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Handle of cotton: wool knitted khadi fabric

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Abstract: *Hand of cotton: woolhand knitted fabrics has been reported in this study. Indian crossbred wool (Rambouillet and Chokla) was blended with cotton (Mech I) in three different ratios (10-90%, 20-80% and 30-70%) and yarns were prepared on hand spinning system.Knitted fabric samples were constructed on 10-12 gauge, flat bed hand knitting machine. Fabric handle was objectively assessed by SiroFAST.*
Key words:*compression, dimensional stability, bending rigidity, formability*

I. Introduction

Handle is one of the most important properties of fabric to be used for apparel. Fabric handle is a complex parameter and is related to several fabric properties such as flexibility, compressibility, elasticity, resiliency, density, surface contour, surface friction, and thermal characteristics. Handle of fabric is affected mainly by fabric structure and fabric geometry.

The world today has suddenly turned its attention towards the natural fibres that are environment friendly and biodegradable. Besides, today's consumer demands well fitted comfortable, economical and easy to care for garments, which can be washed and worn. This demand is easily met by knits. Knittedproducts, whether fabric or garments, are mainly produced in mills. Their production in khadi sector is limited. Cotton wool blend fabrics are growing in popularity due to increased consumer demand for styling, comfort and for eco-friendly natural fibers. Moreover, in Indian climatic conditions, during pre and post winter season use of cotswool is very popular for apparel purpose (Charankar, 2007).

India is a vast country with 44 descript sheep breeds spread over a wide range environmental conditions(http://www.wraindia.com/Karim-Shakyawar.pdf).About 10 % Indian crossbred wool is of apparel grade, 70 % is of carpet grade and 20 % coarse gradesuch as clothing, blankets, carpets etc.The Indian sheep breeds produce wool differing in fineness from 25 to 60 µ. Its utilization is limited in apparel sector(Karim and Shakyawar, 2011) Therefore, to increase the use of Indian cross bread wool in apparel sector blending has been done with cotton fiber to produce fabrics with improved properties.In the present study an attempt has been made to develop cotton: wool knitted fabrics for khadisector by utilizing hand spinning machines and its handle property has been evaluated and reported.

II. Methodology

2.1 Material

Mech-I cotton obtained from KVIC Pooni plant of Raibareilly and crossbred wool (Rambouillet and Chokla) produced in Fatehpur farm of Rajasthan were used in present study.

2.2 Method

Development of cotton wool blended yarns

Indian crossbred wool was blended with cotton (Mech I) in three different ratios (10-90%, 20-80% and 30-70%).Yarn of 100% cotton was prepared for base reference.

Cotton and wool fibres were opened thoroughly and blended. After it sandwich blending technique was followed to prepare blend of fibres. Oiling of wool and cotton was done to minimize the fibre breakage as well as to reduce fly waste and static electricity during carding.After oiling of material carding was done on khadicotton carding machine and different kinds of blends were prepared. New Model Charkha, (Chattopadhyay et.al, 2003) a modified version of Amber charkha used in khadi system for woolen spinning, was used to impart twist to yarns. Properties of yarn viz. unevenness (ASTM D-1425:1996), single yarn strength and elongation (IS: 1670-1991) have been shown in Table1.

Development of knitted fabrics

Knitted fabric samples were constructed on 10-12 gauge, flat bedhandknitting machine. Double jersey fabric was constructed with the help of latch needles.

Determination of handle property of fabrics

Fabric handle was objectively assessed by SiroFAST. SiroFASTis a set of instruments and test methods for measuringmechanical and dimensional properties offabricthat can be used to predict performanceingarmentmanufactureandtheappearanceofthegarmentsin wear. It was developed in Australia bythe CSIRO Division of Wool Technologyto meet industry's need for a simple, reliablemethod of predictingfabricperformance.

SiroFASTconsistsofthreeinstruments andatestmethod:
SiroFAST-1 is a compression meterthat measures the fabric thickness.
SiroFAST 2 is a bending meter that measures thefabric bendinglength.
SiroFAST-3 is an extensionmeterthat measures fabric extensibility.
SiroFAST-4 is a test procedure for measuringdimensional properties offabric.

