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Technical Research Division
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Central Project 1978
The Effects Of Yarn Count Stitch Length And Finishing
On 100% Cotton Knitted Interlock And 1 x 1 Rib
Phase I - Knitting And Grey Fabric Test Results

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Introduction

A contract was drawn up between Meridian Limited and IIC TRD to carry out the described programme. A formal contract was signed whereby Meridian agreed to supply facilities for knitting

- (a) 24" diameter 20 gauge interlock
- (b) 24" diameter 14 gauge 1x1 rib

Both of these machines were located at the Meridian factory at Haydn Road, Nottingham.

Two ranges of 15 fabrics (3 yarn counts x 5 stitch lengths) in both interlock and 1x1 rib were planned using 1/34 Ne, 1/38 Ne and 1/42 Ne for the interlock, and 1/26 Ne, 1/30 Ne and 1/34 Ne for the 1x1 rib.

The stitch length range was originally planned to centralise around the M&S standard specifications, i.e.

- Interlock: 1/38 Ne, stitch length 0.340cm
- 1x1 Rib: 1/30 Ne, stitch length 0.285cm

After studying the situation, it was decided that, in the case of the interlock the M&S specification could be used as a central point but the 1x1 rib was too near to the maximum tightness and the central point was therefore changed to 1/30 Ne, with a stitch length of 0.306cm.

20g Interlock knitting plan

1/34		1/38		1/42	
St.Len. cm	TF	St.Len. cm	TF	St.Len. cm	TF
0.307	13.57	0.307	12.86	0.307 x	12.23
0.324	12.86	0.324 x	12.17	0.324	11.59
0.340 x	12.25	0.340	11.59	0.340 x	11.04
0.359	11.59	0.359 x	10.98	0.359	10.46
0.377 x	11.05	0.377	10.46	0.377	9.96

1x1 Rib knitting plan

1/26		1/30		1/34	
St.Len. cm	TF	St.Len. cm	TF	St.Len. cm	TF
				0.248	16.81
0.267	17.84	0.267	16.61	0.267 x	15.56
0.285	16.71	0.285 x	15.56	0.285	14.61
0.306 x	15.56	0.306	14.49	0.306 x	13.61
0.326	14.62	0.326 x	13.61	0.326	12.78
0.350 x	13.61	0.350	12.67	0.350	11.90

If all the proposed finishing variables were studied repeatedly over all the fabric ranges, the resulting programme would have become too large and expensive. It was therefore decided that for some of the finishing routes a selective range of six fabrics, instead of the full fifteen, should be used.

These fabrics in the limited range are identified by the letter 'x' in the above knitting plans.

The wet processing was proposed as follows.

Interlock wet processing plan

Pretreatment

Set 1	Scour & bleach (winch)	all 15 fabrics*
	Scour & bleach (jet)	fabrics x only
	Scour & bleach (continuous)	fabrics x only
Set 2	Reserve	all 15 fabrics
Set 3	Mercerise, scour & bleach (winch)	all 15 fabrics*

Fabrics marked with * will then be divided into half-piece lengths to form Sets 1/3 A and 1/3 B for finishing

Finishing

1/3 A	Soften (compact?)
1/3 B	Slit and resin finish

1x1 Rib wet processing plan

Pretreatment

Set 1	Scour & bleach (jet)	all 15 fabrics*
	Scour & bleach (winch)	fabrics x only
Set 2	Reserve	all 15 fabrics
Set 3	Mercerise, scour & bleach (jet)	all 15 fabrics*

Fabrics marked with * will then be divided into half-piece lengths to form Sets 1/3 A and 1/3 B for finishing

Finishing

1/3 A	Soften (compact?)
1/3 B	Slit and resin finish

The total fabric requirements planned were:

57 x 100 metres Interlock

51 x 100 metres 1 x 1 Rib

Each 100 metre piece to be identified by a code. The code shows structure/count, stitch length/piece number.

Examples

Code: I/34/359/2
Decode: Interlock, 1/34 Ne, 0.359 cm, Piece No. 2
Code: R/26/326/3
Decode: Rib, 1/26 Ne, 0.326cm, Piece No. 3

During the planning stage, a meeting was held with the yarn suppliers - in this case Carrington Viyella - at which it was explained to them that in order to keep the number of variables to a minimum, it would be ideal if all the yarns were spun from the same blend.

Carrington/Viyella agreed to this proposal and also provided us with a sample of the blend (in sliver form) for fineness/maturity tests. The Uster Classimat results in this report were also provided by Carrington/Viyella.

Yarns

The fibre testing and the following yarn tests were carried out at TRD.

Count
Friction
Turns/inch
Twist Factor
Single-end Strength & Extension at break.

Results are given in *Tables 1 & 2*.

Yarn strength was plotted against yarn tex (*Figure 1*) and the g/tex values were calculated.

Uster evenness tests were carried out at the Shirley Institute (see *Appendix*).

Uster Classimat was provided by Carrington Viyella Limited (see *Appendix*).

All the tests indicated a good quality yarn with no adverse findings.

Knitting

The knitting took place in two separate departments at Meridian, interlock being made in U department and 1x1 rib in WN department. It was initially planned to use just one machine of each type but, due to the time factor, it was decided that the interlock fabrics should be divided between two machines. The machines selected were of the same make and type and every effort was made to ensure similar settings (see knitting plans).

For both fabric types, knock-over on the dial was kept to a minimum: adjustments in general were made on cylinder cams only. Repeated quality control checks were made whenever possible. These included stitch length, courses /3cm between knitting head and rollers, take-down tension using an Esotex tension meter.

All rolls were to be made approximately 100 metres long. These were calibrated from the visible courses per inch (CPI) dimensions off the machine, and not from the CPI's on the machine.

Thus:

$$\text{Interlock machine revolutions} = 2 * 100 * \text{CPI} * 39.37 / \text{Feeders}$$

$$\text{Rib machine revolutions} = 100 * \text{CPI} * 39.37 / \text{Feeders}$$

After the first half roll of Interlock was made, it became obvious that 100 metre lengths would be too large and therefore, 50 metre lengths were made and each piece was given a separate number, either 1 to 10 or 1 to 6 instead of the original 1 to 5 or 1 to 3. 1x1 Rib rolls were 100 metres in length, numbered 1 to 3 or 1 to 4.

Knitting Details		
	20g Interlock	14g 1x1 Rib
Machines	Mayer & Cie, Nos 255, 256	Monarch
No. feeders	24	47
Yarns	1/34 Ne, 1/38 Ne, 1/42 Ne	1/26 Ne, 1/30 Ne, 1/34 Ne
No. needles	1500 x 2	1056 x 2
Run-in	Trip tape	Trip tape
Run-in meter	Welmstar	Wesco
Speed, rpm	31.5	25
Dial height	Nominal: 0.05 inch	Nominal: 0.03 inch
Timing	7½ needle delay	Standard rib timing
Yarn tension, g	3 - 5	3 - 5
Stretcher board, cm	Machine 255: 52 Machine 256: 54	71

20g Interlock Knitting Programme

Machine 255

- 4 I/42/359/1, 2, 3, 4, 5, 6, (6 pieces of ~50 m)
- 5 I/38/359/1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (10 pieces of ~50 m)
- 6 I/34/359/1, 2, 3, 4, 5, 6
- 13 I/34/377/1, 2, 3, 4, 5, 6, 7, 8, 9, 10
- 14 I/38/377/1, 2, 3, 4, 5, 6
- 15 I/42/377/1, 2, 3, 4, 5, 6

Machine 256

1	I/34/340/1, 2, 3, 4, 5, 6, 7, 8, 9, 10
2	I/38/340/1, 2, 3, 4, 5, 6
3	I/42/340/1, 2, 3, 4, 5, 6, 7, 8, 9, 10
9	I/42/324/1, 2, 3, 4, 5, 6
8	I/38/324/1, 2, 3, 4, 5, 6, 7, 8, 9, 10
7	I/34/324/1, 2, 3, 4, 5, 6
12	I/34/307/1, 2, 3, 4, 5, 6
11	I/38/307/1, 2, 3, 4, 5, 6
10	I/42/307/1, 2, 3, 4, 5, 6, 7, 8, 9, 10

1x1 Rib Knitting Programme

1	R/30/285/1, 2, 3, 4 (4 pieces of ~100 m)
2	R/26/285/1, 2, 3 (3 pieces of ~100 m)
3	R/34/285/1, 2, 3
4	R/34/267/1, 2, 3, 4
5	R/30/267/1, 2, 3
6	R/26/267/1, 2, 3
7	R/26/306/1, 2, 3, 4
8	R/30/306/1, 2, 3
9	R/34/306/1, 2, 3, 4
10	R/34/326/1, 2, 3
11	R/30/326/1, 2, 3, 4
12	R/26/326/1, 2, 3
13	R/26/350/1, 2, 3, 4
14	R/30/350/1, 2, 3
15	R/34/350/1, 2, 3
16	R/34/248/1, 2, 3

Quality Control

Stitch length

Both departments involved used different types of run in metres. U department (interlock) use

a Welmstar whilst WN department (1x1 rib) use a Wesco. Meridian have found from past experience that the Welmstar gives an exact reading, whereas the Wesco has a built in error of 2.8%. This will be checked out during grey testing later in the report.

Meridian have a correction chart for the Wesco, but for the IIC programme, the actual readings were used to maintain stitch length quality. This decision was made so that actual readings could be recorded to confirm the Meridian findings, together with any drift from target.

Results are given in *Tables 3, 4 & 5* and these show less than a 1% difference from target (M&S specifications allow $\pm 2\%$).

Fabric tension

In the past, there has been no way of recording fabric tension between the knitting head and the rollers. However, just before the commencement of these trials, we were able to obtain an instrument known as an Esotex tension meter. This seemed an ideal way of both evaluating the instrument and obtaining data which we previously were unable to record.

At the same time that readings were recorded using the Esotex, the actual number of courses were also recorded. This instrument was lent to us on one month's trial from Texmaco Sales Limited.

If one looks at the recorded results calibrated against stitch length (*Figures 2 & 3*) it is difficult to see any correlation between the recorded results. This leads one to suspect the instrument - as a similar graph plotting courses against stitch length - showed a definite trend. (*Figures 4 & 5*). As both sets of readings were recorded at the same time, one would expect some sort of agreement. A drawing of the Esotex instrument is shown in *Figure 6*.

Knitting Faults

No actual record was made of the fault rate, but the general comments were very favourable and we received no adverse comments on any of the yarns involved in this trial.

Change to Planned Programme

As explained earlier in this report, the M&S specification was not used as the central point on the 1x1 rib as it was thought to put the tightness too near to the theoretical tightness where stitch length could be knitted successfully.

At the end of the revised programme, some yarn was available to test out in practice how tight one could go. A new stitch length was added to the 1x1 rib knitting programme (0.248cm).

This confirmed our earlier thoughts as only the lightest yarn, 1/34 Ne could be knitted successfully. This however means that there are 16 points instead of 15 on the 1x1 rib programme.

Grey Fabric Testing

All grey fabric testing was carried out at IIC TRD Manchester. All the fabrics were submitted to the tests shown below. For this report, each set of test data is considered separately, together with a summary of the test method used. The IIC Test laboratories are temperature- and humidity controlled at 20 ± 2 °C and $65 \pm 2\%$ RH. The full test data are given in the *Appendix*.

Test	Sample state
Shrinkage	Dry relaxed (BW)
Area weight, gsm	Dry relaxed, Reference (AW)
Courses & Wales /3cm	Dry relaxed, Reference
Stitch length	Dry relaxed, Reference
Burst strength	Dry relaxed, Reference
Spirality angle	Dry relaxed, Reference
Width	Dry relaxed
Yarn count	Reference
Yarn strength & extension	Reference

Fabric Shrinkage (Dry Relaxed)

Each sample was conditioned until it reached an equilibrium in the standard atmosphere for textile testing. Five test specimens were used from each fabric sample. A 50 x 50 cm template was used to mark out the test area, and three measuring marks were then drawn on each side of the square. The samples were washed in a Hoover De-Luxe washing machine with a 60°C wash plus a long spin, after which they were tumble dried in a Hoover tumble drier. After the first wash and tumble dry, the specimens were soaked in cold water with a few drops of Lissapol for 10 minutes, hydroextracted and then tumble dried. The soaking and tumble drying was repeated a further three times making a total of one wash plus four wetting out cycles each followed by tumble drying. This method was selected as our so-called “Reference” procedure after a study was made comparing five wash cycles against the one wash plus four wetting out cycles and it was found that the results were very similar using both methods. The mean changes in both length and width are calculated and expressed as a percentage of the original means, together with 95% confidence limits.

The results have been plotted against the Reference stitch length in *Figures 7 & 8*. These illustrate the magnitude of length and width shrinkages that one has to contend with to achieve a fully relaxed fabric.

Fabric Weight

The weight per unit area of fabric was determined by use of a β -gauge. Again samples were conditioned. Five readings were taken from each sample and the mean weight recorded in grams per square (gsm). The 95% confidence limits were also recorded.

Note for Digital Version:

The β -gauge method of weight measurement was later shown to be insufficiently accurate for research purposes and was abandoned. In fact, accuracy of weight measurement is a problem for all known test methods and so the Starfish model is actually based upon a calculated weight.

