Research Record No: 174

Crosslinked Interlock And 1x1 Rib (3½%)

A Mathematical Analysis of The Test Data

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1. Introduction

Previous reports, Research Records 126, 159, and 170, describe the application of different levels of a crosslinking agent to rib and interlock fabrics and the procedure for evaluation of the test data. Regression coefficients and correlation coefficients for a number of fabric properties as well as a graphical presentation of the results are given in these reports.

This report briefly describes the application of a further level of crosslinking agent (3½% o.w.f.) to the full range of fabrics and presents the results of a similar analysis of the data. Regression and correlation coefficients are given for this latest level of crosslinking agent as well as plots of the actual data points and the calculated curves for this level and also other levels.

2. Procedure

Five-metre lengths of all 62 fabric variants were prepared and assembled as described in Research Record 162. The finish identifiers used for this series were as follows.

JDX4 and MJDX4

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

80 g/l	Fixapret CPN
12 g/1	$MgCl_2$ 6H20
259/1	Siligen E
25g/1	Perapret PE40
1g/1	Synperonic NX
lcc/1	Acetic Acid

Wet pick-up, 90-100%

Drying with overfeed at 120°C

Curing for 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 treatment.

courses/cm = $a + b/l + c\sqrt{(avTex)}$

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

In each case the equations predict the property in the fully relaxed or reference state. For each property in turn the regression coefficients and the correlation coefficients were obtained using the Tektronix statistical software package.

Presentation of Results

Tables 1 and 2 give the properties of interest for the 1 x 1 rib fabrics.

Tables 3 and 4 give the properties of interest for the interlock fabrics.

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

Table	Property
5	courses/cm
6	wales/cm
7	stitch density
8	weight
9	bursting strength
10	Tex
11	Stitch length

Graphs of the actual data points and also the calculated curves are given in the Appendix as follows.

Fabric	Property	Figures
1 x 1 rib	courses	1-3
	wales	4-6
	stitch density	7-9
	weight	10-12
	bursting strength	13-15
	length shrinkage	16-18

Fabric	Property	Figures
Mercerised 1 x 1 rib	courses	19-21
	wales	22-24
	stitch density	25-27
	weight	28-30
	bursting strength	31-38
	length shrinkage	34-36

Fabric	Property	Figures
Interlock	courses	37-39
	wales	40-42
	stitch density	43-45
	weight	46-48
	bursting strength	49-51
	length shrinkage	52-54

Fabric	Property	Figures
Mercerised Interlock	courses	55-57
	wales	58-60
	stitch density	61-63
	weight	64-66
	bursting strength	67-69
	length shrinkage	70-72

5. Conclusions

As far as courses, wales, stitch density, bursting strength and length shrinkage are concerned the latest treatment has fallen into place with the curves ranked in order of increasing concentration of crosslinking agent. It is clear that we are approaching the point of diminishing returns and the one extra level which has already been carried out (5% o.w.f.) will be sufficient for a full analysis to establish equations where resin concentration is one of the variables.

The one property which has given cause for concern is relaxed weight. Figures 10-12, 28-30, 46-48 and 64-68 all show anomalies. The 2½% crosslinker level is showing lower relaxed weights than the 3½% crosslinker level.

An investigation into the possible causes of this is underway and the first impression is that the weight figures of the 2½% crosslinker level are suspect. Comparing the measured weight (Beta gauge) with the weight calculated from relaxed courses, wales, stitch length and Tex there is a discrepancy of over 20g/m^2 in most cases.

A decision will have to be taken regarding whether to average the measured and calculated weight figures or whether to use the calculated weight figures only.

Once this has been done, the regression equations for weight will have to be re-established for the 2½% o.w.f. level.

1X1 RIB FINISH JDX4 TABLE 1

Sample	c/cm JDX4	w/cm JDX4	Wt.AW JDX4	Bst.AW JDX4	%Shr.L JDX4	l cm JDX4	Tex JDX4
R26/350	11.43	9.67	173.8	266.7	6.9	0.353	22.7
R26/326	12.6	9.77	183.2	292.4	7.4	0.328	22.8
R26/306	13.63	10.27	195.9	313.6	7.8	0.308	23.1
R26/285	15.4	10.77	213.8	306.6	6	0.283	23
R26/267	17.13	10.87	229.5	392.5	5.9	0.268	23
R30/350	11.13	9.67	144.8	238.8	9.1	0.354	19.8
R30/326	12.27	10.07	157.2	219.8	5.4	0.329	20.1
R30/306	13.37	10.47	167.4	258.7	7.2	0.308	19.9
R30/285	15.03	11.03	179.1	265.9	5.5	0.284	19.8
R30/267	16.37	11.47	199.9	349.1	6.2	0.268	20.1
R34/350	11.17	9.43	123.1	170.7	7.8	0.353	17.4
R34/326	11.77	10.4	134.2	207.3	8.3	0.331	17.3
R34/306	12.8	10.6	140.7	226.8	6.7	0.309	17.3
R34/285	14.17	11	152.5	255.6	7.1	0.285	17.2
R34/267	15.47	11.5	163.8	271.5	6.8	0.268	17.7
R34/248	17.37	12.43	182.6	315	8.1	0.247	17.7

MERCERISED 1X1 RIB FINISH MJDX4 TABLE 2

Sample	c/cm MJDX4	w/cm MJDX4	Wt.AW MJDX4	Bst.AW MJDX4	%Shr.L MJDX4	l cm MJDX4	Tex MJDX4
R26/350	12	11.1	202	498.6	8.6	0.33	24.3
R26/326	13.17	11.77	223.4	540	8.5	0.311	24.2
R26/306	14.77	12.13	242.3	527.4	9.2	0.285	24.6
R26/285	16.43	12.8	261.7	584.3	8.2	0.267	24.1
R26/267	18.03	13.17	279	615.2	6.4	0.252	25.4
R30/350	11.6	11.5	176.9	450.4	9.8	0.329	21.7
R30/326	12.5	12.23	186.3	440.2	8.5	0.299	22
R30/306	14.03	12.8	208.2	495.1	9	0.289	21.5
R30/285	14.57	13.5	214.1	517.7	8.4	0.263	21.5
R30/267	17.2	13.33	238.5	547.7	6.2	0.244	21.7
R34/350	11.47	11.47	152.5	374.7	9.6	0.326	18
R34/326	12.8	12.23	158.7	385.6	9.3	0.312	18.6
R34/306	13.07	12.93	174.2	432.9	9	0.289	17.6
R34/285	14.73	13.47	191	441.1	9.1	0.266	18.7
R34/267	16.03	14.13	204.3	459.3	8.7	0.255	17.8
R34/248	17.73	14.7	222.8	546.1	8.4	0.236	19

INTERLOCK FINISH JDX4 TABLE 3

Sample	c/cm JDX4	w/cm JDX4	Wt.AW JDX4	Bst.AW JDX4	%Shr.L JDX4	1 cm JDX4	Tex JDX4
I34/377	11	12.77	176.8	357	10.1	0.375	17.4
I34/359	11.6	12.93	184.6	355.6	8.6	0.356	17.4
I34/340	12.63	13.27	194.4	382	8.7	0.339	17.3
I34/324	13.53	13.5	203.2	414.9	7.9	0.321	17.3
I34/307	14.6	14.1	216.7	427.5	7.9	0.304	17.6
I38/377	10.77	12.8	162.6	304	9.8	0.373	16
I38/359	11.07	13	163.7	321.6	8.7	0.357	15.6
I38/340	12.3	13.5	177	324.3	9.2	0.339	15.8
I38/324	13.03	14.47	186.8	361.9	8.3	0.321	15.9
I38/307	14.07	14.8	193.4	395	8.1	0.304	15.6
I42/377	10.43	13.13	142.2	269.2	10.8	0.376	14.1
I42/359	10.9	13.63	149.2	286	9.6	0.359	14.3
I42/340	11.57	14.43	159.6	294.2	8.3	0.338	14.1
I42/324	12.6	14.53	167.8	316.4	8.7	0.322	14.2
I42/307	13.57	14.67	172.5	324.8	8	0.307	13.9

MERCERISED INTERLOCK FINISH MJDX4 TABLE 4

Sample	c/cm MJDX4	w/cm MJDX4	Wt.AW MJDX4	Bst.AW MJDX4	%Shr.L MJDX4	1 cm MJDX4	Tex MJDX4
I34/377	10.8	16.1	215.3	508.6	9.6	0.352	18.6
I34/359	11.4	16.03	224.5	584	8.8	0.336	18.7
I34/340	12.1	16.83	233.5	619.9	8.6	0.318	18.5
I34/324	13.27	17.23	249.4	646.4	7.3	0.302	18.3
I34/307	14.27	17.3	260	697.6	8.5	0.288	18.5
I38/377	10.53	15.87	194.5	495.7	9.4	0.351	17.1
I38/359	11.03	16.4	196.8	532.3	11.1	0.337	16.6
I38/340	12.1	16.8	216.9	535.6	9.4	0.318	16.8
I38/324	12.6	17.63	223.8	574.7	9.9	0.303	16.8
I38/307	13.63	18.1	234.4	602.8	8.3	0.288	16.7
I42/377	10.43	16.5	179.7	455.4	9.4	0.351	15.6
I42/359	11.03	16.73	182.3	451.8	10.1	0.336	15.2
I42/340	11.97	17.77	198	486.6	10	0.315	15.4
I42/324	12.13	18.43	202.2	480.7	9.4	0.304	15.1
I42/307	13.37	18.77	216.1	540.8	9.3	0.287	15.1

Table 5

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

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

Fabric & Route	a	b	c	r^2
1 x 1 rib				
JDX4	-11.1967	5.5719	1.4607	0.9865
MJDX4	-12.2970	5.4188	1.6121	0.9403
Interlock				
JDX4	-11.9548	5.5961	1.9216	0.9871
MJDX4	-10.0462	4.9720	1.5666	0.9806

Table 6

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

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

Fabric & Route	a	b	c	r^2
1 x 1 Rib				
JDX4	6.8774	1.9608	-0.6283	0.9523
MJDX4	9.2771	2.2807	-1.0161	0.9404
Interlock				
JDX4	13.2205	2.7696	-1.9469	0.9190
MJDX4	16.4973	3.2647	-2.3596	0.9218

Table 7

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

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

Fabric & Route	a	b	c	r^2
1 x 1 Rib				
JDX4	-11.8026	12.9830	0.7308	0.9944
MJDX4	-10.7175	14.2324	0.6238	0.9694
Interlock				
JDX4	-0.4602	18.6319	0.2853	0.9895
MJDX4	14.6456	19.6557	-0.2403	0.9930

Table 8

PREDICTION OF FFR WEIGHT FROM FFR TEX AND FFR STITCH LENGTH

MODEL: $y = a \pm b\ Tex/l$

Fabric & Route	a	b	r^2
1 x 1 Rib			
JDX4	-16.5950	2.8426	0.9861
MJDX4	-4.8494	2.8216	0.9495
Interlock			
JDX4	3.7132	3.7038	0.9968
MJDX4	-4.3605	4.1335	0.9927

Table 9

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

MODEL: $y = a \pm b/l^2 + c_{av.} Tex + d_{av.} SES$

Fabric & Route	a	b	c	d	r^2
1 x 1 Rib					
JDX4	-234.6137	16.8880	15.9573	-	0.8974
MJDX4	-123.4259	16.5820	4.9014	1.5918	0.9452
Interlock					
JDX4	-288.7885	20.8143	33.2595	-1.0870	0.9711
MJDX4	-501.7608	29.8739	57.0864	-1.5287	0.9320

Table 10

PREDICTION OF FFR TEX FROM KNITTED TEX

MODEL: $y = a \pm bx$

Fabric & Route	a	b	r^2
1 x 1 Rib			
JDX4	-0.8696	1.0675	0.9957
MJDX4	-2.5178	1.2216	0.9988
Interlock			
JDX4	-1.0377	1.0821	0.9994
MJDX4	0.2551	1.0696	0.9997

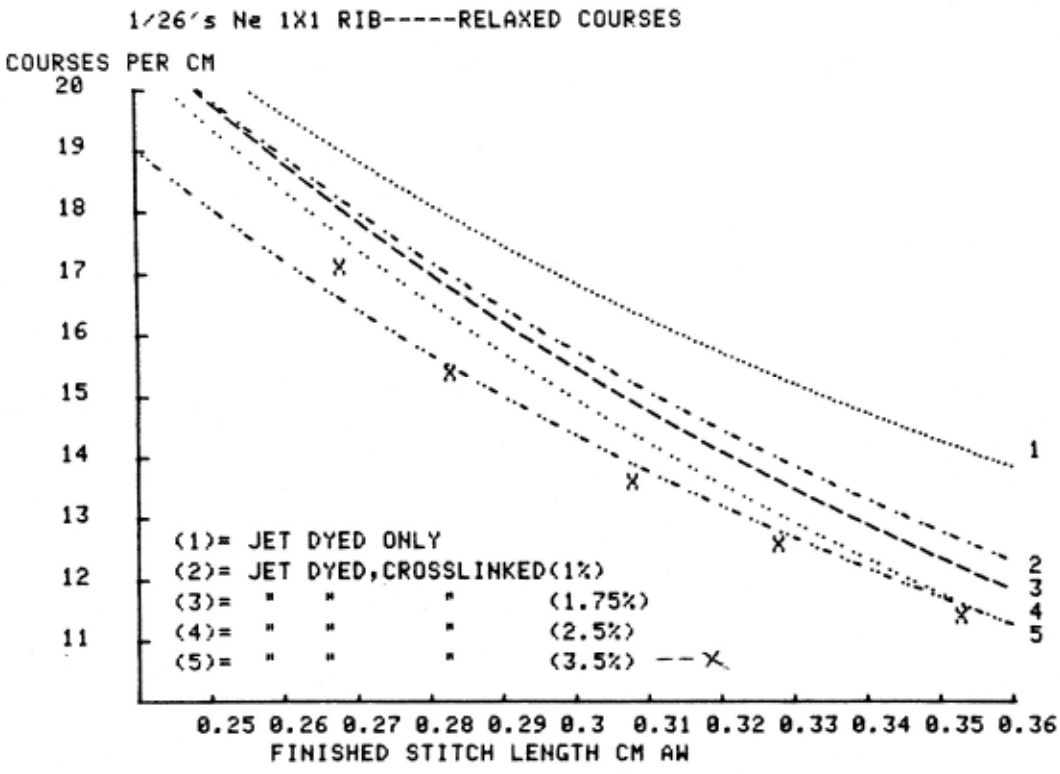
Table 11

PREDICTION OF FFR STITCH LENGTH FROM KNITTED STITCH LENGTH

MODEL: $y = a \pm bx$

Fabric & Route	a	b	r^2
1 x 1 Rib			
JDX4	-0.0009	0.9927	0.9996
MJDX4	0.0081	0.8978	0.9984
Interlock			
JDX4	0.0070	0.9719	0.9992
MJDX4	0.0184	0.8789	0.9992

Figure 1



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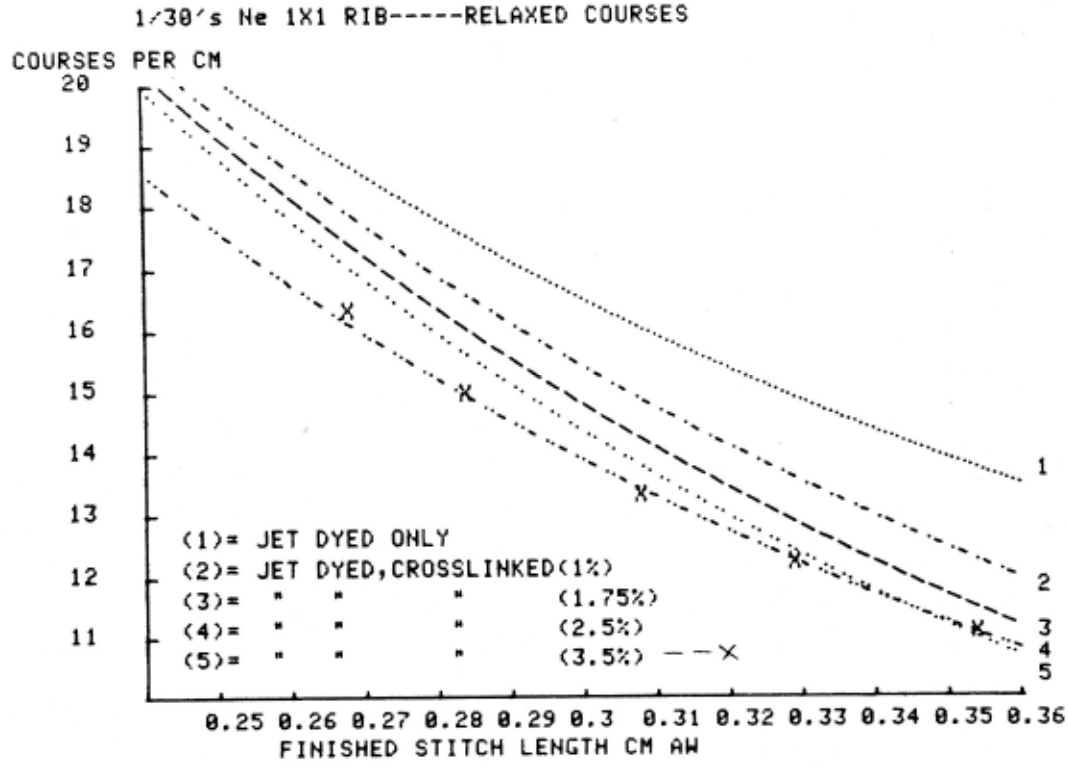

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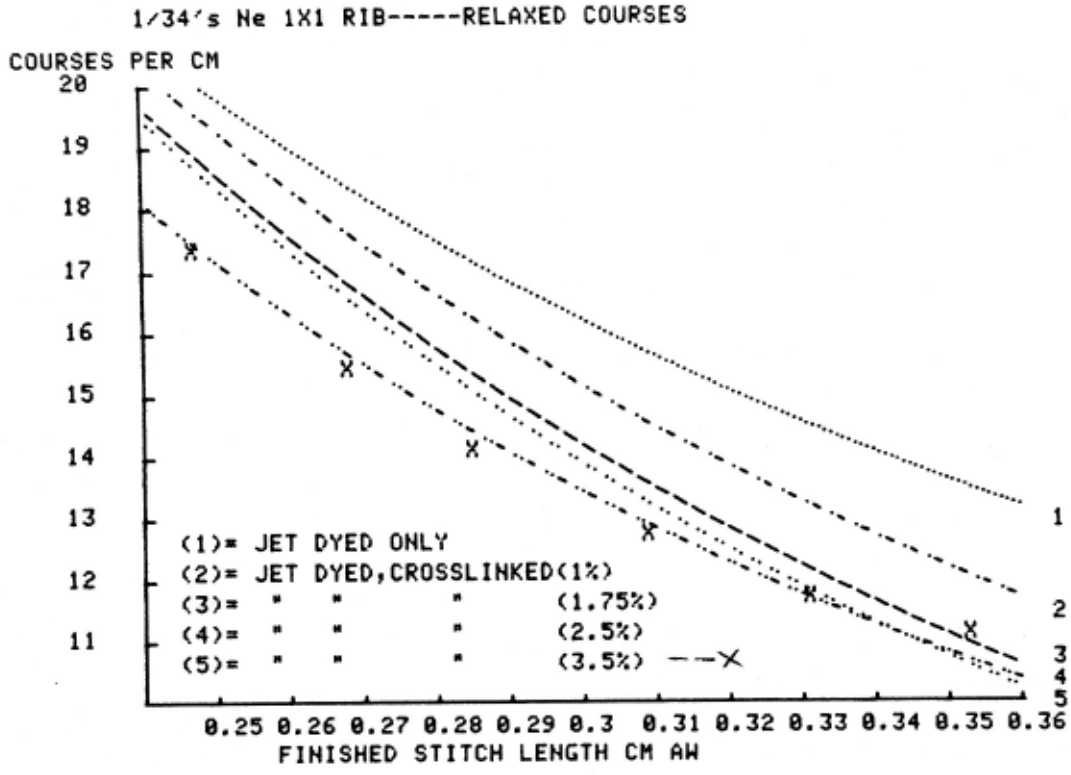

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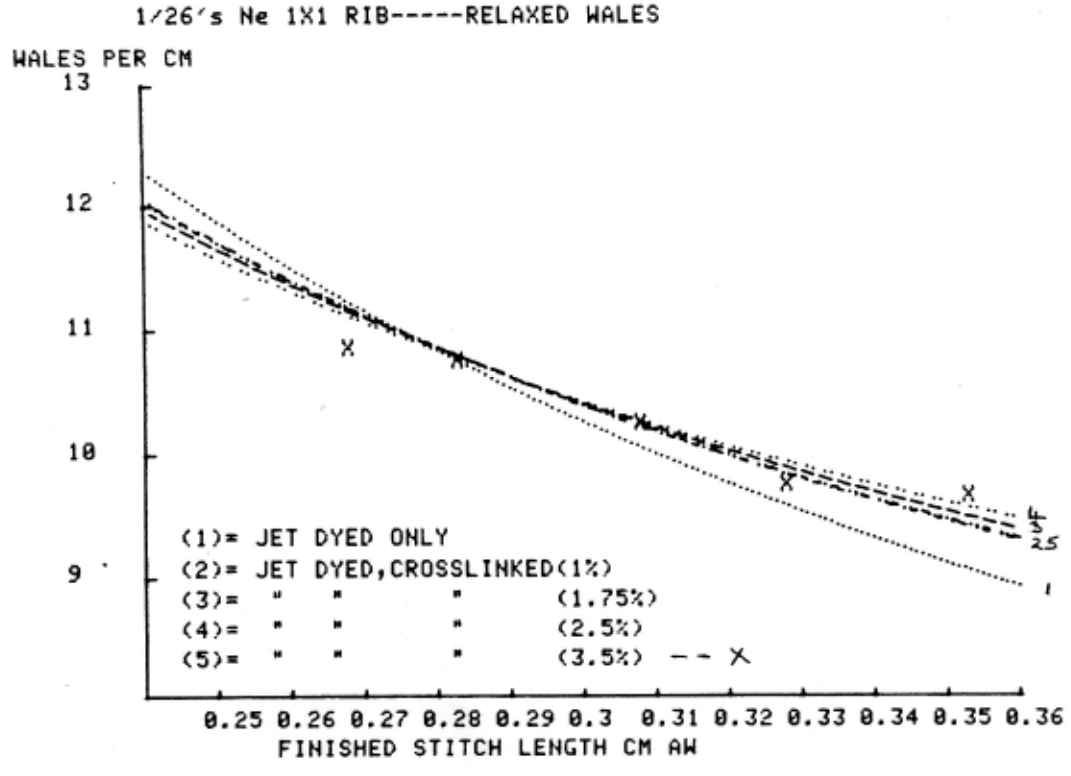

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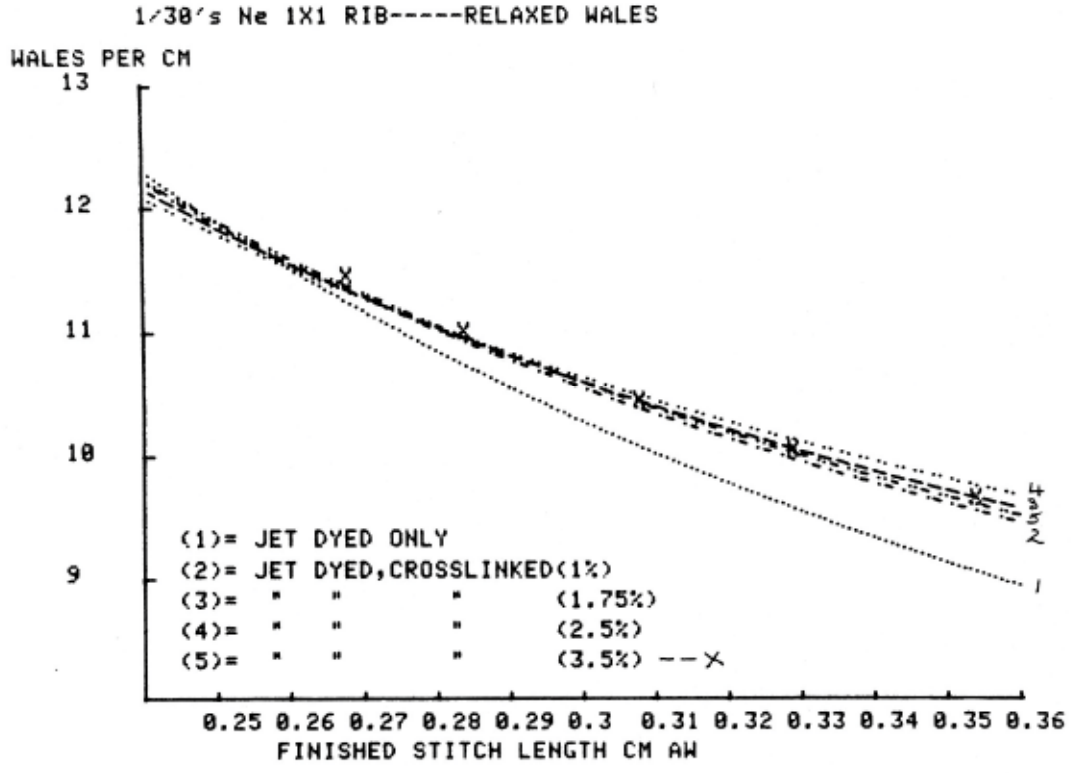

