

S H R I N K A G E 85

INFLUENCE OF MOISTURE CONTENT ON SHRINKAGE DEVELOPMENT
IN TUMBLE DRYING

PART 3 : SINGLE JERSEY, 2-FOLD YARN, DORNIER MERCERISED & GYROSTOCK DYED

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INTRODUCTION

In research record No. 208 the results of a preliminary investigation, which monitored the development of shrinkage and the rate of reduction of moisture content on an interlock winch dyed and finished fabric during a standard 5 cycle relaxation sequence, were reported. In research record No. 210 a similar interlock quality was monitored for shrinkage and moisture content through relaxation cycles of increasing lengths of time in the tumble dryer and with the inclusion of a 10 minute cool down period at the end of each tumbling cycle. The influence of conditioning on the measured shrinkage was also examined and the results compared with those obtained from a controlled line dry test.

The results from both series of experiments confirmed that for an interlock winch processed fabric, maximum length shrinkage is only developed once the average moisture content of the specimens falls below approximately 2%, and is progressive over a number of cycles. Width shrinkage is apparently less sensitive to residual moisture content and maximum levels are achieved when moisture content falls below 4.7%; it did not increase with successive cycles. Conditioning after tumble drying generally reduced variability in length measurements but did not have a significant influence on width measurements. Conditioning also tended to reduce shrinkage for those sets which had been dried to below normal regain but caused a slight increase in the set which had not.

In part 3 of this series a similar series of trials were carried out using a single jersey piece mercerised and dyed fabric knitted from 2 fold yarn. In this series an additional tumble dry set (set 0) was added, of shorter duration (30 + 10 minutes). This was to ensure that at least one set would be removed from the tumble dryer while still thoroughly damp, having regard for the much lighter weight of the jersey test specimens compared to interlock.

In addition a digital temperature probe was positioned in the exhaust outlet of the tumble dryer and temperature readings were taken at 10 minute intervals during the drying cycles of sets 1, 2, 3, 5 and 7.

2. SAMPLE PREPARATION

2.1 TUMBLE DRY SETS

Six sets each comprising 5 standard shrinkage specimens (50 x 50 cm² template) were prepared from a piece of 28 gauge single jersey fabric, knitted from Ne 2/72 combed cotton at 0.287 cm nominal stitch length,

which had been piece mercerised on a Dornier machine and dyed in a Gyrostock during trials which had been carried out at TEBE in Portugal.

Each specimen was conditioned in the laboratory, marked, measured and weighed prior to laundering. Six standard loads of 2.75 kg were made up, including the test specimens, with make-weight fabric of a similar construction.

Initial moisture content and % regain were determined from four separate samples taken from the same fabric piece.

2.2 LINE DRY SET

An additional set of 5 standard shrinkage specimens was prepared from the same fabric piece and the specimens conditioned, marked, measured and weighed. These were then included in a 7th standard load which was made up as before to 2.75 kg with make-weight fabric of a similar construction.

3. EXPERIMENTAL PROCEDURE

3.1 TUMBLE DRY SETS

Each set of 5 shrinkage specimens plus make-weights was washed in a Hoover automatic, domestic washing machine at 60°C.

On completion of the washing cycle the test specimens were weighed and then the full load transferred to a Hoover domestic, continuous action, tumble dryer and tumble dried on the hottest temperature setting for a specified length of time. Tumbling was then continued for a further 10 minutes with the heat turned off, by using the cool down setting on the tumble dryer:-

Set 0	30 minutes hot tumble + 10 minutes cool down Total time in tumble dryer = 40 minutes
Set 1	40 minutes hot tumble + 10 minutes cool down Total time in tumble dryer = 50 minutes
Set 2	50 minutes hot tumble + 10 minutes cool down Total time in tumble dryer = 60 minutes
Set 3	60 minutes hot tumble + 10 minutes cool down Total time in tumble dryer = 70 minutes

Set 5 80 minutes hot tumble + 10 minutes cool down
 Total time in tumble dryer = 90 minutes

Set 7 100 minutes hot tumble + 10 minutes cool down
 Total time in tumble dryer = 110 minutes

On completion of the specified drying time, the test specimens were weighed and measured and then transferred to the laboratory for reconditioning in the standard atmosphere (65% RH, 20°C). Each specimen was allowed to recondition overnight (minimum 12 hours).

After reconditioning the specimens were reweighed and remeasured and then the complete load was re-wet out in the washing machine using the rinse cycle. On completion of the rinse cycle the test specimens were weighed and the load transferred to the tumble dryer and dried for the appropriate length of time, i.e. Set 0 30+10 minutes, Set 1 40+10 minutes etc.

On completion of the specified drying time, the test specimens were weighed and measured and then transferred to the laboratory for reconditioning, reweighing and remeasuring.

The rinse/tumble drying cycles were repeated a further 3 times for each set. Measurements being taken both straight from the tumble dryer and after reconditioning in the laboratory.

For Sets 1, 2, 3, 5 and 7 the temperature of the exhaust from the tumble dryer was recorded at 10 minute intervals throughout the duration of each tumble drying cycle, using a digital temperature probe positioned in the exhaust outlet.

3.2 LINE DRY SET

The line dry set was washed in a Hoover automatic, domestic washing machine at 60°C in the same way as the tumble dry sets.

On completion of the washing cycle the test specimens were weighed and then hung on a line in the laboratory in the standard conditioned atmosphere and left to dry for 24 hours. After 24 hours the test specimens were weighed and measured before being returned, with the make-weights, to the washing machine for rewetting using the rinse cycle.

On completion of the rinse cycle the specimens were reweighed and hung on a line in the laboratory for 24 hours before remeasuring and reweighing.

The rinse/line dry cycle was repeated a further three times.

4. RESULTS

The individual results for shrinkage, weight, moisture content and exhaust temperature, for each set are given in individual appendices at the end of this report.

Tables 1 and 2 and figures 1 - 17 summarise the average results obtained from all sets.

Tables 3 - 8 give the results of the statistical analysis which compared shrinkage results obtained before and after reconditioning for each of the tumble dry sets.

5. DISCUSSION

5.1 MEASURED STRAIGHT FROM THE TUMBLE DRYER

5.1.1 LENGTH SHRINKAGE

With the exception of Set 0 (30 + 10), length shrinkage increased progressively with the number of cycles. Generally also length shrinkage increased with the length of time in the tumble dryer. In particular Sets 0 (30 + 10), 1 (40 + 10) and 2 (50 + 10) did not develop the same amount of shrinkage as found in the other three sets. The differences in shrinkage found between Sets 3 (60 + 10), 5 (80 + 10) and 7 (100 + 10) are however probably not of significance. This appears to indicate that the full shrinkage potential of a fabric during any one cycle will only be achieved if the average moisture content of the specimens falls below approximately 2%. Once the specimens are uniformly dry (between 0-2% residual moisture) tumbling for additional lengths of time does not appear to significantly increase the level of length shrinkage developed. For Set 0 (30 + 10) where the residual average moisture content of the specimens never dropped below approximately 16%, shrinkage was not progressive over cycles.

The specimens which had been line dried developed a small but consistent length extension which increased slightly with the number of cycles, whereas all the tumble dried sets developed shrinkage, although for this particular fabric quality the total length shrinkage to tumble drying was very low, i.e. on average 5% measured straight from the tumble dryer, 3.8% after reconditioning. This result would seem to confirm the opinion that to avoid the possibility of extension during repeated line drying cycles, fabrics should not be finished to pass very low tumble dry shrinkage specifications.

Previous trials have indicated that there is a larger difference between line and tumble dry shrinkage for fabrics which have been mercerised when compared to fabrics of similar quality which have not

been mercerised. However, the average difference between line drying and tumble drying for this fabric quality was found to be similar to the average difference found for the interlock winch dyed quality examined in part 2 of the series (RR 210).

e.g. <u>Diff. \Line/Tumble</u>	Interlock winch dye <u>Length</u>	<u>Width</u>	Single Jersey Mercerised <u>Length</u>	<u>Width</u>
Before Conditioning	-5.9	-5.2	-6.2	-6.4
After Conditioning	-4.3	-5.2	-4.9	-4.8

Variation between specimens within a set improved slightly over Sets 0, 1, 2 and 3 but did not improve further with extended tumbling times. The variation between specimens for the line dry set was similar to Sets 5 and 7.

5.1.2 WIDTH SHRINKAGE

Width shrinkage was not on average progressive with number of cycles but increased slightly with length of time in the tumble dryer. In particular Set 0 and Set 2 developed lower width shrinkages, on average, than the other sets. Maximum width shrinkage is only consistently achieved when moisture contents fall below 2%.

The amount of width shrinkage developed during line drying was slightly higher than that developed during tumble drying for Set 0 (30 + 10) but significantly less than all the other tumble dry sets. In addition there was no apparent increase in width shrinkage in line drying over number of cycles.

Variation between specimens within a set improved slightly over Sets 0, 1 and 2 but did not improve further with extended tumbling times. The variation between specimens for the line dry set was similar to Set 0.

5.1.3 MOISTURE CONTENT

Residual moisture content in the specimens reduced with length of time in the tumble dryer. Consistent minimum levels of residual moisture content were only achieved with Sets 5 and 7, although Set 3 after the first cycle was on average returning residual moisture contents below 1% immediately on leaving the tumble dryer.

Variation in moisture content between specimens also decreased with increased time in the tumble dryer and for Sets 0 and 1 generally over cycles.

Variation in moisture content of the line dry set was insignificant.

5.2 INFLUENCE OF CONDITIONING

5.2.1 LENGTH SHRINKAGE

Conditioning after tumble drying on average reduced the variability between specimens and with the exception of Set 0 caused a reduction in the levels of recorded length shrinkage between approximately 1 and 2%. In the vast majority of cases the improvement in shrinkage due to conditioning was statistically significant. For Set 0 length shrinkage increased with conditioning.

5.2.2 WIDTH SHRINKAGE

Conditioning after tumble drying on average reduced the variability between specimens and with the exception of Set 0 caused a reduction in the recorded levels of width shrinkage. Similarly to length shrinkage the improvement was on average between 1-2% and in the majority of cases statistically significant. For Set 0 width shrinkage increased with conditioning.

5.2.3 MOISTURE CONTENT

Variation in moisture content after reconditioning was negligible for each set, although there was a decrease in the absolute values corresponding to length of time in the tumble dryer.

The moisture content of the line dry set (Set 8) was similar to that of Sets 0 and 1 after reconditioning, while the moisture content of Set 7 after reconditioning was on average approximately 2% less.

Sets 0, 1 and 8 retained higher moisture contents after conditioning compared to the original moisture content of the fabric, while Sets 3, 5 and 7 tended to have lower moisture contents after conditioning compared to the original. Set 2 was on average the same as the original.

5.3 EXHAUST TEMPERATURE DURING TUMBLE DRYING (Fig.15)

Measurements of exhaust temperature taken at 10 minute intervals during each tumble drying cycle show an increase in exhaust temperature with time as the specimens lose moisture. The temperature cut off for the tumble dryer used in these trials is set at approximately 70°C. At this temperature the heater turns on and off automatically causing exhaust temperatures to fluctuate accordingly. This is illustrated by the results obtained from Set 7 (100 + 10). For all sets the exhaust temperature rose sharply during the first 10 minutes, gradually during the next 20 minutes and rapidly from 40 minutes to 60 minutes - the period when the fabric moisture content was between about 20% and 2%. Variability between cycles was also highest during this period of rapid temperature rise, peaking at around 50 minutes. Final exhaust

temperatures after the 10 minute cooling down period rose from approximately 25°C for Set 1 to approximately 35°C for Set 7. Starting temperatures were around 30°C. Maximum exhaust temperatures were only recorded on those sets where tumble drying times were sufficient to reduce the average residual moisture content in the samples to below 2%. In these trials this corresponds to a minimum of 60 minutes - Set 3, which is also the first where maximum shrinkage levels were achieved. The monitoring of exhaust temperature would therefore seem to be an obvious method of controlling tumble drying times to ensure that all shrinkage specimens are uniformly dried to minimal moisture content levels.

6. CONCLUSIONS

- 6.1 For this fabric quality length shrinkage generally increases with length of time in the tumble dryer but once the average moisture content of the specimens falls below approximately 2% no additional shrinkage appears to develop.
- 6.2 Length shrinkage generally increases with the number of cycles but unless the specimens are dried to below approximately 2% residual moisture, maximum length shrinkage does not develop even after 5 cycles. At very high residual moisture contents (Set 0) there is no apparent increase in shrinkage over cycles.
- 6.3 For this fabric quality maximum width shrinkage is only consistently achieved when moisture content falls below 2%, although it is probably less sensitive to residual moisture than is the length shrinkage.
- 6.4 Generally width shrinkage is not progressive over cycles if residual moisture content is low; at high residual moisture contents (short drying times) there is some evidence to suggest that it may be progressive with number of cycles.
- 6.5 Moisture content reduced with length of time in the tumble dryer and fell below 1% consistently for Sets 5 and 7, and with the exception of the first cycle for Set 3 also. For Sets 1, 2 and 3 the residual moisture content generally also reduced with number of cycles.
- 6.6 Conditioning after tumble drying reduced the variability in both length and width measurements and reduced shrinkage in both directions by 1-2% for all sets which had been dried below standard regain. There was a negligible effect of conditioning on Set 1 and a small increase for Set 0.
- 6.7 On average less length and width shrinkage is developed during line drying compared to tumble drying. For this fabric quality there was a small but consistent extension in fabric length after line drying.

6.8 Exhaust temperatures rose with length of tumbling time. Maximum temperatures were only achieved when the corresponding moisture content of the specimens fell below approximately 2% - i.e. when they were uniformly dry. The monitoring of exhaust temperature could be used to control the drying time of shrinkage specimens to ensure that the specimens are always uniformly dry. However, extended tumbling after the specimens have achieved minimum moisture content does not appear to have an adverse effect on fabric shrinkage.

206 SINGLE JERSEY, Ne 2/72, S.L. 0.287, FINISH Dornier merc.+ Gyrostock

Average of 5 replications : Measured straight from the tumble dryer

Cycle No	LSZ	SD	WSZ	SD	MCZ	SD
Set 0 Tumble Dry 30+10 mins						
1	1.12	1.7	11.92	1.56	16.05	3.29
2	0.24	0.8	11.12	1.27	19.3	1.93
3	1.34	0.8	12.62	0.67	16.95	1.19
4	1.58	1.14	13.08	1.28	16.15	2.13
5	0.84	1.13	12.44	1.59	16.37	2.67
	mean	1.11		1.27		2.24
	sd	0.37		0.37		0.79
Set 1 Tumble Dry 40+10 mins						
1	1.28	1.09	18.72	0.83	13.74	3.13
2	1.52	0.82	19.56	1.06	10.1	2.31
3	2.52	0.41	19.8	1.21	7.78	1.15
4	3.68	0.83	20.54	0.56	5.5	0.81
5	3.16	0.52	21.62	1.17	5.26	1.25
	mean	0.73		0.97		1.73
	sd	0.27		0.27		0.96
Set 2 Tumble Dry 50+10 mins						
1	3.02	0.83	17.12	0.78	8.3	0.98
2	4.06	0.82	18.56	0.6	2.19	0.22
3	5.02	0.98	18.58	0.79	0.61	0.14
4	5.02	0.98	18.58	0.79	0.42	0.21
5	4.74	0.91	18.4	0.97	3.57	0.93
	mean	0.9		0.79		0.5
	sd	0.08		0.13		0.42
Set 3 Tumble Dry 60+10 mins						
1	3.8	0.37	20.96	1.29	2.22	0.35
2	5.08	2.25	21.04	0.74	0.62	0.09
3	4.72	0.91	20.92	0.56	0.63	0.12
4	5.48	0.48	21.44	0.94	0.12	0.27
5	5.64	0.41	21.72	0.93	0.04	0.26
	mean	0.88		0.89		0.22
	sd	0.79		0.27		0.11
Set 5 Tumble Dry 80+10 mins						
1	4.04	0.17	19.62	0.62	0.68	0.15
2	4.2	0.77	19.84	0.71	0.63	0.24
3	4.88	0.61	18.86	0.97	0.49	0.29
4	6.04	0.74	20.1	0.51	-0.43	0.09
5	6.08	0.41	19.78	0.69	0.09	0.25
	mean	0.54		0.7		0.2
	sd	0.25		0.17		0.08
Set 7 Tumble Dry 100+10 mins						
1	4.4	0.58	21.4	0.63	-0.29	0.18
2	4.52	0.5	20.56	1.01	0.27	0.28
3	4.76	0.89	20.16	0.61	0.77	0.23
4	5.32	0.59	20.32	0.56	0.3	0.17
5	6.48	0.41	19.8	0.95	-0.08	0.27
	mean	0.59		0.75		0.23
	sd	0.18		0.21		0.05
Set 8 Line Dry 24Hrs Conditioned Atmosphere						
1	-0.68	0.67	14.2	1.48	9.14	0.09
2	-1.18	0.3	13.86	1.11	9.37	0.07
3	-1.2	0.62	14.34	1.01	9.06	0.06
4	-1.26	0.59	13.82	1.33	8.78	0.1
5	-1.48	0.62	13.96	1.16	9.3	0.09
	mean	0.56		1.22		0.08
	sd	0.15		0.19		0.02

206 SINGLE JERSEY, Ne 2/72, S.L. 0.287, FINISH Dornier merc.+ Gyrostock

Average of 5 replications : Measured after conditioning

Cycle No	LS%	SD	WS%	SD	MC%	SD
Set 0 Tumble Dry 30+10 mins						
1	2.38	1.47	14.1	1.21	9.38	0.1
2	1.12	0.44	13.18	1.21	8.97	0.17
3	1.36	0.59	13.38	0.59	9.21	0.14
4	1.62	1.09	13.6	0.94	8.76	0.16
5	1.36	0.85	13.4	1.36	8.91	0.15
	mean	0.89		1.06		0.14
	sd	0.41		0.3		0.03
Set 1 Tumble Dry 40+10 mins						
1	1.56	1.13	18.58	0.64	10.21	0.4
2	1.2	0.51	19.2	0.92	9.62	0.57
3	2.12	0.58	19.24	0.73	9.15	0.37
4	2.56	0.48	19.68	0.71	8.65	0.25
5	2.44	0.88	20.1	0.88	8.73	0.25
	mean	0.72		0.78		0.37
	sd	0.28		0.12		0.13
Set 2 Tumble Dry 50+10 mins						
1	2.6	0.99	16.96	0.63	8.6	0.29
2	2.8	0.68	16.82	0.54	7.8	0.06
3	3.42	0.66	17.4	0.81	7.4	0.07
4	3.62	0.92	17.9	1.18	7.48	0.05
5	3.58	0.51	17.32	0.6	7.78	0.21
	mean	0.75		0.75		0.14
	sd	0.2		0.26		0.11
Set 3 Tumble Dry 60+10 mins						
1	3.08	0.3	19.32	0.81	7.8	0.09
2	3.2	0.32	19.44	0.74	7.49	0.08
3	3.68	0.41	19.44	0.25	7.47	0.06
4	4	0.47	19.32	0.41	7.42	0.03
5	4.28	0.33	19.8	0.7	7.15	0.02
	mean	0.37		0.58		0.06
	sd	0.07		0.24		0.03
Set 5 Tumble Dry 80+10 mins						
1	3.2	0.47	18.34	0.42	7.39	0.05
2	3.2	0.68	18.38	0.45	7.4	0.07
3	4.08	0.44	17.96	0.72	7.36	0.06
4	4.56	0.86	18.14	0.41	7	0.05
5	4.64	0.82	18.3	0.45	7.14	0.08
	mean	0.65		0.49		0.06
	sd	0.19		0.13		0.01
Set 7 Tumble Dry 100+10 mins						
1	3	0.57	19.12	0.71	7.2	0.12
2	3.28	0.63	19.16	1.06	7.44	0.16
3	3.92	0.73	18.6	1.18	7.22	0.12
4	4.16	0.71	19.04	0.38	7.13	0.13
5	4.36	0.91	18.4	0.64	6.96	0.1
	mean	0.71		0.79		0.13
	sd	0.13		0.32		0.02
Set 8 Line Dry 24Hrs Conditioned Atmosphere						
1	-0.68	0.67	14.2	1.48	9.14	0.09
2	-1.18	0.3	13.86	1.11	9.37	0.07
3	-1.2	0.62	14.34	1.01	9.06	0.06
4	-1.26	0.59	13.82	1.33	8.78	0.1
5	-1.48	0.62	13.96	1.16	9.3	0.09
	mean	0.56		1.22		0.08
	sd	0.15		0.19		0.02

