Research Record No 178

Crosslinked Interlock and 1x1 Rib (5%)

A Mathematical Analysis of The Test Data

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September 1983

Classification: Fabrics/Knitted/Properties
Key Words: Interlock, Rib, Relaxed Dimensions, Mercerising, Crosslinking
Digital Version: October 2014

Contents

Appendices

INTRODUCTION

Previous reports, Research Records 126, 159, 170 and 174 describe the application of different levels of crosslinking agent to rib and interlock fabrics and the procedure for evaluation of the test data.

This report briefly describes the application of a further and final level of crosslinking agent (5% o.w.f.) to a full range of fabrics (bar one variant) and presents the results of a similar analysis of the data.

This final level is way above any commercial treatment which is likely to be given but the data is required so that a detailed mathematical analysis of all the data can eventually be carried out to determine whether equations can be obtained where concentration of crosslinker either on the fabric or in the bath will be an independent variable.

Regression and correlation coefficients are given for this latest level as well as plots of the actual data points.

PROCEDURE

Five-metre lengths of 61 fabric variants (mercerised rib 30/285 was no longer available) were prepared and assembled as described in Research Record No. 162. The finish identifiers used for this series were:

JDX5 and MJDX5

The following bath was used for the treatments carried out on the Shirley equipment as on previous occasions.

112 g/1	Fixapret CPN
16.8 g/1	$MgC1_2$ 6H20
25 g/l	Siligen E
25 g/1	Perapret PE40
1 g/l	Synperonic NX

Wet pick-up: 90-100%

Drying with overfeed at 120°C

Curing: 45 seconds at 170°C

All fabrics were submitted to the testing laboratory for comprehensive testing.

Analysis

The following mathematical relationships were taken and tested with the data from the latest treatments.

courses/cm	=	$a + b/l + c\sqrt{(avTex)}$
wales/cm	=	$a + b/l + c\sqrt{(avTex)}$
weight	=	$a + b.Tex/l$
stitch density	=	$a + b/1^2 + c.\ avTex$
burst strength	=	$a + b/1^2 + c.\ avTex + d.\ avSES$

For each property in turn the regression coefficients and the correlation coefficients were obtained using the Tektronix statistical software package.

Presentation of Results

Table 1 gives the properties of interest for the interlock fabrics.

Table 2 gives the properties of interest for the 1 x 1 rib fabrics.

The regression coefficients and correlation coefficients for the properties under investigation are given in the following tables.

Table 3 - courses/cm

Table 4 - wales/cm

Table 5 - stitch density

Table 6 - weight

Table 7 - bursting strength

Table 8 - Tex

Table 9 - stitch length

Graphs of the actual data points are given in the appendix as follows.

FABRIC	PROPERTY	FIGURE
Interlock	Courses	1
Mercerised Interlock	Courses	2
1 x 1 Rib	Courses	3
Mercerised 1 x 1 Rib	Courses	4
Interlock	Wales	5
Mercerised Interlock	Wales	6
1 x 1 Rib	Wales	7
Mercerised 1 x 1 Rib	Wales	8
Interlock	Weight	9
Mercerised Interlock	Weight	10
1 x 1 Rib	Weight	11
Mercerised 1 x 1 Rib	Weight	12
Interlock	Length Shrinkage*	13
Mercerised Interlock	Length Shrinkage*	14
1 x 1 Rib	Length Shrinkage*	15
Mercerised 1 x 1 Rib	Length Shrinkage*	16

* Measured

Conclusions

For the majority of properties investigated, the relationships used have given good correlation coefficients (better than 0.9) and the plots of the actual data points also show this.

However, the one property which has shown poor correlation ($r^2 = 0.81$) is relaxed wales. Oddly enough, this is only the case with the unmercerised fabrics both interlock and rib. The mercerised fabrics have given reasonable correlation coefficients (0.93).

Figures 5 and 7 show the degree of scatter which was obtained with all three counts of yarn.

A prediction of width calculated from the relaxed wales with this 5% crosslinker level will therefore be rather inaccurate.

Figures 13-16 show the actual length shrinkage figures obtained with this 5% treatment. Length shrinkage of 3% to 7% to the tumble test have been obtained which is approximately one third of the corresponding uncrosslinked fabrics.

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INTERLOCK FABRICS 20-SEP-83 10:54

Sample	%Shr.L JDX5	c/cm JDX5	w/cm JDX5	S JDX5	1 cm JDX5	Bst.AW JDX5	Wt.AW JDX5	avSL A JDX5
I34/377	5.8	10.37	12.07	125.09	0.374	281.4	166.9	0.375
I34/359	5.7	11.5	12.43	142.98	0.357	316.8	175.9	0.357
I34/340	5.9	12.53	13.6	170.45	0.339	322.1	182.4	0.338
I34/324	5.3	13.43	13.73	184.48	0.322	314.8	191.8	0.321
I34/307	5.1	14.63	13.93	203.89	0.304	360.1	206.2	0.304
I38/377	6	10.57	12.53	132.44	0.374	243.9	154.2	0.375
I38/359	4.9	10.57	13.1	138.42	0.357	279.5	154.7	0.357
I38/340	6.1	12.07	13.8	166.52	0.339	279.3	168.4	0.338
I38/324	4.5	12.53	13.5	169.2	0.321	307.4	173.8	0.321
I38/307	5.3	13.97	14.67	204.84	0.303	317	187.7	0.304
I42/377	7.2	10.23	12.9	132.01	0.376	244.7	138.5	0.375
I42/359	4.3	10.63	12.37	131.5	0.358	229.4	140.9	0.357
I42/340	6.4	11.83	14.03	166.06	0.336	239.9	150.2	0.338
I42/324	5.6	12.57	14.53	182.64	0.321	259.6	161	0.321
I42/307	3.6	13.1	14.33	187.77	0.304	299.8	171.1	0.304

INTERLOCK FABRICS 20-SEP-83 10:54

Sample	%Shr.L MJDX5	c/cm MJDX5	w/cm MJDX5	S MJDX5	1 cm MJDX5	Bst.AW MJDX5	Wt.AW MJDX5	avSL A MJDX5
I34/377	5.5	10.67	15.1	161.07	0.349	534.3	206.5	0.349
I34/359	4.6	11.3	15.27	172.51	0.333	578.9	213.5	0.333
I34/340	4.5	12.4	15.8	195.92	0.313	598.8	231.6	0.314
I34/324	3.5	13.37	16.57	221.44	0.299	608	240.6	0.3
I34/307	3.4	14.43	16.7	241.04	0.283	640.2	253.1	0.284
I38/377	5.7	10.6	15.4	163.24	0.349	500.9	187.9	0.349
I38/359	4.7	11.37	15.43	175.43	0.332	483.4	199	0.333
I38/340	4.8	11.97	16.57	198.25	0.315	545.8	208.8	0.314
I38/324	3.7	12.73	17	216.47	0.299	568.2	223.4	0.3
I38/307	3.5	13.9	17.2	239.08	0.284	594.8	223.1	0.284
I42/377	6.1	10.37	15.7	162.76	0.348	417.3	169.2	0.349
I42/359	5.9	11.07	15.93	176.33	0.333	424.7	175	0.333
I42/340	4.9	12.17	17.13	208.46	0.313	467.5	194.3	0.314
I42/324	3.9	12.57	17.43	219.08	0.301	491.1	201.2	0.3
I42/307	3.6	13.57	17.9	242.84	0.285	500.8	209.6	0.284

INTERLOCK FABRICS 20-SEP-83 10:54

Sample	avSL K JDX5	av Tex JDX5	act Tx JDX5	ravTx JDX5	avSES JDX5	1/1 JDX5	1/1^2 JDX5	Tex/1 JDX5
I34/377	0.378	17.4	17.06	4.17	86.68	2.674	7.15	47.33
I34/359	0.361	17.4	17.06	4.17	86.68	2.801	7.85	48.74
I34/340	0.341	17.4	17.06	4.17	86.68	2.95	8.7	51.03
I34/324	0.324	17.4	17.06	4.17	86.68	3.106	9.64	53.42
I34/307	0.306	17.4	17.06	4.17	86.68	3.289	10.82	57.24
I38/377	0.378	15.95	15.5	3.99	79.26	2.674	7.15	43.85
I38/359	0.361	15.95	15.5	3.99	79.26	2.801	7.85	44.82
I38/340	0.341	15.95	15.5	3.99	79.26	2.95	8.7	47.2
I38/324	0.324	15.95	15.5	3.99	79.26	3.115	9.7	49.53
I38/307	0.306	15.95	15.5	3.99	79.26	3.3	10.89	51.16
I42/377	0.378	14.48	14.03	3.81	69.64	2.66	7.07	38.56
I42/359	0.361	14.48	14.03	3.81	69.64	2.793	7.8	40.22
I42/340	0.341	14.48	14.03	3.81	69.64	2.976	8.86	42.86
I42/324	0.324	14.48	14.03	3.81	69.64	3.115	9.7	45.17
I42/307	0.306	14.48	14.03	3.81	69.64	3.289	10.82	48.03