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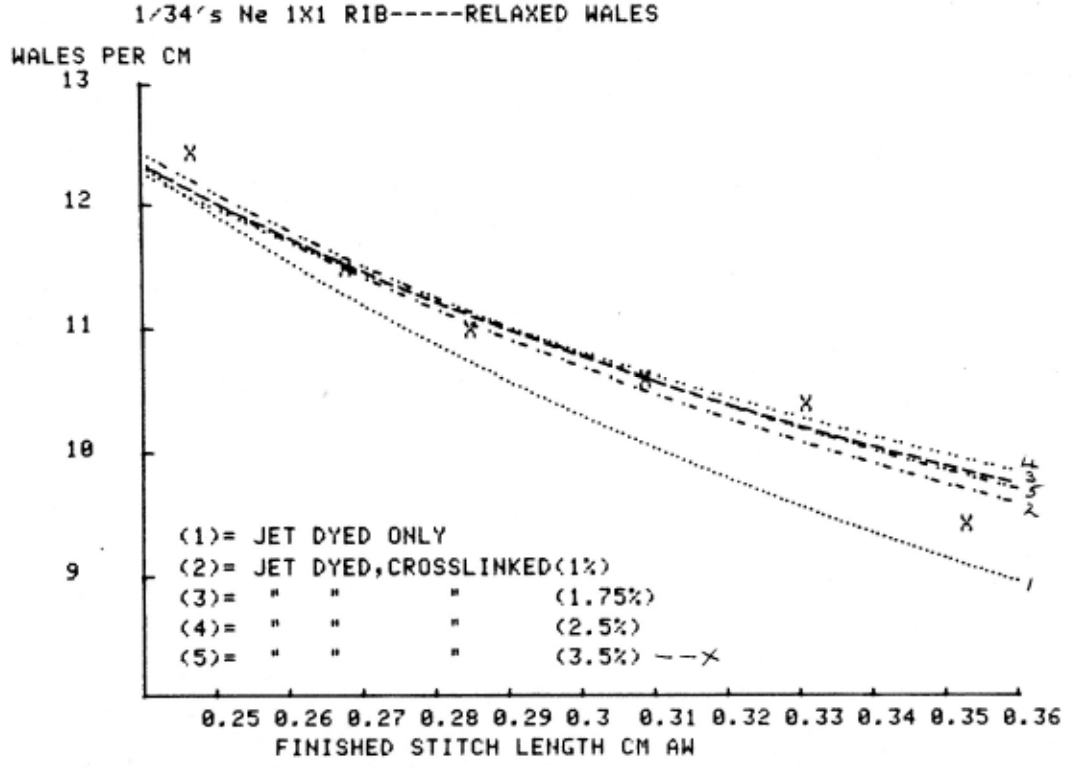

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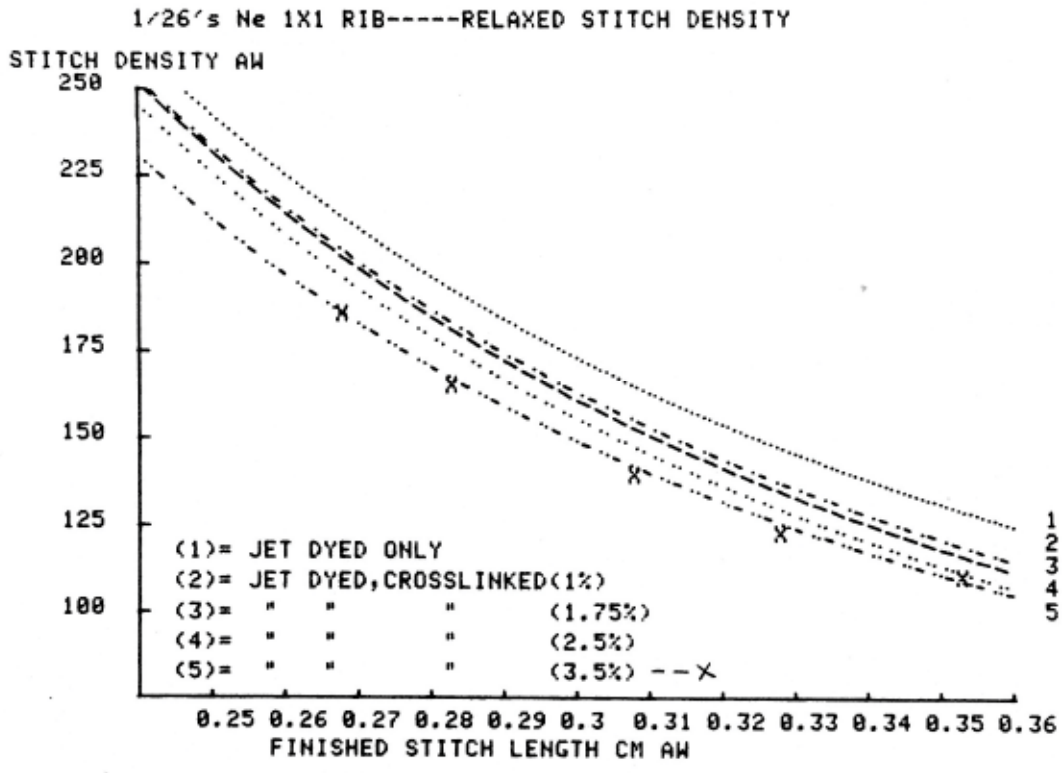

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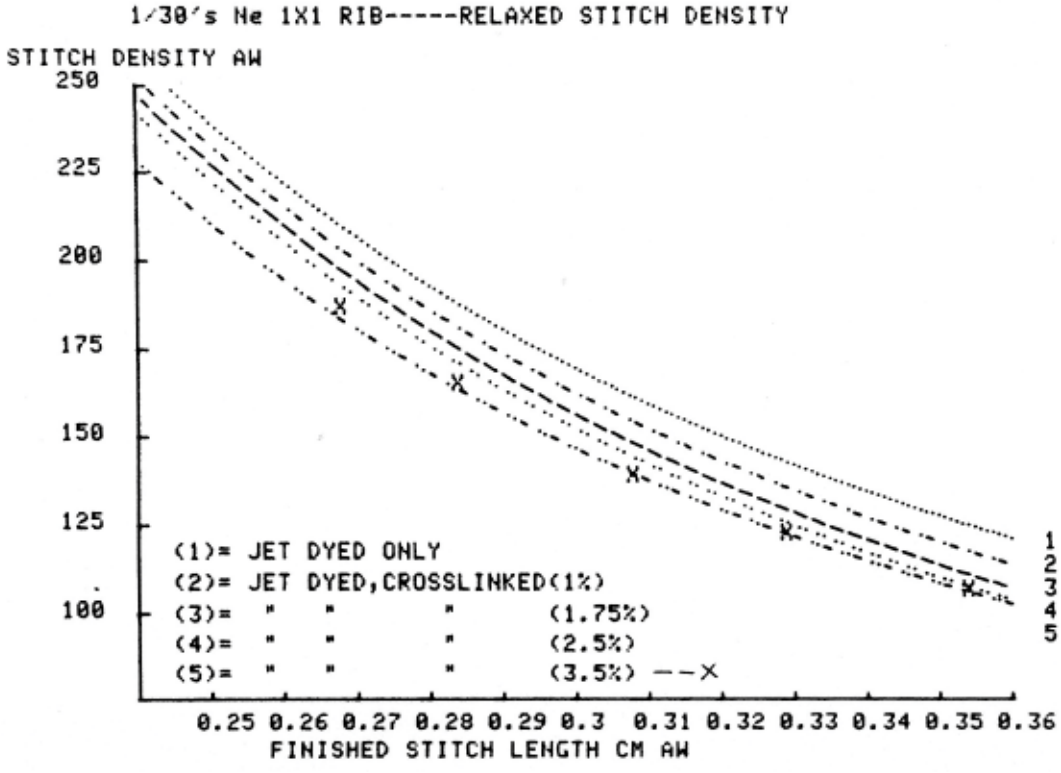

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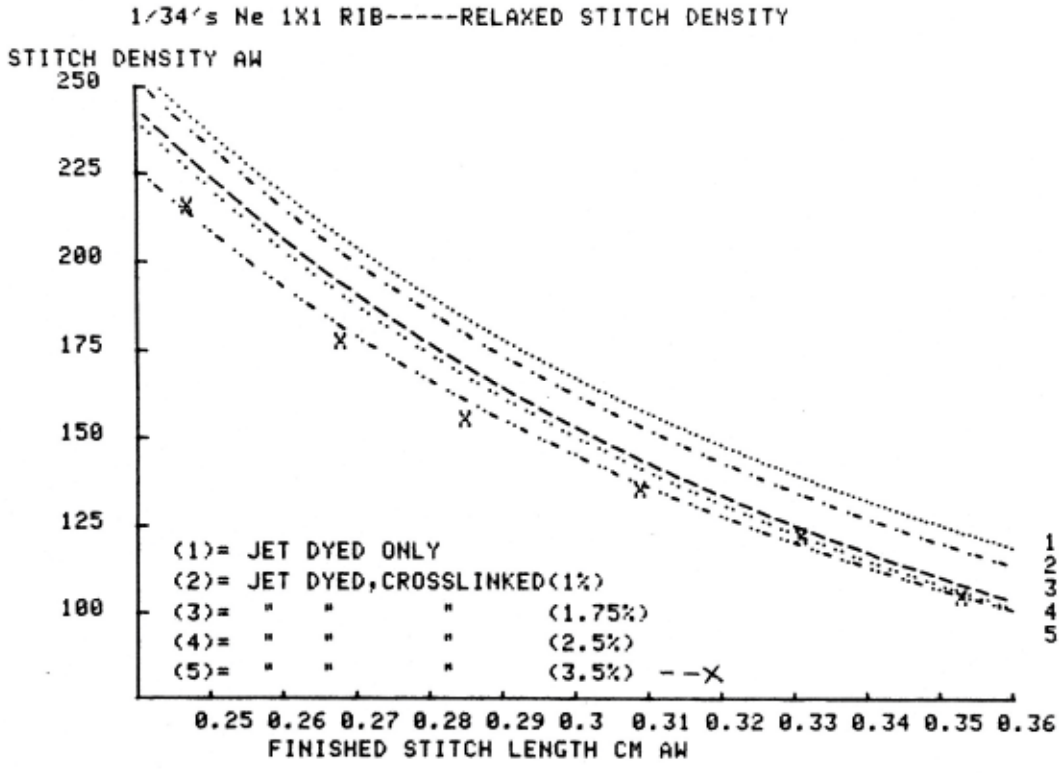

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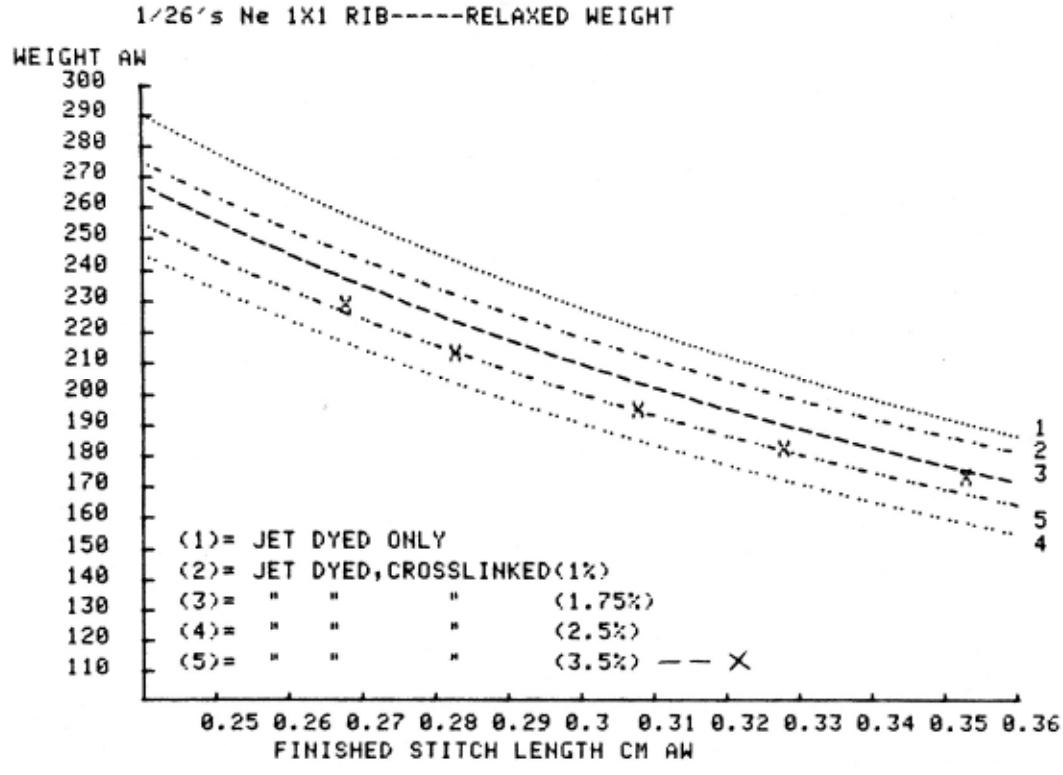

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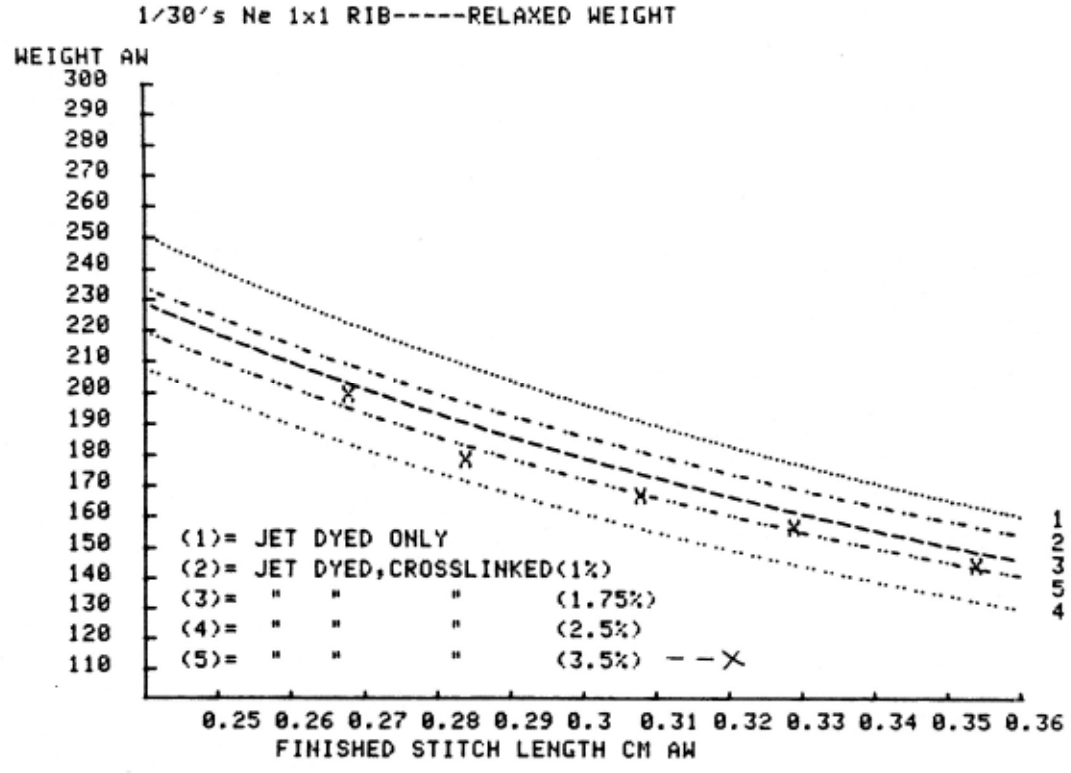

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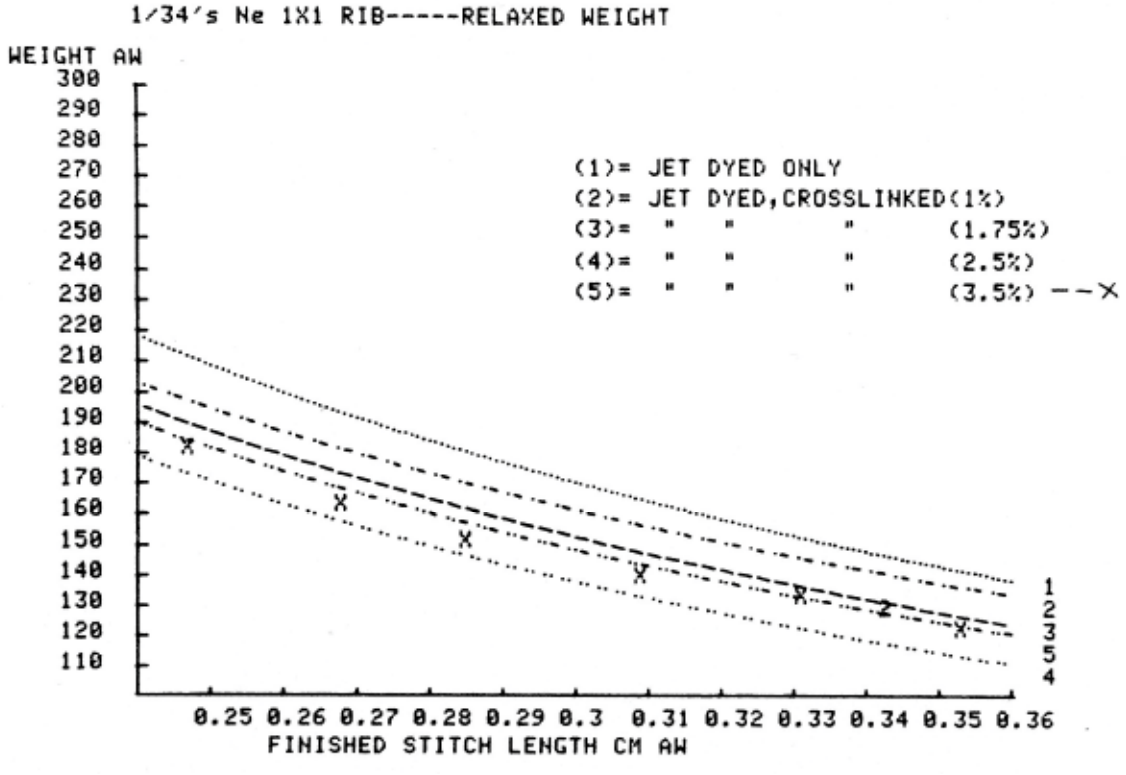

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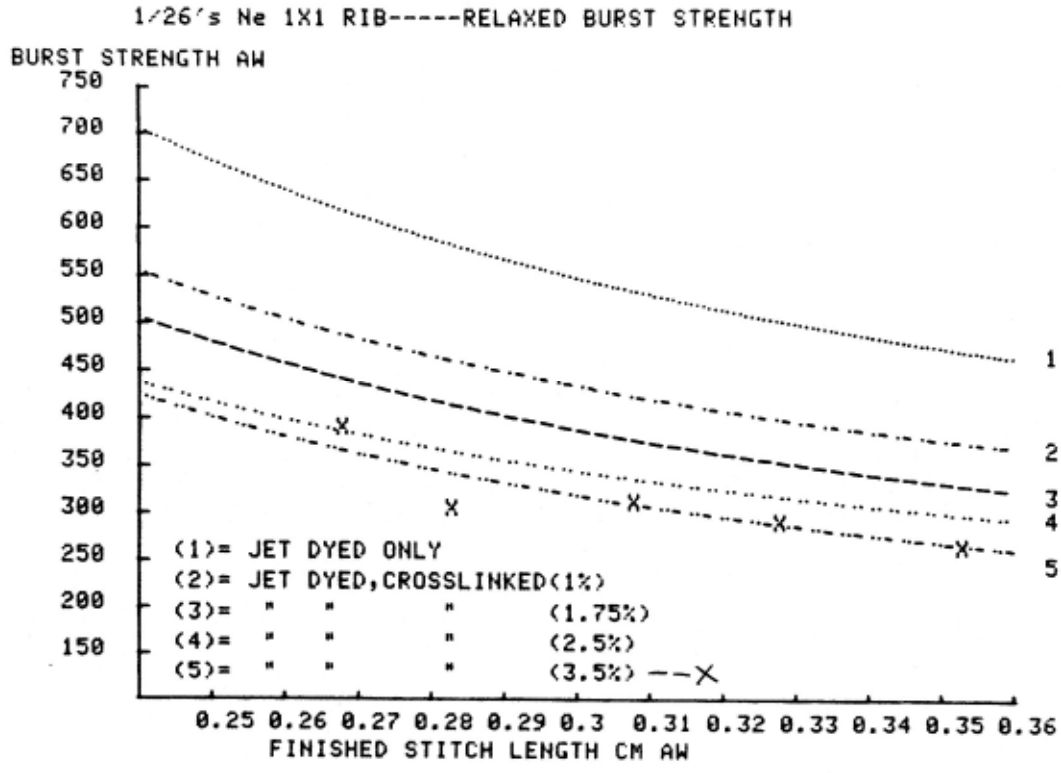

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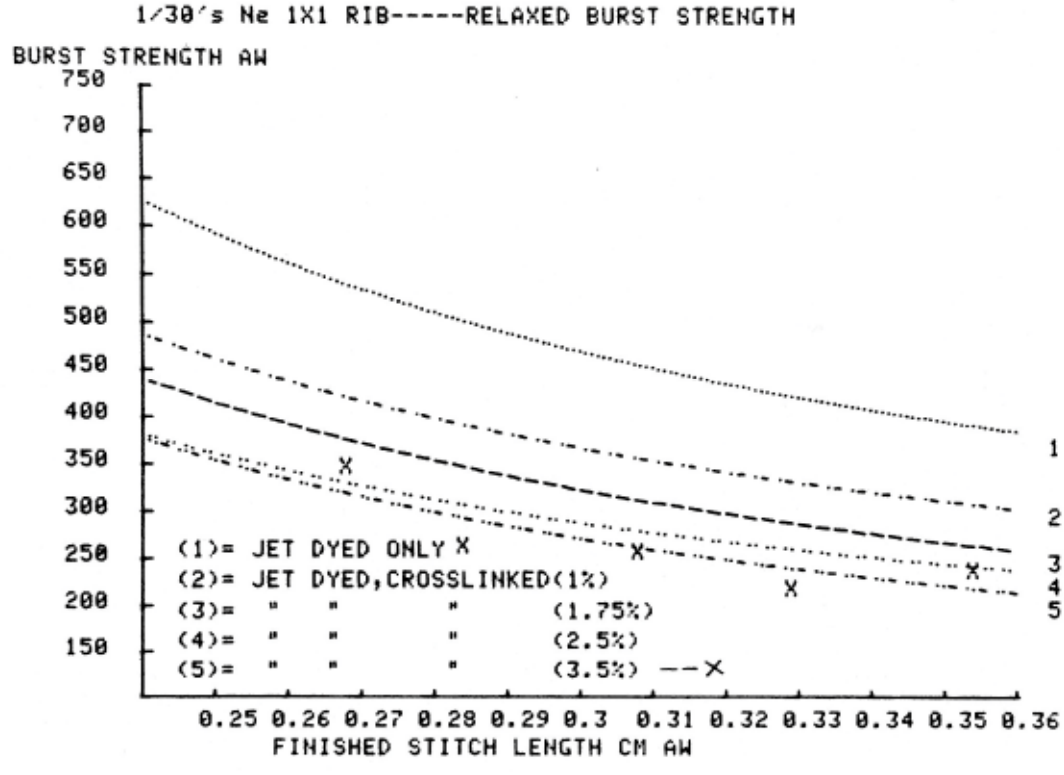