TABLE 3

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 0 : Tumble Dry 30mins HOT + 10mins COOL Down

	Mean Difference	t	r sq
FULL WASH LS	1.26	6.4425 **	0.9598
WS	2.18	3.9768 *	0.5079
1st RINSE LS	0.88	2.1714	0.0581
WS	2.06	16.4145 ***	0.9613
2nd RINSE LS	0.02	0.1138	0.7358
WS	0.76	8.3673 **	0.9323
3rd RINSE LS	0.04	0.2623	0.9289
WS	0.52	2.1141	0.8969
4th RINSE LS	0.52	2.8098 *	0.9414
WS	0.96	4.4882 *	0.9403

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

TABLE 4

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 1 : Tumble Dry 40mins HOT + 10mins COOL Down

	Mean Difference	t	r sq
FULL WASH LS	0.28	1.3503	0.8674
WS	-0.14	0.5864	0.6757
1st RINSE LS	-0.32	1.9124	0.9621
WS	-0.36	2.7611	0.9526
2nd RINSE LS	-0.4	1.372	0.1178
WS	-0.56	0.8025	5.0E-4
3rd RINSE LS	-1.12	5.4011 **	0.8865
WS	-0.86	2.0889	0.0297
4th RINSE LS	-0.72	2.2434	0.4729
WS	-1.52	3.7649 *	0.5254

TABLE 5

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 2 : Tumble Dry 50mins HOT + 10mins COOL Down

	Mean	t	r sq
	Difference		
FULL WASH LS	-0.42	2.312	0.8743
WS	-0.16	0.6015	0.5431
1st RINSE LS	-1.26	15.06 ***	0.9876
WS	-1.74	7.2094 **	0.413
2nd RINSE LS	-1.6	5.488 **	0.6656
WS	-1.18	3.3476 *	0.3732
3rd RINSE LS	-1.4	4.1284 *	0.5592
WS	-0.68	1.2985	0.2463
4th RINSE LS	-1.16	4.3231 *	0.7412
WS	-1.08	3.8984 *	0.7274

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

TABLE 6

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 3 : Tumble Dry 60mins HOT + 10mins COOL Down

	Mean	t	r sq
	Difference		
FULL WASH LS	-0.72	4.3028 *	0.2795
WS	-1.64	4.602 *	0.7513
1st RINSE LS	-1.88	1.8866	0.7098
WS	-1.6	7.5425 **	0.701
2nd RINSE LS	-1.04	3.3392 *	0.6629
WS	-1.48	4.8531 **	8.0E-4
3rd RINSE LS	-1.48	7.5922 **	0.4408
WS	-2.12	5.8131 **	0.4549
4th RINSE LS	-1.36	5.0684 **	9.0E-4
WS	-1.92	8.3399 **	0.7704

TABLE 7

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET, 5 : Tumble Dry 80mins HOT + 10mins COOL Down

	Mean Difference	t		r sq
FULL WASH LS	-0.84	3.6836 *		0.0649
WS	-1.28	5.56 **		0.4453
1st RINSE LS	-1	10 ***		0.9424
WS	-1.46	5.2615 **		0.3878
2nd RINSE LS	-0.8	8 **		0.9611
WS	-0.9	3.182 *		0.668
3rd RINSE LS	-1.48	5.1372 **		0.5668
WS	-1.96	6.645 **		0.0366
4th RINSE LS	-1.44	6.6422 **		0.925
WS	-1.48	7.1372 **		0.6621

STUDENTS T STATISTIC
 DEGREES OF FREEDOM = 4 (N = 5)
 95% = 2.776 *
 99% = 4.604 **
 99.9% = 8.610 ***

TABLE 8

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 7 : Tumble Dry 100mins HOT + 10mins COOL Down

	Mean Difference	t		r sq
FULL WASH LS	-1.4	19.799 ***		0.9412
WS	-2.28	15.034 ***		0.815
1st RINSE LS	-1.24	4.98 **		0.3969
WS	-1.4	5.1121 **		0.7423
2nd RINSE LS	-0.84	3.6836 *		0.7374
WS	-1.56	5.4478 **		0.9896
3rd RINSE LS	-1.16	10.5893 ***		0.9218
WS	-1.28	4.5831 *		0.1208
4th RINSE LS	-2.12	4.7053 **		0.062
WS	-1.4	2.4749		6.0E-4

FIGURE 1

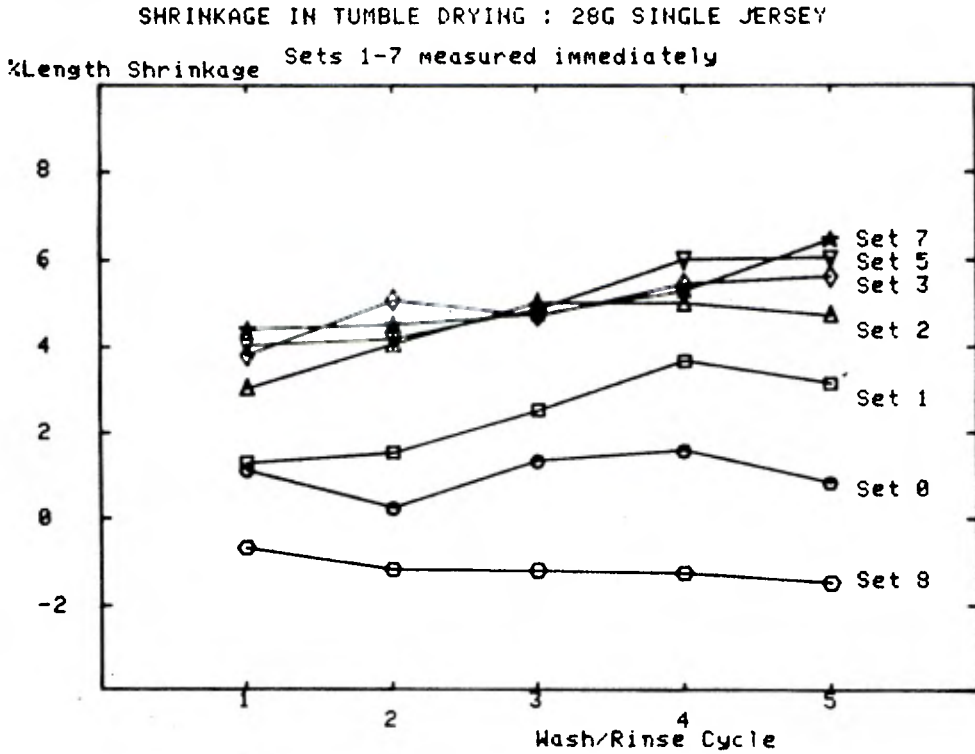


FIGURE 2

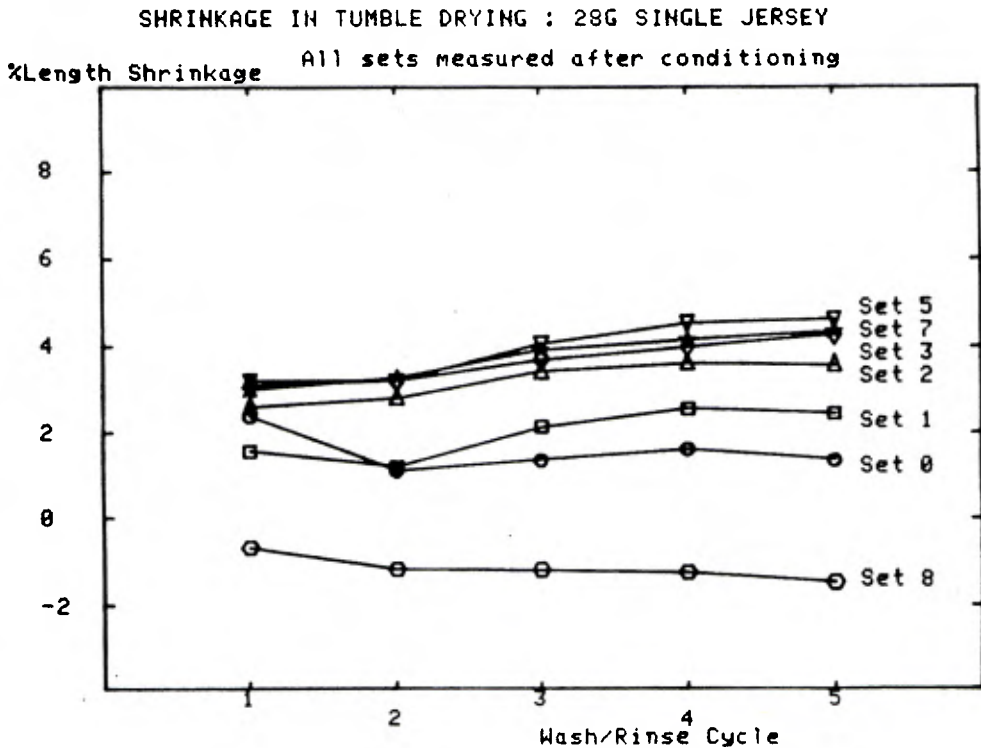


FIGURE 3

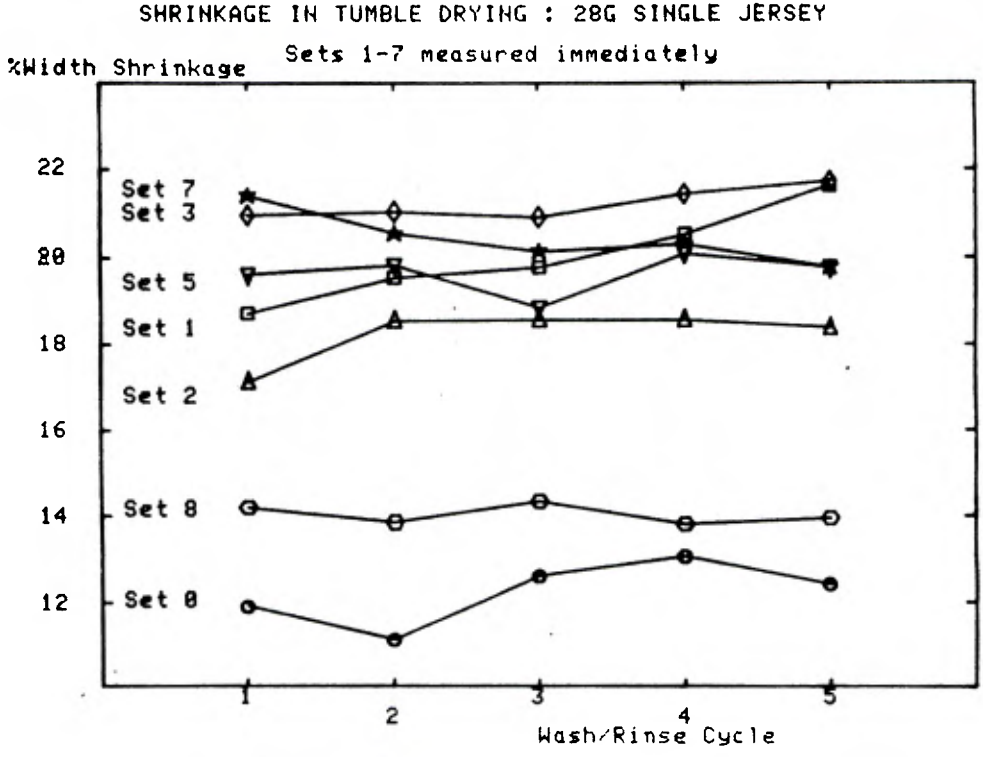


FIGURE 4

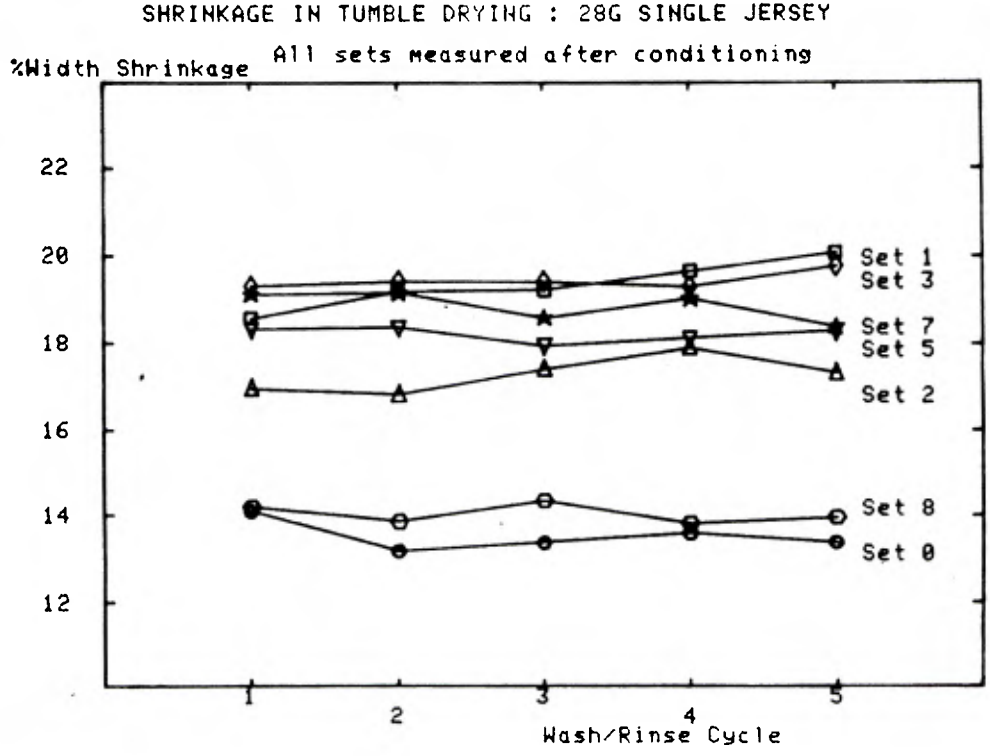


FIGURE 5

LENGTH SHRINKAGE and MOISTURE CONTENT after DRYING
Tumble Dry sets 0,1,2,3,5,7 measured immediately

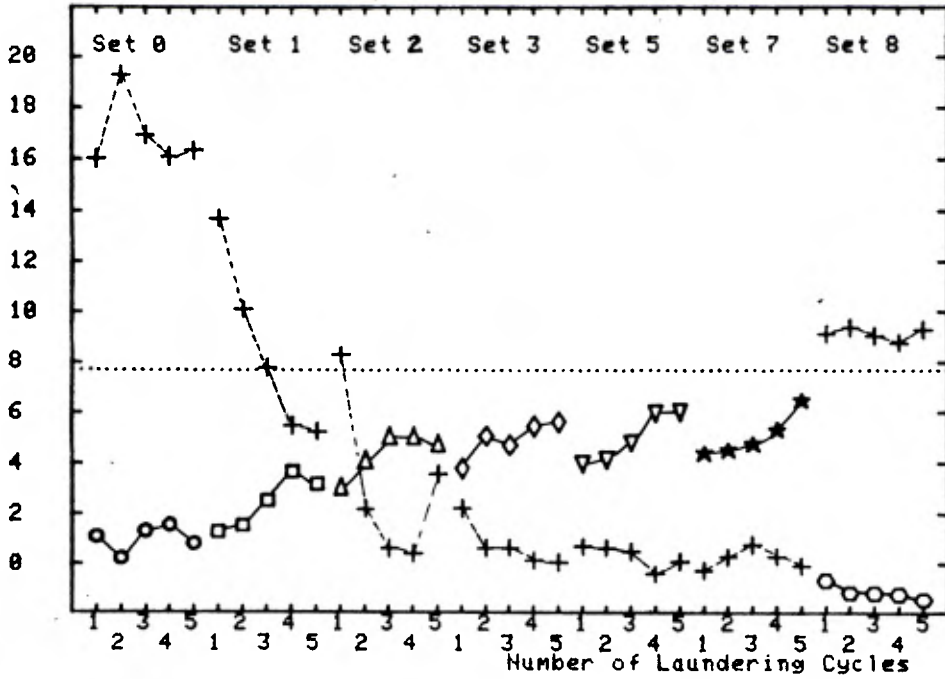
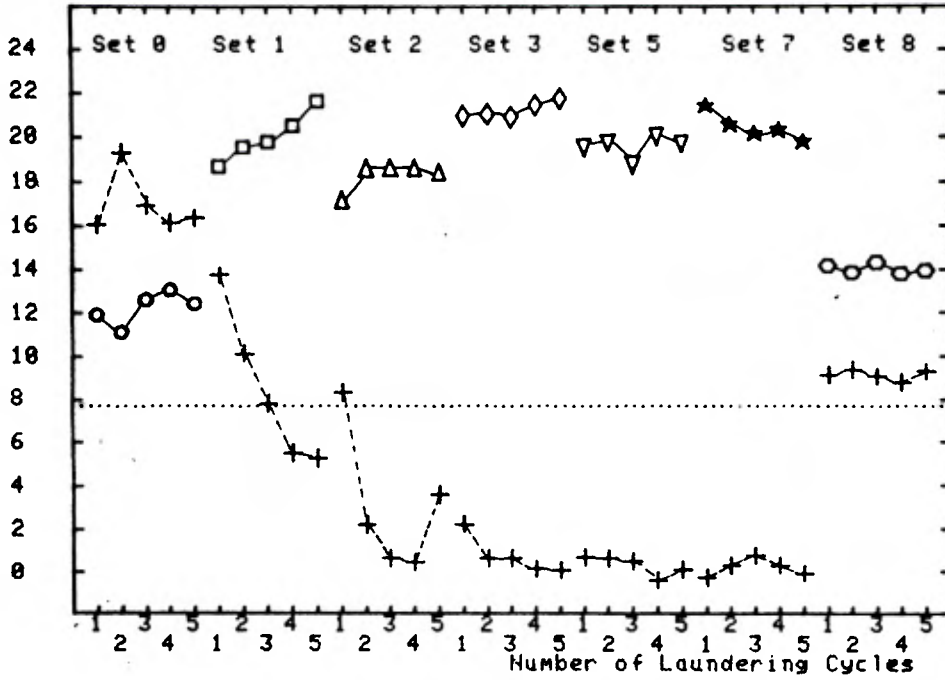


