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A comprehensive study on the effect of different seam parameters on woven fabrics

Abstract

Nowadays, in the ready-made clothing industry, woven fabrics of different construction and pattern are used to a greater extent. Low sewing performance is a common phenomenon that is observed in these fabrics. This study aims to define the dominant parameters such as fiber, yarn, fabric structure, sewing thread, and sewing needle, which affect sewing performance and cause sewing defects, and to examine their effects on sewing quality. The most frequently used needle and sewing thread, fabric weighing under 200g/m^2 which may cause a problem in sewing are selected for this study. Effective sewing parameters and combinations that can work most efficiently with different fabric properties are suggested accordingly. The study aims to determine and minimize the damage caused by sewing needles on thin fabrics.

Keywords: seam parameters, woven fabric, yarn, needle, seam, stitch, seam strength, seam efficiency, sewing thread, seam quality

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Introduction

In the process of garment making, sewing is considered one of the most important operations. It is the process of joining two or more pieces of fabric with a needle and thread. Since sewing is one of the main factors of clothing in ready-made clothing, the quality and appearance of sewing are of great importance in production. Sewing performance, sewing thread, sewing needle, stitch density, stitch direction, sewing type, and sewing machine; depends on tension, speed, fabric thickness/thinness, construction, and fiber types like acetate and linen.[1,2] The selection of sewing parameters according to the fabric construction positively affects the sewing performance. Some woven fabrics are produced unusually according to their styles, as a result of the improper force applied while sewing these fabrics, the fabrics are deformed and lack an aesthetic look that is not appreciated and accepted by the consumers.[3] Although aesthetics in sewing are important, this expectation changes according to the type of clothing and the place of use, strength and flexibility values should be examined for a comfortable and durable seam.[4,5] There is no particular solution that can fix the problem of seam damage. All parameters related to fiber, yarn, fabric construction, sewing thread, sewing needle, and sewing machine, machine design, fabric parameters should be examined for minimum sewing error.[2] If the sewing thread chosen is thicker than the thickness of the fabric, then the thread cuts the fabric whereas the stitching should be durable. If the selected sewing needle is, the needle pierces the fabric.[6] The proper choice of needle and sewing thread is crucial as thin fabrics will show more damage according to the force they endure. The needle should be preferably thin and the thickness of the sewing thread should be chosen corresponding to the selected needle.[7]

Seam puckering is a common problem, especially on tightly woven fabrics that can be considered thin if the stitch parameters are not selected according to the fabric. It is the gathering of a seam during sewing, after sewing, or after laundering, causing an unacceptable seam appearance. It affects not only the aesthetic appearance of the product but also the sewing performance. The seam has a wavy appearance. When the machine settings are kept constant, the most important factors affecting the sewing quality are the production method, strength, thickness, and needle thickness of the sewing thread.[8] Sewing defects can be encountered for many reasons. For a systematic and sustainable production, it is necessary to act in accordance with the fabric thickness, fiber composition, and fabric construction in sewing.[9] Production must be uninterrupted in terms of sustainability and must go on with the least amount of error possible. If the production is interrupted due to errors in the garment, then the time and cost of the materials used will be damaged.[10]

According to the results of the previously conducted studies, it has been seen that the precise selection of sewing parameters is the most important factor in intercepting sewing errors in the fabric.[11] Seam flexibility increases the comfort and performance of the garment. The elasticity of the seam is a measure of whether the seam can recover after the applied force.[12] Seam strength is the strength of the seam assemblies of a garment. It is a measure of the resistance of the seam against the applied force. Depending on the type, strength, and unevenness of the sewing thread, seam breakage occurs first in the thinner areas. It depends on thread tension, stitch density, and needle number. It is not desirable that the strength of the stitch is higher than the strength of the fabric, otherwise, the stitches will cut the fabric.[13,14] Sewing efficiency is improved when sewing parameters are incorporated correctly with each other.[15] High-speed sewing leads to a reduction in seam puckering. The determining factor in this regard is the adjustment according to the fabric construction.[16]

In this study, the most frequently used sewing thread and sewing needle in the ready-made clothing industry and the thin, stylish fabrics with the highest probability of sewing mistakes were selected. Two different fabric structures were selected to determine the sewing

behavior. To compare the sewing performances of the fabrics, the fabrics were sewn using 2 different needles, 2 different sewing threads, and two different densities (number of steps) in the weft and warp direction, and the seam strength, elongation, and seam appearance of the samples were examined.