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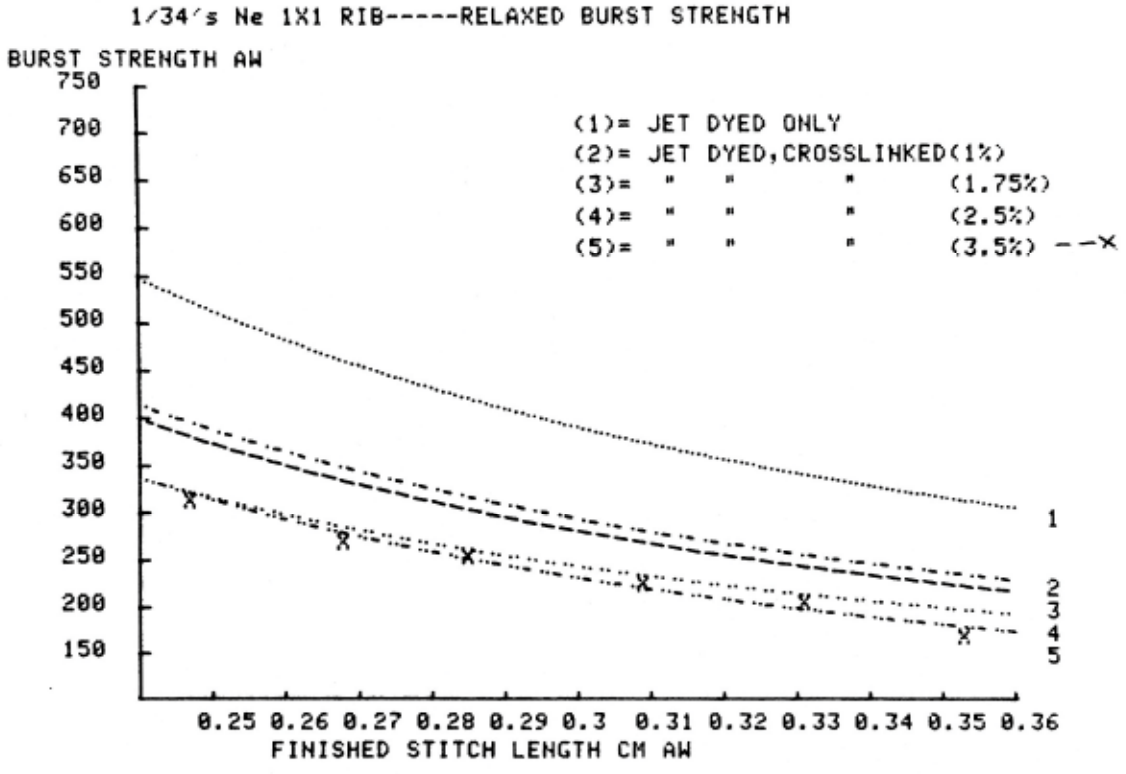

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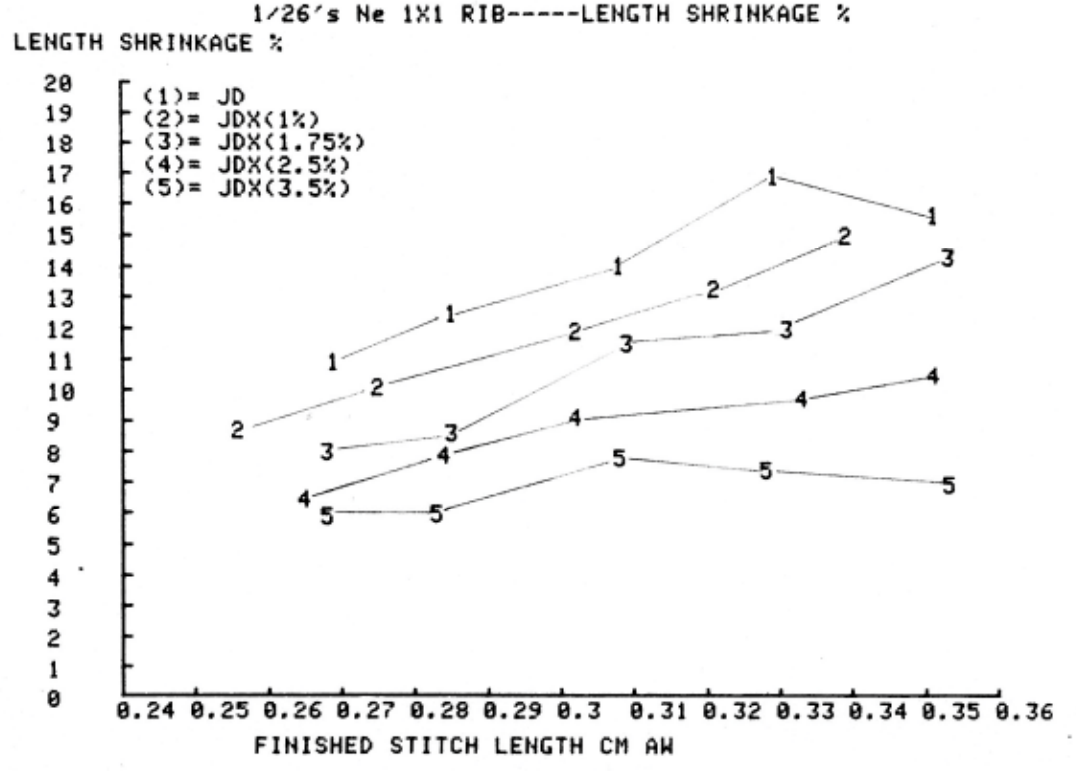

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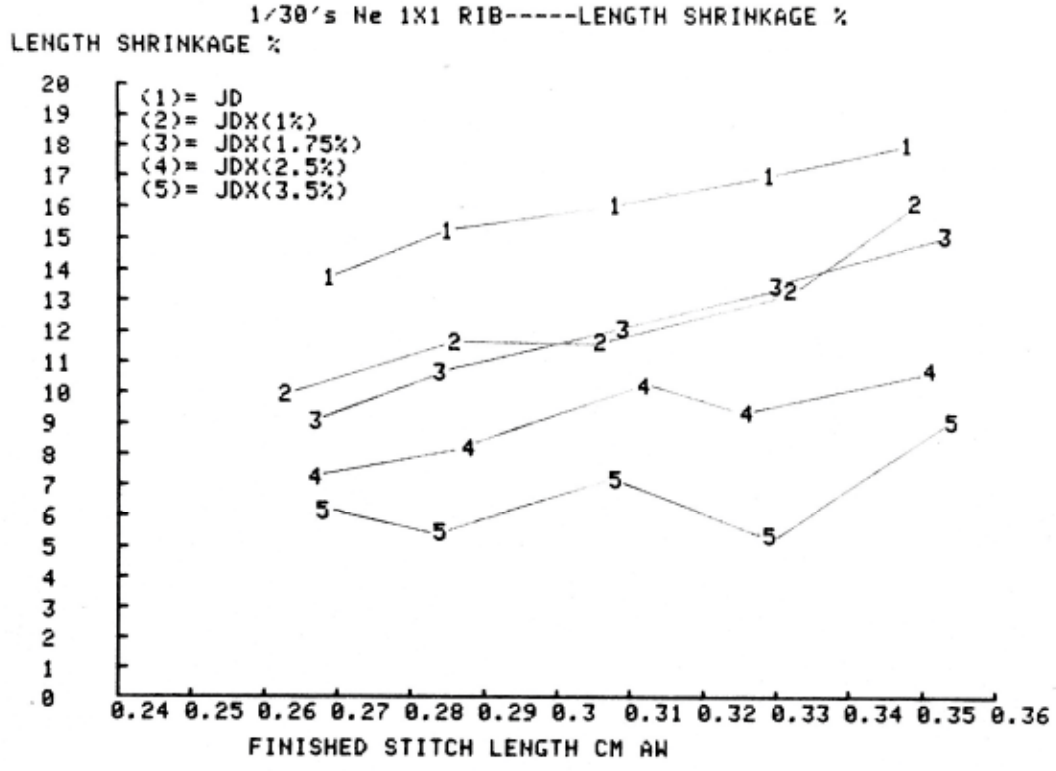

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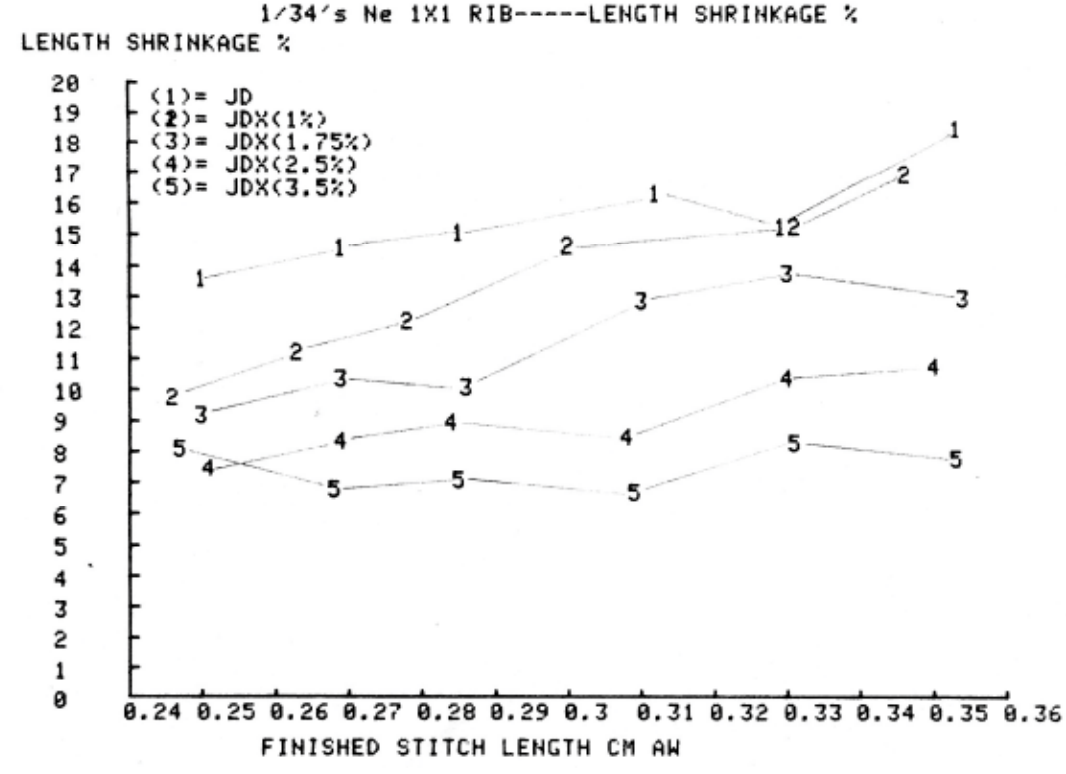

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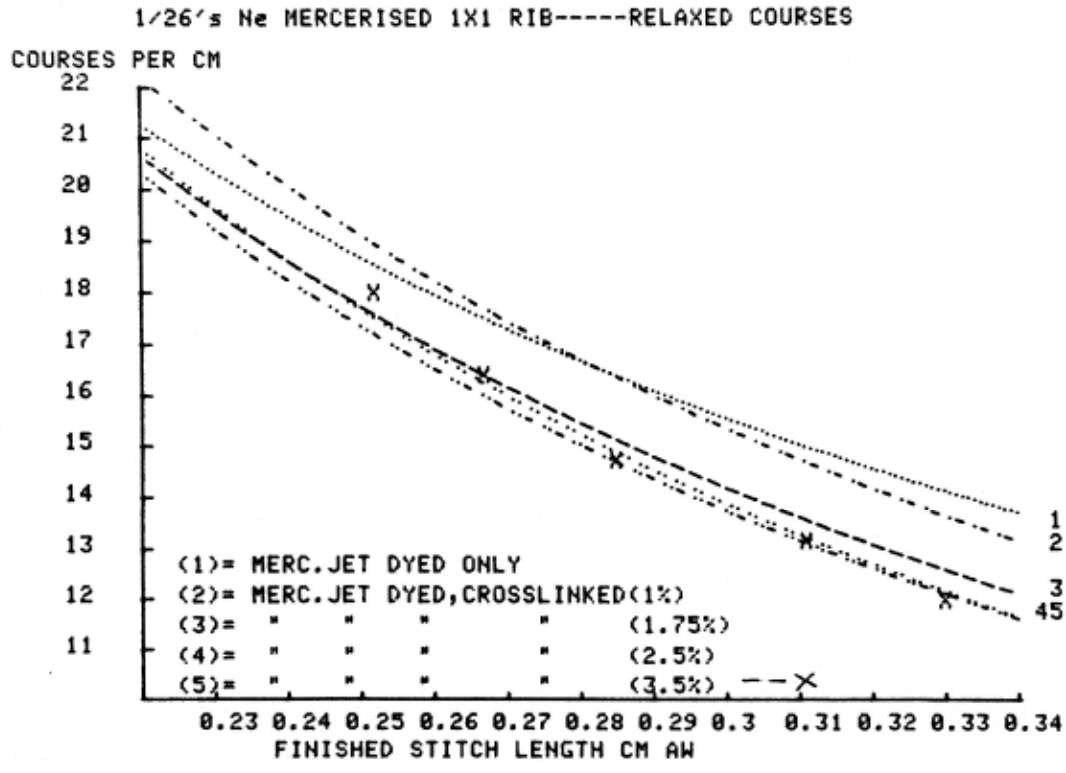

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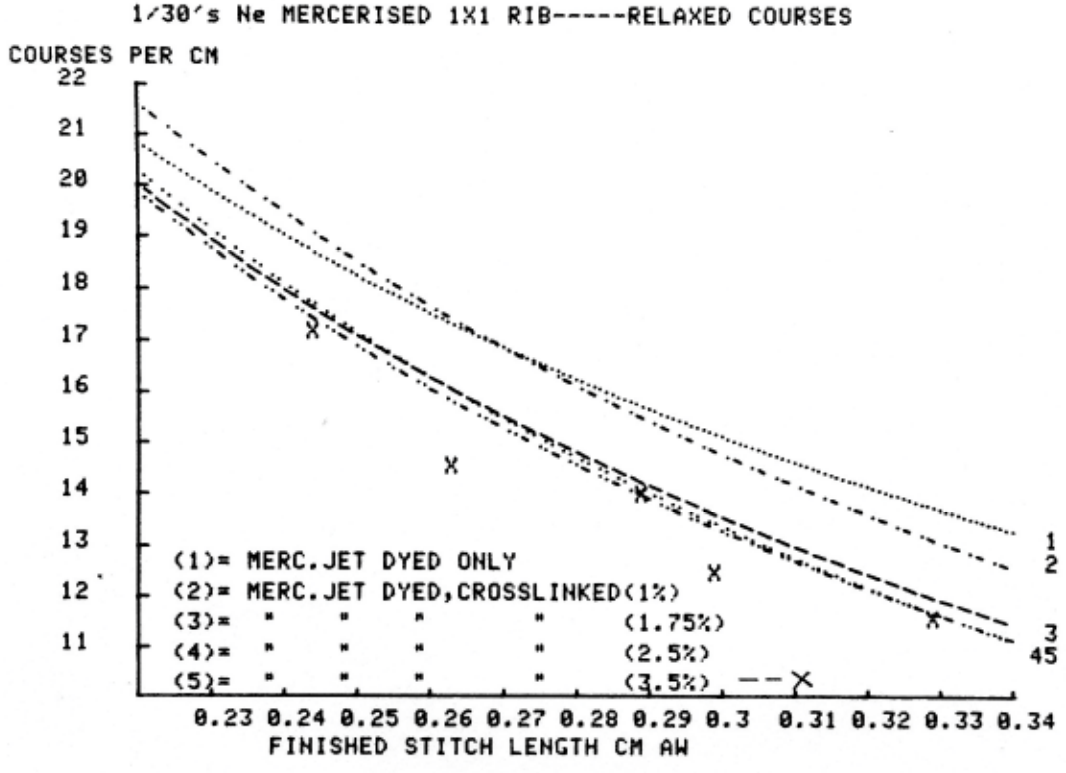

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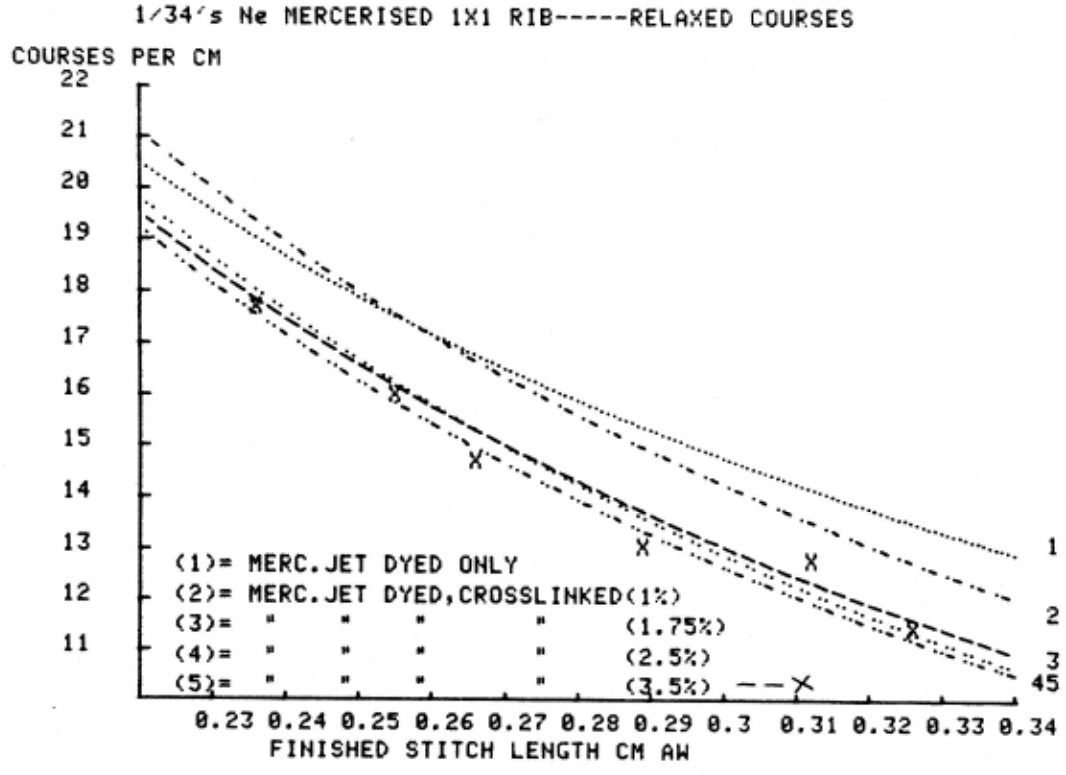

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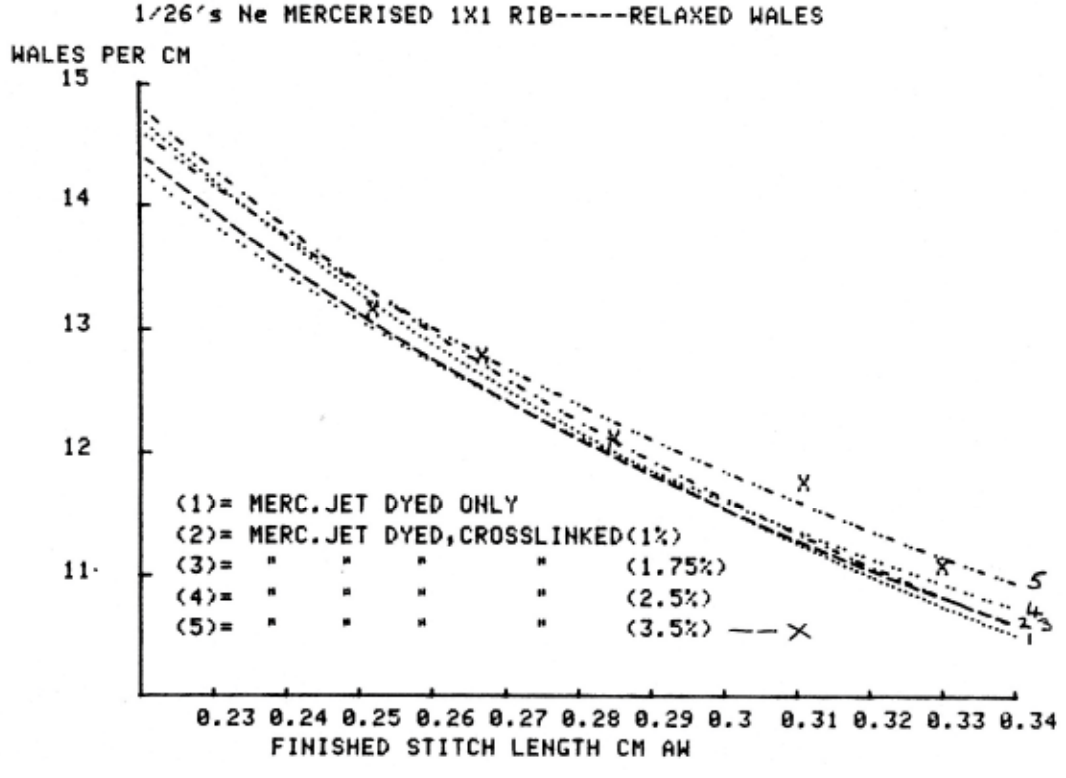
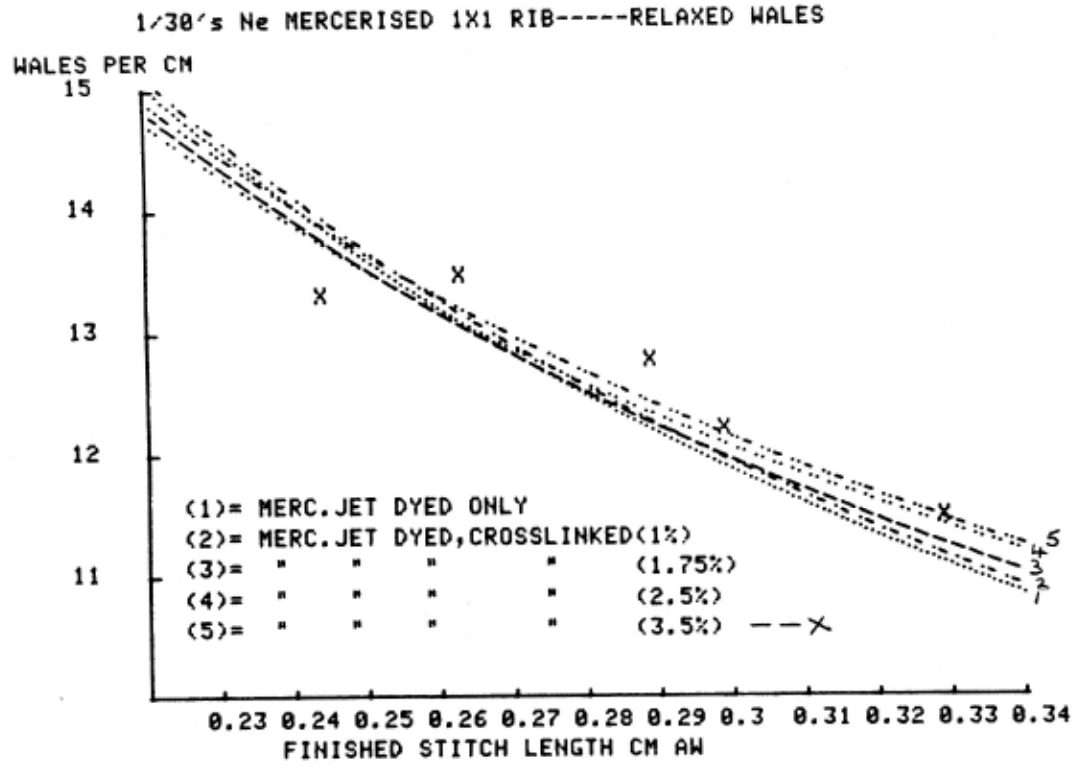


Figure 23



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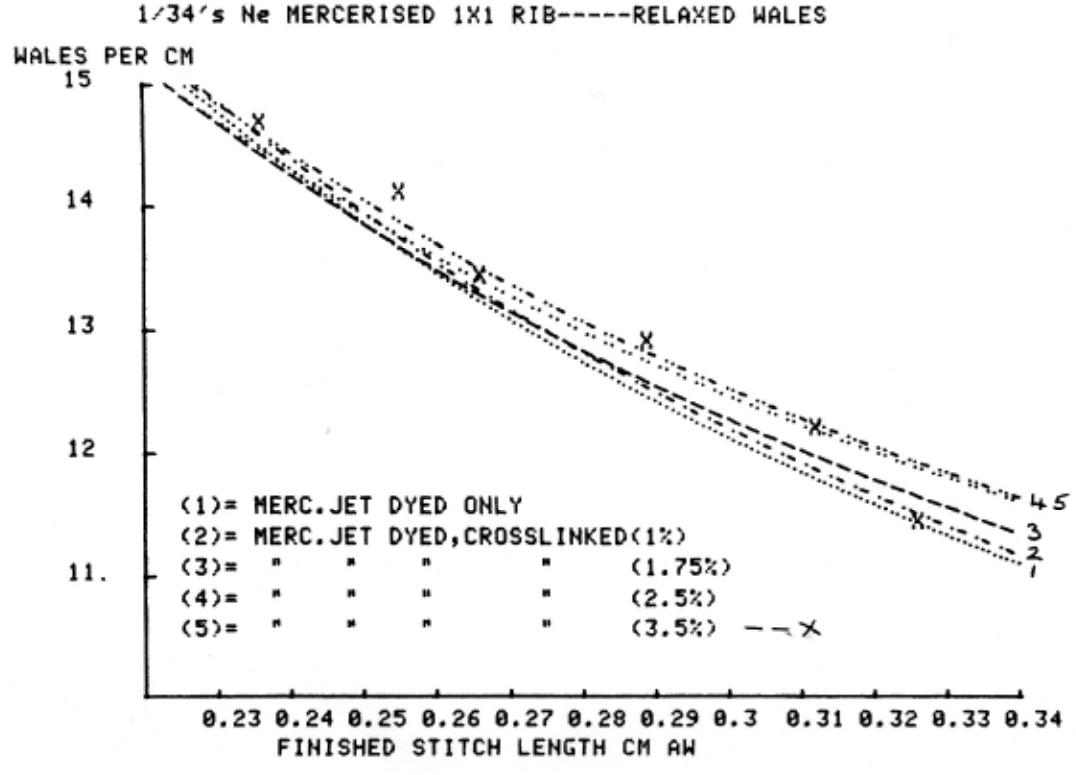

