International Institute For Cotton

Technical Research Division

Manchester

Research Record No: 132

Project K1

The Operations Of Dyeing And Finishing In The Open-Width State

A Report On The Processing Carried Out At Strines Printing Co. During The Period July - October 1980

Robert D. Leah

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1. Introduction

Research Record 122 (*Appendix FF* of the November 1980 *Report to the TPI Steering Committee*) outlined the purposes of the knitting projects K1 and K2 and went on to describe the operations of dyeing and finishing in the tubular state.

That work was carried out at the factory of Meridian Dyers Ltd. of Nottingham, England. The finishing plan drawn up at the project proposal stage called for a comparison to be made between tubular finishing and open-width finishing.

A previous survey of single jersey makers-up carried out by the TRD knitting department indicated that the vast majority of single jersey (primarily polyester / cotton blends) fabric is finished and made-up in the open-width form. It was therefore felt that a comparison between the tubular and open-width finishing routes ought to be carried out to determine:

- which is the better route for producing fabrics with better dimensional stability;
- whether the choice of open-width or tubular processing has any effect on the fully relaxed structure and hence other properties of the fabric.

For the open-width finishing operations a local company, Strines Printing (a branch of Tootal Fabric Division) was recruited for this purpose. Strines Printing is primarily a printworks of predominantly woven fabrics and is the largest printworks in the UK. However, several years ago they absorbed another Tootal factory, Chadkirk Dyers who were predominantly dyers of knitted fabrics made from synthetic yarns. Within the Strines Printworks there is, therefore, a well-equipped dyehouse which has, over the last few years, been adapted to process natural fibres. This dyehouse tends to be operated as a separate unit from the printing operations.

Although they do not regularly process single jersey fabrics from 100% cotton yarns, they were anxious to cooperate in this exercise as much for their benefit, in terms of possible future business, as for ours. This seemed an ideal arrangement since, as well as having suitable equipment, they also had the incentive to cooperate.

This report describes the finishing operations carried out at Strines during the period July - October 1980.

2. Fabric Coding

The complete knitting details of the fabrics to be finished are given in *Research Record 114* (*Appendix W* of the May 1980 *Report to the TPI Steering Committee*). For clarity these consisted of a range of SJ fabrics knitted on 3 gauges of knitting machines (18, 24 and 28) from 6 counts of yarn (3 singles counts and 3 corresponding two-fold counts) at 5 stitch lengths. All single yarns had a twist factor of 3.5 and a standard "Z" direction of twist.

This was termed the basic plan and comprised of a total of 90 individual pieces of fabric, each one different. In addition, a supplementary trial was planned to investigate the effect of yarn twist direction and yarn twist factors on spirality. This consisted of a limited range of fabrics utilising singles yarns with variations in the direction of twist and also the twist factor.

This particular series of fabrics was for finishing by the open-width route only and consisted of an extra 30 pieces of fabric. The total number of fabrics for open-width finishing therefore consisted of 120 (90 + 30) plus a small number of knitting repeats due to yarn variation. Each fabric variant was allocated an identifier which gives the complete history of that particular variant.

Examples

Code	Decode
18/1-16/344/2	18g knitting machine 1/16 Ne combed singles ring-spun yarn 3.44 mm nominal stitch lemgth fabric finishing route #2
24/1-28/321/(n)	24g knitting machine 1/28 Ne combed singles ring-spun yarn 3.21 mm nominal stitch lemgth yarn twist variant #n

Where n =

11 for alternate S + Z twist	(TF 3.5)
12 for S twist	(TF 3.5)
13 for Z twist	(TF 3.0)
14 for Z twist	(TF 4.0)

Note: For the supplementary trial fabrics the ultimate number in the code denotes a yarn variant and not a finishing route.

3. Outline Of Trials

The main purpose of the K1 project has been stated to be:

- to investigate the interactions of yarn count and stitch length on the properties of single jersey fabrics;
- to determine the effect of yarn twist direction and yarn twist factor on the spirality of single jersey fabrics.

To enable these evaluations to be carried out in a meaningful way it is essential to eliminate any extraneous factors which are likely to influence the outcome (these are being investigated in the K2 project).

For the open-width K1 finishing, therefore, all the fabric variants had to be finished by an identical route but to targets calculated individually for that particular variant. The way that these targets were calculated is detailed in the next section.

4. Targets

In an exercise such as this, where many of the fabrics are not in regular commercial production, little is known of their behaviour during processing and no specifications exist which the finisher can use to help him set up his finishing machinery to handle such fabrics. All that can be done, therefore, is to attempt to finish the fabrics to a pre-determined width which should take into account the fact that knitted structures are generally expected to have a certain amount of elasticity in the width direction.

Note for the digital version: In those days, it was thought in the trade that a single jersey fabric needed to be finished with a certain amount of residual shrinkage in the width direction, in order to achieve the desired amount of "elasticity" in the width direction. This belief is now thought to be of dubious validity but it explains why such high width shrinkage targets were chosen.

To arrive at this target width figure, it is necessary to know the fully-relaxed dimensions of a particular fabric construction. From the grey-state test data it is possible to obtain the fully-relaxed wale spacings for all of the fabric variants. Knowing this figure, and also knowing the number of needles in the knitting machine on which the fabric was produced, it is a simple mathematical division to determine the fully relaxed width of any of the knitted variants.

For single jersey fabrics, it was considered that, after finishing, the width should be such that the fabric would have a residual shrinkage value in width direction of 10 - 12% when tested by the IIC method. (*Appendix*).