During the study, the fabric contact increases along with the increase of variable yarn number observed. This phenomenon creates a partial friction effect on the yarns either in warp or weft direction and yarn slippage is visible in warp or weft direction after a few uses of the product. However, the main effect is that the yarns in the weft and warp directions are more durable than the sewing thread, resulting in breakage in the fabric. In both cases, the adverse effect of sewing thread selection on the final product has been extensively investigated in the study.

To define the dominant parameters such as fiber, yarn, fabric structure, sewing thread, and sewing needle, which affect sewing performance and cause sewing defects, and to examine their effects on sewing quality. The most frequently used needle and sewing thread, fabric weighing under 200g/m^2 which may cause a problem in sewing are selected for this study. Effective sewing parameters and combinations that can work most efficiently with different fabric properties are suggested accordingly. The study aims to determine and minimize the damage caused by sewing needles on thin fabrics.

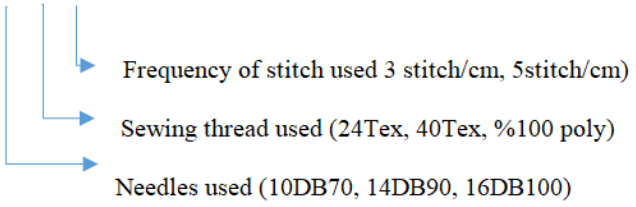
Materials and methods

In the study, Brother DB2-B736-3TR automatic straight stitch machine with a knife, Orange brand sewing needles 10DB70, 14DB90, and 16DB100 were used. For the measurement of seam strength and elongation, 72 samples were taken from two fabrics separately in the warp and weft direction.

The samples used in the experiment were prepared with two different fabrics (acetate, rayon), different directions (warp, weft), different sewing threads (24 Tex, 40 Tex), and different stitch density (3 and 5 stitches/cm). All physical tests applied to the fabric were kept under standard laboratory conditions for 24 hours and were carried out under standard atmospheric conditions (20±2)°C and (65±2%) humidity according to TS EN ISO 139 (10) standard. The supply of fabric and sewing threads used in all tests performed in the study was provided and carried out by AKIN TEXTILE AS (Table 1) (Table 2).

The coding system used in this study in figures, charts, and tables:

10/24/5



The strength and elongation values of fabric 1 and fabric 2 in the warp and weft directions are given in Table 3 and Table 4. It is seen that the samples sewn in the weft direction in Fabric 1 show less elongation compared to the samples sewn in the warp direction. For fabric 2, the same incident is observed. The density of weft yarn is less than warp yarn and the stitch circulates more easily between the weft yarns which is the main reason for the lower elongation and strength values of weft yarn in comparison to the warp yarn. The increase in the number of stitch steps in the fabric decreased the elongation and strength values. It can be said that the increase in the number of steps enhances the performance in the joining process of two fabrics. It has been observed that the increase in the number of threads used in sewing decreases the elongation and strength values. It is due to the increase in sewing thread strength. Although there is no scientific difference in elongation and strength values of the sewing needles, it is very important to select the proper needle. If the needle selection is wrong, then fabrics warp and weft yarns are damaged, which affects the appearance of the fabric.