FIGURE 7

WIDTH SHRINKAGE and MOISTURE CONTENT after DRYING
Tumble Dry sets 0,1,2,3,5,7 measured immediately



WIDTH SHRINKAGE and MOISTURE CONTENT after DRYING
All sets measured after conditioning

FIGURE 8

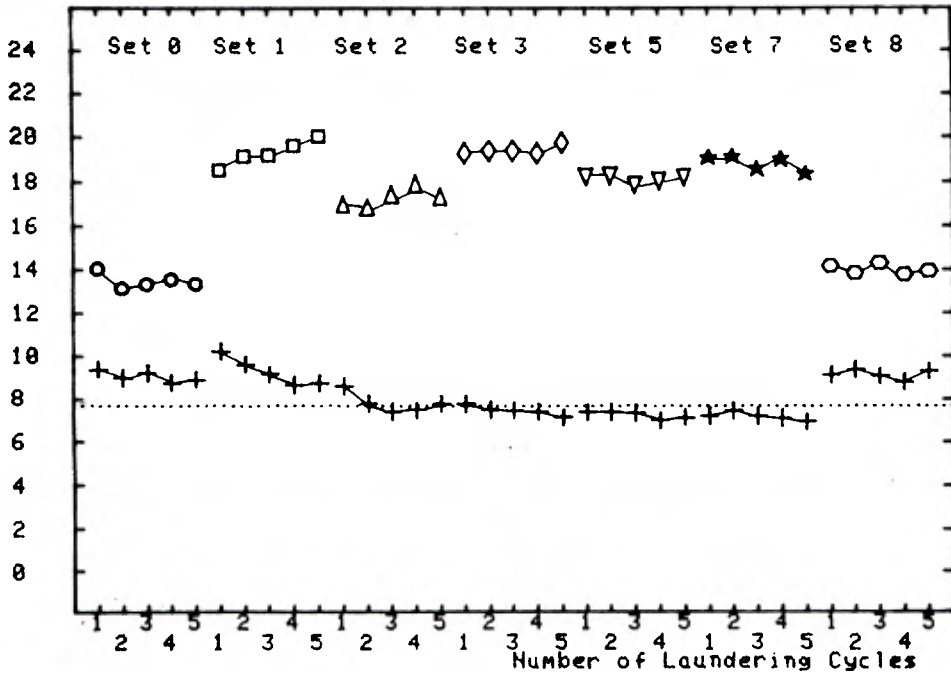
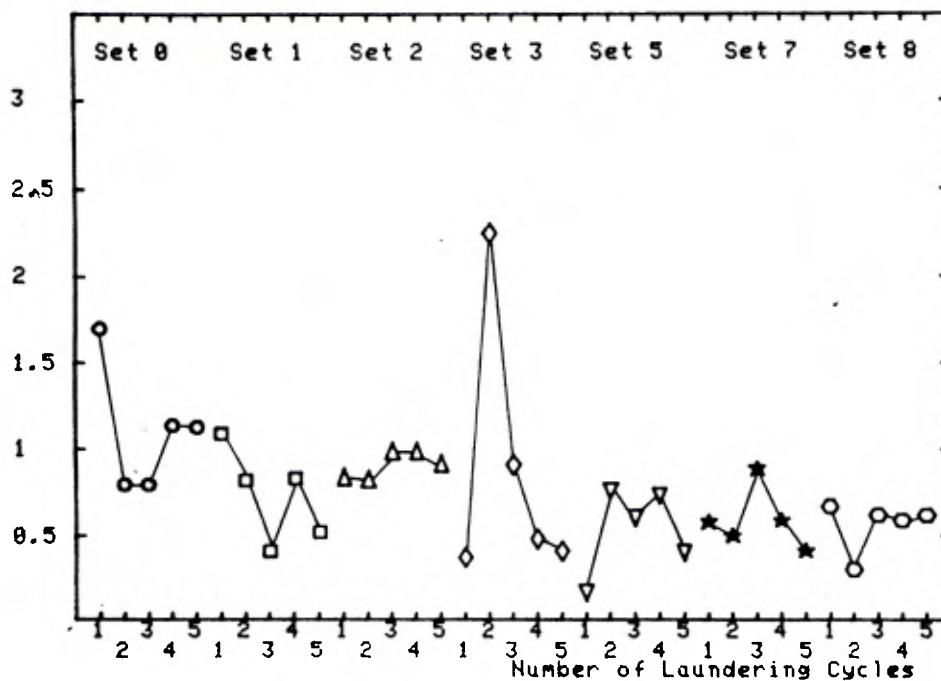


FIGURE 9

% LENGTH SHRINKAGE - STANDARD DEVIATIONS
Tumble Dry sets 0,1,2,3,5,7 measured immediately



% LENGTH SHRINKAGE - STANDARD DEVIATIONS
All sets measured after conditioning

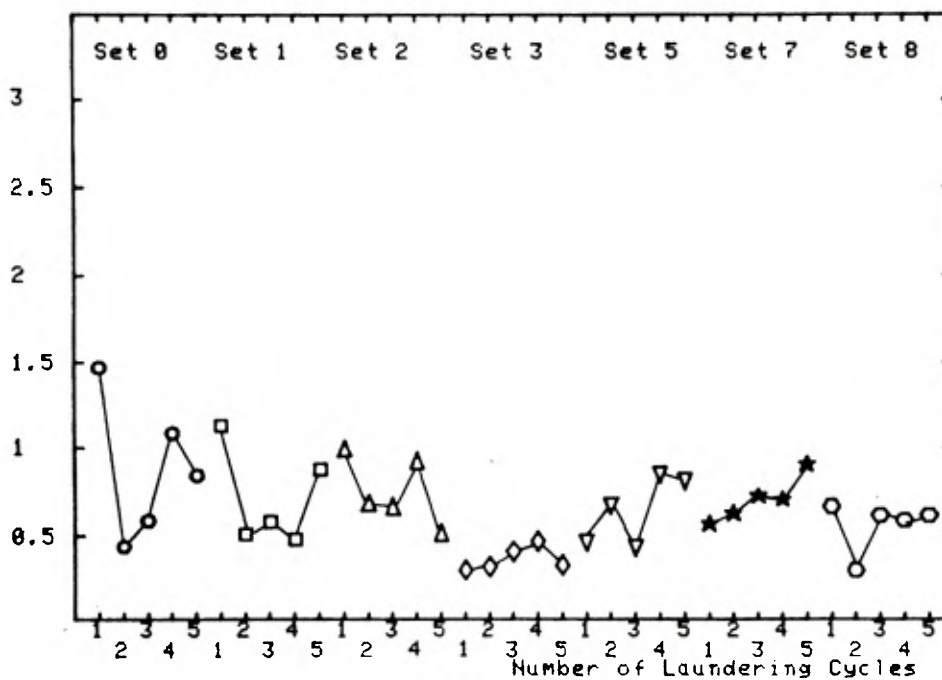
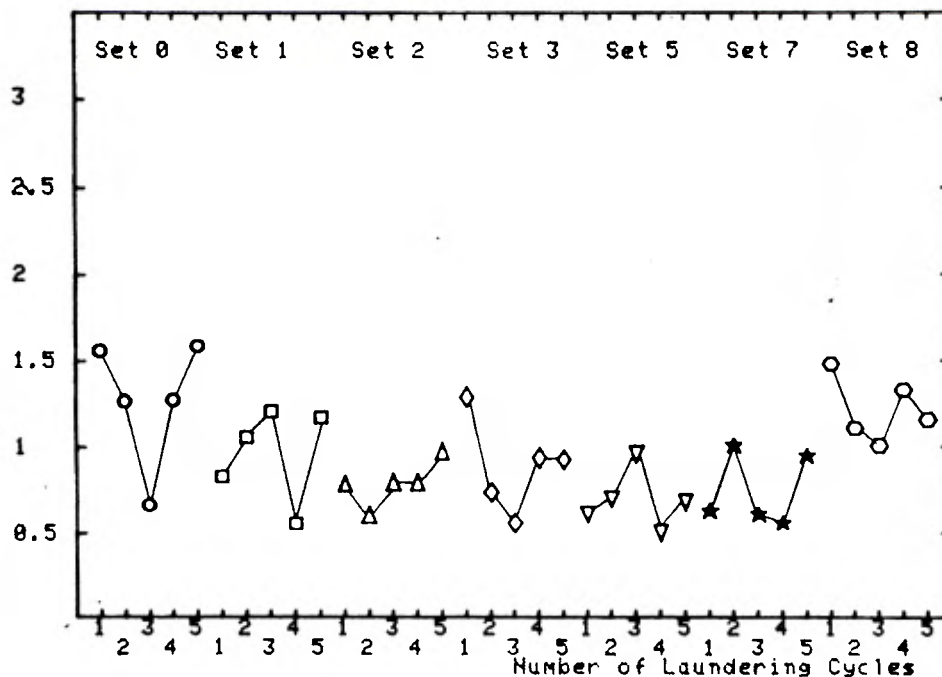


FIGURE 10

FIGURE 11

% WIDTH SHRINKAGE - STANDARD DEVIATIONS
Tumble Dry sets 0,1,2,3,5,7 measured immediately



% WIDTH SHRINKAGE - STANDARD DEVIATIONS
All sets measured after conditioning

FIGURE 12

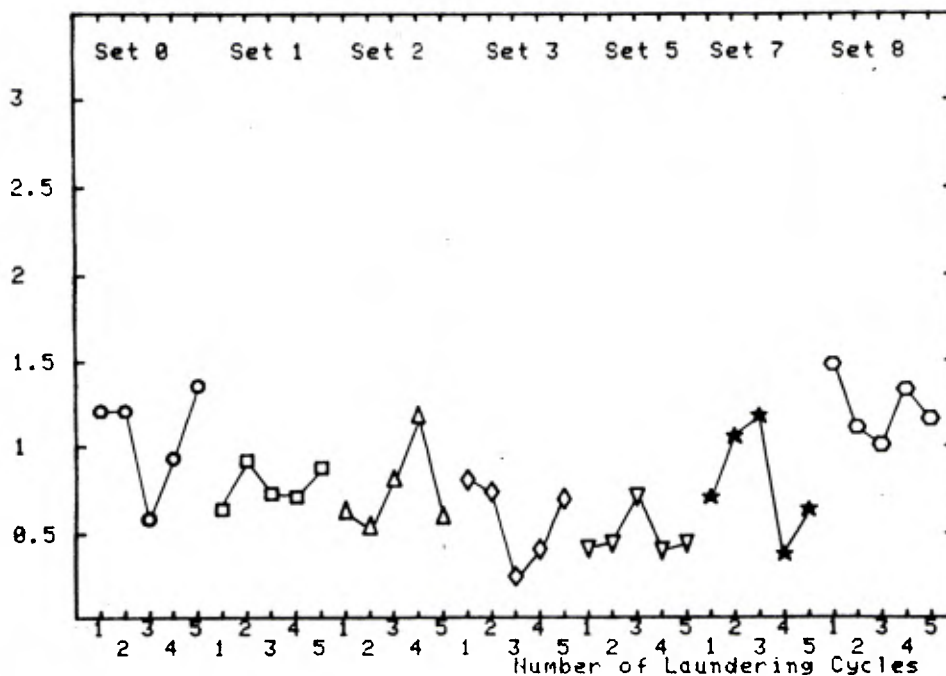
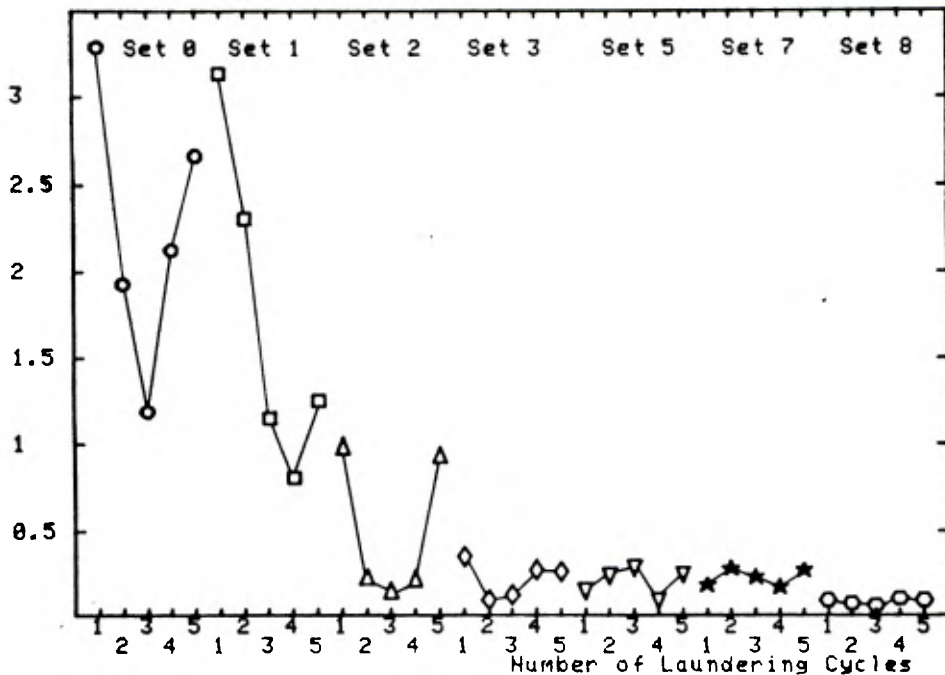


FIGURE 13

% MOISTURE CONTENT - STANDARD DEVIATIONS
Tumble Dry sets 0,1,2,3,5,7 measured immediately



% MOISTURE CONTENT - STANDARD DEVIATIONS
All sets measured after conditioning

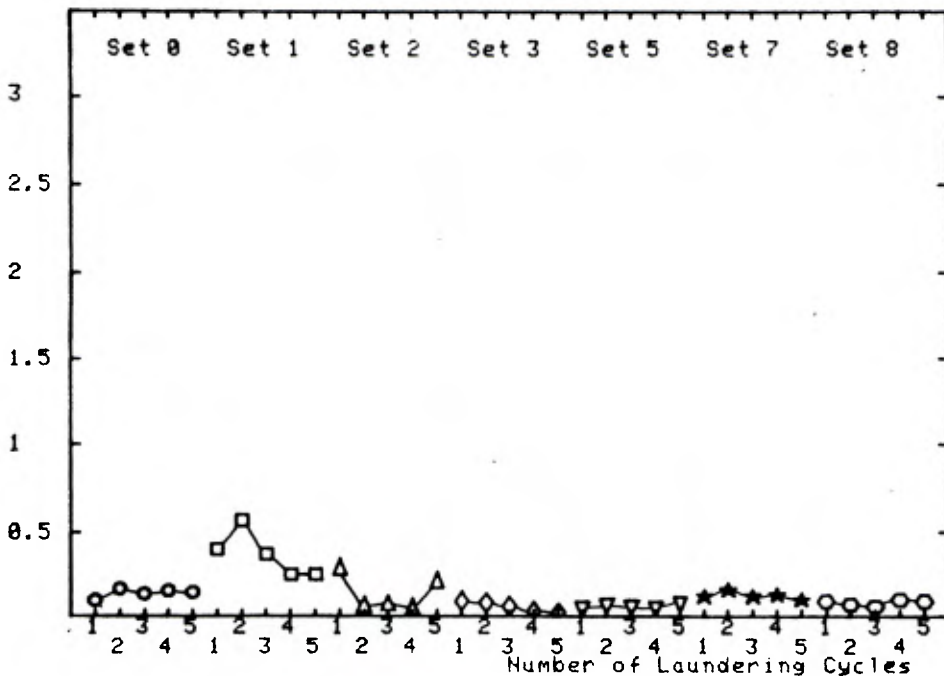


FIGURE 14

FIGURE 15

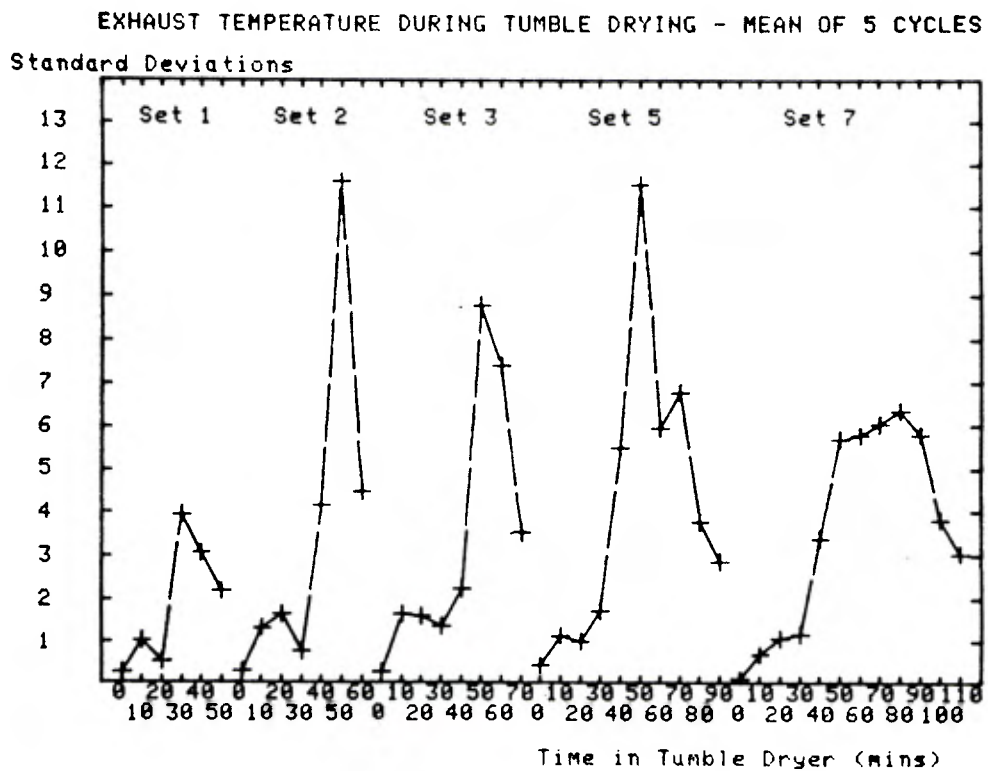
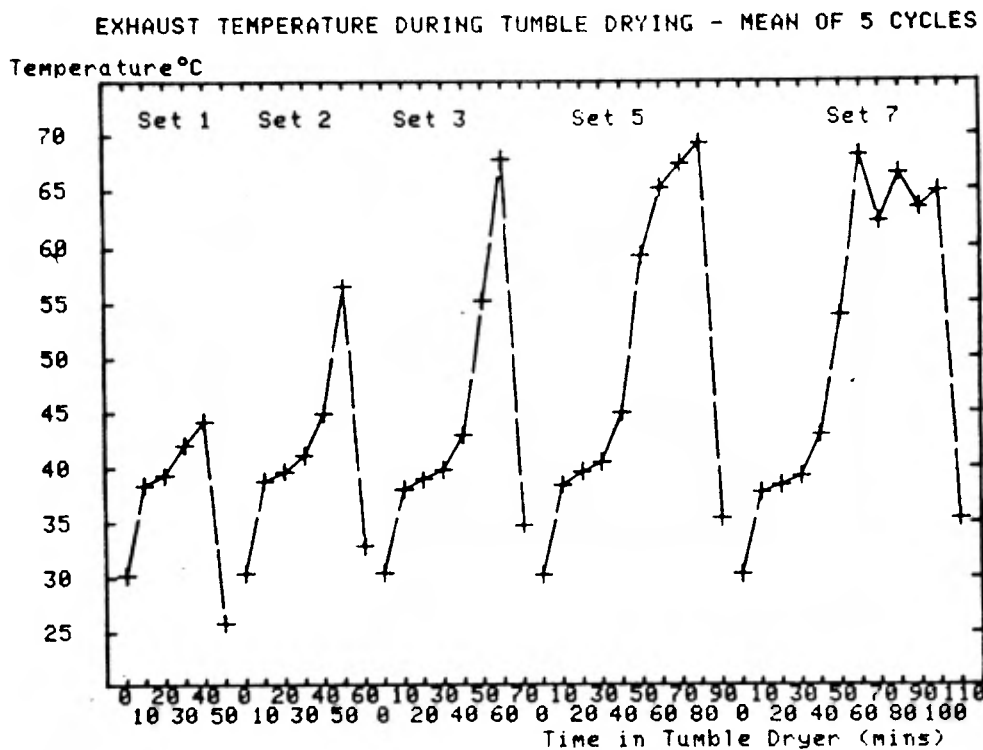
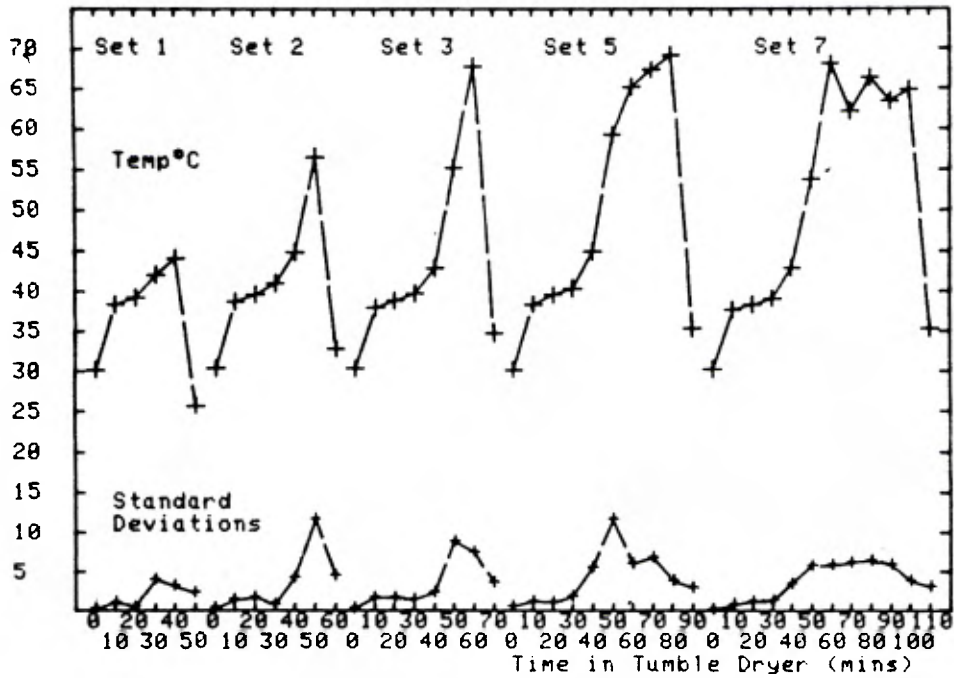


