International Institute For Cotton

Technical Research Division

Manchester

Research Record No. 100

Project 761

The Effect of Yarn Count and Stitch Length On the Physical and Dimensional Properties Of All-knit 100% Cotton Single Jersey Fabrics

Part IV

Comparison of 18, 24, and 28g Fabrics

Jill C. Stevens

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Key Words: Single Jersey, Machine Gauge, Stitch Length, Yarn Count.

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CONTENTS

1. Introduction

Parts I - III of this investigation (Research Records 64, 85 and 88) dealt with the individual analysis of the results obtained from a range of all-knit single jersey fabrics, knitted on three gauges of machine: 24, 18 and 28 gauge respectively. In these reports, certain aspects of the behaviour of single jersey fabrics, in relation to changes in yarn count and stitch length, were documented and several major trends identified. In general terms these can be summarised as follows.

Shrinkage

As stitch length is increased, length shrinkage increases and width shrinkage decreases, and as stitch length is decreased, length shrinkage decreases and width shrinkage increases.

Weight

As stitch length is decreased, fabric weight increases and as stitch length is increased, fabric weight decreases. At the same stitch length however, the coarser the yarn count, the heavier the fabric.

Width

As stitch length is increased, fabric width increases, and as stitch length is decreased, fabric width decreases. At the same stitch length, the coarser the yarn count, the wider the fabric.

Spirality

As stitch length is increased, the angle of spirality developed in the fabric increases, for each yarn count. However, for a range of fabrics knitted on a particular gauge of machine, the angle of spirality appears to be inversely proportional to tightness factor, $K = \sqrt{tex} / l$. As the tightness factor increases, the angle of spirality decreases.

Courses and wales

The assessment of fabric shrinkage from the changes in courses and wales can be considerably influenced by the amount of spirality generated in a fabric. If shrinkage measured and shrinkage calculated from courses and wales are compared without consideration being given to the changes in fabric geometry which result from the fabric spiralling, it is possible that a misleading impression of the behaviour of the fabric may be obtained.

Burst strength

Fabric burst strength appears to be directly proportional to fabric weight. As fabric weight is increased, fabric burst strength increases. There was, however, no conclusive evidence to suggest that an increase in fabric weight caused by relaxation shrinkage significantly affected fabric burst strength.

Although the trends listed above repeated themselves on all three gauges of machine, it is not yet clear whether there is a fundamental and independent effect of machine gauge, which must be taken into account when predicting the behaviour of single jersey fabrics. The objective of this report therefore is to try and discover if a gauge effect exists. There are, however, several reasons why definite conclusions are not possible.

The first is that the test methods used to determine the physical characteristics of the fabrics differed for the fabrics from the three different gauges. The most important difference was in the method of relaxation. The 24 gauge fabrics, in the main, only received one wash and tumble dry relaxation cycle, while the 18 gauge fabrics received five wash and tumble dry cycles, followed by a final hand press, and the 28 gauge samples received five wash and tumble dry cycles. It has been shown in Research Record 59 that grey-state single jersey fabrics continue to change dimensions after one wash and tumble dry cycle and, therefore, the results obtained from the 24 gauge fabrics could be misleading if compared with results obtained under different test conditions. For this reason it was decided not to include the results from the 24 gauge trials in this analysis. The results presented in this report therefore are, in the main, from the 18 and 28 gauge trials and, consequently, important areas of overlap, e.g. in yarn count, have had to be ignored.

Secondly, the results presented in this series of reports have been obtained from grey or machine-state fabrics and recent experience with double jersey cotton fabrics has shown that finishing, in terms of both route and machinery used, can affect the fully-relaxed dimensions of the fabric. This could not previously have been predicted from measurements taken on grey-state fabrics and consequently suggests that differences between gauges which could appear after finishing might not have shown up in the grey testing.

Finally, this report was originally designed to establish a count/gauge relationship for cotton as has previously been established for wool. For this reason, it was necessary to find the extreme knittable ranges for each yarn count on each gauge of machine. Therefore, although it has been possible to show that a wide range of yarn counts and stitch lengths can be knitted, it has meant that the important commercial end of the range is very poorly covered. In all cases, only the three tightest stitch lengths can really be considered to fall within the commercial field and in some cases, only the tightest two.

2. Test Methods

As previously mentioned, the test methods used for determining the properties of the fabrics differed between sets. However, the detailed methods and differences have been reported individually in the previous parts of this study and will not therefore be discussed again.

3. Results

For the reader's convenience, the basic test results for the fabrics from all three gauges have been included in *Tables 5-7* along with the yarn test results, in *Table 1*, and knitting specifications in *Tables 2-4*. The remainder of the tables and graphs relate specifically to this report.

4. Discussion

Wale Spacing

Figure 1 illustrates the relationship between relaxed wales per 3 cm and stitch length for both the 18 and 28 gauge fabrics. To test whether or not a gauge effect exists, the number of wales/3 cm were read for each yarn count at three stitch lengths (*Table 8*) and re-plotted against yarn tex. As can be seen from *Figure 2*, the points fall along a set of similar curves, one for each stitch length tested. If there is an independent effect of machine gauge, a break in the curves at the point where gauge changed would be expected. This is not apparent.

Figure 3 shows wales per 3 cm against tightness factor. The same test was applied and the number of wales noted for each yarn at two different tightness factors (*Table 9*) and then plotted against yarn tex (*Figure 4*). The points again fall on two similar curves, one for each tightness factor tested, and a break in the curves at the point the gauge changed cannot be detected.

Course Spacing

Figure5 illustrates the relationship between relaxed courses and stitch length. In this case, it is more difficult to separate the influence of yarn count as all the points fall quite close to the same curve. The influence of yarn count is more clearly defined in *Figure 6* where relaxed courses are plotted against tightness factor. However, if the test is applied and the number of courses at two tightness factors (*Table 10*) are plotted against tex (*Figure 7*), the same picture emerges: the points fall on two similar curves, one for each tightness factor and a break corresponding to change in machine gauge is difficult to detect.

Spirality

Figure 8 depicts the angle of spirality against tightness factor and in this instance there does appear to be an effect of machine gauge. The fabrics knitted on the 18 gauge machine tend to develop a lower angle of spirality (especially at low tightness factors) than those produced on the 28 gauge machine.

Straight-line constants were calculated for the two gauges and the 28 gauge results show a higher correlation coefficient, 0.993, than the 18 gauge results, 0.979. Although the indication is that machine gauge has an independent effect on fabric spirality, it is possible that the explanation lies in the yarns themselves. For example, the finer the yarn, the more turns per unit length are necessary to maintain the same twist factor. As all the yarns used in these trials had very similar twist factors, it may be that finer yarns with more turns per unit length have a greater tendency to spiral, and this becomes more noticeable at longer stitch lengths (lower tightness factors) where the yarn in the fabric is less restricted (?).

Burst Strength

Figure 9 illustrates the relationship between fabric weight and fabric burst strength. Results obtained after five wash and tumble relaxation cycles for all three machine gauges fall on or around the same straight line, and show a reasonably high correlation coefficient of 0.9815. This appears to indicate that the relationship between strength and weight is fixed by count and stitch length and is unaffected by changes in machine gauge.

Weight

Fabric weight is directly influenced by the amount and count of yarn used to produce the fabric. *Figures 10 and 11* illustrate this relationship in terms of stitch length and tightness factor. In both cases, however, although the major trends are clear, there is a certain amount of confusion which could have been caused by a gauge effect. To examine this aspect more fully, a further three graphs were constructed relating fabric weight to some derivative function of stitch length and yarn count.

Figure 12 shows fabric weight against *tex / l* or weight per loop. The result, as may have been expected, indicates that fabric weight is directly proportional to the weight of a loop, with very high correlation, and irrespective of any other influence. The individual calculations for *tex / l* are shown in *Table 11*.

Figure 13 compares fabric weight against *S.l* or the length of yarn per square centimetre. In this case, the effect of yarn tex is more clearly defined. The straight line constants for each yarn are shown in *Table 12*. The slope, *m*, of the lines should have represented yarn tex. This is almost true for the 1/16 and 1/20 but the error, *c*, becomes greater as the yarns become finer. The uncertainty of the results, especially with the finer yarn counts, is probably due to the fact that the fabrics with very low tightness factors were extremely unstable and easily distorted, making accurate measurement of fabric weight extremely difficult.

The individual calculations for *S.l* are given in *Table 13*.

Figure 14 shows fabric weight as a function of *tex.l*. The effect of yarn count is again neatly separated, the results giving a set of similar curves, one for each yarn count. *Table 14* shows the individual results for the *tex.l* calculations.

To test the correlation between calculated weight (Table 15) and measured weight, the two sets of results were plotted against each other (Graph 15). This shows that although there is a slight tendency to underestimate fabric weight for the heaviest fabrics (possibly due to the lack of points at the top end) and overestimate for the lightest fabrics (possibly due to the instability of these fabrics) the correlation is, in fact, very good, Therefore, if there was an independent effect of machine gauge, it is unlikely that fabric weight could be so accurately predicted over such a wide range of fabric constructions produced on two dissimilar gauges.

Stitch Density

The final dimensional property to be tested for a gauge effect is stitch density (*Table 16*).

Figure 16 illustrates the relationship between stitch density and stitch length. Similar to the relationship between courses and stitch length, the individual curves for yarn count are difficult to accurately define, although there is a tendency for the coarser counts to lay below the finer counts. *Figure 17* (*S/K*), however, defines the effect of yarn count on stitch density much more clearly.

To test for a gauge effect, stitch densities were read at two tightness factors (*Table 17*), and plotted against yarn tex (*Figure 18*). The points fall on two similar curves, one for each tightness factor. Again it is not possible to find a break in the curves where the gauge changes.

The relationship between stitch density and fabric weight is shown in *Figure 19*. The effect of yarn count is clearly defined and the straight-line constants for each line are shown in *Table 18*. Values for fabric weight were read at three levels of stitch density (*Table 19*) and plotted against yarn tex (*Figure 20*). The straight-line constants for this graph are also included in *Table 19*. Again, there is no indication of a gauge effect.

5. Conclusions

From the results of these trials, the indications are that machine gauge does not have an independent effect on the dimensional properties of single jersey fabrics. In only one case, that of spirality, is there any evidence to suggest that machine gauge could have an effect. This particular property of single-jersey fabric however is not as yet fully understood and, although it could prove to be influenced by gauge, past work suggests that spirality is more likely to be related to the properties of the yarn and not a direct effect of machine gauge. In every other case, the differences between fabrics can be explained by the interaction of yarn count and stitch length.

Although the results of these trials appear to be conclusive, before it can be put beyond doubt, similar trials need to be carried out on fabrics knitted from the same yarn count on different gauges, and more importantly, the properties of the fabrics should be measured after the fabrics have been through commercial preparation, dyeing and finishing processes.

Figure 1

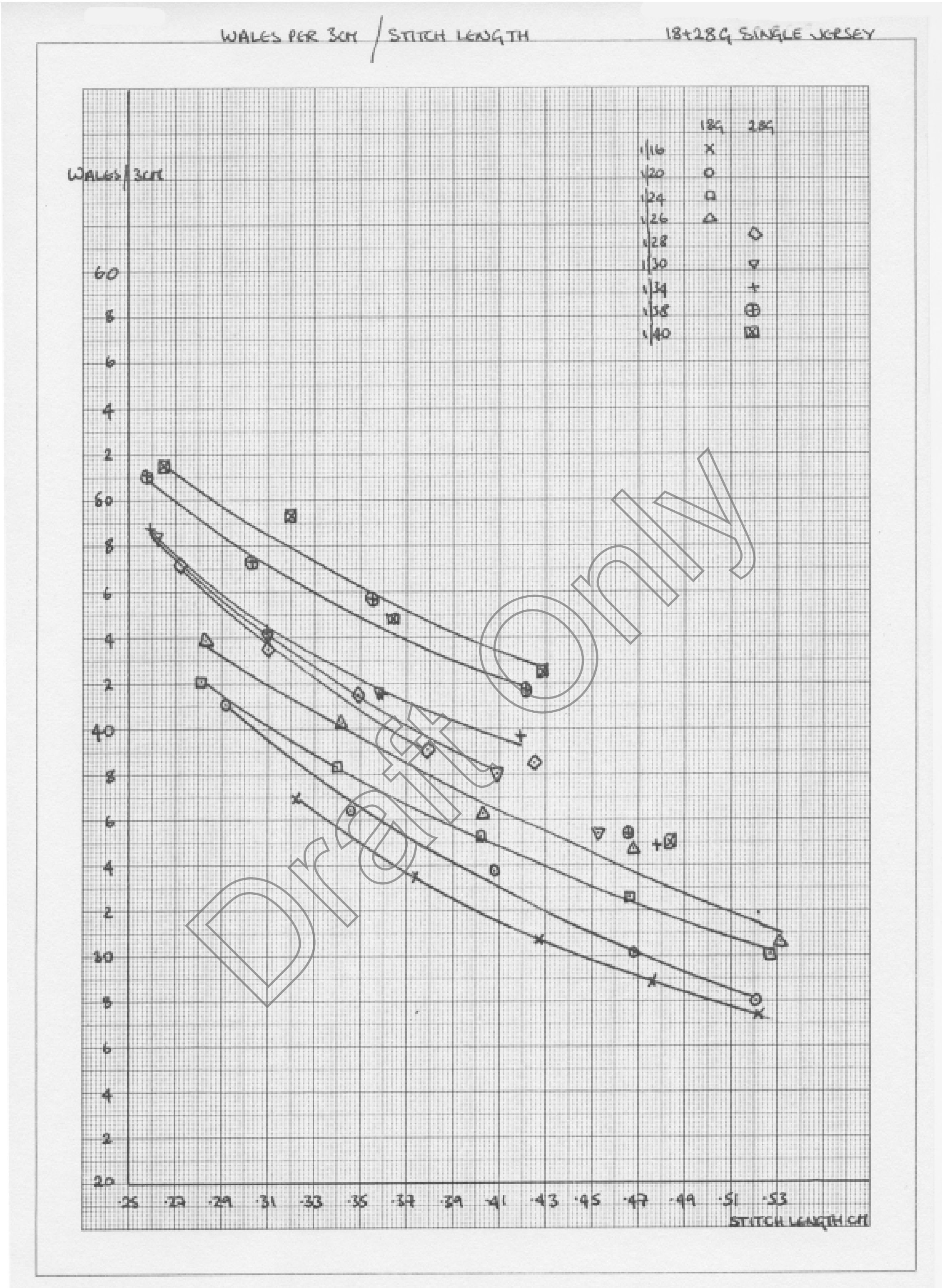

WALES PER 3CM / STITCH LENGTH
18+28G SINGLE JERSEY
WALES/3CM
18G
28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
STITCH LENGTH CM

