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Martins Case Study: 14 Gauge 1x1 Rib

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NB: The Starfish predictions recorded in this report were made using an obsolete model.

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Introduction

Martins Dyers are commission finishers of knitted fabric and, as commission finishers, they have no control over the incoming fabrics. This particular investigation arose as they were experiencing variations in finished fabric from two of their main customers, both M&S suppliers.

As a first stage in this investigation it was decided that the incoming greige parameters should be measured over a period of time to establish if there were any systematic differences between the two firms in question. The two firms have been designated firms A and B.

Five pieces of fabric were taken at random from each incoming batch from each firm. This was repeated five times, making a total of 25 samples from each firm over a 3 month time period (approximately). After the first batch of greige fabric had been tested it was discovered that one firm was using an S-twist yarn and the other was using a Z-twist. In order to establish whether this affected the finished fabric dimensions it was decided that some of the corresponding finished fabrics should be included in these trials. Lots 3, 4 and 5 therefore were sampled, both in the greige state and after finishing.

All the fabrics were presumably made on 30 inch, 14 gauge machines, in a 1x1 rib construction.

Fabric Testing

All the fabrics were tested in both the as received and fully relaxed state in accordance with the IIC testing procedures. The finished fabric testing also includes a one wash and tumble cycle.

NB: All the yarns used by firm A were S twist; all the yarns used by firm B were Z twist.

Number Of Needles In The Knitting Machine

The number of needles in each knitting machine was not given in the information supplied to us when the fabrics were delivered to TRD. It was thought that a quick method of testing for this would be to count the wales per 3cm in a number of places and carry out the calculations from the width. This method proved to be unsuccessful as the results were very variable (see data sheets).

A different method was therefore carried out where the wales or needle spaces were counted around the fabric tube. Unfortunately, some of the samples had been completely used up during the initial testing so only a limited number were available for this exercise. However, three pieces from each firm, in all five deliveries, were available from the greige fabrics together with three pieces from firm A, lot 4 finished, and five pieces from both firms A and B, lot 5 finished.

This method of testing gave reproducible results (see page 8).

Finishing

Lots 3 and 5 were winch bleached (white).

Lot 4A was winch dyed (grey).

Lot 48 was winch dyed (khaki).

Code for Column Headings in Data Tables			
Y	Yarn	SHR 5L	Length shrinkage, % (5 cycles)
WID	Width, cm	SHR 1L	Length shrinkage, % (1 cycle)
Wt	Weight, gsm	SHR 5W	Width shrinkage, % (5 cycles)
C/3	Courses per 3 cm	SHR 1W	Width shrinkage, % (1 cycle)
W/3	Wales per 3 cm	BW	Before wash
CAL	Calculated	AW	After wash
SL	Stitch Length, cm	G	Greige
TF	Twist Factor	FIN	Finished
NE	Cotton Count		
SES	Single end strength, g		
EXT	Yarn extension at break, %		

Information on Fabric As Received

Greige Fabrics

LOT NO. 1

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
7/9/82	1/30's cc	7995	1	69 cms
7/9/82	1/30	7995	2	69
7/9/82	1/30	7995	3	69
7/9/82	1/30	7995	5	69
7/9/82	1/30 (COMBED)	7995	9	69

FIRM B

7/9/82	1/30	1544	3	67
7/9/82	1/30	1544	4	67
7/9/82	1/30	1544	7	67
7/9/82	1/30	1544	9	67
7/9/82	1/30 (COMBED)	1544	13	67

LOT NO. 2

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
17/9/82	1/30's cc	8037	4	69
17/9/82	1/30	8037	6	69
17/9/82	1/30	8037	11	69
17/9/82	1/30	8037	14	69
17/9/82	1/30 (COMBED)	8037	15	69

FIRM B

17/9/82	1/30's cc	1506	12	67
17/9/82	1/30	1506	13	67
17/9/82	1/30	1506	19	67
17/9/82	1/30	1506	23	67
17/9/82	1/30 (COMBED)	1506	24	67

LOT NO 3

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
11/10/82	1/30'scc	8111	1	69 cms
11/10/82	1/30	8111	3	69
11/10/82	1/30	8111	11	69
11/10/82	1/30	8111	14	69
11/10/82	1/30 (Combed)	8111	19	69

FIRM B

11/10/82	1/30	1543	13	67
11/10/82	1/30	1543	17	67
11/10/82	1/30	1543	19	67
11/10/82	1/30	1543	20	67
11/10/82	1/30	1543	21	67

LOT 4

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
26/10/82	1/30'scc	8281	4	69 cms
26/10/82	1/30	8281	6	69
26/10/82	1/30	8281	7	69
26/10/82	1/30	8281	11	69
26/10/82	1/30	8281	15	69
	(COMBED)			

FIRM B

26/10/82	1/30	1915	10	67
26/10/82	1/30	1915	13	67
26/10/82	1/30	1915	15	67
26/10/82	1/30	1915	17	67
26/10/82	1/30	1915	19	67
	(COMBED)			

LOT 5

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
12/11/82	1/30's cc	8413	4	67 cms
12/11/82	1/30	8413	10	67
12/11/82	1/30	8413	13	67
12/11/82	1/30	8413	17	67
12/11/82	1/30	8413	18	67
	(COMBED)			

FIRM B

12/11/82	1/30	1923	17	67
12/11/82	1/30	1923	18	67
12/11/82	1/30	1923	19	67
12/11/82	1/30	1923	20	67
12/11/82	1/30	1923	21	67

Finished Fabrics As Received

LOT 3 FINISHED FABRICS WHITE

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
26/10/82	1/30's cc	8111	1	69 cms
26/10/82	1/30	8111	3	69
26/10/82	1/30	8111	11	69
26/10/82	1/30	8111	14	69
26/10/82	1/30	8111	19	69
	(COMBED)			

FIRM B

26/10/82	1/30	1543	13	67
26/10/82	1/30	1543	17	67
26/10/82	1/30	1543	19	67
26/10/82	1/30	1543	20	67
26/10/82	1/30	1543	21	67

LOT 4 FINISHED FABRICS

FIRM A (COLOUR - GREY)

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
12/11/82	1/30's cc	8281	4	69 cms
12/11/82	1/30	8281	6	69
12/11/82	1/30	8281	7	69
12/11/82	1/30	8281	11	69
12/11/82	1/30	8281	15	69
	(COMBED)			

FIRM B (COLOUR - KHAKI)

12/11/82	1/30	1915	10	67
12/11/82	1/30	1915	13	67
12/11/82	1/30	1915	15	67
12/11/82	1/30	1915	17	67
12/11/82	1/30	1915	19	67
	(COMBED)			

LOT 5 FINISHED FABRIC (WHITE)

FIRM A

DATE	YARN	BATCH NO.	ROLL NO.	FINISHED WIDTH
6/12/82	1/30's cc	8413	9	67 cms
6/12/82	1/30	8413	10	67
6/12/82	1/30	8413	13	67
6/12/82	1/30	8413	17	67
6/12/82	1/30	8413	18	67
	(COMBED)			

FIRM B

6/12/82	1/30	1923	17	67
6/12/82	1/30	1923	18	67
6/12/82	1/30	1923	19	67
6/12/82	1/30	1923	20	67
6/12/82	1/30	1923	21	67

NOTE: FIRM (A) NOW FINISHED TO 67 CMS
LOTS 1, 2, 3 and 4 WERE FINISHED TO 69 CMS

ACTUAL NEEDLES COUNTED AROUND THE FABRIC TUBE

Greige Fabrics

Ref. 924	Lot 1	A5 - 1393	B3 - 1344
		A9 - 1391	B7 - 1344
		A2 - 1393	B11 - 1344
Ref. 925	Lot 2	A11 - 1392	B12 - 1344
		A6 - 1392	B13 - 1345
		A15 - 1392	B23 - 1344
Ref. 929	Lot 3	A11 - 1393	B17 - 1344
		A14 - 1393	B20 - 1345
		A19 - 1393	B21 - 1344
Ref. 933	Lot 4	A4 - 1344	B10 - 1344
		A7 - 1344	B13 - 1344
		A15 - 1345	B17 - 1344
Ref. 938	Lot 5	A10 - 1392	B17 - 1345
		A13 - 1392	B19 - 1345
		A18 - 1392	B21 - 1344

Finished Fabrics

Ref. 939	Lot 4	A6 - 1344	
		A7 - 1343	
		A4 - 1345	
Ref. 942	Lot 5	A13 - 1391	B17 - 1345
		A10 - 1393	B18 - 1344
		A18 - 1392	B19 - 1345
		A4 - 1392	B20 - 1344
		A17 - 1392	B21 - 1344

Greige Fabric Test Data

MARTINS CASE STUDY. 1X1 RIB. 14G.
GREY TEST DATA. FIRMS A and B.

LOT NO	NE/BW	TF/BW	NEEDLES CAL/BW	SL/BW	C/3cms AW	W/3cms AW
	1	2	3	4	5	6
	30.1	3.6	1356	0.281	57.7	35
	29.9	3.5	1355	0.281	58	34.4
1A	29.4	3.48	1342	0.281	57.3	34.4
	29.8	3.42	1391	0.281	57.7	34.9
	29.9	3.9	1352	0.281	58	35.3
	30	3.4	1348	0.281	57.7	34.8
	29.9	3.3	1321	0.281	57.8	35.1
2A	30.1	3.5	1330	0.282	57.3	34.3
	29.8	3.5	1324	0.281	58.4	35
	30	3.4	1366	0.281	57.5	34.6
	29.9	3.5	1350	0.281	57.9	34.5
	29.2	3.6	1322	0.282	57.6	34.1
3A	29.9	3.5	1324	0.281	57.7	34.9
	29.8	3.6	1356	0.281	57.9	34.4
	29.8	3.5	1357	0.282	57.9	34.7
	30	3.4	1305	0.276	58.4	33.2
	29.3	3.4	1282	0.287	56	32.4
4A	29.9	3.3	1294	0.277	58.3	33.9
	29.8	3.3	1311	0.287	55.9	33.4
	29.8	3.4	1312	0.287	56	32.9
	30.6	3.5	1329	0.284	56.2	34
	30.9	3.7	1342	0.281	56.5	32.9
5A	30.9	3.5	1330	0.281	56.3	34.1
	31.1	3.5	1327	0.281	56.7	34.6
	30.5	3.5	1333	0.281	56.3	34.4

MARTINS CASE STUDY. 1X1 RIB. 14G.
GREY TEST DATA. FIRMS A and B.