FIGURE 16

EXHAUST TEMPERATURE / STANDARD DEVIATIONS - MEAN OF 5 CYCLES



A P P E N D I X 1

SET 0 30 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 0 : 30mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	0.8	9.3	0.5	12	2	12.8	0.9	13	1.7	13
B	-1.7	13.1	-0.6	12.9	-0.02	13.7	0.4	14.3	0.1	14.5
C	2.1	12	1.1	10.2	1.7	12.1	1.1	11.5	-0.8	10.1
D	1.9	12.1	0.8	10.5	1.3	12.1	2.3	12.2	1.6	12.2
E	2.5	13.1	-0.6	10	1.7	12.4	3.2	14.4	1.6	12.4

*** COLUMN STATISTICS ***

		N	Mean	SD	CVI
1.	FULL LS%	5	1.1200	1.6976	151.58
2.	WASH WS%	5	11.9200	1.5563	13.06
3.	1st LS%	5	0.2400	0.7956	331.51
4.	RINSE WS%	5	11.1200	1.2677	11.40
5.	2nd LS%	5	1.3360	0.7978	59.72
6.	RINSE WS%	5	12.6200	0.6686	5.30
7.	3rd LS%	5	1.5800	1.1432	72.36
8.	RINSE WS%	5	13.0000	1.2755	9.75
9.	4th LS%	5	0.8400	1.1327	134.84
10.	RINSE WS%	5	12.4400	1.5884	12.77

SHRINKAGE IN TUMBLE DRYING

SET 0 : 30mins HOT Tumble + 10mins COOL Down

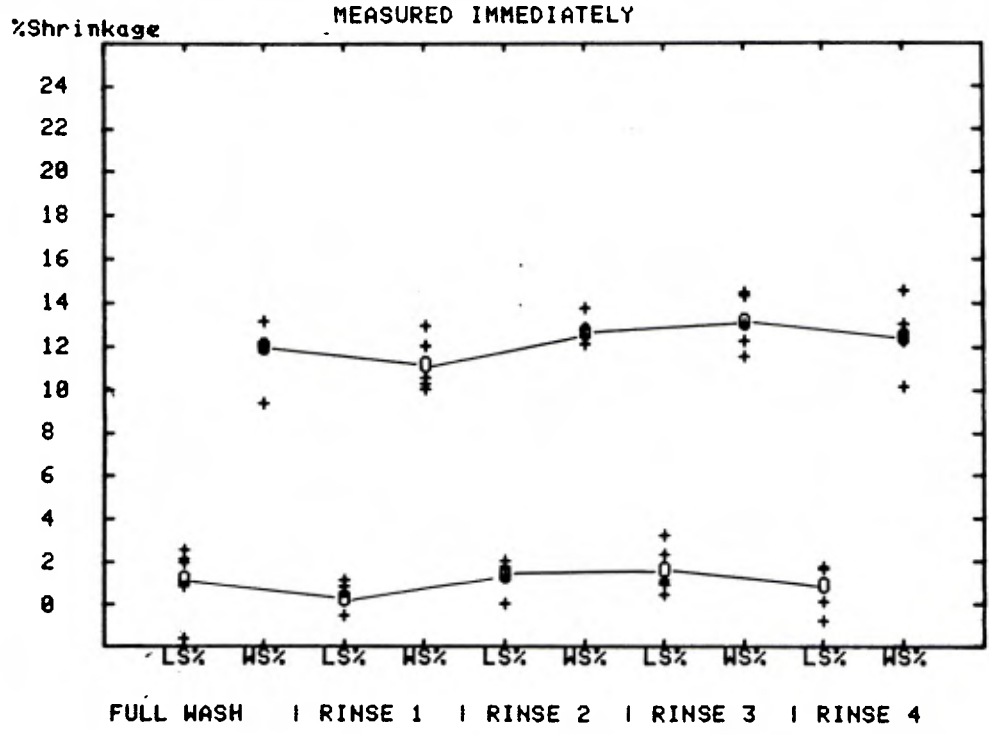
SHRINKAGE MEASURED AFTER CONDITIONING

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	2.6	13.1	1.2	14	2	13.5	0.8	13.7	1.9	13.9
B	-0.2	15.9	0.4	14.8	0.6	14.3	0.8	14.4	0.6	15.1
C	3	13.4	1.2	12.1	1.2	13.1	1.2	12.8	0.3	11.5
D	3.1	13.3	1.2	13	1.1	12.7	1.9	12.5	2.2	12.7
E	3.4	14.8	1.6	12	1.9	13.3	3.4	14.6	1.8	13.8

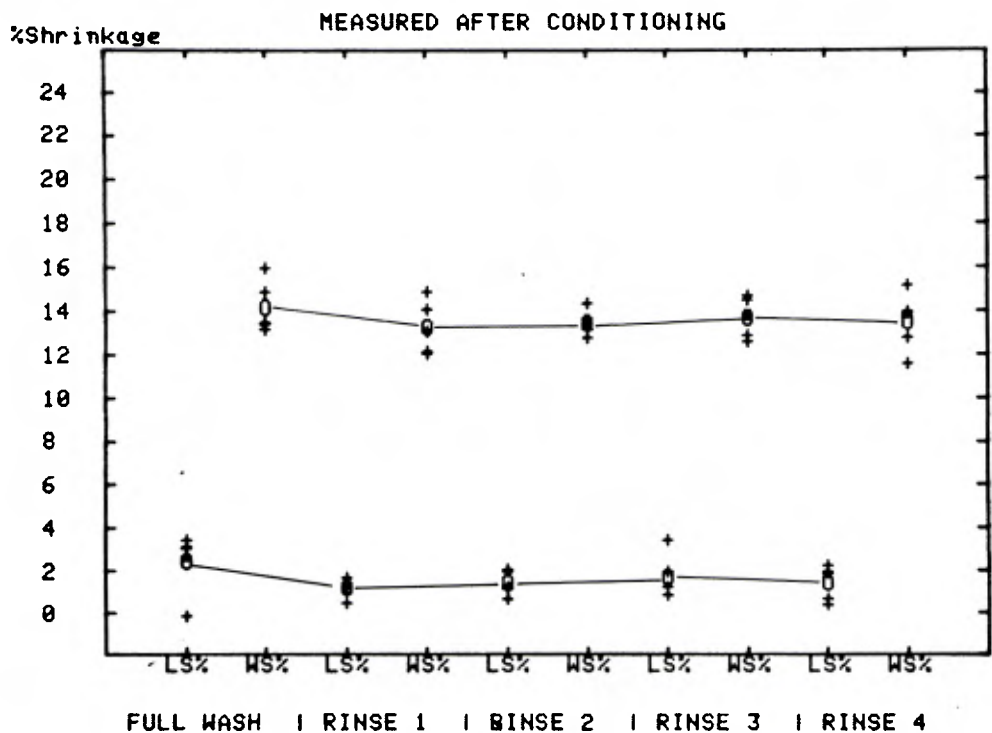
*** COLUMN STATISTICS ***

		N	Mean	SD	CVI
1.	FULL LS%	5	2.3000	1.4704	61.78
2.	WASH WS%	5	14.1000	1.2104	8.58
3.	1st LS%	5	1.1200	0.4382	39.12
4.	RINSE WS%	5	13.1800	1.2133	9.21
5.	2nd LS%	5	1.3600	0.5857	43.06
6.	RINSE WS%	5	13.3800	0.5933	4.43
7.	3rd LS%	5	1.6200	1.0918	67.39
8.	RINSE WS%	5	13.6000	0.9354	6.88
9.	4th LS%	5	1.3600	0.8503	62.52
10.	RINSE WS%	5	13.4000	1.3601	10.15

SHRINKAGE IN TUMBLE DRYING : SET 0 : ALL CYCLES



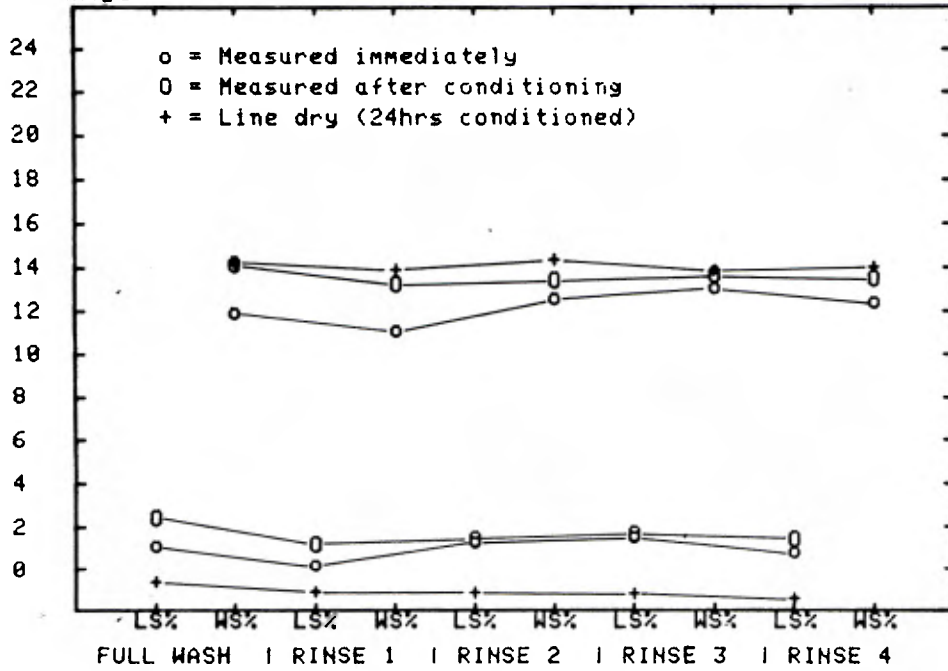
SHRINKAGE IN TUMBLE DRYING : SET 0 : ALL CYCLES



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED

SET 0 Tumble Dry (30+10mins), SET 8 Line Dry

%Shrinkage



SHRINKAGE IN TUMBLE DRYING

SET 0 : 30mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	65.61	58.13	58.68	60.1	63.08
Orig Cond	71.08	62.97	63.57	65.11	68.34
1W+T Wet	118.9	96.84	98.11	101.04	105.58
1W+T Dry	82.45	71.46	67.81	69.2	73.84
1W+T Cond	72.47	64.17	64.66	66.27	69.68
2W+T Wet	108.45	94.78	96.59	97.16	104.55
2W+T Dry	79.32	70.32	73.57	75.06	80.57
2W+T Cond	71.86	63.84	64.51	66.06	69.43
3W+T Wet	106.5	93.72	95.51	96.25	101.6
3W+T Dry	77.38	70.2	71.05	72	77.32
3W+T Cond	72.38	64.03	64.49	66.16	69.59
4W+T Wet	111.86	96.1	98.8	101.36	106.43
4W+T Dry	78.22	69.78	71.95	72.26	72.24
4W+T Cond	71.95	63.56	64.33	65.82	69.31
5W+T Wet	105.67	94.08	97.98	97.86	103.38
5W+T Dry	76.92	67.52	73.75	70.81	76.63
5W+T Cond	72.06	63.63	64.42	66.07	69.33

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	61.1224	3.1618	5.17
2.Orig Cond	5	66.2140	3.4253	5.17
3.1W+T Wet	5	104.0940	8.9328	8.58
4.1W+T Dry	5	72.9520	5.7824	7.93
5.1W+T Cond	5	67.4500	3.5394	5.25
6.2W+T Wet	5	100.3060	5.8860	5.87
7.2W+T Dry	5	75.7680	4.2038	5.55
8.2W+T Cond	5	67.1400	3.4094	5.08
9.3W+T Wet	5	98.7160	5.2495	5.32
10.3W+T Dry	5	73.5900	3.4910	4.74
11.3W+T Cond	5	67.3300	3.5684	5.30
12.4W+T Wet	5	102.9100	6.2882	6.11
13.4W+T Dry	5	72.8900	3.1537	4.33
14.4W+T Cond	5	66.9940	3.5424	5.29
15.5W+T Wet	5	99.7940	4.6655	4.68
16.5W+T Dry	5	73.1260	3.9954	5.46
17.5W+T Cond	5	67.1020	3.5305	5.26

SHRINKAGE IN TUMBLE DRYING

SET 0 : 30mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	44.82	39.98	40.19	40.52	40.25
1W+T Dry	20.42	18.66	13.46	13.15	14.57
1W+T Cond	9.46	9.42	9.25	9.31	9.46
2W+T Wet	39.5	38.67	39.25	38.14	39.66
2W+T Dry	17.28	17.34	20.24	19.93	21.7
2W+T Cond	8.69	8.95	9.03	9.02	9.14
3W+T Wet	38.39	37.98	38.56	37.56	37.91
3W+T Dry	15.21	17.2	17.41	16.52	18.41
3W+T Cond	9.35	9.22	9.01	9.16	9.35
4W+T Wet	41.34	39.51	40.61	40.7	40.73
4W+T Dry	16.12	16.7	18.44	16.82	12.67
4W+T Cond	8.81	8.55	8.78	8.69	8.98
5W+T Wet	37.91	38.21	40.11	38.58	38.98
5W+T Dry	14.7	13.91	20.43	15.12	17.68
5W+T Cond	8.95	8.65	8.91	9.03	9.01

N.B. Moisture Content calculated from sample weights

$$\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6896	0.0004	0.00
3.1W+T Wet	5	41.1487	2.0590	5.00
4.1W+T Dry	5	16.0497	3.2874	20.48
5.1W+T Cond	5	9.3784	0.0982	1.05
6.2W+T Wet	5	39.0432	0.6292	1.61
7.2W+T Dry	5	19.2964	1.9346	10.03
8.2W+T Cond	5	8.9660	0.1678	1.87
9.3W+T Wet	5	38.0781	0.4005	1.05
10.3W+T Dry	5	16.9487	1.1862	7.00
11.3W+T Cond	5	9.2148	0.1436	1.56
12.4W+T Wet	5	40.5782	0.6629	1.63
13.4W+T Dry	5	16.1504	2.1267	13.17
14.4W+T Cond	5	8.7599	0.1602	1.83
15.5W+T Wet	5	38.7579	0.8547	2.21
16.5W+T Dry	5	16.3672	2.6742	16.34
17.5W+T Cond	5	8.9077	0.1539	1.73

A P P E N D I X 2

SET 1 40 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX
A	1.4	19.2	1.8	18.8	2.2	21	4	21	3.8	28
B	1.6	18.8	2.4	20	3	19.6	4.6	21.2	3.2	20.8
C	-0.6	18.4	0.2	20.6	2	18.6	2.4	20.4	2.4	22.8
D	2.2	19.7	1.8	20.3	2.8	21.1	4	20.3	3.4	22.3
E	1.8	17.5	1.4	18.1	2.6	18.7	3.4	19.8	3	22.2

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LSX	5	1.2800	1.0918	85.30
2.	WASH WSX	5	18.7200	0.8349	4.46
3.	1st LSX	5	1.5200	0.8198	53.93
4.	RINSE WSX	5	19.5600	1.0644	5.44
5.	2nd LSX	5	2.5200	0.4147	16.46
6.	RINSE WSX	5	19.8000	1.2062	6.09
7.	3rd LSX	5	3.6800	0.8319	22.61
8.	RINSE WSX	5	20.5400	0.5639	2.75
9.	4th LSX	5	3.1600	0.5177	16.38
10.	RINSE WSX	5	21.6200	1.1713	5.42