The results of weight are plotted against stitch length in *Figures 9 and 10*. These show that the Dry-Relaxed (BW) results are not so well-behaved as the Reference State (AW) results, where the points are more collinear. The relaxed fabric weights illustrate how the same weight can be achieved by varying both stitch lengths and yarn counts.

Courses And Wales per 3cm

All samples were conditioned prior to testing. The sample was laid on a flat surface removing wrinkles without stretching. Five measurements were taken in each direction, spaced to give a good representation of the sample. Each measurement was taken over 3 inches which was then converted to courses and wales per 3 centimetres, 95% confidence limits being recorded.

Relaxed courses and wales have been plotted against measured stitch length in *Figures 11 & 12*. These illustrate that the behaviour pattern of the courses is very similar for both interlock and rib, whereas the wale densities are much more influenced by the yarns.

The relaxed width of both fabrics was calculated from the number of needles in the machine divided by the relaxed wales per centimetre and is shown plotted against the relaxed stitch length in *Figures 13 & 14*. This shows that, with the interlock fabric, each selective yarn has a separate behaviour pattern, whereas the 1x1 rib shows much less influence of the yarn.

The fabric shrinkage can also be calculated from the changes in course and wale densities brought about by the relaxation process.

Thus:

$$\text{Length Shrinkage \%} = 100.(1 - C_B / C_A)$$

$$\text{Width Shrinkage \%} = 100.(1 - W_B / W_A)$$

Where:

C_B = Dry-relaxed Course density (Before Wash)

C_A = Reference Course density (After Wash)

W_B = Dry-relaxed Wale density (Before Wash)

W_A = Reference Wale density (After Wash)

The result of these calculations is given in *Tables 6 & 7* where it can be seen that the calculated shrinkages give the same results as the standard shrinkage method, the average difference being under 1 percentage point.

Stitch Length

All yarns were conditioned in the standard atmosphere for testing textiles. Two test pieces of 100 wales were cut from different parts of each sample and five readings were taken from each, making a total of 10 readings from each sample.

Initially, samples for grey stitch length measurements were all taken from the No. 1 rolls. Subsequently, the measurements were repeated on rolls No. 6 as a precaution. Results are given in *Tables 8 & 9*.

The analysis of the course length counters used in the knitting trials is as follows.

Welmstar (interlock)

From the stitch length extracted from the grey fabric the indications are that the spread of results is rather similar to the spread measured on the knitting machine, i.e. less than 0.5% difference.

Wesco (1x1 rib)

Both sets of test data reveal a plus in the measured stitch length of approximately 1.5%. This indicates that a figure nearer the target could be achieved if the Wesco figure were reduced by approximately 1%, i.e. when setting up the knitting machine, the Wesco course length reading should be divided by 1.01.

In practice, under current commercial conditions, both of these instruments could be used without any correction and they would still produce fabric to comply with most known specifications.

Tables 8 & 9 also show the change in stitch length after one wash and four wetting out and tumble cycles. It indicates yarn shrinkages of approximately 1.6% on the 1x1 rib, and 2.2% on the interlock.

Burst Strength

Samples were conditioned prior to testing. A Heals Bursting Strength Tester was used with a 7.07 cm² diaphragm. Ten measurements were taken over each sample, spaced to give a good representation. Readings are given in Kn/m².

Bursting strength has been plotted against relaxed weight in *Figures 15 & 16*. A good correlation was established and it is interesting that the different structures did not seem to alter the trend.

Spirality Angle

The angle of spirality is defined, for the purpose of this test, as the angle by which the line of wales deviates from the normal to the line of courses. Samples were again conditioned and spirality angles were measured twice on five test specimens, giving a total of ten readings on each sample. The average grey readings were approximately 4°. This reduced to 2° after washing. As this was a very small amount, no systematic plotting of the results was carried out.

Table1: Fibre Testing

FMT - Fineness & Maturity Testing (sliver)				
	Before Shirley Analyser		After Shirley Analyser	
	PL	PH	PL	PH
1	209	159.5	204	152.5
2	209	156	201	151.5
3	210.5	159	205.5	154
4	209	156	202.5	154
Ave	209.375	157.625	203.25	153
Fineness	174.4		179.6	
Maturity	0.85		0.85	
Micronaire	4.01		4.09	

Table 2: Yarn Testing at TRD

Parameter	Yarn				
	26	30	34	38	42
Ne, nominal					
Ne, measured	26.97	29.79	35.06	38.41	42.42
tex, measured	21.95	19.82	16.82	15.38	13.93
Coeff. of Friction	0.104	0.110	0.120	0.120	0.090
Twist, t/in	17.96	18.26	21.06	21.49	22.36
Twist Factor	3.48	3.35	3.55	3.49	3.44
Twist, t/m	707.1	718.9	829.1	846.1	880.3
Single end strength, g	309.4	252.3	235.6	188.5	183.0
Tenacity, g/tex	14.1	12.7	14.0	12.3	13.1
Extension at break, %	6.95	6.98	7.14	6.23	6.63

Table 3: Measurements Made on 20g Interlock - Machine No.256

Piece ID	Course length			C /3cm on mach.	Esotex reading
	Target	Measured	Diff. %		
I/34/340/1	510	~	~	32	37
I/34/340/5	510	~	~	33	36
I/34/340/1	510	~	~	32	36
I/34/340/6	510	~	~	32	37
I/34/340/1	510	510.33	0.06	31	44
I/34/340/6	510	509.5	-0.09	30	41
I/42/324/1	486	486	0.0	35	~
I/42/324/2	486	484.33	-0.34	35	37
I/42/324/1	486	484	-0.41	37	27
I/42/324/2	486	~	~	37	26
I/38/324/6	486	485.33	-0.14	35	45
I/38/324/8	486	483.67	-0.48	35	43
I/38/324/10	486	485.67	-0.07	34	46
I/38/324/1	486	485	-0.21	~	~
I/38/324/5	486	484.33	-0.34	34	49
I/34/307/5	460.5	460	-0.11	38	45
I/34/307/5	460.5	459	-0.33	39	35
I/38/307/5	460.5	458.67	-0.40	38	40
I/42/307/5	460.5	459	-0.33	~	~
I/42/307/5	460.5	459	-0.33	37	43
I/42/307/5	460.5	458.33	-0.47	37	44
Mean			-0.25		

Table 4: Measurements Made on 20g Interlock - Machine No.255

Piece ID	Course length			C /3cm on mach.	Esotex reading
	Target	Measured	Diff. %		
I/42/359/1	538.5	539	0.09	~	~
I/42/359/6	538.5	538.5	0.0	~	~
I/42/359/7	538.5	539	0.09	28	44
I/38/359/1	538.5	538.5	0.00	29	50
I/38/359/6	538.5	539	0.09	29	44
I/34/359/1	538.5	539.6	0.20	~	~
I/34/359/5	538.5	539	0.09	29	45
I/34/377/1	565.5	565.5	0.00	26	55
I/34/377/6	565.5	565	-0.09	27	45
I/42/377/1	565.5	565	-0.09	~	~
I/38/377/2	565.5	562	-0.62	28	44
I/38/377/3	565.5	566.5	0.18	28	46
I/38/377/6	565.5	566	0.09	26	49
I/38/377/10	565.5	566.5	0.18	~	~
Mean			0.02		

Table 5: Measurements Made on 14g 1x1 Rib

Piece ID	Course length			C /3cm on mach.	Esotex reading
	Target	Measured	Diff. %		
R/30/285/1	601.9	598	-0.65	41	52
R/26/285/1	601.9	598	-0.65	43	~
R/26/285/3	601.9	~	~	42	49
R/34/285/1	601.9	597	-0.81	38	52
R/34/285/3	601.9	598	-0.65	40	~
R/34/267/1	563.9	565	0.20	44	50
R/30/267/3	563.9	561	-0.51	44	~
R/26/267/1	563.9	560	-0.69	46	~
R/26/306/2	646.3	647.5	0.19	37	54
R/34/306/1	646.3	647.5	0.19	34	47
R/34/306/3	646.3	648	0.26	34	50
R/34/326/1	688.5	689	0.07	34	~
R/34/326/2	688.5	690	0.22	32	45
R/30/326/1	688.5	689.5	0.15	31	52
R/30/326/2	688.5	692	0.51	~	~
R/26/326/1	688.5	691	0.36	34	49
R/26/326/3	688.5	690	0.07	~	~
R/26/350/1	739.2	739	-0.03	30	~
R/26/350/4	739.2	738	-0.16	30	49
R/30/350/2	739.2	739	-0.03	29	49
R/34/248/1	523.8	521.5	-0.44	51	50
Mean			-0.12		

Table 6: Interlock - Shrinkages Calculated From Course and Wale Densities

Sample	Courses /3cm		Wales /3cm		Meas. Shrinkage %		Calc. Shrinkage %		(Calc.-Meas.)		
	BW	AW	BW	AW	Len.	Wid.	Len.	Wid.	Len.	Wid.	
I34/377	34.8	44.33	38	40.32	20.96	8.23	21.50	5.75	0.54	-2.48	
I34/359	36.2	47.4	37.6	41.65	20.92	10.45	23.63	9.72	2.71	-0.73	
I34/340	39.5	49.45	35.5	42.91	18.07	16.74	20.12	17.27	2.05	0.53	
I34/324	44.6	52.05	35	43.7	15.49	20.83	14.31	19.91	-1.18	-0.92	
I34/307	50	55.75	36	44.8	10.58	21.28	10.31	19.64	-0.27	-1.64	
I38/377	34.1	44.57	38.9	42.28	23.35	8.28	23.49	7.99	0.14	-0.29	
I38/359	35	45.98	38.9	43.15	23.23	9.08	23.88	9.85	0.65	0.77	
I38/340	39.7	49.06	36.3	43.7	19.02	15.62	19.08	16.93	0.06	1.31	
I38/324	43.9	52.36	36.3	45.12	13.83	21.14	16.16	19.55	2.33	-1.59	
I38/307	48.1	54.33	35.7	45.98	11.68	22.02	11.47	22.36	-0.21	0.34	
I42/377	32.4	43.39	40.1	43.86	22.95	5.46	25.33	8.57	2.38	3.11	
I42/359	34.9	47.01	40.6	44.57	24.44	10.56	25.76	8.91	1.32	-1.65	
I42/340	38.4	48.58	36.5	45.43	20.74	16.43	20.96	19.66	0.22	3.23	
I42/324	43.2	51.97	36.8	45.98	16	22.42	16.88	19.97	0.88	-2.45	
I42/307	46.4	54.8	36.4	47.24	14.51	23.27	15.33	22.95	0.82	-0.32	
									Mean	0.83	-0.19

Table 7: 1x1 Rib - Shrinkages Calculated From Course and Wale Densities

Sample	Courses /3cm		Wales /3cm		Meas. Shrinkage %		Calc. Shrinkage %		(Calc. - Meas.)		
	BW	AW	BW	AW	Len.	Wid.	Len.	Wid.	Len.	Wid.	
R26/350	34.5	45.12	26.9	28.74	19.36	6.39	23.54	6.40	4.18	0.01	
R26/326	39.1	48.19	26.2	30.39	17.62	13.4	18.86	13.79	1.24	0.39	
R26/306	42.8	51.81	26.2	32.28	15.31	16.11	17.39	18.84	2.08	2.73	
R26/285	50.7	56.54	26.4	33.7	12.05	22.67	10.33	21.66	-1.72	-1.01	
R26/267	56.1	61.34	25.1	34.8	7.85	28.72	8.54	27.87	0.69	-0.85	
R30/350	35.6	43.94	27.1	28.11	20.72	4.5	18.98	3.59	-1.74	-0.91	
R30/326	39.1	47.8	27.2	30	19.62	10.37	18.20	9.33	-1.42	-1.04	
R30/306	42.8	50.71	27.6	31.65	17.95	16.67	15.60	12.80	-2.35	-3.87	
R30/285	48.7	56.14	26.1	34.17	13.65	21.83	13.25	23.62	-0.40	1.79	
R30/267	53.5	59.37	26.1	35.43	10.71	26.64	9.89	26.33	-0.82	-0.31	
R34/350	35.2	44.09	26.5	27.01	20.04	-1.43	20.16	1.89	0.12	3.32	
R34/326	36.9	47.56	26.2	29.29	21.02	5.68	22.41	10.55	1.39	4.87	
R34/306	40.7	50	27.2	31.73	19.22	14.78	18.60	14.28	-0.62	-0.50	
R34/285	45.7	55.59	28.1	34.49	16.81	20.85	17.79	18.53	0.98	-2.32	
R34/267	50.9	60.08	26.4	35.28	13.24	24.79	15.28	25.17	2.04	0.38	
R34/248	64.4	65.43	25.4	36.93	3.71	33.93	1.57	31.22	-2.14	-2.71	
									Mean	0.10	0.00