Table 1 Used fabrics properties

Fabric no	Warp	Weft	Warp density	Weft density	Weight (g/m^2)	Thickness (mm)
1	A:60/2RR Penye Compact T24Z B:16/1 Linen	A:60/2RR Penye Compact T24Z B:16/1 Linen	24	18	130	0.42
2	120F65 Acetate Glossy TM600S	120F30 Rayon Glossy T1300S	68	35	146	0.34

Table 2 Used seam parameters

Fabric no	Seam direction	Sewing thread (Tex)	Seam needles	Seam tightness (stitch/cm)
1	Weft	24	10DB70	3
2	Warp	40	14DB90 16DB100	5

Table 3 Seam strength and elongation values for warp and weft direction of fabric1

FABRIC 1												
Direction	Warp						Weft					
Seam tightness	3 Stitch/cm			5 Stitch/cm			3 Stitch/cm			5 Stitch/cm		
Needles	10	14	16	10	14	16	10	14	16	10	14	16
Str/El.	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mmN	mm/N
24Tex	3.5/60	3.5/60	3.33/59.9	5.33/60	May-60	4.5/60	2.8/59.7	3.16/60	3.5/60	5.17/60	4.8/60	5.33/59.3
40Tex	3.66/60	Mar-60	3.34/60	4.66/60	Apr-60	4.83/60	3.5/60	Mar-60	3.5/60	3.66/59.47	May-60	May-60

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Table 4 Seam Strength and Elongation Values for Warp and Weft direction of Fabric2

FABRIC 2												
Direction	**Warp**						**Weft**					
Seam tightness	**3 Stitch/cm**			**5 Stitch/cm**			**3 Stitch/cm**			**5 Stitch/cm**		
Needles	10	14	16	10	14	16	10	14	16	10	14	16
Str/El.	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N	mm/N
24Tex	5.5/59.9	6.17/60	Jun-60	4.83/60	5/59.9	4.66/60	2.16/60	2.5/60	2.5/59.9	3.33/59.7	3.67/59.9	3.5/60
40Tex	May-60	May-60	5.17/59.9	4/59.3	4.5/60	Apr-60	2/59.3	2/59.7	2/59.7	3.33/59.3	3.16/59.3	3.16/60

Results and discussions

When Figure 1 is examined, the lowest elongation is seen in 16DB100 needle and 24Tex sewing thread. If the 16DB100 needle is thicker than it should be, it disrupts the 90-degree right angle formed by the warp and weft threads and creates a hole. However, the formation of this hole is positive from the point of view of the sewing thread.

Figure 5L illustrates the negative effects in the sections where the stitching is along with perforations due to the abrasion in the warp and weft threads of the fabric. Choosing needle number 10DB70, which is a finer needle molded with 24Tex sewing thread, will be more usable in terms of fabric appearance and elongation values.

Compared to the samples prepared in the warp direction, they gave the expected values in the samples formed in the weft direction. In the samples prepared in the weft direction, a large density of the stitch passes over the warp yarns of the fabric, and the strength and elongation values and the stitch appearance are directly proportional. Because of this situation, the values in Figure 2 directly determine the appropriate parameters. The lowest elongation and strength values are seen in the 10DB70 needle and 24Tex sewing thread. Figure 5G shows that the fabric appearance is also smooth.

When Figure 3 is examined, low elongation and strength values are seen in needles 16DB100 and 10DB70. When the 16DB100 needle pierces the warp yarns of the fabric, the elongation values are low. The appearance of the needle number 10 DB70 is also quite good when looking at Figure 5A. When the density is examined in Figure 3, it is seen that as the number of stitch/cm increases, although there was not much change in the strength and elongation values, the decrease in the number of stitching due to the construction of the fabric 2 caused a grin in the seam. An increase in the number of sewing steps too much is not considered appropriate as it will compress the warp yarns of the fabric, thus causing shrinkage and increasing the risk of sewing thread slippage.