INTERLOCK FABRICS 20-SEP-83 10:54

Sample	avSL K MJDX5	av Tex MJDX5	act Tx MJDX5	ravTx MJDX5	avSES MJDX5	1/1 MJDX5	1/1^2 MJDX5	Tex/1 MJDX5
I34/377	0.378	18.84	17.06	4.34	121.92	2.865	8.21	53.87
I34/359	0.361	18.84	17.06	4.34	121.92	3.003	9.02	56.76
I34/340	0.341	18.84	17.06	4.34	121.92	3.195	10.21	60.38
I34/324	0.324	18.84	17.06	4.34	121.92	3.344	11.19	62.21
I34/307	0.306	18.84	17.06	4.34	121.92	3.534	12.49	67.14
I38/377	0.378	17.18	15.5	4.14	111.82	2.865	8.21	49.28
I38/359	0.361	17.18	15.5	4.14	111.82	3.012	9.07	52.11
I38/340	0.341	17.18	15.5	4.14	111.82	3.175	10.08	54.6
I38/324	0.324	17.18	15.5	4.14	111.82	3.344	11.19	58.53
I38/307	0.306	17.18	15.5	4.14	111.82	3.521	12.4	58.8
I42/377	0.378	15.46	14.03	3.93	95.06	2.874	8.26	45.4
I42/359	0.361	15.46	14.03	3.93	95.06	3.003	9.02	45.65
I42/340	0.341	15.46	14.03	3.93	95.06	3.195	10.21	49.84
I42/324	0.324	15.46	14.03	3.93	95.06	3.322	11.04	50.83
I42/307	0.306	15.46	14.03	3.93	95.06	3.509	12.31	54.04

RIB FABRICS 20-SEP-83 11:14

Sample	%Shr.L JDX5	c/cm JDX5	w/cm JDX5	S JDX5	l cm JDX5	Bst.AW JDX5	Wt.AW JDX5	avSL A JDX5
R26/350	7	10.7	9.27	99.15	0.351	262.3	166.2	0.353
R26/326	6.9	12.57	9.37	117.71	0.327	272.2	171.7	0.329
R26/306	6.2	13.33	10.3	137.33	0.31	289.2	183.3	0.311
R26/285	4.8	15.07	10.4	156.69	0.284	321.5	206.2	0.283
R26/267	3.4	16.2	10.33	167.4	0.266	364.6	219.1	0.268
R30/350	8.3	10.93	9	98.4	0.354	223.2	135.8	0.353
R30/326	6.8	11.93	9.97	118.94	0.329	236.7	152.2	0.329
R30/306	6.8	12.9	10.23	132.01	0.311	233.6	158.4	0.311
R30/285	5	14.6	10.67	155.73	0.282	278.4	176.9	0.283
R30/267	5.3	16.3	10.73	174.95	0.268	300.7	185.8	0.268
R34/350	7.2	10.43	9.1	94.94	0.353	190.7	116.3	0.353
R34/326	7.6	11.77	9.9	116.49	0.331	194.1	127.8	0.329
R34/306	7	12.57	10.4	130.69	0.311	213.5	137.6	0.311
R34/285	5.7	12.8	10.53	134.83	0.284	237.8	148.3	0.283
R34/267	5.8	15.73	10.97	172.54	0.269	260.9	157.8	0.268
R34/248	3.8	16.03	10.93	175.3	0.248	317.2	172.9	0.248

RIB FABRICS 20-SEP-83 11:14

Sample	%Shr.L MJDX5	c/cm MJDX5	w/cm MJDX5	S MJDX5	l cm MJDX5	Bst.AW MJDX5	Wt.AW MJDX5	avSL A MJDX5
R26/350	8.2	11.67	10.87	126.78	0.332	425.1	192.6	0.332
R26/326	7.8	12.77	11.5	146.82	0.308	451.9	213.1	0.308
R26/306	6.6	14.2	11.73	166.61	0.287	461.8	232	0.289
R26/285	4.8	15.7	12.03	188.92	0.266	498	246.4	0.267
R26/267	4.6	17.47	12.77	222.99	0.25	513.2	266.8	0.25
R30/350	8.3	11	11.17	122.83	0.331	382.1	169.5	0.332
R30/326	6.6	12.07	12.1	146.01	0.307	390.3	182.8	0.308
R30/306	7	13.47	12.53	168.78	0.291	416.9	198.9	0.289
R30/285	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
R30/267	5.5	16.6	13.17	218.57	0.251	443.3	223.8	0.25
R34/350	8.6	10.8	11.17	120.6	0.334	371.7	141.5	0.332
R34/326	7.2	11.47	11.7	134.16	0.309	359.4	149.8	0.308
R34/306	7	12.5	12.67	158.33	0.29	378.6	165.7	0.289
R34/285	6.4	14.23	13.13	186.93	0.268	397.9	178	0.267
R34/267	5.2	15.3	13.53	207.06	0.25	432.6	190.4	0.25
R34/248	4.5	17.23	13.93	240.12	0.232	430.6	211.3	0.232

RIB FABRICS 20-SEP-83 11:14

Sample	avSL K JDX5	av Tex JDX5	act Tx JDX5	ravTx JDX5	avSES JDX5	1/1 JDX5	1/1^2 JDX5	Tex/1 JDX5
R26/350	0.356	23.08	22.18	4.8	109.6	2.849	8.12	66.1
R26/326	0.333	23.08	22.18	4.8	109.6	3.058	9.35	71.56
R26/306	0.311	23.08	22.18	4.8	109.6	3.226	10.41	73.23
R26/285	0.288	23.08	22.18	4.8	109.6	3.521	12.4	80.99
R26/267	0.27	23.08	22.18	4.8	109.6	3.759	14.13	86.84
R30/350	0.356	19.81	19.7	4.45	95.7	2.825	7.98	53.95
R30/326	0.333	19.81	19.7	4.45	95.7	3.04	9.24	61.4
R30/306	0.311	19.81	19.7	4.45	95.7	3.215	10.34	63.67
R30/285	0.288	19.81	19.7	4.45	95.7	3.546	12.57	70.92
R30/267	0.27	19.81	19.7	4.45	95.7	3.731	13.92	74.63
R34/350	0.356	17.46	17.06	4.18	80.32	2.833	8.03	49.58
R34/326	0.333	17.46	17.06	4.18	80.32	3.021	9.13	52.57
R34/306	0.311	17.46	17.06	4.18	80.32	3.215	10.34	56.59
R34/285	0.288	17.46	17.06	4.18	80.32	3.521	12.4	61.97
R34/267	0.27	17.46	17.06	4.18	80.32	3.717	13.82	63.57
R34/248	0.25	17.46	17.06	4.18	80.32	4.032	16.26	70.97

RIB FABRICS 20-SEP-83 11:14

Sample	avSL K MJDX5	av Tex MJDX5	act Tx MJDX5	ravTx MJDX5	avSES MJDX5	1/1 MJDX5	1/1^2 MJDX5	Tex/1 MJDX5
R26/350	0.356	24.5	22.18	4.95	171.22	3.012	9.07	73.49
R26/326	0.333	24.5	22.18	4.95	171.22	3.247	10.54	79.87
R26/306	0.311	24.5	22.18	4.95	171.22	3.484	12.14	85.71
R26/285	0.288	24.5	22.18	4.95	171.22	3.759	14.13	92.48
R26/267	0.27	24.5	22.18	4.95	171.22	4	16	97.2
R30/350	0.356	21.25	19.7	4.61	145.17	3.021	9.13	64.35
R30/326	0.333	21.25	19.7	4.61	145.17	3.257	10.61	69.06
R30/306	0.311	21.25	19.7	4.61	145.17	3.436	11.81	73.88
R30/285	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
R30/267	0.27	21.25	19.7	4.61	145.17	3.984	15.87	83.67
R34/350	0.356	18.65	17.06	4.32	121.4	2.994	8.96	55.69
R34/326	0.333	18.65	17.06	4.32	121.4	3.236	10.47	60.84
R34/306	0.311	18.65	17.06	4.32	121.4	3.448	11.89	64.14
R34/285	0.288	18.65	17.06	4.32	121.4	3.731	13.92	69.78
R34/267	0.27	18.65	17.06	4.32	121.4	4	16	73.6
R34/248	0.25	18.65	17.06	4.32	121.4	4.31	18.58	81.03