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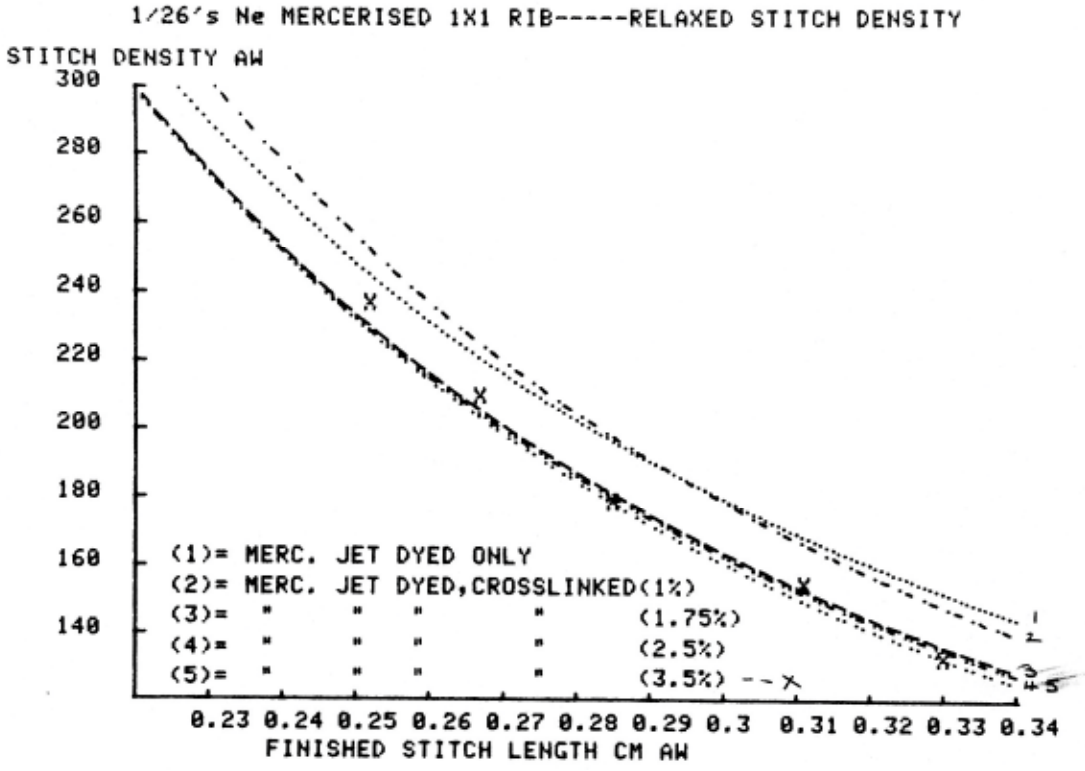

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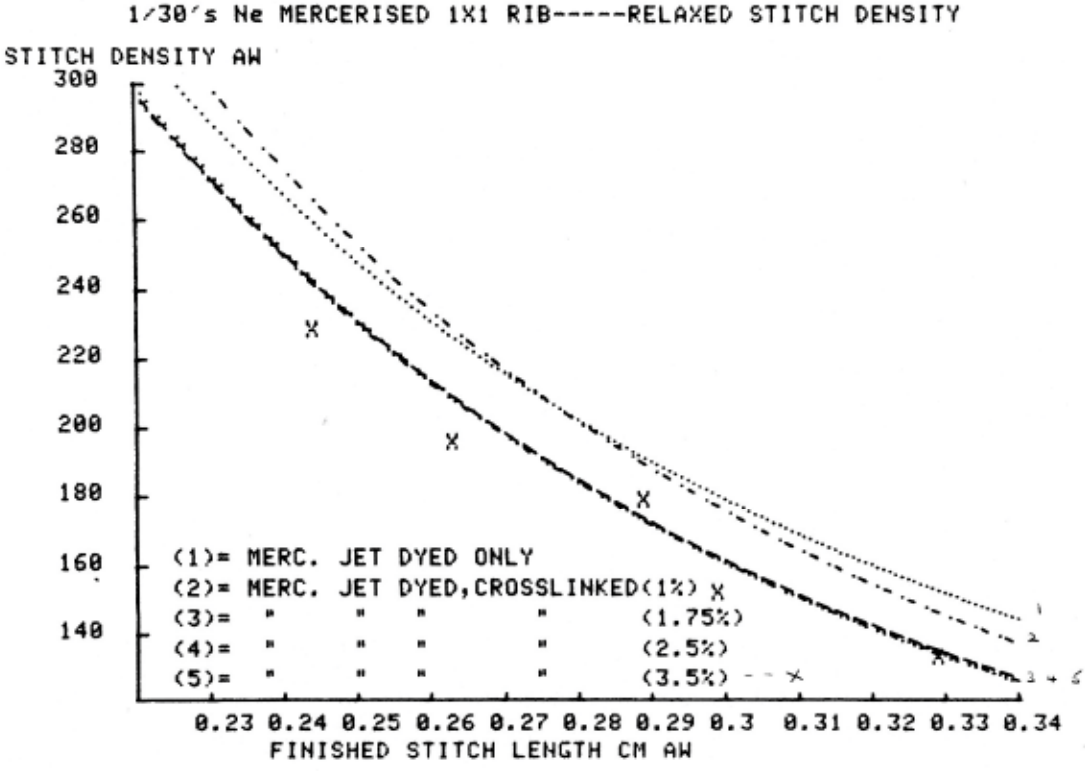

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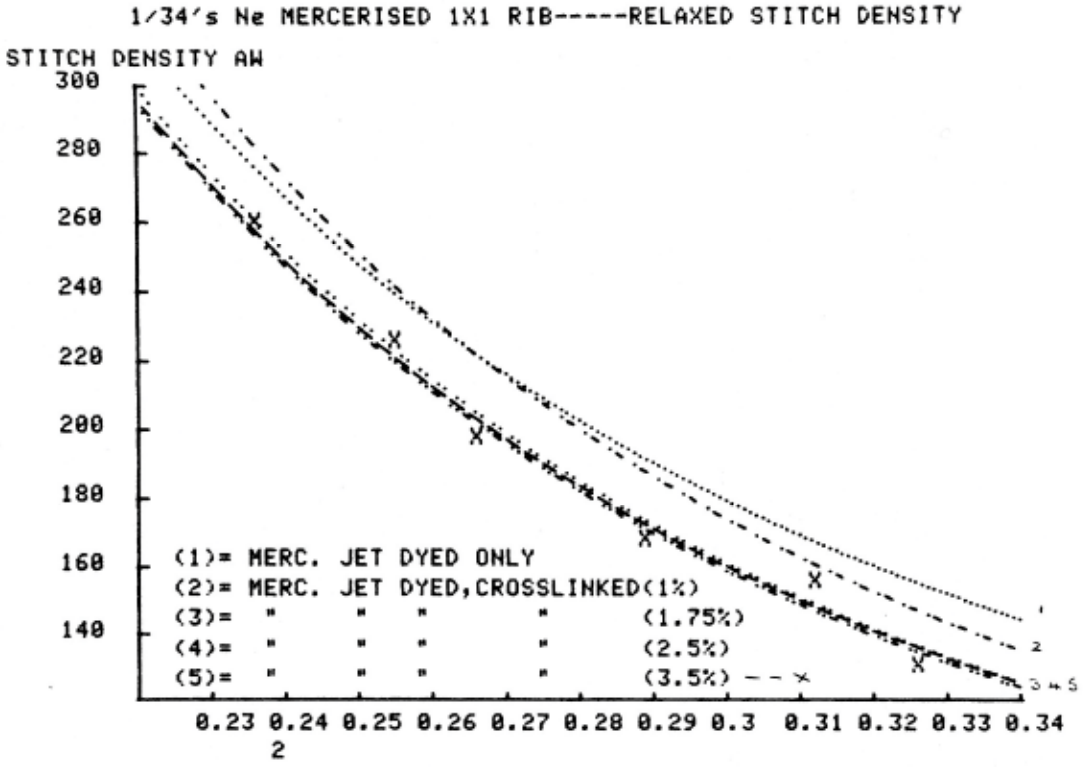

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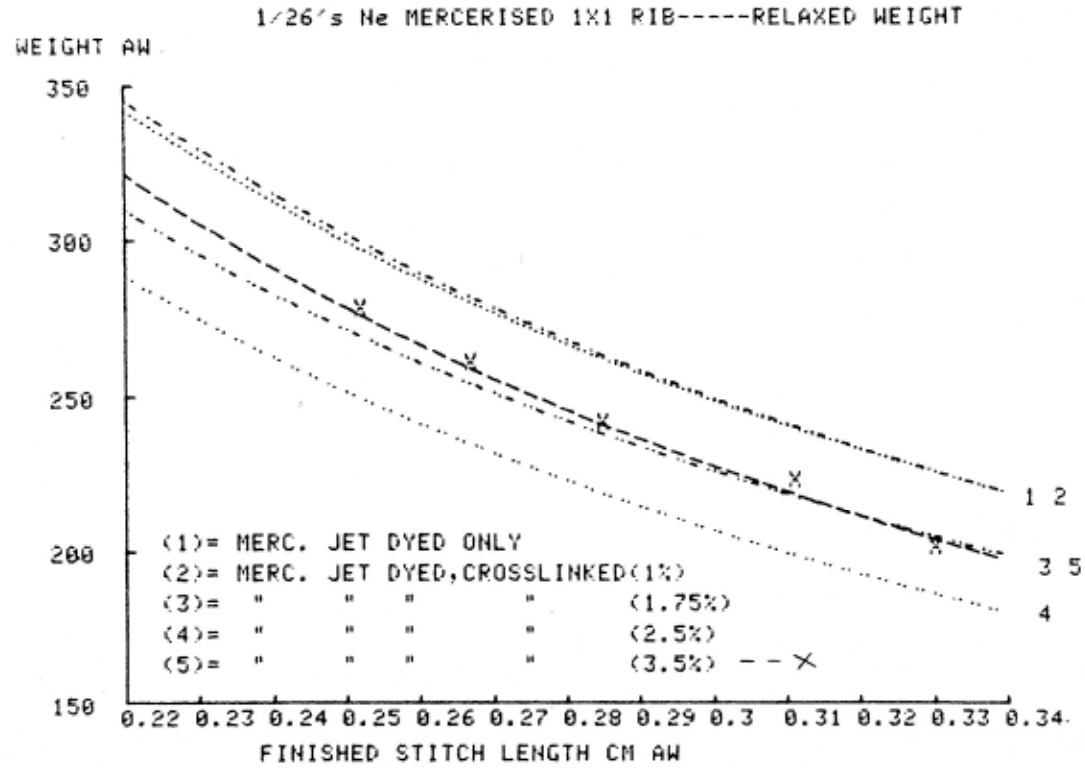

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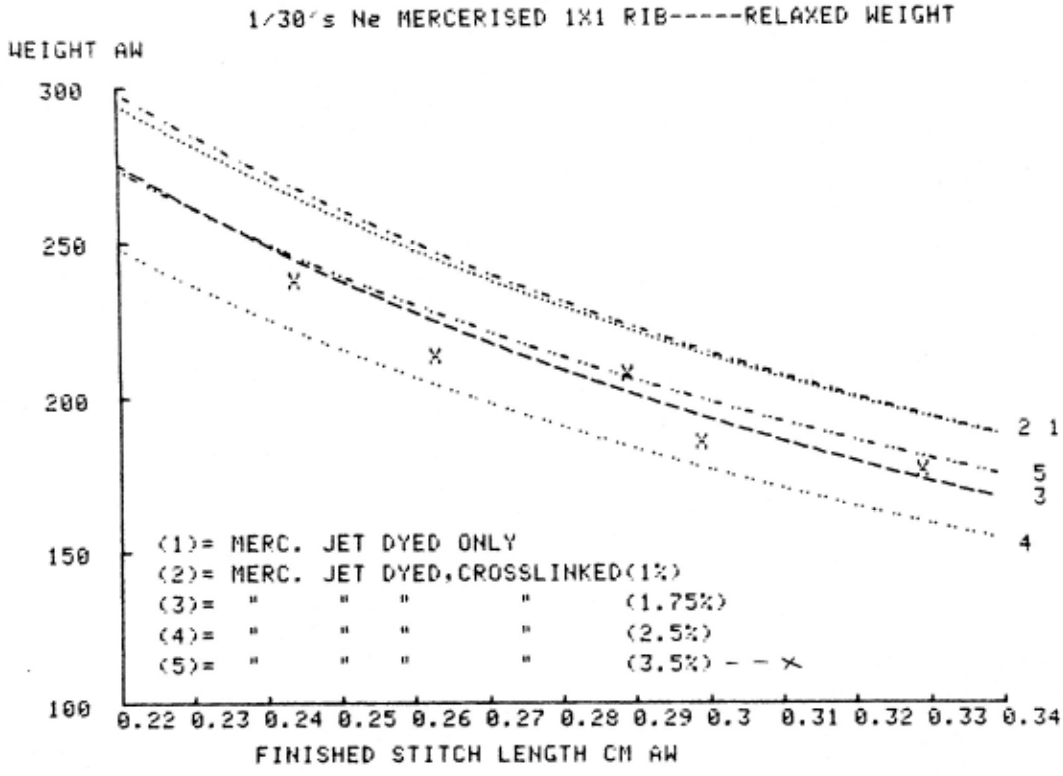

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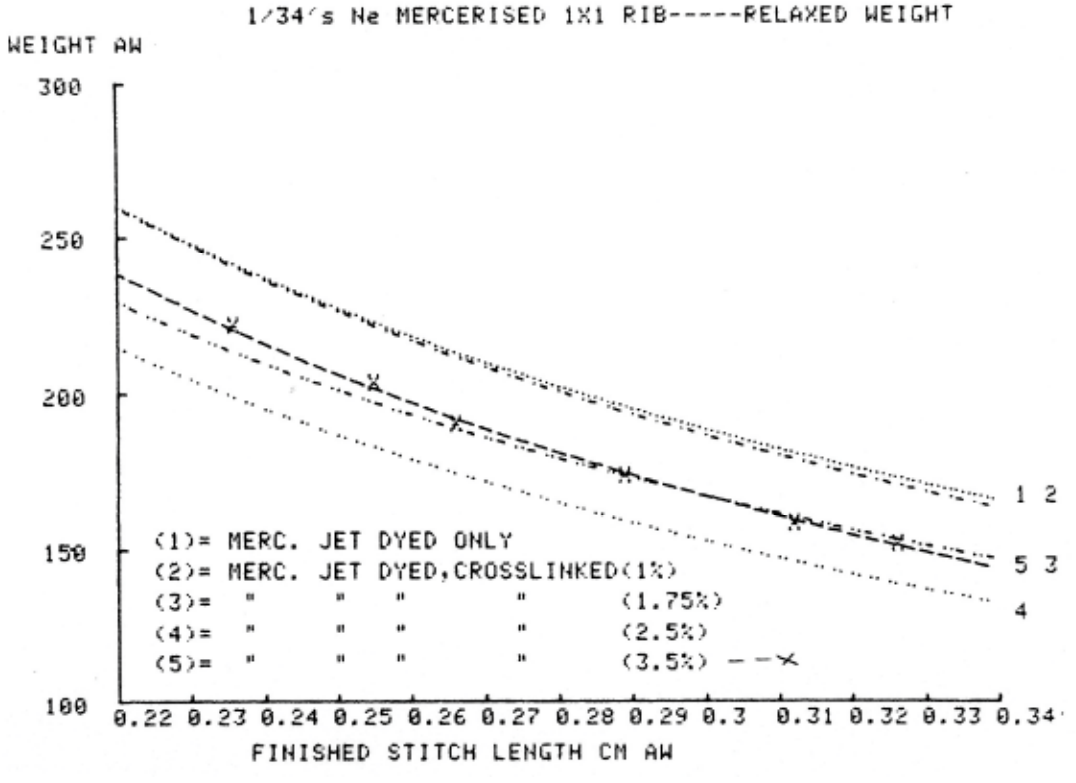

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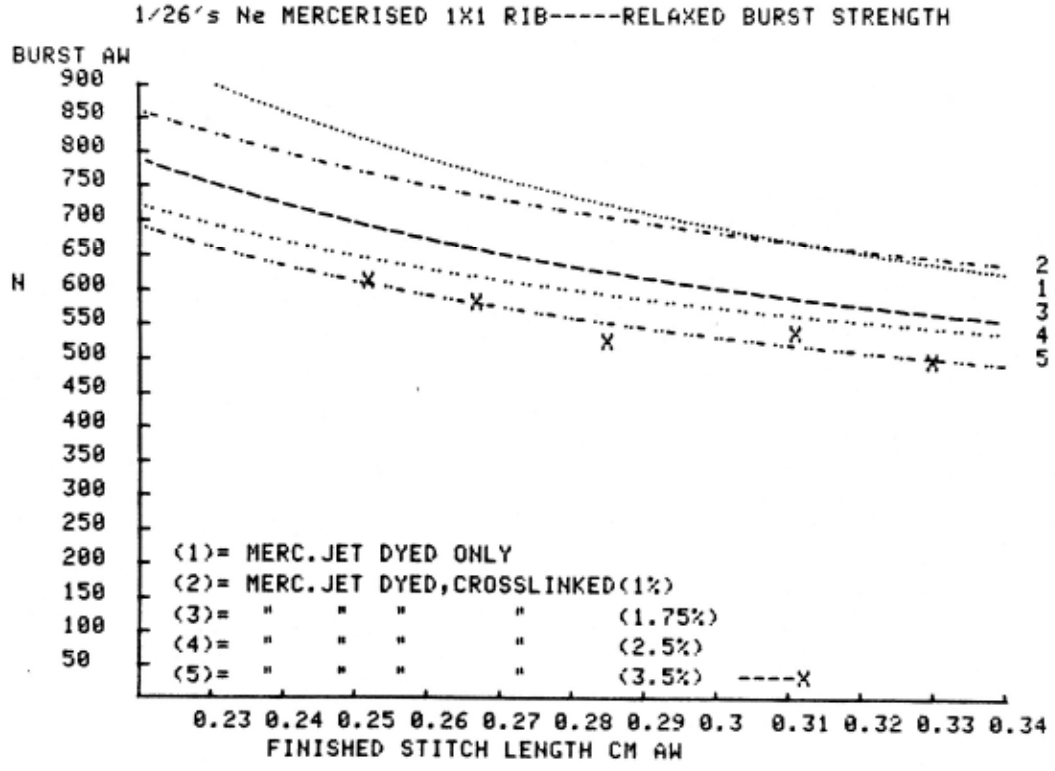

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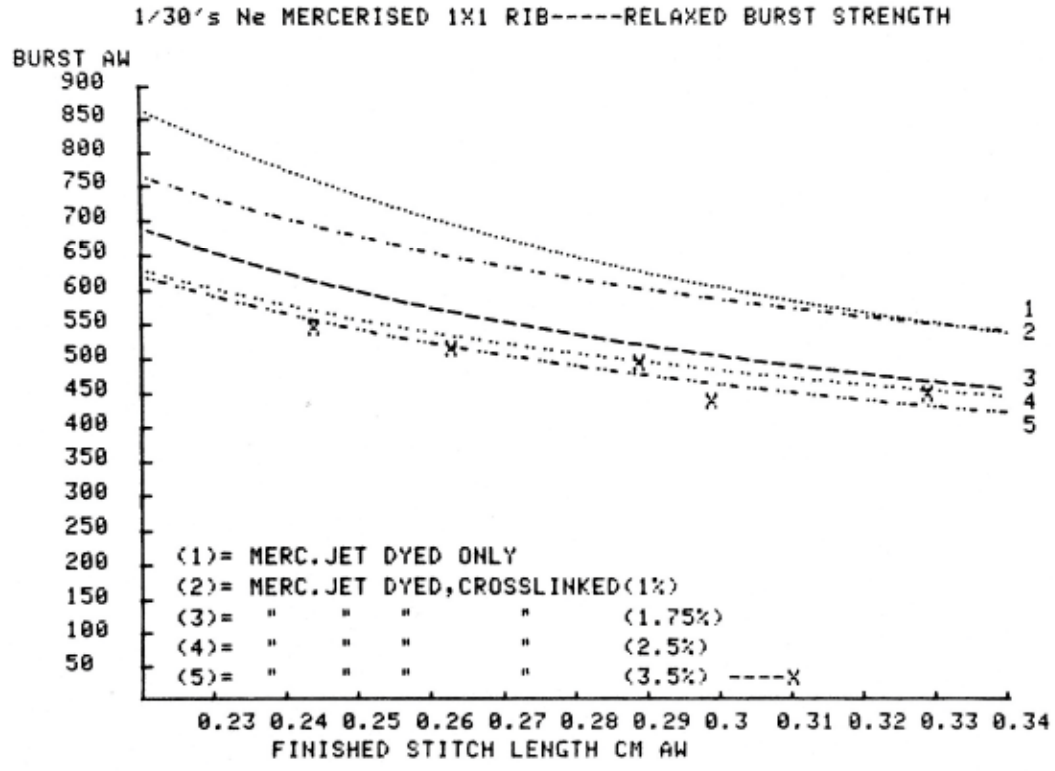

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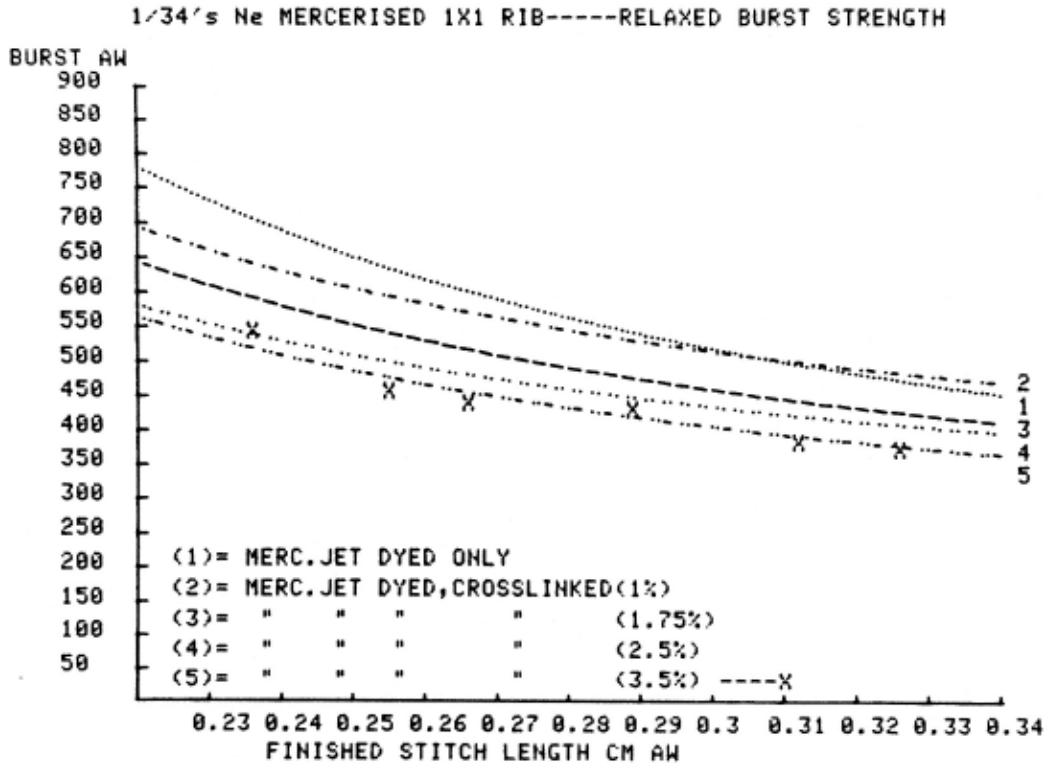

