

## TECHNICAL NOTE

### An investigation into the properties of cotton/spandex and polyester/spandex knitted fabrics

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*(Received 11 June 2008; final version received 7 July 2008)*

Very little work has been done in the area of spandex-blend weft knits. This paper presents the findings of knits produced from cotton/spandex- and polyester/spandex-blend knits produced from core spun yarns. The dimensional properties of cotton/spandex knits compare well with those of cotton knits. The behaviour of the loops in both the spandex-blend knits in the course direction gives rise to the difference in the properties. The feed yarn tension has insignificant effect.

**Keywords:** cotton; course; spandex; wale

#### Introduction

Considerable work has been done in the area of knitted fabrics. A number of research workers have made noteworthy contributions in the field. Munden (1959) derived equations considering the diameter of the yarn being small compared with the width of the loop for minimum bending (necessary for minimum energy consideration). Nutting and Leaf (1963) showed experimentally that the loop shape (geometry) of weft-knitted fabrics is controlled by the loop length, fibre type and properties and method of relaxation. Marmarali (2003) studied the dimensional and physical properties of cotton/spandex-plated single-jersey fabrics and the results are compared with those of plain cotton knits. So far, very exhaustive work has been done on cotton single-jersey knitted fabrics and the relationship between machine and fabric parameters has been established theoretically and verified experimentally. However, no work has been reported on the dimensional stability of spandex-knitted fabrics. Since knitting of stretch fabrics using spandex in core or plated form is gaining momentum for various end uses, it becomes necessary to study systematically the dimensional stability of spandex-blended fabrics for the purpose of estimating the finished fabric dimensions beforehand. The preliminary study on cotton/spandex knitted fabrics was necessary to understand the general behaviour of such fabrics before going into detailed investigation.

#### Materials and methods

##### *Cotton/spandex*

Cotton/spandex core spun yarn of 20-tex linear density was used in this study. The denier of spandex (Lycra) filament is

40. The experimental samples were knitted on a 24-gauge, 20-inch-diameter high-speed circular knitting machine equipped with positive feeders.

Single-jersey fabrics with four levels of loop length were produced. The samples were subjected to dry relaxation and wet relaxation. For dry relaxation, the samples were left lying on a smooth flat surface in standard atmosphere for 3 days. Then, the samples were wet relaxed and bleached using hydrogen peroxide and dried in accordance with current manufacturing practices.

Measurements of the fabric parameters such as courses/cm and wales/cm were taken in wet-relaxed state.

##### *Polyester/spandex*

The polyester/spandex core air-covered high-stretch yarn was used in this experiment. The linear density of the yarn is 97 denier. The total number of filaments is 109 (108 polyester + 1 Lycra). The denier of spandex (Lycra) filament is 40. The spandex is 12.5% and polyester component is 87.5%.

The experimental samples were knitted on a 28-gauge, 30-inch-diameter Mayer & Cie circular high-speed knitting machine with positive storage feeders. The total number of needles is 2640. The number of feeders is 64 and the machine speed was 25 rpm.

A total of nine single-jersey fabrics were produced with three levels of loop length and three levels of feed yarn tension. The loop lengths used are 2.6, 2.9 and 3.2 mm. The feed yarn tensions employed are 2.5, 4 and 6 cN.

All the samples were subjected to dry relaxation and wet relaxation. For dry relaxation, the samples were left lying on a smooth flat surface in standard atmosphere for

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Table 1. Dimensional properties of wet-relaxed 20-tex cotton/spandex knitted fabrics.

Sl no.	Actual loop length (cm)	Tightness factor	Courses/cm	Wales/cm	Stitch density	Loop shape factor courses/cm or wales/cm
1	0.28	16.27	28.4	17.3	491.3	1.64
2	0.31	14.70	27.6	17.3	477.5	1.60
3	0.33	13.81	26.8	17.3	463.6	1.55
4	0.34	13.40	26.0	17.3	449.8	1.50