Table 3

PREDICTION OF FFR COURSES/CM FROM FFR TEX AND FFR STITCH LENGTH

Model: $y = a \pm b/l \pm c/\sqrt{av.Tex}$

FABRIC&ROUTE	a	b	c	r^2
INTERLOCK				
JDX5	-14.2523	5.7427	2.3193	0.9593
MJDX5	-8.8509	5.1962	1.0812	0.9885
1 X 1 RIB				
JDX5	-10.5640	5.2451	1.4625	0.9395
MJDX5	-15.6378	5.3939	2.2516	0.9865

Table 4

PREDICTION OF FFR WALES/CM FROM FFR TEX AND FFR STITCH LENGTH

Model: $y = a \pm b/l \pm c/\sqrt{av.Tex}$

INTERLOCK				
JDX5	9.3539	3.1388	-1.3107	0.8125
MJDX5	15.8990	3.1632	-2.3276	0.9375
1 X 1 RIB				
JDX5	6.7501	1.4823	-0.3452	0.8154
MJDX5	10.3572	1.9406	-1.0715	0.9319

Table 5

PREDICTION OF FFR STITCH DENSITY FROM FFR TEX AND FFR STITCH LENGTH

Model: $y = a + b/l^2 + c\ av.Tex$

FABRIC & ROUTE	a	b	c	r^2
INTERLOCK				
JDX5	-38.7621	19.2229	1.9605	0.9407
MJDX5	26.3033	19.2882	-1.3597	0.9909
1 X 1 RIB				
JDX5	-5.4534	10.7080	1.1266	0.9327
MJDX5	-22.6121	13.0215	1.3527	0.9884

Table 6

PREDICTION OF FFR WEIGHT FROM FFR TEX AND FFR STITCH LENGTH

Model: $y = a + b\ Tex/l$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
JDX5	-12.5630	3.8244	0.9860
MJDX5	4.6977	3.7420	0.9836
1 X 1 RIB			
JDX5	-13.0450	2.6688	0.9891
MJDX5	-27.1324	2.9957	0.9915

Table 7

PREDICTION OF FFR BURST FROM FFR TEX, FFR STITCH LENGTH AND FFR SES

Model: $y = a + b/l^2 + c.\ avTex + d\ av.\ SES$

FABRIC & ROUTE	a	b	c	d	r^2
INTERLOCK					
JDX5	-243.4199	16.9077	33.0636	-1.8710	0.9004
MJDX5	-274.9564	23.7566	9.1703	3.7019	0.9714
1 X 1 RIB					
JDX5	-187.7399	15.2336	15.3435	-0.2755	0.9707
MJDX5	-237.5161	9.4919	68.8286	-6.4026	0.9539

Table 8

PREDICTION OF FFR TEX FROM KNITTED TEX

Model: $y = a + bx$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
JDX5	0.9825	0.9633	0.9996
MJDX5	-0.1558	1.1150	0.9992
1 X 1 RIB			
JDX5	-1.2775	1.0895	0.9881
MJDX5	-0.8498	1.1373	0.9946

Table 9

PREDICTION OF FFR STITCH LENGTH FROM KNITTED STITCH LENGTH

Model: $y = a \pm bx$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
JDX5	0.0027	0.9832	0.9997
MJDX5	0.0079	0.9009	0.9993
1 X 1 RIB			
JDX5	-0.0010	0.9944	0.9975
MJDX5	-0.0042	0.9416	0.9994