Figure 2

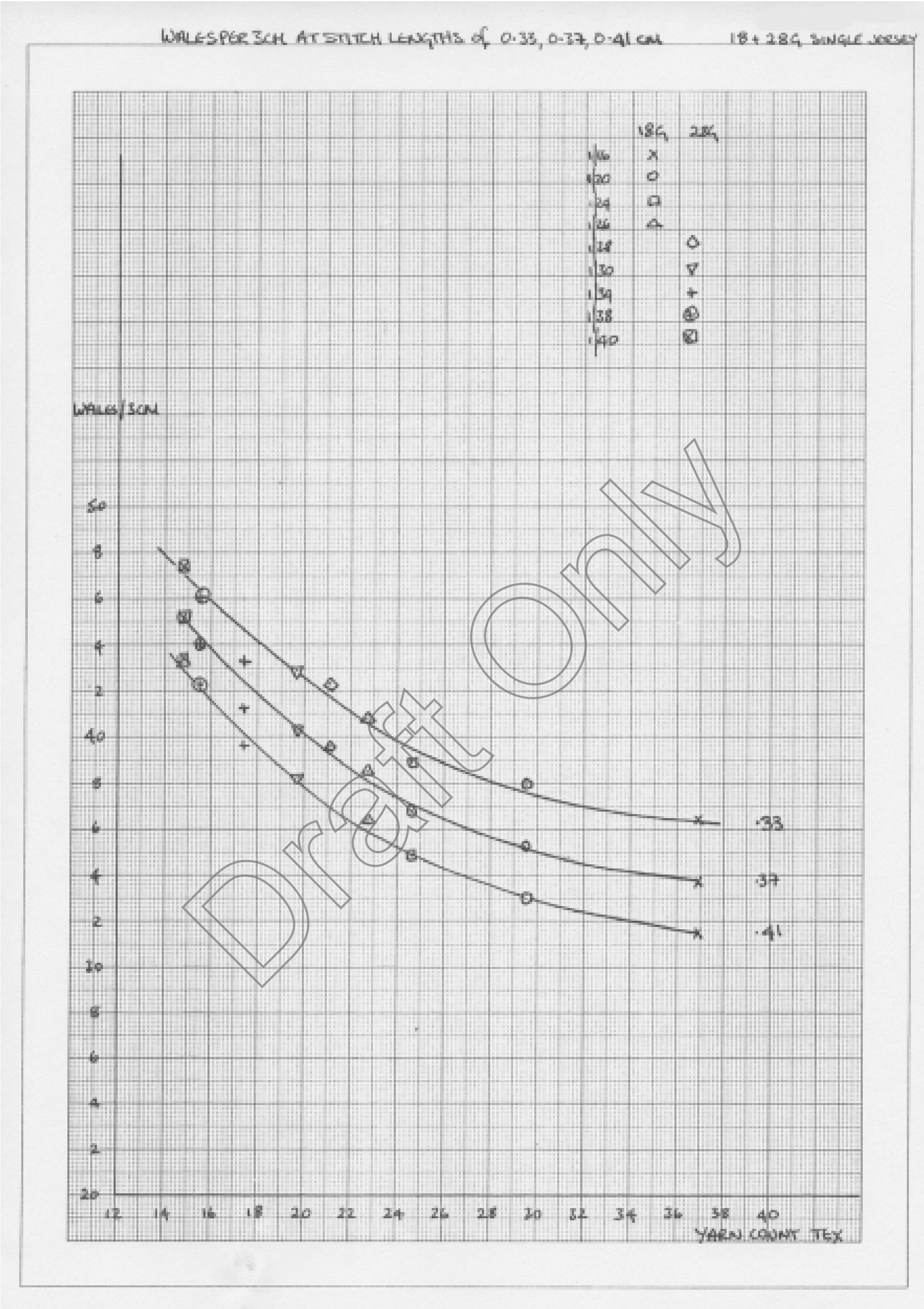

WALES PER 3CM AT STITCH LENGTHS of 0·33, 0·37, 0·41 CM
18 + 28G SINGLE JERSEY
18G
28G
WALES/3CM
YARN COUNT TEX
·33
·37
·41

Figure 3

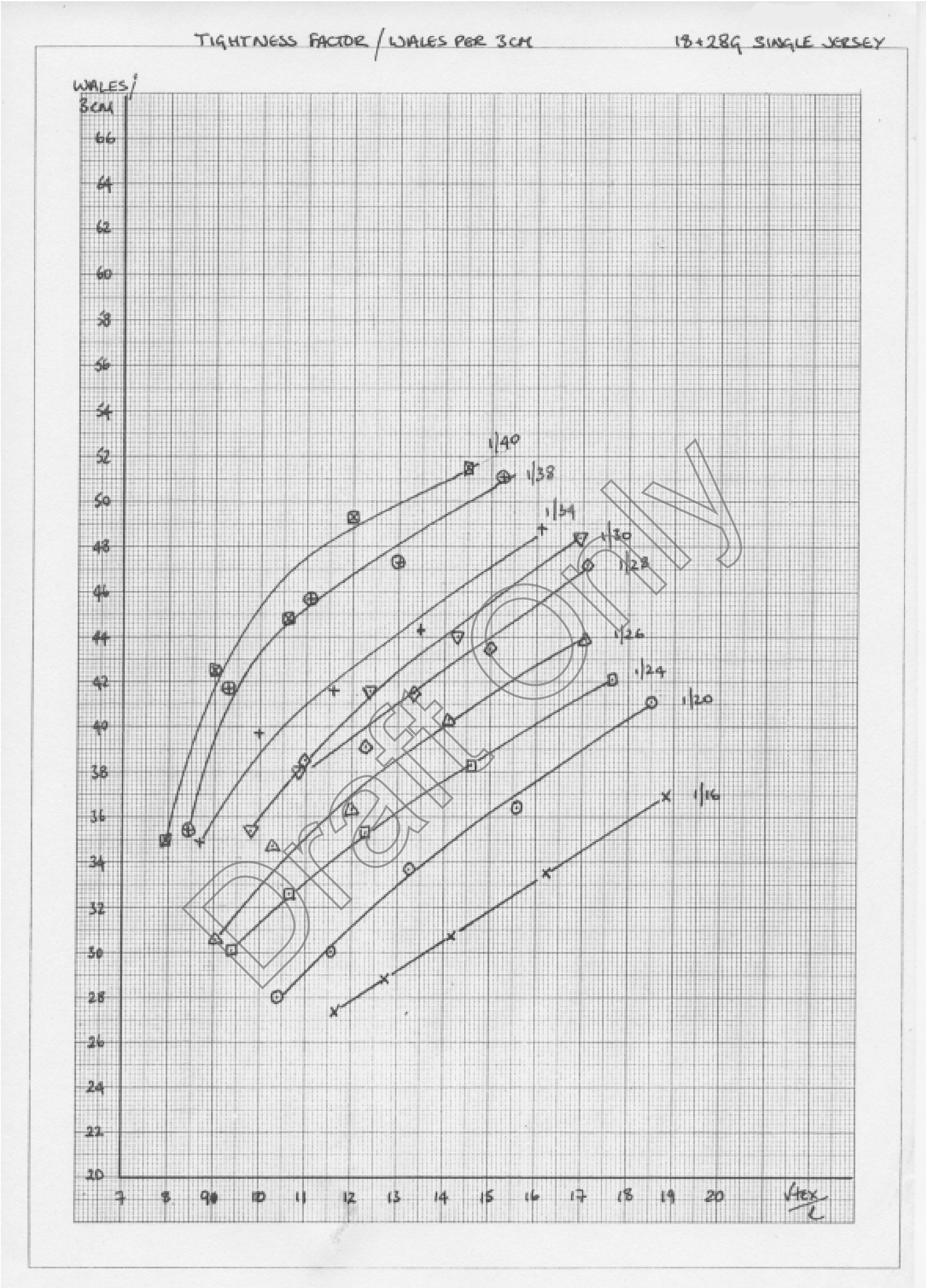
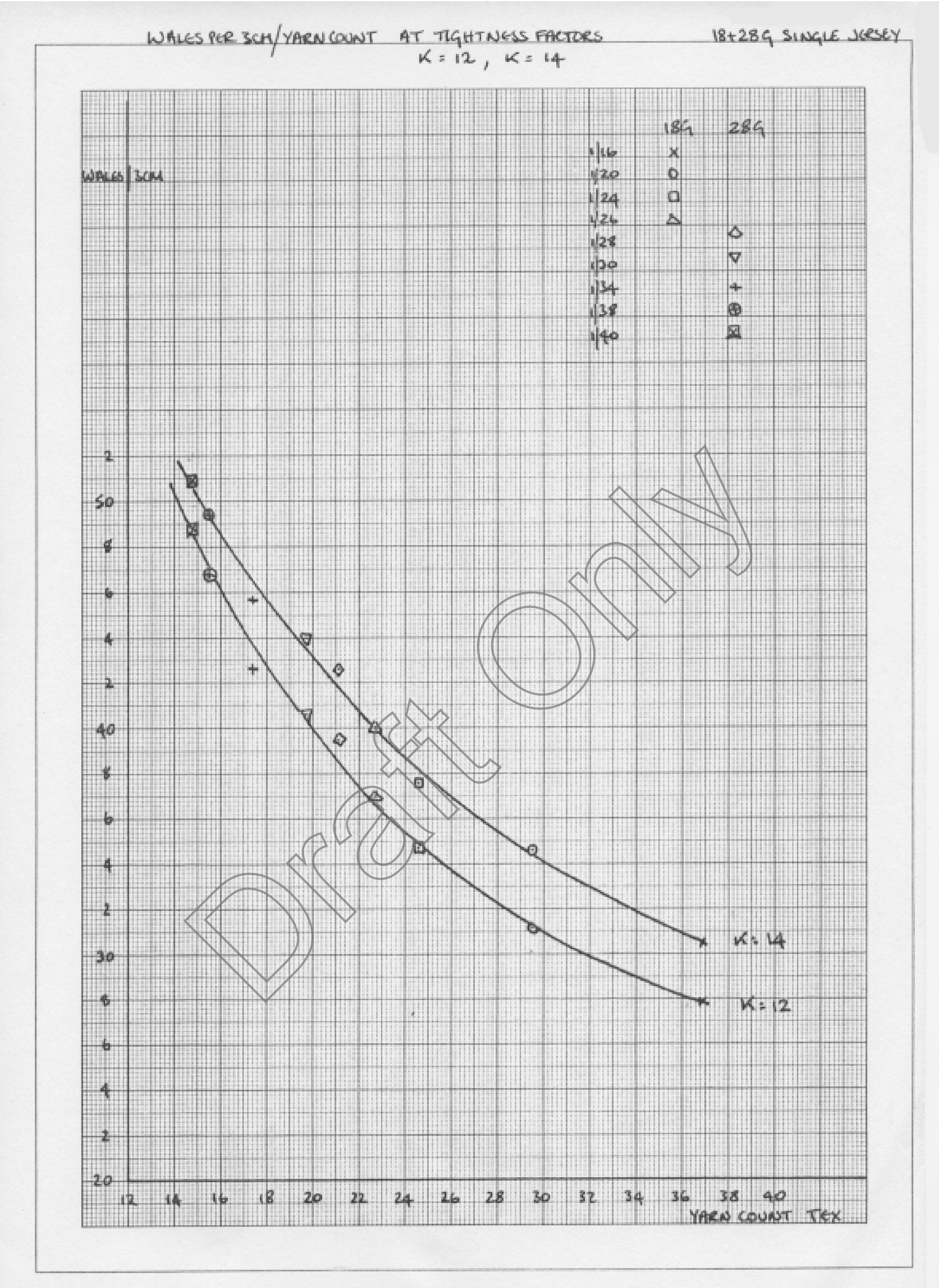

TIGHTNESS FACTOR / WALES PER 3CM
18+28G SINGLE JERSEY
WALES/3CM
1/40
1/38
1/34
1/30
1/28
1/26
1/24
1/20
1/16

Figure 4



WALES PER 3CM/YARN COUNT AT TIGHTNESS FACTORS
K = 12 , K = 14
18+28G SINGLE JERSEY
WALES/3CM
18G
28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
K=14
K=12
YARN COUNT TEX

Figure 5

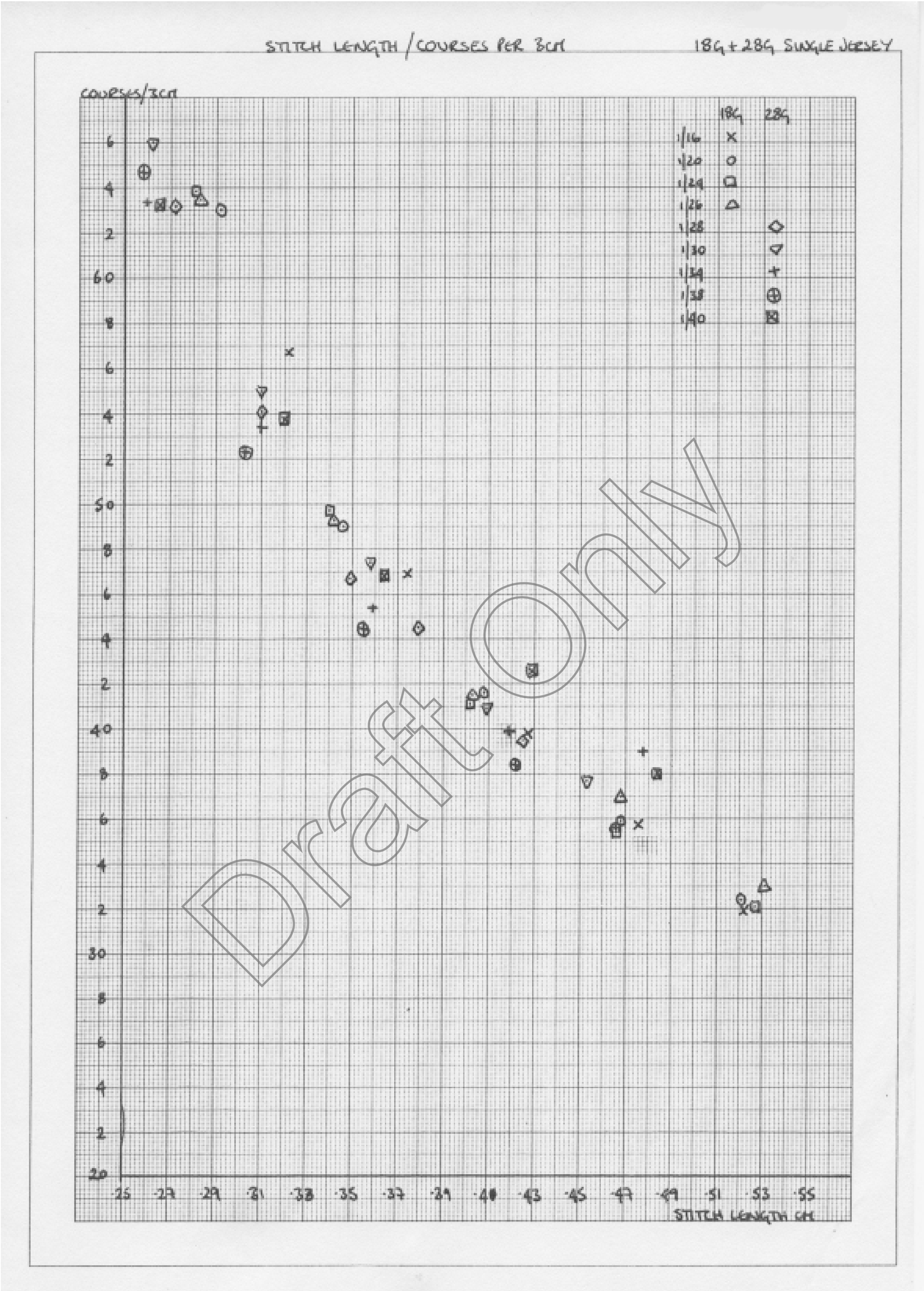

STITCH LENGTH / COURSES PER 3CM
18G + 28G SINGLE JERSEY
COURSES/3CM
STITCH LENGTH CM
18G
28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40