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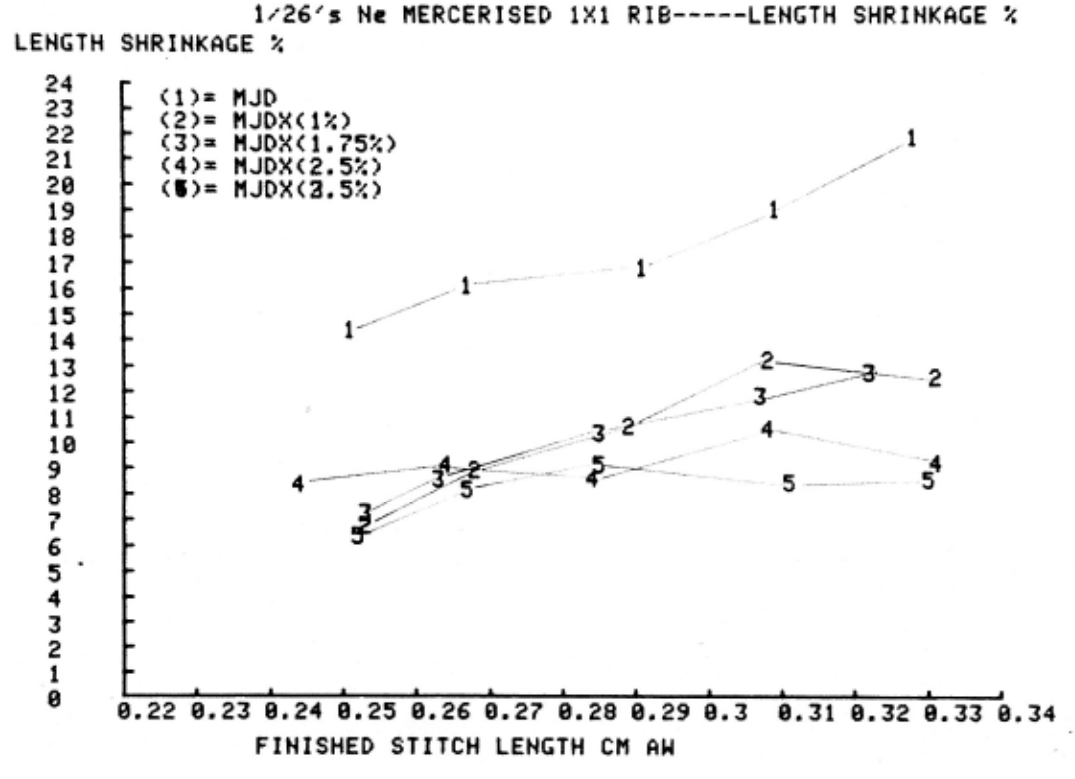

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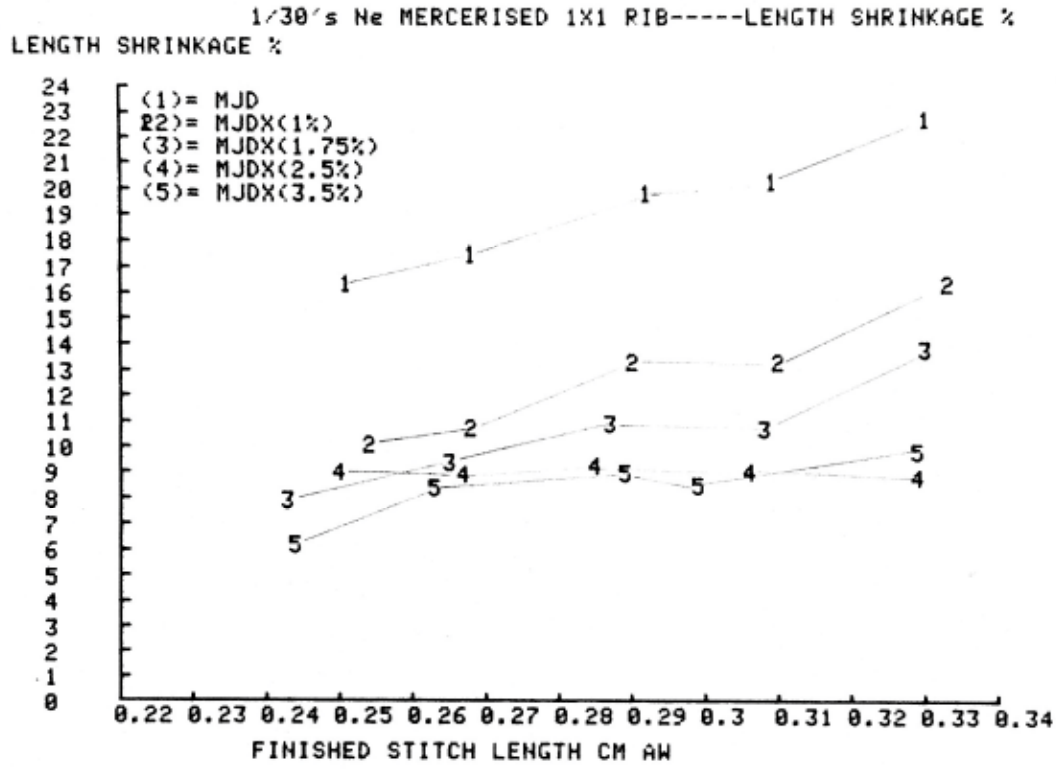

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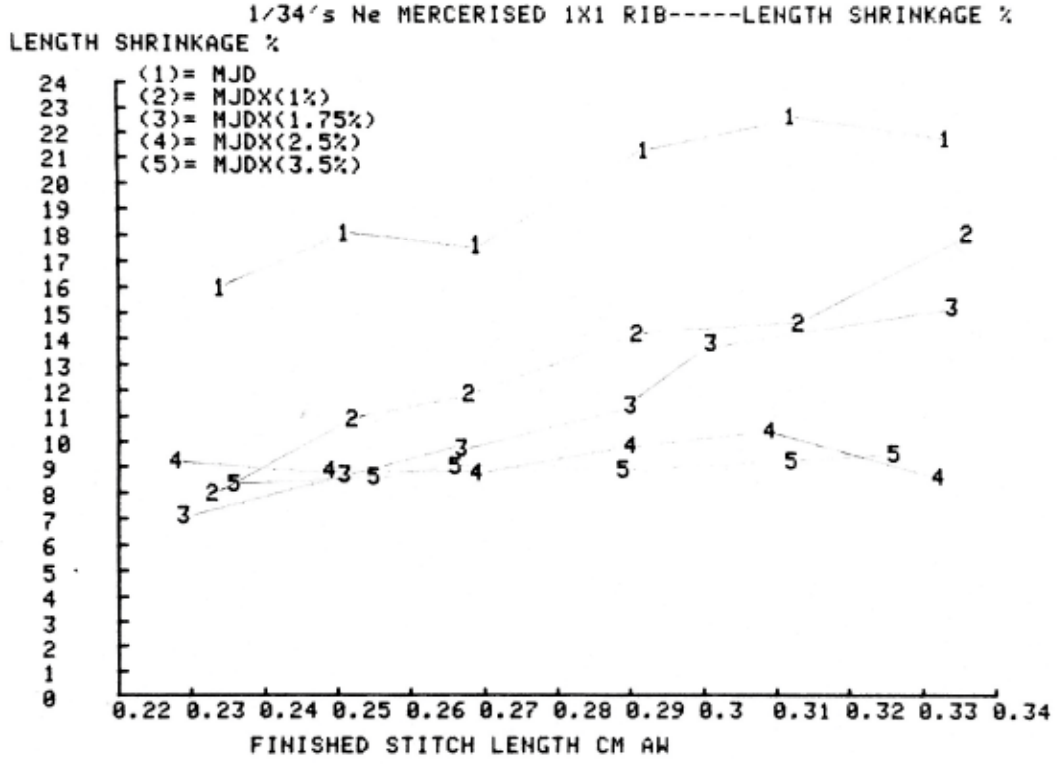

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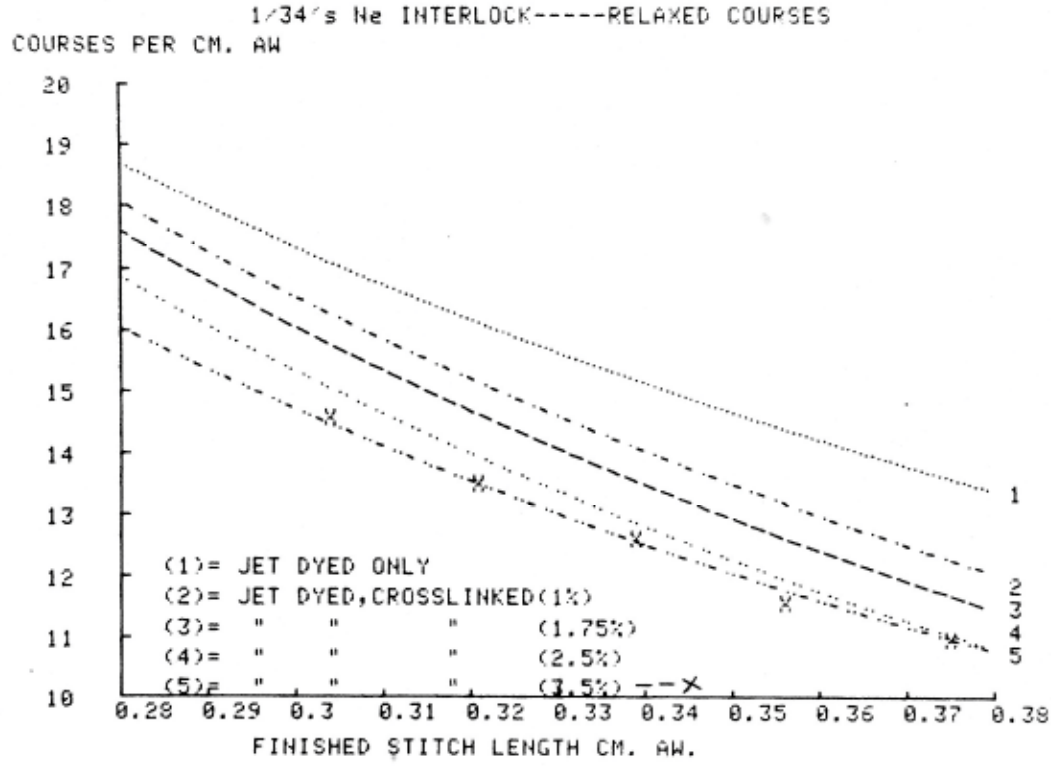

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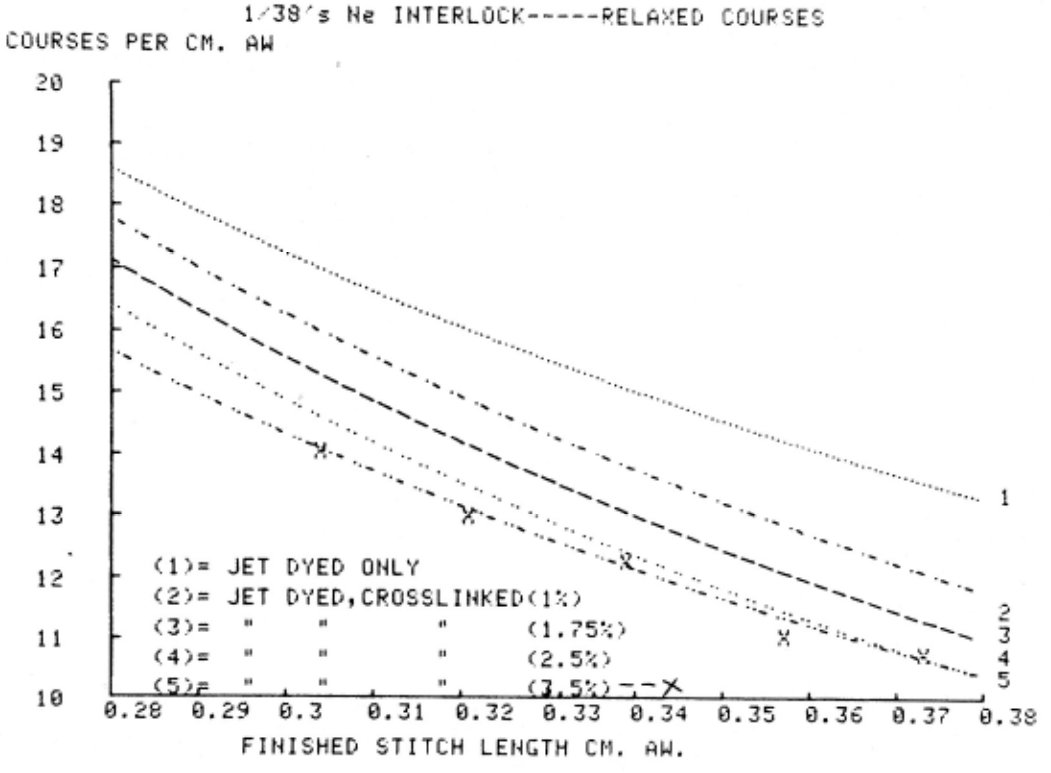

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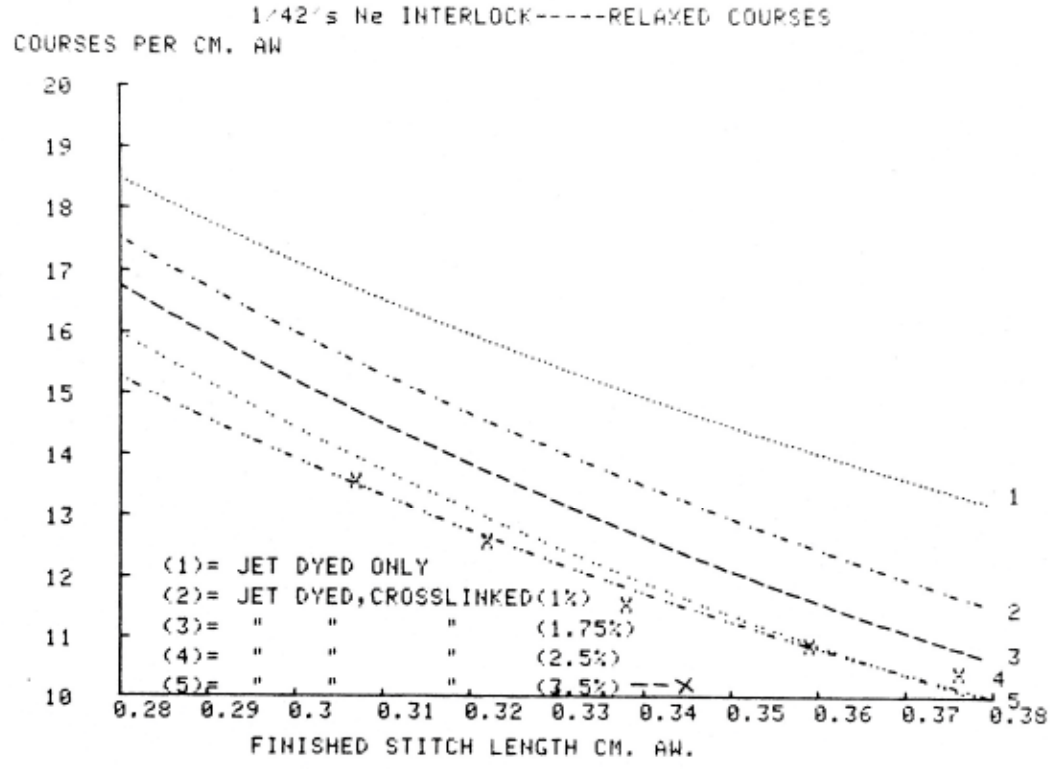

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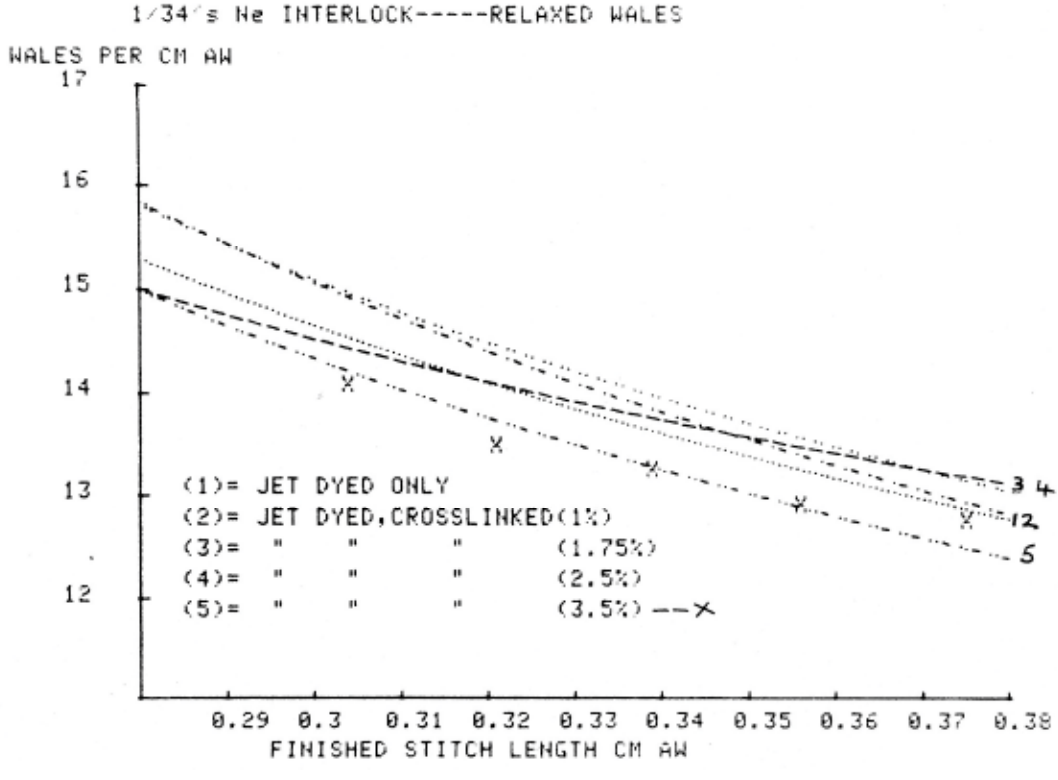

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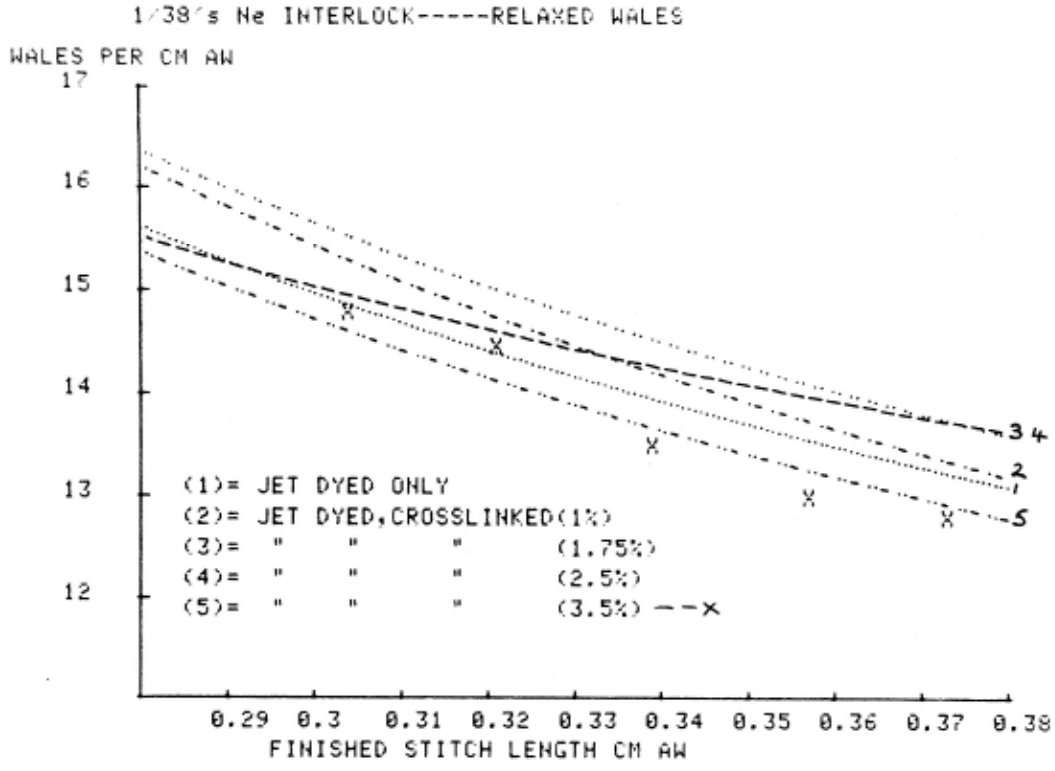

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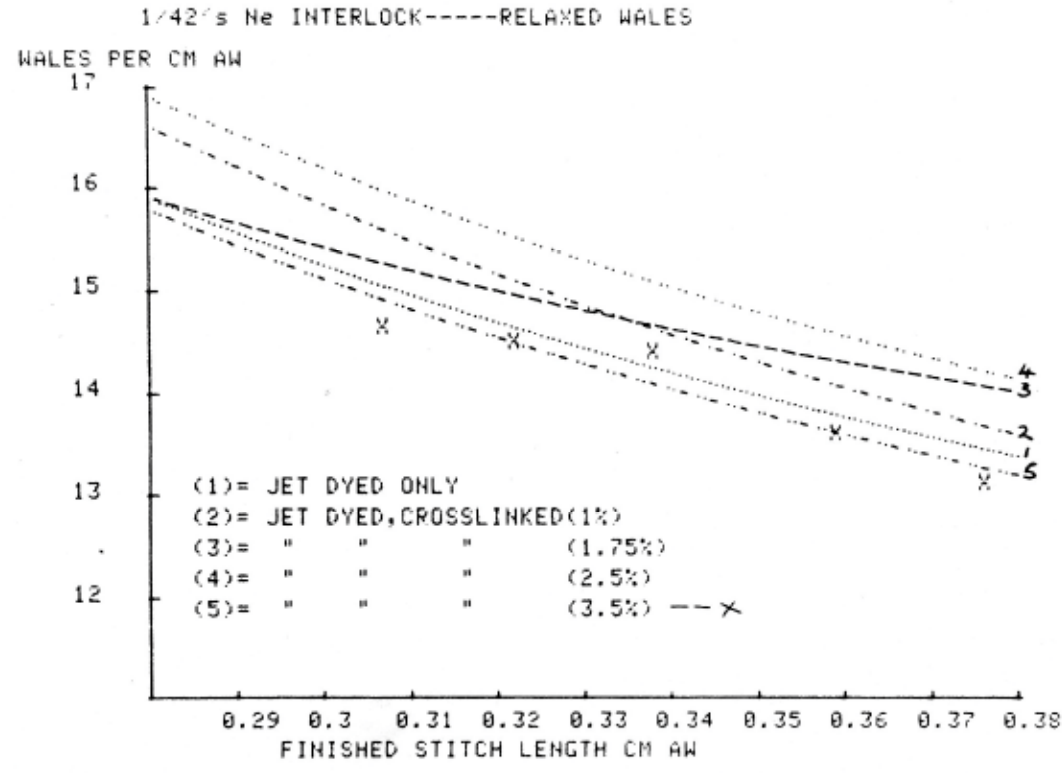

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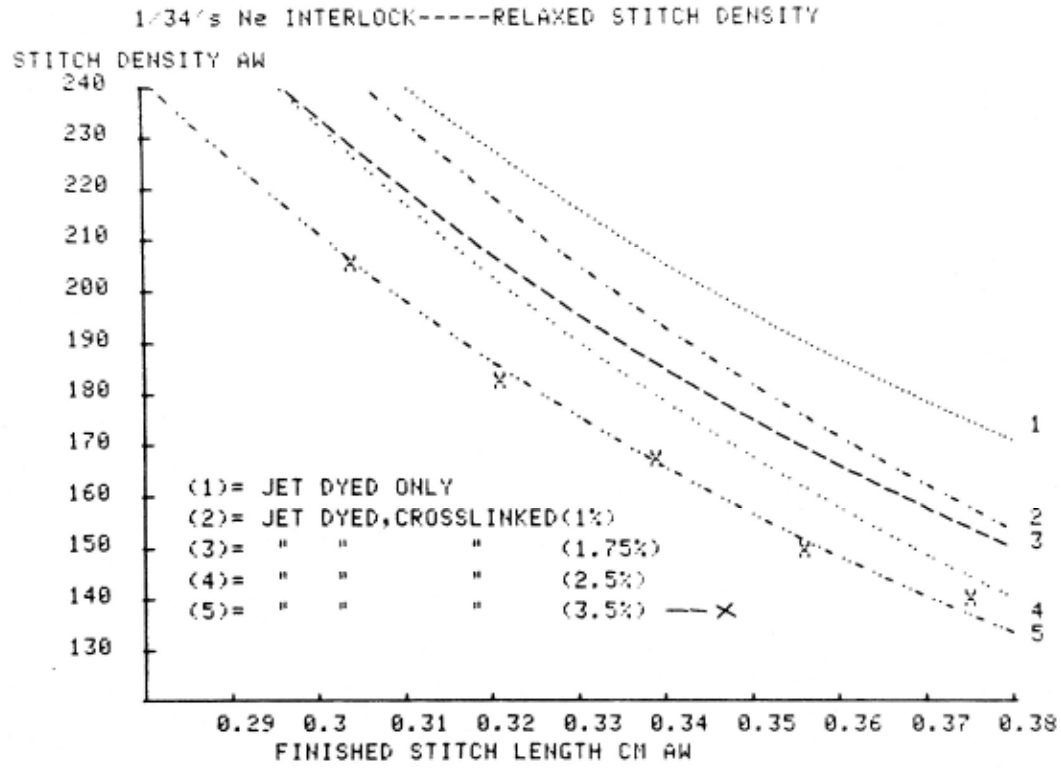