Table 8: Interlock - Stitch Length Measured in the Grey Fabrics

Sample	Target	Roll No.1				Roll No.6	
		Measured		(M-T)	(M-AW)	Meas.	(M-T)
		BW	AW	%	%	BW	%
I34/377	3.770	3.767	3.729	-0.08	1.01	3.76	-0.27
I34/359	3.590	3.608	3.535	0.50	2.02	~	~
I34/340	3.400	3.425	3.336	0.74	2.60	3.41	0.29
I34/324	3.240	3.261	3.188	0.65	2.24	3.25	0.31
I34/307	3.070	3.05	3.024	-0.65	0.85	3.03	-1.30
I38/377	3.770	3.705	3.694	-1.72	0.30	3.79	0.53
I38/359	3.590	3.613	3.444	0.64	4.68	3.61	0.56
I38/340	3.400	3.519	3.364	3.50	4.40	3.41	0.29
I38/324	3.240	3.248	3.188	0.25	1.85	3.24	0.00
I38/307	3.070	3.1	3.019	0.98	2.61	3.07	0.00
I42/377	3.770	3.819	3.709	1.30	2.88	3.78	0.27
I42/359	3.590	3.576	3.506	-0.39	1.96	3.63	1.11
I42/340	3.400	3.457	3.322	1.68	3.91	3.40	0.00
I42/324	3.240	3.229	3.192	-0.34	1.15	3.22	-0.62
I42/307	3.070	3.046	3.046	-0.78	0.00	3.04	-0.98
Mean				0.42	2.16		0.01

Table 9: 1x1 Rib - Stitch Length Measured in the Grey Fabrics

Sample	Target	Roll No.1				Roll No.6	
		Measured		(M-T)	(M-AW)	Meas.	(M-T)
		BW	AW	%	%	BW	%
R26/350	3.500	3.550	3.486	1.43	1.80	3.55	1.43
R26/326	3.260	3.339	3.218	2.42	3.62	3.34	2.45
R26/306	3.060	3.115	3.080	1.80	1.12	3.11	1.63
R26/285	2.850	2.855	2.826	0.18	1.02	2.85	0.00
R26/267	2.670	2.702	2.670	1.20	1.18	2.70	1.12
R30/350	3.500	3.574	3.505	2.11	1.93	3.57	2.00
R30/326	3.260	3.306	3.283	1.41	0.70	3.31	1.53
R30/306	3.060	3.100	3.056	1.31	1.42	3.10	1.31
R30/285	2.850	2.892	2.822	1.47	2.42	2.89	1.40
R30/267	2.670	2.717	2.656	1.76	2.25	2.72	1.87
R34/350	3.500	3.570	3.530	2.00	1.12	3.57	2.00
R34/326	3.260	3.348	3.277	2.70	2.12	3.35	2.76
R34/306	3.060	3.103	3.055	1.41	1.55	3.10	1.31
R34/285	2.850	2.883	2.843	1.16	1.39	2.88	1.05
R34/267	2.670	2.692	2.673	0.82	0.71	2.69	0.75
R34/248	2.480	2.505	2.472	1.01	1.32	2.51	1.21
Mean				1.51	1.60		1.49