Note for the digital version: The IIC method was later re-named as the "Starfish Reference Relaxation Procedure" and the "Fully-Relaxed State" was termed the "Starfish Reference State".

However, experience obtained during the *Central Project 78* exercise has taught us that, if the target widths are calculated on the basis of the grey-state, fully-relaxed wale spacings, then the residual width shrinkage values tend to be too low. This is due to the fact that the fully-relaxed wale spacing after dyeing is different from the grey-state fully-relaxed wale spacing (difference varies with processing route).

At the time when the target width figures have to be determined however, (when assembling dyelots), the only data available are for the grey-state fully-relaxed structure and, therefore, the targets have to be calculated on the basis of these data. To allow for the difference between grey-state and dyed-state structure, the 10 - 12% residual width shrinkage target is increased to 15% based on the grey state fully relaxed width.

The calculation to determine the target width of each variant is therefore as follows.

Fully-relaxed open-width, cm = Number of Needles / Relaxed Wales/cm

Fully-relaxed open-width = Target finished width *x* 0.85

Target width = Fully-relaxed open-width / 0.85

Target width = Fully-relaxed width *x* 1.17 (+17%)

Note: After dyelot assembly and just prior to commencement of processing at Strines, test data from the K2 processing at Meridian became available. This indicated that the target widths of the fabrics processed on the Thies Rotostream were too low by 0 to 5% (width shrinkage values 7 to 12%).

A decision was therefore taken after consultation with colleagues at TRD to increase the target widths of all the fabrics to be treated at Strines by 2% in every case.

5. Dyelot Assembly

Target finished widths were calculated for each piece of fabric and these were listed in increasing order together with the individual weights of each piece. The fabrics from the

supplementary spirality trial were interspersed with the basic fabrics to facilitate easier processing.

The dyeing vessel to be used at Strines requires three ropes of fabric and therefore dyelots consisting of 21 pieces of fabric (3 *x* 7) were assembled from the list of ascending widths. The weight of each dyelot was in the range 260 - 320 Kg.

In assembling the ropes, care was taken to ensure that the cutting lines were aligned to prevent undue problems at the slitting stage. At the beginning/end of each rope a small length of polyester fabric was sewn in, so that the dyer would know the point at which he should break the rope at the end of the dyeing cycle, ensuring that the fabrics were removed from the machine in the correct width order.

To complete the dyeing operation a total of six dyelots was required. To make up the loading for the last dyelot, additional pieces were used which had been made from yarn surplus to requirements.

6. Processing Details

6.1. Dyeing

The jet machine which was used at Strines for all the dyelots was the Thies Rotostream (see *Appendix*). This is a similar machine to the one used at Meridian for part of the K2 fabrics (Lot 4) with the exception that it is the three-rope version as against the two rope version at Meridian.

The volume of liquor used is 2000 litres which gives an approximate liquor-to-goods ratio of 7 to 1. The machine is operated at a rope speed of approximately 300 metres/minute.

The pretreatment consisted of a peroxide bleach, and this together with the precise dyeing procedure was identical to the method employed at Meridian. The actual procedure and formulations employed are detailed in the *Appendix.*

The dyestuff and depth of shade was once again 2% o.w.f. Procion H-EG. Some problems associated with the depth of shade achieved were encountered and these are discussed in a later section.

6.2. Softening

It is usual to apply cationic softening agents as a post-dyeing treatment whilst the fabric is still in the dyeing vessel. This had been carried out in all cases at Meridian. The particular softeners used at Meridian are not normally utilised at Strines and they therefore requested that we use one of their regular products Sandolube NV (Sandoz Products Ltd.) which they have found to be particularly effective in improving sewability. Their request was agreed to but, after drying the first dyelot, softener marks were apparent which were attributed to foaming. These were not serious and for the second dyebatch it was suggested that the fabric should be removed from the dye vessel before the softener bath was dropped to eliminate the foam/scum. This was done but, after drying, the softener marks were more pronounced and signs of emulsion breakdown were apparent.

The problem was immediately referred to Sandoz who after carrying out tests advised us that the product was failing under the shear conditions of the Rotostream circulating pump. (This was the first time that Strines had tried to use the product in the Rotostream, although it is recommended for use in jets.)

We were strongly advised by Sandoz to apply the softener at a different stage or to change

products. It was felt that, at some later date, we would possibly be evaluating sewability on these fabrics and the lesser of the two evils would be to stick to Sandolube NV but to apply it at a later stage. The mode of application of softening agent for a particular dyelot is indicated on the individual processing sheets given in the *Appendix*.

6.3. Hydroextraction

Following removal from the dyeing vessel the fabric was loaded into a centrifuge and spun for approximately four minutes.

6.4. Slitting

De-twisting and wet-slitting is carried out at Strines using a modern Calator CR220 slitting machine (*Appendix*) which incorporates a revolving turntable.

The majority of fabrics were slit without trouble but certain variants gave the operator considerable difficulty. These were the ones which displayed excessive spirality which caused the fabric to move to one side of the machine, causing the fabric tube to fall from the slitting cone.

In particular the supplementary fabrics designated 12 (*see Section 2: Fabric Coding*) appeared to give more problems than any other of the fabrics.

As the fabrics came over the slitting machine the first fabric measurements were taken. Fabric width and course spacing measurements were taken and these are recorded on the individual processing sheets given in the *Appendix*.