When Figure 4 is examined, it is observed that the lowest elongation and strength value is in the 40Tex sewing thread. As the sewing thread passes between the warp and weft yarns of the fabric, it creates frictional force and movement together with the sewing needle. Figure 5B depicts that it directly affects the fabric appearance and elongation values. For fabric 2, 40Tex sewing threads are considered suitable. It has been observed that the thread to be used in fabric sewing is close to the fabric warp count, which minimizes the mistakes that occur during sewing and enhances the sewing performance.

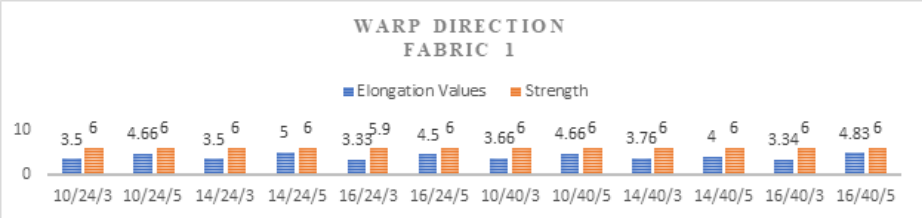

Figure 1 Strength and elongation graph of fabric 1 (Sewed with a frequency of 3 and 5 in the warp direction).

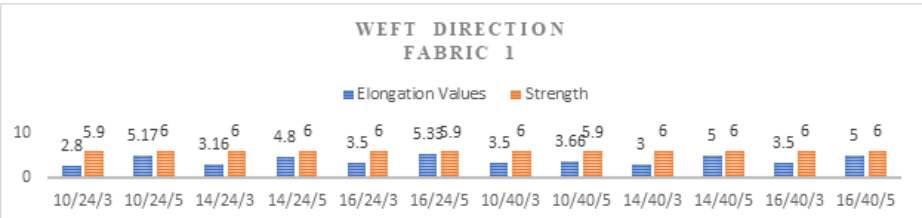

Figure 2 Strength and elongation graph of fabric 1 (Sewed with a frequency of 3 and 5 in the weft direction).

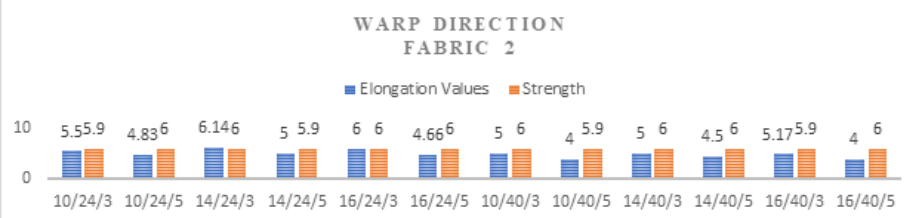

Figure 3 Strength and elongation graph of fabric 2 (Sewed with a frequency of 3 and 5 in the warp direction).