Figure 1

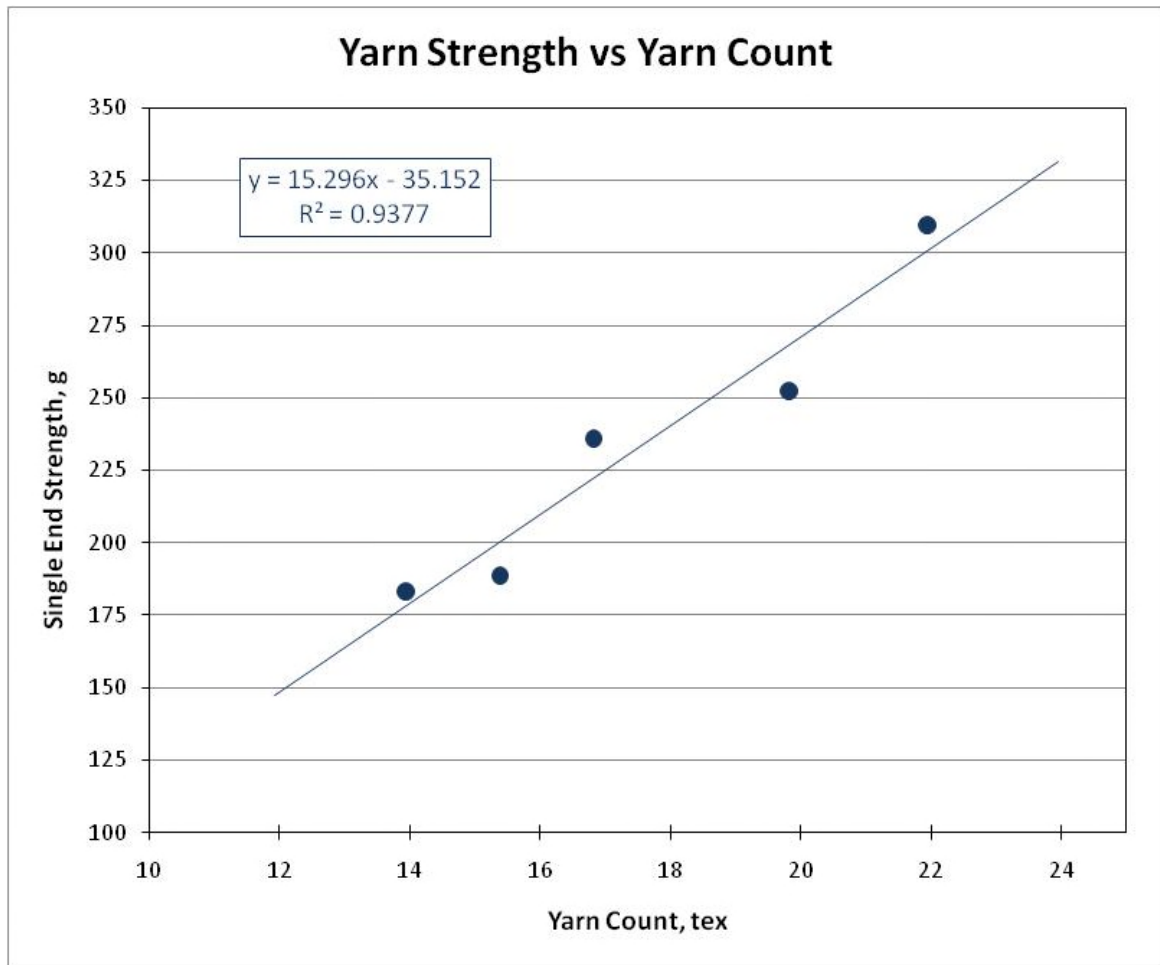


Figure 2

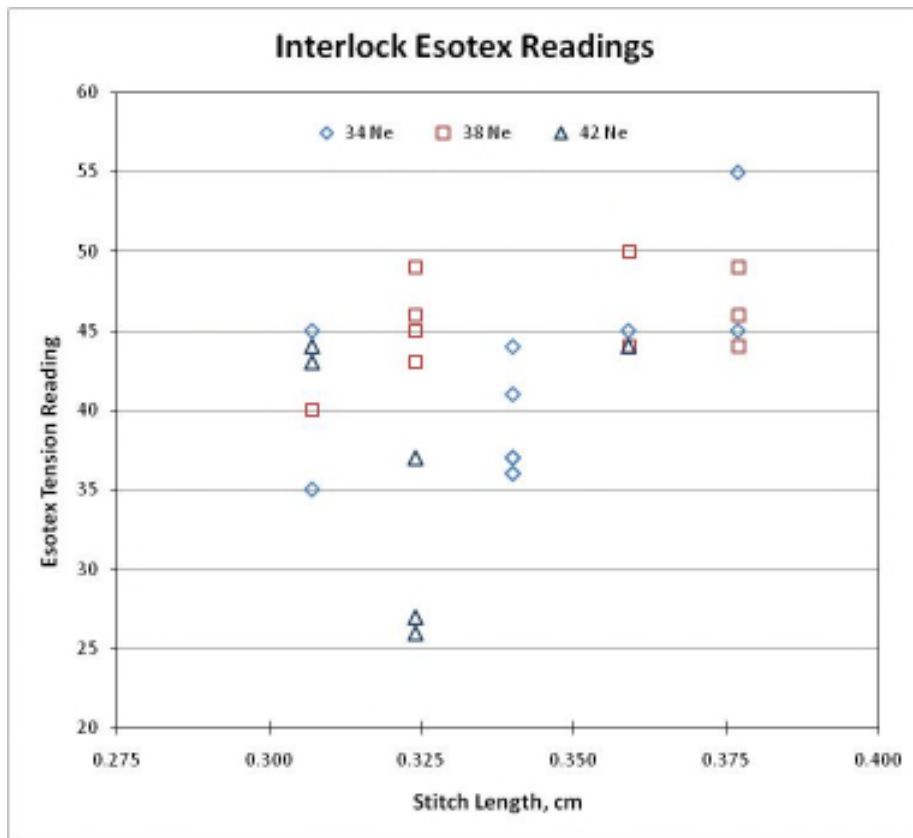


Figure 3

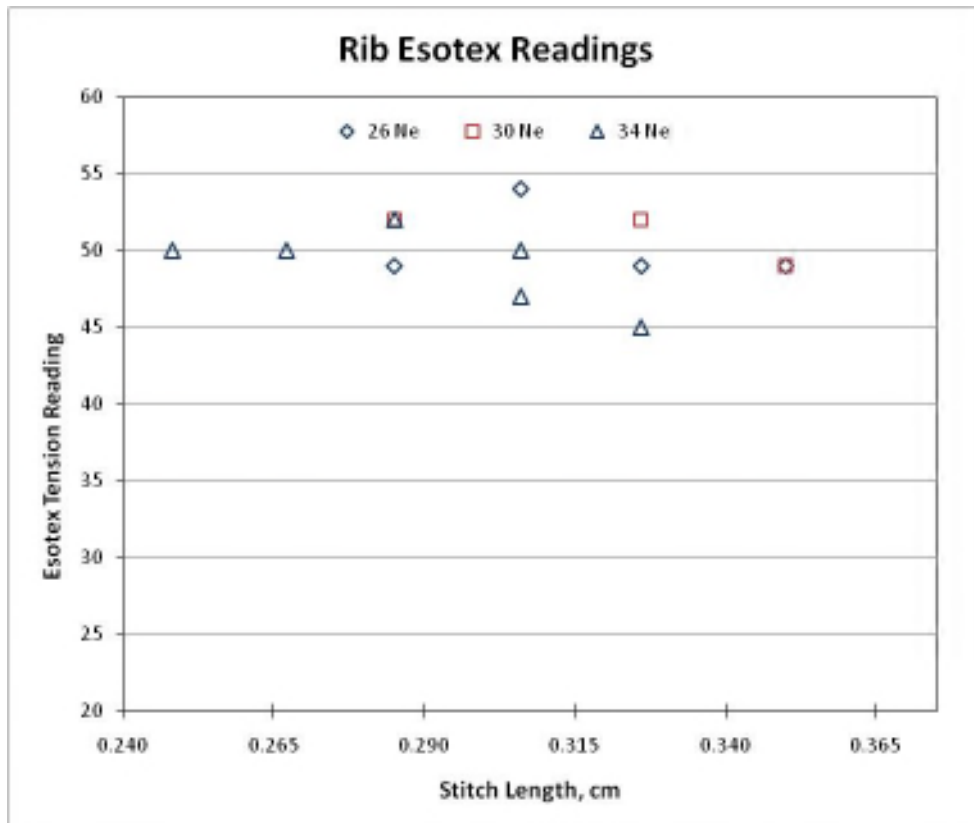


Figure 4

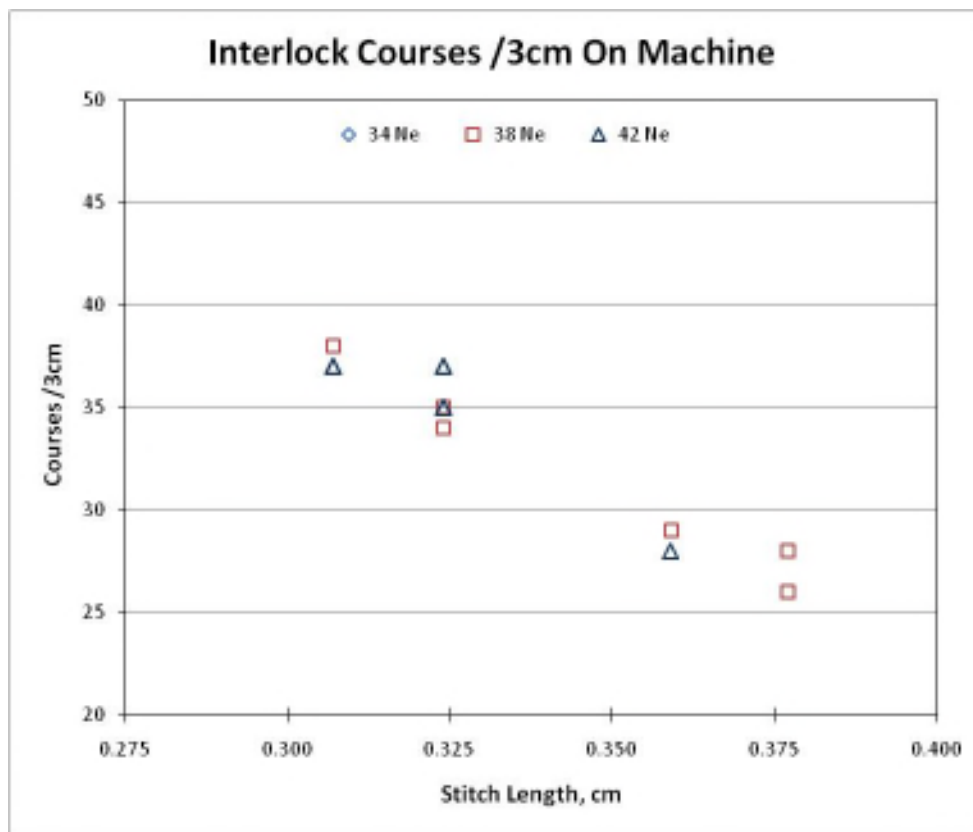


Figure 5

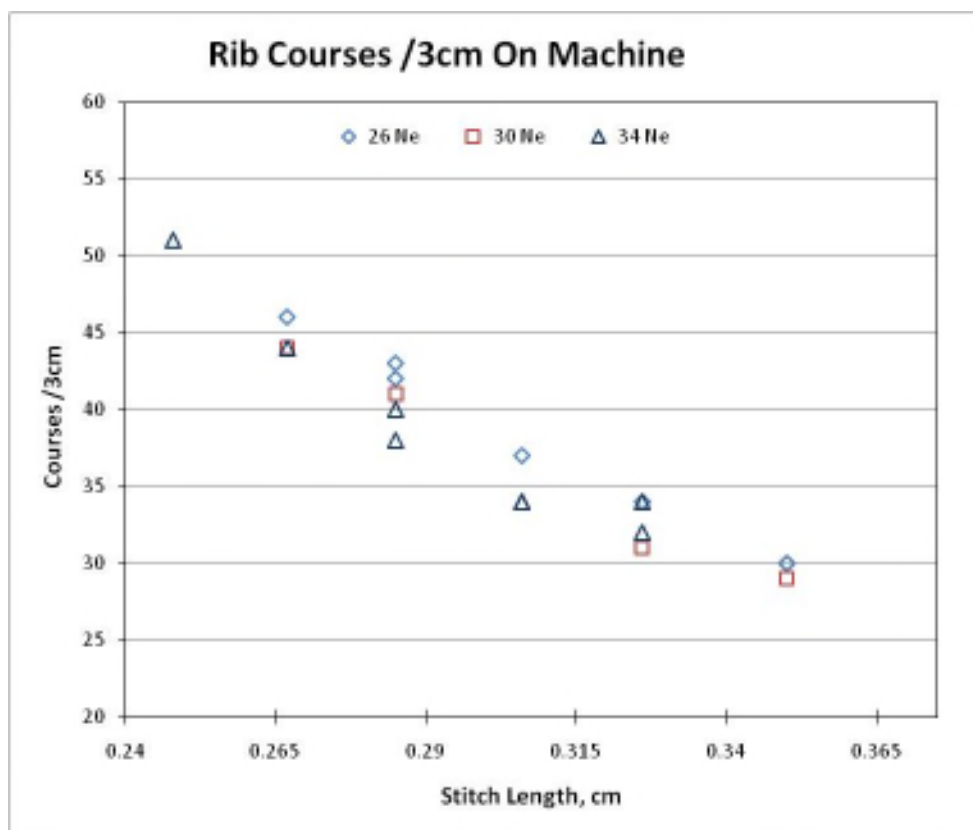


Figure 6: The Esotex Instrument - Schematic

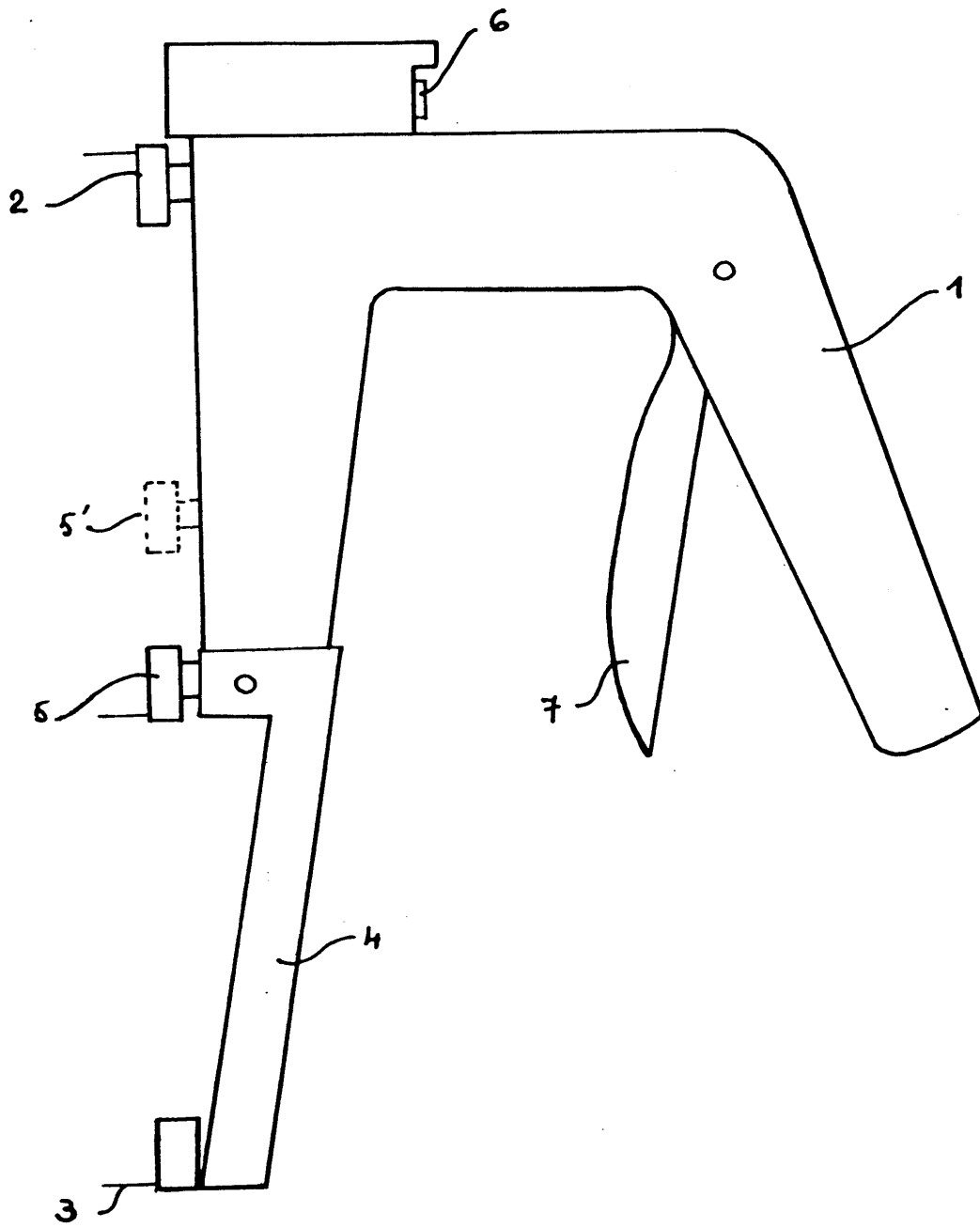


Figure 7

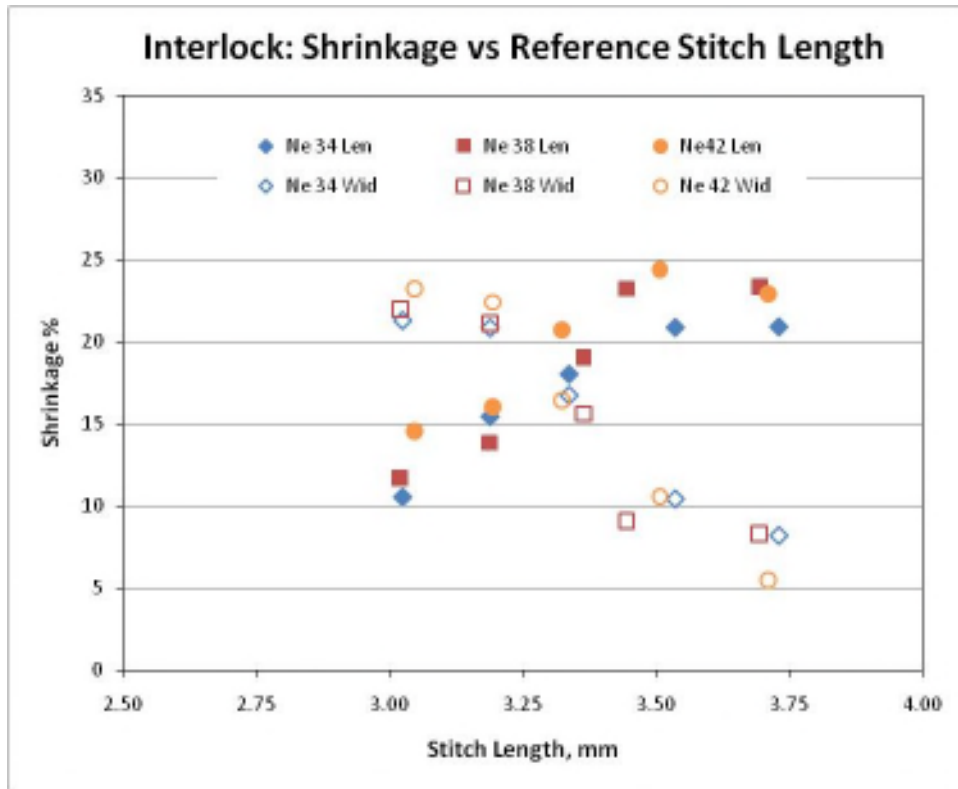


Figure 8

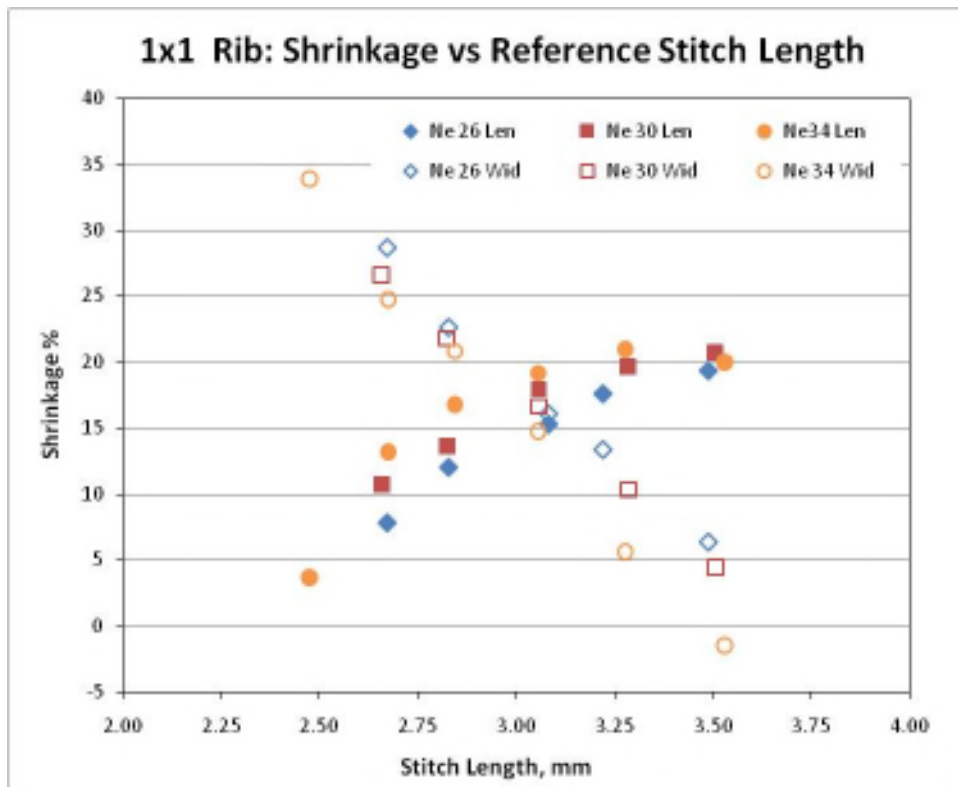


Figure 9

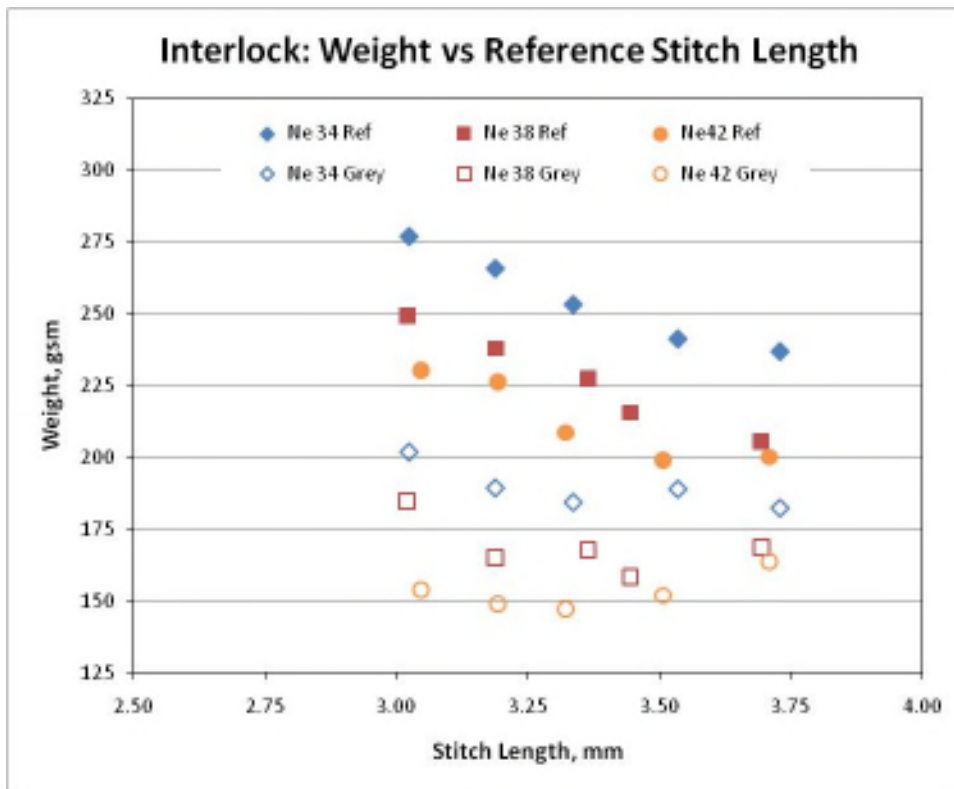


Figure 10

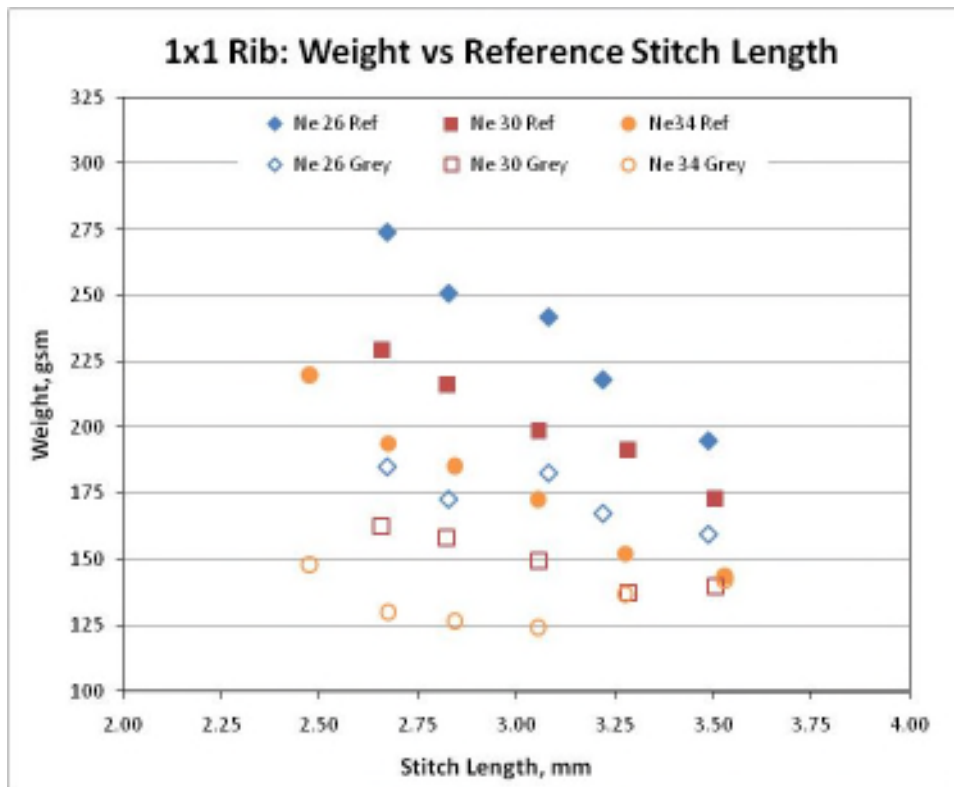


Figure 11

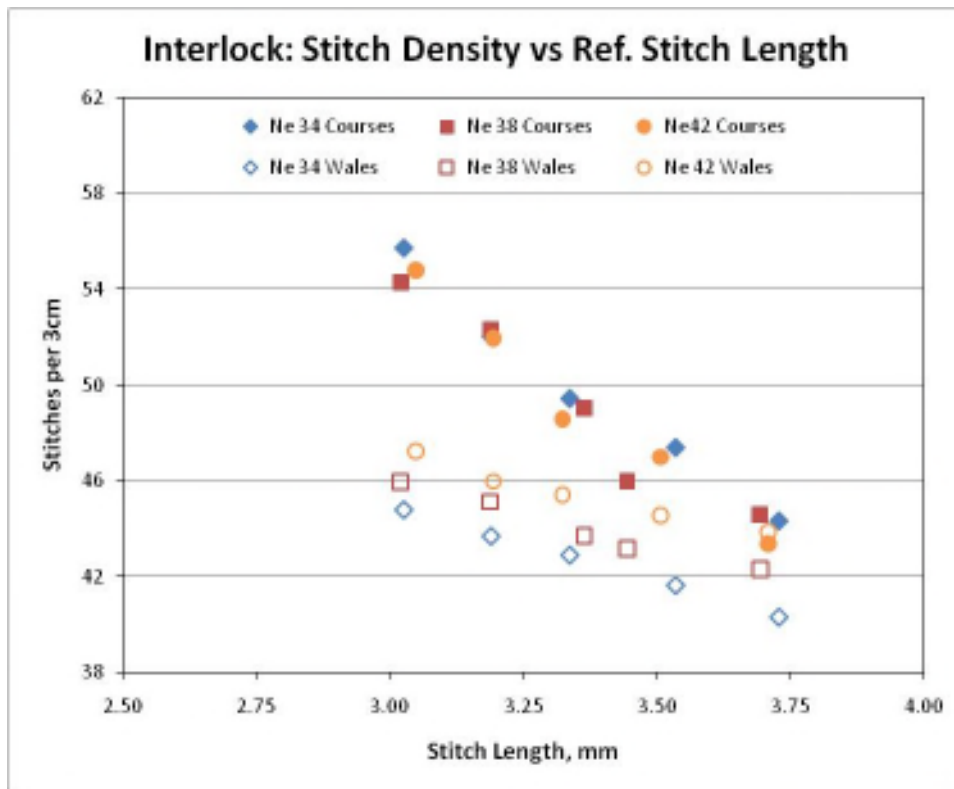


Figure 12

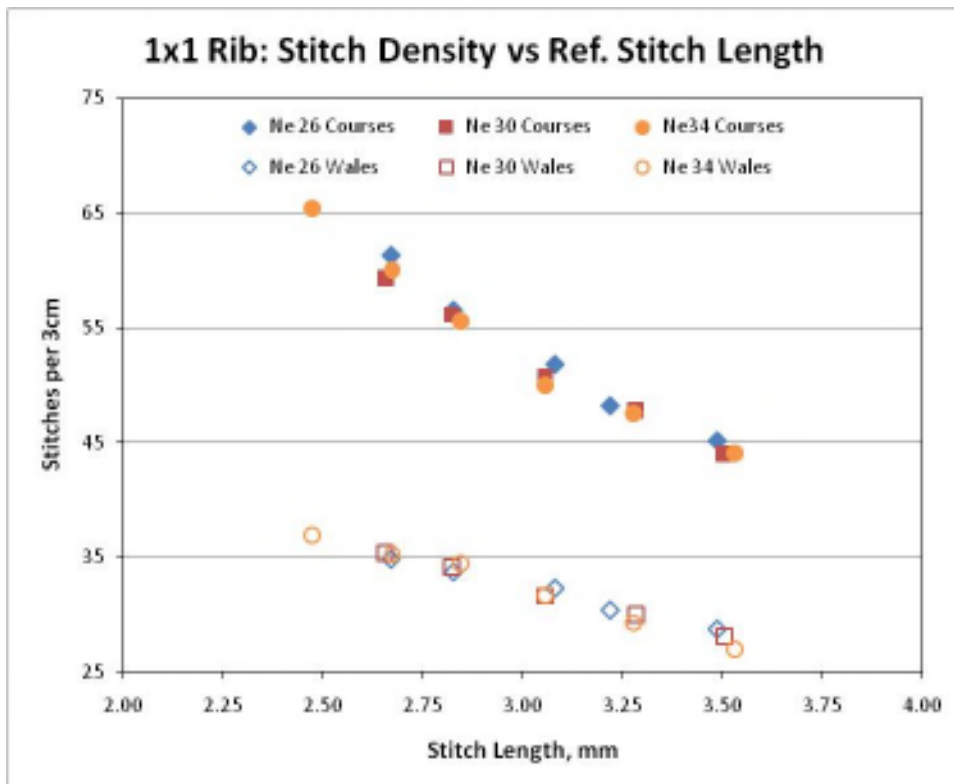


Figure 13

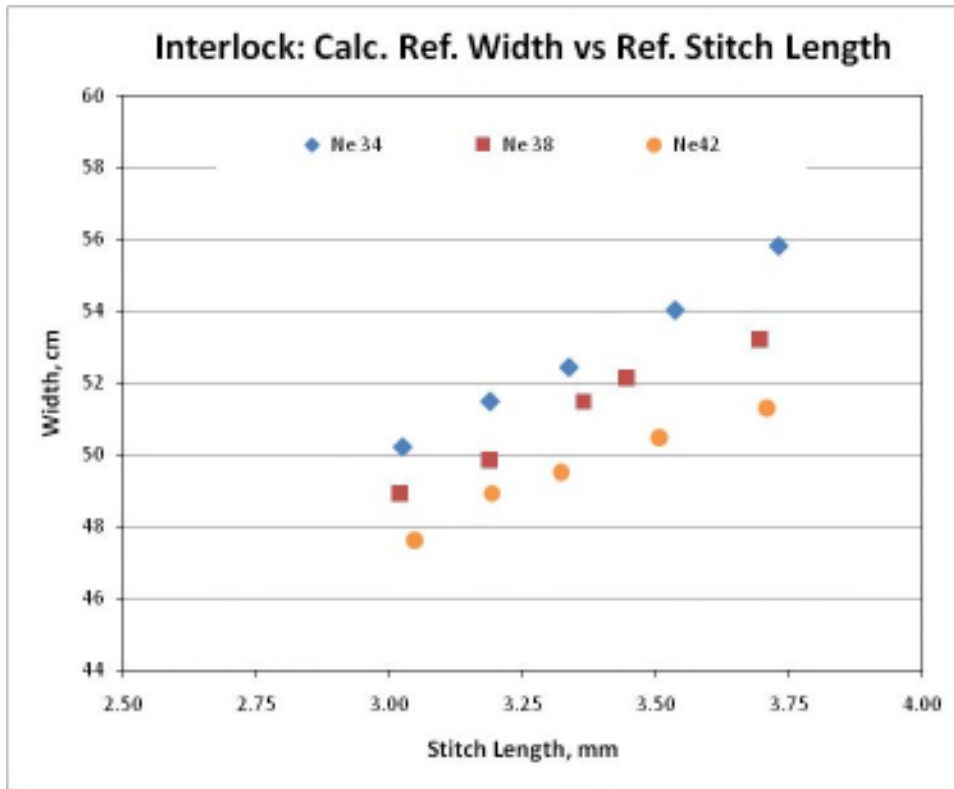


Figure 14

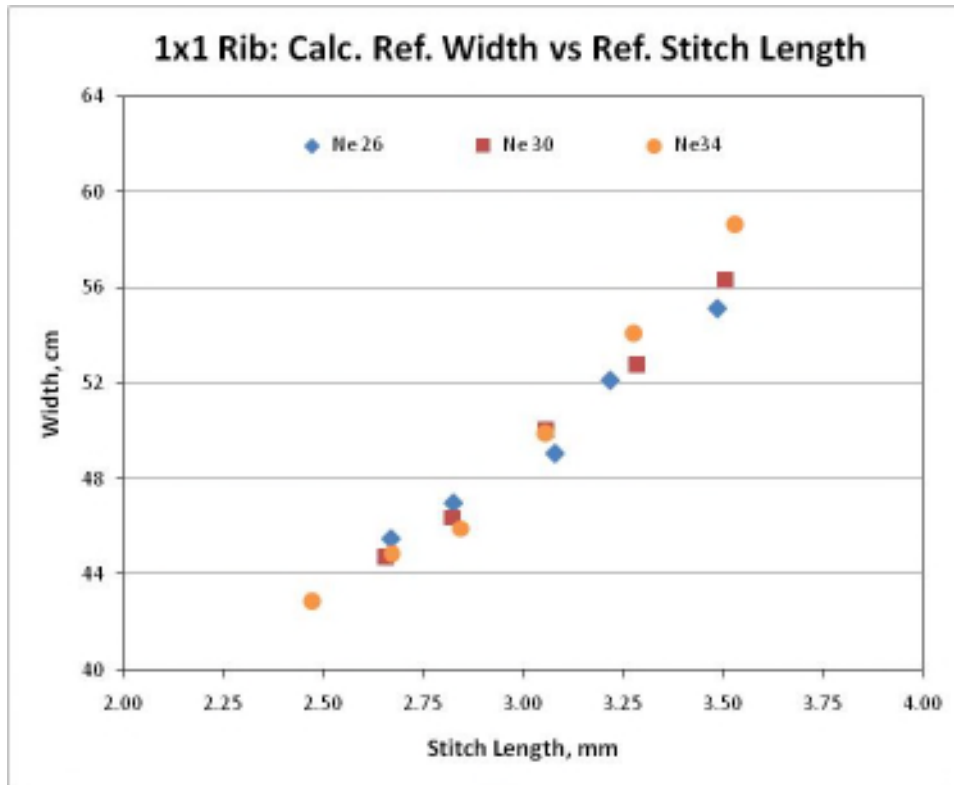


Figure 15

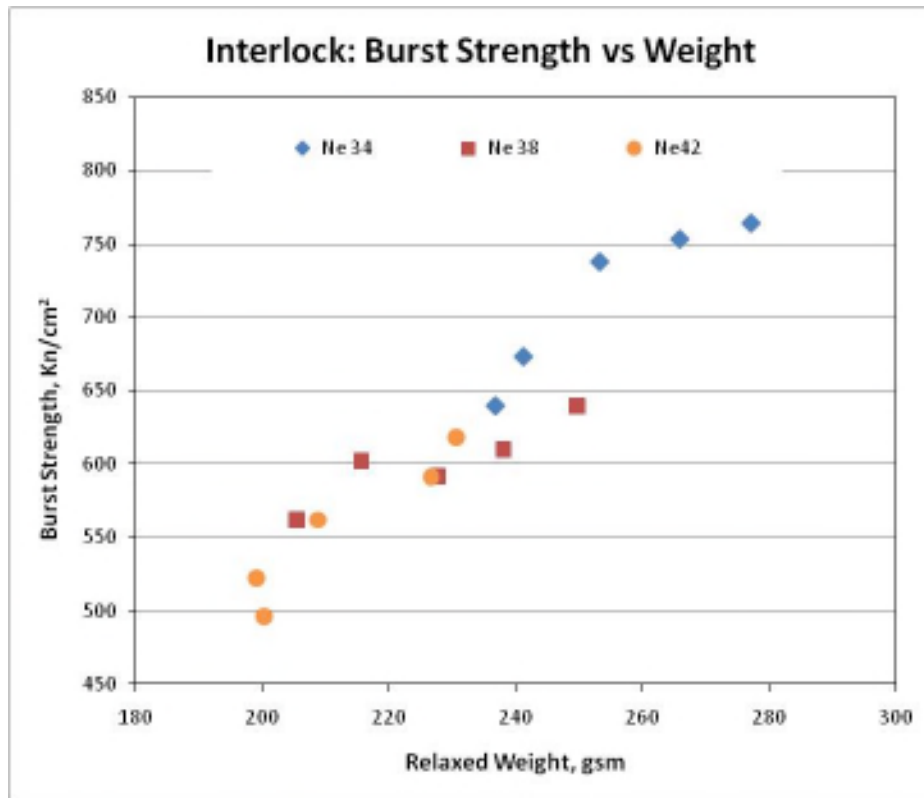
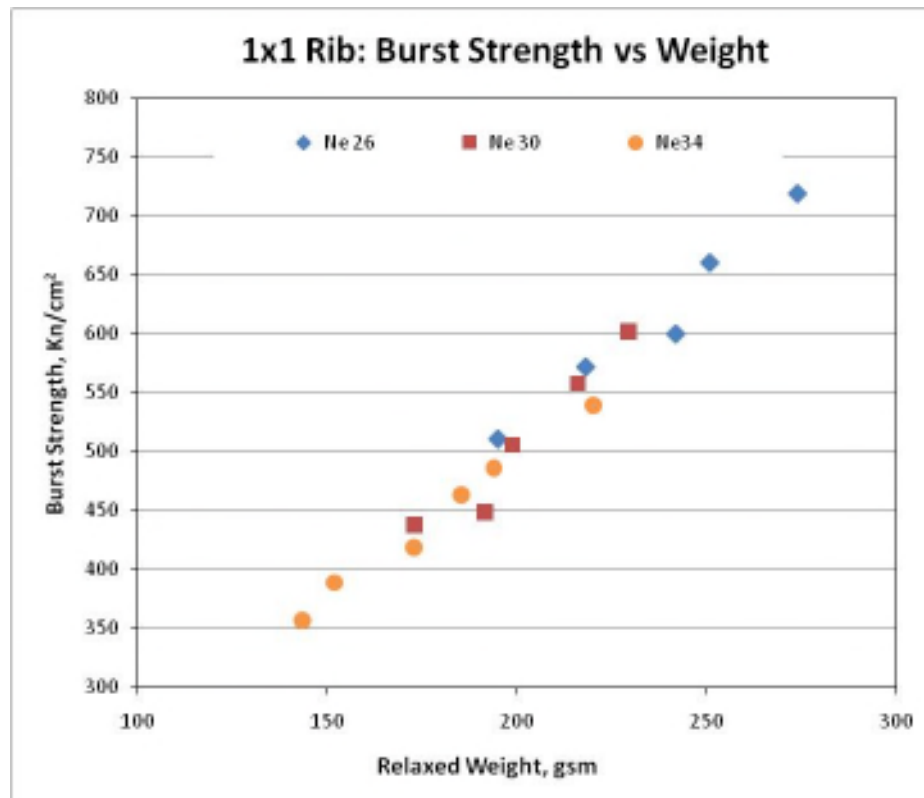


Figure 16



Appendices

Shirley Institute Yarn Test Report

Uster Classimat Charts

Original TRD Test Sheets*

* Note: The full test data (but not the 95% confidence limits) plus the Tables & Graphs of this report are available in RR83.xls

SHIRLEY INSTITUTE

THE COTTON SILK AND MAN-MADE FIBRES RESEARCH ASSOCIATION

DIDSBURY MANCHESTER M20 8RX

Ms. Pawline Keher,
International Institute for Cotton
Technical Research Div.,
Kingston Road,
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Telephone: 061-445 8141
Telegrams: Explore, Manchester 20
Telex 668417 Shirley Mchr.

Ref. No: MS 852M
15th May 1978

CONFIDENTIAL REPORT ON

Tests on Five Sets of Yarn

Description