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

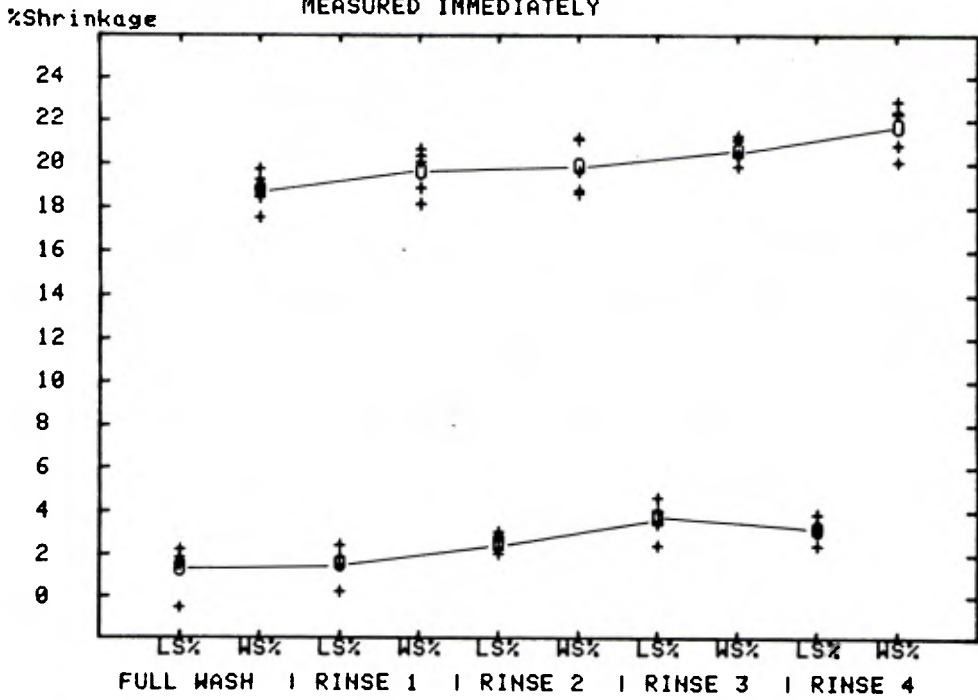
Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX
A	2.2	18.6	1.4	18.6	1.8	18.6	2.8	19.4	2.8	19.4
B	1.6	18.2	1.8	19.6	2.4	19.8	3.2	19.6	3.6	19.6
C	-0.4	18.8	0.4	19.8	1.8	19.8	2	20.2	1.2	21.2
D	2	19.5	1.2	20.1	1.6	19.7	2.6	20.5	2.4	20.9
E	2.4	17.8	1.2	17.9	3	18.3	2.2	18.7	2.2	19.4

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LSX	5	1.5600	1.1349	72.75
2.	WASH WSX	5	18.5800	0.6419	3.45
3.	1st LSX	5	1.2000	0.5099	42.49
4.	RINSE WSX	5	19.2000	0.9192	4.79
5.	2nd LSX	5	2.1200	0.5762	27.18
6.	RINSE WSX	5	19.2400	0.7301	3.79
7.	3rd LSX	5	2.5600	0.4775	18.65
8.	RINSE WSX	5	19.6800	0.7050	3.58
9.	4th LSX	5	2.4400	0.8764	35.92
10.	RINSE WSX	5	20.1000	0.8775	4.37

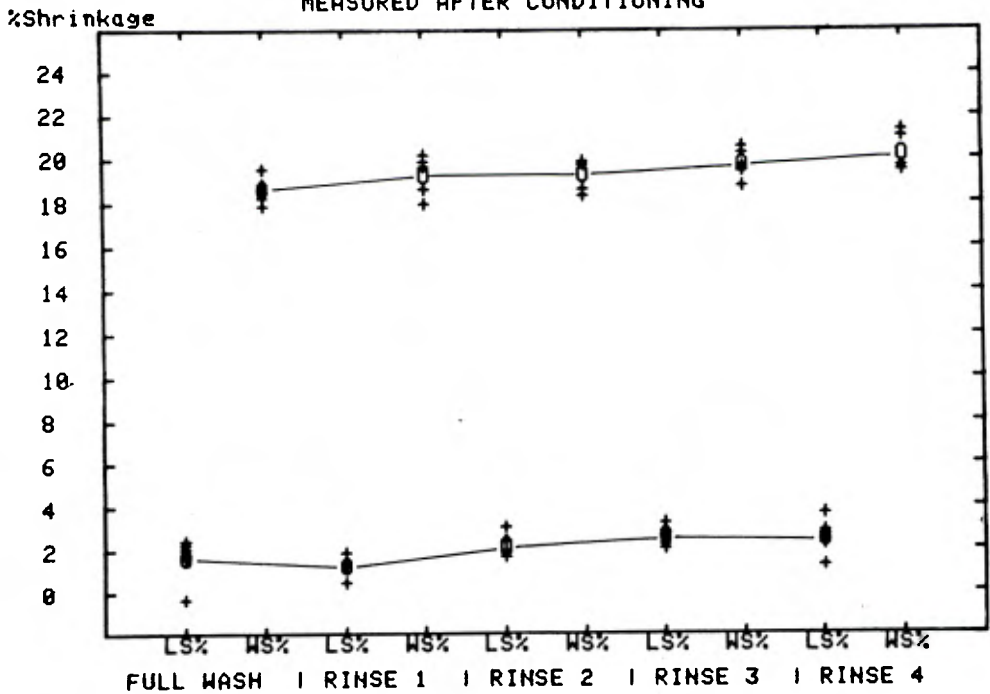
SHRINKAGE IN TUMBLE DRYING : SET 1 : ALL CYCLES

MEASURED IMMEDIATELY



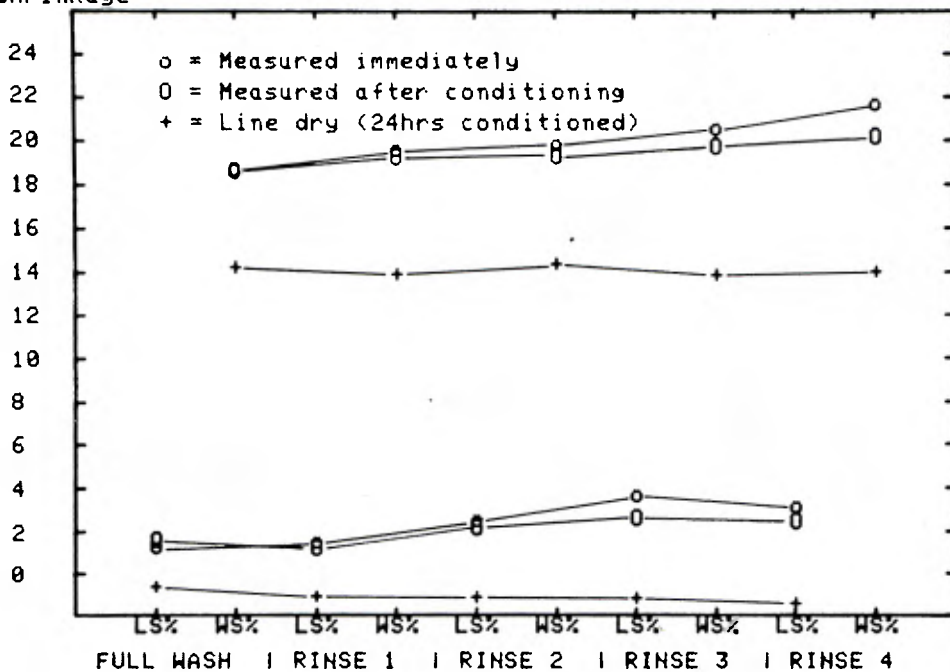
SHRINKAGE IN TUMBLE DRYING : SET 1 : ALL CYCLES

MEASURED AFTER CONDITIONING



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED
 SET 1 Tumble Dry (40+10mins), SET 8 Line Dry

%Shrinkage



SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	45.62	44.2	46.15	45.16	44.19
Orig Cond	49.42	47.88	50	48.92	47.87
1W+T Wet	81.33	75.88	82.11	79.45	76.23
1W+T Dry	51.34	52.09	56.62	50.76	50.72
1W+T Cond	50.42	49.37	51.56	50.3	49.28
2W+T Wet	79.58	75.87	81.02	80.02	78.84
2W+T Dry	51.29	48.44	51.46	48.63	50.93
2W+T Cond	50.73	48.74	51.17	49.5	49.17
3W+T Wet	77.44	73.94	76.37	73.87	71.58
3W+T Dry	48.76	48	49.65	49.89	48.03
3W+T Cond	49.97	48.63	50.71	50.01	48.7
4W+T Wet	76.54	73.81	78.94	78.17	75.78
4W+T Dry	48.06	46.27	48.78	48.33	47.01
4W+T Cond	49.94	48.18	50.51	49.61	48.41
5W+T Wet	80.85	76.09	78.68	78.91	77.48
5W+T Dry	48.69	47.44	48.04	47.3	46.37
5W+T Cond	50.1	48.58	50.4	49.46	48.32

=====

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	45.0640	0.8695	1.93
2.Orig Cond	5	48.8180	0.9419	1.93
3.1W+T Wet	5	79.0000	2.8597	3.62
4.1W+T Dry	5	52.3060	2.4747	4.73
5.1W+T Cond	5	50.1860	0.9277	1.85
6.2W+T Wet	5	79.0660	1.9531	2.47
7.2W+T Dry	5	50.1500	1.4882	2.97
8.2W+T Cond	5	49.8620	1.0408	2.09
9.3W+T Wet	5	74.6400	2.3065	3.09
10.3W+T Dry	5	48.8660	0.8836	1.81
11.3W+T Cond	5	49.6040	0.9066	1.83
12.4W+T Wet	5	76.6480	2.0242	2.64
13.4W+T Dry	5	47.6900	1.0263	2.15
14.4W+T Cond	5	49.3300	1.0015	2.03
15.5W+T Wet	5	78.4020	1.7694	2.26
16.5W+T Dry	5	47.5680	0.8668	1.82
17.5W+T Cond	5	49.3720	0.9122	1.85

-SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	43.91	41.75	43.79	43.16	42.03
1W+T Dry	11.14	15.15	18.48	11.04	12.88
1W+T Cond	9.52	10.48	10.48	10.22	10.33
2W+T Wet	42.67	41.75	43.03	43.57	43.95
2W+T Dry	11.05	8.76	10.31	7.14	13.24
2W+T Cond	10.07	9.32	9.8	8.77	10.13
3W+T Wet	41.09	40.22	39.56	38.87	38.27
3W+T Dry	6.44	7.92	7.04	9.48	8
3W+T Cond	8.71	9.11	8.98	9.7	9.26
4W+T Wet	40.4	40.12	41.53	42.23	41.69
4W+T Dry	5.08	4.48	5.38	6.56	6
4W+T Cond	8.65	8.26	8.62	8.97	8.72
5W+T Wet	43.57	41.91	41.34	42.77	42.97
5W+T Dry	6.31	6.83	3.92	4.53	4.7
5W+T Cond	8.94	9.02	8.42	8.7	8.55

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N.B. Moisture Content calculated from sample weights

$$\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6898	0.0004	0.01
3.1W+T Wet	5	42.9286	0.9924	2.31
4.1W+T Dry	5	13.7376	3.1342	22.81
5.1W+T Cond	5	10.2065	0.3987	3.91
6.2W+T Wet	5	42.9939	0.8526	1.98
7.2W+T Dry	5	10.0993	2.3106	22.88
8.2W+T Cond	5	9.6189	0.5719	5.95
9.3W+T Wet	5	39.6026	1.1096	2.80
10.3W+T Dry	5	7.7764	1.1531	14.83
11.3W+T Cond	5	9.1533	0.3690	4.03
12.4W+T Wet	5	41.1934	0.8977	2.18
13.4W+T Dry	5	5.5001	0.8091	14.71
14.4W+T Cond	5	8.6461	0.2544	2.94
15.5W+T Wet	5	42.5133	0.8860	2.08
16.5W+T Dry	5	5.2590	1.2450	23.67
17.5W+T Cond	5	8.7264	0.2536	2.91

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

EXHAUST TEMPERATURE DURING TUMBLE DRYING, Degrees C

Time Interval	1st Wash	1st Rinse	2nd Rinse	3rd Rinse	4th Rinse
0mins	30	30	30.4	30.6	30.2
10mins	38.6	38.8	39.1	38.9	36.6
20mins	39.1	39.8	39.7	39.3	38.5
30mins	39.8	41	49.1	39.9	40.5
40mins	40.5	42	44.5	45.6	48.4
Cool Down					
50mins	22.6	27	26.3	24.6	28.3

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1. 0mins	5	30.2400	0.2608	0.86
2. 10mins	5	38.4000	1.0223	2.66
3. 20mins	5	39.2800	0.5215	1.33
4. 30mins	5	42.0600	3.9652	9.43
5. 40mins	5	44.2000	3.0911	6.99
6. 50mins	5	25.7600	2.2143	8.60

A P P E N D I X 3

SET 2 50 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	4.1	16.3	4.3	17.7	5.5	19.2	5.5	19.2	5.9	18.6
B	3.4	17.3	5	18.5	6.2	18.9	6.2	18.9	3.6	18.7
C	2	17.8	3.2	19.3	4	18.7	4	18.7	4.4	19.1
D	3.2	17.9	4.6	18.9	5.4	18.9	5.4	18.9	5.4	18.9
E	2.4	16.3	3.2	18.4	4	17.2	4	17.2	4.4	16.7

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	3.0200	0.8319	27.55
2.	WASH WS%	5	17.1200	0.7823	4.57
3.	1st LS%	5	4.0600	0.8234	20.28
4.	RINSE WS%	5	18.5600	0.5983	3.22
5.	2nd LS%	5	5.0200	0.9808	19.54
6.	RINSE WS%	5	18.5800	0.7918	4.26
7.	3rd LS%	5	5.0200	0.9808	19.54
8.	RINSE WS%	5	18.5800	0.7918	4.26
9.	4th LS%	5	4.7400	0.9899	19.20
10.	RINSE WS%	5	18.4000	0.9695	5.27

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

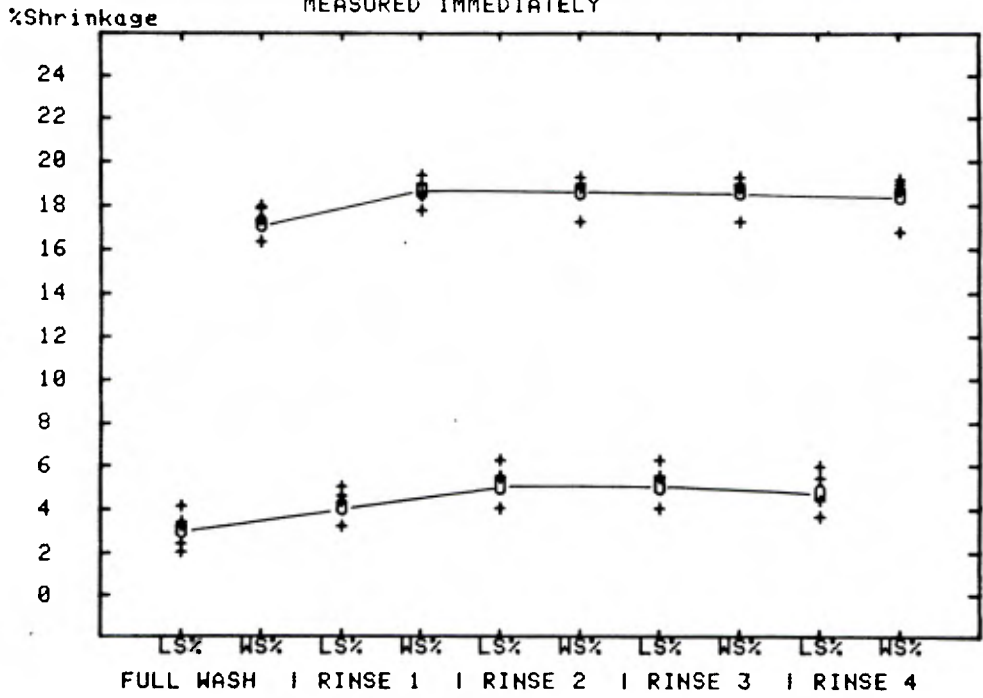
Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	3.8	16.7	3	16.7	4.3	16.9	4.7	17.1	4.3	16.9
B	2.6	16.8	3.6	16.6	3.8	17.5	4	17.7	3.2	17.5
C	1.2	18	2	17.4	2.6	18.2	2.2	19.3	3	17.8
D	3.2	17	3.2	17.3	3.4	18.1	3.8	18.9	3.8	17.9
E	2.2	16.3	2.2	16.1	3	16.3	3.4	16.5	3.6	16.5

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	2.6000	0.9899	38.07
2.	WASH WS%	5	16.9600	0.6348	3.74
3.	1st LS%	5	2.8000	0.6782	24.22
4.	RINSE WS%	5	16.8200	0.5357	3.19
5.	2nd LS%	5	3.4200	0.6648	19.44
6.	RINSE WS%	5	17.4000	0.8862	4.63
7.	3rd LS%	5	3.6200	0.9238	25.50
8.	RINSE WS%	5	17.9000	1.1832	6.61
9.	4th LS%	5	3.5800	0.5119	14.38
10.	RINSE WS%	5	17.3200	0.6017	3.47

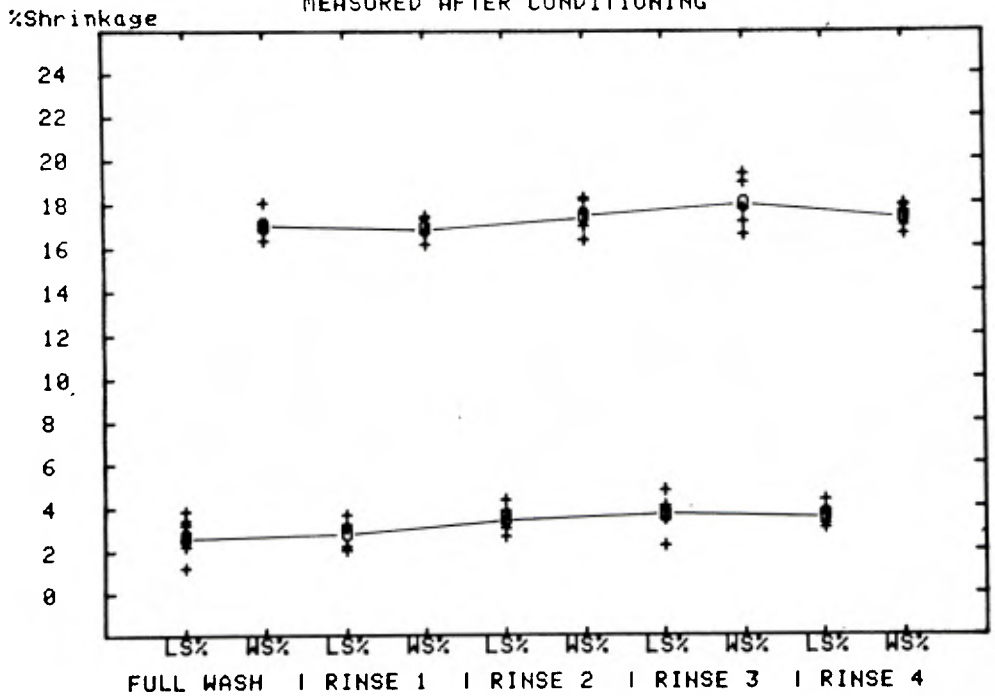
SHRINKAGE IN TUMBLE DRYING : SET 2 : ALL CYCLES