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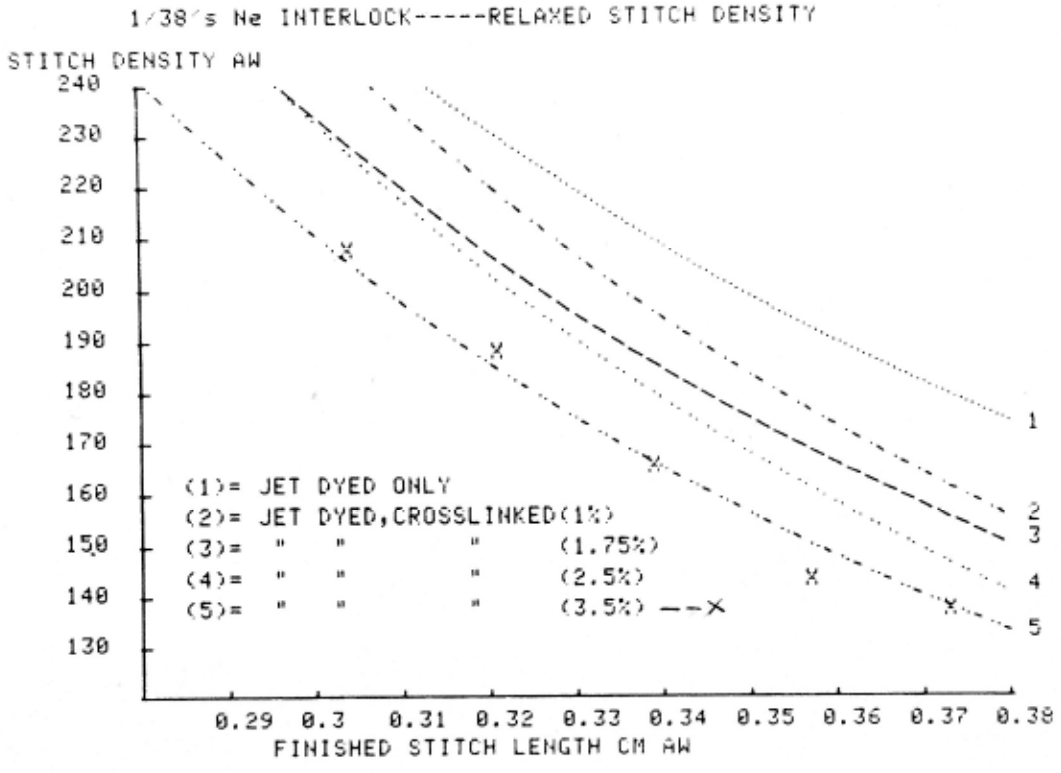

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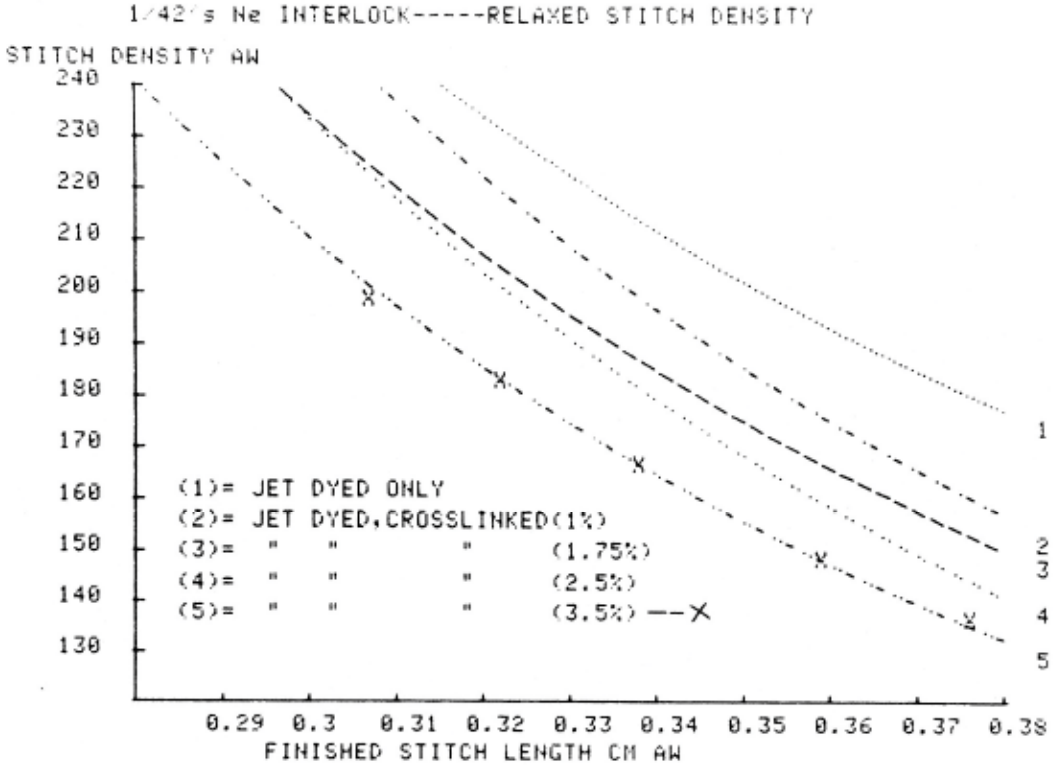

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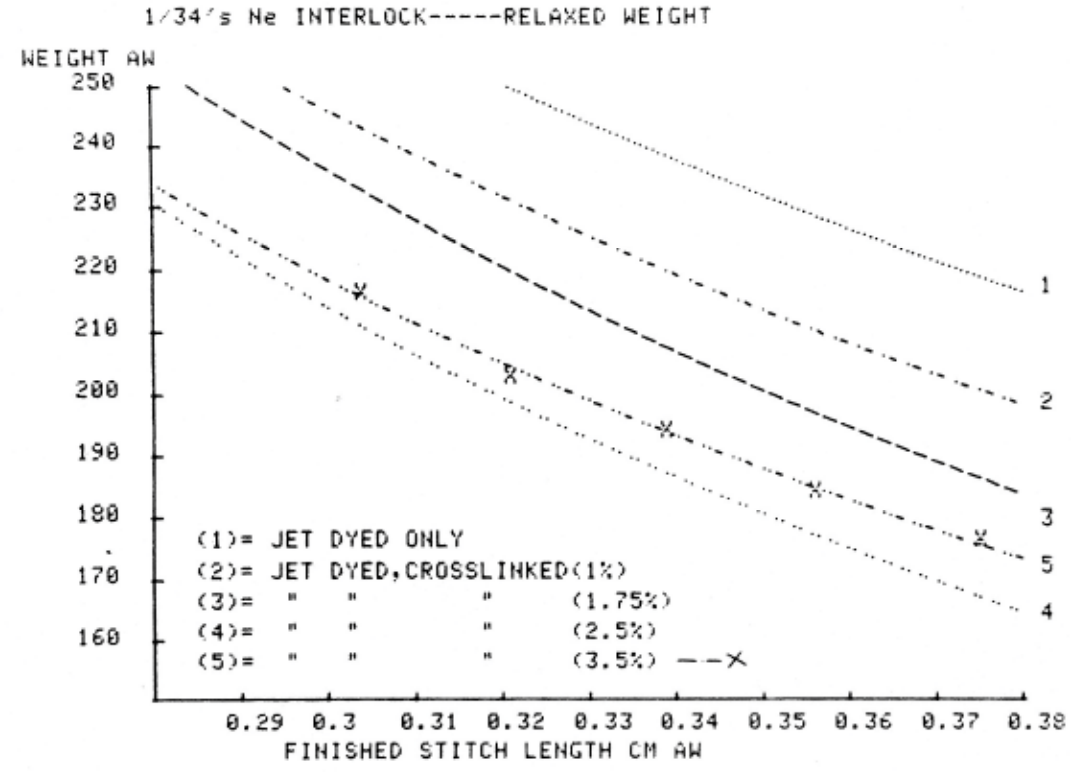

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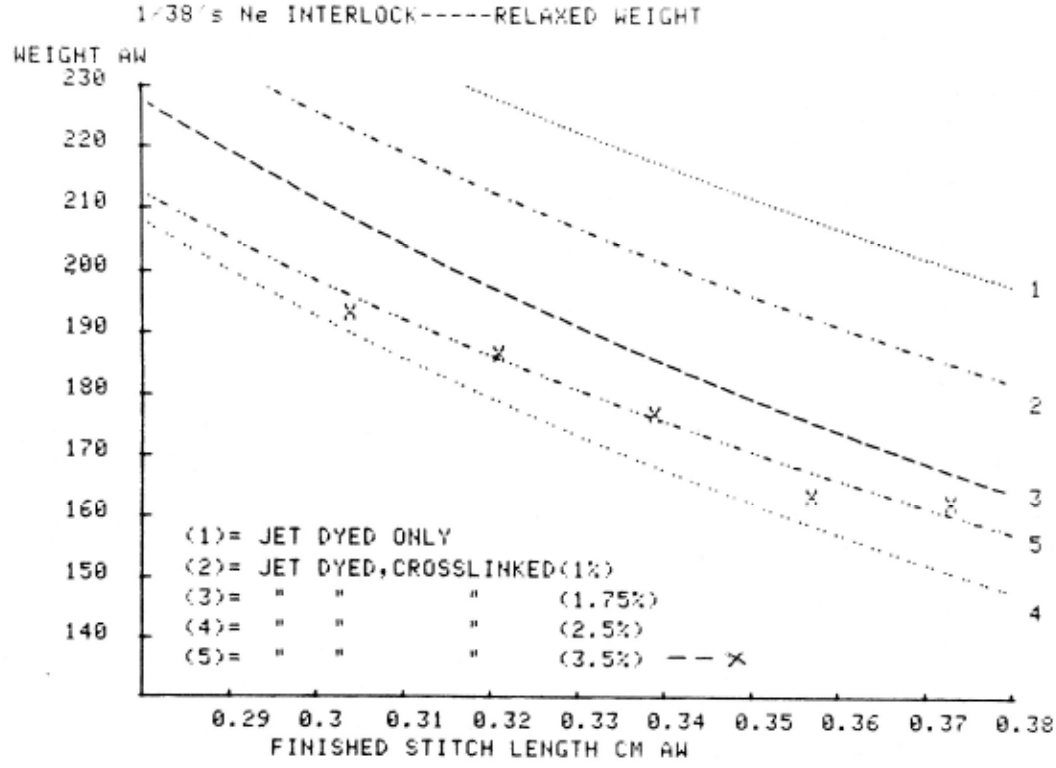

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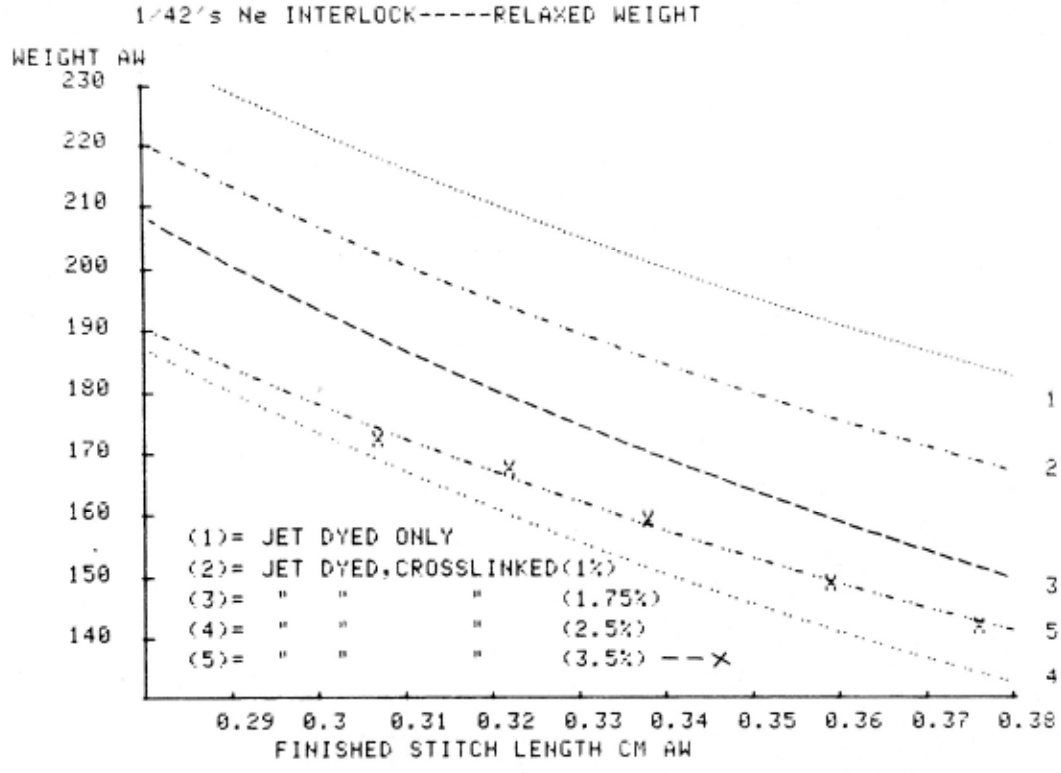

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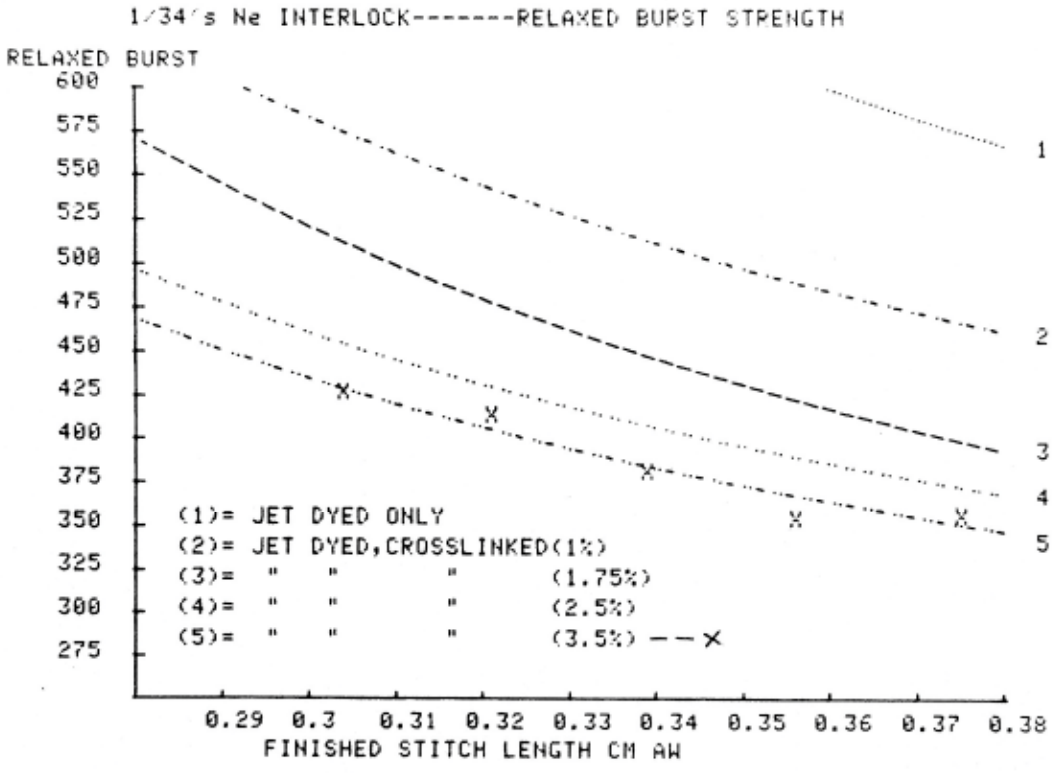

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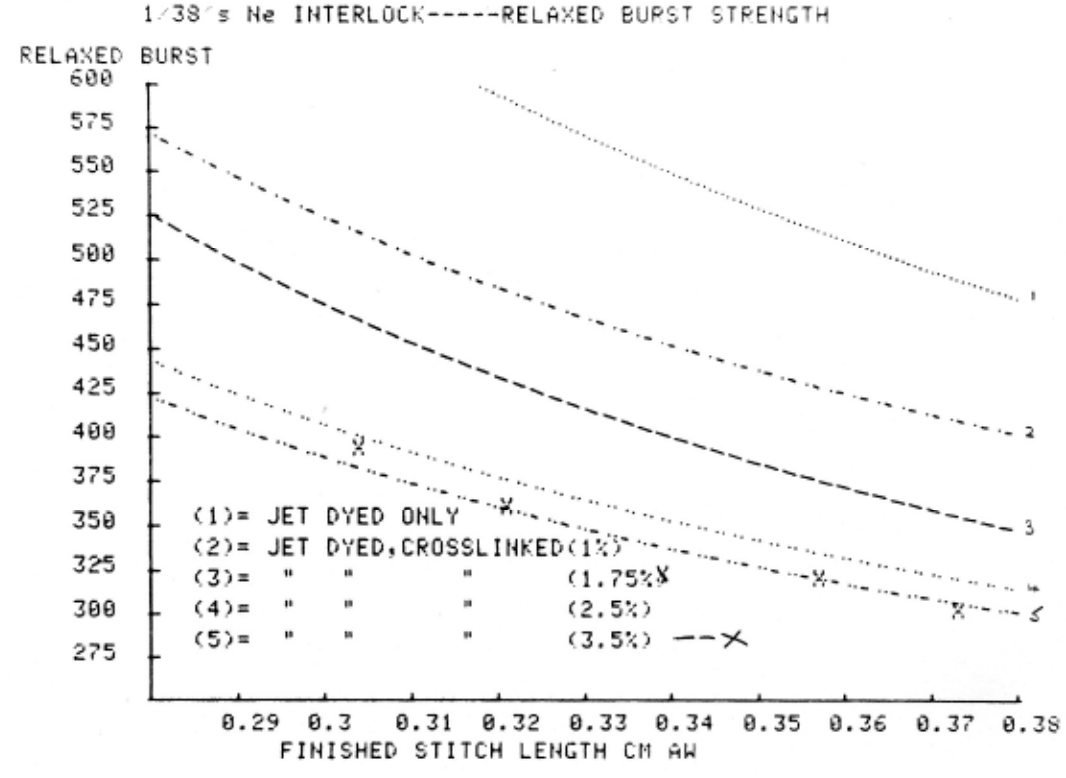

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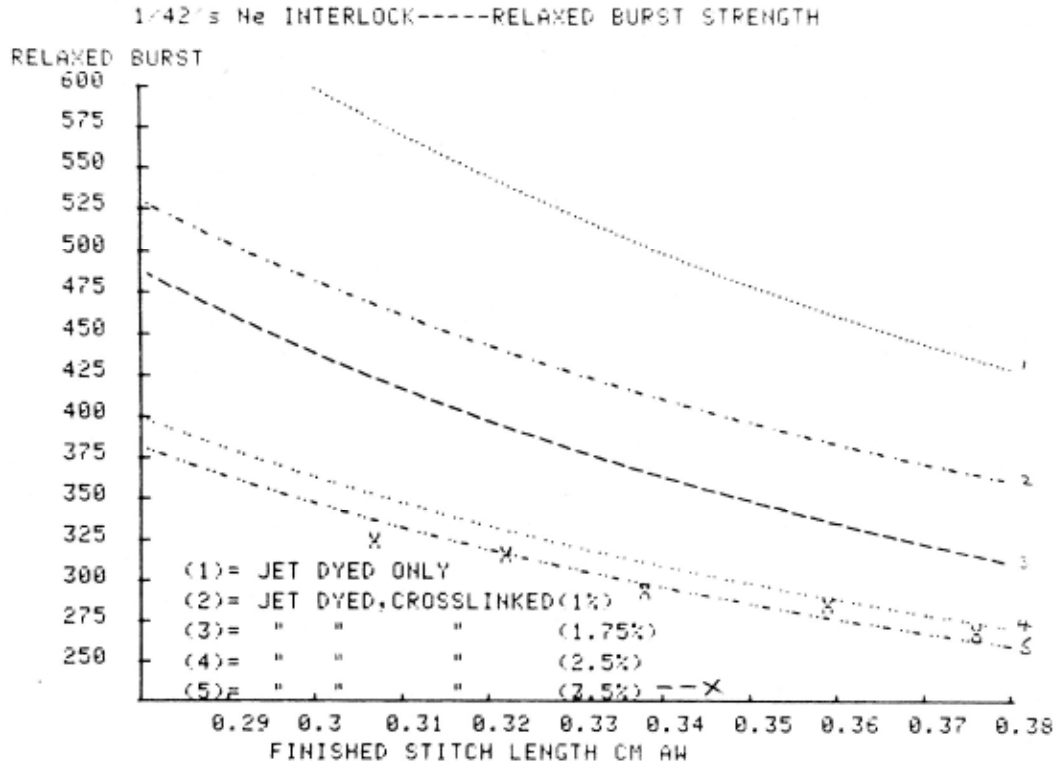

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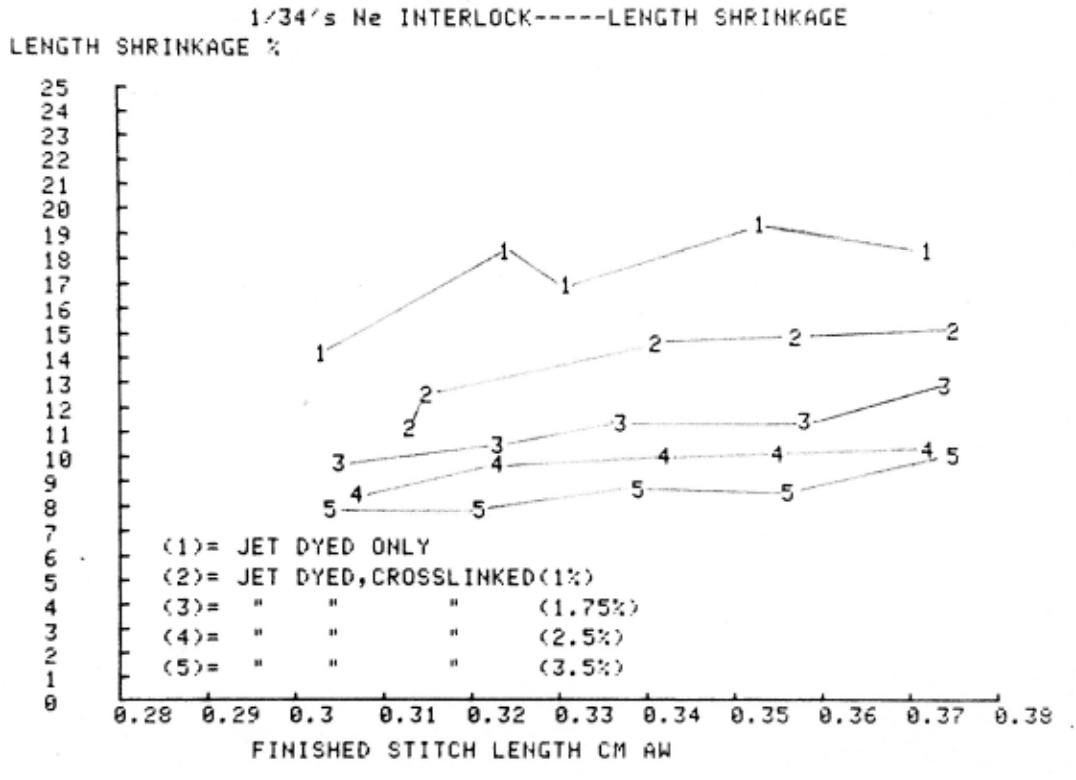

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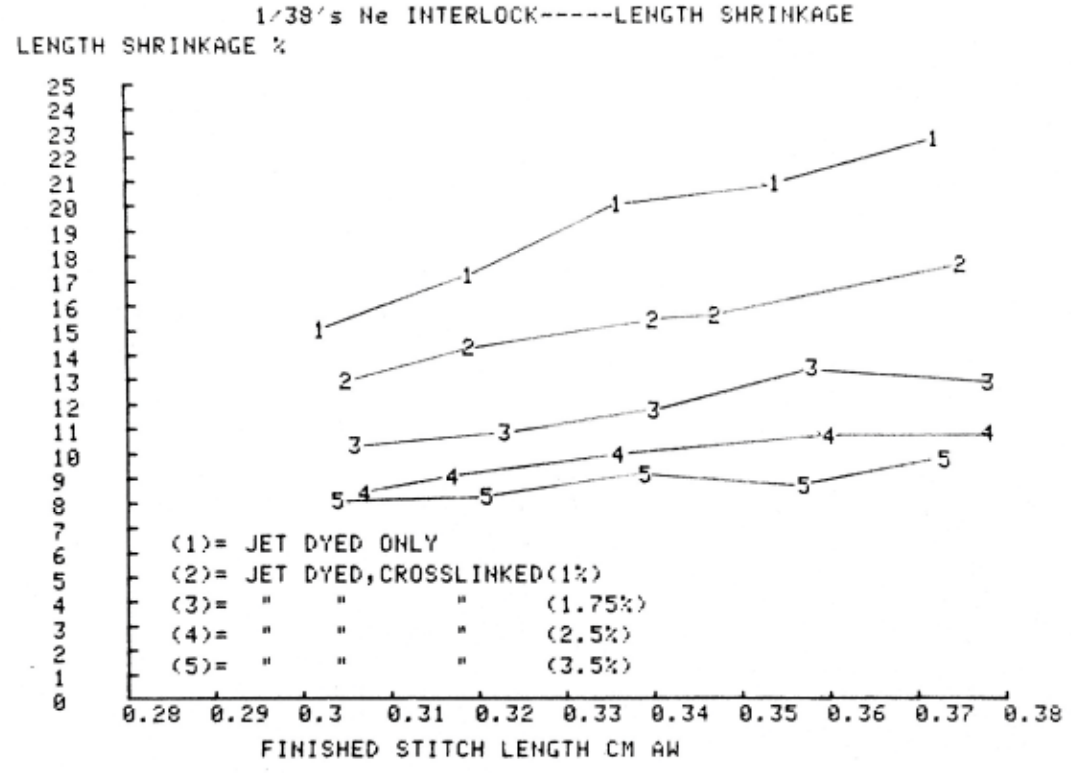

