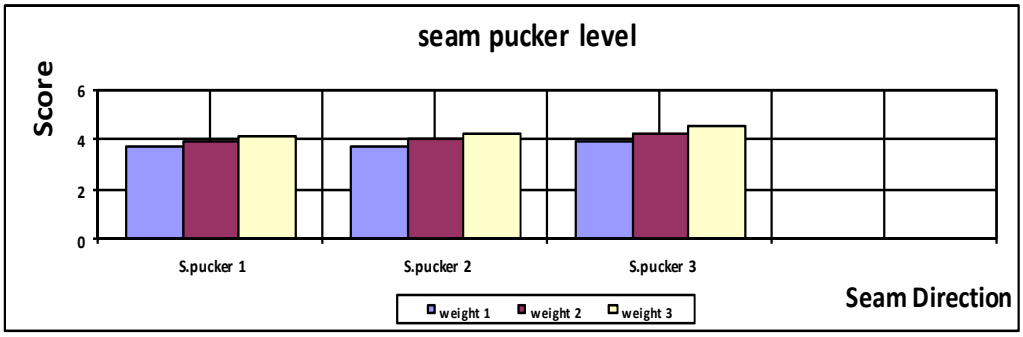

Fig .2 Fabrics strength in different weights fabrics and direction

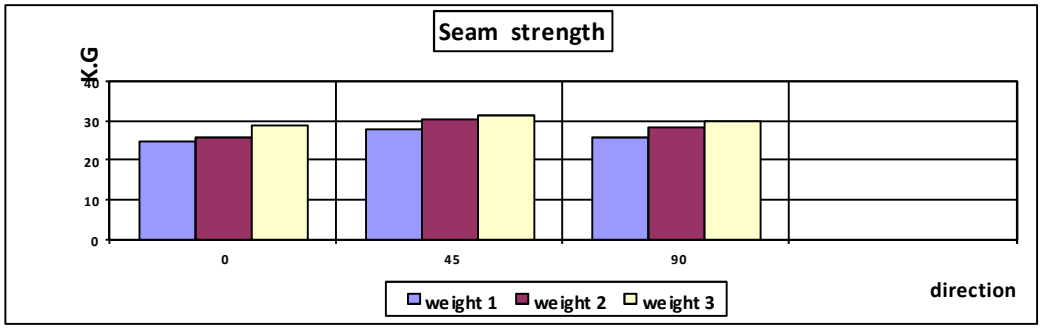

Fig. 1 Seam strength in different weights fabrics and direction

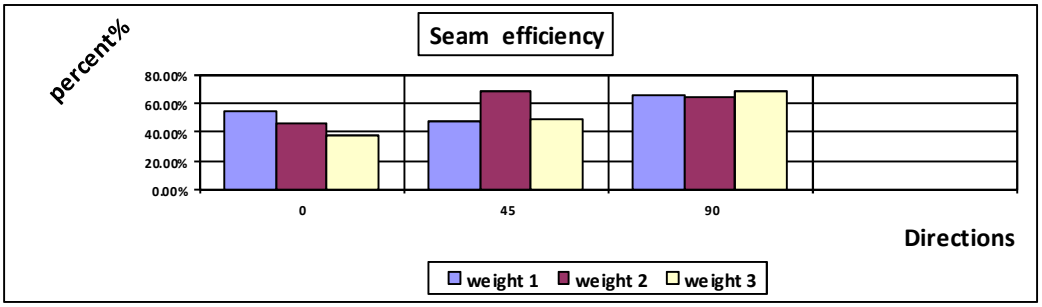

Fig. 3 seam efficiency in different weight and direction of fabrics

Table 3, Seam Puckering Test Results

Weave structure	Seam Direction	Weight of Fabric-g/m^2	Thickness Of Fabric mm	Average Grad of Seam Pucker– (1for the worst,5for the best)
1/3 Denim	Warp	332	0.6	3.7
		395	0.73	3.9
		456	0.78	4.1
1/3 Denim	Weft	332	0.77	3.7
		395	0.83	4.0
		456	0.88	4.2
1/3 Denim	45^0	332	0.77	3.95
		395	0.83	4.27
		456	0.88	4.48

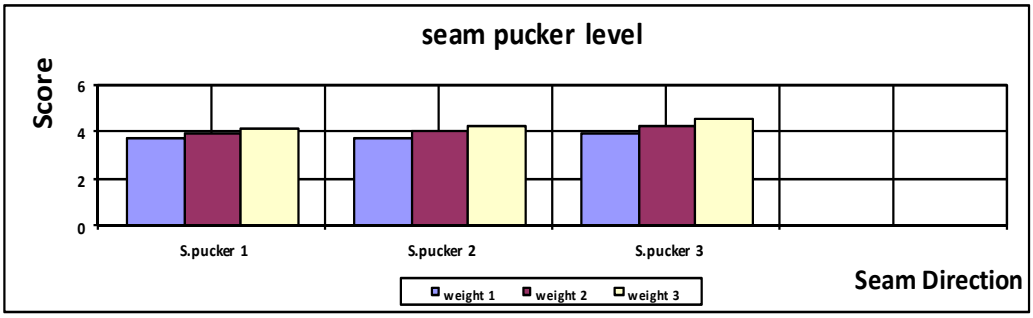

Fig. 4, Seam puckers in different weight fabrics and direction

Table 4, Seam puckers level in different Direction with Lock stitch no.301

Fabric weight - g/m^2	0^0	45^0	90^0	Angles / Stitch density/cm
Fabric 1	4.40	4.9	4.6	4 S/cm
	3.11	3.31	3.9	7 S/cm
	2.59	2.61	2.8	10 S/cm
Fabric 2	4.42	4.8	4.9	4 S/cm
	3.44	3.87	4.21	7 S/cm
	2.72	2.68	3.1	10 S/cm
Fabric 3	3.87	4.9	4.6	4 S/cm
	3.91	3.31	3.9	7 S/cm
	2.60	2.78	3.0	10 S/cm

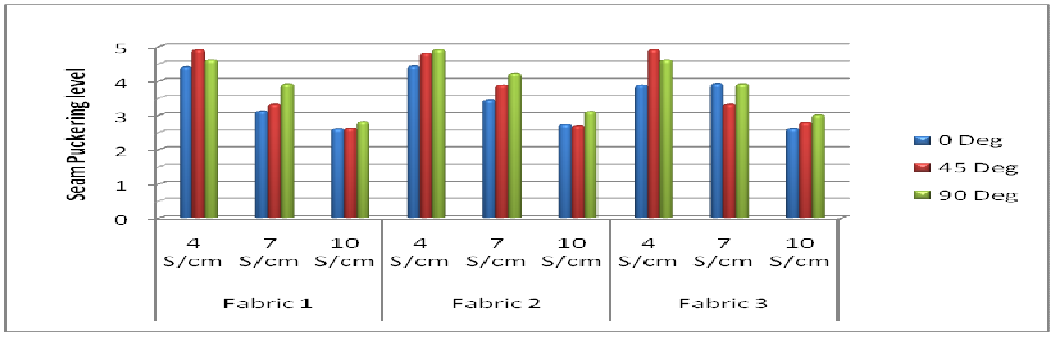

Fig. 5 Stitch Density - Seam pucker level - Seam Direction – by Lock stitch No.301

3. RESULTS AND DISCUSSION

There are relationships between difference weights of denim, stitch density, seam efficiency, seam pucker and denim sewability.

All specimens with different weights were sewn with constant sewing parameters and machine settings.

The specimens were tested in warp, weft and angle 45^0 directions in three level of stitch density as (4-7-10 s/cm).

For seam strength, seam efficiency and seam pucker tests, the average load of seam strength are presented in Table no2, 3, and 4. It has been found from this studies that factors other than sewing parameters which effect on sewability of denim 100% cotton such as :-

Seam strength, Seam pucker, Fabric weight, Seam efficiency, Including, fabric thickness and seam direction.

The researcher found there are relations between sewability of denim and all elements which were mentioned before as following:-

For the pucker test, the result was the higher with heavier and thicker fabrics in the 90˚ direction, while there was effect but not effective with stitch density as shown in Table No. 4.

The results for the tensile seam strength were higher for fabric in weight heavier, thicker and in the direction at an angle of 45˚ as shown in Table No. 2.

Shows the relation of the three variables against the stitch densities at 0˚, 45˚ and 90˚ respectively for the heavy weight fabric. It is clearly shown form table (4) and diagrams (5) that the relative seam strength and the breaking load are dramatically increasing due to the incremental of stitch density. On the other hand the extension due to the increasing of stitch density is not vigorous such like other two factors, it could be due to the type of stitch (Lock stitch type 301) which is strong but not flexible enough to get that limit of extension.

4. CONCLUSION

The researcher sees that the recognizing that the relationship between sewability of denim and seam quality is essential for producing high quality garments and it is an important for process manufacturing.

We can try making garments without defects, while high seam quality help us to do.

If we can defining the relationship between seam and sewability, apparel manufacturer can make good decision about the selecting best sewing operations and how make the garments are quality in garments manufacture.

REFERENCES

1)F.T.Pierc", The Handle of Cloth as a Measurable Quantity", J. Textile Institute,.vol. 21,1930.

2)J.Skelton "Fundamentals of Fabric Shear", Text.Res.J.Vol.46-No. 12- 1976.

3)T.J. Mahar and R. Pestle, Fabrics Handle. A Comparison of Australian Japanese Assessments of suiting Materials, Aust.Text.,No.2 Jan./Feb 1982.

4)F. Fathy Saied, Z. m.abdel-megeid and L.K. El Gabry, The relation between fabric construction, treatments and sewability, Journal of American Science, 2011;7(9)p.p272-280.

5)Brown, Patty, and Janett Rice. Ready – To – Wear Apparel Analysis. 3 ed.

6)Upper Saddle River: Prentice-Hall, Courtney, LaPere, The Effects of Different Fabric Types and Seam Designs on the Seams Efficiency, Eastern Michigan University press , Michigan, on June 19, 2006.

7)B.K. Behera, S. Chand, T.G. Singh, P. Rathee, (1997) "Sewability of denim", International Journal of Clothing Science and Technology, Vol. 9 Iss: 2, pp.128 – 140

8)K.P.S. Cheng & K.P.W. Poon, Studies on the Seam Properties of Some Selected Woven Fabrics, Journal of Textiles DOI: 10.1155/2013/157034 Sep 16, 2014, p.p. 486-496.

9)Oktay PAMUK1*, Özlem KURTOĞLU2, Derya TAMA1, Ziynet ÖNDOĞAN1, TEKSTİL ve KONFEKSİYON 3/2011, Journal of Textile & Apparel / Tekstil ve Konfeksiyon;2011, Vol. 21 Issue 3, p301-304.

10)Öndoğan, Z., Utkun, E., Pamuk, O. and Yıldız, E.Z., 2010, Sewability in Apparel Industry, International Conference of Applied Research in Textile, CIRAT-4, Monastir, Tunusia.

11)Nayak, R., Padhye, R., Gon, D.P., 2010, "Sewing Performance of Stretch Denim", *Journal of Textile and Apparel, Technology and Management*, Vol. 6, I. 3, pp. 1-9.

12)Gurarda, A., Meric, B., 2007, "The Effects of Elastane Yarn Type and Fabric Density on Sewing Needle Penetration Forces and Seam Damage of PET/Elastane Woven Fabrics", *Fibres & Textiles in Eastern Europe*, Vol. 15, No. 4 (63), pp. 73-76.

13)Sumit Mandal, Nandita Abraham, An overview of sewing threads mechanical properties on seam quality, Pakistan Textile Journal, apparel and knitwear, january2010,pp40-43.

14)West, D.(1993), " Sewing Thread- How to chose, Textile Asia, Vol.24 No.5,82-87.

15)Taylor, M A.(1990), "Technology of textile properties", London.

16)Ukponmwan, J O et al.(2000) "Sewing Threads", Textile Progress, Vol.30 No3/4,pp79-80.

17)G. Sundaresan, P. K Hari & K R Salhotra, Journal of Textile Institute,1998,89, part-1 423.

18)Munden, D L. & Dorkin, C M C.(1973) " Development in the clothing industry", Textile Progress ,Vol 5 No 1, pp-24.

19)Prabir Janaa* & Noshad Ali Khana, 17 Apr 2014,The sewability of lightweight fabrics using X-feed mechanism, International Journal of Fashion Design, Technology and Education,Volume 7, Issue 2, 2014,pp. 133-142, DOI:10.1080/17543266.2014.906661.

20)G G. Stylios, D.W. Lloyd, (1989) "THE MECHANISM OF SEAM PUCKER IN STRUCTURALLY JAMMED WOVEN FABRICS", International Journal of Clothing Science and Technology, Vol. 1 Iss: 1, pp.5 - 11.

21)Thanaa Moustaf AL Sarhan, Interaction between Sewing Thread Size and Stitch Density and Its Effects on the Seam Quality of Wool Fabrics, Journal of Applied Sciences Research, 9(8): 4548-4557, 2013, ISSN 1819-544X pp4548-4557.

22)Annual Book of ASTM Standards, Section 7, Vol. 7.01, ASM 1996