Sampling for SiroFAST tests

For SiroFAST-1, 2, and 3, test samples of size 150 mm X 50 mm are cut. 5 replicates are required for SiroFAST - 1 Compression. 3 warp and 3 weft replicates are needed for SiroFAST – 2 Bending, 3 warp, 3 weft, and 6 bias replicates (3 left-bias and 3 right-bias) for SiroFAST- 3 Extension and aseparatesampleof 300 X 300 mm is cut for SiroFAST-4.

III. Result and discussion

Compression meter

Thickness of fabrics has been measured at two different pressures, 2gf/cm^2(T2) and 100 gf/cm^2(T100). ST is thickness of surface layer which is difference of T2 and T100. T2R and T100R is released thickness i.e. thickness after removal of pressure. STR is released surface thickness. The released surface thickness is often ameasure of the stability of a fabric.

Table 1: Thickness and surface thickness of fabric

S. No.	Blend percent	T2 (mm)	T100 (mm)	ST (mm)	T2R (mm)	T100R (mm)	STR (mm)
1	100 C	2. 315	1.870	.445	2.195	1.810	. 386
2	90C:10W	2.274	1.849	.425	2.081	1.750	. 331
3	80C:20W	2.540	2.059	.481	2.158	1.831	. 327
4	70C:30W	2.521	1.992	.529	2.133	1.758	. 375

Data presented in Table 1 shows that thickness of blended fabrics decreases when 10% wool is blended with cotton. But on further increasing the wool percentage to 20 and 30, thickness of fabric increases. This trend is observed in case of T2, T100 and ST. Fabric thickness is directly affected by yarn thickness. Diameter of blended yarns is more than pure cotton yarn. Further, yarn diameter has increased with increase in wool percent (Table) that is why fabric thickness has also increased. Correlation coefficient has been calculated between yarn count and fabric thickness. High negative correlation (r = - 0.972) significant at 0.05% is found between these two parameters. It is negative because count has been calculated in indirect system.

Although no particular trend is found on increasing the wool percent from 10 to 30 in cotton wool blend, but it can be seen that released thickness (T2R, T100R) and released surface thickness (STR) of cotton wool blended fabrics is less than that of pure cotton fabric.

Bending rigidity and Shear rigidity

Bending properties of a fabric are determined bythe yarn bending behavior, the construction of the fabric and the finishing treatments applied. Bending length is related to the ability of a fabric to drape, and bending rigidity is related more to the quality of stiffness feltwhen the fabric is touched or handled.

Table 2: Bending rigidity and shear rigidity

S. No.	Blend percent	Bending rigidity (µN.m)		Shear rigidity(N/m) G
		Wale wise B-1	Course wise B-2	
1	100C	142.7	69.9	6.6
2	90C:10W	107.8	36.5	7.0
3	80C:20W	119.5	41.8	8.9
4	70C:30W	84. 3	41.7	7.9

Bending rigidity- Data presented in Table 2 show that rigidity of blended fabrics has decreased compared to pure cotton fabric. Thus incorporation of wool fibre in blends has profound positive impact on bending rigidity of fabrics. Wool fibre is soft and pliable whereas cotton is comparatively stiff. That is why considerable decrease has been found in stiffness of blended fabrics.

Shear Rigidity- The ability of a two-dimensional fabric to form a three-dimensional product is related to the ability of the fabric to be sheared in its plane. This is characterized by shear rigidity, a parameter derived from bias extensibility. Table shows that shear rigidity of fabrics has increased after blending wool fibrewith cotton `fibre.

Extension meter

The ability of a fabric to stretch at low loads is critical to garment and other sewn products' making-upprocedures. Low values of extension give problems in moulding, produce seam pucker and give difficulties in producing overfed seams. High values of extension give problems in laying up and such fabrics are easily stretched during cutting with a consequent shrinkage to a smaller size afterwards. Problems also occur in case of high extension during matching of plaids owing to the ease with which fabric distorts.