Five sets of yarn, 10 packages in each set, cotton counts 26, 30, 34, 38, 42 were received for Uster evenness tests.

Lab Work

The tests were made on the Uster II evenness equipment using a yarn speed of 400 m/minute and a test duration of 2½ minutes i.e. 1000 m/package.

The following results were obtained:-

<u>Package No.</u>	<u>C V %</u>				
	<u>26's</u>	<u>30's</u>	<u>34's</u>	<u>38's</u>	<u>42's</u>
1.	13.58	14.64	14.70	14.95	15.35
2.	12.95	14.57	14.40	15.78	15.67
3.	13.30	15.28	14.35	15.58	16.15
4.	12.74	14.62	14.57	14.94	16.87
5.	13.21	15.09	14.16	17.38	15.85
6.	13.38	15.48	14.47	15.81	16.35
7.	12.86	15.80	15.12	15.51	15.81
8.	13.72	14.58	14.14	15.65	16.76
9.	14.30	14.81	13.95	16.44	15.88
10.	14.16	14.89	14.94	16.49	15.74
<u>Mean</u>	<u>13.42</u>	<u>14.98</u>	<u>14.48</u>	<u>15.86</u>	<u>16.05</u>

Diagram and spectrogram traces were taken during the tests and these are enclosed for your inspection. (Diagram speed 10cms/minute).

/over

Signed:
Officer in charge of investigation

Signed: 
Head of Member Service and Training Department

Investigations, measurements, and tests are undertaken by the Shirley Institute for organizations that request its expert assistance. A particular objective is to discover the causes of faults and processing difficulties in order to prevent their recurrence.

This report applies only to the samples provided for examination. Because of this proviso, full consideration should always be given to the choice of sufficiently representative and sufficiently large samples to be sent to the Institute for examination.

A duplicate report (or reports) will be sent to the third party (or parties) on request.