MEASURED IMMEDIATELY



SHRINKAGE IN TUMBLE DRYING : SET 2 : ALL CYCLES

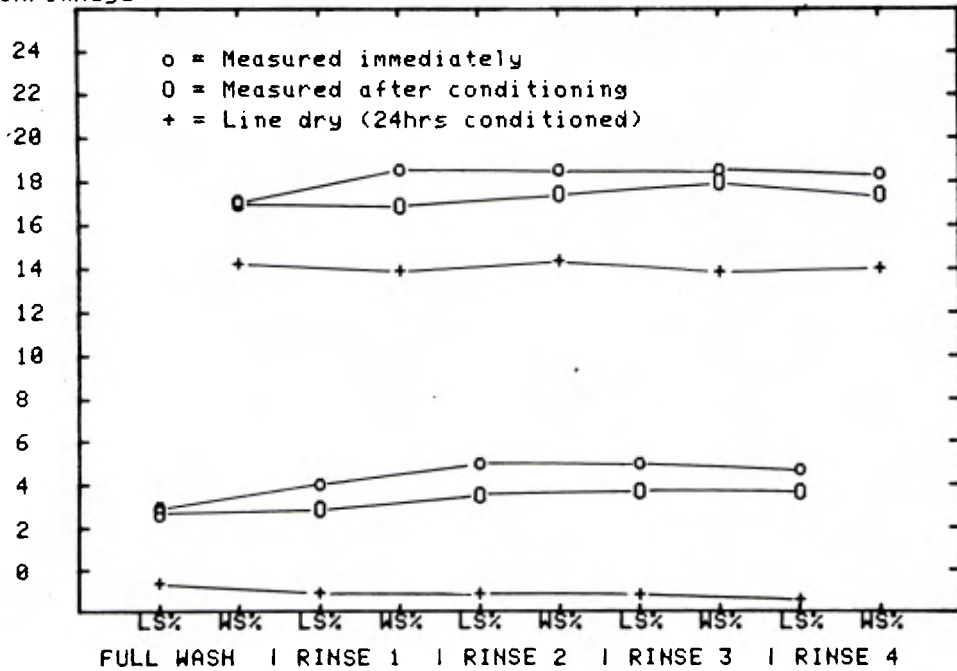
MEASURED AFTER CONDITIONING



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED

SET 2 Tumble Dry (50+10mins), SET 8 Line Dry

%Shrinkage



SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	47.24	49.43	51.12	50.23	51.7
Orig Cond	51.18	53.55	55.38	54.42	56.01
1W+T Wet	84.49	84.15	87.81	87.78	90.23
1W+T Dry	51.71	53.32	56.63	54.31	56.41
1W+T Cond	51.74	53.96	56.2	54.78	56.56
2W+T Wet	81.07	83.25	86.34	85.01	89.59
2W+T Dry	48.48	50.5	52.15	51.38	52.8
2W+T Cond	51.27	53.57	55.44	54.47	56.12
3W+T Wet	81.66	81.39	82.35	80.23	83.97
3W+T Dry	47.58	49.79	51.48	50.48	51.93
3W+T Cond	51.05	53.43	55.17	54.22	55.81
4W+T Wet	79.63	80.55	81.37	80.15	85.33
4W+T Dry	47.58	49.61	51.35	50.47	51.77
4W+T Cond	51.09	53.44	55.2	54.3	55.88
5W+T Wet	78.42	82.48	85.16	80.85	86.07
5W+T Dry	49.01	52.03	53.09	51.53	53.31
5W+T Cond	51.29	53.74	55.5	54.32	55.96

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	49.9468	1.7402	3.48
2.Orig Cond	5	54.1080	1.8853	3.48
3.1W+T Wet	5	86.8920	2.5525	2.94
4.1W+T Dry	5	54.4760	2.0853	3.83
5.1W+T Cond	5	54.6480	1.9372	3.54
6.2W+T Wet	5	85.0520	3.2155	3.78
7.2W+T Dry	5	51.0620	1.6799	3.29
8.2W+T Cond	5	54.1740	1.8891	3.49
9.3W+T Wet	5	81.9200	1.3777	1.68
10.3W+T Dry	5	50.2520	1.7124	3.41
11.3W+T Cond	5	53.9360	1.8507	3.43
12.4W+T Wet	5	81.4060	2.2838	2.81
13.4W+T Dry	5	50.1560	1.6631	3.32
14.4W+T Cond	5	53.9820	1.8604	3.45
15.5W+T Wet	5	82.5960	3.1282	3.79
16.5W+T Dry	5	51.7940	1.7215	3.32
17.5W+T Cond	5	54.1620	1.8354	3.39

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	44.08	41.26	41.78	42.77	42.7
1W+T Dry	8.64	7.29	9.73	7.5	8.34
1W+T Cond	8.69	8.39	9.04	8.3	8.59
2W+T Wet	41.72	40.62	40.79	40.91	42.29
2W+T Dry	2.55	2.11	1.98	2.23	2.08
2W+T Cond	7.85	7.72	7.79	7.77	7.87
3W+T Wet	42.15	39.27	37.92	37.39	38.43
3W+T Dry	0.71	0.72	0.7	0.49	0.44
3W+T Cond	7.46	7.48	7.34	7.35	7.36
4W+T Wet	40.67	38.63	37.18	37.32	39.41
4W+T Dry	0.71	0.36	0.45	0.47	0.13
4W+T Cond	7.53	7.5	7.39	7.49	7.47
5W+T Wet	39.76	40.07	39.97	37.87	39.93
5W+T Dry	3.6	4.99	3.71	2.51	3.01
5W+T Cond	7.89	8.02	7.89	7.52	7.61

N.B. Moisture Content calculated from sample weights

$$\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6905	0.0010	0.01
3.1W+T Wet	5	42.5189	1.0812	2.54
4.1W+T Dry	5	8.3012	0.9761	11.76
5.1W+T Cond	5	8.6009	0.2900	3.37
6.2W+T Wet	5	41.2670	0.7115	1.72
7.2W+T Dry	5	2.1891	0.2209	10.09
8.2W+T Cond	5	7.8030	0.0594	0.76
9.3W+T Wet	5	39.0295	1.8743	4.80
10.3W+T Dry	5	0.6094	0.1365	22.40
11.3W+T Cond	5	7.3975	0.0663	0.90
12.4W+T Wet	5	38.6421	1.4654	3.79
13.4W+T Dry	5	0.4216	0.2079	49.32
14.4W+T Cond	5	7.4761	0.0513	0.69
15.5W+T Wet	5	39.5181	0.9302	2.35
16.5W+T Dry	5	3.5670	0.9317	26.12
17.5W+T Cond	5	7.7848	0.2106	2.70

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

EXHAUST TEMPERATURE DURING TUMBLE DRYING, Degrees C

Time Interval	1st Wash	1st Rinse	2nd Rinse	3rd Rinse	4th Rinse
0mins	30.8	30.1	30.5	30.5	30.2
10mins	40.4	39.5	37.2	37.7	39.2
20mins	41.8	40	37.5	38.6	40.3
30mins	41.5	40.8	40.5	42.2	40.4
40mins	42.4	43.4	45	52.1	41.8
50mins	43.4	53.4	65.4	71.5	49.1
Cool Down					
60mins	26.3	34.5	35.3	37.6	30.4

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1. 0mins	5	30.4200	0.2775	0.91
2. 10mins	5	38.8000	1.3210	3.40
3. 20mins	5	39.6400	1.6502	4.16
4. 30mins	5	41.0800	0.7596	1.85
5. 40mins	5	44.9400	4.1819	9.31
6. 50mins	5	56.5600	11.6208	20.55
7. 60mins	5	32.8200	4.4774	13.64

A P P E N D I X 4

SET 3 60 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	3.8	19.6	9	20.8	4.8	21.2	4.8	22.4	5.6	21.2
B	4.2	21.3	3.4	21.9	3.8	21.7	5.6	21.7	6	23.3
C	4	21	4.6	20	5.8	20.8	6	22.2	6	21
D	3.2	22.9	3.8	20.9	3.8	20.7	5.2	20.5	5.6	21.3
E	3.8	20	4.6	21.6	5.4	20.2	5.8	20.4	5	21.8

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	3.8000	0.3742	9.85
2.	WASH WS%	5	20.9600	1.2896	6.15
3.	1st LS%	5	5.0000	2.2521	44.33
4.	RINSE WS%	5	21.0400	0.7436	3.53
5.	2nd LS%	5	4.7200	0.9121	19.33
6.	RINSE WS%	5	20.9200	0.5630	2.69
7.	3rd LS%	5	5.4000	0.4817	8.79
8.	RINSE WS%	5	21.4400	0.9397	4.38
9.	4th LS%	5	5.6400	0.4099	7.27
10.	RINSE WS%	5	21.7200	0.9311	4.29

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

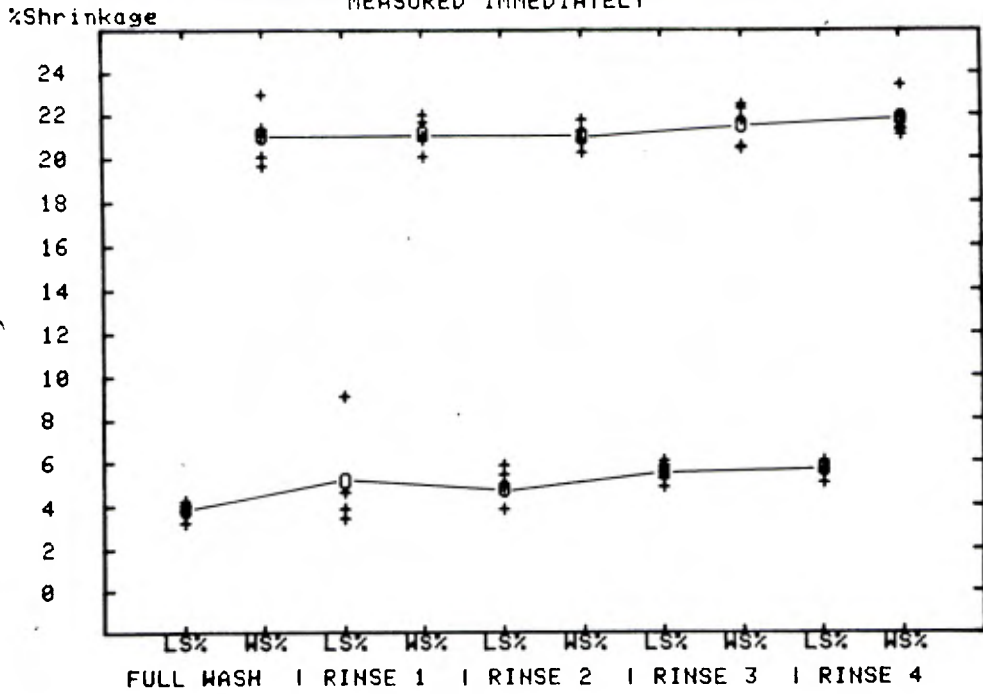
Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	3	18.2	3.6	19	4	19.6	3.6	19.4	4.6	19.2
B	3	19.5	2.8	20.7	3.2	19.5	3.8	19.9	3.8	20.7
C	3.6	20	3.4	18.8	4.2	19	4.8	19.4	4.6	19
D	2.8	20.1	3	19.3	3.4	19.5	4	19.1	4.2	19.9
E	3	18.8	3.2	19.4	3.6	19.6	3.8	18.8	4.2	20.2

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	3.0000	0.3033	9.85
2.	WASH WS%	5	19.3200	0.8106	4.20
3.	1st LS%	5	3.2000	0.3162	9.80
4.	RINSE WS%	5	19.4400	0.7436	3.83
5.	2nd LS%	5	3.6000	0.4147	11.27
6.	RINSE WS%	5	19.4400	0.2510	1.29
7.	3rd LS%	5	4.0000	0.4690	11.73
8.	RINSE WS%	5	19.3200	0.4087	2.12
9.	4th LS%	5	4.2000	0.3347	7.82
10.	RINSE WS%	5	19.8000	0.7036	3.55

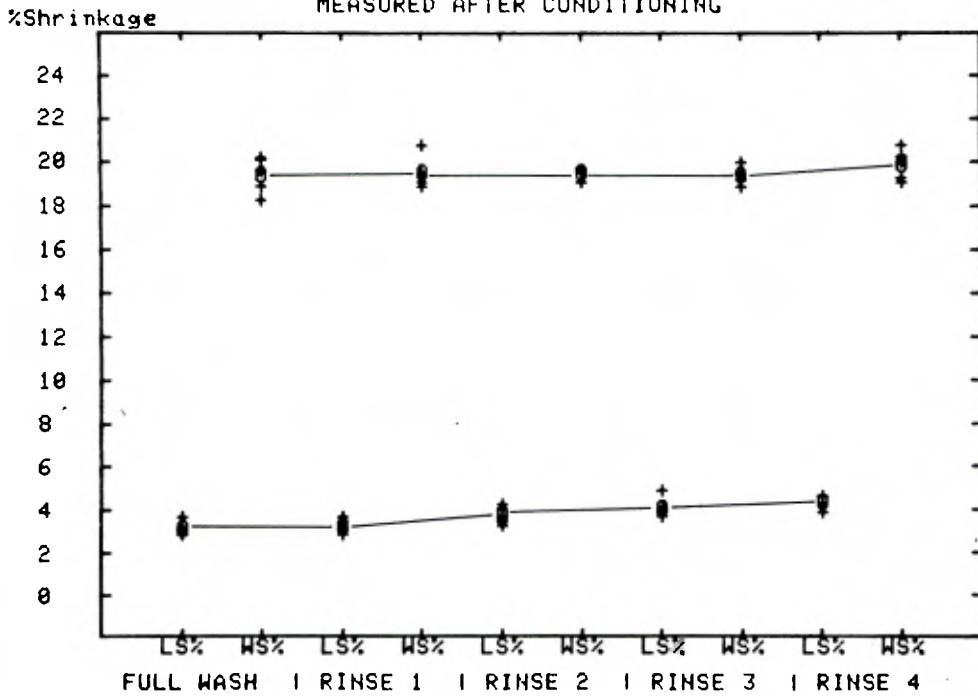
SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

MEASURED IMMEDIATELY



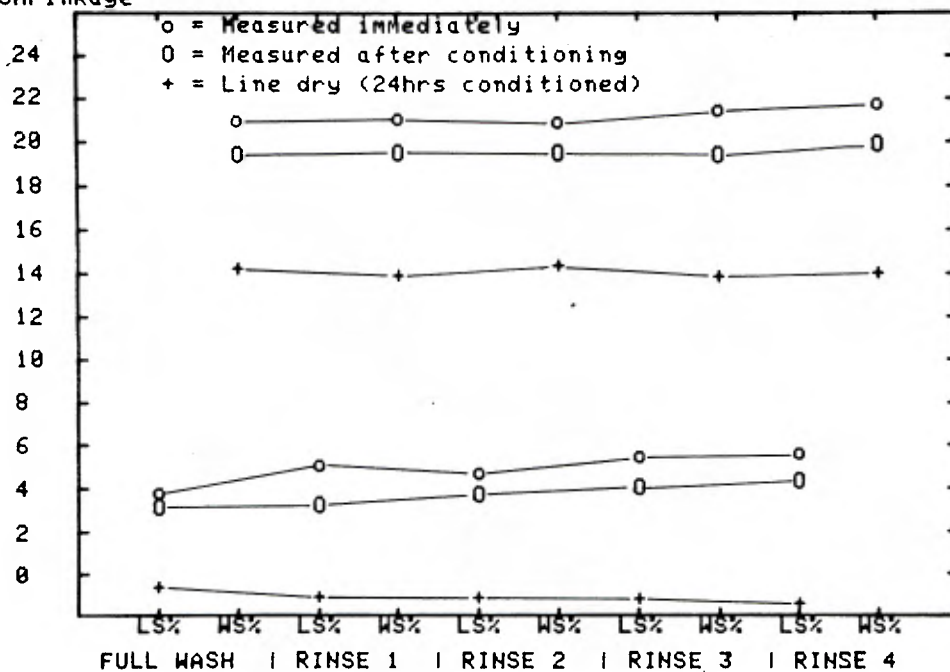
SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

MEASURED AFTER CONDITIONING



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED
 SET 3 Tumble Dry (60+10mins), SET 8 Line Dry

%Shrinkage



SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	50.9	49.42	50.23	49.21	48.19
Orig Cond	55.14	53.54	54.42	53.31	52.2
1W+T Wet	88.84	85.15	85.32	86.57	82.97
1W+T Dry	52.1	50.67	51.24	50.09	49.47
1W+T Cond	55.14	53.63	54.5	53.34	52.33
2W+T Wet	86.07	80.64	85.19	83.2	81.9
2W+T Dry	51.18	49.76	50.61	49.52	48.44
2W+T Cond	55.02	53.44	54.34	53.12	52.11
3W+T Wet	81.28	79.15	80.29	81.95	78.75
3W+T Dry	51.22	49.66	50.57	49.61	48.47
3W+T Cond	55.02	53.43	54.24	53.22	52.05
4W+T Wet	87.35	81.64	81.08	83.67	80.92
4W+T Dry	50.72	49.59	50.32	49.33	48.28
4W+T Cond	54.97	53.4	54.26	53.17	52.03
5W+T Wet	83.21	79.74	82.63	79.52	78.98
5W+T Dry	50.92	49.41	50.15	49.14	48.42
5W+T Cond	54.82	53.23	54.11	52.99	51.91

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	49.5908	1.0339	2.08
2.Orig Cond	5	53.7220	1.1200	2.08
3.1W+T Wet	5	85.7700	2.1501	2.51
4.1W+T Dry	5	50.7140	1.0169	2.01
5.1W+T Cond	5	53.7880	1.0824	2.01
6.2W+T Wet	5	83.4000	2.2495	2.70
7.2W+T Dry	5	49.9020	1.0533	2.11
8.2W+T Cond	5	53.6060	1.1225	2.09
9.3W+T Wet	5	80.2840	1.3608	1.69
10.3W+T Dry	5	49.9060	1.0462	2.10
11.3W+T Cond	5	53.5920	1.1182	2.09
12.4W+T Wet	5	82.9320	2.7023	3.26
13.4W+T Dry	5	49.6480	0.9456	1.90
14.4W+T Cond	5	53.5660	1.1176	2.09
15.5W+T Wet	5	80.8160	1.9513	2.41
16.5W+T Dry	5	49.6080	0.9598	1.93
17.5W+T Cond	5	53.4120	1.1110	2.08

-SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	42.71	41.96	41.12	43.16	41.92
1W+T Dry	2.3	2.46	1.96	1.76	2.6
1W+T Cond	7.69	7.84	7.83	7.74	7.92
2W+T Wet	40.86	38.71	41.03	40.85	41.16
2W+T Dry	0.55	0.68	0.74	0.63	0.52
2W+T Cond	7.49	7.52	7.55	7.36	7.53
3W+T Wet	37.38	37.56	37.43	39.95	38.81
3W+T Dry	0.62	0.48	0.66	0.81	0.59
3W+T Cond	7.49	7.5	7.38	7.53	7.42
4W+T Wet	41.73	39.46	38.04	41.19	40.45
4W+T Dry	-0.35	0.34	0.17	0.24	0.19
4W+T Cond	7.4	7.45	7.42	7.45	7.39
5W+T Wet	38.83	38.02	39.2	38.12	38.99
5W+T Dry	0.04	-0.03	-0.17	-0.14	0.48
5W+T Cond	7.15	7.15	7.16	7.13	7.17

N.B. Moisture Content calculated from sample weights

$$\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6900	0.0006	0.01
3.1W+T Wet	5	42.1730	0.7848	1.86
4.1W+T Dry	5	2.2156	0.3491	15.75
5.1W+T Cond	5	7.8043	0.0897	1.15
6.2W+T Wet	5	40.5247	1.0218	2.52
7.2W+T Dry	5	0.6231	0.0899	14.43
8.2W+T Cond	5	7.4900	0.0761	1.02
9.3W+T Wet	5	38.2261	1.1308	2.96
10.3W+T Dry	5	0.6313	0.1198	18.98
11.3W+T Cond	5	7.4660	0.0610	0.82
12.4W+T Wet	5	40.1743	1.4635	3.64
13.4W+T Dry	5	0.1177	0.2719	230.89
14.4W+T Cond	5	7.4211	0.0265	0.36
15.5W+T Wet	5	38.6320	0.5329	1.38
16.5W+T Dry	5	0.0369	0.2636	715.25
17.5W+T Cond	5	7.1543	0.0149	0.21