Table3: Extensibility of fabrics

Blend percent	E5-1 (%) Wale wise	E5-2 (%) Course wise	E20-1 (%) Wale wise	E20-2 (%) Course wise	E100-1 (%) Wale wise	E100-2 (%) Course wise	EB5 (%)
100C	5.6	21.0	17.4	21.0	20.9	21.0	18.7
90C:10W	4.1	21.0	16.1	21.0	20.8	21.0	17.7
80C:20W	2.8	21.0	14.2	21.0	20.9	21.0	13.9
70C:30W	4.1	21.0	16.4	21.0	20.8	21.0	15.5

Extensibility of fabrics has been measured at three fixed forces- 5, 20 and 100 gf/cm. Besides, extension has also been measured on the bias at a force of 5 gf/cm. Result of extensibility has been shown in Table3.

It is evident that extensibility of blended fabrics is less than that of pure fabric at 5 gf/cm (E5) and 20 gf/cm (E20) loads and in bias direction at 5 gf/cm (EB 5) but there is no significant difference in extensibility of fabrics at 100gf/cm (E100). Table also shows that extensibility of fabrics has increased continuously with increase in load from 5 gf/cm to 100 gf/cm.

IV. Dimensional stability and formability of knitted fabrics

Poor dimensional stability has a negative impact on the final appearance of textile products,including size changes, poor matching of seams, and puckering.The dimensional stability of cotton-wool knitted fabrics has been expressed by two properties namely: relaxation shrinkage and hygral expansion. Hygral expansion is defined as the reversible change in fabric dimensions that occur when the moisture content of the fabric is altered while, the relaxation shrinkage is the irreversible change in dimensions that occurs when a fabric is relaxed in steam or water.Hygral expansion or contraction is caused by the swelling or de-swelling of hygroscopic fibres in atmospheres of changing humidity. Relaxation shrinkage is due to the recovery of fibres strained during manufacturing processes. Some relaxationshrinkage is necessary, for reducing bulk in eased seams (armholes etc.), though high levels cause problems. Result has been given in Table 4.

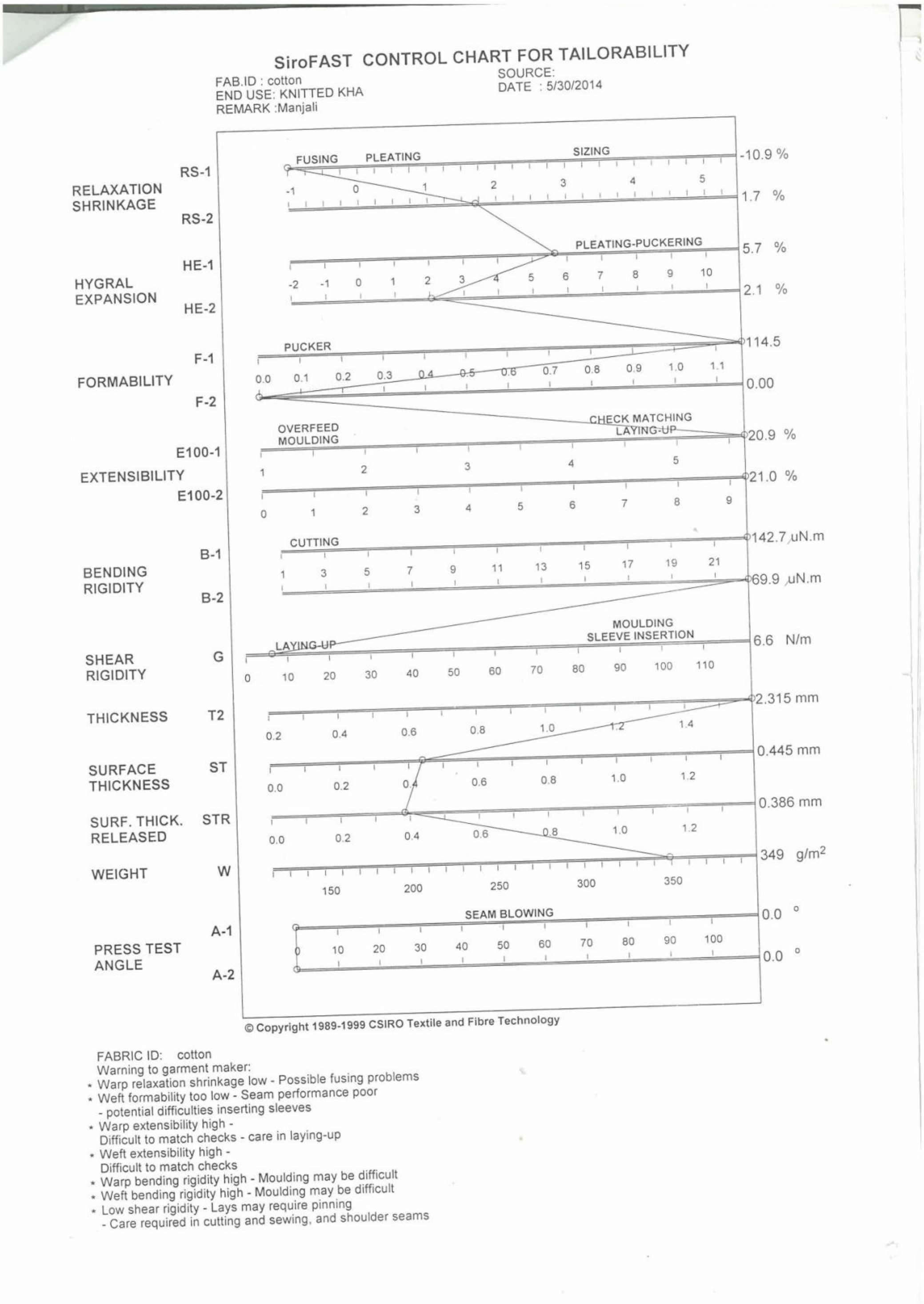
Table4: Dimensional stability and formability