Figure 6

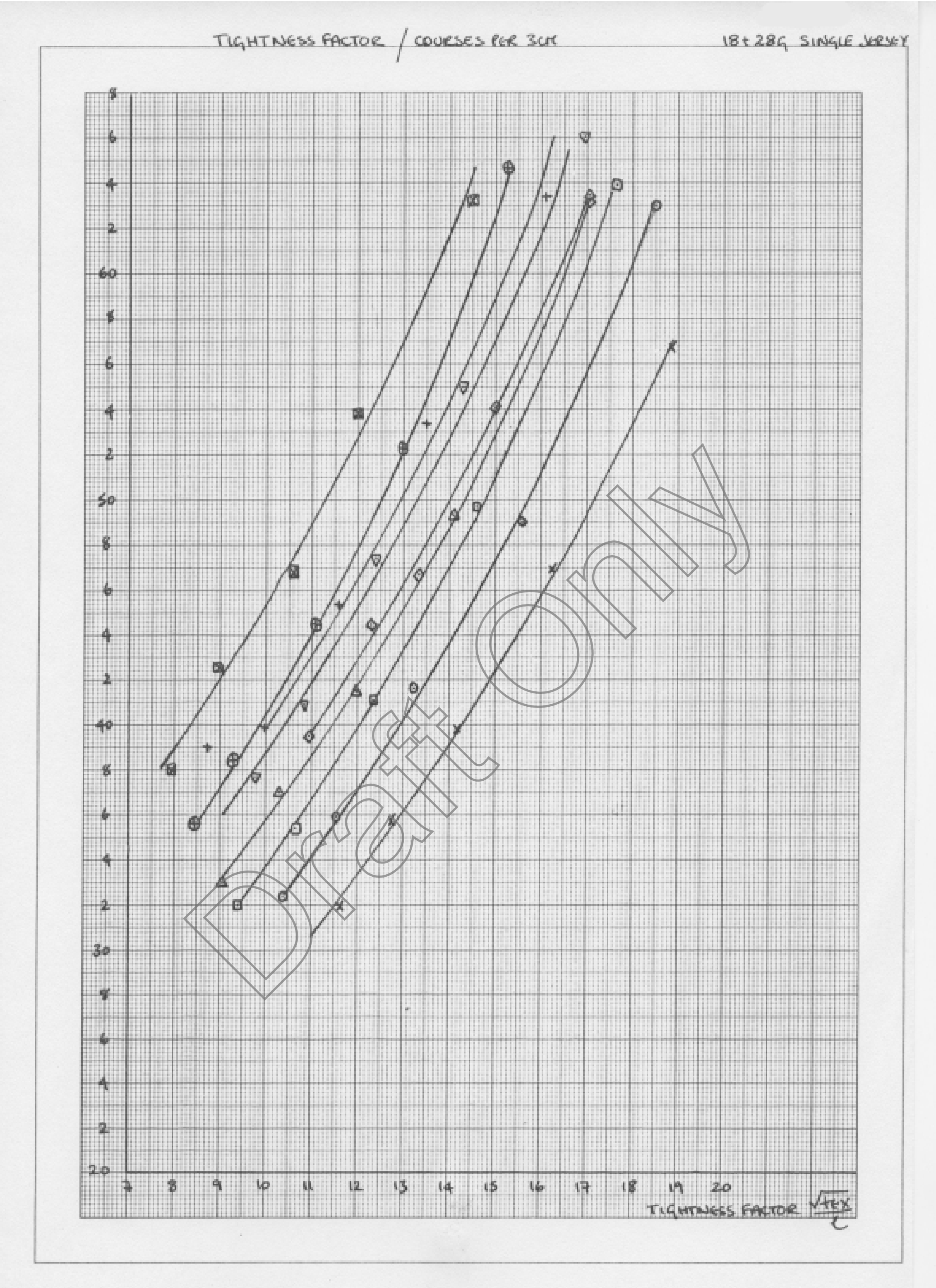

TIGHTNESS FACTOR / COURSES PER 3CM
18+28G SINGLE JERSEY
TIGHTNESS FACTOR

Figure 7

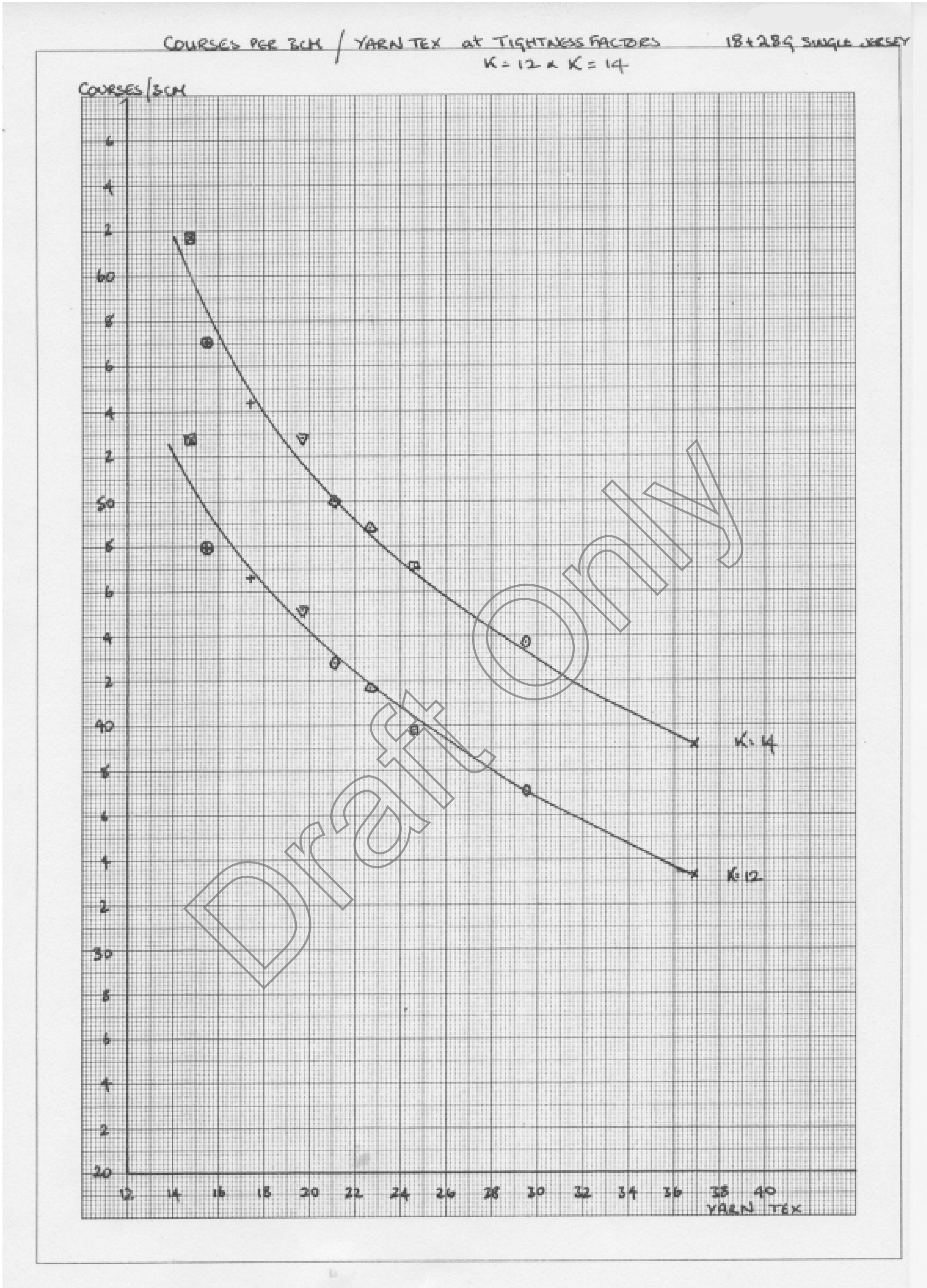

COURSES PER 3CM / YARN TEX at TIGHTNESS FACTORS
K = 12 & K = 14
18+28G SINGLE JERSEY
COURSES/3CM
K=14
K=12
YARN TEX

Figure 8

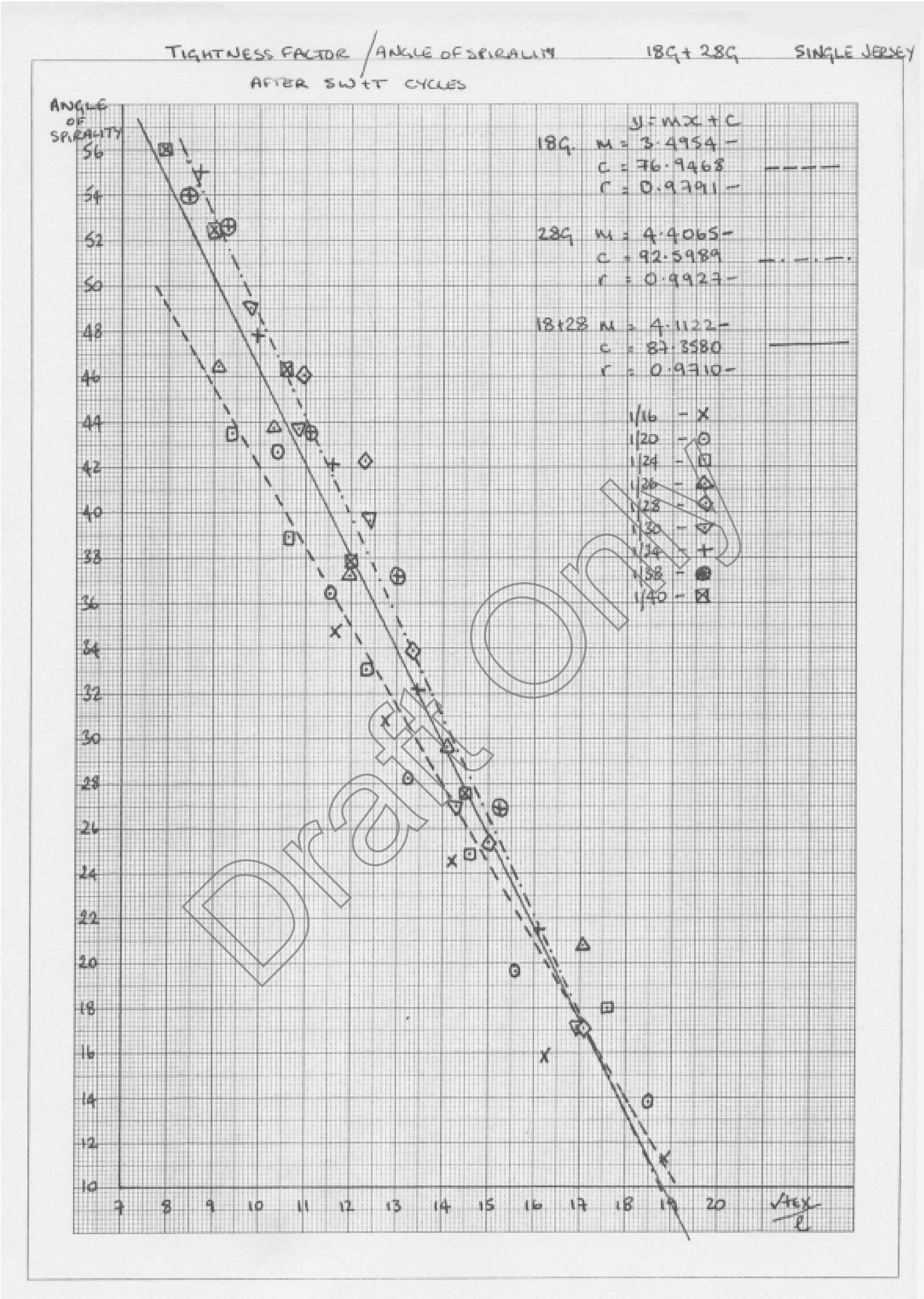
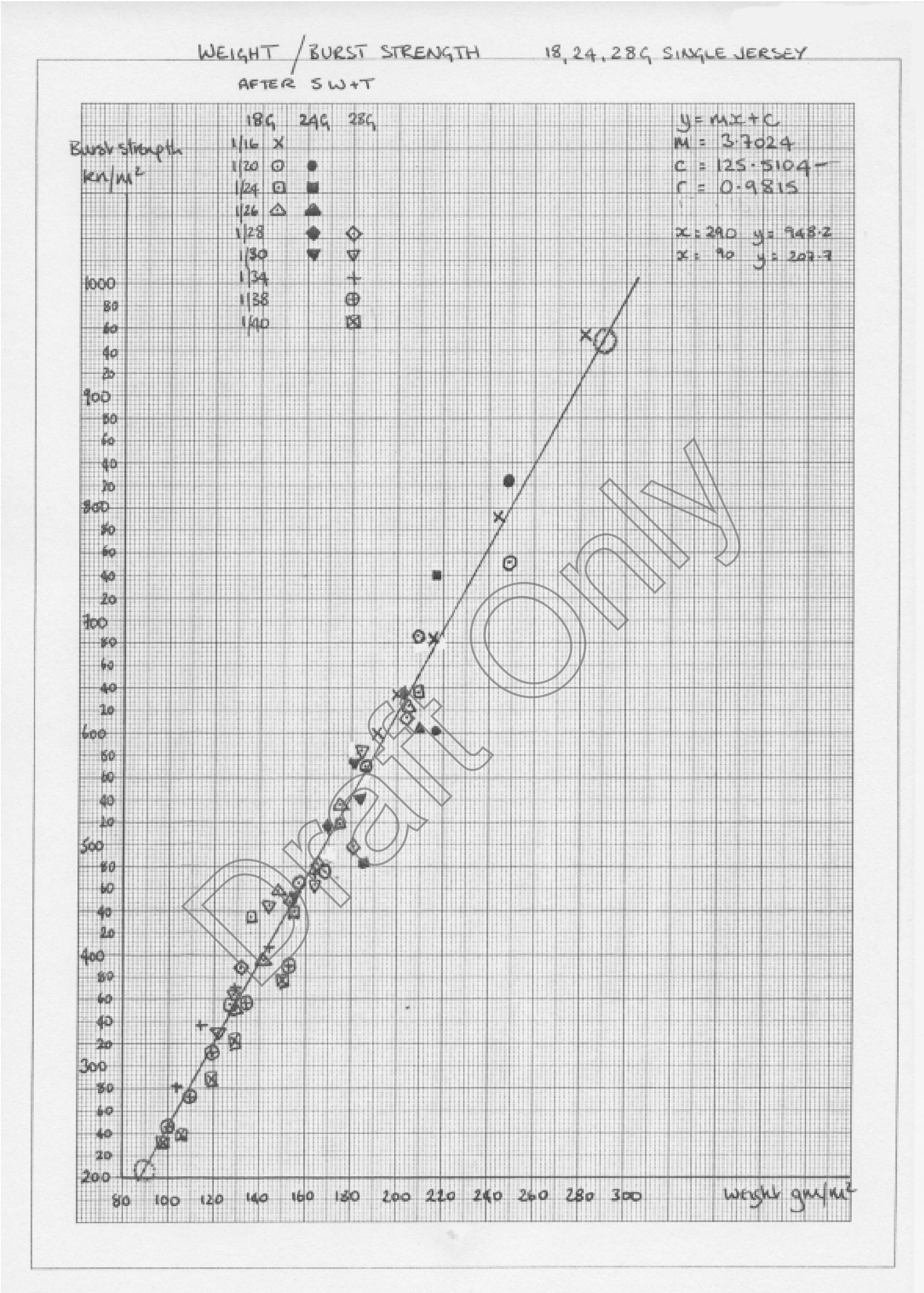