Figure 1

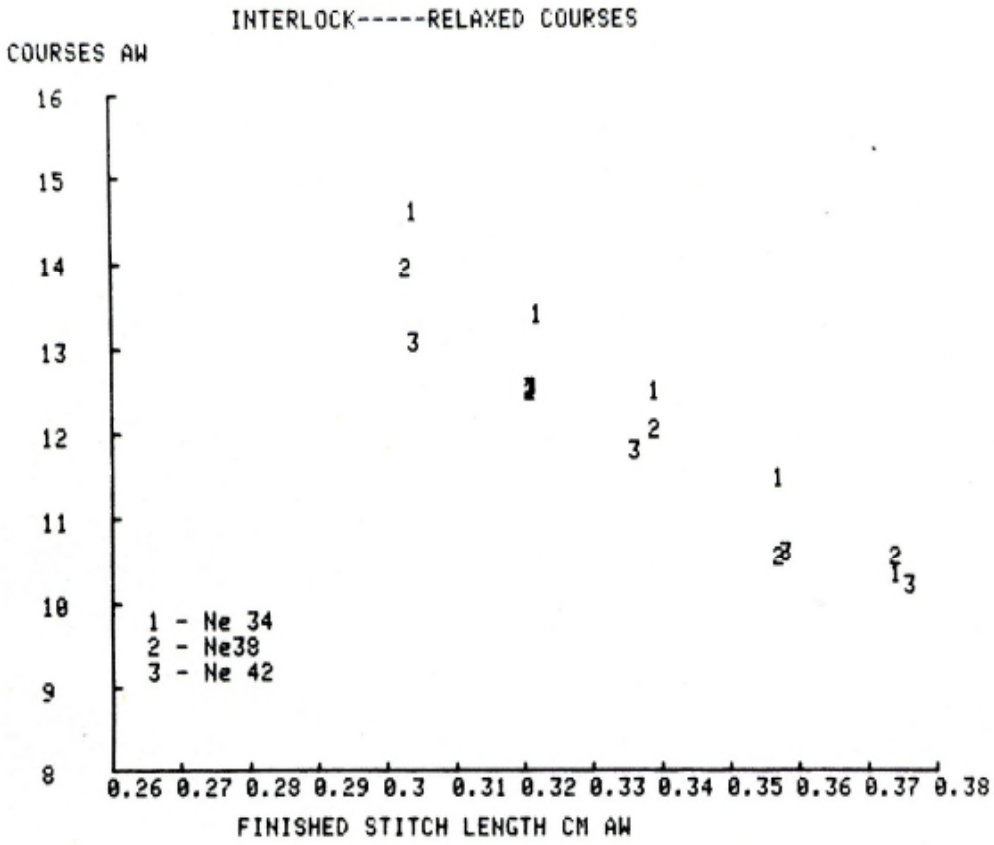

Figure 2

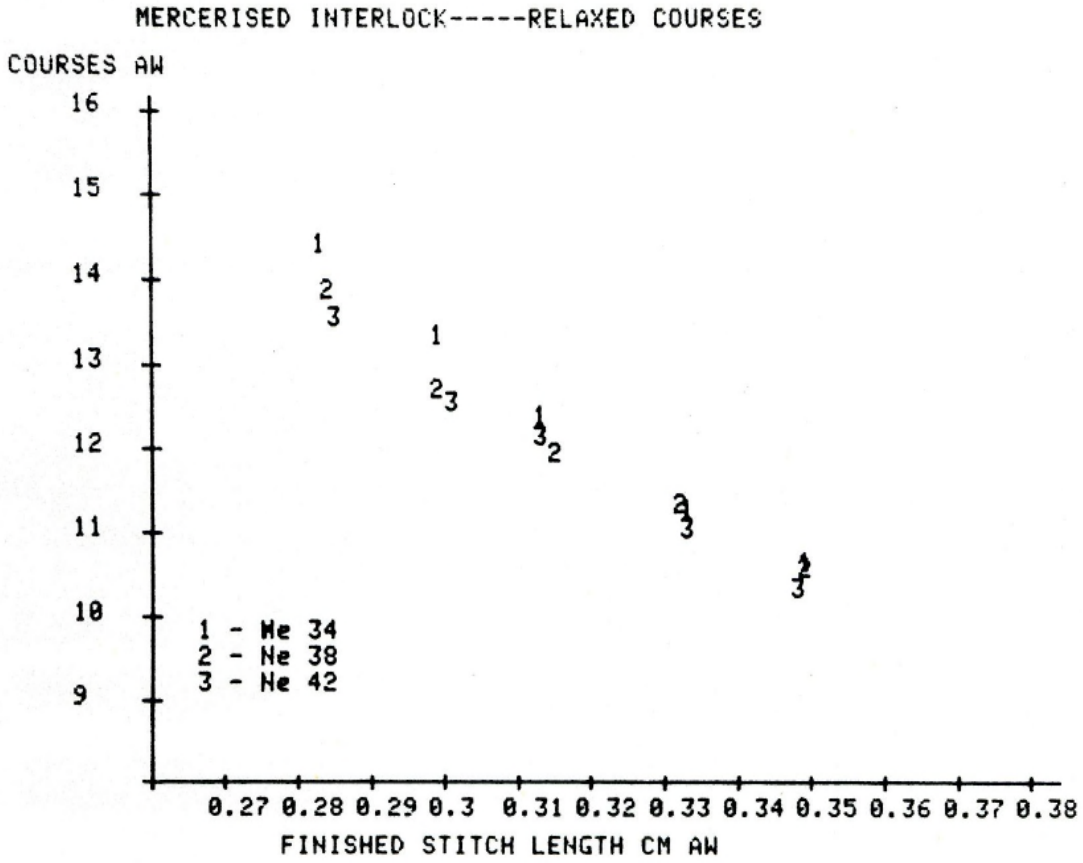

Figure 3

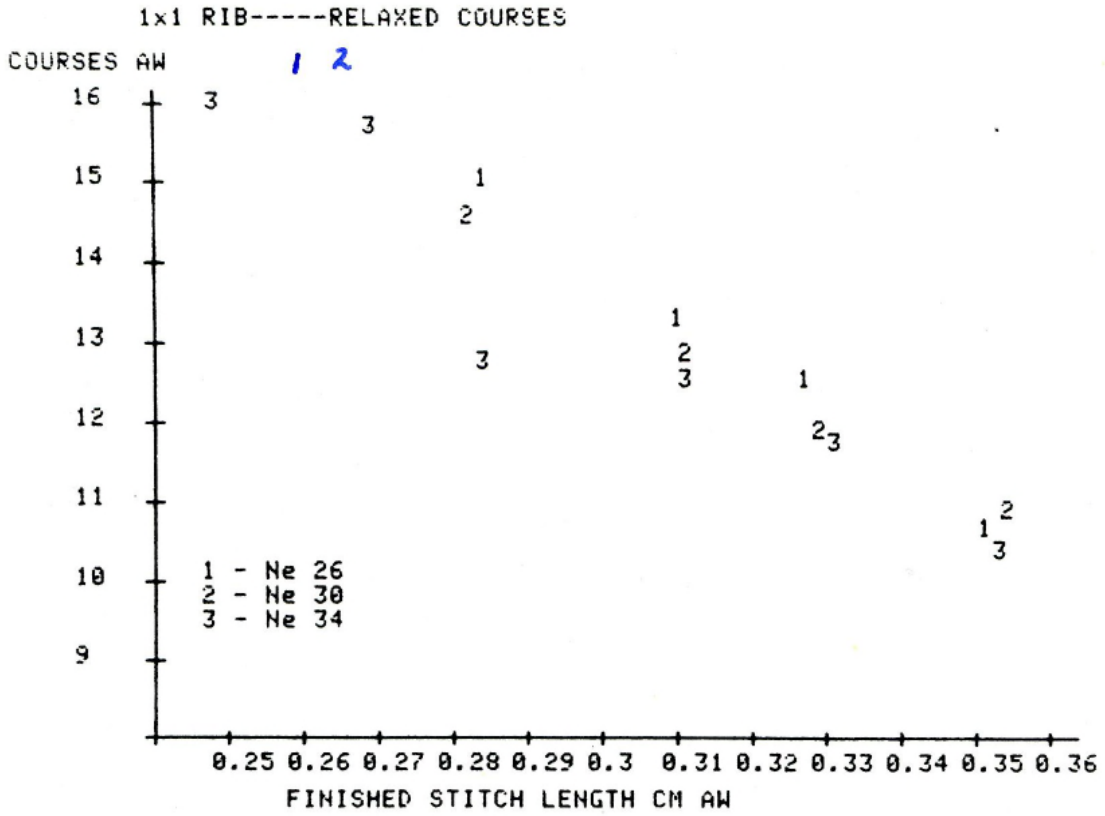