LOT NO	NE/BW	TF/BW	NEEDLES CAL/BW	SL/BW	C/3cms AW	W/3cms AW
	7	8	9	10	11	12
	29.9	3.8	1294	0.285	58.5	33.7
	30	3.8	1271	0.283	58.2	33.9
1B	28.9	4	1304	0.282	59.1	34.4
	29.2	3.8	1294	0.282	58.2	33.5
	29.2	3.9	1286	0.284	58.7	33.5
	29.9	4	1289	0.28	58.1	34.1
	29.7	3.8	1285	0.283	58.1	34
2B	29.8	3.7	1303	0.282	59.2	34.2
	29.7	3.9	1264	0.284	58	34.1
	29.8	3.9	1265	0.284	58.2	33.8
	29.8	3.8	1272	0.281	57.8	34.1
	29.5	3.9	1274	0.284	57.1	33.5
3B	29.7	3.7	1252	0.284	57.3	33.1
	29.6	3.8	1248	0.284	57.4	33.3
	29.8	3.9	1273	0.284	58.6	33.5
	30.5	3.8	1274	0.284	58.1	33.4
	30.1	3.9	1277	0.285	57.9	34.5
4B	30.4	3.7	1270	0.282	58.2	33.4
	29.9	3.7	1270	0.282	58.9	33.6
	30.1	3.7	1275	0.284	58.4	34.1
	30.2	3.8	1283	0.284	58.5	33
	30.5	3.8	1287	0.282	58	34.2
5B	29.7	3.8	1298	0.283	57.9	33
	29.8	3.8	1278	0.282	57.6	33.4
	29.9	3.7	1281	0.284	57.7	33.2

*** COLUMNS STATISTICS ***

				Mean	SD	CV%	Max	Min
FIRM A	1.		NE/BW	30.012	0.468	1.56	31.100	29.200
	2.		TF/BW	3.498	0.129	3.71	3.900	3.200
	3.	NEEDLES	CAL/BW	1336.080	23.608	1.77	1391.000	1282.000
	4.		SL/BW	0.282	0.002	0.89	0.287	0.276
	5.	C/3cms	AW	57.216	0.822	1.44	58.400	55.900
	6.	W/3cms	AW	34.328	0.622	1.81	35.200	32.900
FIRM B	7.		NE/BW	29.828	0.372	1.25	30.500	28.900
	8.		TF/BW	3.816	0.090	2.35	4.000	3.700
	9.	NEEDLES	CAL/BW	1278.690	14.100	1.10	1304.000	1248.000
	10.		SL/BW	0.283	0.001	0.42	0.285	0.280
	11.	C/3cms	AW	58.152	0.524	0.90	59.200	57.100
	12.	W/3cms	AW	33.704	0.443	1.31	34.500	33.000

Greige Fabric: Measured vs Predicted Dimensions

GREY FABRICS FULLY RELAXED COURSES AND WALES AGAINST PREDICTED FULLY RELAXED

FIRM A

AVERAGE OVER 5 SAMPLES FROM EACH LOT

LOT NO.	LAB TEST	PREDICTED	DIFFERENCES ACTUAL	DIFFERENCES %	ACTUAL DIFFERENCES OVER S.D.
1A					
Courses/3cm	57.74	57.58	-0.16	0.28	0.555
Wales/3cm	34.80	34.30	-0.50	1.44	1.269
2A					
Courses/3cm	57.74	57.50	-0.24	0.42	0.577
Wales/3cm	34.76	34.28	-0.48	1.38	1.495
3A					
Courses/3cm	57.80	57.50	-0.30	0.52	2.128
Wales/3cm	34.52	34.26	-0.26	0.75	0.858
4A					
Courses/3cm	56.92	57.18	+0.26	0.46	0.199
Wales/3cm	33.36	34.12	+0.76	2.28	2.082
5A					
Courses/3cm	56.38	57.36	+0.98	1.74	4.516
Wales/3cm	34.20	34.18	-0.02	0.06	0.068
$\bar{X}$ of all five	Courses/3cm		+0.11	0.20	
	Wales/3cm		-0.10	0.27	

S.D. within each lot (measured)

	Courses	Wales
1A	0.288	0.394
2A	0.416	0.321
3A	0.141	0.303
4A	1.307	0.365
5A	0.217	0.292

GREY FABRIC FULLY RELAXED COURSES AND WALES AGAINST PREDICTED FULLY RELAXED

FIRM B

AVERAGE OVER 5 SAMPLES FROM EACH LOT

LOT NO.	LAB TEST	PREDICTED	DIFFERENCES ACTUAL	DIFFERENCES %	ACTUAL DIFFERENCES OVER S.D.
1B					
Courses/3cm	58.54	57.10	-1.4	2.39	3.70
Wales/3cm	33.80	34.08	+0.3	0.89	0.80
2B					
Courses/3cm	58.34	57.20	-1.1	1.88	2.23
Wales/3cm	34.06	34.14	+0.1	0.29	0.55
3B					
Courses/3cm	57.64	57.04	-0.6	1.04	1.01
Wales/3cm	33.50	34.06	-0.6	1.79	1.60
4B					
Courses/3cm	58.30	56.96	-1.3	2.23	3.41
Wales/3cm	33.80	34.04	+0.2	0.59	0.41
5B					
Courses/3cm	57.94	57.02	-0.9	1.59	2.56
Wales/3cm	33.36	34.06	+0.7	2.10	1.41
$\bar{x}$ of all five	Courses/3cm		-1.06	1.83	
	Wales/3cm		+0.14	0.42	

S.D. within each lot (measured)

	Courses	Wales
1B	0.378	0.374
2B	0.493	0.182
3B	0.594	0.374
4B	0.381	0.485
5B	0.351	0.498

Finished Fabric Test Data

FINISHED, TEST DATA, FIRM A.

LOT NO	SHR SL	SHR SW	SHR 1L	SHR 1W	WT BW	WT AW
3A	13.5	10.6	11.4	11.4	164.2	208.7
	13.5	12.1	12.2	13.5	161.1	206.7
	12.7	11.2	10.6	12	166.9	211.4
	11.9	11.4	9.6	12.8	170.9	212.9
	12.1	11.9	10.1	11.8	162.3	207.4
4A	12.4	10.8	9.5	10.7	170.3	209.3
	13	10.8	10.4	10.6	162	202.7
	12.3	11.6	9.6	11.2	169.1	209.6
	12.4	9.2	9.6	8.9	166.1	208.4
	13.2	10	10	8.4	166.8	210.9
5A	13.8	13.1	11.1	10.2	164.2	204.6
	13.1	9.7	10.5	10	164.2	200.8
	14.1	9.7	11.4	9.5	160.1	201.8
	12.7	8.2	9.8	8.6	161.4	199.9
	14.2	10.2	11.5	10.4	162.4	202

MARTINS CASE STUDY, 1X1 RIB, 14G
FINISHED, TEST DATA, FIRM A.

LOT NO	C/3 BW	C/3 AW	W/3 BW	W/3 AW	SL BW	SL AW
3A	46.4	53	30.8	34.8	0.275	0.279
	46.1	53.4	30.4	35.1	0.277	0.275
	47.2	54	30.5	35.2	0.276	0.275
	47.5	53.9	30.7	34.9	0.276	0.274
	46.8	52.2	30.2	35	0.276	0.277
4A	48	54.3	30.7	34.8	0.275	0.273
	45.2	51.8	30.7	34.4	0.281	0.279
	47.9	54	30.7	34.7	0.275	0.273
	46.1	52	31.2	34.7	0.28	0.279
	45.5	52.5	31	34.6	0.282	0.28
5A	46.2	53	30.5	34.5	0.278	0.273
	47.4	52.6	30.2	33.9	0.277	0.275
	46.2	52.4	31.2	34.2	0.276	0.275
	47.6	54.1	30.5	34.1	0.276	0.275
	46.2	52.2	31.6	34	0.276	0.277

MARTINS CASE STUDY, 1X1 RIB, 14G
FINISHED, TEST DATA, FIRM A.

LOT NO	NE BW	NE AW	WID BW	Y/TF BW	N/CAL BW
3A	30.5	31.7	67.7	3.23	1388
	30.9	31.1	68.4	3.1	1385
	31.3	31.3	67.4	3.21	1372
	30.5	31.1	66.9	3.16	1363
	31.1	31.7	68.9	3.21	1394
4A	31	31	65.5	3.22	1342
	31.4	31.1	65.6	3.14	1344
	31.1	31.2	65.4	3.26	1337
	30.9	30.8	65.1	3.32	1357
	30.7	31.1	64.9	3.25	1342
5A	22	31.6	67.7	3.2	1377
	31.2	31.6	67.8	3.2	1368
	31.9	31.9	67.8	3.2	1413
	31.5	32	67.2	3.1	1367
	30.8	31.8	67.2	3.2	1416

MARTINS CASE STUDY, 1X1 RIB, 14G
FINISHED, TEST DATA, FIRM B.

LOT NO	SHR SL	SHR SW	SHR LL	SHR LW	WT BW	WT AW
2B	13.5	8.7	11.1	9.2	170	212.5
	13.9	7.4	11.9	8	167.6	212.5
	13.9	8	11.7	8.4	170.1	211.7
	13.6	6.4	11.1	7.7	168.5	209.8
	14	6.9	12	7.9	171.1	207.5
4B	12.6	11.1	9.7	10.6	172.1	211.2
	13.4	11.4	11.3	10.4	167.7	209.3
	13.5	11.7	10	10	164.2	213.6
	12.2	10.6	9.6	9.8	165.1	210.2
	13	9.3	10.2	9.1	169.1	212
5B	13.6	10	11.2	8.3	164.9	204.9
	13.3	10.2	11	9.6	166.2	207.3
	13.8	10.1	11.5	9.9	162.2	206.7
	14.2	10.1	12.1	10	166.8	206.7
	14.4	9.7	11.9	9.9	160.2	208.8

MARTINS CASE STUDY, 1X1 RIB, 14G
FINISHED, TEST DATA, FIRM B.