6.5. Drying and Finishing

The knitgoods finishing stenter at Strines is a 6-bay Famatex pin/clip machine. The first two bays are heated by indirect steam and the remaining four bays are heated by direct gas burners. In front of the stenter is a 3-bowl, heavy-duty pad mangle and between the two units is a stainless steel accumulator.

The overall length of the chain is around 25 metres which is approximately one third the length of the individual fabric pieces. Width changing is therefore difficult since an alteration in the chain width setting will consume 25 metres of fabric before the full extent of the alteration to the setting shows itself in stabilised fabric width.

In discussions with the finishing personnel at Strines it was agreed that alteration of chain width for a single variant was impractical and that fabrics should be grouped into sets of a similar width: all fabrics in a set should then be finished to the same width. The way in which the dyelots had been assembled made this task easier. In fact, with the majority of dyelots, the individual fabric ropes made up a suitable set and were finished to a standard width.

The target width figures discussed in *Section 4* were, in some cases, exceeded but, in no case, was any fabric finished to a width which exceeded its target by more than 5 cm. The individual target widths and the grouped widths are shown on the individual processing sheets.

It is customary when processing single jersey fabrics to gum and trim the fabric selvedges during the final stentering operation to reduce curling and to give a cleaner selvedge. This results in a loss in fabric width of 5 cm. The target widths at the stenter exit are therefore reduced to compensate for the trimming.

After de-twisting and slitting into open-width the dyed fabric was presented to the stenter for drying. Where softening agent had been applied in the jet, the fabrics were padded through

water to even out the moisture content which varied due to partial drying out during waiting periods. Where softener had not been applied in the jet, the fabrics were padded through 30 g/1 Sandolube NV (wet on wet) on the padder. From the padder the fabric was plaited into the scray accumulator and from there fed onto the stenter chain.

In the feed section of the stenter are housed two pairs of skew rollers which are adjusted manually. By adjusting these to alter fabric path length some possibility exists to eliminate spirality. Overfeed was applied to such a degree that the fabric was slightly rippled as it entered the drying enclosure. The overfeed setting was adjusted for each variant in turn since the fabric width prior to stentering governs the amount of overfeed which can be applied. The overfeed dial indicated that 25 - 40% overfeed was applied to the majority of variants.

Wherever possible the skew rollers were adjusted so that the fabric "weft" was straight as it entered the drying chamber. Drying temperature was 130˚C.

Prior to leaving the chain at the stenter exit the fabric was trimmed by rotating circular blades and the fabric was batched onto a beam.

Note: The first dye-batch was plaited from the stenter but this caused problems at the rolling stage and all subsequent dye-batches were beamed.

Fabric width was measured on the beam and minor chain-width alterations made to ensure that fabrics approached target width. All measurements are given on the individual processing sheets.

6.6 Re-rolling

The individual fabric pieces were separated from the beam using a wide-width inspection machine. A Calator surface drive unwinding unit was utilised to drive the large beam so that tension was not generated in the fabric as it was removed from the beam. The first 15 metres of each variant (last 15 metres from the stenter) was removed for sampling purposes and the remainder of the piece rolled and shrink-wrapped for storage at TRD.

6.7 Sampling

Once back at TRD the 15-metre lengths were sampled for testing and also for reference purposes. Additionally, width measurements and course spacings were taken together with "rough" wale spacings. These were determined using line gratings and measurements were taken approximately three inches in from either selvedge and also in the centre. This was carried out for comparative reasons and will be used when assessing the set of fabrics which has been piece-mercerised in open-width form.

All measurements are recorded on the individual processing sheets.

7. Comments And Observations

7.1 Depth of shade

In the *Appendix* are samples showing the depths of shade obtained on the six dyelots processed at Strines together with a typical Meridian sample. Apart from the final dyelot all other dyelots are considerably thin on shade. When the first batch had been dried and the weak shade was apparent it was thought that human error may have been the major contributing factor and therefore no alteration was made for the next dyelot. Although this came out a little deeper it was still very thin when compared with the standard Meridian dyeing.

During the processing of a further dye batch, samples of dye liquor were removed from the dye vessel at several points in the dyeing cycle and exhaustion determinations carried out. This indicated an exhaustion of 70% had occurred which although a little on the low side would not explain the lack of shade depth. The problem was referred to ICI and full details of processing were supplied to them. They eventually suggested that the washing-off treatment following the peroxide bleach, prior to dyeing had not been adequate. They suggested that residual alkali left in the fabric had possibly bled into the dyebath causing hydrolysis of some of the dyestuff prior to salt addition. Additionally Procion Blue H-EG is particularly sensitive to peroxide bleach and residual peroxide could result in a destruction of some of the chromophore causing a weak shade.

A laboratory evaluation to try to simulate the problem produced a slightly reduced depth of shade but this was considerably deeper than the Strines dyeings.

7.2 Spirality

Varying degrees of spirality were apparent in the fabrics after the dyeing stage. In some cases this was quite excessive and a single passage through a stenter was quite insufficient to correct the deformation. Commercially, fabrics exhibiting high degrees of spirality are sometimes given two passages through the stenter to achieve an acceptable appearance.

The variation in degree of spirality from piece to piece created additional problems for the stenter operative. Each fabric exhibited a different degree of spirality and, because of the unavoidable way in which the exercise was carried out, deformation could be transmitted from piece to piece because pieces of completely different construction were sewn together.

This fact must be given serious consideration when evaluating final test data.

7.3 Width

In the vast majority of cases, target width was achieved during the drying operation on the stenter without much trouble. However, it was noted, and this is apparent from the data on the individual processing sheets, that relaxation in width occurred between stentering and the final sampling operation. The degree of width relaxation was variable and in some cases was as much as 10 cm. Whether the relaxation in width had terminated at the sampling stage or whether further relaxation was likely to take place is unknown.