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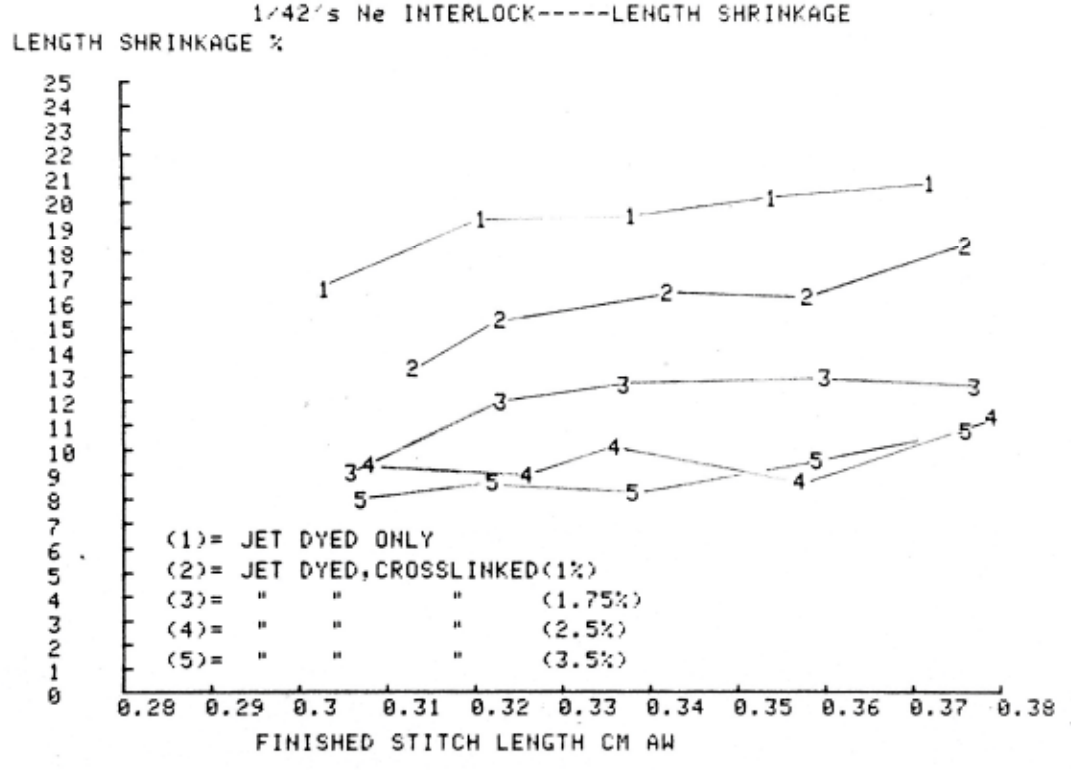

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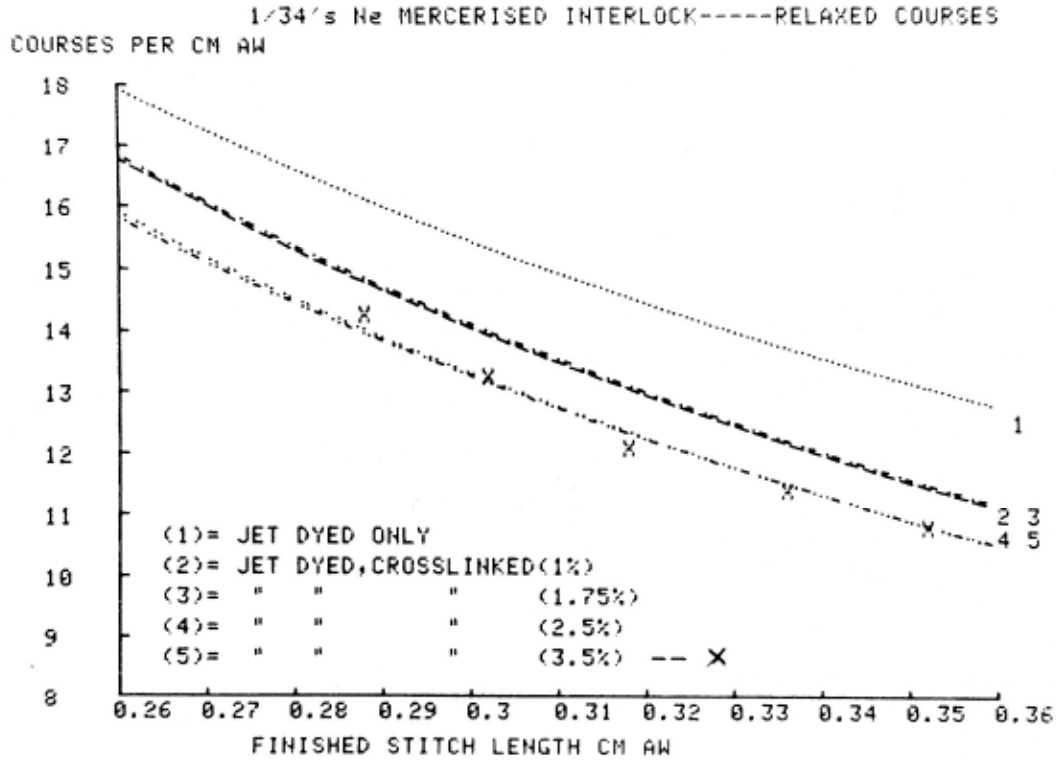

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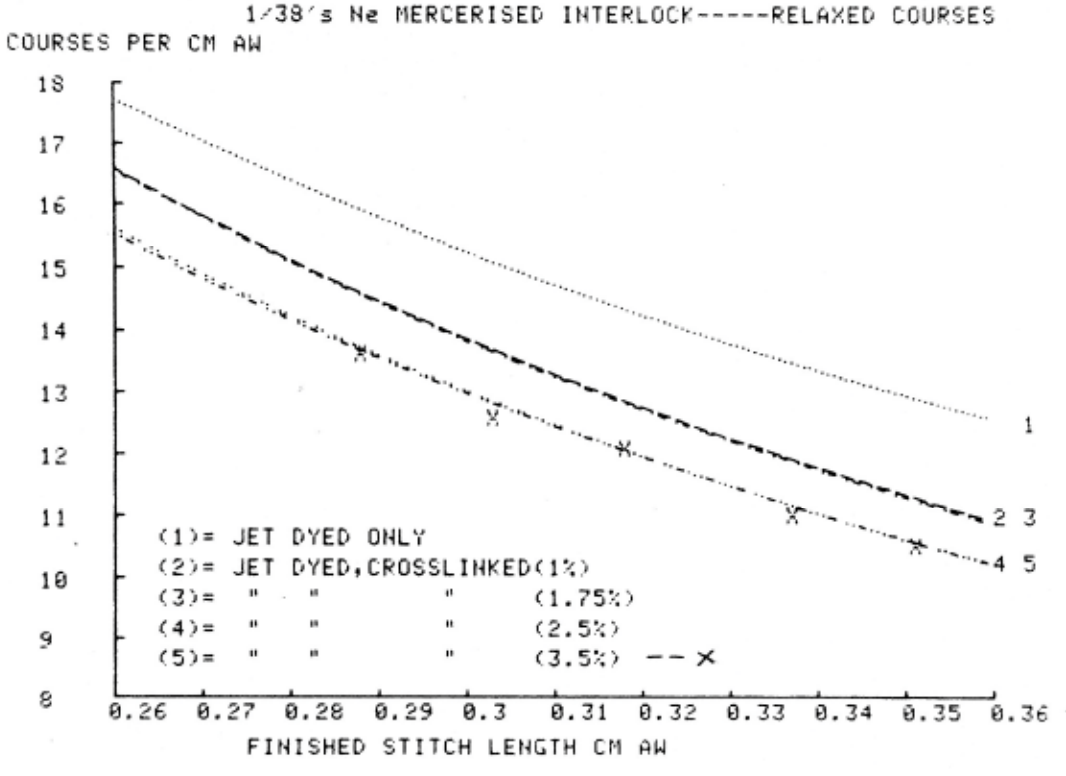

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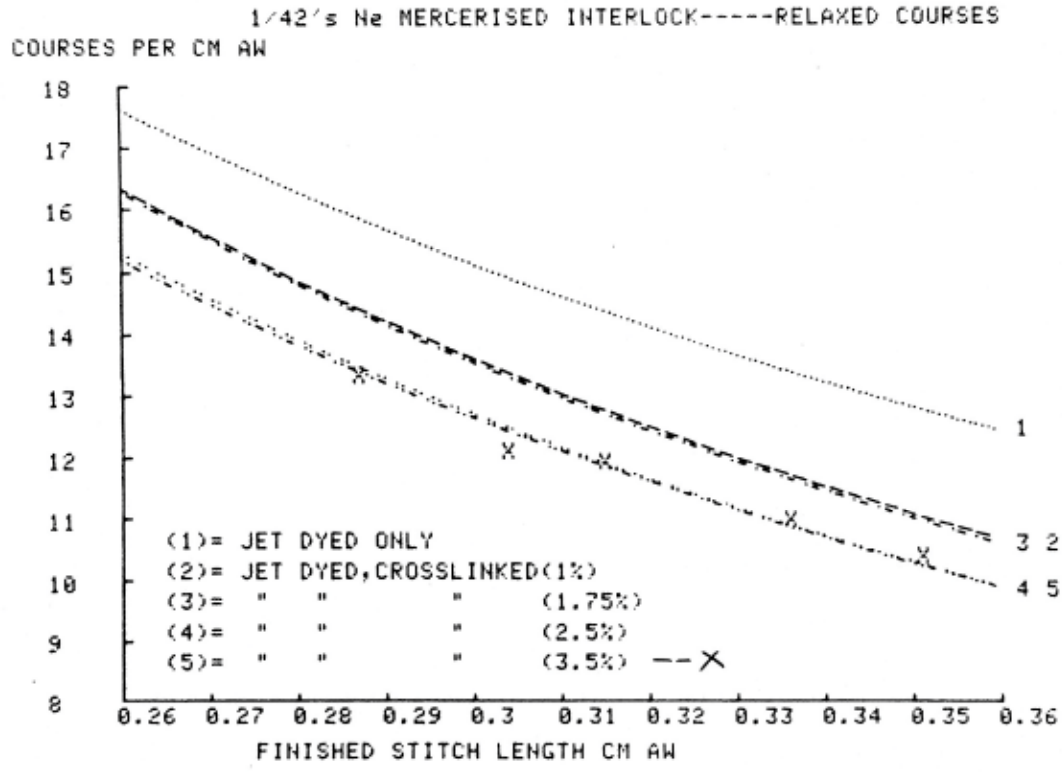

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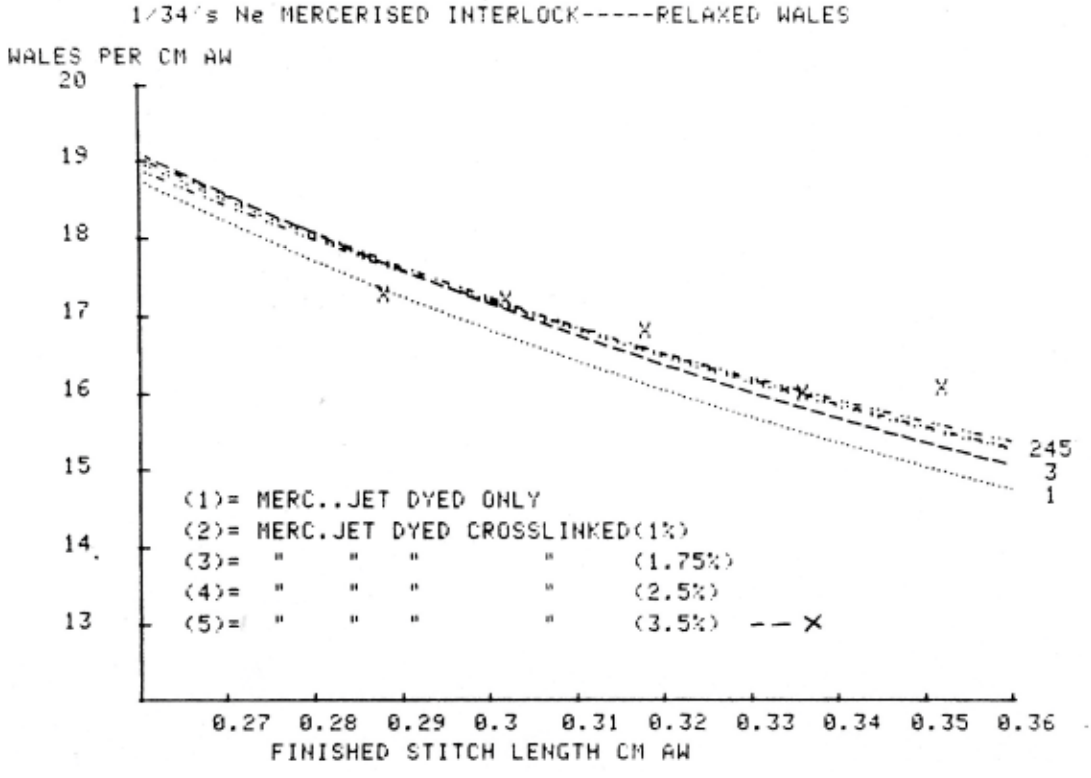

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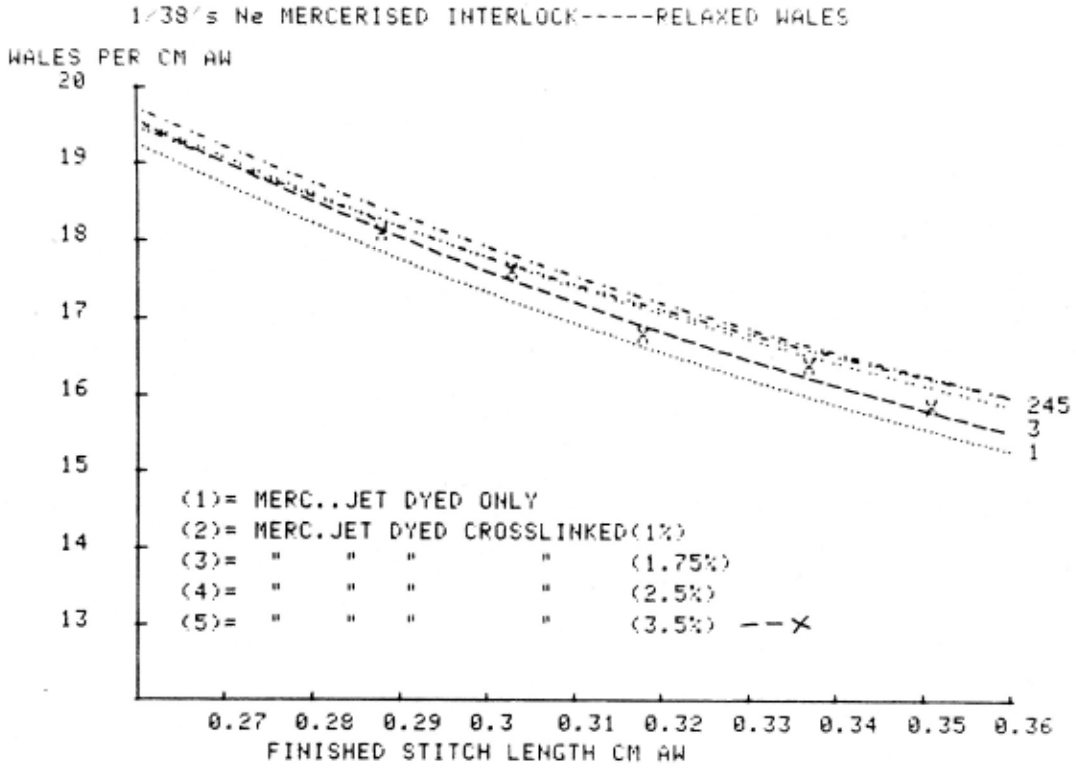

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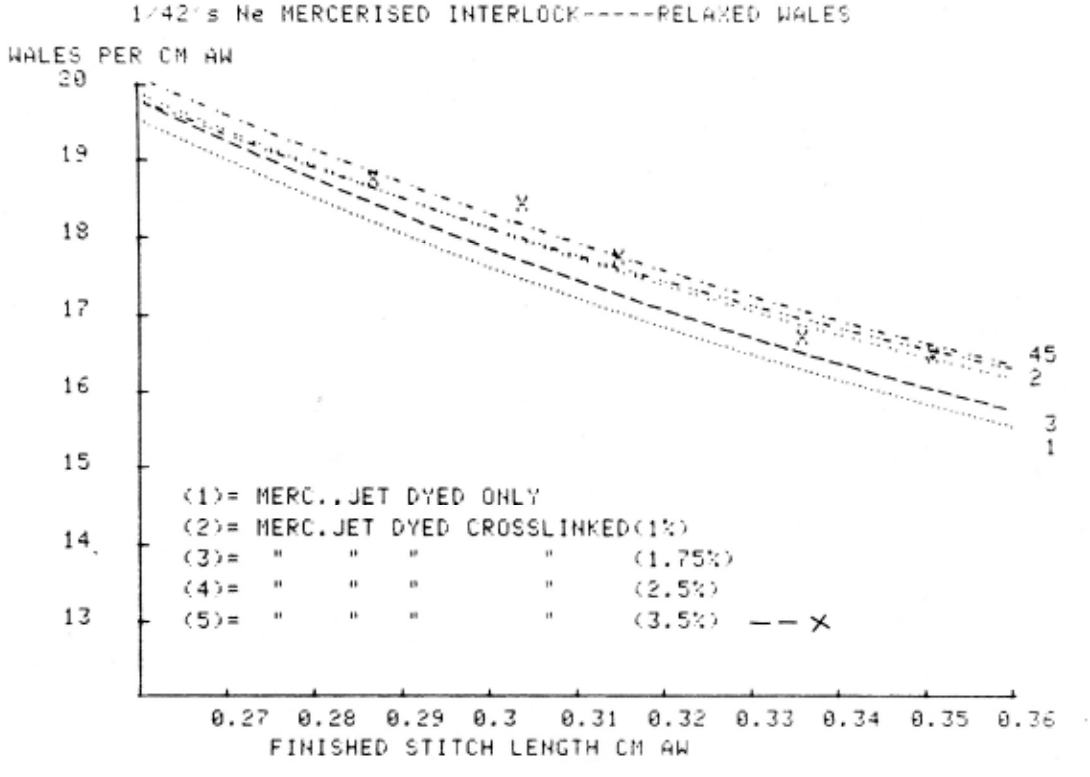

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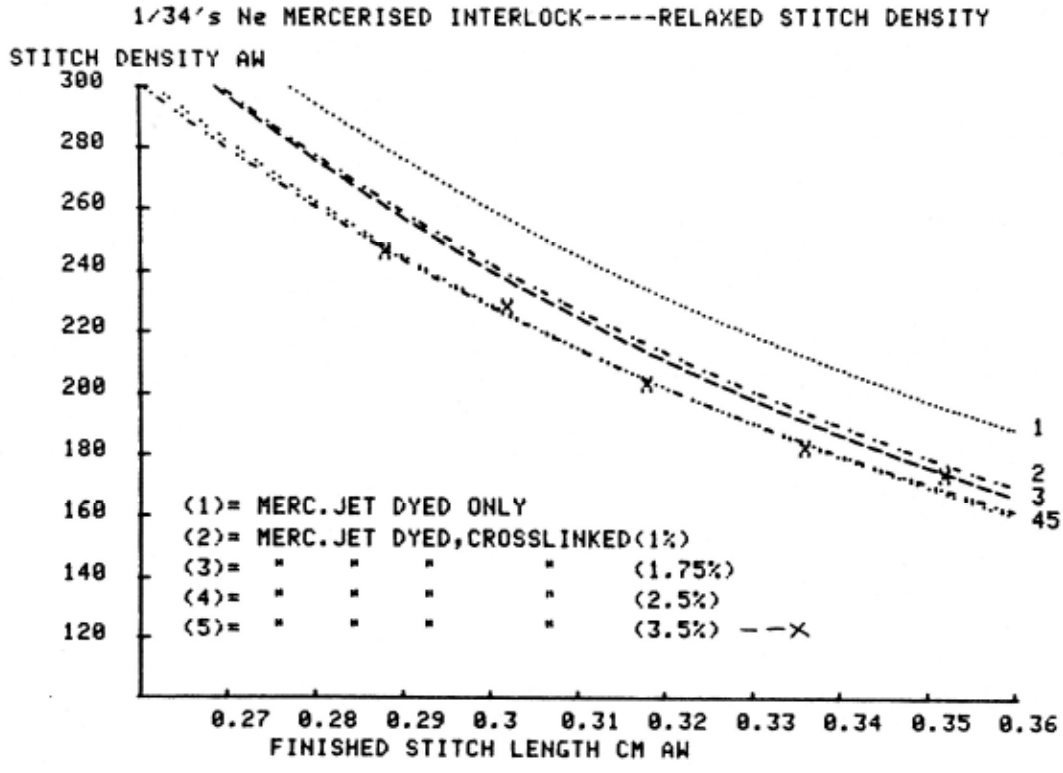

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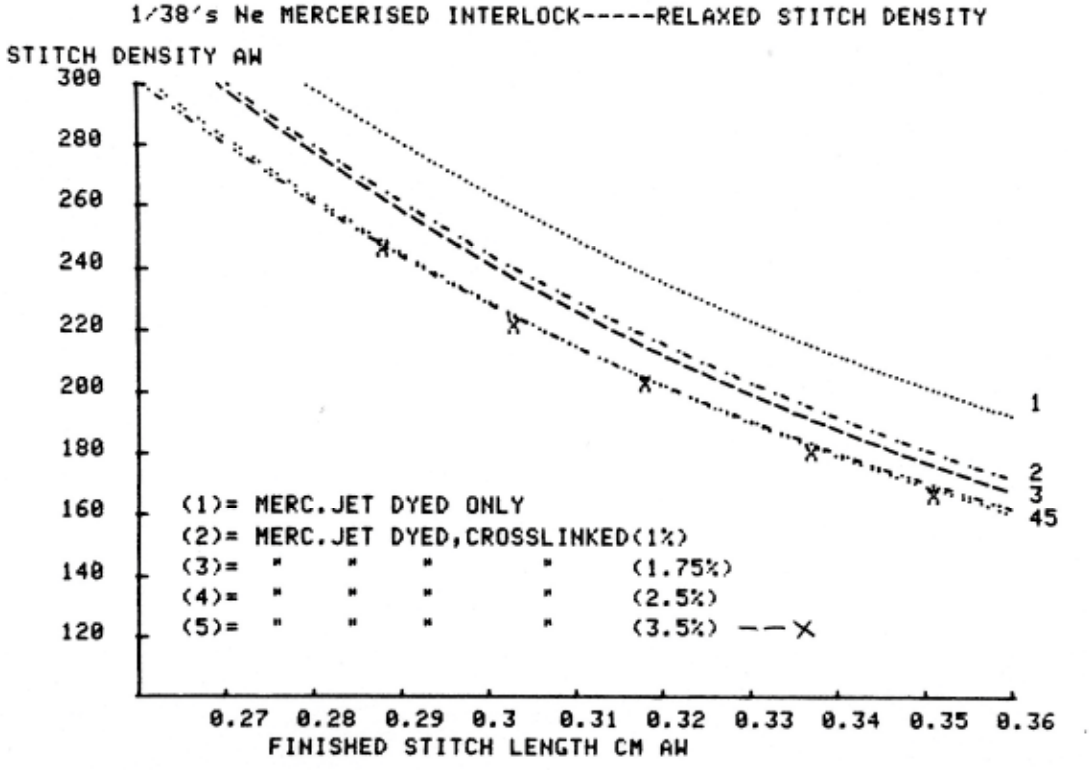