LOT NO	C/2 BW	C/2 AW	W/2 BW	W/2 AW	SL BW	SL AW
2B	47.5	54.8	30.6	34.1	0.277	0.275
	47.1	54.6	30.2	33.1	0.279	0.277
	46.7	53.8	30.6	34.2	0.279	0.277
	47.7	53.9	30.7	33.2	0.279	0.276
	47	54	30.3	33.6	0.278	0.277
4B	48.2	54.4	29.8	34.1	0.279	0.274
	47.2	54.6	29.8	34.2	0.277	0.275
	47.7	54.2	30	34.5	0.277	0.275
	48	53.9	30.2	34.4	0.278	0.275
	47.4	54.4	30.7	34	0.275	0.275
5B	48.1	55.1	30.3	33.1	0.278	0.276
	47.8	54	30.1	33.4	0.279	0.278
	47.6	54.5	30	33.7	0.279	0.277
	46.5	54.1	30.3	33.5	0.279	0.276
	46.8	53.9	30	33.2	0.28	0.276

MARTINS CASE STUDY, 1X1 RIB, 14G
FINISHED, TEST DATA, FIRM B.

LOT NO	NE BW	NE AW	WID BW	W/TF BW	N/CRL BW
2B	30.5	30.8	65	2.67	1321
	30.5	30.7	65.6	2.54	1322
	30.5	30.6	65.3	2.59	1332
	30.4	30.4	66	2.61	1352
	30.2	30.5	64.7	2.75	1308
4B	31.1	30.8	66.5	2.64	1321
	31.4	31	66.3	2.52	1310
	31.1	31.1	66.9	2.66	1335
	31.2	31.1	66.8	2.55	1345
	30.7	31.1	66	2.61	1348
5B	31.3	30.6	67.7	2.5	1366
	30.8	31	68	2.6	1365
	30.9	31.2	67.4	2.7	1364
	30.5	30.5	67.5	2.8	1363
	31	30.7	67	2.6	1359

Finished Fabrics

FINISHED FABRICS

COLUMNS STATISTICS ***

			Mean	SD	CV%	Max	Min	
1.	SHR	SL	12.993	0.720	5.54	14.200	11.900	A
2.	SHR	SW	10.713	1.253	11.70	13.100	8.200	
3.	SHR	1L	10.487	0.854	8.15	12.200	9.500	
4.	SHR	1W	10.667	1.490	13.97	13.500	8.400	
5.	WT	BW	164.813	3.424	2.08	170.900	160.100	
6.	WT	AW	206.540	4.148	2.01	212.900	199.900	
7.	C/3	BW	46.700	0.854	1.83	48.000	45.300	
8.	C/3	AW	53.240	0.793	1.49	54.300	51.800	
9.	W/3	BW	30.747	0.380	1.23	31.600	30.300	
10.	W/3	AW	34.607	0.408	1.18	35.300	33.900	
11.	SL	BW	0.277	0.002	0.80	0.282	0.275	
12.	SL	AW	0.276	0.002	0.87	0.280	0.273	
13.	NE	BW	31.127	0.450	1.44	32.000	30.500	
14.	NE	AW	31.400	0.374	1.19	32.000	30.800	
15.	WID	BW	66.907	1.276	1.91	68.900	64.900	
16.	Y/TF	BW	3.213	0.068	2.11	3.320	3.100	
17.	N/CAL	BW	1371.000	24.917	1.82	1416.000	1337.000	
18.	SHR	SL	13.533	0.592	4.38	14.400	12.200	B
19.	SHR	SW	9.440	1.634	17.31	11.700	6.400	
20.	SHR	1L	11.087	0.841	7.58	12.100	9.600	
21.	SHR	1W	9.260	0.963	10.40	10.600	7.700	
22.	WT	BW	167.073	3.336	2.00	172.100	160.200	
23.	WT	AW	209.720	2.699	1.29	213.600	204.900	
24.	C/3	BW	47.427	0.520	1.10	48.200	46.500	
25.	C/3	AW	54.293	0.383	0.70	55.100	53.800	
26.	W/3	BW	30.240	0.302	1.00	30.700	29.800	
27.	W/3	AW	33.740	0.500	1.48	34.500	33.100	
28.	SL	BW	0.278	0.001	0.45	0.280	0.275	
29.	SL	AW	0.276	0.001	0.40	0.278	0.274	
30.	NE	BW	30.807	0.367	1.19	31.400	30.200	
31.	NE	AW	30.813	0.272	0.88	31.300	30.400	
32.	WID	BW	66.447	1.008	1.52	68.000	64.700	
33.	Y/TF	BW	3.623	0.084	2.31	3.800	3.500	
34.	N/CAL	BW	1340.133	19.231	1.44	1366.000	1308.000	

FINISHED FABRIC

Change of Yarn Count and Stitch Length as a Result of 5 Wash and Tumble Cycles

YARN:- MEAN OF 15 FABRICS

A	(Mean BW	31.127cc	S.D. 0.450	CV% 1.44
	(Mean AW	31.400cc	S.D. 0.374	CV% 1.19
	Difference	0.273cc		
B	(Mean BW	30.807cc	S.D. 0.367	CV% 1.19
	(Mean AW	30.813cc	S.D. 0.272	CV% 0.88
	Difference	0.006cc		

STITCH LENGTH:- MEAN OF 15 FABRICS

A	(Mean BW	0.277cms	S.D. 0.002	CV% 0.80
	(Mean AW	0.276cms	S.D. 0.002	CV% 0.87
	Difference	0.001cms		
B	(Mean BW	0.278cms	S.D. 0.001	CV% 0.45
	(Mean AW	0.276cms	S.D. 0.001	CV% 0.40
	Difference	0.002cms		

Finished Fabric: Measured vs Predicted

MEASURED STITCH LENGTHS AND YARN COUNT CHANGES DURING FINISHING AGAINST PREDICTED CHANGES

STITCH LENGTH

LOT NO.	AW LAB TEST	S.D.	PREDICTED	S.D.	% DIFFERENCES
3A	0.276	0.002	0.276	0	0
4A	0.277	0.003	0.279	0.006	+0.72
5A	0.275	0.001	0.277	0.001	+0.72
3B	0.276	0.001	0.278	0.001	+0.72
4B	0.275	0	0.280	0.001	+1.82
5B	0.277	0.001	0.278	0	+0.36
All A (S)	0.276	0.002	0.277	0.003	+0.36
All B (Z)	0.276	0.001	0.279	0.001	+1.09

YARN: COTTON COUNTS

3A	31.38	0.303	30.90	0.339	-1.53
4A	31.04	0.152	31.74	0.313	+2.25
5A	31.78	0.179	32.16	0.297	+1.20
3B	30.60	0.158	30.88	0.130	+0.91
4B	31.02	0.130	32.20	0.245	+3.80
5B	30.82	0.327	31.26	0.378	+1.43
All A (S)	31.40	0.374	31.60	0.616	+0.64
All B (Z)	30.81	0.272	31.45	0.627	+2.07

THE DIFFERENCES IN FABRIC PARAMETERS BETWEEN THE MEASURED AND PREDICTED

The average differences within each lot is shown together with the mean over all 15 fabrics from each firm.

These figures are the predicted against the measured.

FIRM A - FULLY RELAXED

	LOT 3	LOT 4	LOT 5	MEAN
Courses	+2.3%	+1.89%	+1.53%	+1.91%
Wales	-6.73%	-3.81%	-4.15%	-4.90%
Weight	-0.66%	+0.39%	-1.23%	-0.50%

FIRM A - MEASURED SHRINKAGES

Courses	+1.67%	+1.16%	+0.48%	+1.10%
Wales	-5.37%	-3.43%	-4.58%	-4.46%
Weight	-2.64%	-1.98%	-4.87%	-3.16%

FIRM B - FULLY RELAXED

Courses	-0.22%	-1.18%	-0.54%	-0.65%
Wales	-3.37%	-2.92%	-2.46%	-2.92%
Weight	-1.97%	-3.03%	-1.38%	-2.13%

FIRM B - MEASURED SHRINKAGES

Courses	-1.23%	-2.10%	-1.68%	-1.67%
Wales	-1.31%	-1.53%	-2.85%	-1.90%
Weight	-2.93%	-5.06%	-3.60%	-3.86%

FINISHED FABRICS PREDICTED

S.D. of the predicted dimensions within each lot, using grey measured yarn counts and stitch lengths for the input, together with measured shrinkages.

LOT 3A	SD	$\bar{x}$ DIFF OVER SD
Courses	0.4207	1.854
Wales	0.2449	6.697
Weight	0.9176	4.817
Width	0.6269	6.987

LOT 3B	SD	$\bar{x}$ DIFF OVER SD
Courses	0.3347	1.733
Wales	0.2387	1.676
Weight	1.7358	2.869
Width	0.4868	3.492

LOT 4A		
Courses	1.2410	0.435
Wales	0.3834	2.765
Weight	2.4031	1.398
Width	0.8649	2.706

LOT 4B		
Courses	0.3962	2.524
Wales	0.2799	1.643
Weight	3.2365	2.639
Width	0.6914	2.256

LOT 5A		
Courses	0.4393	0.501
Wales	0.6671	2.129
Weight	3.4041	2.332
Width	1.6757	2.077

LOT 5B		
Courses	0.2702	2.961
Wales	0.0447	19.239
Weight	1.6269	3.663
Width	0.0894	14.765