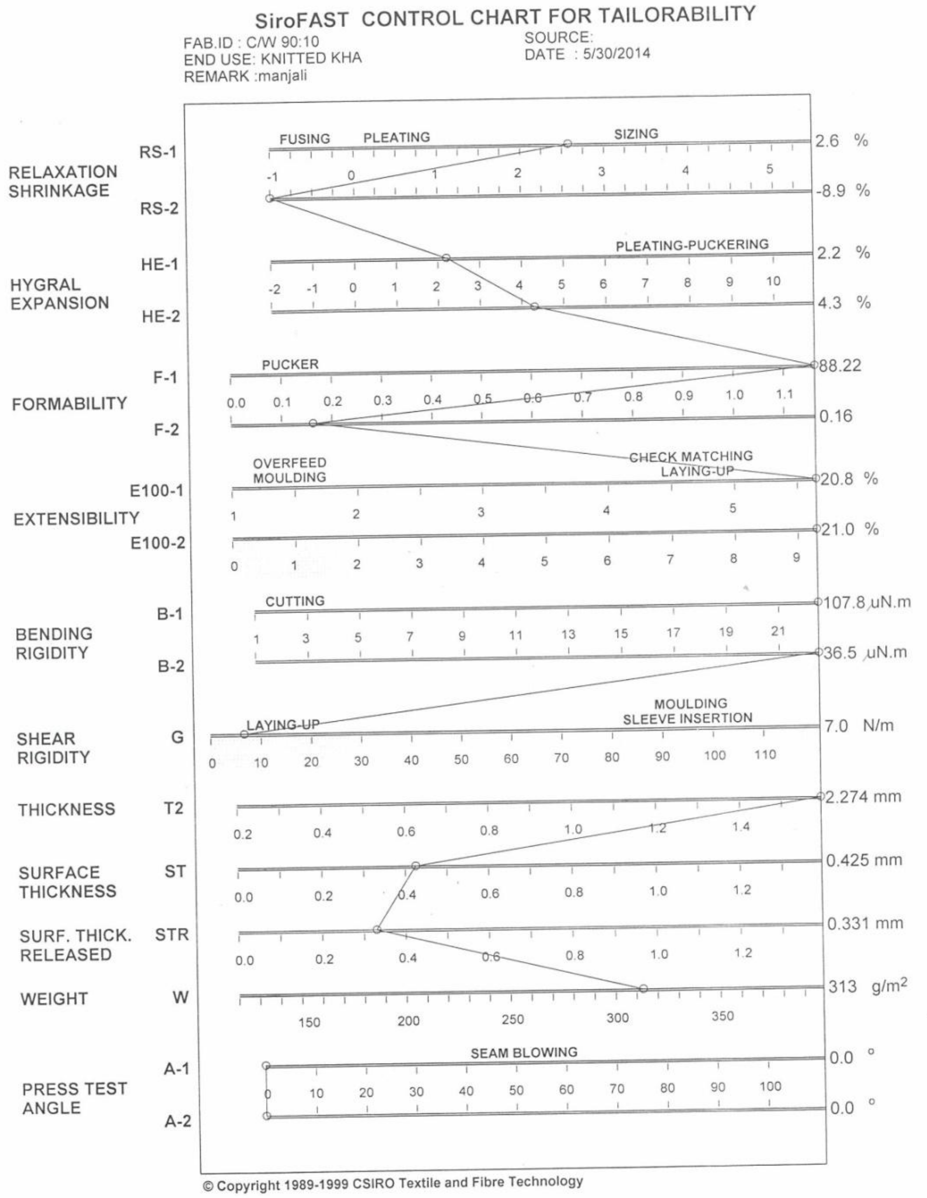
Blend percent	Relaxation shrinkage RS%		Hygral expansion HE %		Formability	
	Wale wise RS-1	Course wise RS-2	Wale wise HE-1	Course wise HE-2	Wale wise F-1	Course wise F-2
100C	-10.9	1.7	5.7	2.1	114.51	0.00
90C:10W	2.6	-8.9	2.2	4. 3	88.22	0.16
80C:20W	0.4	-2.5	4.2	1.2	92.98	0.00
70C :30W	-0.4	-2.2	3.4	0.9	70.53	0.00