Care must be taken therefore during data analysis when relating width shrinkage, wale spacing and "finished width".

8. Concluding Remarks

The open-width finishing operation described in this report was carried out as near possible to plan and with no major disasters.

The variation in fabric shade from dye-batch to dye-batch should only affect the aesthetic evaluation of the fabrics. It is extremely unlikely it will affect any of the other properties under study.

As far as the general plan of operation is concerned, one or two comments may serve to influence the planning of any future such projects.

- With so many fabric variables involved, the way in which they have to be assembled is not conducive to satisfactory open-width finishing.
- To optimise machine settings, to obtain the best finishing conditions for a particular

fabric construction, several hundred metres of a particular fabric quality would be required. This is not the case with tubular finishing where machine path lengths are considerably shorter (e.g. drying: open-width ~25 metres; tubular ~3 metres),

- Mixing fabrics with differing degrees (and directions) of spirality gives rise to additional problems. For example, a fabric made from two-fold yarns should not exhibit spirality but, if it is processed along with a fabric which does exhibit spirality, the deformation is transmitted through the piece sewings to that piece.

9. Acknowledgement

The work described in this report could not have been carried out without the utmost cooperation from management and operatives alike. Even though their own personal future was uncertain, they did not allow this to affect this cooperation. For this, the author is most grateful.

Appendix

IIC Shrinkage Test Method

Preparation and Dyeing Details

Diagram of Thies Rotostream Jet Dyeing Machine

Diagram of Calator Slitting Machine

In-process Measurements Dyelots 1 to 6

Dyed Samples

International Institute For Cotton

Method Of Test

KT1A

Determination Of The Dimensional Changes Induced In Cotton Weft Knitted Fabrics By A Specified Relaxation Procedure.

May 1978

Principle

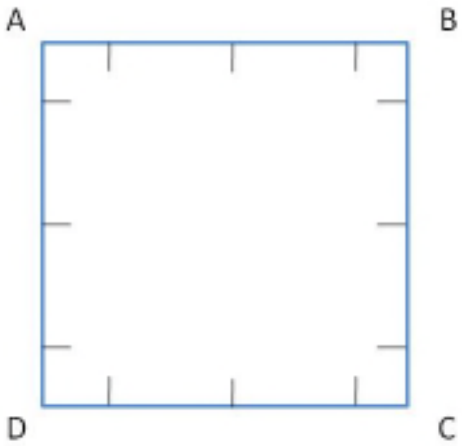
A fabric is subjected to a specified procedure and dried under the appropriate conditions, and any changes in dimensions are determined.

Method 1: By washing in a domestic automatic washing machine and tumble drying.

Apparatus

1. Hoover automatic De-Luxe washing machine.
2. Hoover tumble dryer
3. Two Perspex templates a) 25 x 25 cm and b) 50 x 50 cm, both having equidistantly located measuring marks on all sides (*Figure 1*).

Figure 1



Markings on AD are opposite those on BC (width measurement) and the markings on AB are opposite those on DC (length measurement).

4. Ruler and indelible pen.
5. A domestic automatic washing powder.
6. Means for providing the standard atmosphere for testing textiles specified in B.S. 1051, namely 65 ±2% RH and 20 ±2°C.

Test Procedure

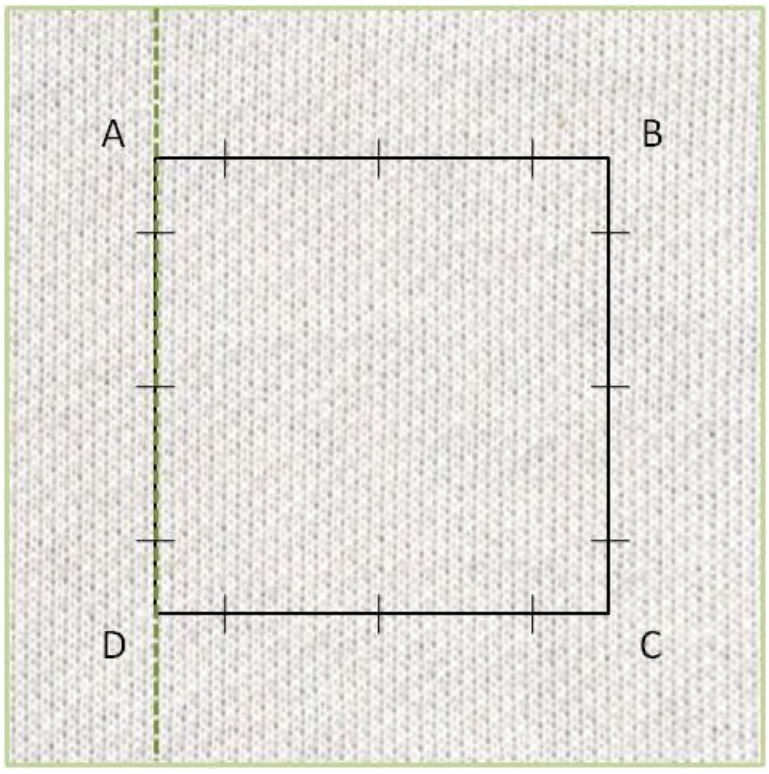
Conditioning

Samples are allowed to condition until they have reached equilibrium in the standard atmosphere for testing textiles (minimum 4 hours).