Figure 4

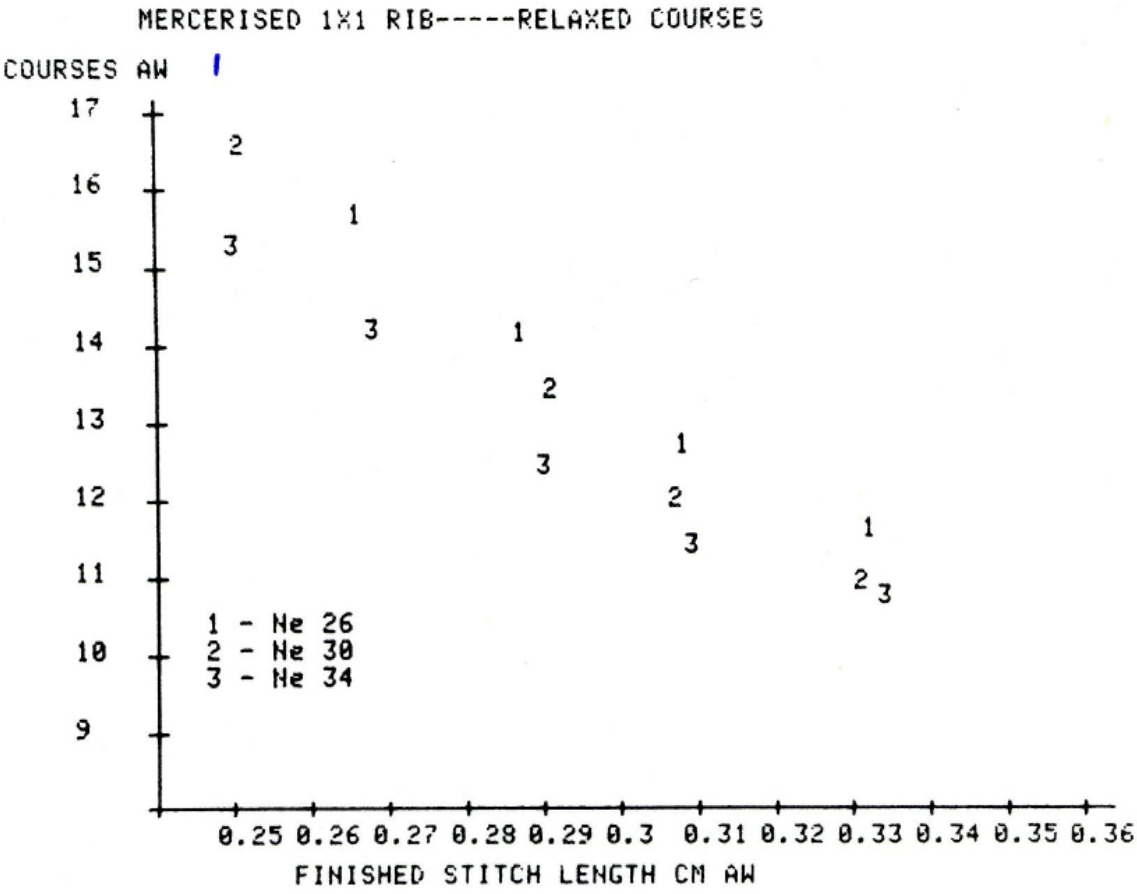

Figure 5

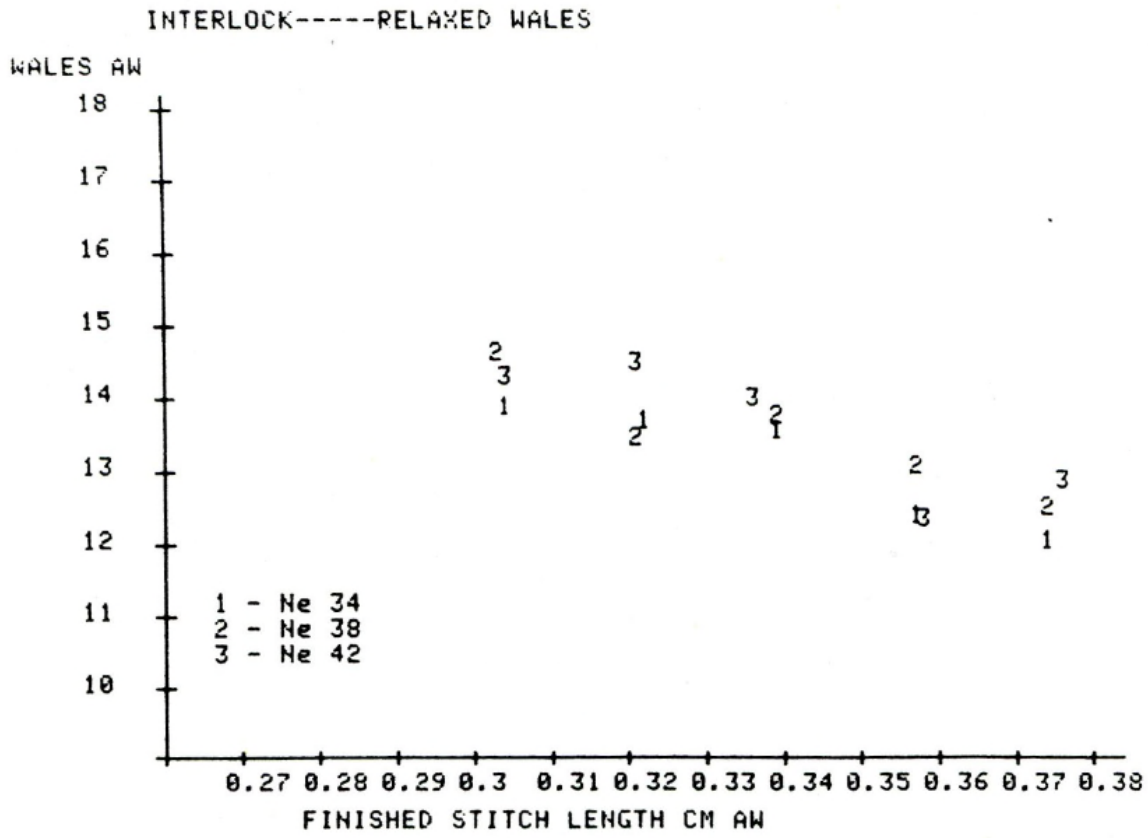

Figure 6

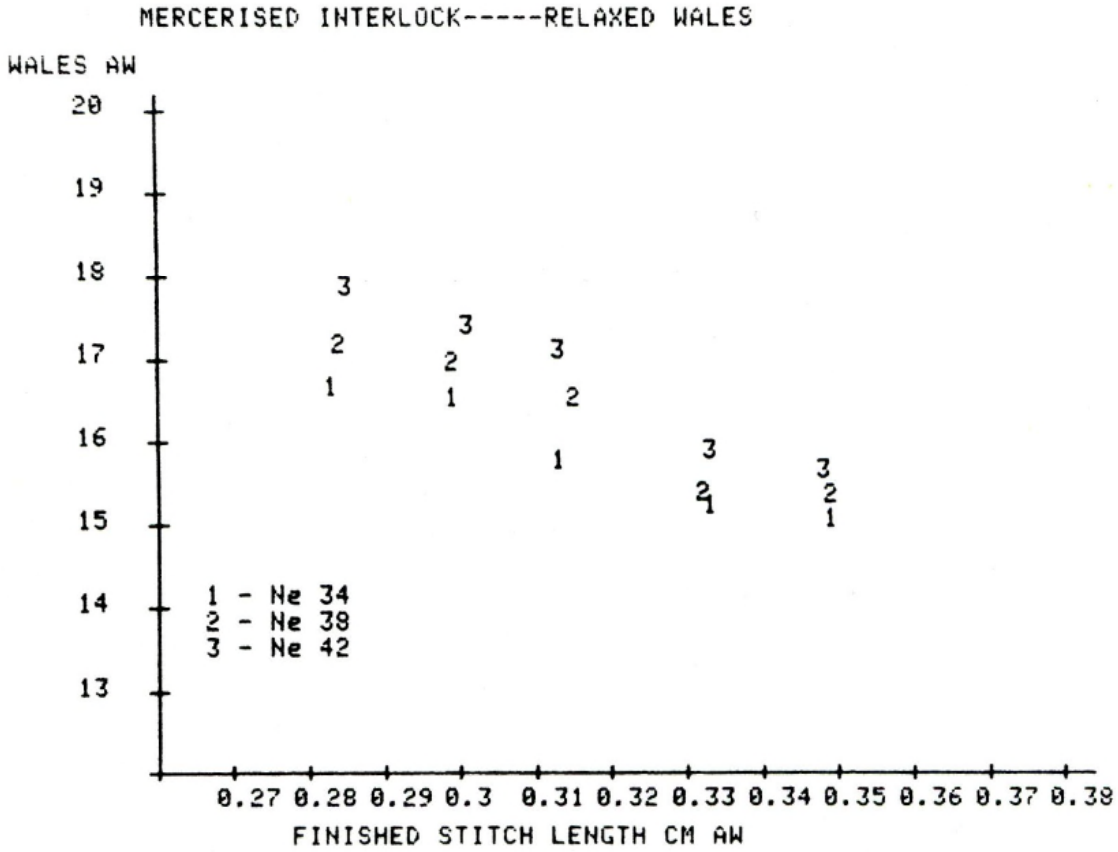

Figure 7