Result of relaxation shrinkage shows that 100 C fabric shows extension in wale wise direction and shrinkage in course wise direction whereas90C:10W fabric shows wale wise shrinkage and course wise extension. There is comparatively less wale wise shrinkage and course wise extension in 80C:20W fabric. On the other hand 70C :30W fabric exhibit extension in both the directions, very little in wale wise direction than in course wise direction. Thus no particular trend is seen in relaxation shrinkage on blending 10-30% wool with cotton fiber.

So far as hygral expansion is concerned, 100 C fabric shows highest expansion in wale wise direction as compared to blend fabrics. But in course wise direction, no specific trend is visible.

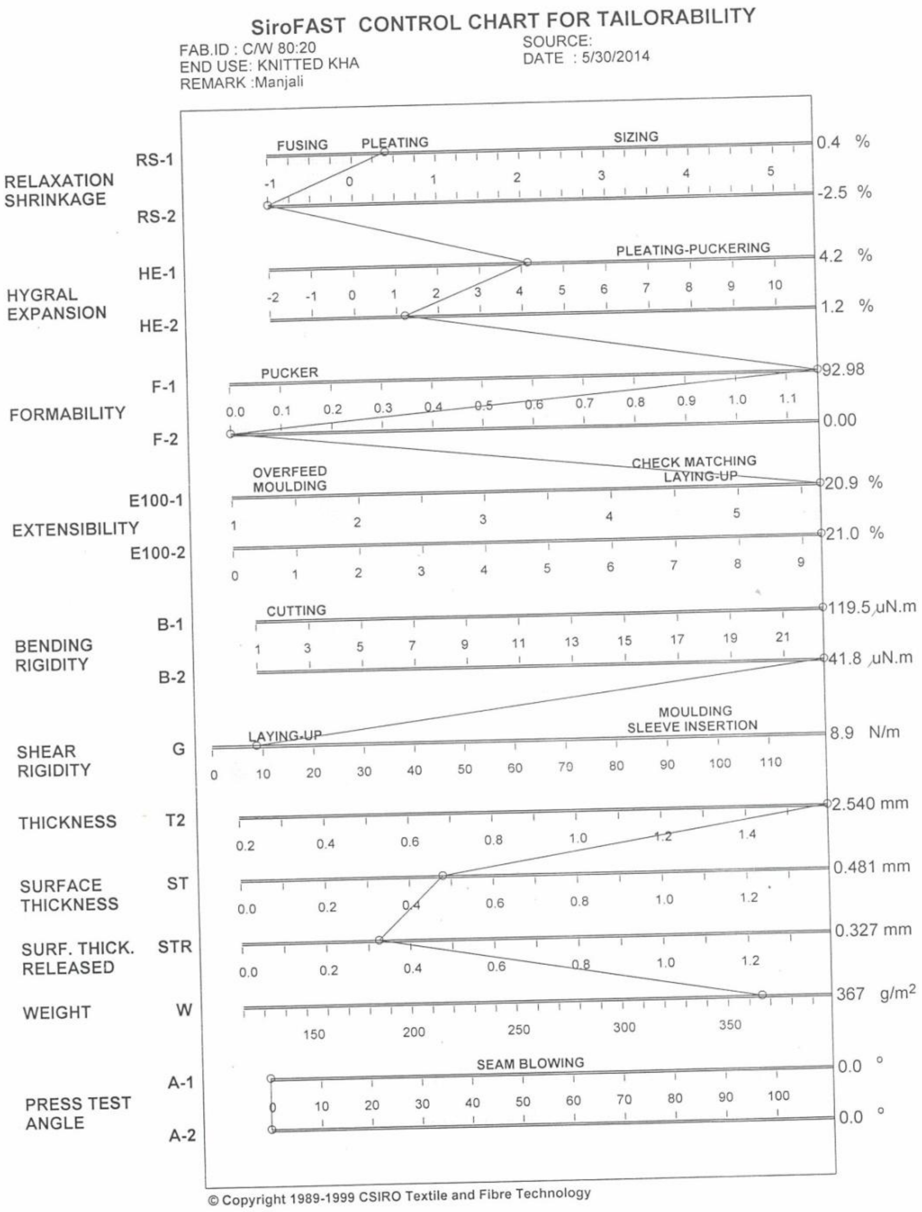
Formability is a term derived by Lindbergh, relating to the relationship between fabric properties and performance in garment manufacture. Formability is a measure of the extent to which fabrics can be compressed in-plane before buckling and thus can be used to predict seam pucker. Formability is related to bending rigidity and extensibility. As a tailoringparameter, it related to the amount of overfeed possible in eased seams (sleeve cap, neckline).Data presented in Table shows that formability (F1) of cotton-wool blend fabric is less than 100% cotton fabric in wale wise direction. Thus it has decreased after blending wool. In course wise direction remains more or less same i.e zero.