TIGHTNESS FACTOR / ANGLE OF SPIRALITY
18G + 28G
SINGLE JERSEY
AFTER 5W+T CYCLES
ANGLE OF SPIRALITY
y = mx + c
18G. m = 3·4954 – c = 76·9468 r = 0·9791 –
28G m = 4·4065 – c = 92·5989 r = 0·9927 –
18+28 m = 4·1122 – c = 87·3580 r = 0·9710 –
1/16 – X
1/20 – ⊙
1/24 – ⊡
1/26 – △
1/28 – ◇
1/30 – ▽
1/34 – +
1/38 – ⊕
1/40 – ⊠
√tex / ℓ

Figure 9



WEIGHT / BURST STRENGTH 18, 24, 28G SINGLE JERSEY
AFTER SW+T
18G 24G 28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
Burst strength kn/m²
y = mx + c
m = 3.7024
c = 125.5104
r = 0.9815
x: 290 y: 948.2
x: 90 y: 207.7
weight gm/m²

Figure 10

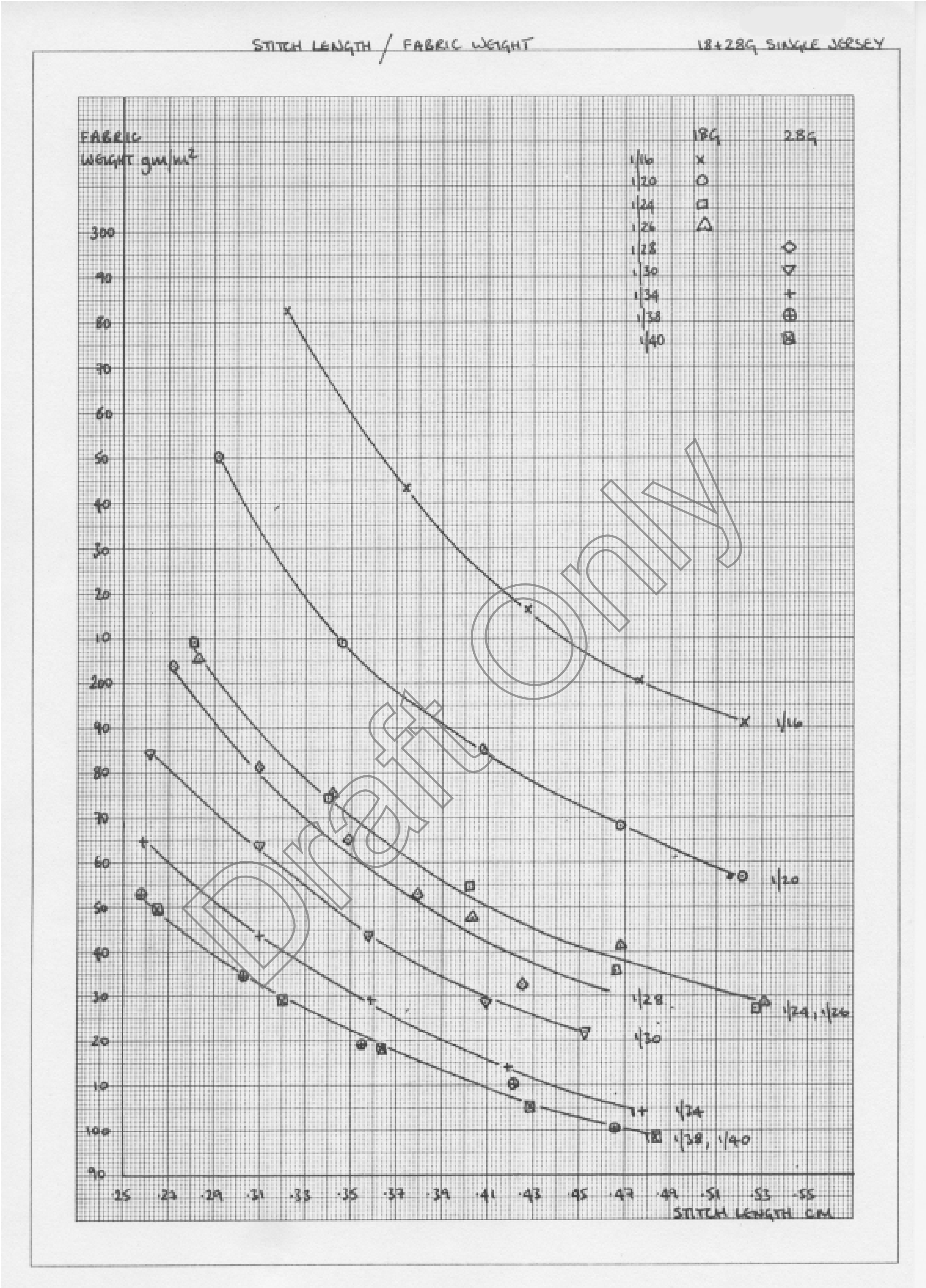

STITCH LENGTH / FABRIC WEIGHT
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
18G
28G
STITCH LENGTH CM
Draft Only

Figure 11

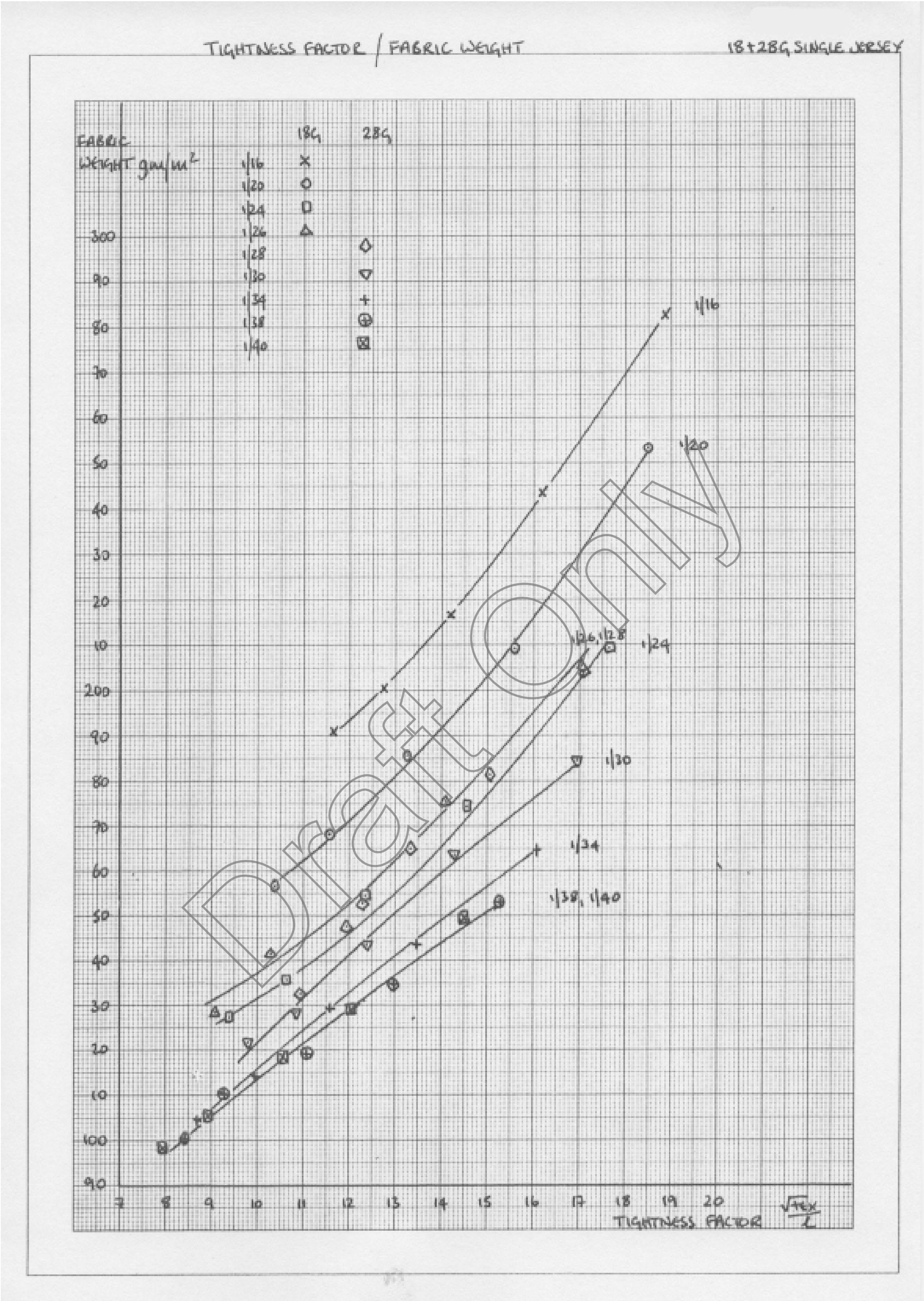

TIGHTNESS FACTOR / FABRIC WEIGHT
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
18G
28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
300
200
100
7
8
9
10
11
12
13
14
15
16
17
18
19
20
TIGHTNESS FACTOR
√Tex / l
1/16
1/20
1/26, 1/28
1/24
1/30
1/34
1/38, 1/40
Draft Only