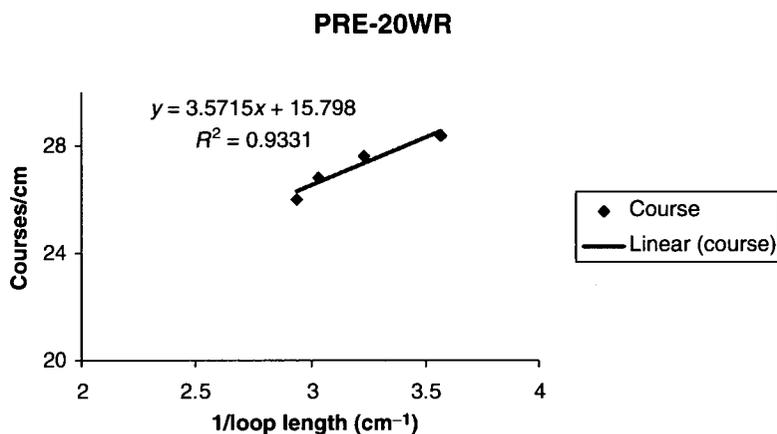


Figure 1. Courses/cm plotted against 1/loop length for wet-relaxed 20-tex cotton/spandex plain knitted fabrics.

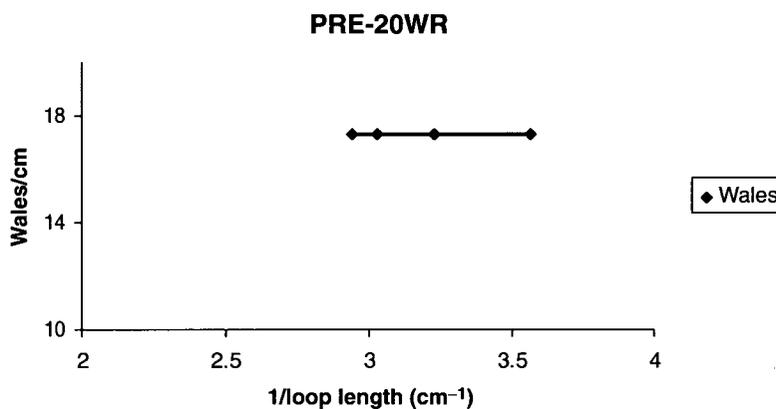


Figure 2. Wales/cm plotted against 1/loop length for wet-relaxed 20-tex cotton/spandex plain knitted fabrics.

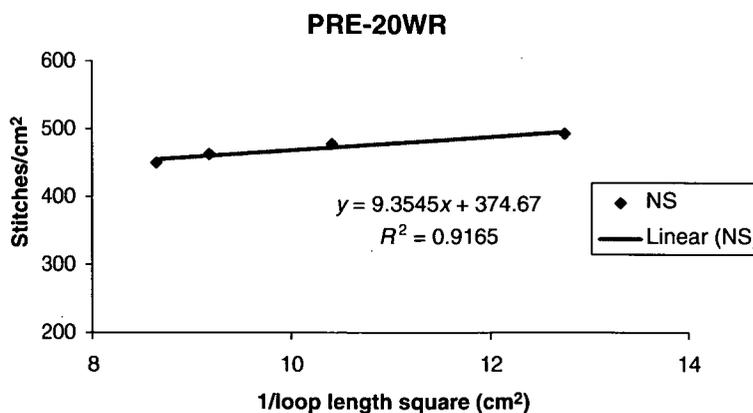


Figure 3. Stitch density plotted against 1/loop length square for 20-tex cotton/spandex plain knitted fabrics.

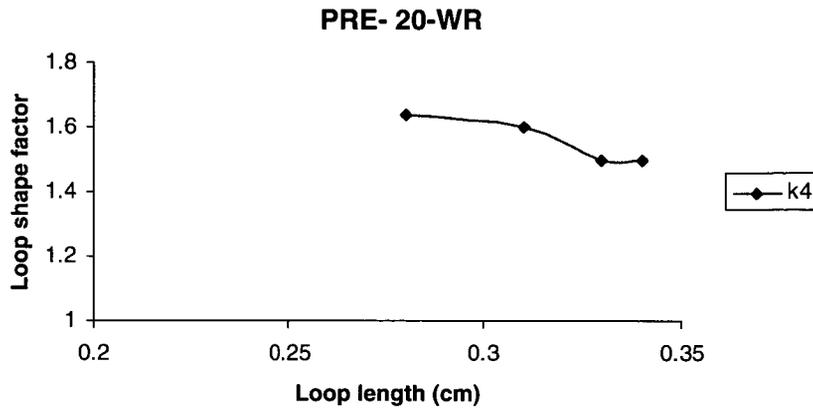


Figure 4. Loop shape factor for wet-relaxed 20-tex cotton/spandex plain knitted fabrics.