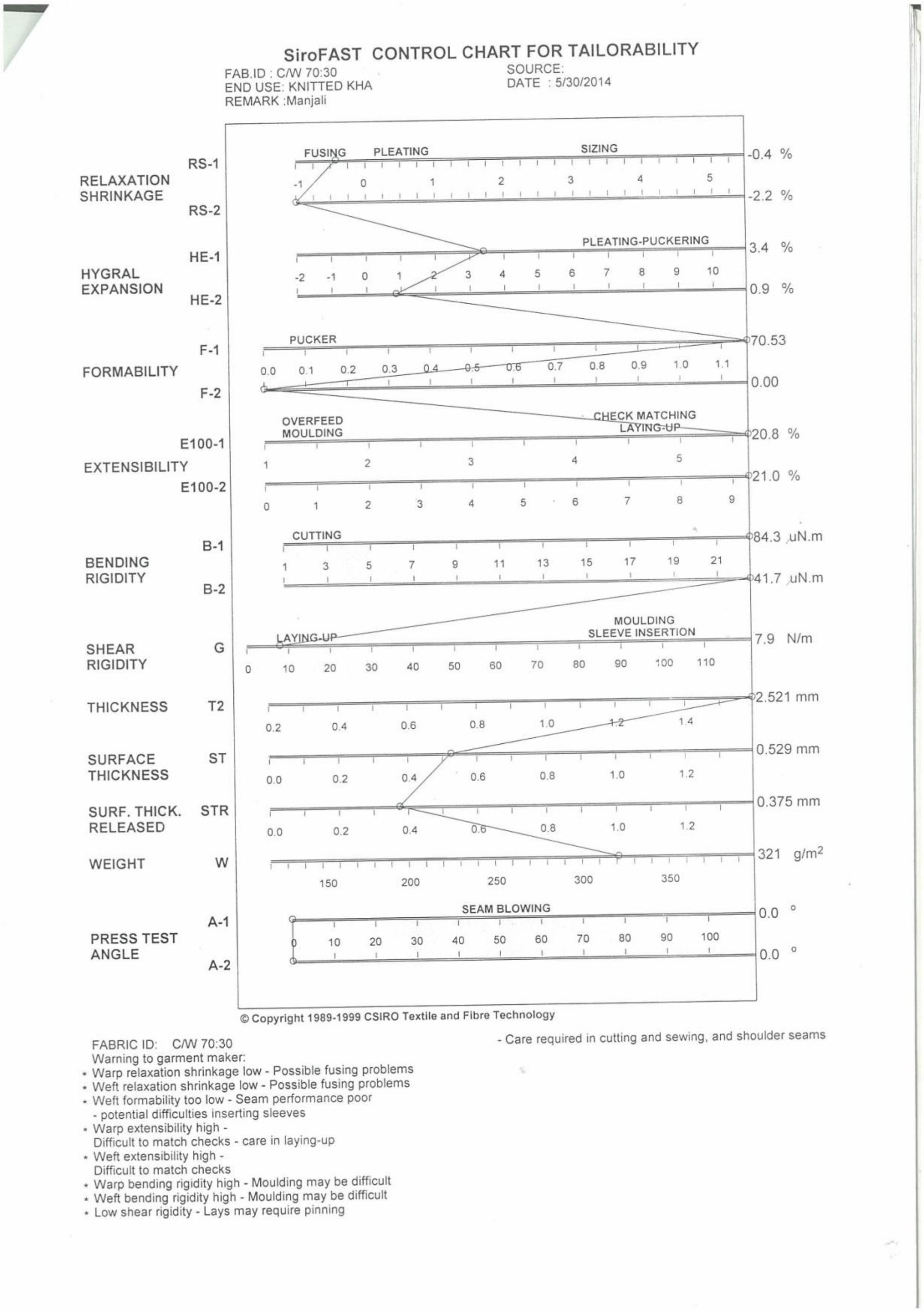
FABRIC ID: C/W 90:10
Warning to garment maker:

- Weft relaxation shrinkage low - Possible fusing problems
- Weft formability too low - Seam performance poor
  - potential difficulties inserting sleeves
- Warp extensibility high -
  Difficult to match checks - care in laying-up
- Weft extensibility high -
  Difficult to match checks
- Warp bending rigidity high - Moulding may be difficult
- Weft bending rigidity high - Moulding may be difficult
- Low shear rigidity - Lays may require pinning
  - Care required in cutting and sewing, and shoulder seams



FABRIC ID: C/W 80:20
Warning to garment maker:

- Weft relaxation shrinkage low - Possible fusing problems
- Weft formability too low - Seam performance poor
  - potential difficulties inserting sleeves
- Warp extensibility high -
  Difficult to match checks - care in laying-up
- Weft extensibility high -
  Difficult to match checks
- Warp bending rigidity high - Moulding may be difficult
- Weft bending rigidity high - Moulding may be difficult
- Low shear rigidity - Lays may require pinning
  - Care required in cutting and sewing, and shoulder seams



The whole of the results have been plotted on charts (1-4). The shaded areas show regions where the fabric properties are likely to cause problems in garment manufacture.

V. Conclusion

It is a known fact that knitted fabrics require special care in handling of fabrics while cutting and stitching due to their structure. SIROFast test conclude that all four fabrics 100% cotton and cotton-wool (90-10, 80-20 and 70-30)) blended fabrics shows warning to garment maker in terms of warp relaxation shrinkage of knitted fabrics. It is found that possible fusing problems may take place. Weft formability is too low itmaycause poor seam performance and difficulties in inserting sleeves. Warp and weft extensibility are high so it may be difficult to match checks, care will be needed in laying up. As warp and weft bending rigidity is high-moulding may be difficult. Shear rigidity is low so lays may require pinning. Care will be required in cutting and sewing especially in shoulder seams.

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