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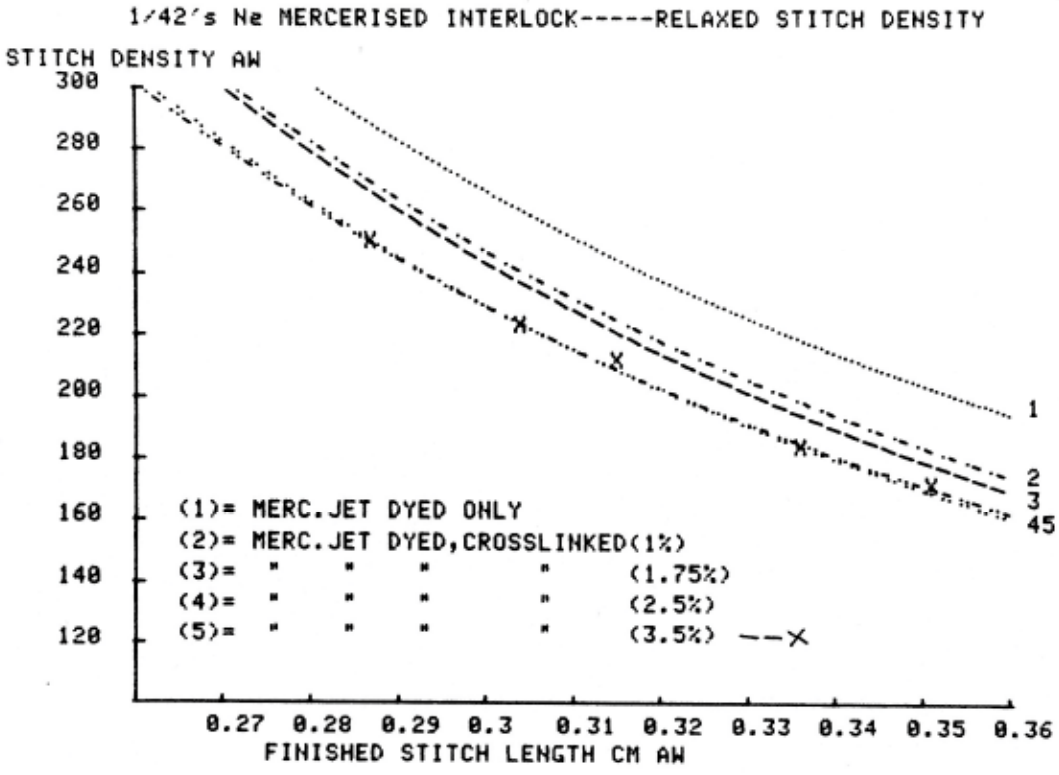

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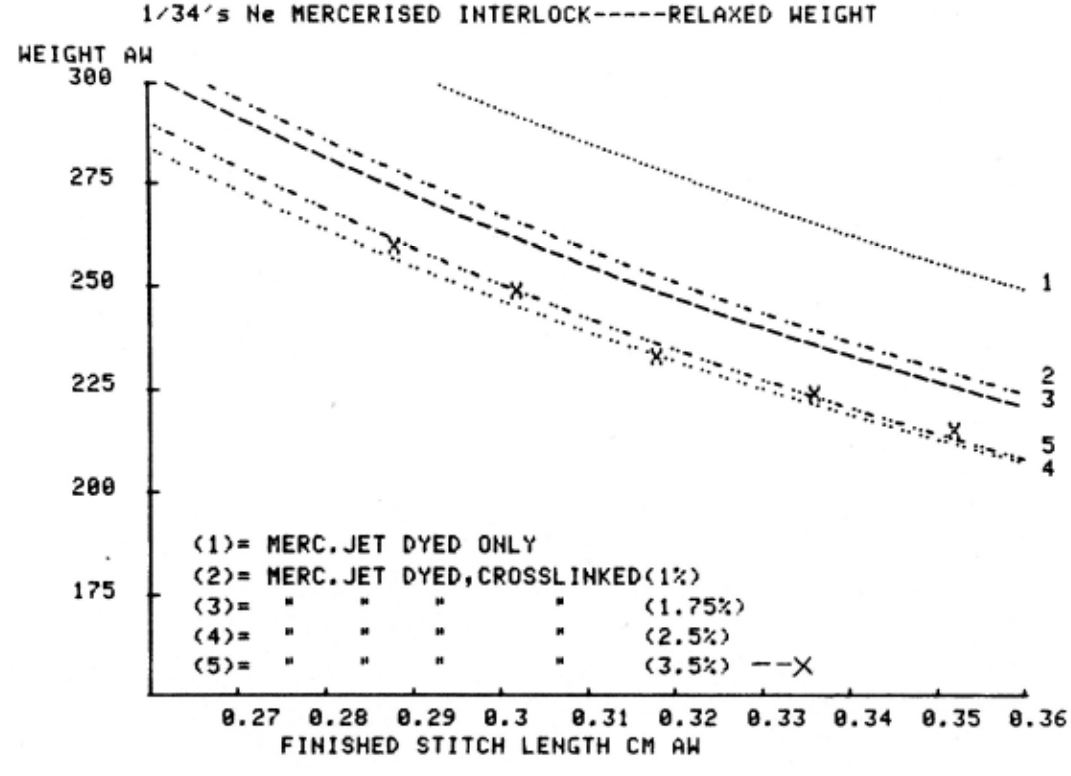

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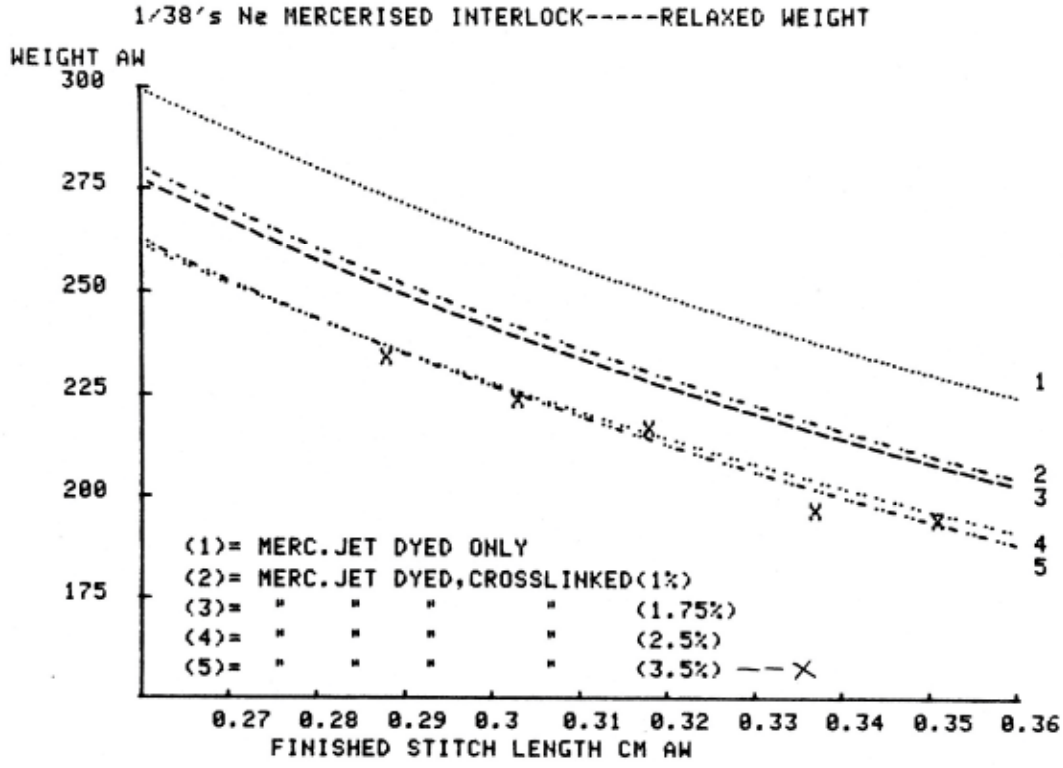

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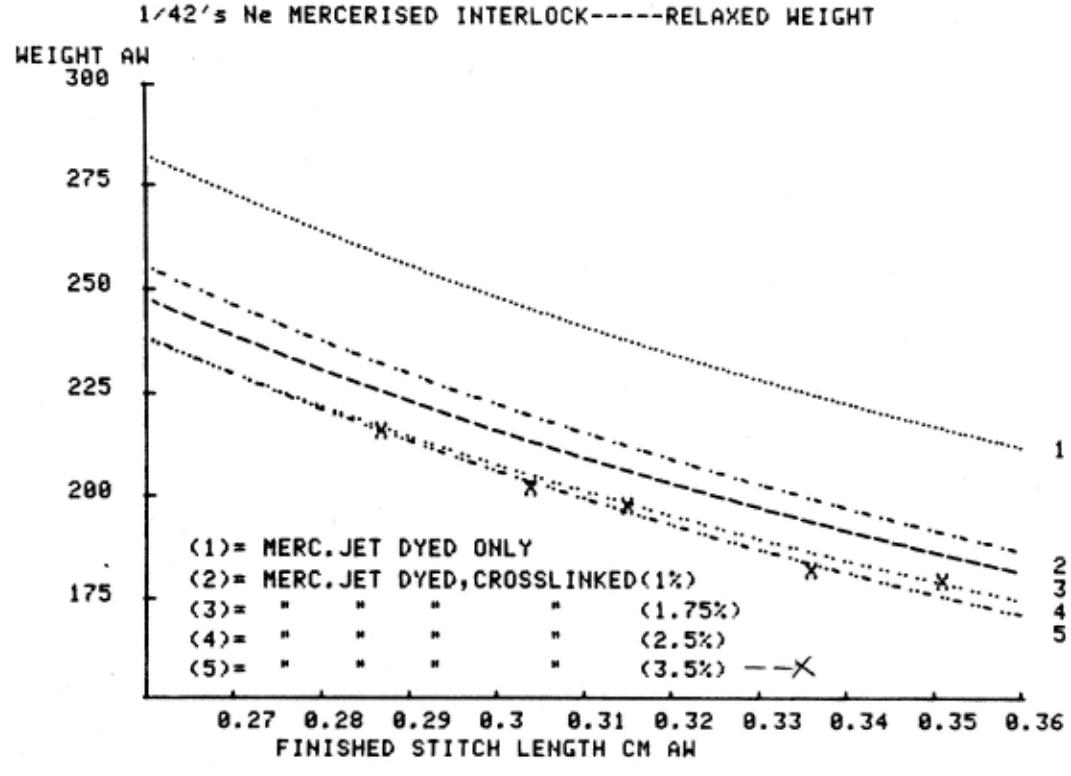

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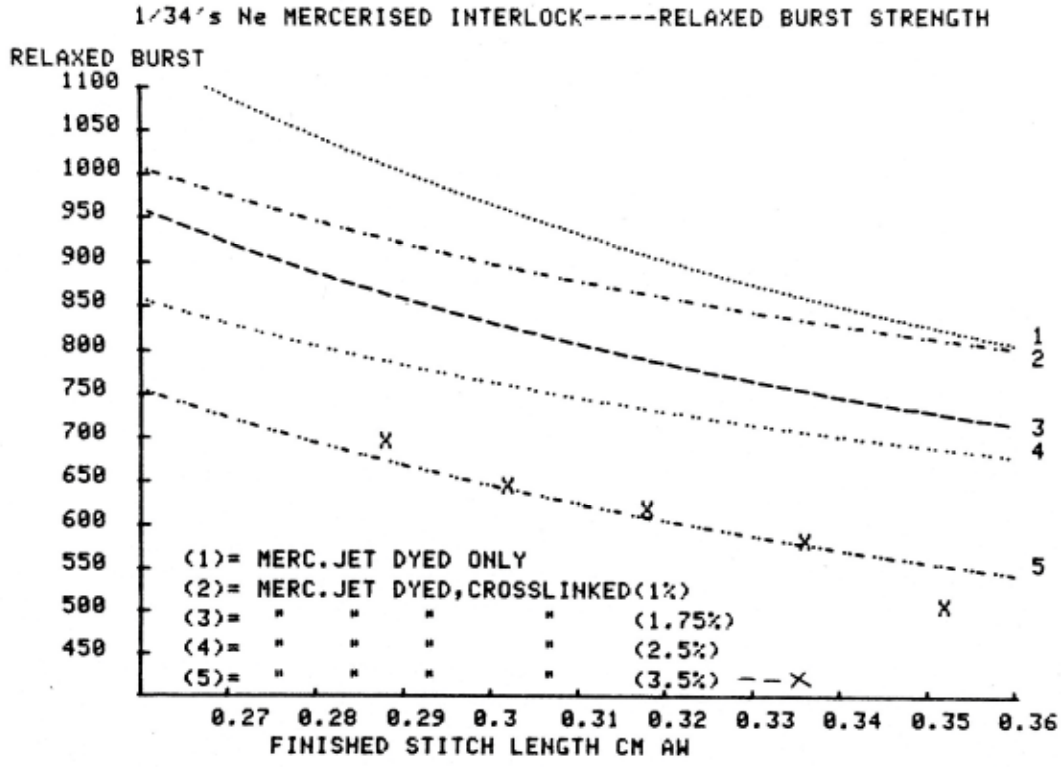

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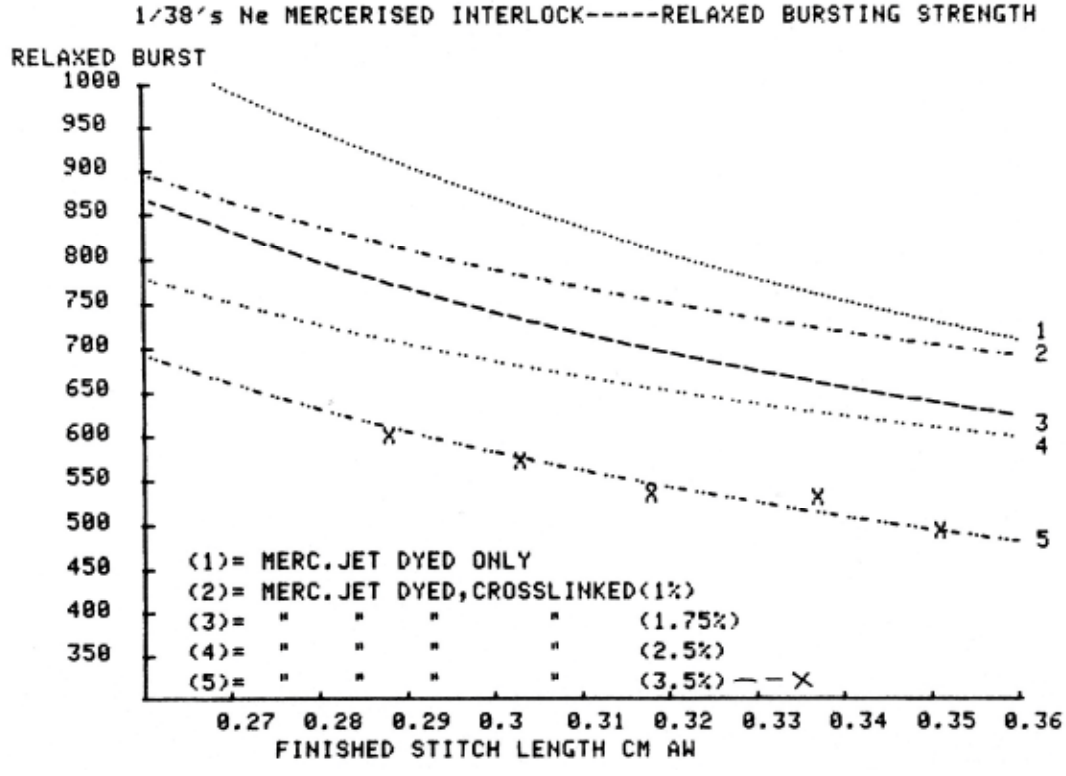

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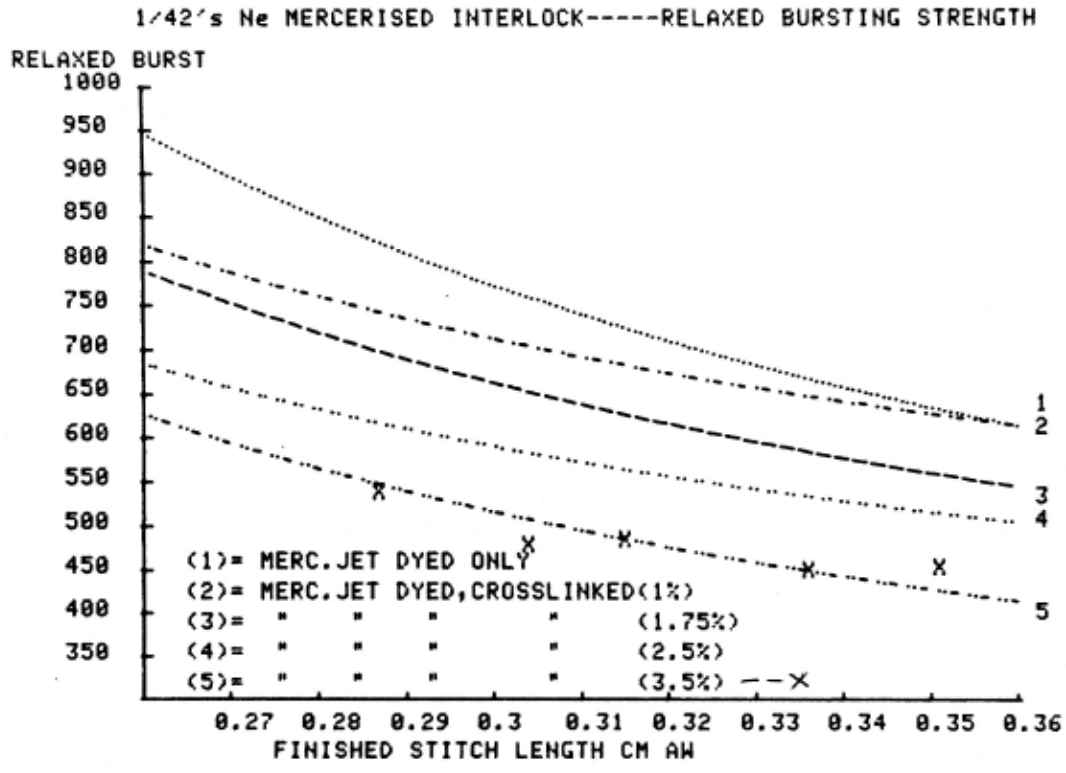

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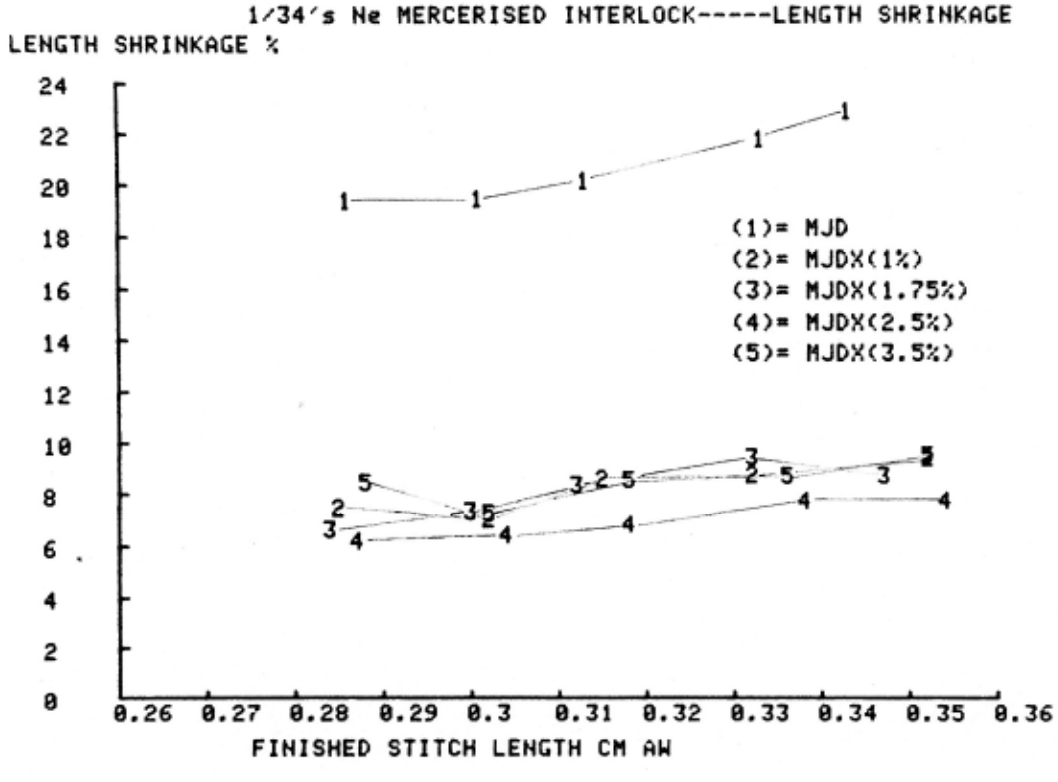

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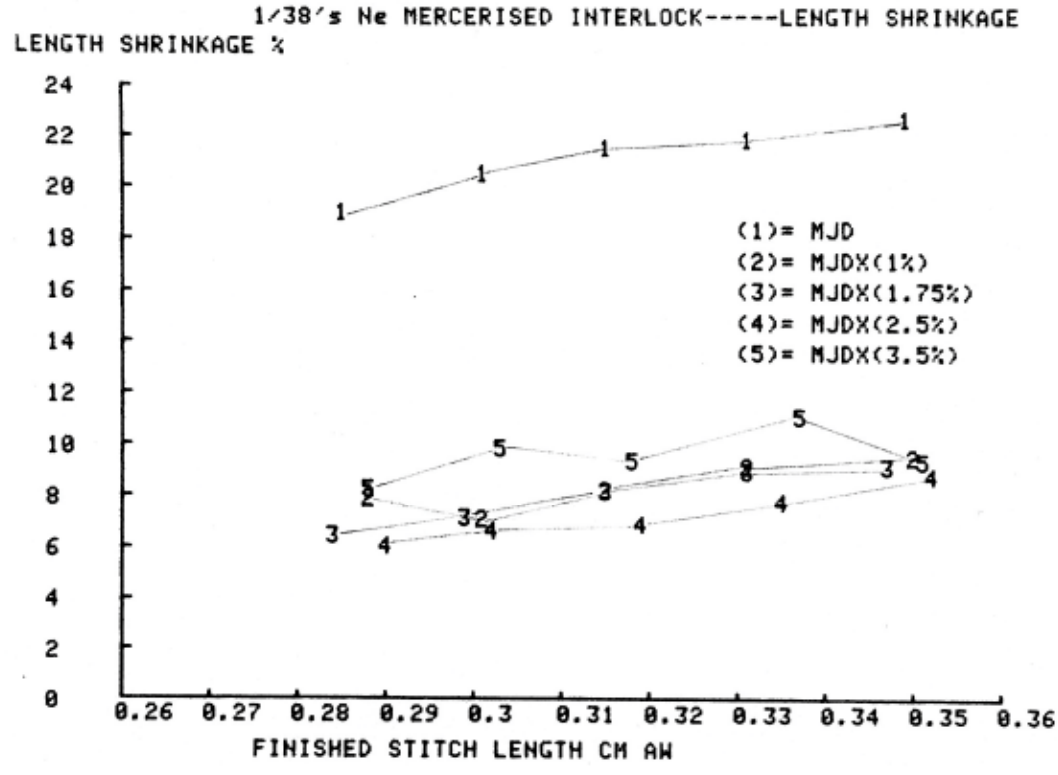
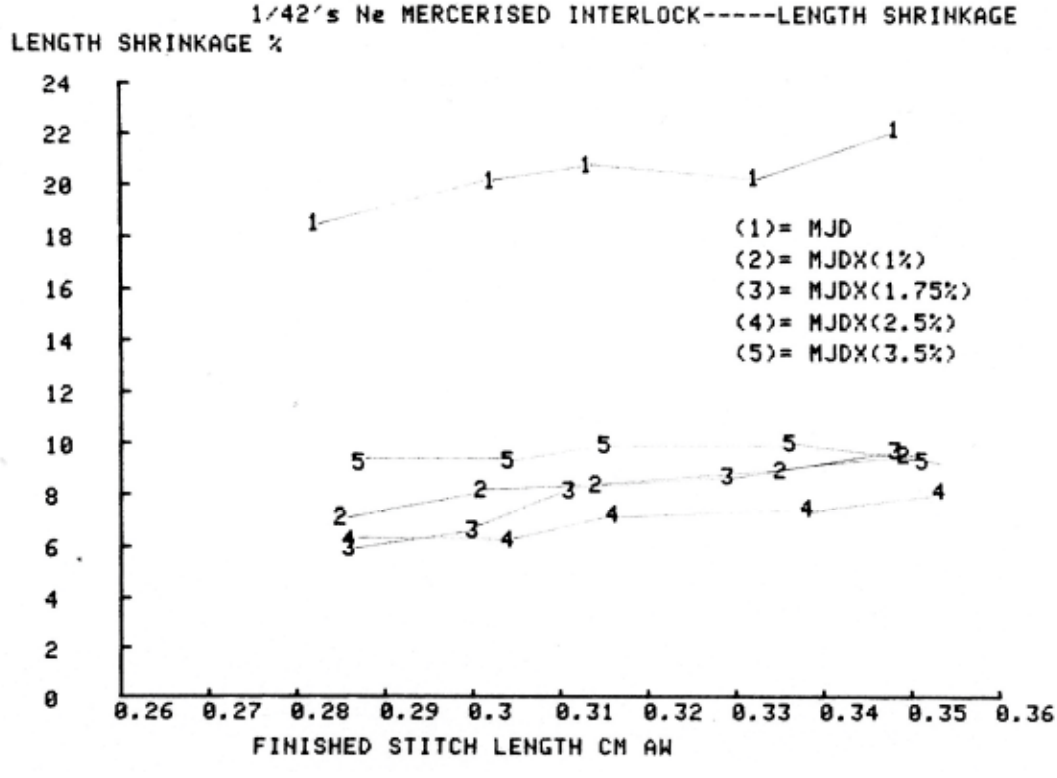
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