Figure 12

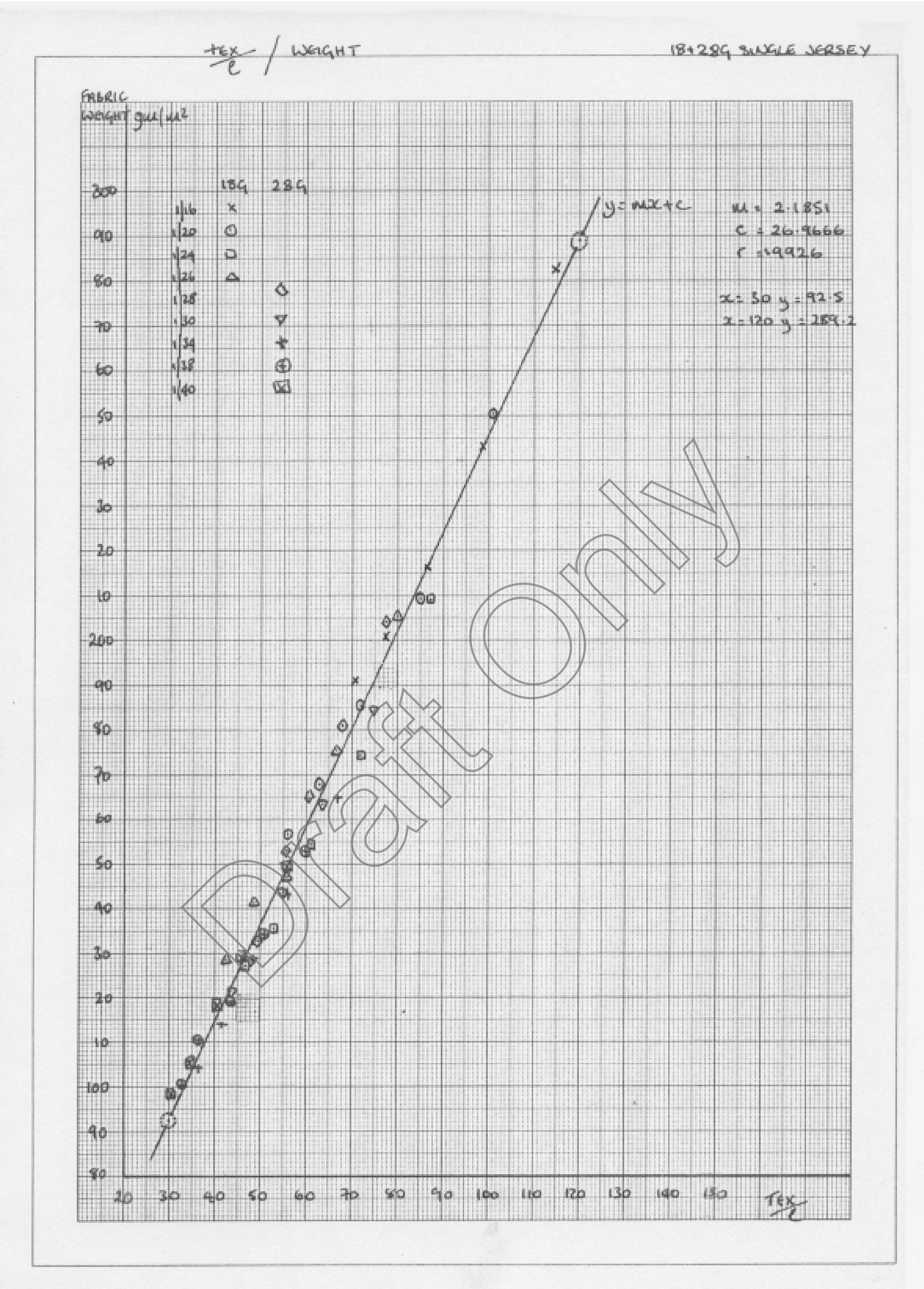
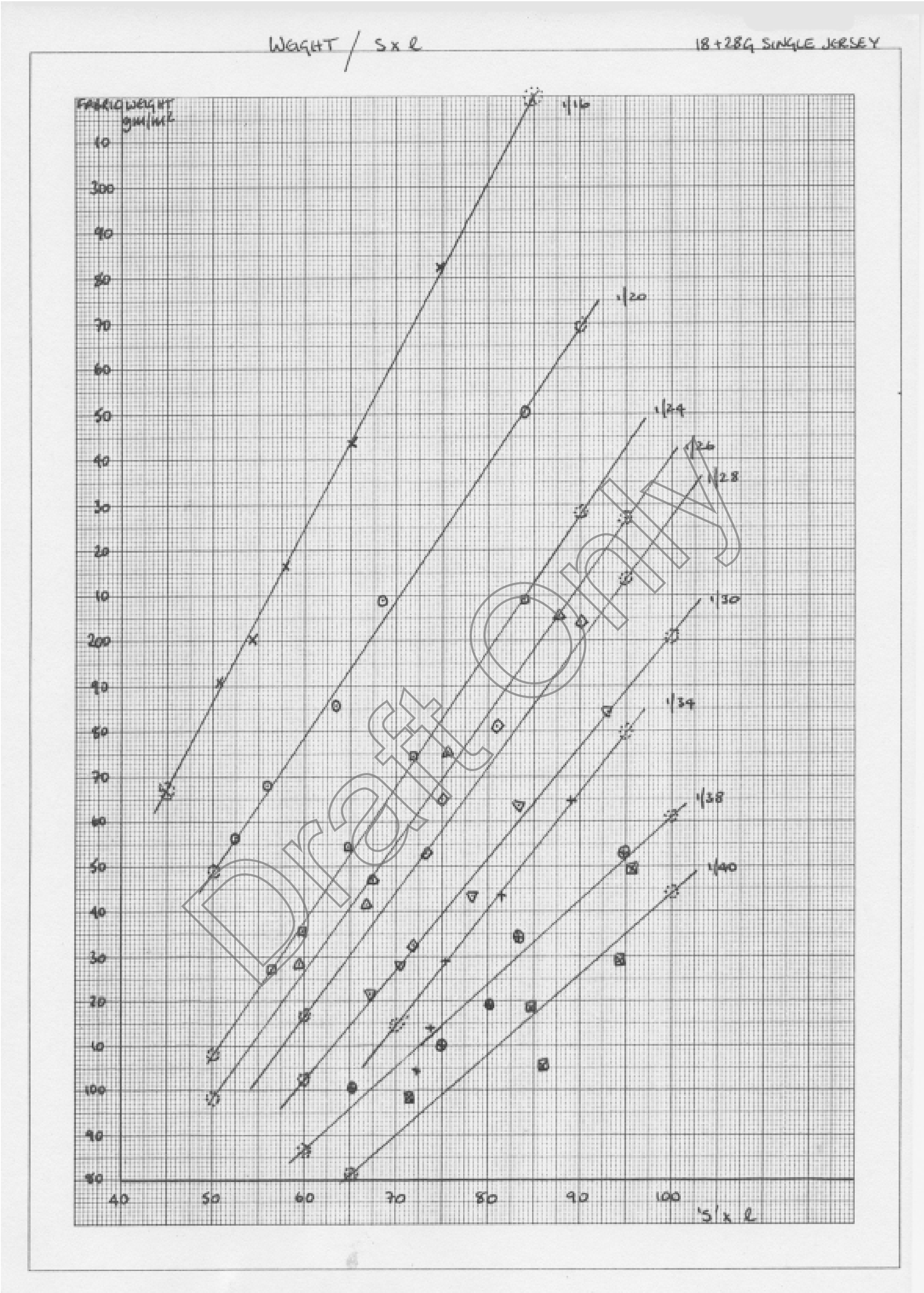

tex/l / WEIGHT
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
18G 28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
y = mx+c
m = 2·1851
c = 26·9666
r = ·9926
x = 30 y = 92·5
x = 120 y = 289·2
300
90
80
70
60
50
40
30
20
10
200
90
80
70
60
50
40
30
20
10
100
90
80
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Tex/l

Figure 13



WEIGHT / S x l
18 + 28G SINGLE JERSEY
FABRIC WEIGHT gm/m2
'S' x l
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
Draft Only

Figure 14

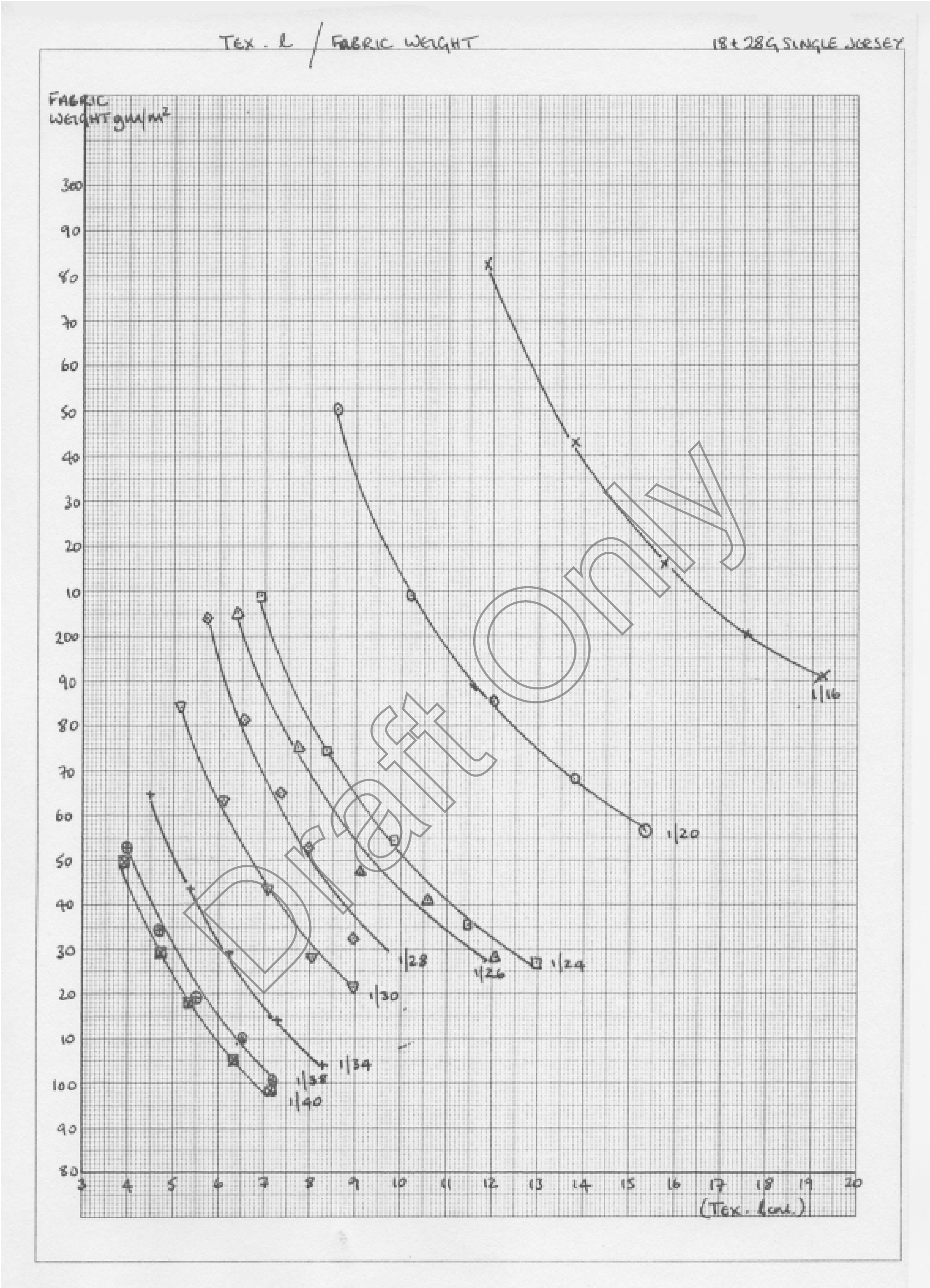
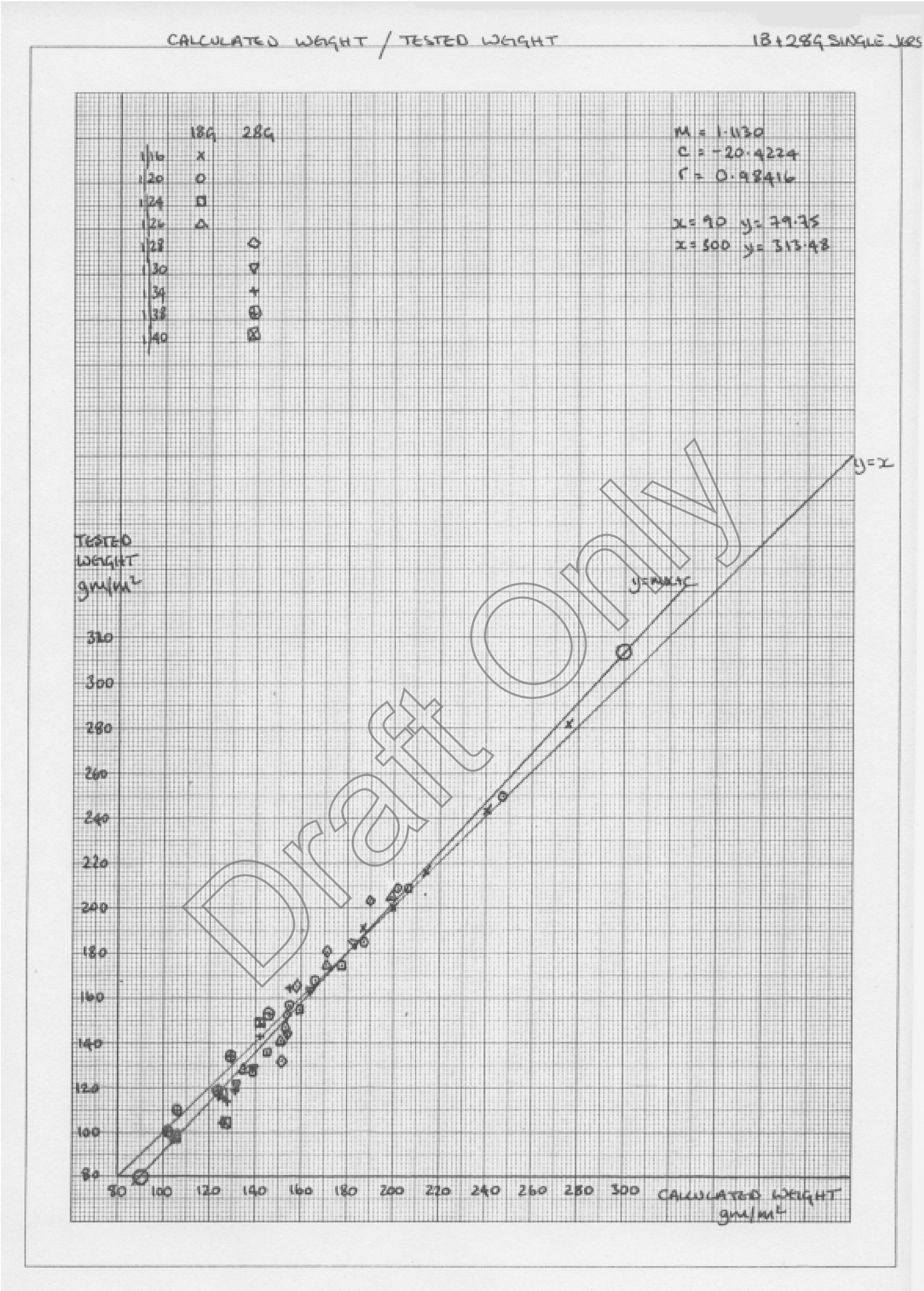

TEX . l / FABRIC WEIGHT
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
(TEX . l cm.)
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
Draft Only

Figure 15



CALCULATED WEIGHT / TESTED WEIGHT
18G
28G
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
M = 1·1130
C = −20·4224
r = 0·98416
x = 90 y = 79·75
x = 300 y = 313·48
y=x
TESTED WEIGHT gm/m²
320
300
280
260
240
220
200
180
160
140
120
100
80
100
120
140
160
180
200
220
240
260
280
300
CALCULATED WEIGHT gm/m²