Specimen Preparation

1. The sample is laid on a flat surface removing wrinkles without stretching.
2. Five test specimens are prepared for each conditioned fabric sample, a minimum of 20cm larger in both directions than the required size of template, `e.g. the 25 x 25 cm template requires a specimen of at least 45 x 45 cm.`
3. The required size of template is placed centrally on the specimen so that one edge follows a wale line.
4. The test area is defined by drawing round the template. The three measuring marks are then drawn on each side of the square ABCD (*Figure 2*).

Figure 2



5. The distances between the marks are measured and recorded.

Laundering

1. Recommended loading for absorbent materials in a Hoover De-Luxe washing machine is 2.75 kilos (6 1b).
2. The specimens are weighed and placed in the machine. (Where necessary, the load is made up to 6 1b).

3. The prescribed amount of washing powder is placed in the dispenser and the machine set to wash at 60°C with a long spin.
4. On completion of the wash cycle, the load is tumble dried at the highest temperature setting, establishing the required drying time.
5. The laundering and tumble drying is repeated a further four times, making a total of five cycles.
6. After the fifth tumble drying cycle the test specimens are conditioned before measuring.

Measurement

1. The specimens are laid on a flat surface, removing wrinkles without stretching.
2. The distances between the pairs of marks are measured and recorded.

Calculation Of Results

The mean changes in dimensions in both length and width directions are calculated and expressed as percentages of the original mean length and width respectively. The 95% Confidence Limits and the % Accuracy are also calculated.

An extension is indicated by the prefix Ext.