All A - 3,4,5 SD	
Courses	0.7882
Wales	0.5812
Weight	4.4937
Width	2.2792

All B - 3,4,5 SD	
Courses	0.3199
Wales	0.3994
Weight	3.5880
Width	0.8956

Graphs – Greige Fabrics

Figure 1

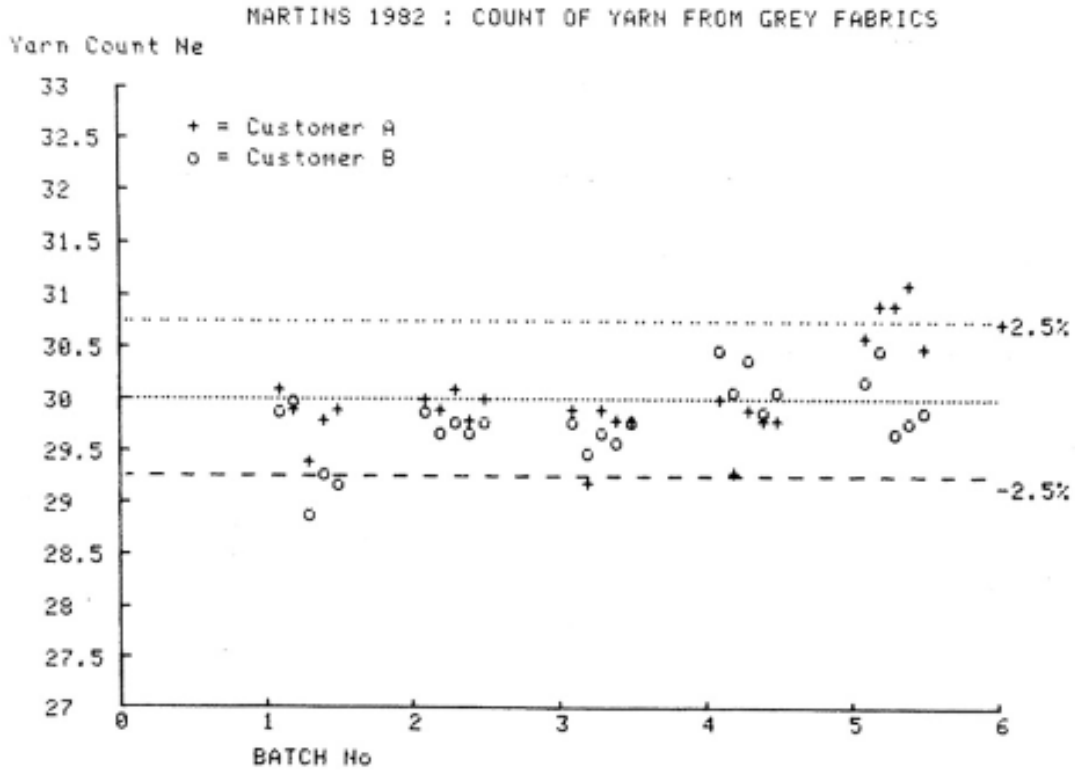


Figure 2