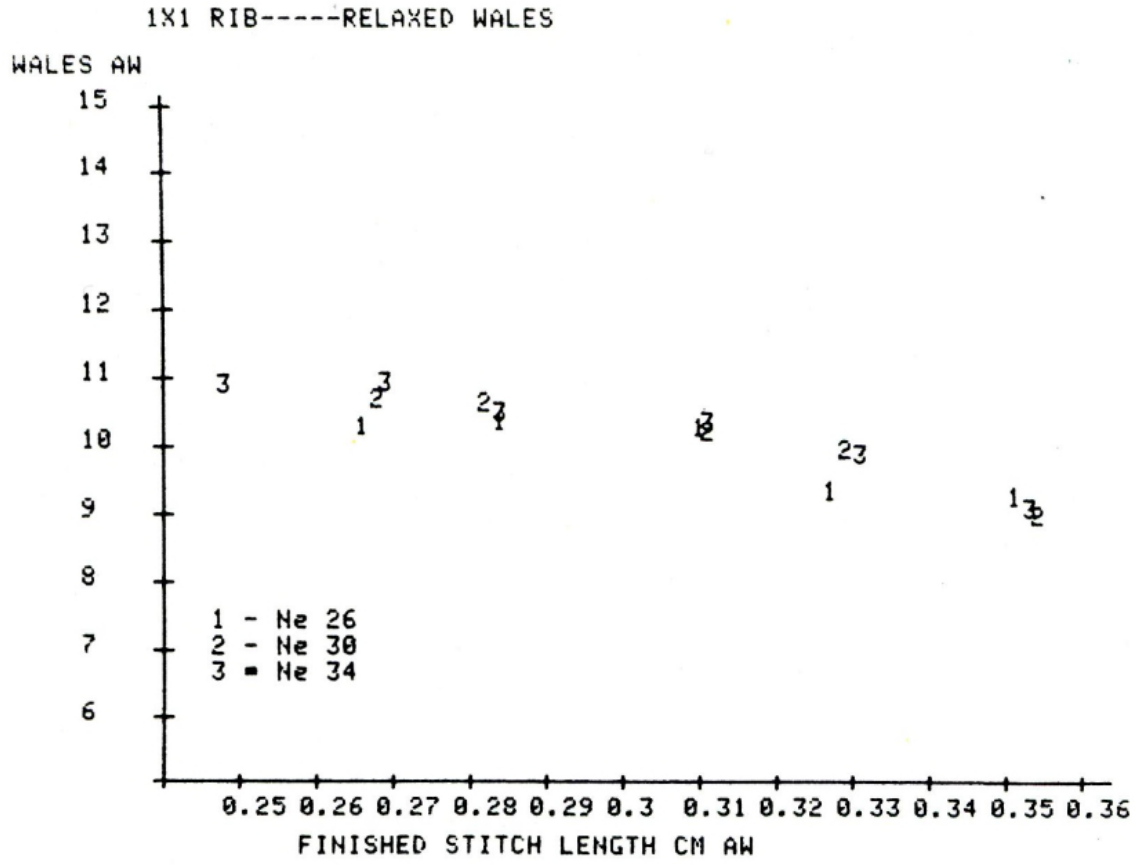

Figure 8

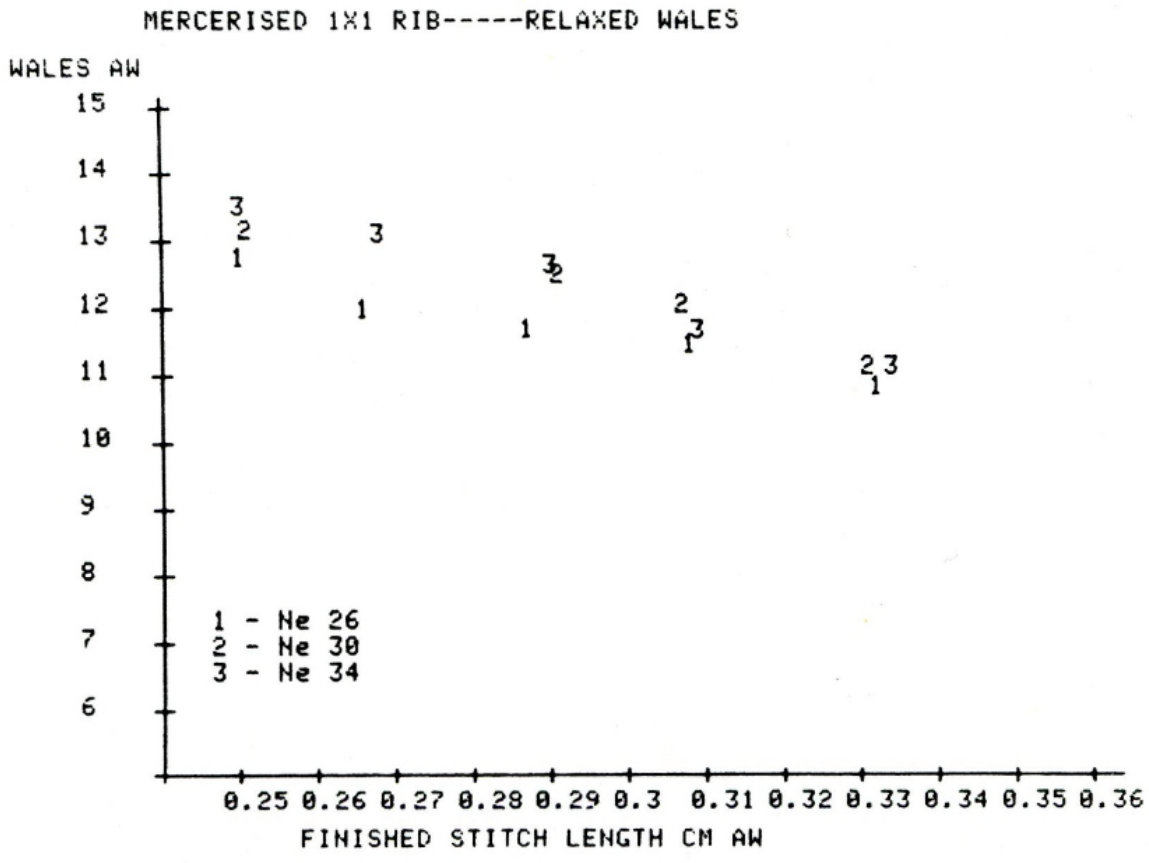

Figure 9

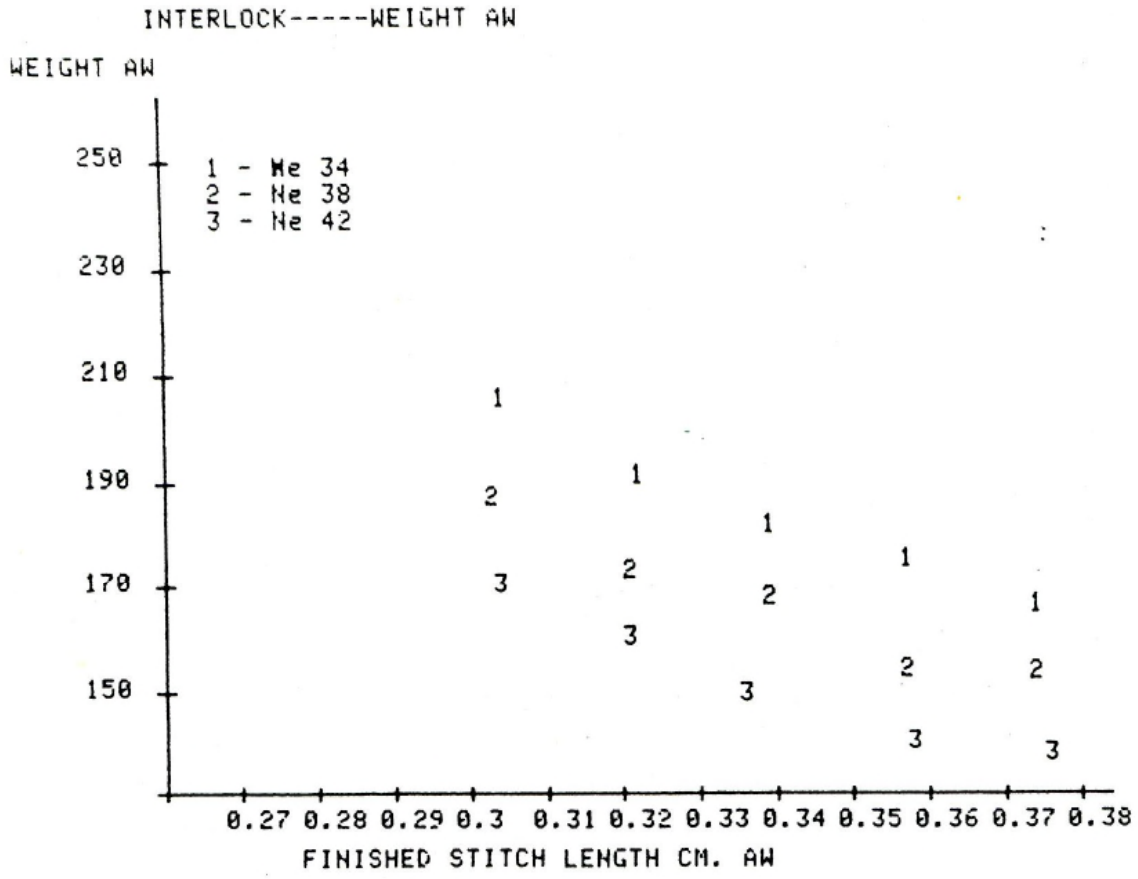

Figure 10