Figure 16

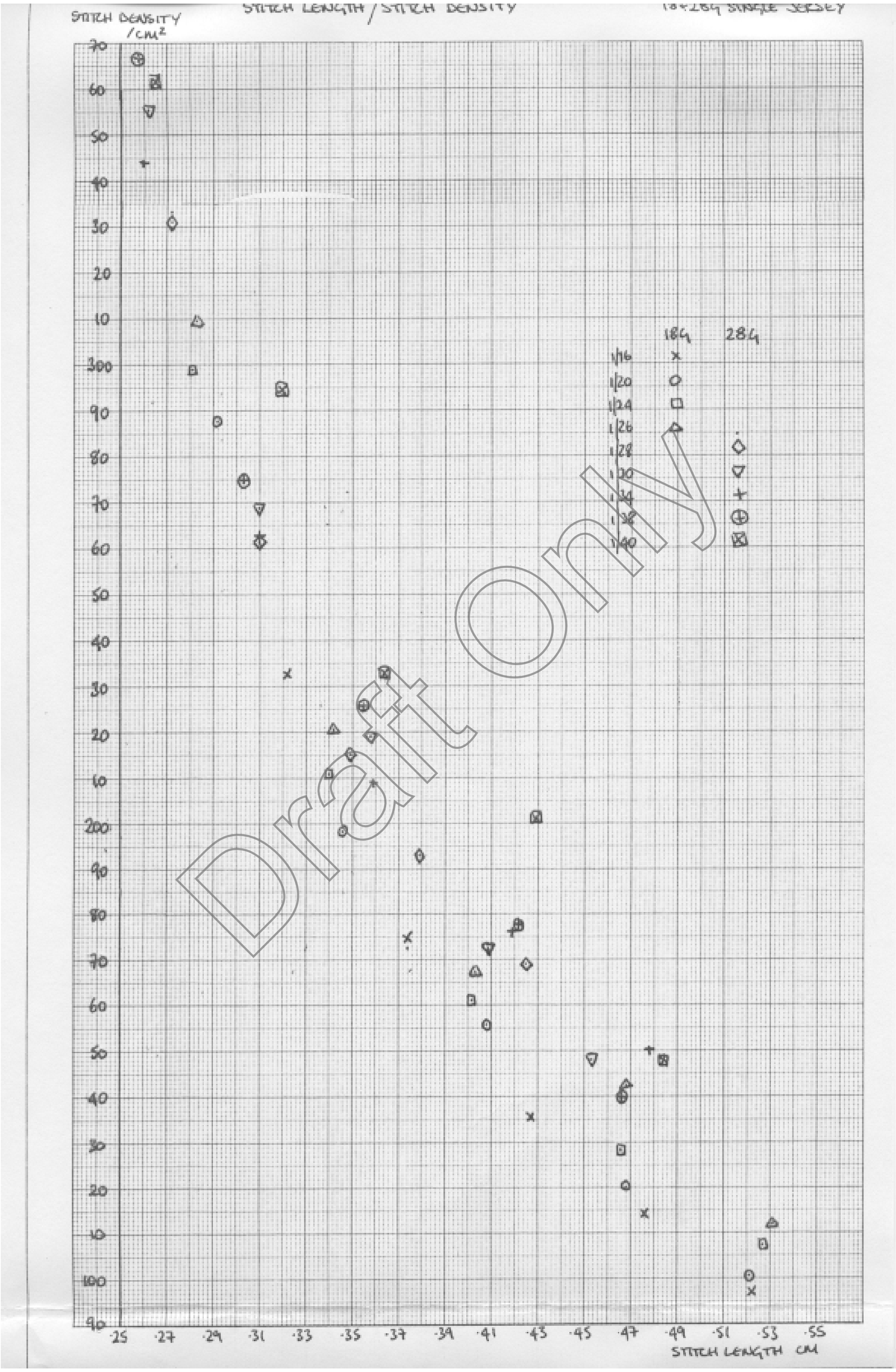

STITCH DENSITY /CM²
STITCH LENGTH / STITCH DENSITY
STITCH LENGTH CM
184 284
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40
Draft Only

Figure 17

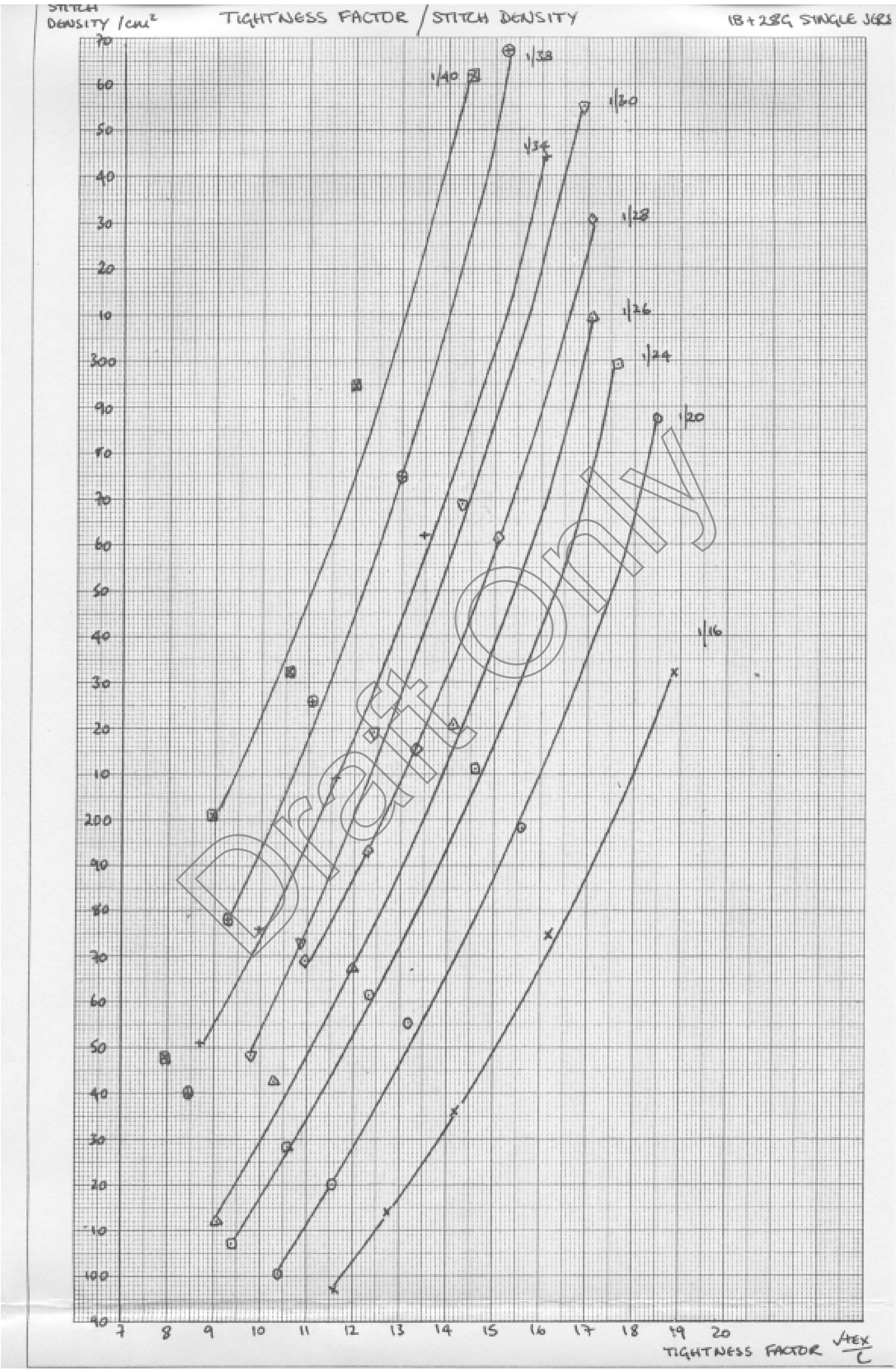
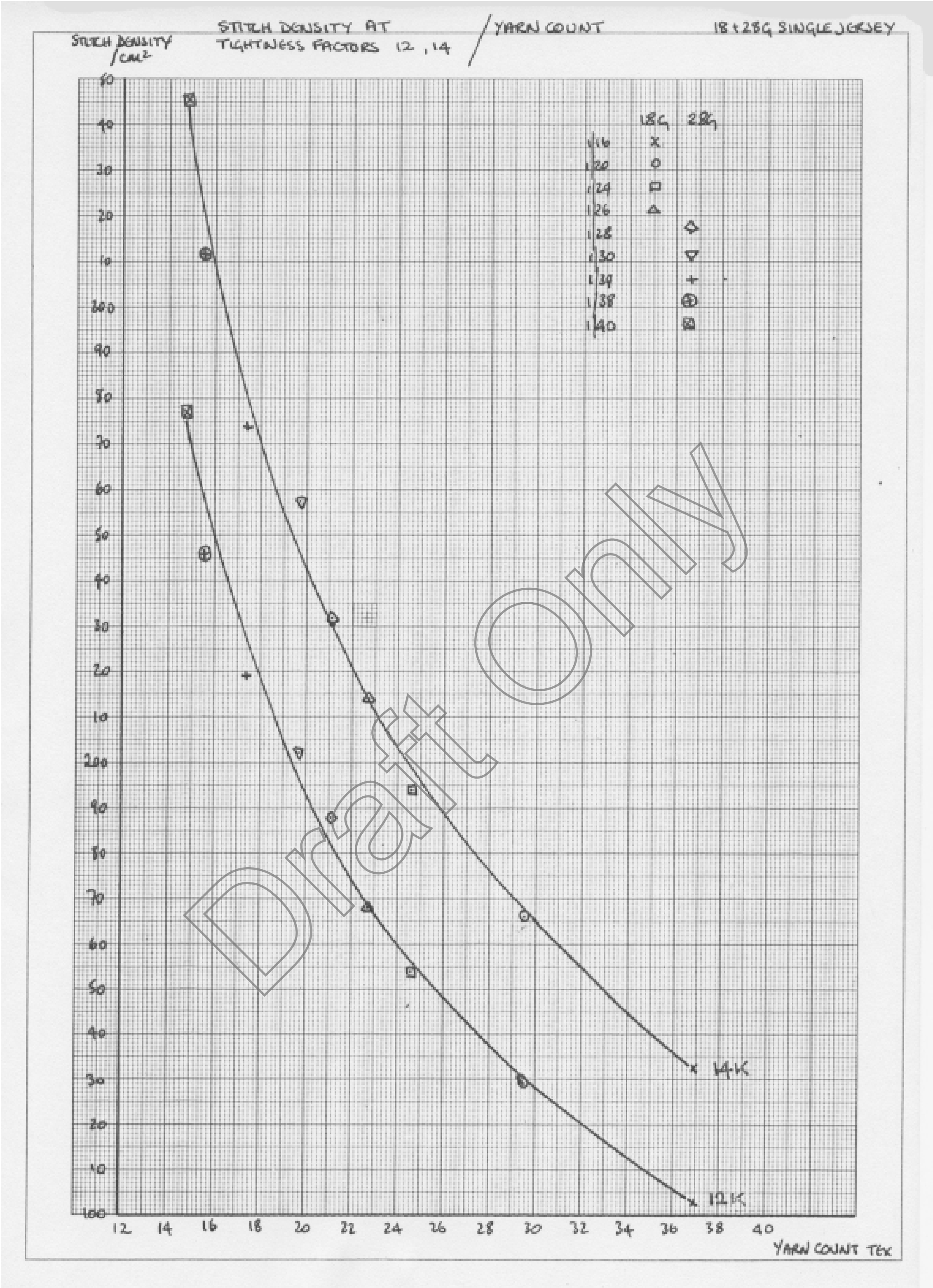
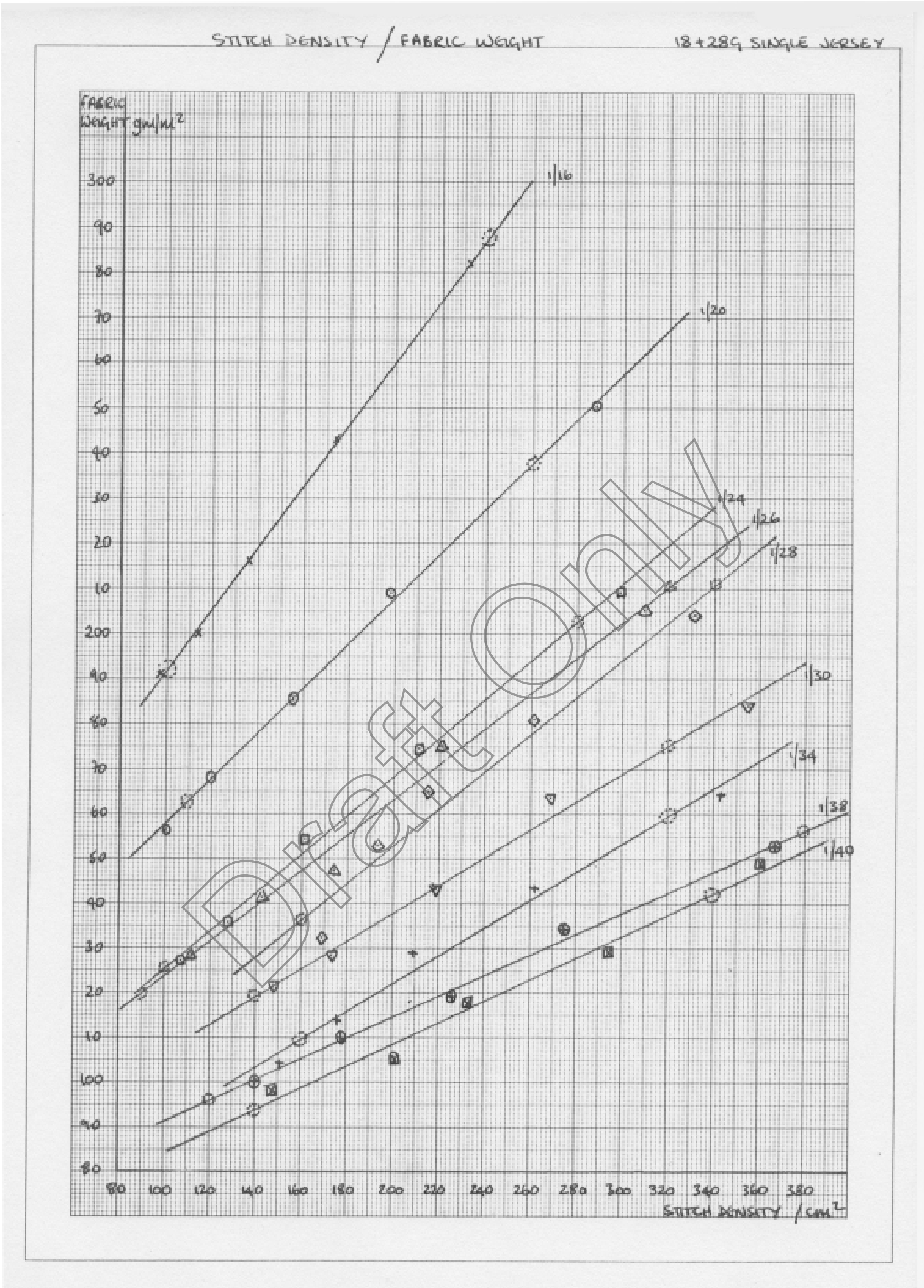

STITCH DENSITY /cm²
TIGHTNESS FACTOR / STITCH DENSITY
1/40
1/38
1/30
1/34
1/28
1/26
1/24
1/20
1/16
7 8 9 10 11 12 13 14 15 16 17 18 19 20
TIGHTNESS FACTOR √tex / l