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

EXHAUST TEMPERATURE DURING TUMBLE DRYING, Degrees C

Time Interval	1st Wash	1st Rinse	2nd Rinse	3rd Rinse	4th Rinse
0mins	30.1	30.7	30.6	30.2	30.3
10mins	39.6	38.2	37.9	38.9	35.3
20mins	39.9	39.2	40.2	39	36.2
30mins	39.6	40.2	40.5	41	37.5
40mins	40.3	42.3	43.8	46.3	42.2
50mins	42.8	53.6	54.5	67.3	58
60mins	55.3	68.7	74.3	72.3	68.8
Cool Down					
70mins	31.7	35.7	37.6	38.4	30.4

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1. 0mins	5	30.3800	0.2588	0.85
2. 10mins	5	37.9800	1.6362	4.31
3. 20mins	5	38.9000	1.5875	4.08
4. 30mins	5	39.7600	1.3612	3.42
5. 40mins	5	42.9800	2.2332	5.20
6. 50mins	5	55.2400	8.8183	15.96
7. 60mins	5	67.8800	7.4251	10.94
8. 70mins	5	34.7600	3.5557	10.23

A P P E N D I X 5

SET 5 80 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX
A	4	19	4.8	19.6	4.6	18.8	5.6	20.4	5.6	19.6
B	4.2	19.4	3.6	20.9	5	19.2	5.8	19.4	6	20
C	4	20.5	3.2	20.1	4	20.1	5.2	20.7	5.8	20.7
D	4.2	20	5	19.6	5.6	18.8	7	19.8	6.4	19.8
E	3.8	19.2	4.4	19	5.2	17.4	6.6	20.2	6.6	18.8

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LSX	5	4.0400	0.1673	4.14
2.	WASH WSX	5	19.6200	0.6181	3.15
3.	1st LSX	5	4.2000	0.7746	18.44
4.	RINSE WSX	5	19.8400	0.7892	3.57
5.	2nd LSX	5	4.8000	0.6899	12.50
6.	RINSE WSX	5	18.8600	0.9737	5.16
7.	3rd LSX	5	6.0400	0.7403	12.26
8.	RINSE WSX	5	20.1000	0.5899	2.54
9.	4th LSX	5	6.8000	0.4147	6.02
10.	RINSE WSX	5	19.7800	0.6878	3.47

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

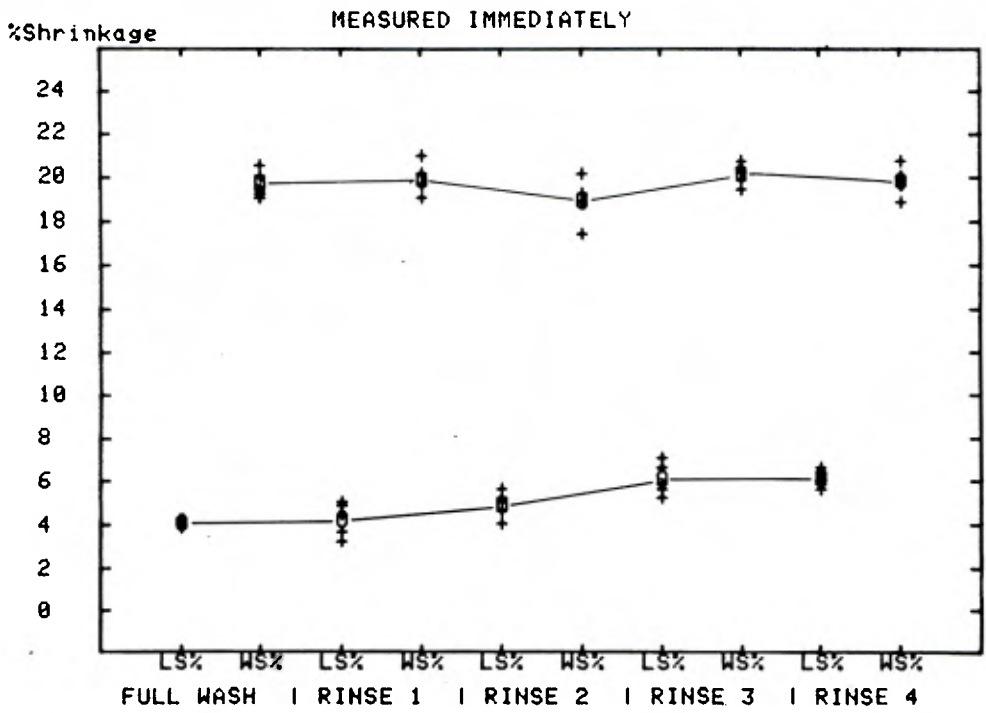
SHRINKAGE MEASURED AFTER CONDITIONING

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX	LSX	WSX
A	3.2	18.2	3.6	18.8	4	17.3	4	18.4	3.6	18.2
B	3.6	18.6	2.8	18.6	4.2	18	5	18.4	4.4	18
C	2.4	18.9	2.2	18.7	3.4	18.9	3.4	18.5	4.4	18.9
D	3.4	18.2	3.8	18	4.6	18.4	4.8	17.8	5	18.6
E	3.4	17.8	3.6	17.8	4.2	17.2	5.6	17.6	5.8	17.8

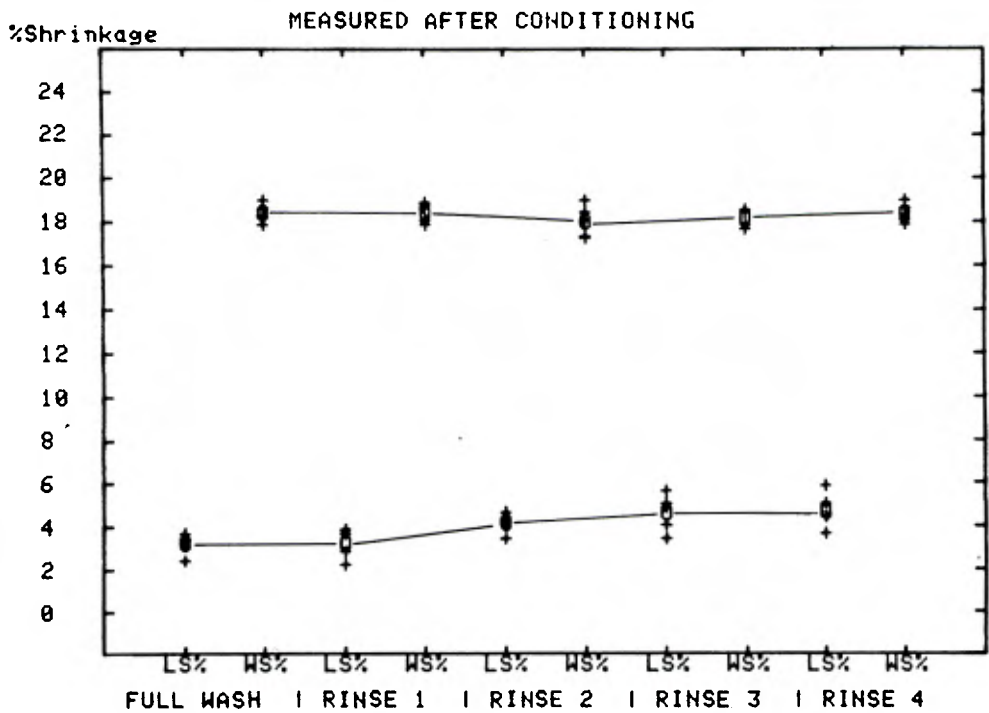
*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LSX	5	3.2000	0.4698	14.66
2.	WASH WSX	5	18.3400	0.4219	2.30
3.	1st LSX	5	3.2000	0.6782	21.19
4.	RINSE WSX	5	18.3800	0.4494	2.45
5.	2nd LSX	5	4.0800	0.4382	10.74
6.	RINSE WSX	5	17.9600	0.7232	4.03
7.	3rd LSX	5	4.5600	0.8649	18.97
8.	RINSE WSX	5	18.1400	0.4899	2.26
9.	4th LSX	5	4.6400	0.8173	17.61
10.	RINSE WSX	5	18.3000	0.4472	2.44

SHRINKAGE IN TUMBLE DRYING : SET 5 : ALL CYCLES



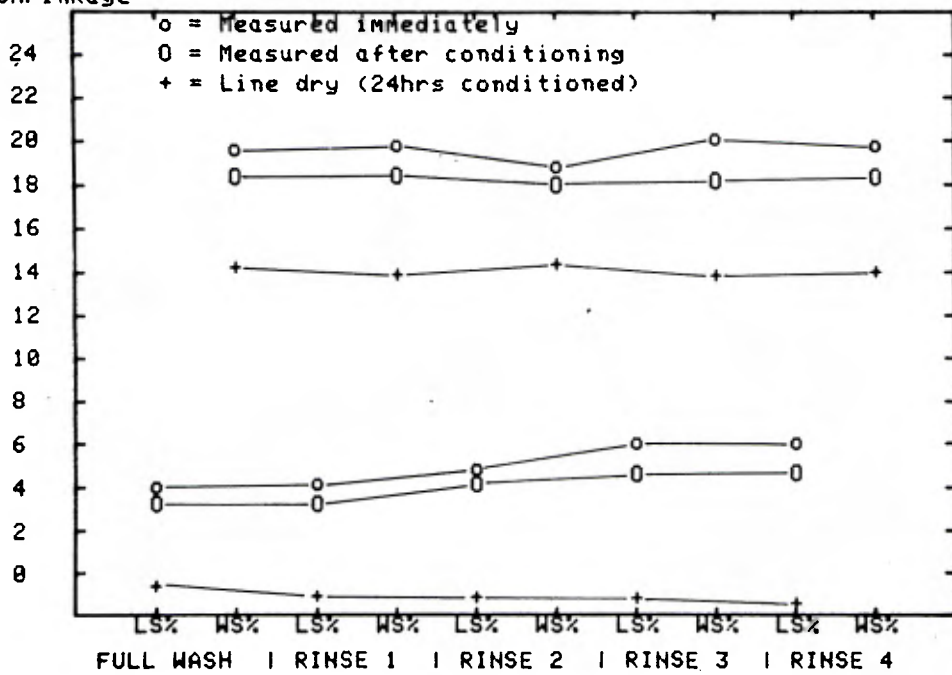
SHRINKAGE IN TUMBLE DRYING : SET 5 : ALL CYCLES



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED

SET 5 Tumble Dry (80+10mins), SET 8 Line Dry

%Shrinkage



-SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	48.14	49.83	51.54	50.3	51.64
Orig Cond	52.15	53.98	55.83	54.49	55.94
1W+T Wet	83.55	85.12	90.11	88.03	87.01
1W+T Dry	48.58	50.21	51.81	50.6	51.96
1W+T Cond	51.96	53.8	55.67	54.28	55.79
2W+T Wet	79.38	82.37	84.51	82.1	84.37
2W+T Dry	48.44	49.97	51.98	50.73	51.92
2W+T Cond	52.02	53.78	55.6	54.35	55.79
3W+T Wet	77.36	78.11	81.52	80.16	81.81
3W+T Dry	48.24	49.96	51.83	50.56	52.12
3W+T Cond	51.91	53.8	55.62	54.3	55.78
4W+T Wet	75.7	78.72	82.85	79.32	82.18
4W+T Dry	47.95	49.66	51.27	50.04	51.45
4W+T Cond	51.74	53.6	55.38	54.08	55.56
5W+T Wet	80.3	79.55	82.07	82.99	88.47
5W+T Dry	48.36	49.94	51.46	50.24	51.66
5W+T Cond	51.82	53.68	55.43	54.2	55.66

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N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	50.2888	1.4324	2.85
2.Orig Cond	5	54.4780	1.5519	2.85
3.1W+T Wet	5	86.7640	2.5442	2.93
4.1W+T Dry	5	50.6320	1.3731	2.71
5.1W+T Cond	5	54.3000	1.5671	2.89
6.2W+T Wet	5	82.5460	2.0879	2.53
7.2W+T Dry	5	50.6080	1.4770	2.92
8.2W+T Cond	5	54.3080	1.5314	2.82
9.3W+T Wet	5	79.7920	1.9961	2.50
10.3W+T Dry	5	50.5420	1.5642	3.09
11.3W+T Cond	5	54.2820	1.5727	2.90
12.4W+T Wet	5	79.7540	2.8794	3.61
13.4W+T Dry	5	50.0740	1.4149	2.83
14.4W+T Cond	5	54.0720	1.5481	2.86
15.5W+T Wet	5	82.6760	3.5162	4.25
16.5W+T Dry	5	50.3320	1.3311	2.64
17.5W+T Cond	5	54.1580	1.5468	2.86

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	42.38	41.46	42.81	42.86	40.65
1W+T Dry	0.91	0.76	0.53	0.59	0.62
1W+T Cond	7.35	7.38	7.42	7.33	7.44
2W+T Wet	39.36	39.51	39.02	38.73	38.8
2W+T Dry	0.62	0.28	0.85	0.85	0.54
2W+T Cond	7.46	7.35	7.31	7.45	7.44
3W+T Wet	37.77	36.21	36.78	37.25	36.88
3W+T Dry	0.21	0.26	0.57	0.51	0.92
3W+T Cond	7.26	7.38	7.34	7.37	7.43
4W+T Wet	36.41	36.7	37.79	36.59	37.16
4W+T Dry	-0.4	-0.34	-0.52	-0.52	-0.37
4W+T Cond	6.96	7.04	6.94	6.99	7.06
5W+T Wet	40.05	37.36	37.2	39.39	41.63
5W+T Dry	0.45	0.22	-0.15	-0.12	0.04
5W+T Cond	7.1	7.17	7.02	7.2	7.23

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N.B. Moisture Content calculated from sample weights

$$\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6897	0.0004	0.01
3.1W+T Wet	5	42.0324	0.9536	2.27
4.1W+T Dry	5	0.6808	0.1515	22.25
5.1W+T Cond	5	7.3863	0.0466	0.63
6.2W+T Wet	5	39.0813	0.3399	0.87
7.2W+T Dry	5	0.6289	0.2374	37.74
8.2W+T Cond	5	7.4013	0.0694	0.94
9.3W+T Wet	5	36.9778	0.5804	1.57
10.3W+T Dry	5	0.4948	0.2859	57.79
11.3W+T Cond	5	7.3553	0.0603	0.82
12.4W+T Wet	5	36.9307	0.5585	1.51
13.4W+T Dry	5	-0.4285	0.0860	20.08
14.4W+T Cond	5	6.9963	0.0506	0.72
15.5W+T Wet	5	39.1275	1.8717	4.78
16.5W+T Dry	5	0.0901	0.2521	279.65
17.5W+T Cond	5	7.1441	0.0816	1.14

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

EXHAUST TEMPERATURE DURING TUMBLE DRYING, Degrees C

Time Interval	1st Wash	1st Rinse	2nd Rinse	3rd Rinse	4th Rinse
0mins	30.0	30.4	30.3	30.1	29.6
10mins	39.3	39.5	38.2	36.6	38.5
20mins	39.8	40.2	40	37.8	40.2
30mins	39.5	41.1	43	38.4	40.1
40mins	40.7	46.8	53.9	41.4	42.2
50mins	46.5	66.7	74.7	50.5	58.2
60mins	58.9	59.5	65.6	71.2	71
70mins	71.4	64	57.2	74.2	70.1
80mins	70.3	64	66.9	73.4	71.8
Cool Down					
90mins	36.2	36.8	35.7	30.4	37.8

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1. 0mins	5	30.2400	0.4393	1.45
2. 10mins	5	38.4200	1.1520	3.00
3. 20mins	5	39.6000	1.0198	2.58
4. 30mins	5	40.4200	1.7427	4.31
5. 40mins	5	45.0000	5.5168	12.26
6. 50mins	5	59.3200	11.5586	19.49
7. 60mins	5	65.2400	5.9576	9.13
8. 70mins	5	67.3800	6.8031	10.10
9. 80mins	5	69.2000	3.8049	5.49
10. 90mins	5	35.3800	2.8917	8.17

A P P E N D I X 6

SET 7 100 MINS HOT TUMBLE + 10 MINS COOL DOWN

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	4	20.4	3.8	19.4	4.2	19.2	4.4	20.8	5.8	18.2
B	4.2	22	5	21.8	4.4	20.2	5.4	20.2	6.8	20
C	4.8	21.7	4.8	19.7	6.2	20.3	6	19.9	6.8	19.9
D	5.2	21.2	4.8	21.2	5	20.2	5.2	21	6.6	20.2
E	3.8	21.7	4.2	20.7	4	20.9	5.6	19.7	6.4	20.7

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	4.4000	0.5031	13.25
2.	WASH WS%	5	21.4000	0.6285	2.94
3.	1st LS%	5	4.5200	0.5020	11.11
4.	RINSE WS%	5	20.5600	1.0065	4.90
5.	2nd LS%	5	4.7600	0.8077	18.65
6.	RINSE WS%	5	20.1600	0.6187	3.03
7.	3rd LS%	5	5.3200	0.5933	11.15
8.	RINSE WS%	5	20.3200	0.5630	2.77
9.	4th LS%	5	6.4000	0.4147	6.40
10.	RINSE WS%	5	19.8000	0.9460	4.78

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

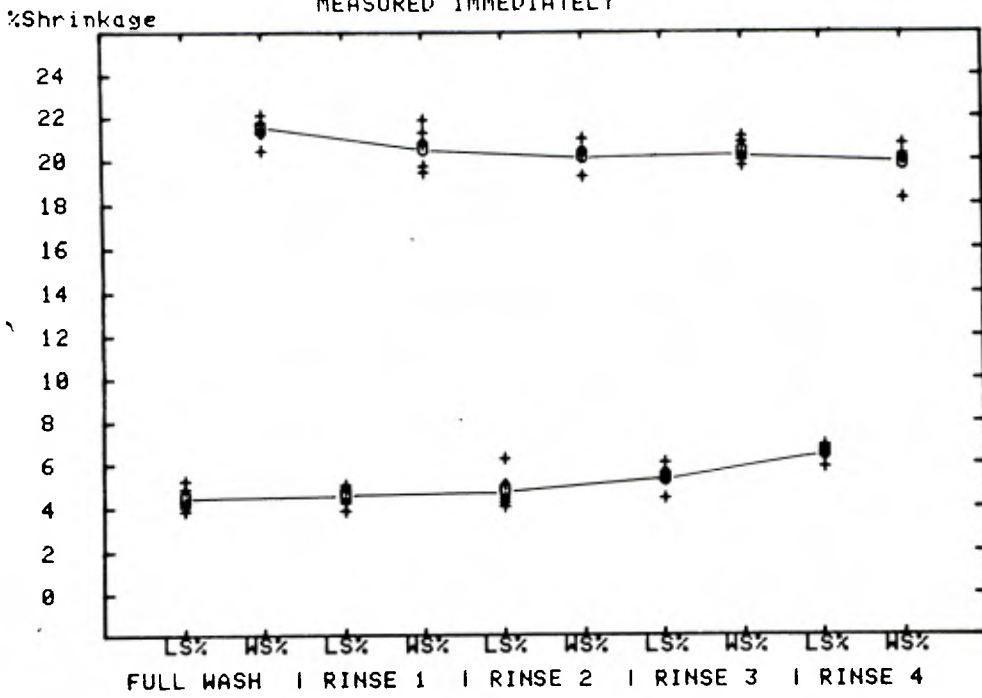
Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	2.6	18	2.6	17.6	3.6	16.8	3	18.6	3.4	18
B	2.8	19.4	3	20.6	3.4	18.6	4.6	19.2	4.2	18.8
C	3.6	19.9	4.2	19.1	5.2	18.7	4.8	18.9	3.6	19.1
D	3.6	19	3.6	19.2	3.6	18.8	4	19.6	5.2	18.6
E	2.4	19.3	3	19.3	3.8	20.1	4.4	18.9	5.4	17.5