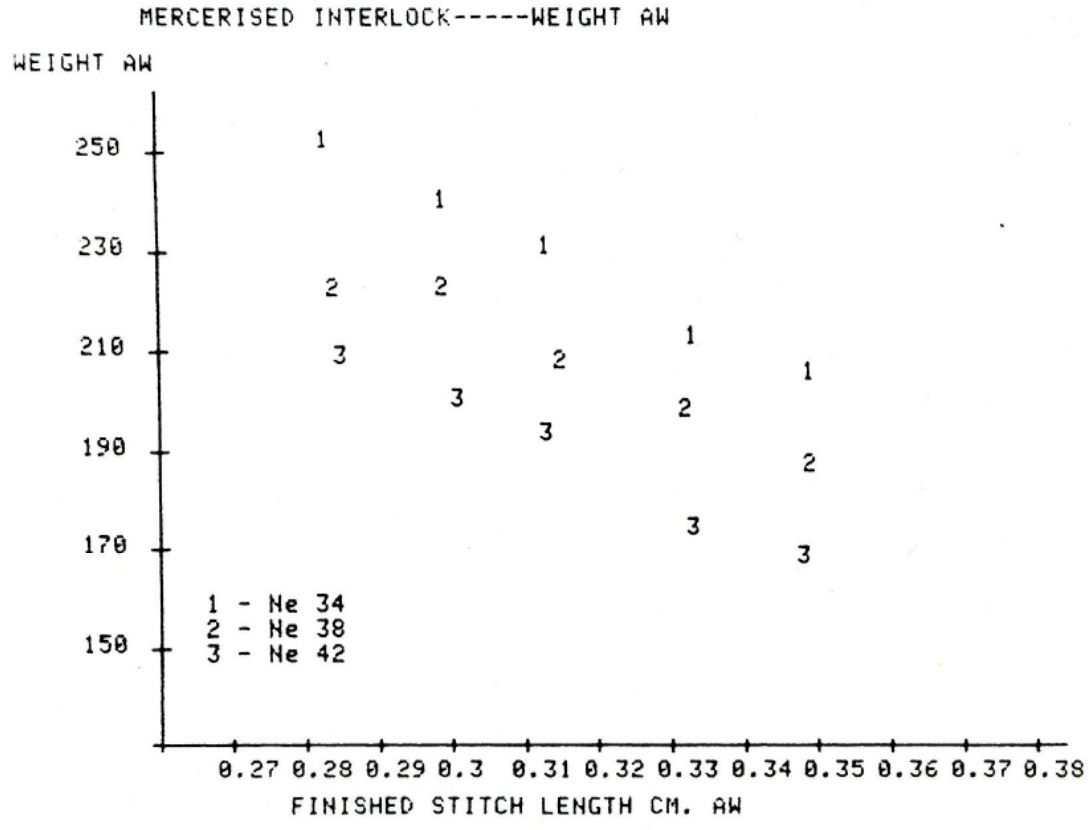

Figure 11

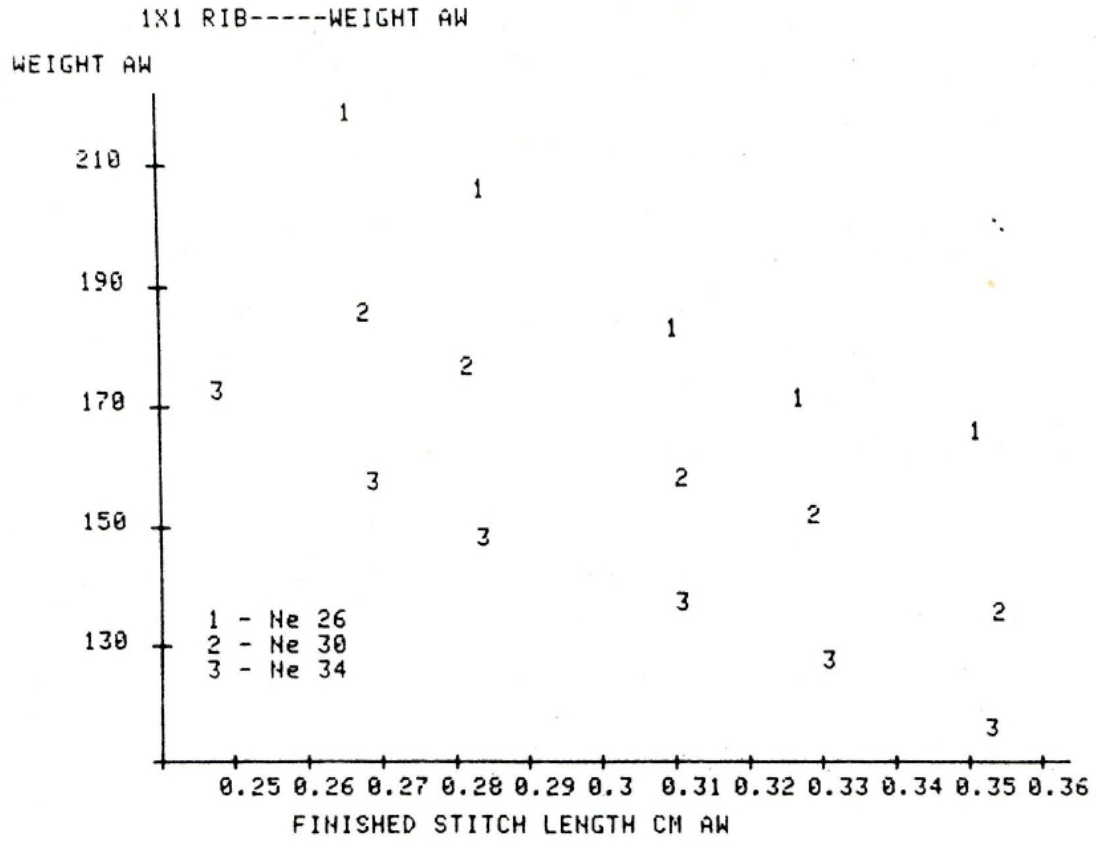

Figure 12

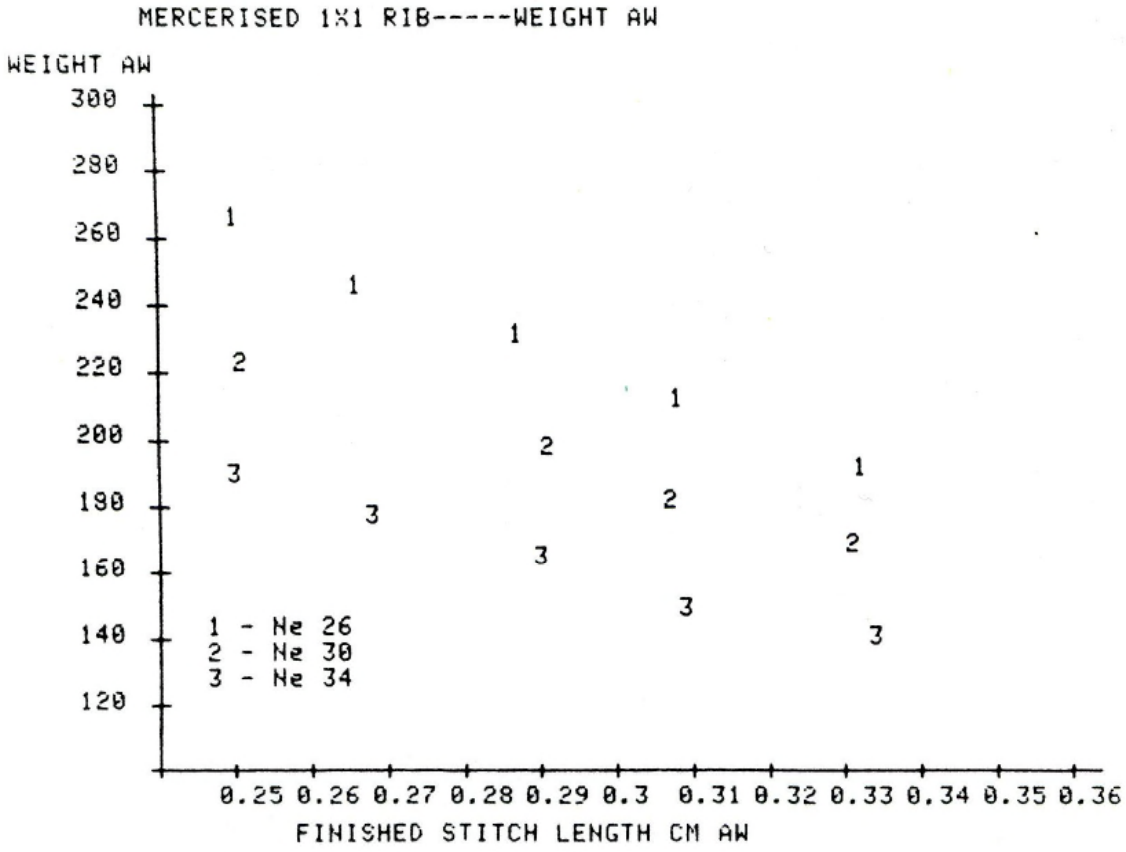

Figure 13