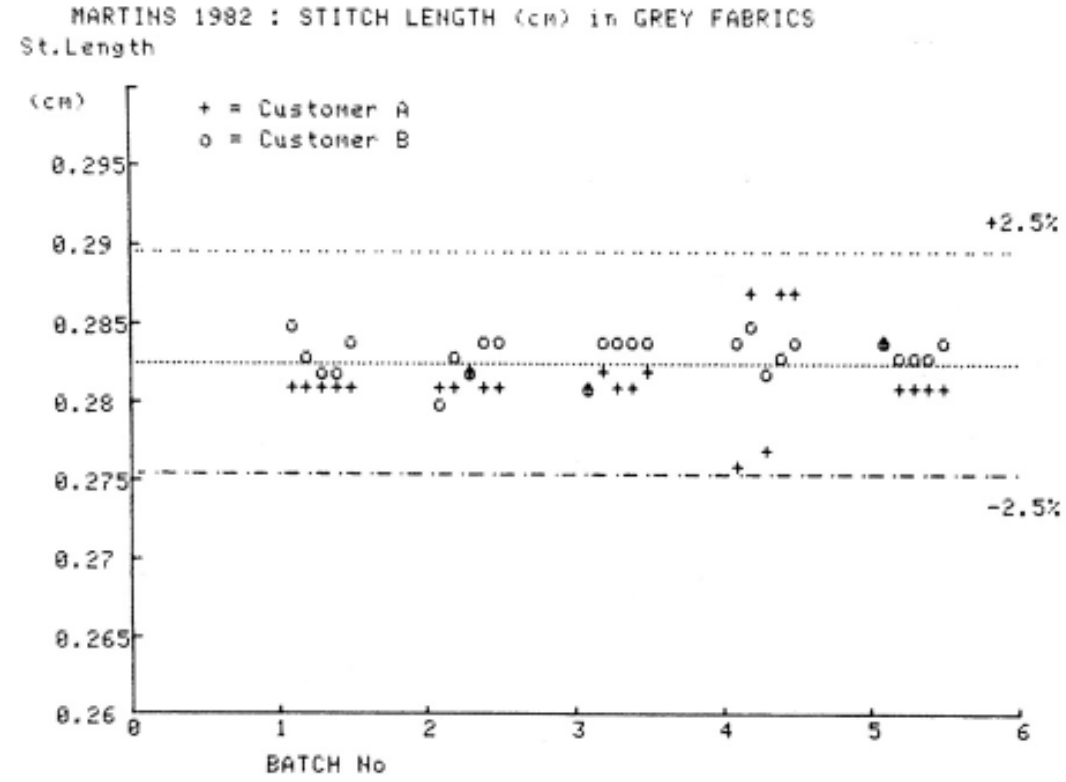


Figure 3

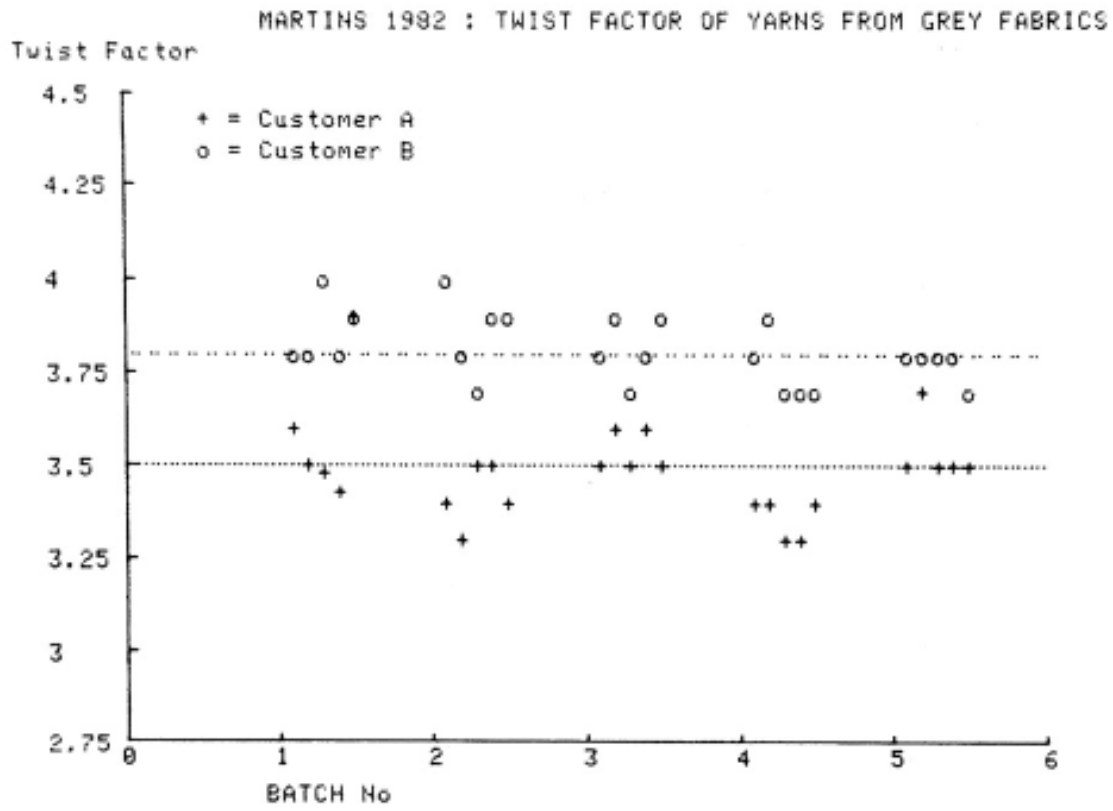


Figure 4

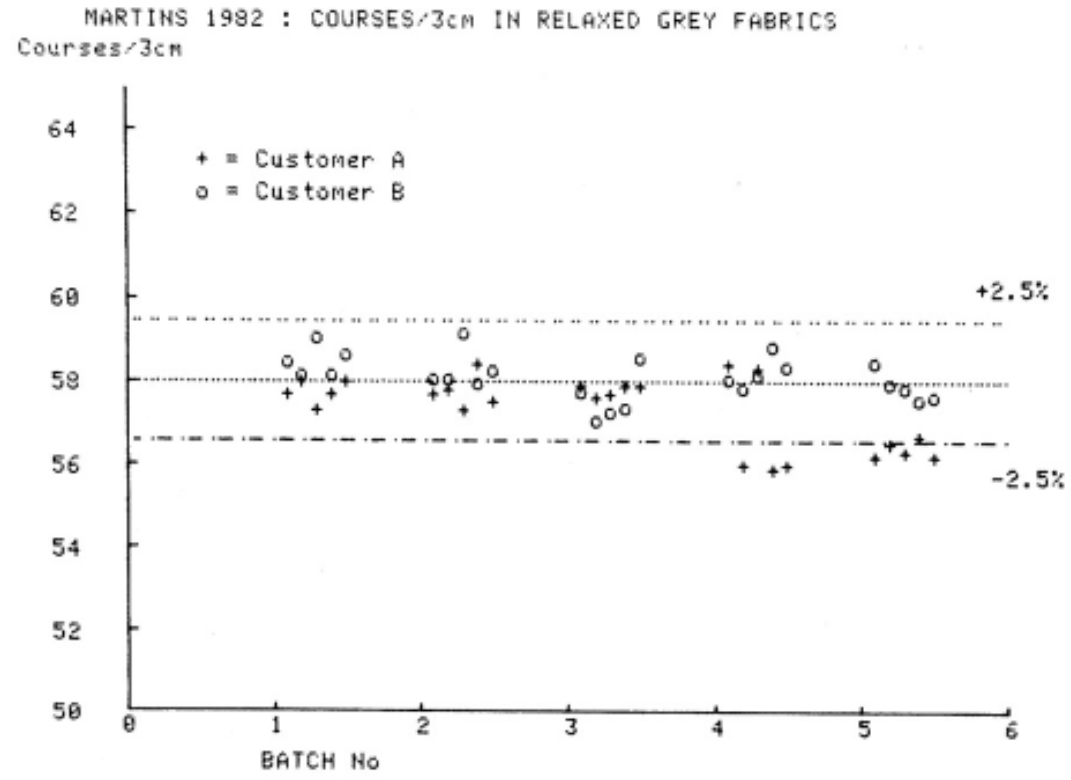


Figure 5

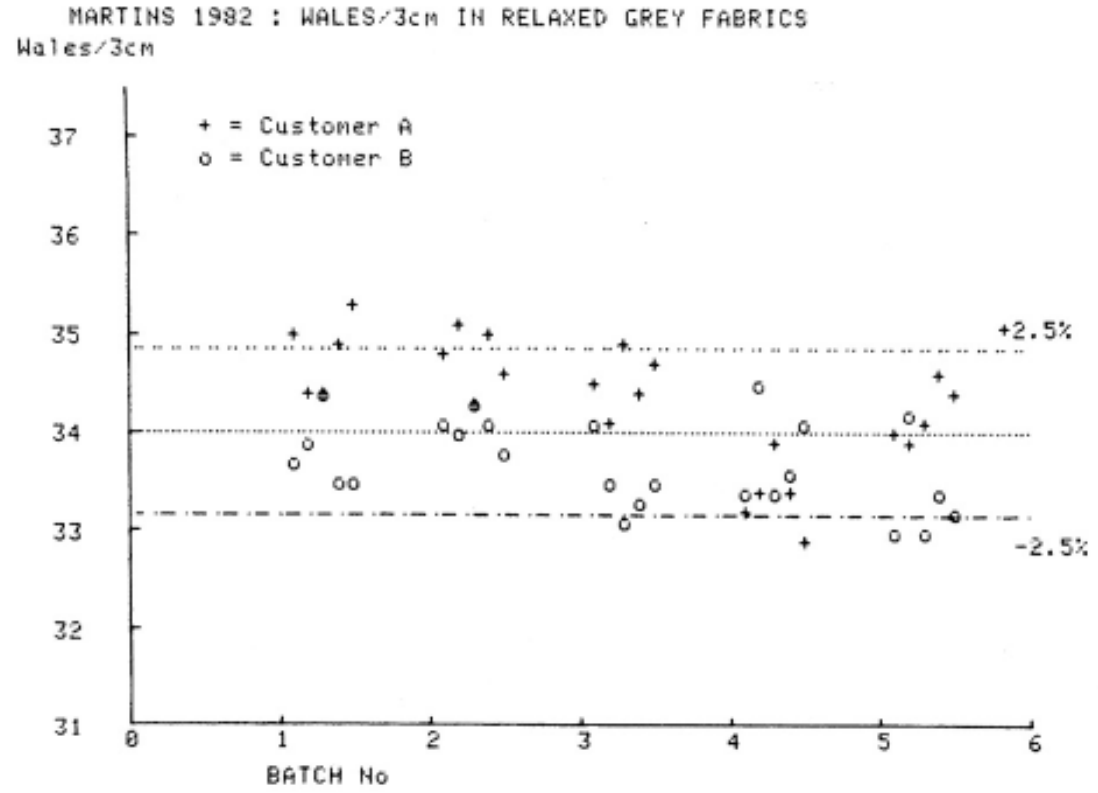
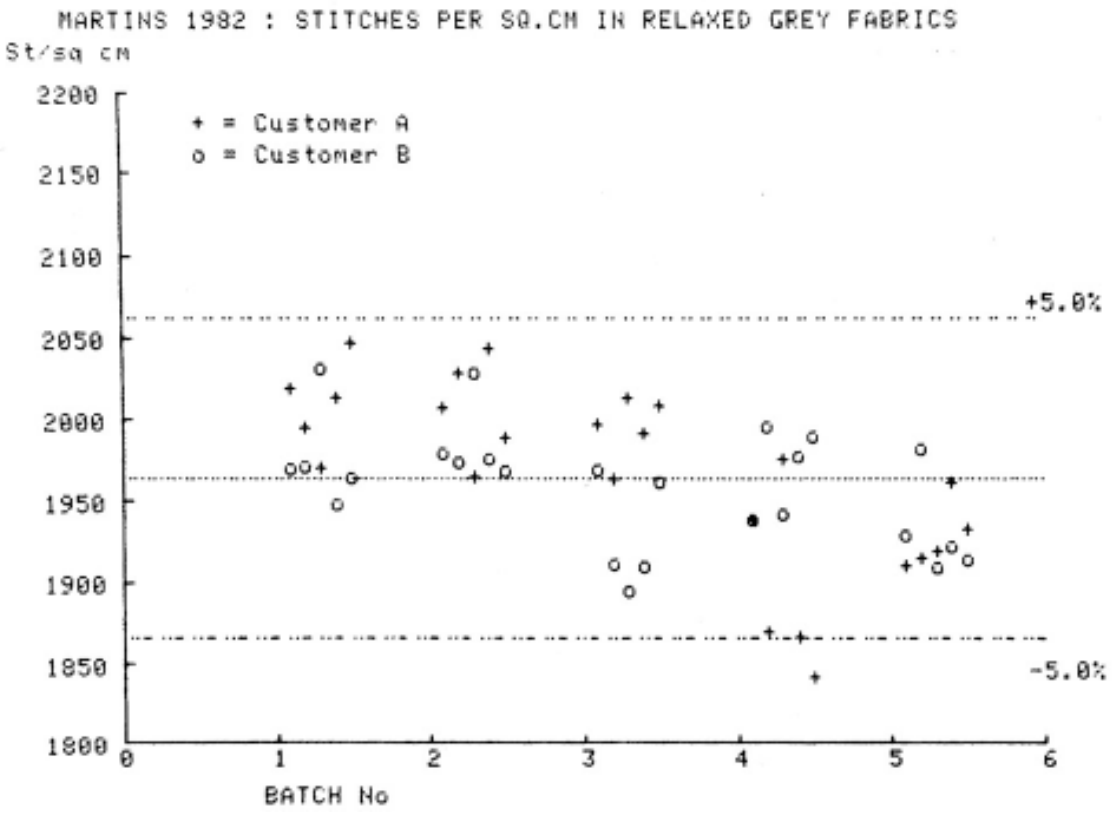