The mean results were compared with the data given in the Uster Statistics (1975) for combed cotton yarns. These have been compiled from a world-wide survey of yarns and their properties and are presented in the form of a series of graphs with parameters at 5%, 10%, 25%, 50%, 75%, 90%, and 95%, that at 50% (the median) being considered the most important. The 50% line means that of the yarns tested in the Uster survey half gave a worse result and half a better result than that level. Similarly at the 25% level, 25% of the yarns tested gave a better result than the values represented by the 25% level and 75% had a worse result. The lower the % rating the better the yarn rating. The % ratings of the mean values obtained for your yarns are as follows.

<u>Yarn Count</u>	<u>Rating</u>
26's	15%
30's	40%
34's	24%
38's	50%
42's	48%

Signed: *Olive Brien*
Officer in charge of investigation
Mrs. O. Brien

Signed: *W.T. Cowhig*
Head of Member Service Dept.
W.T. Cowhig

Investigations, measurements, and tests are undertaken by the Shirley Institute for organizations that request its expert assistance. A particular objective is to discover the causes of faults and processing difficulties in order to prevent their recurrence.

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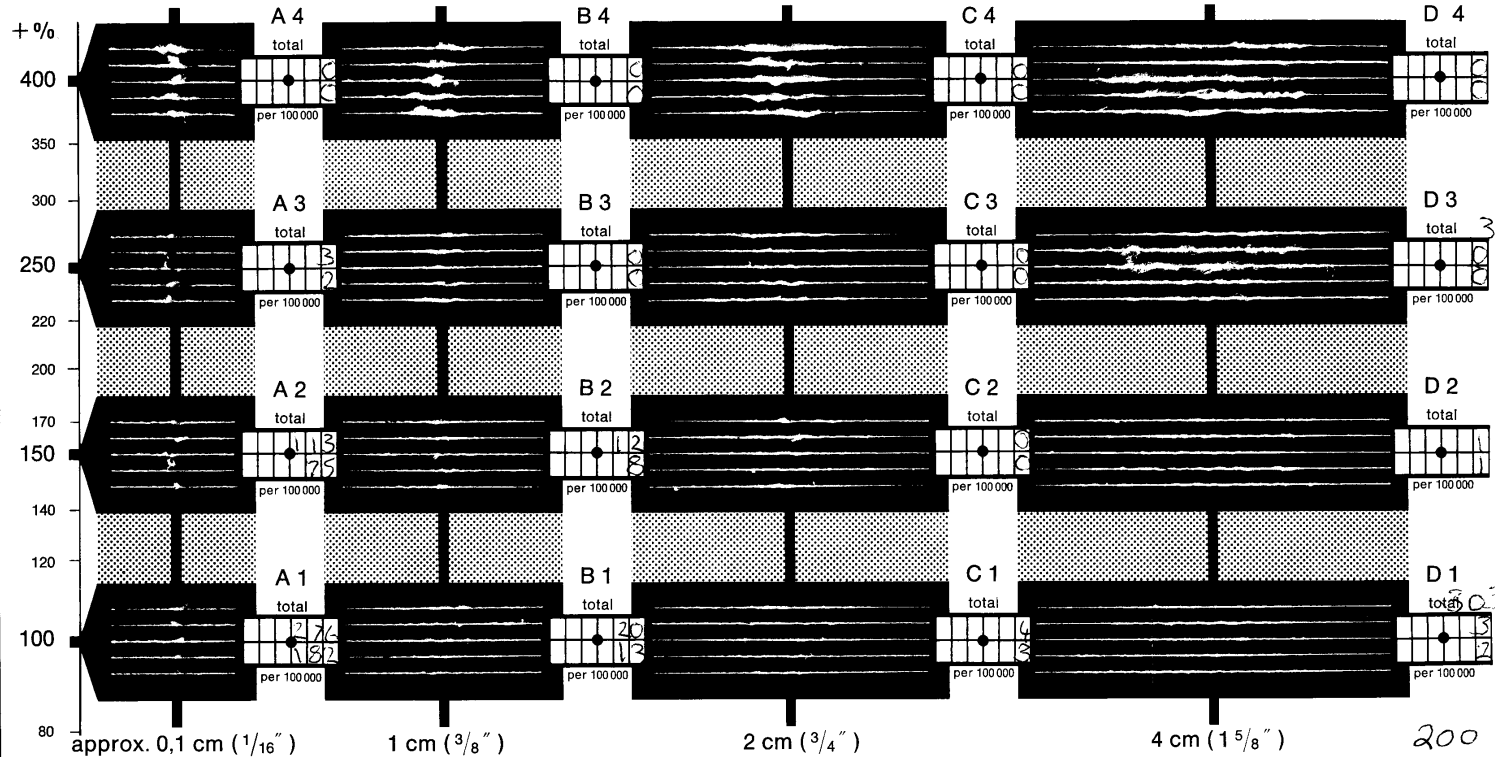


Test Results
Prüfprotokoll
Compte-Rendu

Cotton Ne 15-30
Baumwolle Nm 25-50
Coton Tex 20-40

Lot / Partie / Los: Holdens
Cajachite PART CONES

Ne 265 Nm 2 Tex 1
Material Scale Materialziffer RH% Dat. 15/3/78
Caractéristique de matière 7.5 Vis.