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	3.0000	0.5657	18.86
2.	WASH WS%	5	19.1200	0.7050	3.69
3.	1st LS%	5	3.2800	0.6261	19.09
4.	RINSE WS%	5	19.1600	1.0644	5.56
5.	2nd LS%	5	3.9200	0.7294	18.61
6.	RINSE WS%	5	18.6000	1.1769	6.33
7.	3rd LS%	5	4.1600	0.7127	17.13
8.	RINSE WS%	5	19.0400	0.3782	1.99
9.	4th LS%	5	4.3600	0.9099	20.87
10.	RINSE WS%	5	18.4000	0.6442	3.50

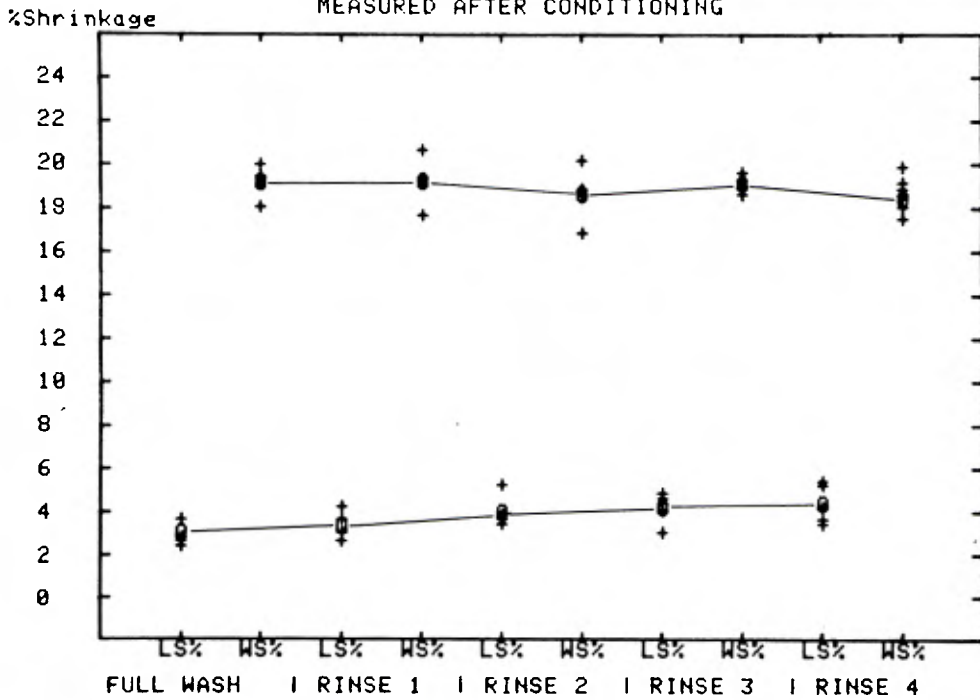
SHRINKAGE IN TUMBLE DRYING : SET 7 : ALL CYCLES

MEASURED IMMEDIATELY

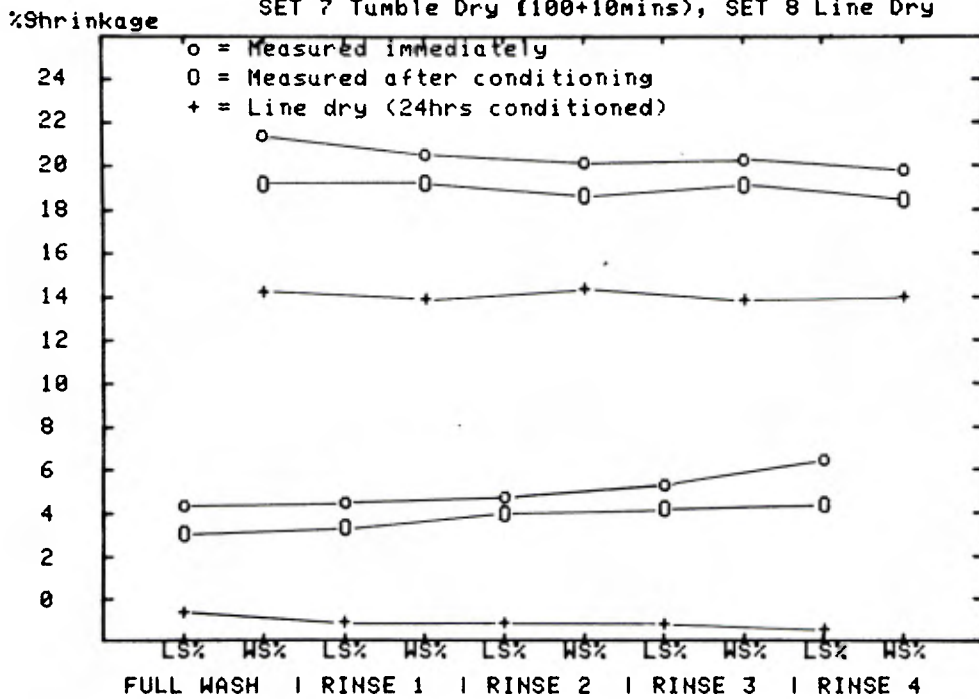


SHRINKAGE IN TUMBLE DRYING : SET 7 : ALL CYCLES

MEASURED AFTER CONDITIONING



SHRINKAGE IN TUMBLE DRYING : 28G SINGLE JERSEY MERCERISED
 SET 7 Tumble Dry (100+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	54.95	50.14	51.52	51.3	50
Orig Cond	59.53	54.32	55.81	55.57	54.17
1W+T Wet	94.77	85.03	86.92	89.1	85.35
1W+T Dry	54.93	49.92	51.34	51.21	49.78
1W+T Cond	59.34	53.99	55.45	55.28	53.87
2W+T Wet	94.5	87.05	85.37	86.77	86.4
2W+T Dry	55.34	50.27	51.59	51.46	49.97
2W+T Cond	59.55	54.1	55.61	55.41	54
3W+T Wet	93.86	84.21	84.33	85.21	80.72
3W+T Dry	55.53	50.56	51.97	51.67	50.21
3W+T Cond	59.36	53.99	55.48	55.27	53.9
4W+T Wet	91.57	80.66	85.13	83.08	80.29
4W+T Dry	55.24	50.17	51.71	51.42	50.15
4W+T Cond	59.31	53.94	55.42	55.25	53.8
5W+T Wet	88.01	80.5	82.34	82.74	80.73
5W+T Dry	55.09	49.96	51.59	51.16	49.92
5W+T Cond	59.15	53.82	55.34	55.14	53.76

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	51.5824	1.9993	3.88
2.Orig Cond	5	55.8800	2.1669	3.88
3.1W+T Wet	5	88.2340	3.9931	4.53
4.1W+T Dry	5	51.4360	2.0802	4.04
5.1W+T Cond	5	55.5860	2.2190	3.99
6.2W+T Wet	5	88.0180	3.6790	4.18
7.2W+T Dry	5	51.7260	2.1421	4.14
8.2W+T Cond	5	55.7340	2.2560	4.05
9.3W+T Wet	5	85.6660	4.8918	5.71
10.3W+T Dry	5	51.9880	2.1123	4.06
11.3W+T Cond	5	55.6000	2.2217	4.00
12.4W+T Wet	5	84.1460	4.5892	5.45
13.4W+T Dry	5	51.7380	2.0824	4.02
14.4W+T Cond	5	55.5440	2.2304	4.02
15.5W+T Wet	5	82.8640	3.0378	3.67
16.5W+T Dry	5	51.5440	2.1137	4.10
17.5W+T Cond	5	55.4420	2.1972	3.96

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+T Wet	42.02	41.03	40.73	42.43	41.41
1W+T Dry	-0.04	-0.45	-0.35	-0.17	-0.45
1W+T Cond	7.4	7.13	7.09	7.21	7.18
2W+T Wet	41.85	42.4	39.65	40.88	42.12
2W+T Dry	0.7	0.25	0.14	0.32	-0.07
2W+T Cond	7.72	7.31	7.36	7.42	7.4
3W+T Wet	41.46	40.45	38.91	39.8	38.05
3W+T Dry	1.04	0.82	0.87	0.72	0.41
3W+T Cond	7.43	7.13	7.14	7.19	7.23
4W+T Wet	39.99	37.83	39.48	38.26	37.72
4W+T Dry	0.52	0.05	0.37	0.24	0.29
4W+T Cond	7.35	7.04	7.04	7.15	7.06
5W+T Wet	37.56	37.71	37.43	38	38.06
5W+T Dry	0.25	-0.37	0.14	-0.27	-0.17
5W+T Cond	7.1	6.83	6.91	6.97	6.99

N.B. Moisture Content calculated from sample weights
 $\%MC = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6907	0.0017	0.02
3.1W+T Wet	5	41.5233	0.6980	1.68
4.1W+T Dry	5	-0.2899	0.1817	62.68
5.1W+T Cond	5	7.1992	0.1196	1.66
6.2W+T Wet	5	41.3818	1.1228	2.71
7.2W+T Dry	5	0.2691	0.2841	105.55
8.2W+T Cond	5	7.4440	0.1622	2.18
9.3W+T Wet	5	39.7342	1.3224	3.33
10.3W+T Dry	5	0.7742	0.2345	30.28
11.3W+T Cond	5	7.2225	0.1224	1.70
12.4W+T Wet	5	38.6570	1.0219	2.64
13.4W+T Dry	5	0.2961	0.1732	58.50
14.4W+T Cond	5	7.1284	0.1334	1.87
15.5W+T Wet	5	37.7539	0.2723	0.72
16.5W+T Dry	5	-0.0817	0.2669	326.51
17.5W+T Cond	5	6.9590	0.0998	1.43

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

EXHAUST TEMPERATURE DURING TUMBLE DRYING, Degrees C

Time Interval	1st Wash	1st Rinse	2nd Rinse	3rd Rinse	4th Rinse
0mins	30.3	30.2	30.4	30.4	30.3
10mins	37	38.3	38.6	37.4	37.4
20mins	36.8	38.6	39.8	38.4	38.4
30mins	37.5	39.2	40.8	39.1	39.4
40mins	39	48	44.1	42.9	40.9
50mins	45.1	58.8	58.8	54.9	51.9
60mins	59.9	64.5	74.1	71.3	70.9
70mins	61.1	58	61.9	57.5	72.5
80mins	59.9	64.3	62.1	70.4	75.4
90mins	58.8	68	58	61.3	71.1
100mins	70.1	67.1	61.9	60.7	64.6
Cool Down					
110mins	30.3	36.6	36.7	35.1	38.2

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1. 0mins	5	30.3200	0.0837	0.28
2. 10mins	5	37.7400	0.6768	1.79
3. 20mins	5	38.4000	1.0677	2.78
4. 30mins	5	39.2000	1.1726	2.99
5. 40mins	5	42.9800	3.4142	7.94
6. 50mins	5	53.9000	5.7110	10.60
7. 60mins	5	68.1400	5.7938	8.50
8. 70mins	5	62.2000	6.0647	9.75
9. 80mins	5	66.4200	6.3669	9.59
10. 90mins	5	63.4400	5.8132	9.16
11. 100mins	5	64.8800	3.8278	5.90
12. 110mins	5	35.3800	3.0442	8.60

A P P E N D I X 7

SET 8 LINE DRIED 24 HOURS CONDITIONED ATMOSPHERE

SHRINKAGE IN TUMBLE DRYING

SET 8 : Line Dried

SHRINKAGE MEASURED AFTER LINE DRYING (24HRS) IN CONDITIONED ATMOSPHERE

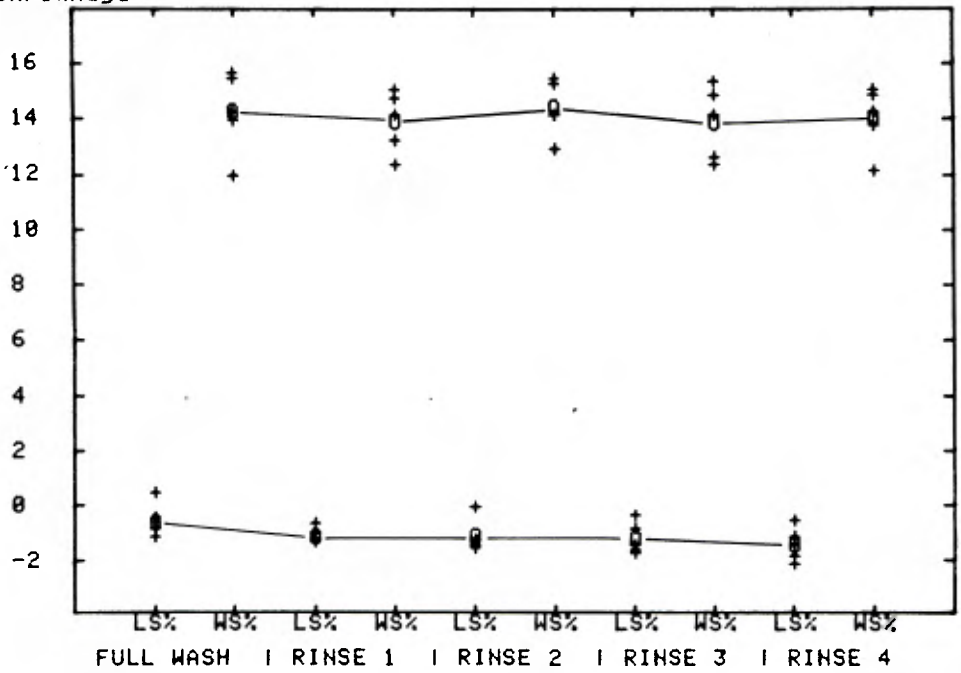
Sample Reference	FULL WASH		1st RINSE		2nd RINSE		3rd RINSE		4th RINSE	
	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%	LS%	WS%
A	-1.2	15.6	-1.4	14.1	-1.5	14.1	-1.8	14.1	-2.2	14.2
B	-0.9	14.2	-1.4	15	-1.5	15.2	-1.7	15.3	-1.5	15
C	0.4	11.9	-0.7	12.3	-0.1	12.9	-0.4	12.3	-0.6	12.1
D	-0.5	15.4	-1.3	14.7	-1.6	15.4	-1.5	14.8	-1.2	14.8
E	-1.2	13.9	-1.1	13.2	-1.3	14.1	-0.9	12.6	-1.9	13.7

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1.	FULL LS%	5	-0.6800	0.6686	98.32
2.	WASH WS%	5	14.2000	1.4816	10.43
3.	1st LS%	5	-1.1800	0.2950	25.00
4.	RINSE WS%	5	13.8600	1.1104	8.01
5.	2nd LS%	5	-1.2000	0.6245	52.04
6.	RINSE WS%	5	14.3400	1.0065	7.02
7.	3rd LS%	5	-1.2600	0.5941	47.15
8.	RINSE WS%	5	13.8200	1.3255	9.59
9.	4th LS%	5	-1.4800	0.6221	42.03
10.	RINSE WS%	5	13.9600	1.1589	8.30

SHRINKAGE IN TUMBLE DRYING : SET 8 : ALL CYCLES

SET 8 Line Dry (24hrs conditioned atmosphere)



SHRINKAGE IN TUMBLE DRYING

SET 8 : LINE DRY FOR 24HRS IN CONDITIONED ATMOSPHERE

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	60.42	58.7	60.77	58.38	62.6
Orig Cond	65.45	63.59	65.83	63.24	67.82
1W+L Wet	104.35	102.85	107.49	102.24	106.51
1W+L Dry	66.54	64.51	66.95	64.26	68.88
2W+L Wet	100.21	96.62	100.41	95.31	102.22
2W+L Dry	66.74	64.71	67.06	64.39	69.06
3W+L Wet	99.14	98.2	102.33	97.36	102.71
3W+L Dry	66.47	64.55	66.87	64.13	68.81
4W+L Wet	101.54	94.96	97.87	96.06	105.34
4W+L Dry	66.25	64.29	66.71	64.03	68.54
5W+L Wet	97.75	99.86	101.93	95.68	103.8
5W+L Dry	66.66	64.63	67.03	64.41	68.97

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	60.1734	1.7120	2.85
2.Orig Cond	5	65.1860	1.8545	2.84
3.1W+L Wet	5	104.6880	2.2724	2.17
4.1W+L Dry	5	66.2280	1.9024	2.87
5.2W+L Wet	5	98.9540	2.8762	2.91
6.2W+L Dry	5	66.3920	1.9054	2.87
7.3W+L Wet	5	99.9480	2.4346	2.44
8.3W+L Dry	5	66.1660	1.8931	2.86
9.4W+L Wet	5	99.1540	4.2653	4.30
10.4W+L Dry	5	65.9640	1.8585	2.82
11.5W+L Wet	5	99.8040	3.2294	3.24
12.5W+L Dry	5	66.3400	1.8805	2.83

SHRINKAGE IN TUMBLE DRYING

SET 8 : LINE DRY FOR 24HRS IN CONDITIONED ATMOSPHERE

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	7.69	7.69	7.69	7.69	7.69
1W+L Wet	42.1	42.93	43.47	42.9	41.22
1W+L Dry	9.2	9.01	9.23	9.15	9.11
2W+L Wet	39.71	39.25	39.48	38.75	38.75
2W+L Dry	9.47	9.29	9.38	9.34	9.35
3W+L Wet	39.06	40.22	40.62	40.04	39.05
3W+L Dry	9.11	9.06	9.13	8.97	9.02
4W+L Wet	40.5	38.18	37.91	39.23	40.57
4W+L Dry	8.8	8.69	8.91	8.83	8.66
5W+L Wet	38.19	41.22	40.38	38.99	39.69
5W+L Dry	9.37	9.18	9.34	9.37	9.23

N.B. Moisture Content calculated from sample weights

$$\text{M.C.} = (\text{Sample Weight} - \text{Calc Oven Dry Weight}) / \text{Sample Weight} * 100$$

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	7.6897	0.0002	0.00
3.1W+L Wet	5	42.5236	0.8758	2.06
4.1W+L Dry	5	9.1414	0.0889	0.97
5.2W+L Wet	5	39.1883	0.4302	1.10
6.2W+L Dry	5	9.3659	0.0693	0.74
7.3W+L Wet	5	39.7971	0.7105	1.79
8.3W+L Dry	5	9.0565	0.0634	0.70
9.4W+L Wet	5	39.2781	1.2478	3.18
10.4W+L Dry	5	8.7789	0.1012	1.15
11.5W+L Wet	5	39.6934	1.1780	2.97
12.5W+L Dry	5	9.2956	0.0881	0.95