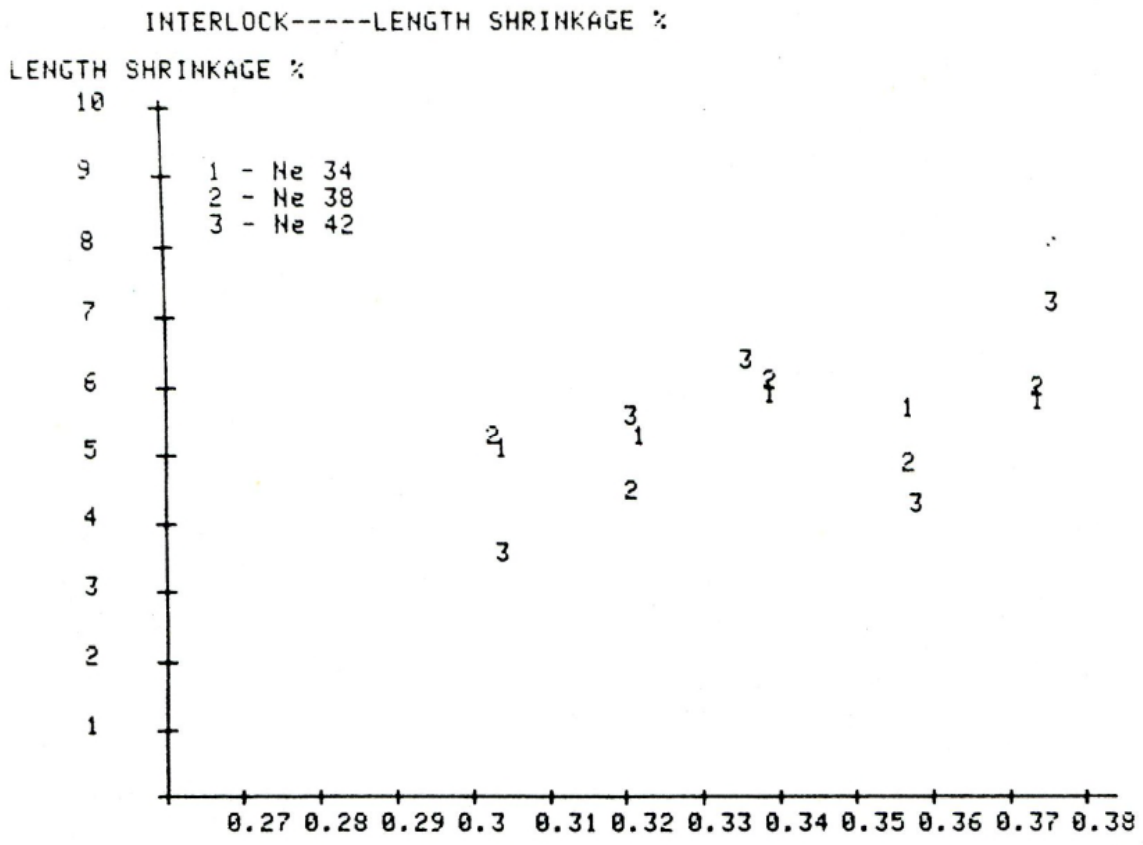

Figure 14

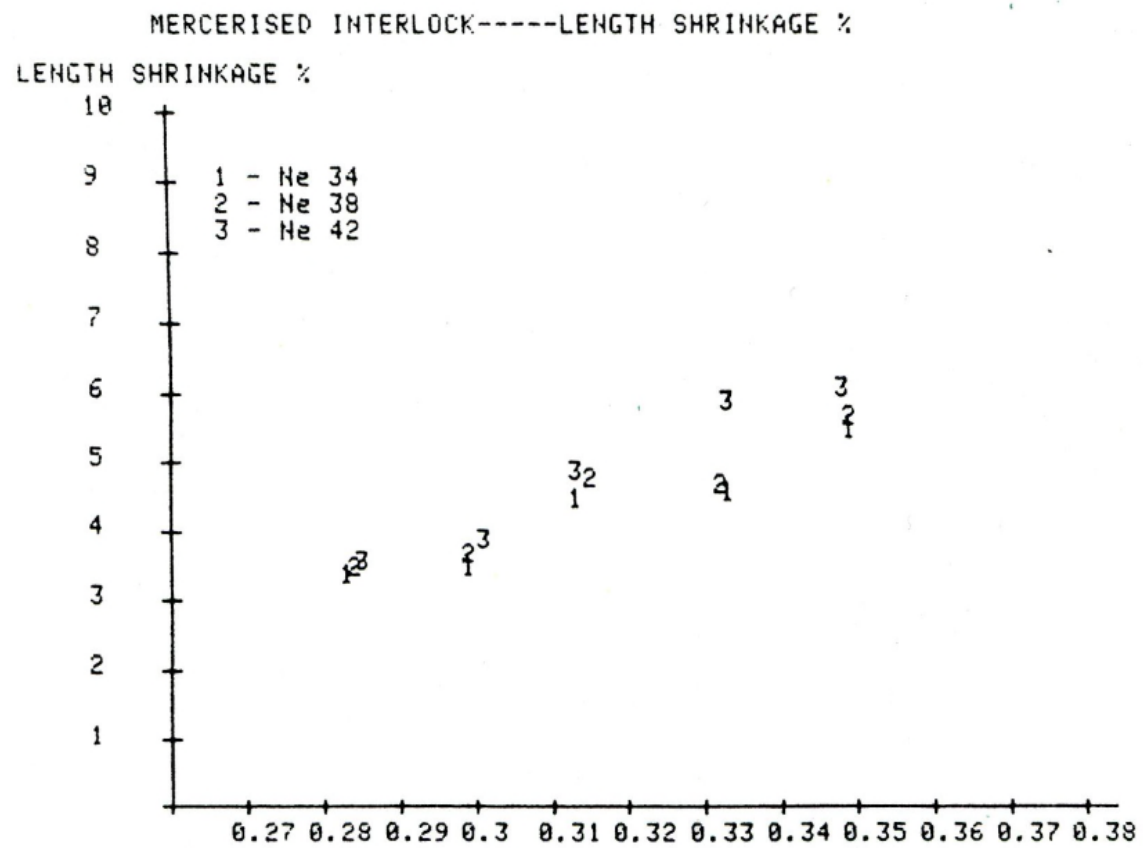

Figure 15

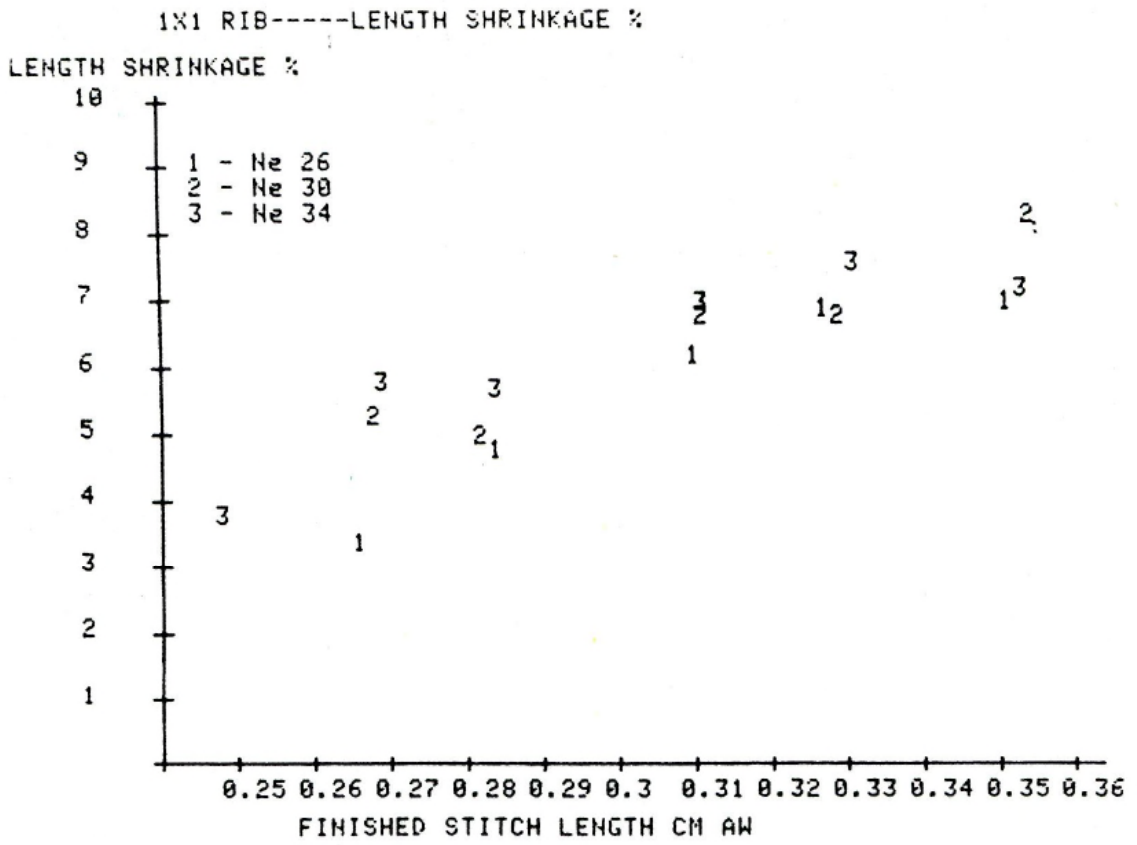

Figure 16