Ne of yarn tested
Nm des geprüften Garnes
Nm du fil contrôlé

265 Ne
Nm 1365.0

Weight of yarn tested
Gewicht der geprüften Garne
Poids du fil contrôlé

111 oz
Kg

Tested length
Geprüfte Länge
Longueur contrôlée

15155 yds
m @ 250% = 0.43
@ 100% = 43.7

Conversion of values to per 100 000
Umrechnung der Werte auf 100 000 yds/m
Conversion des valeurs pour 100 000

Counter reading
Zählerstand
Lecture

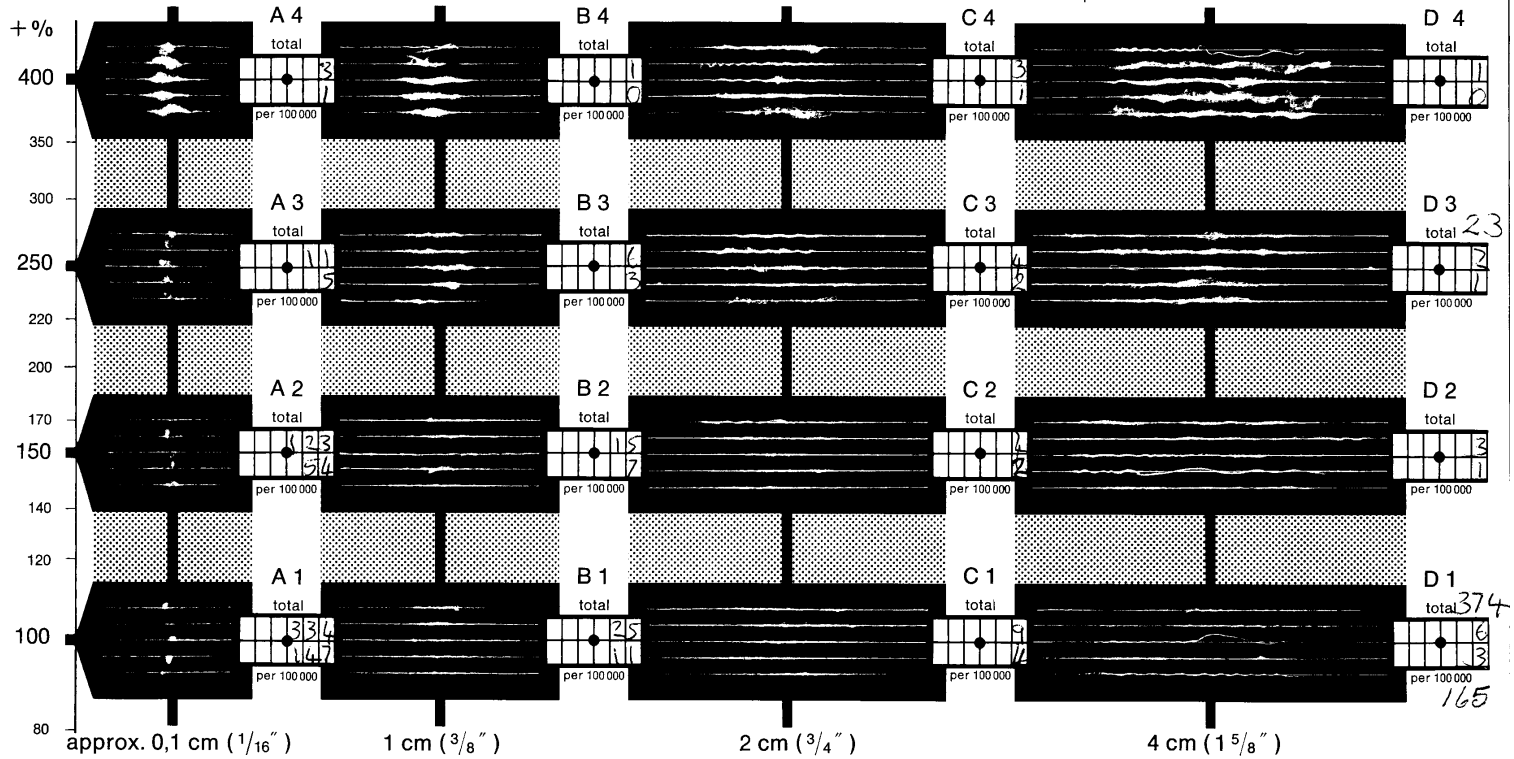
Tested Length
Geprüfte Länge
Longueur contrôlée



Test Results
Prüfprotokoll
Compte-Rendu

Cotton Ne 30—60
Baumwolle Nm 50—100
Coton Tex 10—20

Lot / Partie / Los: Maldens
col/white PART CONES
Ne 30s Nm - Tex -
Material Scale RH% - Dat. 14/3/78
Materialziffer Caractéristique de matière 7.5 Vis. -



Ne of yarn tested
Nm des geprüften Garnes
Nm du fil contrôlé

Weight of yarn tested
Gewicht der geprüften Garne
Poids du fil contrôlé

Tested length
Geprüfte Länge
Longueur contrôlée

Conversion of values to per 100 000
Umrechnung der Werte auf 100 000 yds/m
Conversion des valeurs pour 100 000

Counter reading
Zählerstand
Lecture

Tested Length
Geprüfte Länge
Longueur contrôlée

30s Ne
Nm

15750

1.14 oz
Kg

227194 yds
m

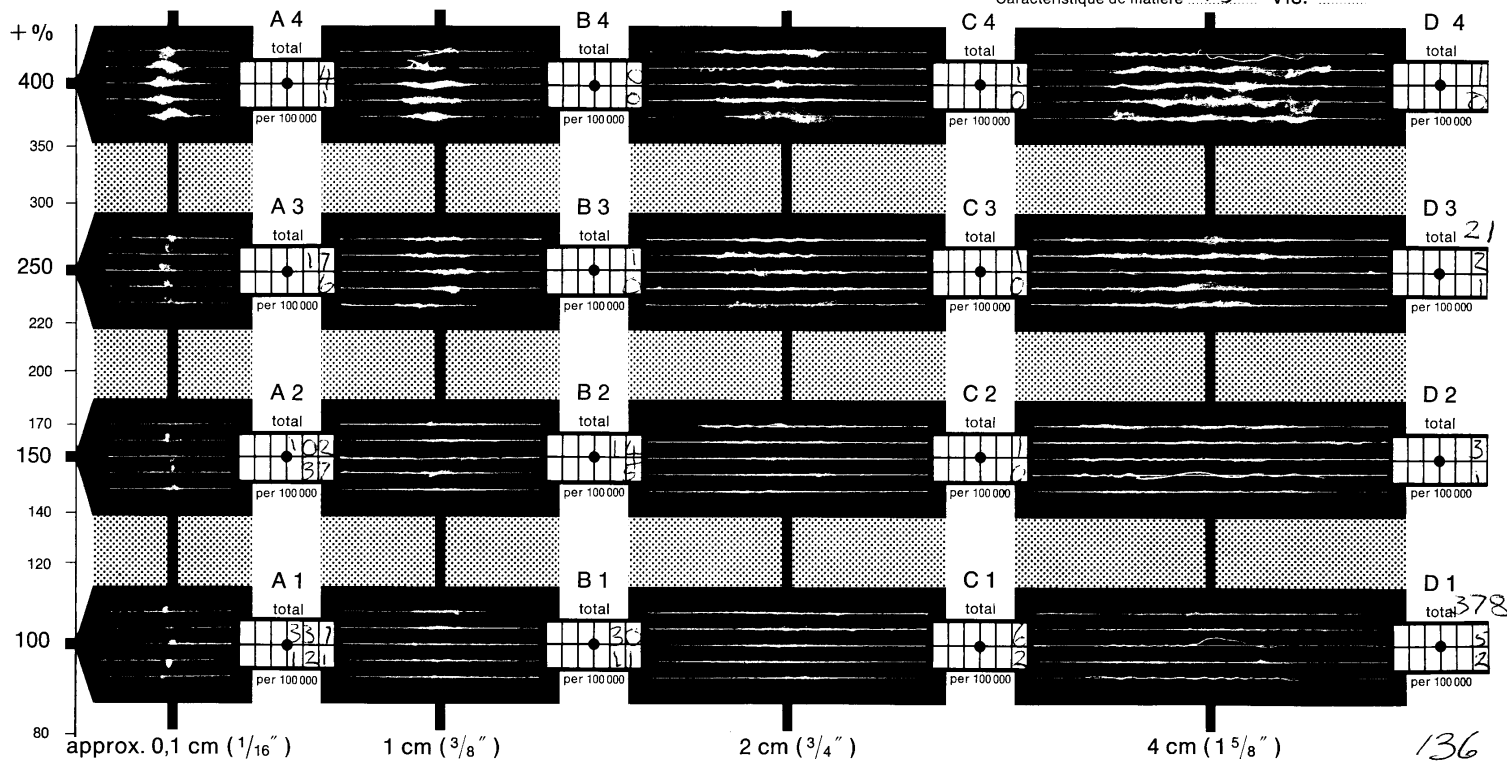
@ 250% = 2.55
@ 100% = 41.5



Test Results
Prüfprotokoll
Compte-Rendu

Cotton Ne 30—60
Baumwolle Nm 50—100
Coton Tex 10—20

Lot / Partie / Los: Haldens
colwhite PART CONES
Ne 34.5 Nm — Tex —
Material Scale Materialziffer Caractéristique de matière 7.5 Vis. —
RH% — Dat. 13/3/78



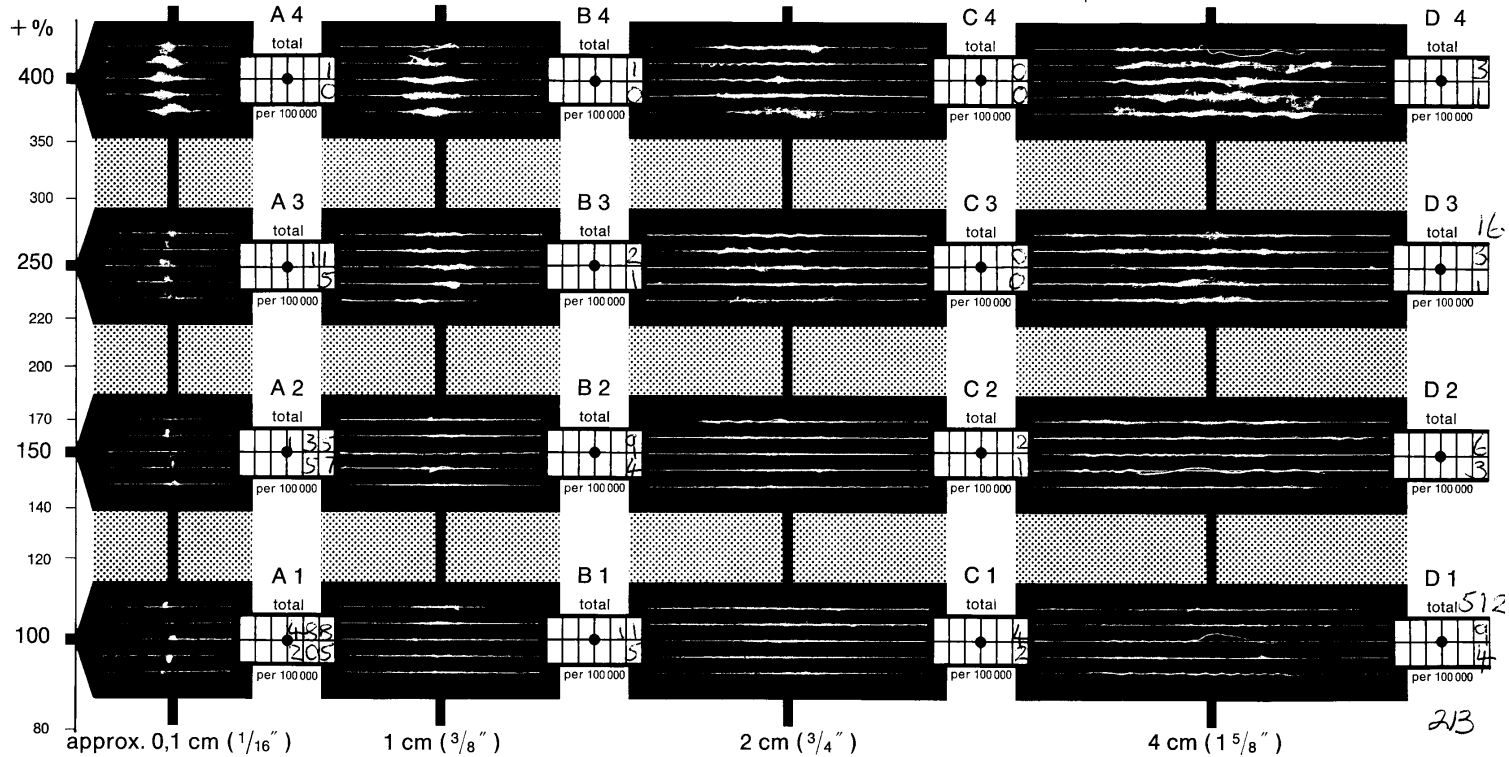
Ne of yarn tested Nm des géprüften Garnes Nm du fil contrôlé	Weight of yarn tested Gewicht der géprüften Garne Poids du fil contrôlé	Tested length Géprüfte Länge Longueur contrôlée	oz × 52.5 × Ne = yards Nm × Kg × 1000 = meter	Conversion of values to per 100 000 Umrechnung der Werte auf 100 000 yds/m Conversion des valeurs pour 100 000	Counter reading Zählerstand Lecture
<u>34.5</u> Ne <u>NMT</u>	<u>1785</u> oz <u>156</u> kg	<u>27999</u> yds <u>—</u> m	@ 250% = <u>2.14</u> @ 100% = <u>38.6</u>		<u>136</u> × 100 000