Figure 18



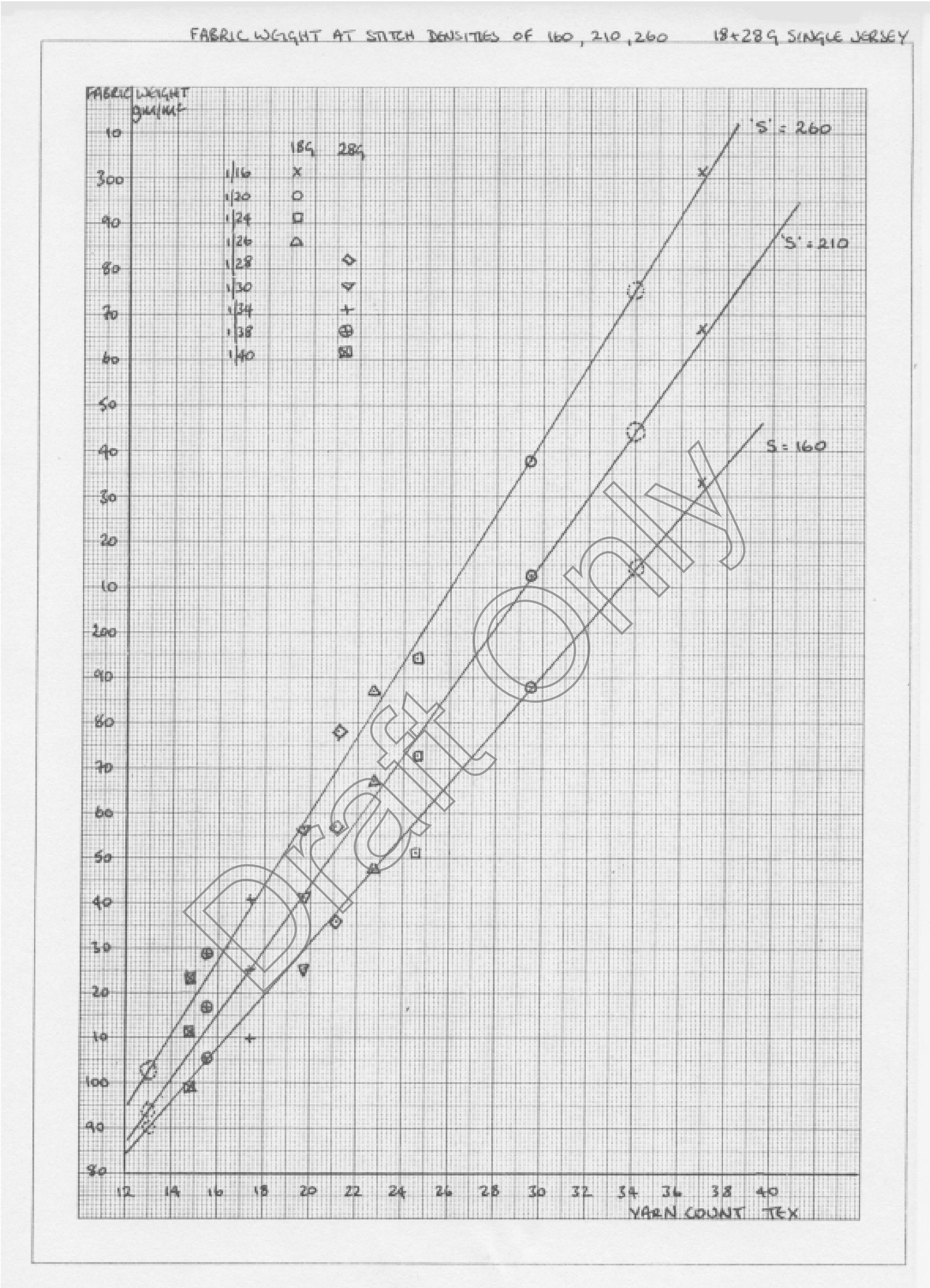
STITCH DENSITY AT TIGHTNESS FACTORS 12, 14 / YARN COUNT
18 + 28G SINGLE JERSEY
STITCH DENSITY /CM²
18G 28G
1/16 x
1/20 o
1/24
1/26
1/28
1/30
1/34 +
1/38
1/40
14K
12K
YARN COUNT TEX
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

Figure 19



STITCH DENSITY / FABRIC WEIGHT
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
STITCH DENSITY / cm²
1/16
1/20
1/24
1/26
1/28
1/30
1/34
1/38
1/40

Figure 20



FABRIC WEIGHT AT STITCH DENSITIES OF 160, 210, 260
18+28G SINGLE JERSEY
FABRIC WEIGHT gm/m²
'S' = 260
'S' = 210
S = 160
18G
28G
YARN COUNT TEX

Table 1

YARN TEST RESULTS 18, 24, 28G SINGLE JERSEY

COTTON COUNT	TEX	SES GMS	% EXT	TWIST FACTOR	FRICTION AGAINST STEEL	GM/TEX
16	36.9	469	6.6	3.5	0.11	12.71
20	29.5	371	7.9	3.5	0.10	12.58
24	24.6	274	6.3	3.3	0.10	11.14
26	22.7	287	6.9	3.5	0.12	12.64
28	21.1	264	7.7	3.5	0.11	12.51
30	19.7	238	7.5	3.3	0.11	12.08
34	17.4	206	7.0	3.5	0.11	11.84
38	15.5	172	6.3	3.5	0.11	11.10
40	14.8	158	6.8	3.3	0.12	10.67

ALL YARNS TESTED AT LEEDS UNIVERSITY

Table 2

KNITTING SPECIFICATIONS FOR 18 GAUGE SAMPLES

YARN NE 1/16 TEX 36.9					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.55	0.50	0.45	0.39	0.33
TIGHTNESS FACTOR	11.0	12.1	13.5	15.6	18.4
COURSES/3CM ON M/C	18.9	23.6	28.3	37.8	54.3

YARN NE 1/20 TEX 29.2					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.55	0.49	0.43	0.36	0.30
TIGHTNESS FACTOR	9.8	11.0	12.6	15.0	18.4
COURSES/3CM ON M/C	17.7	23.6	29.5	39.0	55.5

YARN NE 1/24 TEX 24.6					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.55	0.48	0.42	0.36	0.29
TIGHTNESS FACTOR	9.0	10.3	11.8	13.8	17.1
COURSES/3CM ON M/C	17.7	22.4	28.3	39.0	55.5

YARN NE 1/26 TEX 23.3					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.55	0.48	0.42	0.36	0.29
TIGHTNESS FACTOR	8.8	10.0	11.5	13.3	16.6
COURSES/3CM ON M/C	17.7	21.2	28.3	40.2	55.5

Table 3

KNITTING SPECIFICATIONS FOR 24 GAUGE SAMPLES

YARN NE 1/20					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.532	0.476	0.413	0.357	0.298
TIGHTNESS FACTOR	10.16	11.34	13.09	15.13	18.16
COURSES/3CM ON M/C	18.3	22.4	28.3	37.8	54.3

YARN NE 1/24					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.532	0.484	0.417	0.353	0.286
TIGHTNESS FACTOR	9.33	10.24	11.91	14.04	17.36
COURSES/3CM ON M/C	17.1	20.7	26.0	36.6	56.7

YARN NE 1/26					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.556	0.489	0.421	0.353	0.286
TIGHTNESS FACTOR	8.69	9.89	11.48	13.66	16.89
COURSES/3CM ON M/C	16.5	19.5	26.0	35.4	55.5

YARN NE 1/28					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.595	0.516	0.437	0.357	0.278
TIGHTNESS FACTOR	7.83	9.03	10.67	13.04	16.77
COURSES/3CM ON M/C	14.2	17.7	23.0	33.1	59.0

YARN NE 1/30					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.567	0.492	0.421	0.349	0.274
TIGHTNESS FACTOR	7.82	9.02	10.55	12.71	16.21
COURESES/3CM ON M/C	15.4	18.9	24.8	34.3	56.7

Table 4

KNITTING SPECIFICATIONS FOR 28 GAUGE SAMPLES

YARN NE 1/28					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.43	0.39	0.35	0.31	0.27
TIGHTNESS FACTOR	10.8	11.9	13.3	15.0	17.2
COURSES/3CM ON M/C	21.3	21.3	26.0	33.1	48.4

YARN NE 1/30					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.45	0.40	0.35	0.30	0.26
TIGHTNESS FACTOR	9.9	11.1	12.7	14.8	17.1
COURSES/3CM ON M/C	21.3	21.3	27.2	33.1	49.6

YARN NE 1/34					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.47	0.42	0.37	0.31	0.26
TIGHTNESS FACTOR	8.9	9.9	11.3	13.4	16.0
COURSES/3CM ON M/C	20.1	21.3	26.0	31.9	49.6

YARN NE 1/38					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.47	0.42	0.37	0.31	0.26
TIGHTNESS FACTOR	8.4	9.4	10.6	12.7	15.1
COURSES/3CM ON M/C	20.1	21.3	26.0	33.1	49.6

YARN NE 1/40					
SAMPLE NO.	1	2	3	4	5
STITCH LENGTH CM	0.47	0.42	0.37	0.31	0.26
TIGHTNESS FACTOR	8.2	9.1	10.3	12.3	14.8
COURSES/3CM ON M/C	20.1	20.1	26.0	33.1	49.6

Table 5

18GAUGE SINGLE - JERSEY

SAMPLE NO	STITCH LENGTH m.m.	WEIGHT gm/m²	BURST STRENGTH Kn/m²	COURSES /3cm	WALES /3cm	ANGLE OF SPIRALITY	TIGHTNESS FACTOR $K=\frac{\sqrt{tex}}{\ell}$	LENGTH SHRINKAGE %	WIDTH SHRINKAGE %	SHRINKAGE FROM COURSES %	SHRINKAGE FROM WALES %
16-1	5.22	191.04	599.4	31.9	27.4	34.73	11.64	25.37	4.34+	23.33	8.19
2	4.76	200.5	634.6	35.7	28.8	30.8	12.76	23.97	0.82	21.85	8.61
3	4.27	216.39	684.9	39.8	30.7	24.48	14.23	19.61	7.77	17.80	13.46
4	3.74	243.39	792.5	46.9	33.5	15.85	16.24	9.78	14.25	9.57	17.61
5	3.22	282.6	954.5	56.7	36.9	11.35	18.86	2.61+	26.37	2.71+	26.92
20-1	5.21	156.78	465.0	32.4	28.0	42.68	10.37	26.55	6.20+	25.91	8.86
2	4.68	168.22	478.1	35.9	30.1	36.47	11.55	22.98	3.35	21.38	12.16
3	4.08	185.55	569.8	41.6	33.7	28.30	13.24	18.70	12.59	17.90	20.00
4	3.46	209.0	685.6	49.0	36.4	19.66	15.62	7.35	22.42	5.78	25.97
5	2.92	250.37	752.5	63.0	41.1	13.79	18.51	9.51+	33.88	9.57+	35.34
24-1	5.27	127.28	357.4	32.1	30.1	43.49	9.41	30.08	13.03+	27.94	15.69
2	4.66	135.87	435.3	35.4	32.6	38.92	10.64	25.98	2.86	23.67	20.29
3	4.02	154.58	439.5	41.1	35.8	33.11	12.34	17.85	14.26	17.82	24.08
4	3.40	174.57	517.4	49.7	38.3	24.88	14.59	8.99	24.24	7.60	29.01
5	2.81	209.16	635.9	65.9	42.1	17.98	17.65	9.64+	35.19	10.54+	36.24
26-1	5.31	128.65	352.6	33.0	30.6	46.45	9.09	29.96	12.23+	31.18	17.37
2	4.68	141.49	396.0	37.0	34.7	43.78	10.31	25.47	0.23+	25.56	22.11
3	4.03	147.42	458.6	41.5	36.3	37.23	11.98	18.57	13.17	17.38	24.76
4	3.42	175.53	556.7	49.5	40.3	29.68	14.11	9.65	26.10	7.91	31.96
5	2.83	205.39	624.9	65.5	43.9	20.86	17.06	9.59+	35.59	9.11+	37.90

ALL RESULTS AFTER FIVE WASH + TUMBLE DRY CYCLES PLUS FINAL PRESS.

Table 6

24 GAUGE SINGLE - JERSEY

SAMPLE No.	STITCH LENGTH M.M.	WEIGHT gm/m²	BURST STRENGTH Kn/m²	COURSES /3cm	WALES /3cm	TIGHTNESS FACTOR $K = \sqrt{tex}/\ell$	LENGTH SHRINKAGE %	WIDTH SHRINKAGE %	SHRINKAGE FROM COURSES %	SHRINKAGE FROM WALES %
20-1	5.4	169.3		31.8	33.0	10.51	34.36	14.80+	25.47	3.64
2	4.67	180.3		36.6	34.2	11.57	25.59	0.57	25.41	10.53
3	3.45	191.1		42.6	34.2	13.68	18.79	4.32	19.72	3.51
4	3.49	212.8	602.6	49.5	36.6	15.48	13.46	10.75	11.52	9.84
5	2.90	241.3	830.16	61.5	41.4	16.70	3.59	19.43	0.00	20.29
24-1	5.17	143.7		34.2	34.2	9.59	39.51	19.48+	30.70	7.02
2	4.60	159.7		36.6	34.2	10.78	34.54	4.0+	25.41	7.02
3	4.09	164.6		41.4	36.6	12.13	10.97	11.55	23.19	9.84
4	3.42	184.0	481.27	48.3	39.0	14.50	15.83	13.39	11.80	15.38
5	2.83	212.5	746.04	63.9	43.8	17.53	1.24	29.08	1.88	21.92
26-1	5.42	129.0		31.8	29.4	8.91	35.92	34.67+	25.47	4.08+
2	4.81	146.5		36.6	37.8	10.04	33.62	19.25+	25.41	15.87
3	4.01	156.5		41.4	39.0	11.78	26.95	5.31	17.39	12.31
4	3.42	172.0	595.04	49.5	40.2	14.12	18.99	15.62	16.36	14.93
5	2.69	204.0	608.14	63.9	45.0	17.96	4.42	25.3	1.88	26.67
28-1	5.86	135.0		20.1	34.2	7.95	46.28	51.12+	5.97	24.62
2	5.01	148.0		24.9	35.4	9.30	25.21	23.08+	9.64	19.67
3	4.27	155.0		30.6	35.4	10.41	22.17	4.7+	10.78	13.56
4	3.51	163.0	517.13	41.4	36.6	13.09	16.86	11.86	8.70	3.39
5	2.72	194.0	645.37	66.0	39.0	17.20	0.42	25.53	5.00	7.02
30-1	5.68	93.1		22.5	34.2	7.82	46.98	62.16+	16.00	3.51
2	4.78	106.1		33.0	33.0	9.29	36.77	18.15+	24.55	0.00
3	4.09	138.9		39.0	39.0	10.86	24.87	0.94+	18.46	15.38
4	3.42	152.1	457.83	48.3	37.8	12.98	16.93	19.87	11.80	9.52
5	2.73	181.4	541.95	63.9	45.0	16.26	4.89	30.84	1.88+	26.67