REFERENCES

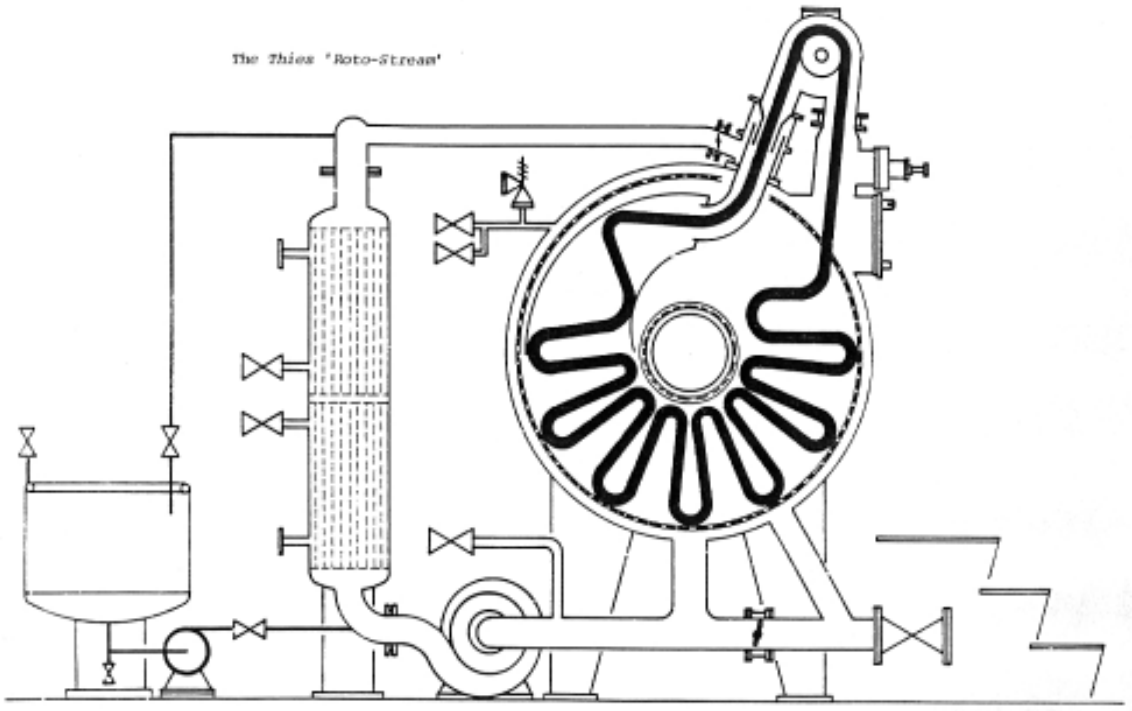
Research Record No. 59

B.S. 1051

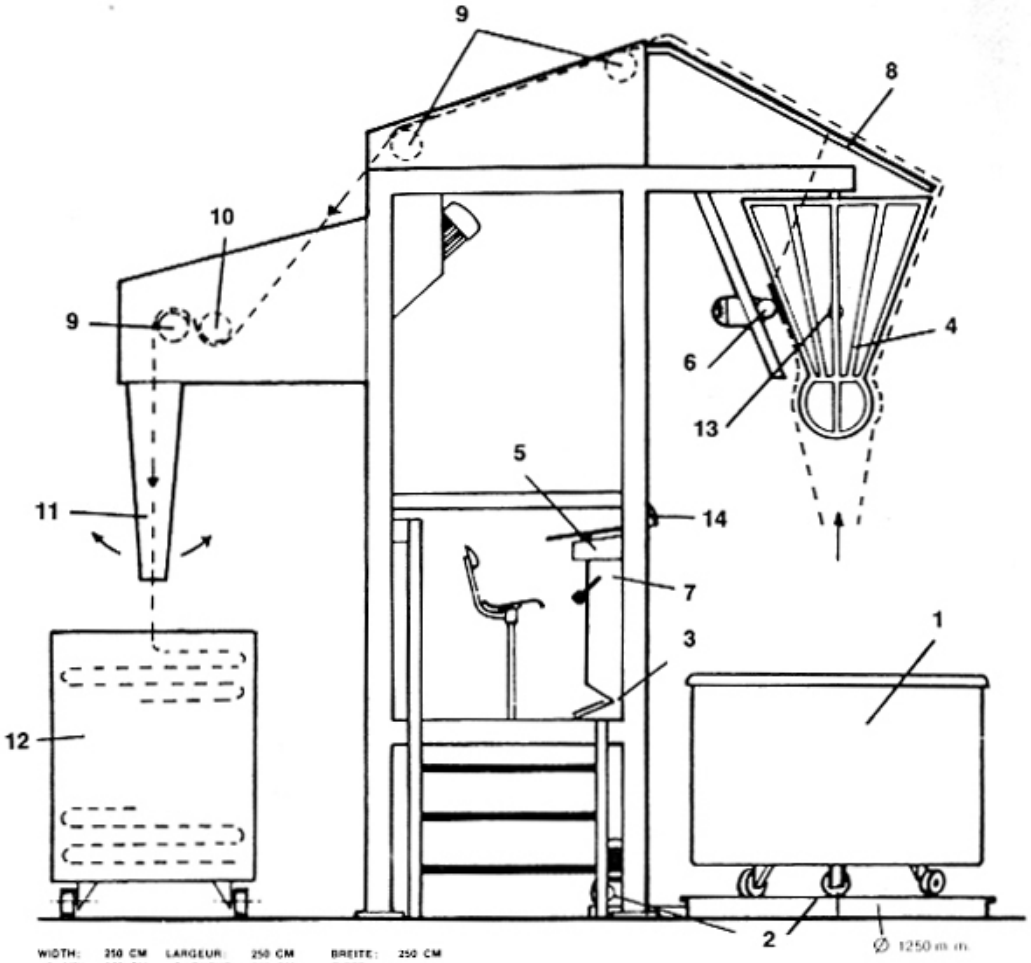
Dyeing Method

Prebleach	l g/l Viscavin CA 2.5 g/1 NaOH 8 g/1 Hydrogen Peroxide	Raise to boil over3 0 minutes. Maintain at boil for 30 minutes
Rinse Well	l g/l Soda Ash	10 minutes at the boil
Rinse	0.5 g/1 Acetic Acid	5 minutes cold
Rinse		
Dyeing Procedure	2.2 g/1 Matexil PAL 2% Procion Blue H-EG 90 g/1 Salt (in 3 parts) 15 g/1 Soda Ash (in 2 parts) 5 g/1 Sodium Bicarbonate	Start with Matexil at 50°C Add dye over 10 minutes Run for 20 minutes Raise to 80°C over 20 minutes Run for 20 minutes Add one-third salt over 20 minutes Run for 20 minutes Add one-third salt over 20 minutes Run for 20 minutes Add one-third salt over 20 minutes Run for 30 minutes Add Sodium Bicarbonate over 10 minutes Run for 15 minutes Add soda ash in two equal parts over 20 minutes Run for 45 minutes Drop
Soap-off	1 g/l Lenetolo BW	
Post-softening	2% owf Sandolube NV	20 min at 35 °C

Thiess Rotostream Jet Dyeing Machine

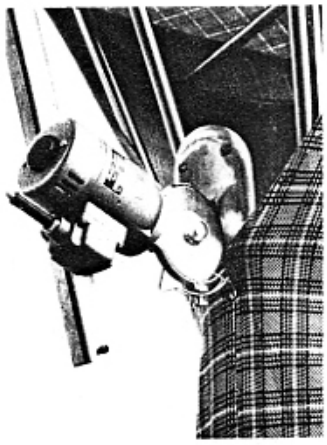


CALATOR CR220



WIDTH:	350 CM	LARGEUR:	350 CM	BREITE:	350 CM
LENGTH:	350 CM	LONGUEUR:	350 CM	TIEFE:	350 CM
HEIGHT:	350 CM	HAUTEUR:	350 CM	HÖHE:	350 CM

Control panel
Place de maneuvre
Schaltbrett



Slitter with guide cone
Ciseau et cône de guidage
Schneidvorrichtung und Steuerkonus

Dyelot #1

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS

DYELOT NO. /

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING LHS	M	RHS
18/1-24/311/2	125	125	120	125	43	112/119	119½	44/45	24	24	24
18/2-48/311/2	133	133	128	119	44/45	128	127	44/45	23	22½	23
18/1-24/327/2	133			130	41/42	130	125½	41	22½	22½	23
18/2-40/327/2	139	141	136	121	43/44	136	126½	42	23	22	23
18/2-48/327/2	140			130	N.A.	135	129	38/39	22½	22½	22
18/1-24/344/2	141			136	39/40	134	129	34/35	23½	22	22
18/1-20/327/2	141			130	45	137	131½	41/42	22	21½	23
28/1-40/246/2	142	147	142	128	53	141	133½	50/51	30	30	30
18/1-24/362/2	145			138	35/36	140	134	32/33	21½	21½	21½
18/2-40/344/2	146			130	40	142	138	39	20½	21	20½
18/1-24/380/2	147			135	32/33	138	131½	30	22	21½	22½
18/2-48/344/2	147			128	36/37	141	131	38	21½	21½	21½
18/1-20/327/11	147			127	42	141	138	43/44	21	21	21
18/1-20/344/2	148			132	40/41	140	136	39/40	21	20½	21½
18/1-16/344/2	150	151	146	129	45	151	148	44	19	19	19½
18/2-32/344/2	150			136	45/46	153	150½	43/44	19	19	18½
24/1-32/276/2	150			141	53	146	141½	46	26	25½	25½
28/1-40/269/2	151			140	51	145	138½	51	28½	29	29
24/1-32A/276/2	151			140	51	145	139	50	26½	26½	26½
28/1-36/269/2	151			143	56	144	138	53	29	28½	29½
28/2-80/246/2	151			133	56/57	144	136½	54	29½	30	29½
			SOFTENER APPLIED ON PAD								