Figure 6



Graphs – Finished Fabrics

Figure 7

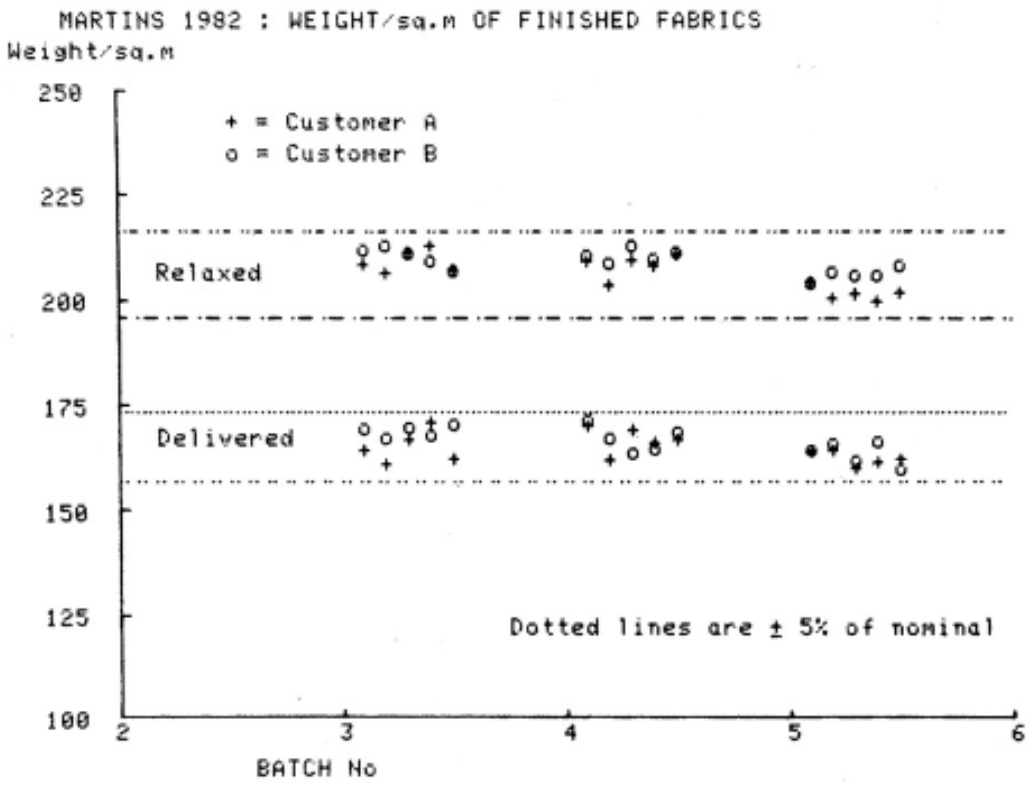


Figure 8

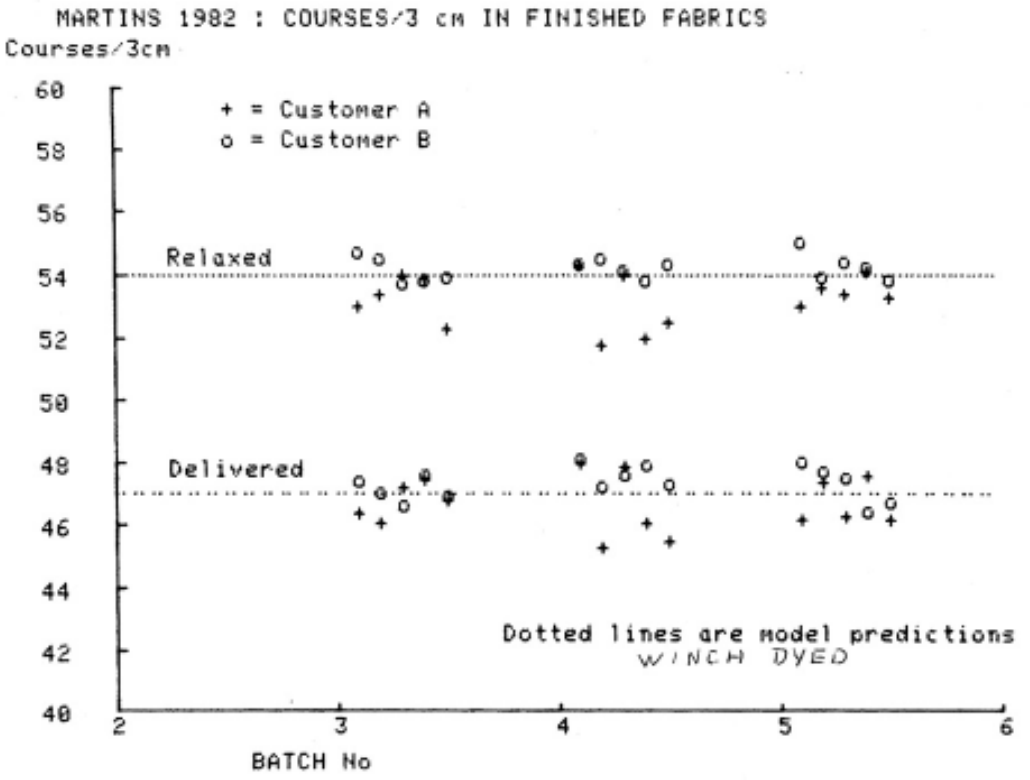


Figure 9

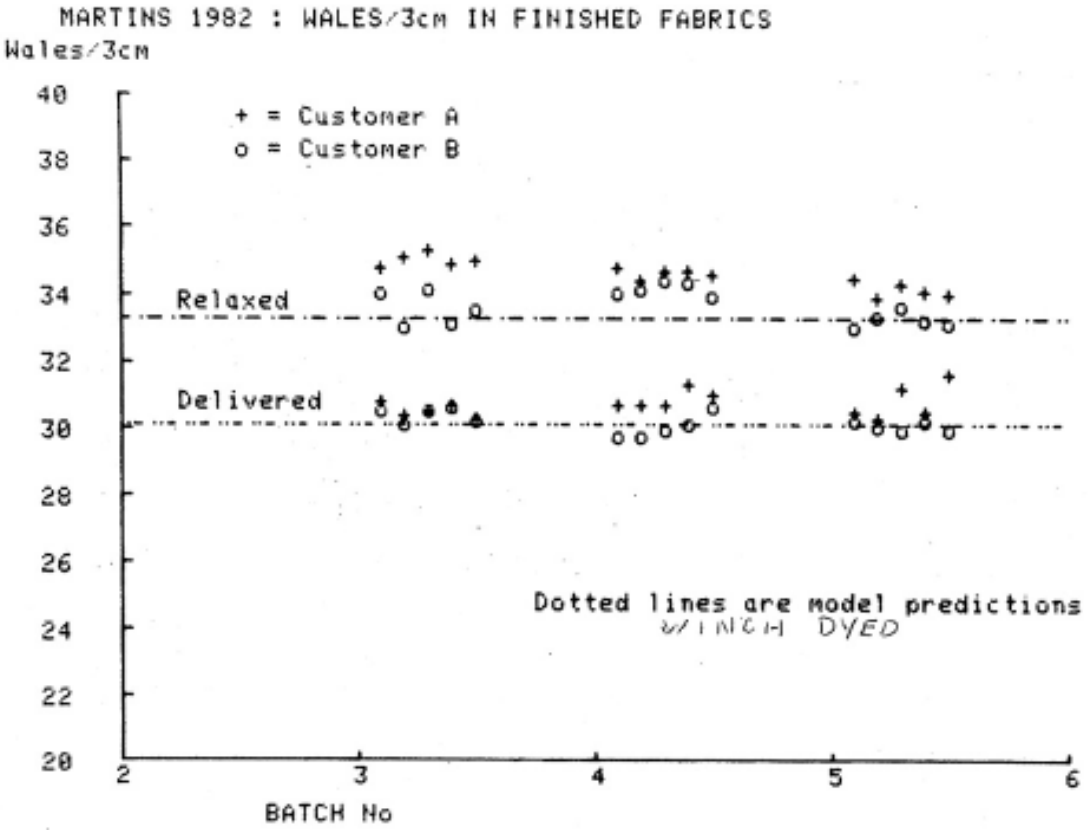


Figure 10

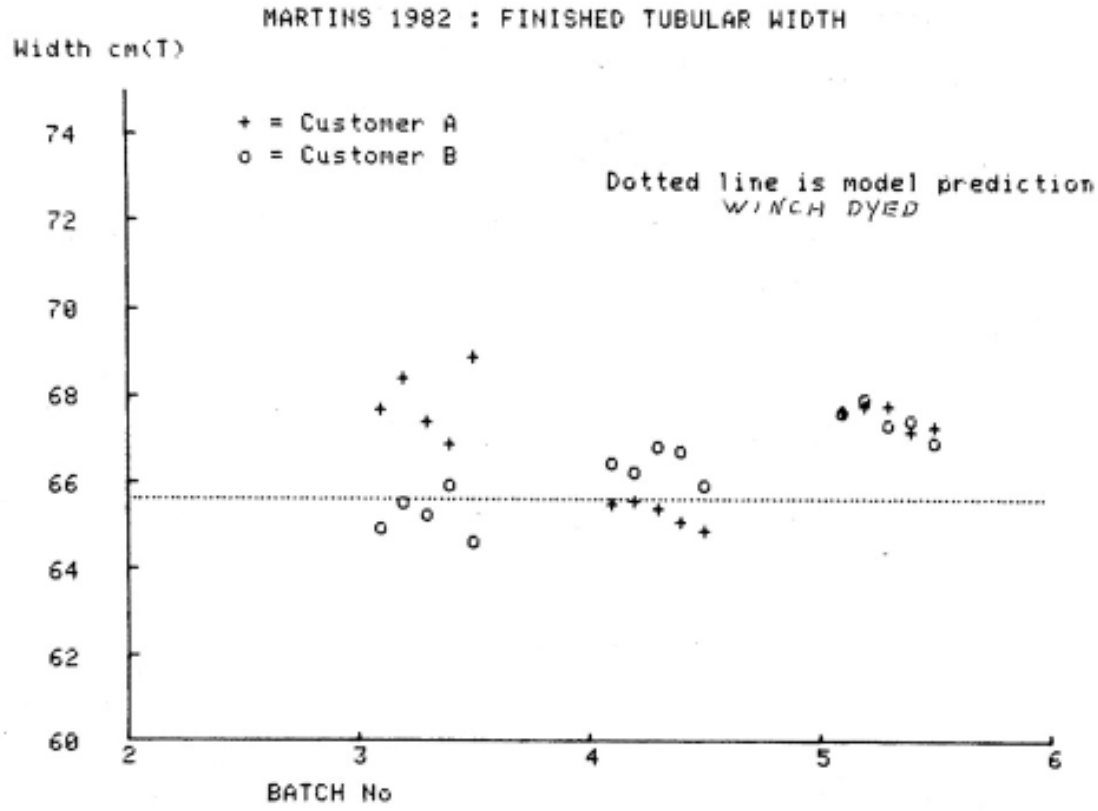


Figure 11

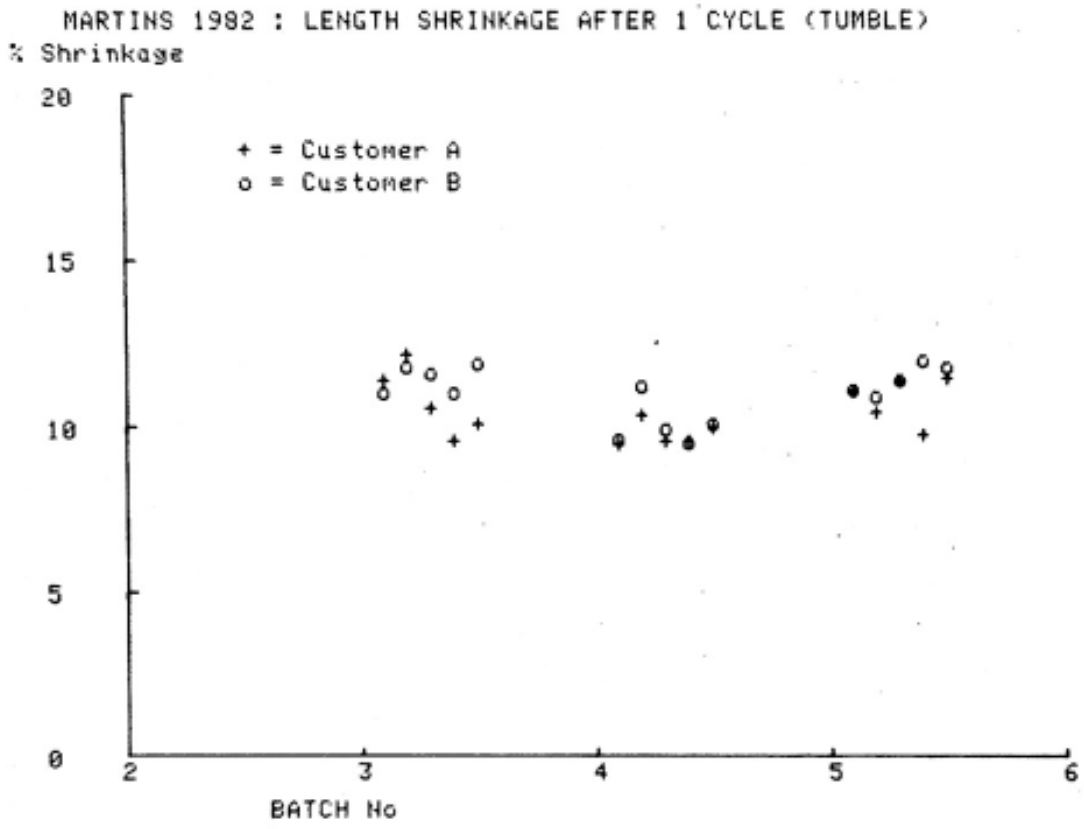


Figure 12

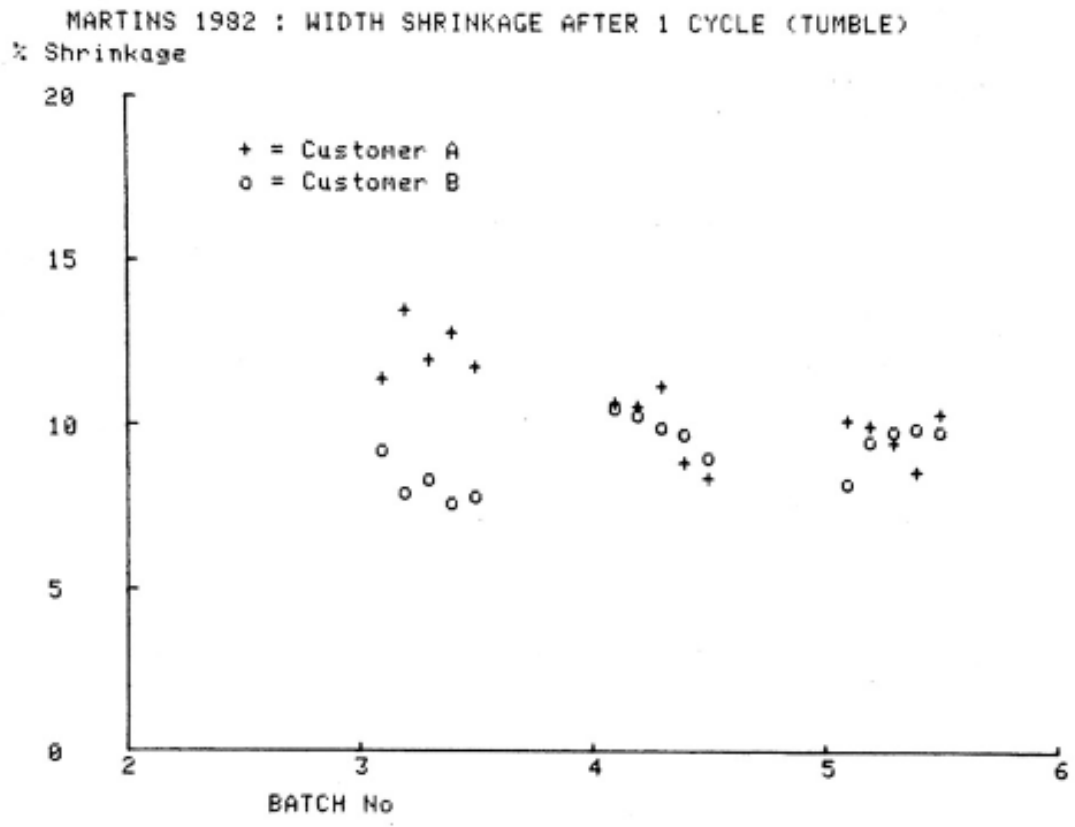


Figure 13

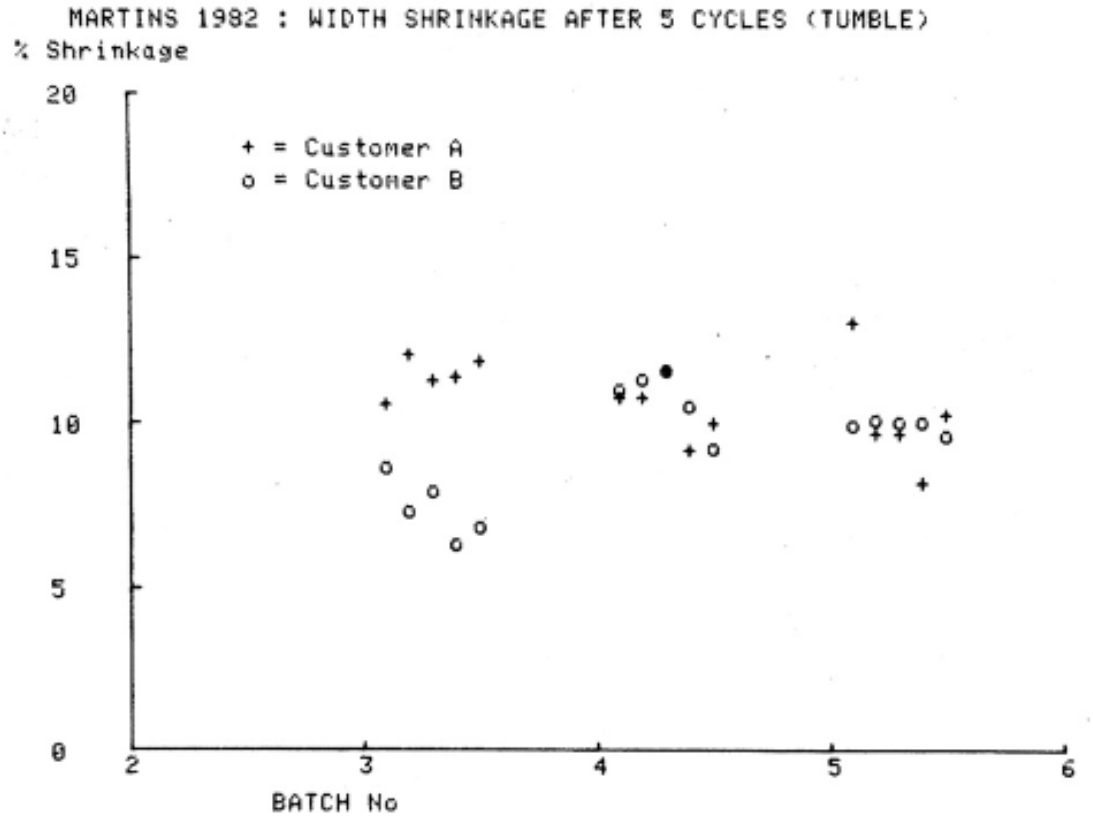
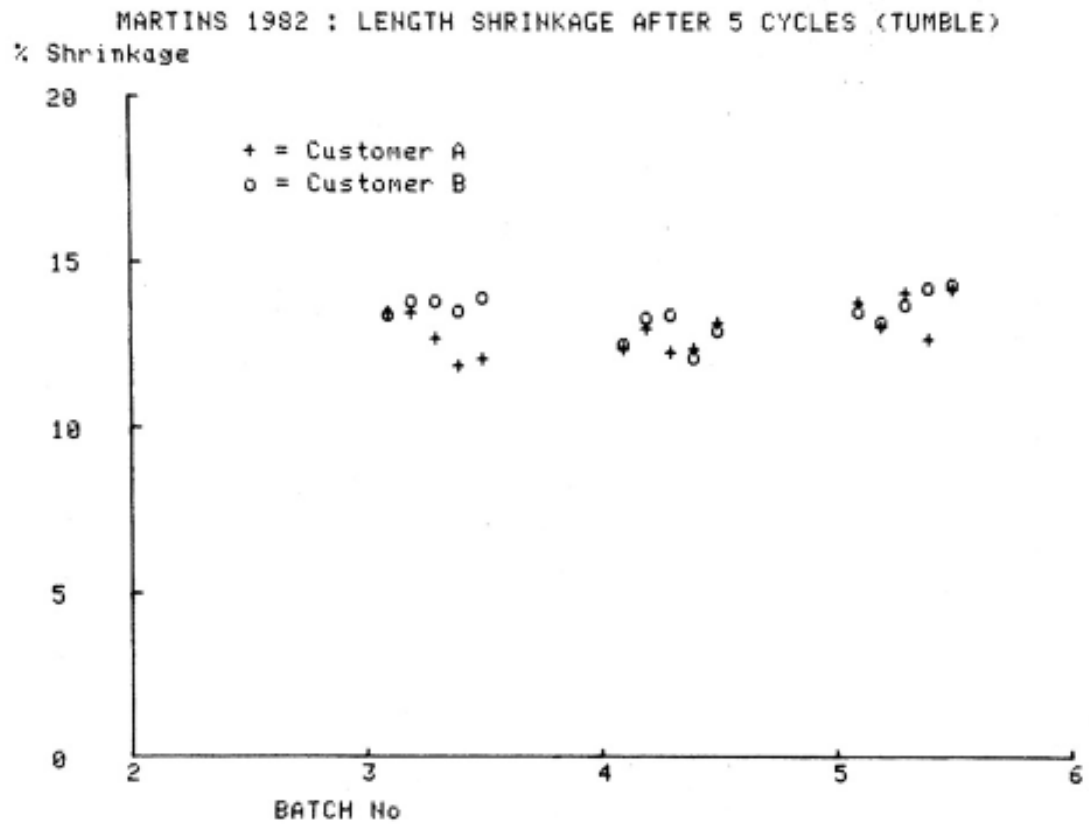


Figure 14



Discussion of Results

Firm A had a higher number of needles than firm B in Lot 1, 2, 3 and 5, but the same number in Lot 4. (See page 8).

Greige fabrics

The yarn count had a few points outside the ± 2.5% tolerance, but in the main, the count was on target from both firms (*Figure 1*).

The stitch length had a mean of 0.283cm and, in all cases, the spread was well within the ±2.5% tolerance normally allowed (*Figure 2*).

The twist characteristics were very different between the two firms.

Firm A: using S twist and a twist factor of 3.5

Firm B: using Z twist and a twist factor of 3.8

This practice of using yarn with differing physical properties should be avoided when making to the same specifications.

Finished Fabrics

There appears to be a difference in the fully relaxed courses and wales between the two firms, with firm A having lower courses and higher wales. Whether this is due to the amount of twist in the yarn or the direction of the twist is difficult to ascertain (*Figures 8 and 9*). The fabric weight is very similar between the two firms (*Figure 7*).

Measurements of the fabric width as received show a greater spread than the wales measured at the same time (*Figures 9 and 10*). The shrinkages appear to be very similar between the two firms and should pass most UK standards.

The differences recorded between the 1 and 5 wash and tumble cycles are as follows.

- The length shrinkage increases by a further 2.5% between the 1 and 5 cycles.
- The width appears to remain similar between the two sets of washing conditions

Measurements of the changes in the yarn count and stitch length after five wash and tumble cycles indicate that no further change occurs after finishing.

Predictions From Starfish (April - May 1983)

The predictions for Step 1, i.e. the finished relaxed values of yarn count and stitch length appear to be higher than those measured in all but one instance.

The predictions of the fabric parameters suggests that the different yarn used by firm A (S twist TF 3.5) has an influence on the relaxed dimensions after finishing and resulted in the wale prediction being approximately 4.5% lower than the measured and the course prediction approximately 1.5% higher than the measured, whereas the (Z twist TF 3.8) yarn used by firm B predicted lower than measured on courses, wales and weight, although not to a significant amount (*Page 37 & Figures 8 and 9*).

The Appendix at the back of this report deals with the Z yarn only and appears to suggest that Step 1 of the STARFISH model (March 83) is giving a higher cotton count and higher stitch length than that actually measured.

APPENDIX

The reason for this Appendix is that this particular case study was not originally designed to test out the IIC STARFISH model, or even to study normal variations in a particular finishing works. However, of course, the data obtained during this technical service exercise is still valid for a case study. The equation coefficients in the STARFISH model were compiled from work carried out on Z twist yarns and therefore in order to check out the accuracy of the STARFISH model against the actual measured parameters being achieved by any given producer, we should first check out only yarns which are similar to the ones used to compile the model.

This Appendix therefore looks only at the Z twist yarns from firm B. The differences between measured shrinkages and shrinkages calculated from the changes in courses and wales are also studied together with its effect on the predictive model.

Measured Stitch Lengths And Yarn Count Changes During Finishing Compared Against Predicted Changes.

Firm B only

Yarn Count

Lot No.	AW Lab Test	SD	Predicted	SD	% Differences
3B	30.6	0.158	30.88	0.130	+ 0.91
4B	31.02	0.130	32.20	0.245	+ 3.80
5B	30.82	0.327	31.26	0.378	+ 1.43
Mean	30.81	0.272	31.45	0.627	+ 2.07

Stitch Length

3B	0.276	0.001	0.278	0.001	+ 0.72
4B	0.275	0	0.280	0.001	+ 1.82
5B	0.277	0.001	0.278	0	+ 0.36
Mean	0.276	0.001	0.279	0.001	+ 1.09

Note: Lots 3 and 5 were predicted using winch bleach finishing routes. Lot 4 was predicted using winch dyed finishing.

The differences in fabric parameters between measured and predicted are given below. The average difference within each lot is shown together with the mean over all 15 fabrics.

The figures given are the predicted against measured.

A. Firm B – Fully Relaxed

	Lot 3	Lot 4	Lot 5	Mean %
Courses	-0.22%	-1.18%	-0.54%	-0.65%
Wales	-3.37%	-2.92%	-2.46%	-2.92%
Weight	-1.97%	-3.03%	-1.38%	-2.13%

B. Firm B – With Measured Shrinkages

Courses	-1.23%	-2.10%	-1.68%	-1.67%
Wales	-1.31%	-1.53%	-2.85%	-1.90%
Weight	-2.93%	-5.06%	-3.60%	-3.86%

Note: Lot 3 and 5 were predicted using winch bleached and lot 4 predicted using winch dyed.

In physical terms the differences are on average approximately:

0.8 of a course

0.57 of a wale

6.49 g/m2

The predictions were made using measured yarn counts, stitch length and measured shrinkages as inputs.

Length Shrinkage Calculated From The Change In Courses In Five Wash And Tumble Cycles

All B Fabrics	Courses BW	Courses AW		% Change
	47.5	54.8		13.32
	47.1	54.6		13.74
3B	46.7	53.8		13.20
	47.7	53.9		11.50
	47.0	54.0		12.97
SD of change 0.8553	CV 6.61%		Mean	12.95
	48.2	54.4		11.40
	47.3	54.6		13.37
4B	47.7	54.2		11.99
	48.0	53.9		10.95
	47.4	54.4		11.58
SD of change 0.9240	CV 7.79%		Mean	11.86
	48.1	55.1		12.70
	47.8	54.0		11.48
5B	47.6	54.5		12.66
	46.5	54.3		14.36
	46.8	53.9		13.17
SD of change 1.039	CV 8.07%		Mean	12.87
SD of change 1.013	CV 8.06%		Grand Mean	12.56

$$\% \text{ Change} = \frac{\text{Courses AW} - \text{Courses BW}}{\text{Courses AW}} \times 100$$

Width Shrinkage Calculated From The Change In Wales In Five Wash And Tumble Cycles

All 8 Fabrics	Wales BW	Wales AW		% Change
	30.6	34.1		10.26
	30.2	33.1		8.76
3B	30.6	34.2		10.53
	30.7	33.2		7.53
	30.3	33.6		9.82
SD of change 1.235	CV 13.16%		Mean	9.38
	29.8	34.1		12.61
	29.8	34.2		12.86
4B	30.0	34.5		13.04
	30.2	34.4		12.21
	30.7	34.0		9.70
SD of change 1.369	CV 11.33%		Mean	12.08
	30.3	33.1		8.46
	30.1	33.4		9.88
5B	30.0	33.7		10.98
	30.3	33.3		9.01
	30.0	33.2		9.64
SD of change 0.9529	CV 9.93%		Mean	9.59
SD of change 1.686	CV 16.29		Grand Mean	10.35
All 15 fabrics				

$$\text{Change calculation} = \frac{\text{wales AW} - \text{Wales BW}}{\text{wales AW}} \times 100$$

	Shrinkage measured Length	Shrinkage calculated from courses	Diff.
3B mean 5 fabrics	13.78	12.95	- 0.83
4B mean 5 fabrics	12.94	11.86	- 1.08
5B mean 5 fabrics	13.88	12.87	- 1.01
3,4 and 5B mean	13.53	12.56	- 0.97

	Shrinkage measured Width	Shrinkage calculated from wales	Diff.
3B mean 5 fabrics	7.48	9.38	+ 1.90
4B mean 5 fabrics	10.82	12.08	+ 1.26
5B mean 5 fabrics	10.02	9.57	- 0.45
3,4 and 5B mean	9.44	10.35	+ 0.91

On average, the physically measured appear to give approximately 1% less in length and 1% more in width than the percentage changes in courses and wales.

STARFISH predictions using measured yarn count and stitch length averaged over each lot and using the average measured shrinkages and comparing against the average calculated shrinkages.

	Lab Meas.	Predicted from Meas. Shrinkage	Diff.	Predicted from Calc. Shrinkage	Diff.
3B					
Courses	47.2	46.7	-0.5	47.2	0
Wales	30.48	30.1	-0.38	29.5	-0.98
Weight	169.50	165.1	-4.40	163.2	-6.30
4B					
Courses	47.72	46.6	-1.12	47.2	-0.52
Wales	30.10	29.6	-0.50	29.2	-0.90
Weight	167.64	158.8	-8.84	158.5	-9.14
5B					
Courses	47.36	46.6	-0.76	47.2	-0.16
Wales	30.14	29.3	-0.84	29.4	-0.74
Weight	164.08	158.4	-5.68	161.1	-2.98

By using the shrinkages calculated from the changes in courses and wales in the STARFISH model it appears that the course prediction is somewhat closer, but the wales and weight are, if anything, further away from the measured. See *Figures 15-16*.

Figure 15

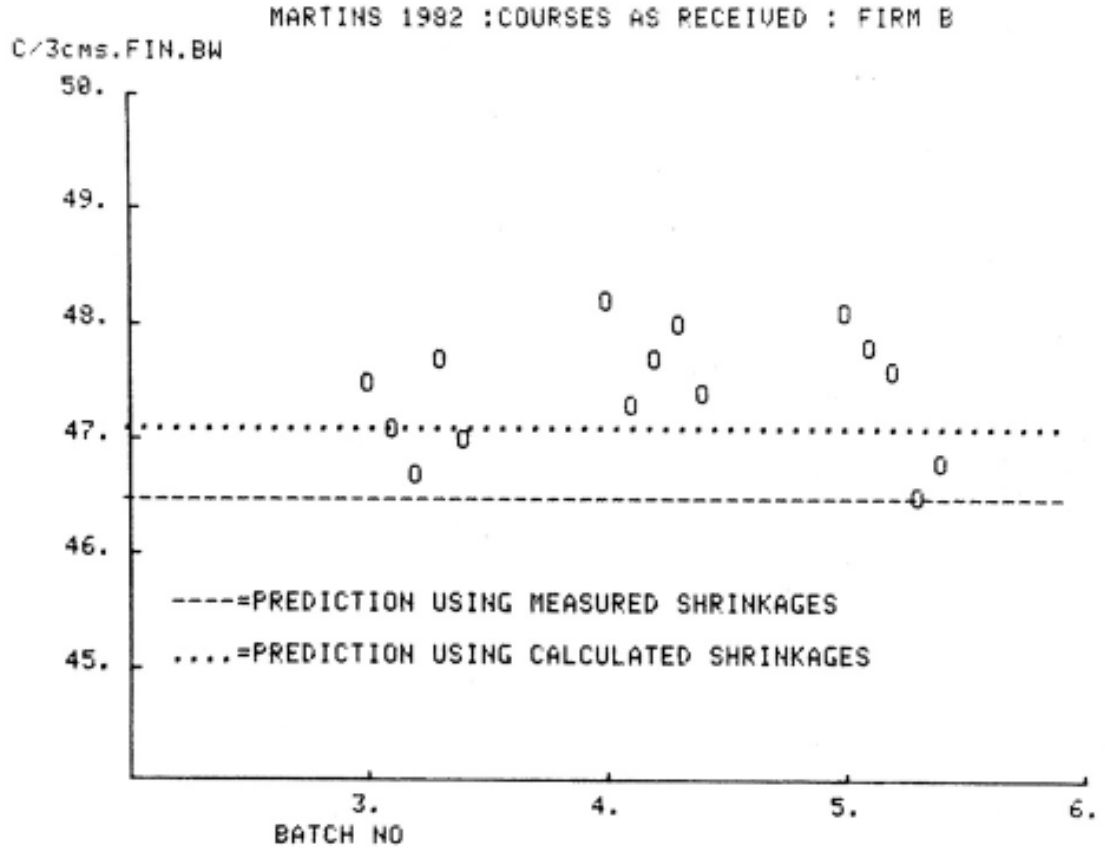


Figure 16