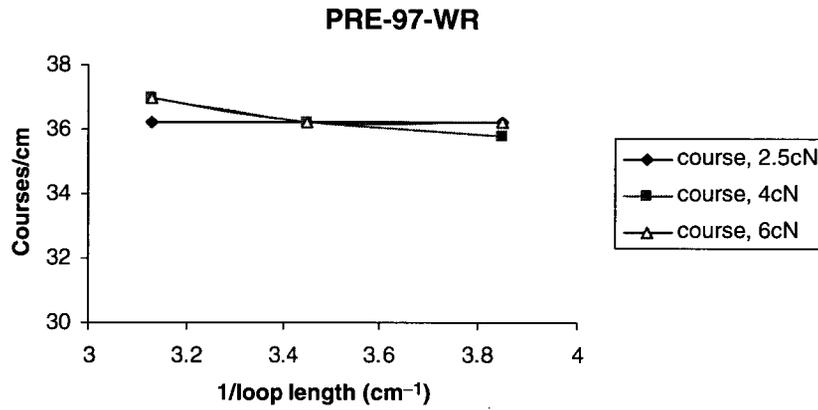


Figure 5. Courses/cm plotted against 1/loop length for wet-relaxed 97d polyester/spandex plain knitted fabrics.

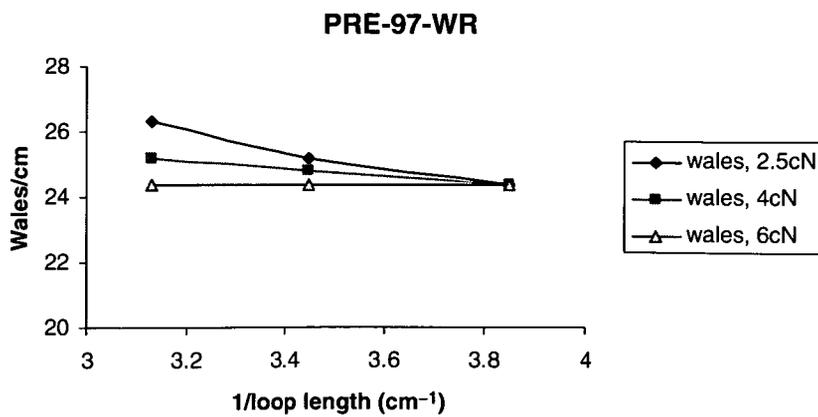


Figure 6. Wales/cm plotted against 1/loop length for wet-relaxed 97d polyester/spandex plain knitted fabrics.

Table 2. Results of wet-relaxed 97d polyester/spandex plain knitted fabrics.

Sl no.	Loop length (cm)	Feed yarn tension (cN)	Courses/cm	Wales/cm	Stitch density	Loop shape factor courses/cm or wales/cm
1	0.26	2.5	36.2	24.4	883.2	1.48
		4.0	35.8	24.4	873.5	1.46
		6.0	36.2	24.4	883.3	1.48
2	0.29	2.5	36.2	25.2	912.2	1.44
		4.0	36.2	24.8	897.8	1.45
		6.0	36.2	24.4	883.3	1.48
3	0.32	2.5	36.2	26.3	952.0	1.37
		4.0	37.0	25.2	932.4	1.46
		6.0	37.0	24.4	902.8	1.51

3 days. For wet relaxation, the samples were hot washed at 60°C for 45 minutes with 0.05 g/L wetting agent. After washing, the samples were given a brief hydro-extraction. Drying was done in air.

Fabric parameters such as courses/cm and wales/cm were measured for all the samples in the wet-relaxed state as per the procedure given in Section 3.