COMMENTS Many of these fabrics were very tight on the stenter frame and some difficulty in maintaining width was experienced. This is also shown in the creep back of width after stentering

Dyelot #2

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS

DYELOT NO. 2

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING LHS	M	RHS
24/1-32/291/2	153			131	49	149/150	150	43	24	24½	24
18/1-20/362/2	153			125	38	149/150	147½	40	19½	20	19½
18/2-48/362/2	153			128	36/37	150/148	149½	37	19	19½	19
18/2-40/362/2	154	154	149	121	38/39	149	149	38/39	19	19½	19
18/1-20/344/11	155			120	42	149/150	150	42	18½	19	19½
24/2-64/276/2	155			119	52	149	149½	51	24	24½	24
24/1-32A/291/2	155			131	44	150/151	148	46½	24	25½	24½
28/1-40/273/2	155			130	50/51	152/153	150	47	26½	27½	27½
28/2-80/259/2	155			120	50/51	152	149½	54	26	26½	27
28/2-72/259/2	155			118	53/54	153/152	150½	56	27	27½	27
18/2-32/362/2	156			125	41/42	154/152	150½	43	19½	19½	19½
28/1-36/273/2	157	157	152	128	46/47	153/151	151	45	27	27½	27
28/1-40/287/2	157			133	43/44	152	150	44	25½	27	27
24/1-28/291/2	158			131	49/50	152/155	153	49	23½	24½	24
24/1-28/291/14	158			136	48	154/156	156	48/49	23	23½	23½
18/1-16/362/2	158			129	40	157/156	151	42	19	19½	19
18/1-20/380/2	158			132	36	154	151	36	19	19	19
24/1-28/291/12	158	159	154	140	49	155	153	49	23½	24½	24
24/1-32A/306/2	158			146	44	155/154	152	43	24	24½	24
24/1-28/306/14	158			142	44	154	152½	45/46	24	24½	24
18/1-20/399/2	159			148	34	155	149	35	19	19½	19½
			SOFTENER APPLIED IN JET								

COMMENTS Softener stains apparent on drying. This fabric was plaited after stentering and batched on an inspection machine. This fabric is too flimsy for this procedure. ALL SUBSEQUENT DYELOTS SHOULD BE BATCHED ON THE STENTER.

Dyelot #3

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS

DYELOT NO. 3

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING LHS	M	RHS
18/2-40/380/2	159			138	35	155	153	35/36	19	19½	19
24/2-64/291/2	160			131	44	155	151	45	24	24½	24½
24/1-28/291/13	160			134	47	155	148	47	24	25	24½
28/1-32A/273/2	160	160	155	139	53	155	152	53	27	27½	27
18/2-48/380/2	160			132	33	155	151½	33	19½	19	19
24/1-32/306/2	160			141	42/43	155	148½	43	24½	24½	24½
28/2-72/273/2	161			129	49	155	148½	50	26½	27	27½
24/2-56/291/2	161			138	48/49	159	155	49	23½	24	23½
28/1-32/273/2	162			142	50	159	154½	51	26½	26½	26½
28/1-36/287/2	162			144	45	159	154	44	25½	26½	26
28/2-80/273/2	162	162	159	134	47	159	154	47	26½	26½	27
18/1-16/380/2	163			142	38	159	153	39/40	19	19	19
18/2-32/380/2	163			141	38/39	159	156½	37/38	18½	19	18½
28/2-64/273/2	163			140	51	159	155	51	26½	27	26½
24/1-32A/321/2	163			150	41	159	152½	41	23½	25	23½
24/1-28/306/2	164			148	46	160	156½	46/47	23	24	24
18/1-20/362/11	164			134	37	161	159	39	17½	18	19
28/1-40/301/2	165	165	160	140	40	160	157½	40/41	25½	26½	26
18/2-32/399/2	165			147	35/36	161	156½	36/37	18½	19	18
24/1-28/321/14	165			155	44	160	155	43	23½	24½	24
18/1-16/399/2	166			153	37	158	154	36/37	18½	19½	19
			SOFTENER		APPLIED	IN	JET				

COMMENTS Softener stains apparent through the cm. Appears as if the emulsion is cracking.

Dyelot #4

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS FIG. 9.

DYELOT NO. 4.