Test Results
Prüfprotokoll
Compte-Rendu

Cotton Ne 30—60
Baumwolle Nm 50—100
Coton Tex 10—20

Lot / Partie / Los: Holdens
col white PART CONES
Ne 38s Nm - Tex -
Material Scale Materialziffer Caractéristique de matière 7.5
RH% Vis. Dat. 14/3/78



Ne of yarn tested
Nm des geprüften Garnes
Nm du fil contrôlé

38s Ne
Nm 19950

Weight of yarn tested
Gewicht der geprüften Garne
Poids du fil contrôlé

120 1/4 oz
1.7 kg

Tested length
Geprüfte Länge
Longueur contrôlée

239899 yds
m @ 250% = 2.13
@ 100% = 68.1

Conversion of values to per 100 000
Umrechnung der Werte auf 100 000 yds/m
Conversion des valeurs pour 100 000

Counter reading
Zählerstand
Lecture

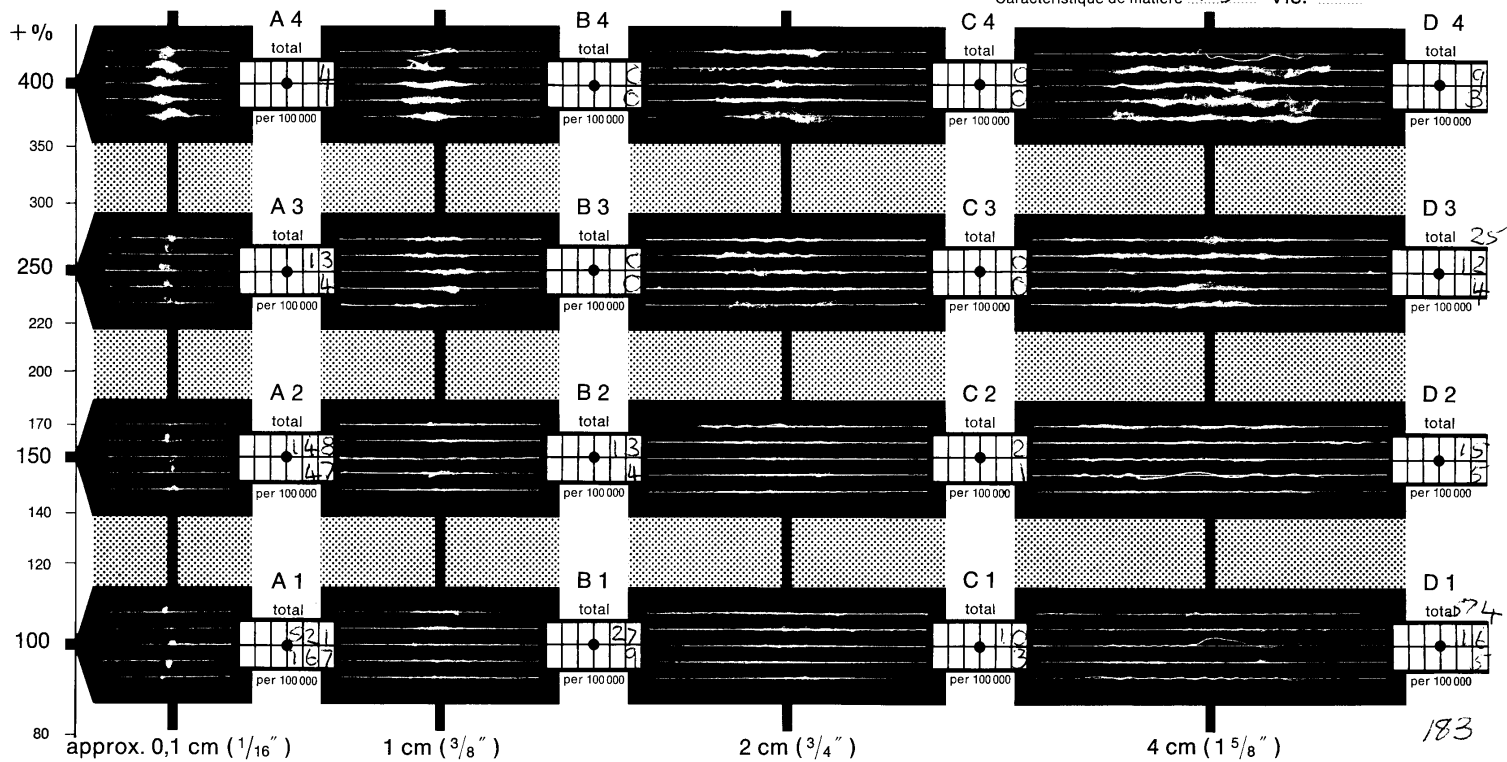
Tested Length
Geprüfte Länge
Longueur contrôlée



Test Results
Prüfprotokoll
Compte-Rendu

Cotton Ne 30—60
Baumwolle Nm 50—100
Coton Tex 10—20

Lot / Partie / Los: Holdens
color/white. PART CONES
Ne 425 Nm Tex —
Material Scale Materialziffer Caractéristique de matière 7.5 Vis. —
RH% — Dat. 13/3/78



Ne of yarn tested
Nm des geprüften Garnes
Nm du fil contrôlé

Weight of yarn tested
Gewicht der geprüften Garne
Poids du fil contrôlé

Tested length
Geprüfte Länge
Longueur contrôlée

oz × 52.5 × Ne = yards
Nm × Kg × 1000 = meter
Conversion of values to per 100 000
Umrechnung der Werte auf 100 000 yds/m
Conversion des valeurs pour 100 000

Counter reading
Zählerstand
Lecture

Tested Length
Geprüfte Länge
Longueur contrôlée

Ne 425
Nm

2205 C

oz 14.14
kg

32 yds
313661 m

@ 250% = 2.81
@ 100% = 64.6

× 100 000

in yds/m
en yds/m

Project

TESTS REQUIRED	Interlock - 38 c.c.						SAMPLE				
	✓	307	95%CL	x 324	95%CL	340	95%CL	x 359	95%CL	377	95%CL
% SHRINKAGE	length	11.68	0.84	13.53	0.7	19.02	1.83	23.23	0.54	23.35	1.49
	width	22.02	0.66	21.14	0.94	15.62	1.57	9.08	1.0	8.28	1.56
FABRIC WEIGHT $\frac{g}{cm^2}$	BW	184.6	0.68	164.8	2.69	167.6	4.93	158.2	2.69	168.6	5.38
	AW	249.6	4.17	238	3.83	227.6	4.44	215.6	4.17	205.4	5.16
C/3 CM	BW	48.1	0.54	43.9	1.23	39.7	0.94	35	0.94	34.1	0.82
	AW	54.33	0.98	52.36	1.2	49.06	1.18	45.98	1.26	44.57	0.94
W/3 CM	BW	35.7	0.63	36.3	0.94	36.3	0.42	38.9	0.8	38.9	0.8
	AW	45.98	0.53	45.12	0.56	43.7	0.91	43.15	0.95	42.28	0.55
STITCH LENGTH MM	BW	3.10	0.03	3.248	0.01	3.519	0.01	3.613	0.01	3.705	0.04
	AW	3.019	0.03	3.188	0.02	3.364	0.03	3.444	0.06	3.694	0.01
BURST STRENGTH $\frac{KN}{m^2}$	BW	792.5	20.71	713.2	30.77	714.6	30.15	707.7	12.56	679.19	30.2
	AW	727.0	30.86	667	32.62	650.46	32.37	607.94	28.18	590.5	34.49
SPIRALITY ANGLE'S	BW	3.7	1.76	3	1.21	2.7	0.61	1.8	0.66	5.85	1.85
	AW	1.17	0.71	2.55	1.29	1.25	0.59	2.15	0.79	3.60	1.05
Width cm x 2		63.5		63.1		60.93		58.2		58.2	
Xim Count	AW	38.44		37.51		38.58		38.07		37.5	
SES g	AW	170.79	12.38	169.53	15.98	145.65	12.17	171.7	10.09	160.9	13.56
% cont		8.93	1.38	9.51	0.84	10.41	0.59	9.61	0.64	9.26	0.79

COMMENTS: Spirality - Interlock - 10 readings only.
Overall SES g - 5-9.5% Accuracy

FABRIC DETAILS:

Grage State - As Received - BW
fully Relaxed - AW.

TESTS REQUIRED	SAMPLE												
	✓	267	95%CL	285	95%CL	306	95%CL	326	95%CL	350	95%CL	248	95%CL
SHRINKAGE length		13.24	0.48	16.81	0.6	19.22	0.74	21.02	0.89	20.04	0.98	3.71	0.76
width		24.79	1.69	20.55	1.43	14.78	1.45	5.68	2.08	14.36	3.63	33.93	0.87
FABRIC WEIGHT gsm	BW	130.4	3.78	126.8	1.62	124.4	2.08	137.2	3.18	142.4	4.61	148.2	3.09
	AW	194	3.62	185.4	3.35	172.8	2.04	152	2.32	143.4	3.89	220.2	1.86
C/3 CM	BW	50.9	0.81	45.7	0.91	40.7	1.32	36.9	0.40	35.2	0.41	64.4	1.13
	AW	60.08	0.74	55.59	0.64	50.0	0.35	47.56	0.94	44.09	0.89	65.43	2.3
W/3 CM	BW	26.4	1.11	28.1	0.26	27.2	0.34	26.2	0.89	26.5	1.22	25.4	0.26
	AW	35.28	1.13	34.49	0.56	31.73	0.89	29.29	0.89	27.01	0.56	36.93	0.63
STITCH LENGTH mm	BW	2.692	0.01	2.883	0.01	3.103	0.02	3.348	0.02	3.57	0.01	2.505	0.01
	AW	2.673	0.01	2.843	0.02	3.055	0.02	3.277	0.01	3.53	0.01	2.472	0.02
BURST STRENGTH kn/m ²	BW	499.9	20.91	496.7	17.23	474	21.18	447.5	18.8	421.55	17.46	536.7	31.68
	AW	498.1	18.56	503.6	15.42	436.7	20.79	352.25	17.58	349.15	16.64	593.2	31.78
SPIRALITY ANGLES	BW	4.71	1.25	3.66	1.32	5.2	1.28	3.14	0.86	2.14	0.49	4.2	1.14
	AW	1.80	0.44	1.57	0.5	1.54	0.44	2.44	0.68	3.73	0.91	1.52	0.35
Width in cm x 2		59.4		58.9		58.9		58.9		58.27		65.3	
Yarn Count	AW	3583		2958		3446		3466		349		3539	
SES g	AW	199.45	11.44	200.1	14.83	184.85	10.13	203.55	15.97	198.3	12.94	200.65	15.88
% cont		10.12	0.92	9.94	0.77	9.68	0.75	10.58	0.56	10.8	0.62	9.37	0.76

COMMENTS:

FABRIC DETAILS:

TESTS REQUIRED	SAMPLE										
	✓	267	95%CL	285	95%CL	306	95%CL	326	95%CL	350	95%CL
% SHRINKAGE	length	10.71	0.79	13.65	1.11	17.95	0.54	19.62	0.8	20.72	1.91
	width	26.64	0.71	21.83	1.13	16.67	1.74	10.37	2.3	4.5	1.15
FABRIC WEIGHT g/smbw		162.6	4.17	158	3.4	149.4	6.42	137.2	4.92	139.6	4.52
	AW	229.3	4.59	216	4.21	198.8	2.83	191.6	2.87	173	4.39
C/3 CM	BW	53.5	0.91	48.7	0.56	42.8	1.61	39.1	0.55	35.6	0.82
	AW	59.37	1.05	56.14	0.56	50.71	0.63	47.8	0.59	43.94	0.56
W/3 CM	BW	26.1	1.32	26.1	0.54	27.6	0.85	27.2	0.69	27.1	1.00
	AW	35.43	0.35	34.17	0.63	31.65	0.74	30	1.27	28.11	0.56
STITCH LENGTH H.M.BW		2.717	0.01	2.892	0.02	3.100	0.02	3.306	0.01	3.574	0.01
	AW	2.656	0.01	2.822	0.01	3.056	0.01	3.283	0.02	3.505	0.01
BURST STRENGTH $\frac{kn}{m^2}$	BW	613.2	15.14	596	22.79	566.3	27.25	536.7	30.01	474.6	24.04
	AW	630.47	26.0	602.2	26.4	532.1	23.23	470.5	21.33	439.5	18.6
SPIRALITY ANGLES BW		3.54	1.06	2.28	0.48	3.82	1.04	4.45	1.15	5.02	1.79
	AW	1.41	0.38	1.52	0.43	1.86	0.39	2.33	0.70	1.64	0.53
Width $\times 2$		60.63		59.13		59.3		59.4		58.5	
Yarn Count	AW	31.03		31.57		31.39		30.8		30.78	
SES $\frac{g}{\% Ext}$	AW	245.49	15.51	241.1	13.2	223.5	15.52	227.5	14.84	212.3	17.81
		9.85	0.55	9.92	0.01	9.78	0.78	10.49	0.51	10.03	0.86

COMMENTS:

FABRIC DETAILS:

