Relative Performance of Lockstitch and Chainstitch at the Seat Seam of Military Trouser

Arunangshu Mukhopadhyay, Ph.D.

National Institute of Technology Jalandhar, Jalandhar, INDIA

Correspondence to:
Arunangshu Mukhopadhyay, Ph.D. email: mukhopadhyay.arunangshu@gmail.com

ABSTRACT
An experimental investigation of the effect of two different type of stitches viz., lockstitch and chainstitch at the seat seam of trouser for military armed forces has been reported. Performance of chainstitched seam is found to be much better as regards lower value of force at low level of strain, higher value of force at break, strain at break and work of rapture. In general with the change in thread linear density, greater improvement in seam strength, seam strain at break and work up to fracture are obtained in case of chainstitched seam. On laundering, in general force at small strain and force at break increases, the change being more in case of lockstitched fabric. However, strain at break decrease marginally on laundering in case of both the stitches.

INTRODUCTION
Military armed forces in particular require to move, live, survive and fight in hostile environment, which often demand garments of high serviceability. Among the several quality parameters of a sewn product [1-5], mechanical performance of the seam can be adjudged as one of the most important parameter for designing military fabric. In this regard, it is worth mentioning that the stress concentration is maximum at the seat seam of trouser which calls for high performance requirement. Failure of a seam makes trouser unsuitable even though the fabric may be in good condition. Further force at seam at low level of strain influences the ease of deformation of the fabric at the place of seam. Apart from the above, elongation at break and seam work of rupture also decide the service life of seam under varied situation.

About the selection of stitch, chainstitch is less widely used than lockstitch. Chainstitch machine overcomes the bobbin thread limitation and can operate at higher speeds, but it does have disadvantages. The seams are not as secure as the lockstitch (problem of unraveling); and the appearance of the seam from top and bottom of the fabric is different. However, the advantages of the chainstitch far outweigh its disadvantages. A chain stitch seam is strong and can be produced more quickly than a lockstitch seam. Most of the long seams in factory- sewn apparel are made with a chain stitch machine or with variations of it [6]. In case of military trouser both type of stitching is prevalent and, there is lack of idea regarding the choice of the right kind of stitching (viz., lockstitch and chainstitch) to achieve satisfactory level of seat seam performance.

In this article an effort has been made to study the relative performance of the two types of stitching with the variation of sewing thread linear density. Since in the lifetime of a garment, both the cloth and the seam undergo laundering, quality and performance of sewn product might change. Seam performance after laundering is important to adjudge the suitability of the sewn product.

EXPERIMENTAL
Three different two-plied polyester-cotton core spun sewing thread differing in linear density viz., 40 tex, 60 tex, 80 tex are used for making seam. The physical and mechanical properties of the threads are presented in *Table I*. Two different fabrics for military armed forces viz., Jungle-print fabric and Khaki fabric of twill (3/1) and plain woven construction respectively and differing in material constituents are used for stitching (*Table II*). Lockstitch type 301 and chainstitch type 401 are used with stitch density (stitches/10 cm) of 28 for stitching the fabric along warp direction. The tensile properties of seam and fabrics are evaluated using ZWICK universal tester (model 1441) following ASTM standard (D 1683-90a). Load on the test specimen is applied at right angles to the direction of stitching. During loading at constant rate of extension, jaw speed up to the preload of 200 cN is set at 50 mm/min and thereafter speed of 300 mm/min is kept up to the breaking point. The parameters such as force at 1% strain, seam strength, strain at fracture, and work up to fracture are evaluated. For each samples 15 tests are conducted. Differences among the test results are investigated based on t test at 95% confidence level.

The above properties are measured before and after laundering of test specimen. The fabrics with seam are subjected to laundering process in a domestic twin-tub washing machine as per the ASTM standard (D 13 – 1950) using 0.5 g/lit solution of non-ionic detergent Vaptex 1535 (96%). The entire specimens are given seven laundering cycle at 45^{0}C temperature which is followed by drying in the open space during day light.

RESULTS AND DISCUSSION

The changes that occurred in the seam properties with the change in type of stitching, linear density of sewing threads, before and after laundering are given in *Figures 1-8*.

Effect on seam force at 1% strain

It has been observed from *Fig. 1* and *2* that force at 1% strain shows marginal change with the change in sewing thread linear density. The said parameter is mainly influenced by the fabric characteristics and the type of stitches. Chainstitched fabric shows considerably less force at 1% strain than lockstitched fabric. On laundering the change in force at small level of strain become higher and the change is greater in case of lockstitched fabric. Further, change is more in case of Jungle-print fabric, which may be attributed to greater change in dimensional parameter in the printed fabric made out of cotton.

TABLE I
Properties of 2-ply Polyester-cotton core spun sewing threads

Thread linear density (tex)	Modulus at 1% elongation (N/tex)	Load at 1% elongation (cN)	Breaking load (N)	Tenacity (cN/tex)	Extension at break (%)	Work up to fracture (N-m)
40	355	142	16.58	41.45	22.52	0.87
60	270	162	25.41	42.35	21.25	1.18
80	387	309	40.31	50.39	21.3	2.18

TABLE II
Fabric specification

Fabric type	Composition	Linear density (tex)		Thread density		Crimp (%)		Fabric strength (kN/m)	Fabric weight (g/m^2)
		Warp	Weft	Ends/cm	Picks/cm	Warp	Weft		
Jungle-print fabric without laundering	100% cotton	59*	59	28.3	15.4	5.5	6.1	7.0	273.2
Jungle-print fabric with laundering				28.8	15.7	13.2	9.3	7.4	294.1
Khaki fabric without laundering	Polyester-cotton (67:33)	39.4*	39.4*	25.9	18.9	6.2	8.3	9.2	189.2
Khaki fabric with laundering				26	19.2	8.2	9.6	9.5	194.1

* Double yarn

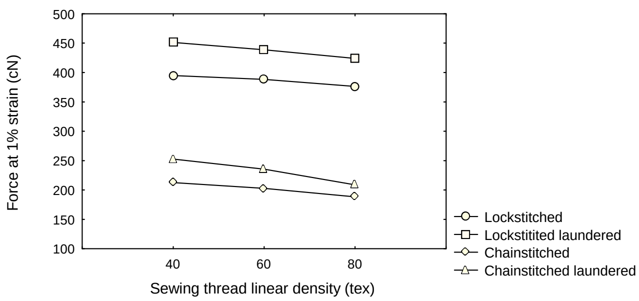

Figure 1. Effect of stitch type and laundering on force at 1% strain of Jungle-print fabric.

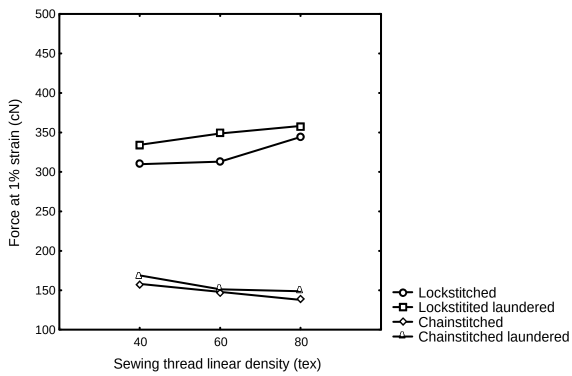

Figure 2. Effect of stitch type and laundering on force at 1% strain of Khaki fabric.

Effect on seam strength

It is seen from *Figure 3* and *4* that force at break increase with the increase in linear density of sewing thread. However, in case of lockstitched fabric the said increase is lower particularly after the linear density of 60 tex.

In case of chainstitched fabric sharp rise in fabric strength is observed with the increase in thread linear density and particularly, improvement in strength is more in case of Khaki fabric. After laundering, improvement in strength is observed which may be due to greater compactness between sewing thread and fabric after the laundering process.

Effect on seam strain at fracture

It has been observed that the above fabric characteristic increases with the increase in linear density of sewing thread [*Fig. 5* and *6*]. The chainstitched fabric show greater seam strain at fracture than lockstitched fabric at all level of sewing thread linear density. The nature of changes in seam strain at fracture is different with the change in linear density of sewing thread. The said parameter is greater in case of Khaki fabric particularly stitched with chain stitch. On laundering marginal decrease in the said parameter is observed. Reduction in seam strain at fracture after laundering may be due to greater compactness between sewing threads and fabrics.

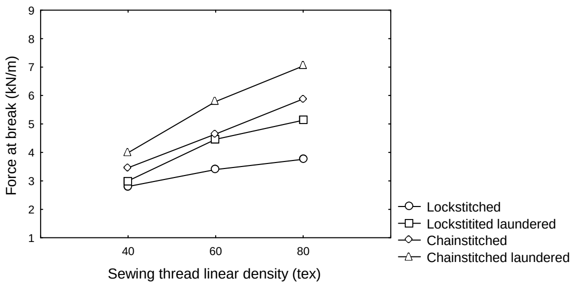

Figure 3. Effect of stitch type and laundering on force at break of Jungle-print fabric.

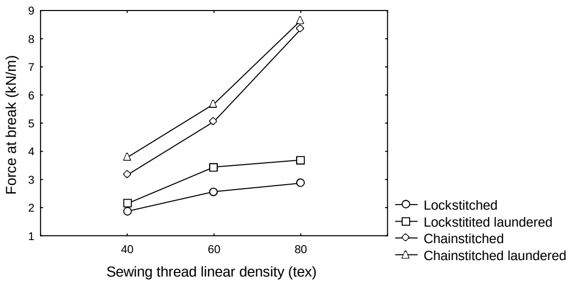

Figure 4. Effect of stitch type and laundering on force at break of Khaki fabric.

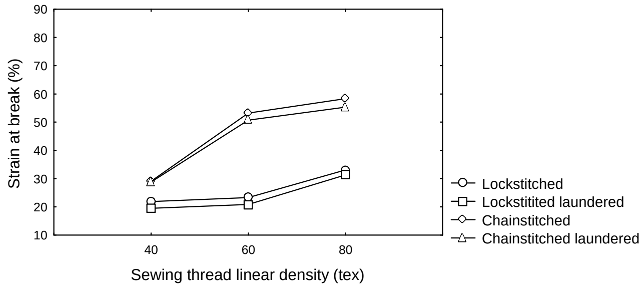

Figure 5. Effect of stitch type and laundering on stain at break of Jungle-print fabric.

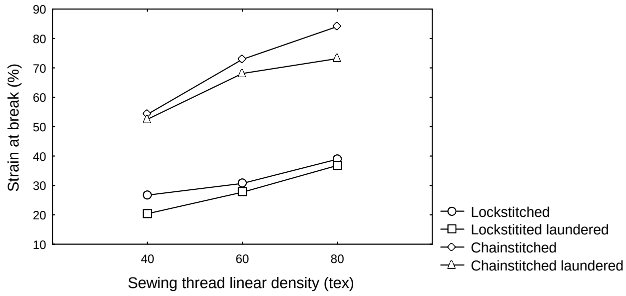

Figure 6. Effect of stitch type and laundering on strain at break of Khaki fabric.

Effect on seam work up to fracture

It has been found that seam work up to fracture increases with the increase in sewing thread linear density [*Fig. 7* and *8*]. Chainstitched fabric exhibit higher work up to fracture than lockstitched fabric and particularly for the seam stitched with thread of higher linear density, difference is large. After laundering improvement in the said parameter is observed only in case of Jungle-print fabric stitched with thread of higher linear density.

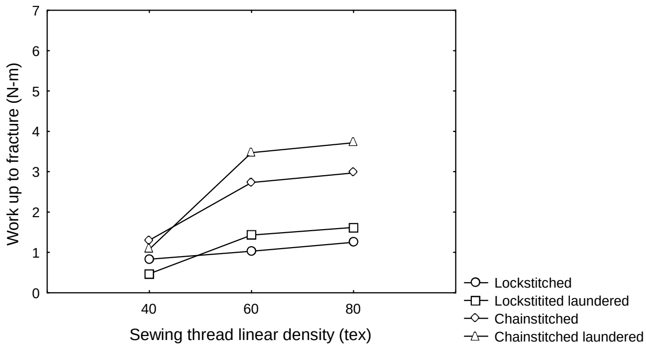

Figure 7. Effect of stitch type and laundering on work up to fracture of Jungle-print fabric.

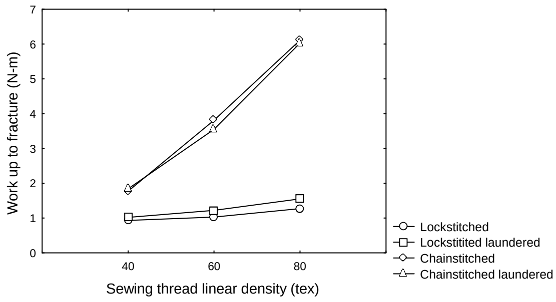

Figure 8. Effect of stitch type and laundering on work up to fracture of Khaki fabric.

CONCLUSIONS

The tensile properties of seat seam of military trouser are significantly affected by the type of stitches (chainstitch/lockstitch), linear density of core spun sewing thread and type of fabric (Jungle-print/Khaki). Chainstitched seam perform much better as regards lower value of force at low level of strain, higher value of force at break, strain at break and work of rapture. In general with the change in thread linear density, force at low level of strain is less susceptible to change among various above stated tensile characteristics. Greater improvement in seam strength, seam strain at break and work up to fracture are obtained in case of chainstitched seam stitched with thread of higher linear density. On laundering, force at small strain and force at break increases, the change being more in case of lockstitched fabric stitched with coarser sewing thread. However, strain at break decrease marginally on laundering.

REFERENCES

[1] Carr H & Latham B, *The Technology of Clothing Manufacture, Blackwell Science*, Oxford, UK, 2nd edition, 1994, 113.

[2] Dorkin C M C & Chamberlain N H, *Clothing Institute Technical Report* No. 11, 1961.

[3] Mukhopadhyay A, Sikka M & Karmakar A K, *Int. J. Clothing Science & Technology*, **16**, 2004, 394.

[4] Ukponmwan J O, Mukhopadhyay A & Chatterjee K N, *Sewing Threads*, Textile Progress, The Textile Institute, UK, **30** (3/4) 2000.

[5] Mukhopadhyay A, Ghosh S & Kaur R, *Melliand Int*., **11** (4), 2005, 311.

[6] Abernathy F H, A Stitch in Time, Oxford University Press US, 1999, 155.

AUTHOR'S ADDRESS

Arunangshu Mukhopadhyay, Ph.D.
National Institute of Technology Jalandhar
Deparment of Textile Technology
G T Road Bypass
Jalandhar, Punjab 144011
INDIA