## Results and discussion

### Cotton/spandex

The results of the tests carried out in the wet-relaxed 20-tex cotton/spandex plain knitted samples are given in Table 1.

From Table 1, it can be observed that the courses/cm decreases with the increase in loop length while the wales/cm remains constant. The stitch density also decreases with the increase in loop length. The loop shape factor (the ratio of courses/cm to wales/cm) decreases with loop length, indicating its dependence on the loop length.

In Figure 1, the courses/cm is plotted against 1/loop length for wet-relaxed 20-tex cotton/spandex plain knitted fabrics and a regression line has been drawn. The regression coefficient is good at 0.93, indicating that the courses/cm is linearly related with 1/loop length.

In Figure 2, wales/cm is plotted against 1/loop length and it can be seen that the wales/cm is not affected by loop length for wet-relaxed 20-tex cotton/spandex plain-knitted fabrics. In Figure 3, the stitch density is plotted against 1/loop length square and a regression line has been drawn. The regression coefficient is good at 0.91, indicating that the stitch density is linearly related with 1/loop length square.

In Figure 4, the loop shape factor is drawn against loop length and it can be observed that the loop shape depends on loop length for cotton/spandex plain knitted fabrics.

### Polyester/spandex

The results of the experiments are given in Table 2 for wet-relaxed fabrics. From Table 2, it can be observed that there is a no clear trend observed in the case of either effect of loop length or effect of feed yarn tension as observed in the cotton/spandex fabrics.

For wet-relaxed fabrics, the courses/cm is plotted against 1/loop length (Figure 5), the wales/cm is plotted against 1/loop length in Figure 6, and stitch density is plotted against 1/loop length square in Figure 7.

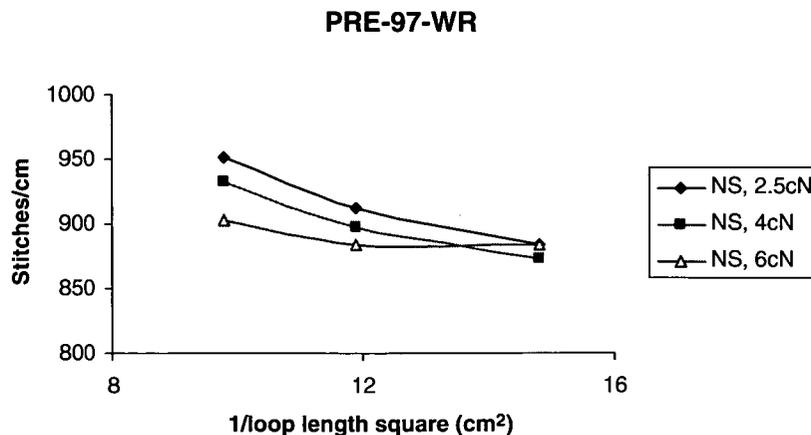


Figure 7. Stitch density plotted against 1/loop length square for wet-relaxed 97d polyester/spandex plain-knitted fabrics.

## Conclusion

### *Cotton/spandex*

The following conclusions have been deduced from the study:

- a. The courses/cm decreases with the increase in loop length while wales/cm remains constant.
- b. The stitch density also decreases with the increase in loop length.
- c. The loop shape factor (the ratio of courses/cm to wales/cm) decreases with loop length, indicating its dependence on the loop length.
- d. The regression coefficient is good at 0.93, indicating that the courses/cm is linearly related with 1/loop length.
- e. The change in loop shape in cotton/spandex-knitted fabric makes this fabric different from 100% cotton knitted fabrics.
- f. The regression coefficient is good at 0.91, indicating that the stitch density is linearly related with 1/loop length square.
- g. The loop shape depends on loop length.

From the above findings, it can be inferred that the difference in behaviour is due to the difference in behaviour of the cotton/spandex loops in course direction and this prompts for further studies to be carried out in this area.

### *Polyester/spandex*

The feed yarn tension has a slight influence on wales/cm, but there is no clear trend observed. Changes in the loop length does not affect the courses/cm and wales/cm. This is due to the effect of spandex offsetting the effect of loop length on dimensions. It can thus be concluded that the feed yarn tension does not have a significant influence.

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