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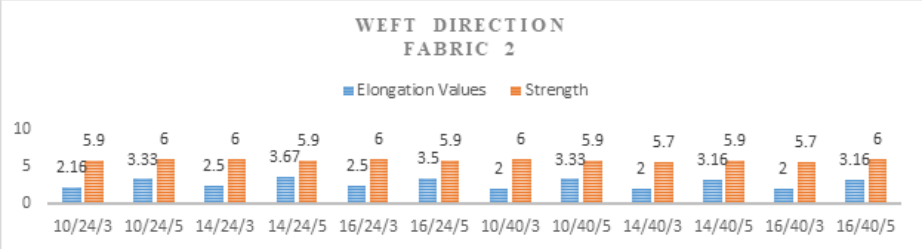
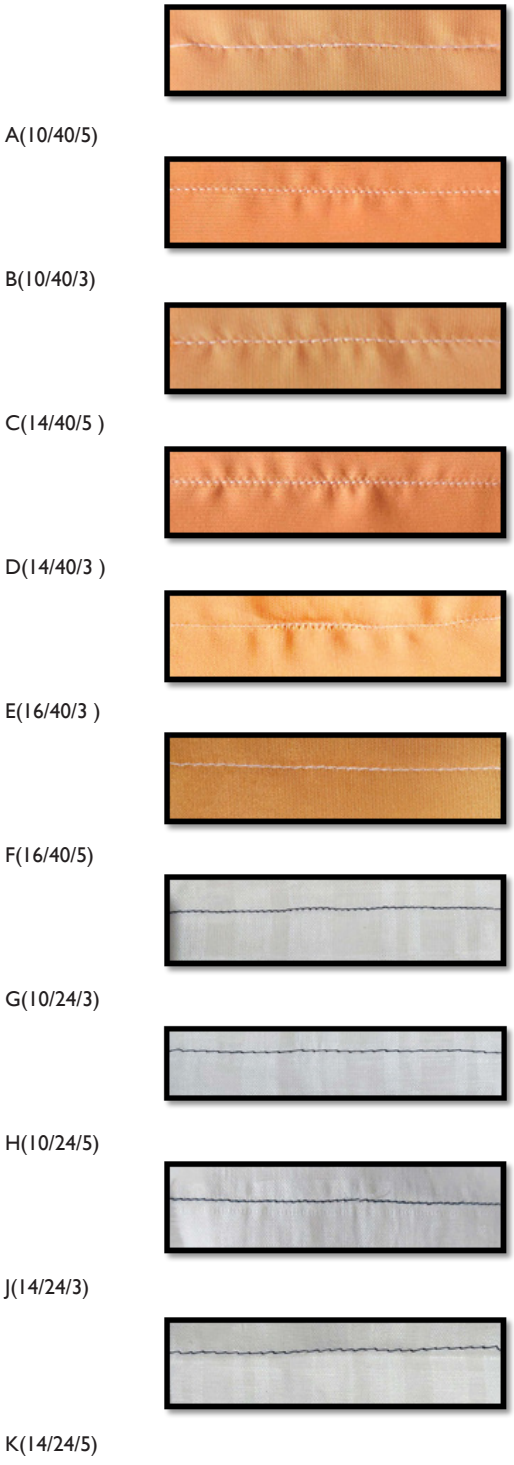


Figure 4 Strength and elongation graph of fabric 2 (Sewed with a frequency of 3 and 5 in the weft direction).



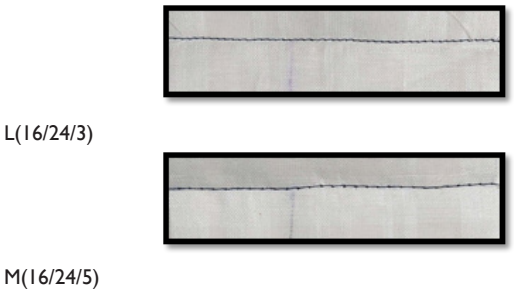


Figure 5 Photos of the samples used in fabric 1and fabric 2.

Conclusion

In the study, the parameters that can be applied to fabrics weighing under 200 gr/m2 with thicknesses less than 0.4 mm were examined, and the results were observed. Thinner sewing threads increased the elongation values, yarn breaks were observed whereas visible shrinkage was observed in much thicker sewing threads. The suitability of the needle parameter in sewing has been decided by considering the appearance of the fabric after sewing. For weights, less than 200gr/cm and fabric thickness of 0.4mm, needle size 10DB70 are suitable for both fabrics. Increasing the seam per step in the fabric combination causes puckering due to fabric faults, while excessive lowering causes the seam to be open. 3-5 stitches/cm is considered ideal for both fabrics. When warp and weft samples are examined, the weft direction corresponding to the stitch in the production direction is more suitable because it ensures that the main stitch passes over the fabric warp threads, making it stronger. Moreover, the warp threads are thinner than the weft threads. As a result, they do not form potholes or thickness on the fabric surface.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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