RESULTS AFTER ONE WASH + TUMBLE DRY CLYCLE EXCEPT BURST WHICH IS AFTER FIVE

Table 7

28GAUGE SINGLE - JERSEY

SAMPLE No	STITCH LENGTH m.m.	WEIGHT gm/m²	BURST STRENGTH Kn/m²	COURSES /3cm	WALES /3cm	ANGLE OF SPIRALITY	TIGHTNESS FACTOR $K = \frac{\sqrt{tex}}{\ell}$	LENGTH SHRINK-AGE %	WIDTH SHRINK-AGE %	SHRINK-AGE FROM COURSES %	SHRINK-AGE FROM WALES %
28-1	4.25	132.8	390.5	39.5	38.5	46.08	10.96	40.30	26.76+	37.77	7.53
2	3.79	153.0	447.8	44.5	39.1	42.34	12.29	36.04	12.48+	35.94	7.74
3	3.49	165.0	482.9	46.7	41.5	33.90	13.35	30.10	0.25	27.39	10.12
4	3.10	181.4	497.4	54.1	43.5	25.40	15.03	23.33	8.66	19.58	11.87
5	2.72	204.0	614.6	63.2	47.2	17.03	17.13	13.58	16.24	10.21	18.38
30-1	4.53	121.8	329.9	37.7	35.4	49.06	9.80	38.55	29.37+	34.78	4.67
2	4.09	128.6	363.4	40.9	38.0	43.76	10.85	36.31	16.35+	32.96	6.13
3	3.58	143.6	446.1	47.4	41.6	39.66	12.40	29.65	2.24+	31.01	11.23
4	3.10	163.6	464.99	55.0	44.0	27.04	14.32	24.9	9.95	22.13	15.27
5	2.62	184.4	585.0	66.1	48.4	17.18	16.94	12.42	19.98	7.66	20.30
34-1	4.78	104.4	281.6	39.0	34.9	55.08	8.73	34.44	30.58+	34.84	8.54
2	4.19	114.0	336.1	39.9	39.7	47.84	9.46	35.07	21.0+	35.87	9.05
3	3.59	129.2	370.5	45.4	41.6	42.16	11.62	33.25	6.72+	30.98	10.51
4	3.10	143.6	407.5	53.4	44.3	32.24	13.46	24.49	9.16	23.77	15.63
5	2.59	164.8	474.0	63.4	48.8	21.50	16.11	14.46	19.13	8.66	20.73
38-1	4.66	100.8	246.2	35.6	35.4	54.02	8.45	38.46	32.83+	30.60	8.55
2	4.22	110.4	272.4	38.4	41.7	52.66	9.33	40.68	30.32+	32.99	12.29
3	3.55	119.0	312.4	44.5	45.7	43.46	11.09	34.18	7.88+	32.12	17.67
4	3.03	134.6	357.4	52.3	47.3	37.26	12.99	25.58	8.18	19.47	19.70
5	2.58	153.0	390.1	64.7	51.1	26.94	15.26	14.67	19.97	13.23	24.07
40-1	4.84	98.5	232.4	38.0	35.0	56.0	7.95	40.03	45.65+	33.86	4.97
2	4.29	105.4	238.8	42.6	42.5	52.52	8.97	39.52	27.56+	37.79	15.10
3	3.64	118.8	288.9	46.8	44.8	46.32	10.57	33.62	8.96+	31.79	14.73
4	3.20	129.0	322.45	53.8	49.3	37.82	12.02	24.61	8.35	21.72	23.31
5	2.65	149.8	375.8	63.2	51.5	27.66	14.56	16.62	20.06	11.75	23.88

ALL RESULTS AFTER FIVE WASH+TUMBLE DRY CYCLES

Table 8

WALES PER 3 CM AT STITCH LENGTHS OF .33, .37, .41 CM

	NE	TEX	l = .33	l = .37	l = .41
18G	16	35.9	36.4	33.7	31.5
	20	29.5	38.0	35.3	33.0
	24	24.6	38.9	35.7	34.8
	26	22.7	40.8	38.5	36.4
28G	28	21.1	42.3	39.5	-
	30	19.7	42.8	40.2	38.2
	34	17.4	43.3	41.2	39.6
	38	15.5	46.0	43.9	42.3
	40	14.8	47.4	45.2	43.4

Table 9

WALES PER 3 CM AT TIGHTNESS FACTORS 12, 14

	NE	TEX	K = 12	K = 14
18G	16	36.9	27.8	30.5
	20	29.5	31.1	34.6
	24	24.6	34.7	37.6
	26	22.7	37.0	40.0
28G	28	21.1	39.5	42.6
	30	19.7	40.6	44.0
	34	17.4	42.6	45.7
	38	15.5	46.8	49.4
	40	14.8	48.8	50.9

Table 10

COURSES PER 3 CM AT TIGHTNESS FACTORS 12, 14

	NE	TEX	K = 12	K = 14
18G	16	36.9	33.3	39.1
	20	29.5	37.1	43.7
	24	24.6	39.8	47.1
	26	22.7	41.7	48.8
28G	28	21.1	42.8	50.0
	30	19.7	45.2	52.8
	34	17.4	46.6	54.4
	38	15.5	47.9	57.1
	40	14.8	52.8	61.7

Table 11

$\frac{TEX}{\ell}$

NE	TEX	18 GAUGE	NE	TEX	28 GAUGE
16	36.9	1. 70.69	28	21.1	1. 49.65
		2. 77.52			2. 55.67
		3. 86.42			3. 60.46
		4. 98.66			4. 68.06
		5. 114.60			5. 77.57
20	29.5	1. 56.62	30	19.7	1. 43.49
		2. 63.03			2. 48.17
		3. 72.30			3. 55.03
		4. 85.26			4. 63.55
		5. 101.03			5. 75.19
24	24.6	1. 46.68	34	17.4	1. 36.40
		2. 52.79			2. 41.53
		3. 61.19			3. 48.47
		4. 72.35			4. 56.13
		5. 87.54			5. 67.18
26	22.7	1. 42.75	38	15.5	1. 33.26
		2. 48.50			2. 36.73
		3. 56.33			3. 43.66
		4. 66.37			4. 51.16
		5. 80.21			5. 60.08
			40	14.8	1. 30.58
					2. 34.50
					3. 40.66
					4. 46.25
					5. 55.85

Table 12

STRAIGHT LINE CONSTANTS FOR (S.ℓ.)/WEIGHT

y = mx + c r = correlation coefficient

YARN COUNT NE	TEX	m	c	r	x	y
18G 16	36.9	3.8447	-6.3587	0.9987	45 85	166.65 320.44
20	29.5	3.0004	-0.9471	0.9967	50 90	149.07 269.09
24	24.6	3.0009	-41.9926	0.9990	50 90	108.05 228.09
26	22.7	2.8553	-44.1419	0.9933	50 95	98.62 227.11
28G 28	21.1	2.7706	-49.6395	0.9462	60 95	116.50 213.57
30	19.7	2.4724	-45.7940	0.9936	60 100	102.55 201.45
34	17.4	2.6064	-67.7328	0.9987	70 95	114.72 179.88
38	15.5	1.8502	-23.9442	0.9734	60 100	87.07 161.08
40	14.8	1.8004	-35.5259	0.8594	65 100	91.50 144.51

Table 13

STITCH DENSITY x STITCH LENGTH (S x ℓ)

18 GAUGE				28 GAUGE			
NE	TEX	SAMPLE	S x ℓ	NE	TEX	SAMPLE	S x ℓ
16	36.9	1	50.70	28	21.1	1	71.81
		2	54.38			2	73.27
		3	57.97			3	75.15
		4	65.29			4	81.06
		5	74.86			5	90.15
20	29.5	1	52.52	30	19.7	1	67.17
		2	56.19			2	70.63
		3	63.55			3	78.43
		4	68.57			4	83.36
		5	84.01			5	93.13
24	24.6	1	56.58	34	17.4	1	72.29
		2	59.76			2	73.74
		3	64.80			3	75.34
		4	71.91			4	81.48
		5	83.99			5	89.04
26	22.7	1	59.58	38	15.5	1	65.25
		2	66.76			2	75.08
		3	67.45			3	80.22
		4	75.50			4	83.29
		5	87.66			5	94.78
				40	14.8	1	71.53
						2	86.30
						3	84.80
						4	94.30
						5	95.83

Table 14

TEX x STITCH LENGTH (TEXℓ)

18 GAUGE				28 GAUGE			
NE	TEX	SAMPLE	TEX ℓ	NE	TEX	SAMPLE	TEX ℓ
16	36.9	1	19.26	28	21.1	1	8.97
		2	17.56			2	8.00
		3	15.76			3	7.36
		4	13.8			4	6.54
		5	11.88			5	5.74
20	29.5	1	15.37	30	19.7	1	8.92
		2	13.81			2	8.06
		3	12.04			3	7.05
		4	10.21			4	6.11
		5	8.61			5	5.16
24	24.6	1	12.96	34	17.4	1	8.32
		2	11.46			2	7.29
		3	9.89			3	6.25
		4	8.36			4	5.39
		5	6.91			5	4.51
26	22.7	1	12.05	38	15.5	1	7.22
		2	10.62			2	6.54
		3	9.16			3	5.50
		4	7.76			4	4.70
		5	6.42			5	4.00
				40	14.8	1	7.16
						2	6.35
						3	5.39
						4	4.74
						5	3.92

Table 15

CALCULATED WEIGHT GM/M^2 = $\frac{S \times TEX \times \ell}{10}$

Where: S = stitch density cpc x wpc, tex = yarn count (nominal)
ℓ = stitch length cm, 10 = scale factor

18 GAUGE				28 GAUGE			
NE	TEX	SAMPLE NO.	CALC. WEIGHT	NE	TEX	SAMPLE NO.	CALC. WEIGHT
16	35.9	1	187.07	28	21.1	1	151.53
		2	200.66			2	154.60
		3	213.91			3	158.57
		4	240.92			4	171.04
		5	276.22			5	190.23
20	29.5	1	154.92	30	19.7	1	132.33
		2	165.76			2	139.14
		3	187.48			3	154.52
		4	202.28			4	164.21
		5	247.82			5	183.47
24	24.6	1	139.18	34	17.4	1	125.78
		2	146.99			2	128.32
		3	159.42			3	131.08
		4	176.90			4	141.78
		5	206.62			5	154.92
26	22.7	1	135.24	38	15.5	1	101.14
		2	151.55			2	116.38
		3	153.12			3	124.34
		4	171.38			4	129.09
		5	198.90			5	146.90
				40	14.8	1	105.86
						2	127.69
						3	125.50
						4	139.57
						5	141.84

Table 16

STITCH DENSITY/CM^2

COURSES/CM x WALES/CM = STITCH DENSITY/CM^2

18 GAUGE			24 GAUGE			28 GAUGE		
16	1	97.12	20	1	116.60	28	1	168.97
	2	114.24		2	139.08		2	193.33
	3	135.76		3	161.88		3	215.34
	4	174.57		4	201.30		4	261.48
	5	232.47		5	282.90		5	331.45
20	1	100.80	24	1	129.96	30	1	148.29
	2	120.07		2	139.08		2	172.69
	3	155.77		3	168.36		3	219.09
	4	198.18		4	209.30		4	268.89
	5	287.70		5	310.98		5	355.47
24	1	107.36	26	1	103.88	34	1	151.23
	2	128.23		2	153.72		2	176.00
	3	161.20		3	179.40		3	209.85
	4	211.50		4	221.10		4	262.85
	5	298.91		5	319.50		5	343.77
26	1	112.20	28	1	87.10	38	1	140.03
	2	142.66		2	101.26		2	177.92
	3	167.38		3	120.36		3	225.96
	4	220.75		4	162.84		4	274.87
	5	309.74		5	250.80		5	367.35
			30	1	85.50	40	1	147.78
				2	121.00		2	201.17
				3	169.00		3	232.96
				4	202.86		4	294.70
				5	319.50		5	361.64

Table 17

STITCH DENSITY AT TIGHTNESS FACTORS OF K = 12, K = 14

NE		TEX	K = 12	K = 14
18G	1/16	36.9	103	132.5
	20	29.5	129	166
	24	24.6	154	194
	26	22.7	168	214
28G	28	21.1	188	232
	30	19.7	202	257.5
	34	17.4	219	274
	38	15.5	246	312
	40	14.8	277	345.5

Table 18

STRAIGHT LINE CONSTANTS FOR STITCH DENSITY/WEIGHT

$y = mx + c$ r = correlation coefficient

NE	TEX	m	c	r	x	y
18G 16	36.9	0.6840	123.608	0.9998	100 240	192.01 287.77
20	29.5	0.4996	107.805	0.9993	110 260	162.76 237.70
24	24.6	0.4280	82.6181	0.9971	100 280	125.42 202.46
26	22.7	0.3949	84.4403	0.9964	90 320	119.98 210.81
28G 28	21.1	0.4145	70.2018	0.9805	160 340	136.52 211.13
30	19.7	0.3103	76.14	0.9958	140 320	119.58 175.44
34	17.4	0.3105	60.1714	0.9933	160 320	109.85 159.53
38	15.5	0.2319	68.5518	0.9970	120 380	96.38 156.67
40	14.8	0.2418	60.415	0.9896	140 340	94.27 142.63

Table 19

FABRIC WEIGHTS AT STITCH DENSITIES OF 160, 210, 260.

NE	TEX	S = 160	S = 210	S = 260
16	36.9	233	267	301.5
20	29.5	188	213	237.5
24	24.6	151	172.5	194
26	22.7	147.5	167	187
28	21.1	136	157	178
30	19.7	125.5	141	156.5
34	17.4	109.85	125	140.5
38	15.5	105.5	117	128.5
40	14.8	99	111	123

Straight Line Constants for Above

$y = mx+c$

S = 160 x = 12.5 y = 90.24
m = 6.0692 x = 34 y = 213.98
c = 7.6301
correlation coefficient r = 0.9975

S = 210 x = 12.5 y = 93.12
m = 7.0503 x = 34 y = 244.70
c = 4.9921
correlation coefficient r = 0.9981

S = 260 x = 12.5 y = 102.85
m = 8.0381 x = 34 y = 275.67
c = 2.3766
correlation coefficient r = 0.9978