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING
24/1-28/306/13	166			133	45	161	157	45/46	23½ 23½ 23½
18/2-40/399/2	166			154	33	161½	154½	34	19 18½ 19
24/1-28/306/12	166			155	49/50	161	158½	48	23 23½ 23
24/1-24/306/2	166			151	48	160	158½	49	23 23½ 23
24/2-64/306/2	167	166	161.	150	43	160	154	44	24 23½ 24½
28/1-36/301/2	167			155	43	N.A.	154	42/43	25½ 26 26
28/2-80/287/2	167			150	44	156	149	43/44	27 27 27
24/1-32A/337/2	167			160	38	163	159	36	22½ 23 23½
24/1-28/337/14	167			163	41	164	159	39/40	23 23½ 23½
24/2-56/306/2	167			147	44	164	160½	45	23 23 23
28/2-72/287/2	168	168	163.	147	46	164	160	47	N.A.
24/2-48/306/2	168			146	47	165	160½	49	22 23½ 22
24/1-28/321/12	169			160	43/44	163	160	41/42	22½ 23 22½
24/1-28/321/2	169			157	41/42	163	159½	42	22½ 23 22½
28/2-64/287/2	170			150	47/48	167	164	50	25 25 25
24/2-56/321/2	171			160	47	167	163½	43	22 23 22
28/1-32A/287/2	171			154	49	167	163½	49/50	23½ 25 23½
28/1-36/316/2	171	171.	166.	172	42	167	164	39	24½ 24½ 24½
24/1-24/321/2	171			160	45	167	164	45	22½ 22½ 22½
18/1-20/380/11	171			158	35	167	164	37/38	18 17½ 17½
24/1-28/337/12	172			166	41	166½	160	39/40	22½ 24 22½
			SOFTENER		APPLIED		ON PAD		

COMMENTS It was observed that the special fabrics marked with Suffix 12 exhibited a high degree of spirality which could not be eliminated and affected other seams to them.

Dyelot #5

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS FIG. 10.

DYELOT NO. 5.

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING
28/1-36/259/11	172			144	52	168	167½	58/59	23 23½ 23
28/1-32A/301/2	172			159	42	168	165½	46	24 24½ 25
24/1-28/354/14	172			165	37	168	163½	37½	23 23 22½
24/1-28/321/13	173	173	168	155	39/40	168	165	42	21½ 21½ 21½
24/1-28/337/2	173			164	37/41	169	166½	39	21½ 21½ 21½
28/2-64/301/2	173			151	44	168	167	45	24 24 23½
24/2-64/321/2	173			152	39/43	164	160½	41	22 23½ 22
24/1-28/291/11	174			146	44	171	170	51/52	21½ 21½ 21½
18/1-20/399/11	174			156	32	171	171	33/34	17½ 17½ 17½
24/2-48/321/2	174			154	42	170	171	43	22 21 21½
18/1-16/419/2	175	175	170	167	32/33	169	168	34	17½ 17½ 17½
28/1-32A/316/2	176			167	39/40	170	168	42	23 24 23½
24/1-28/337/13	176			168	39	171	170½	38/39	21½ 21½ 21½
18/2-32/419/2	177			156	34/35	170	167	35	17 17 17½
24/1-28/354/2	177			168	35/36	173	170	37	21 22 21½
24/1-24/337/2	179			164	42	173	169	42/43	21½ 21½ 22
28/2-80/301/2	179			157	39/40	173	170	43	23½ 23½ 23
28/2-64/316/2	179	178	173	168	41	173	170	41	23 23 23
24/1-28/354/13	179			174	35/36	173	169½	36	21½ 21½ 21½
24/2-56/337/2	179			165	38/39	174	169	N.A.	21½ 22 21
28/2-72/301/2	179			163	42	175	170½	45	23 23½ 23

COMMENTS SOFTENER APPLIED ON PAD

Dyelot #6

PROJECT K1 STRINES ——— IN-PROCESS MEASUREMENTS FIG. 11.

DYELOT NO. 6

VARIANT	TARGET WIDTH BEFORE TRIMMING		TARGET WIDTH AFTER TRIMMING	WIDTH AFTER SLITTING	COURSES PER 3CM AFTER SLITTING	WIDTH OFF STENTER	WIDTH AT SAMPLING	COURSES PER 3CM AT SAMPLING	WALES PER 2CM AT SAMPLING
24/2-48/337/2	181			162	41	179	175	42/43	21½ 21½ 21½
28/1-36/273/11	182			151	50	178	176	54	23 23 23
24/1-28/354/12	182			163	N.A.	178	172½	37½	21½ 19½ 20½
24/1-24/354/2	182	183	178	170	37	178	175½	37/38	22 21 21½
24/2-48/354/2	183			167	36	179	174	39	21 21 21½
24/1-28/306/11	183			151	43	178	176	49	21½ 21½ 20½
28/2-72/316/2	184			167	39	178	175½	40/41	22½ 22½ 22½
28/1-32A/332/2	184			163	38	181	176	39/40	23½ 23½ 23½
24/2-64/337/2	185	186	181	162	35/36	181	176	39	21½ 21 21½
24/1-24/372/2	185			175	34	180	175	35	20½ 20½ 20
28/1-36/287/11	187			155	43	181	179	52	22½ 22½ 22
24/2-56/354/2	190			163	33/34	187	182	38/39	20 21 20
24/1-28/321/11	190	192	187	158	40	184	183	44	21 20 20
28/2-64/332/2	192			166	37	186	182½	40	22 22 22
24/2-48/372/2	198	198	193	173	34/37	193	189½	36/37	20 20½ 20
28/1-36/301/11	198			165	42	193	190	45/46	22 22 22
24/1-28/337/11	203	205	200	173	37	200	193	44	20 18½ 19
28/1-36/316/11	207			171	36	200	194½	44	21 21 21
24/1-28/354/11	211			173	34	200	194½	41	18 18½ 19
24/1-28/354/ES	211	211	206	173	35	206	200·5	41/42	18 18½ 18
24/1-28/354/ES	211								
			SOFTENER		APPLIED		ON PAD		

COMMENTS The ES fabrics were extras knitted to make up the jet load.

The widest fabrics are at the limit of strines width processing capability

Dyed Fabric Samples