International Institute For Cotton

Technical Research Division

Manchester

Research Record No: 166

Central Project 1978 - Phase 2 (Supplementary) Analysis Of The Test Data

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Classification: Fabrics/Knitted/Properties

Key Words: Interlock, Rib, Fully Relaxed Dimensions

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Contents

1. Introduction

Research Record No. 158 describes the processing of two complete sets of 20 gauge interlock and two complete sets of 14 gauge 1x1 rib by the winch route and also a second jet route. This additional processing was done for a number of reasons including the following.

1. The initial winch processing was carried out on only six of the fifteen (or sixteen) fabric construction variants and therefore complete confidence could not be placed in the equations used in the STARFISH predictive model due to insufficient data points.
2. The Thies R-Jet 95 jet dyeing machine is rapidly losing favour as a machine suitable for dyeing knitted cotton due to its severe mechanical action which results in unacceptable fabric appearance.

A new generation of jet dyeing machines which are hybrids of the winch and the pure jets are emerging as "typical" cotton dyeing machines and therefore the computer predictions based on the processing of fabrics in the Thies R-Jet 95 may not be sufficiently accurate if there are differences.

The processing details of these additional sets are fully described in *Research Record No. 158*.

Following processing, samples from the full range of fabrics were submitted for the established comprehensive range of tests and the results entered into the CP78 data base together with any of the required derivations.

This report describes the analysis of these data.

2. The Analysis

To differentiate these latest processing lots from the original winch and jet processed lots the following identifiers were adopted.

WD	Winch Dye 1	i.e. original winch dyeing
WD2	Winch Dye 2	i.e. latest winch dyeing
JD	Thies R-Jet 95	i.e. original jet dyeing
EJD	Thies Ecosoft	i.e. latest jet dyeing

In *Research Record No. 129*, of November 1980, Jill C. Stevens describes the original analysis carried out to establish the form of the equations to be used in the STARFISH model to enable particular fabric properties to be predicted knowing the original fabric construction (knitted tex and stitch length) and the processing route.

In that analysis it was clearly shown that the *forms* of the established equations for predicting particular fabric properties were applicable for all the different processing routes, but that the *coefficients* varied depending on the route adopted. The general forms of the equations are as shown in the following table where all parameters, both inputs and outputs, are measured in the finished, fully relaxed state (Starfish Reference State) with the exception of the inputs for equations 1 & 2 which are Tex (T) and Stitch Length (L) as-knitted.

Equation No.	Output y	Input x_i	Equation Form
1	Tex	Tex, as knitted	$y = a + b.T$
2	Stitch Length	SL as knitted	$y = a + b.L$
3	Courses /cm	Tex, SL	$y = a + b/L + c/\sqrt{T}$
4	Wales /cm	Tex, SL	$y = a + b/L + c/\sqrt{T}$
5	Stitch Density /cm^2	Tex, SL	$y = a + b/L^2 + c.T$
6	Weight gsm	Tex, SL	$y = a + b.T/L$

In this analysis, the Tektronix statistical software package was used to analyse the latest data and establish new coefficients for the processing routes in a similar manner to the original analysis. The coefficients resulting from this latest analysis are given in *Tables 1 - 6*.

3. Observations

To enable a comparison of the two jet lots to be carried out visually, the actual data points have been plotted together with the regression lines for each of the properties examined.

The jet and winch routes have been plotted on separate graphs, to avoid clutter of points, and the yarn counts have also been separated.

Interlock - Relaxed Courses

1/34's *Figures 1 and 2*

1/38's *Figures 3 and 4*

1/42's *Figures 5 and 6*

The overall impression is that there is a small consistent difference between the two jet machines, but that the two winch dyeing treatments are very similar.

Interlock - Relaxed Wales

1/34's *Figures 7 and 8*

1/38's *Figures 9 and 10*

1/42's *Figures 11 and 12*

There is a considerable difference in the fully relaxed wales between the two jet dyeing machines. The difference is of the order of 1 wale/cm on 14 which is approximately 7%. Identical fabrics dyed in the two machines would show considerable differences in width shrinkage if they were finished to the same width. The Ecosoft dyed fabrics need to be finished narrower.

There appears to be very little difference in relaxed wales between the two winch dyed lots.

Interlock - Relaxed Stitch Density

1/34's *Figures 13 and 14*

1/38's *Figures 15 and 16*

1/42's *Figures 17 and 18*

There is a consistent difference in relaxed stitch density between the two jet dyeing machines whereas it is difficult to separate the two winch dyeings. If the jet and winch graphs are superimposed it can be seen that the relaxed stitch densities from the four dye routes are not very far apart.

Interlock - Relaxed Weight

1/34's *Figures 19 and 20*

1/38's *Figures 21 and 22*

1/42's *Figures 23 and 24*

The relaxed weights obtained from the two jet dyeing machines are virtually the same over the three yarn counts.

Similarly, there is little to choose between the two winch lots.

1x1 Rib - Relaxed Courses

1/26's *Figures 25 and 26*

1/30's *Figures 27 and 28*

1/34's *Figures 29 and 30*

There are no appreciable differences in the relaxed courses: the two jet dyeing lots and the two winch dye lots are virtually identical. Superimposing the jet and winch plots for the same yarn count show the points from the four dye lots virtually lying on top of one another.

1x1 Rib - Relaxed Wales

1/26's *Figures 31 and 32*

1/30's *Figures 33 and 34*

1/34's *Figures 35 and 36*

As with the interlock construction there is a considerable difference between the two jet dyeing machines as regards relaxed wales. Again, the Ecosoft dyed fabric would have to be finished narrower to give the same width shrinkage as a R-Jet 95 dyed fabric.

There is little to choose between the two winch dyed lots as regards relaxed wales.

1x1 Rib - Relaxed Stitch Density

1/26's *Figures 37 and 38*

1/30's *Figures 39 and 40*

1/34's *Figures 41 and 42*

There is a consistent difference in relaxed stitch density between the two jet dyeing machines. There are no apparent differences between the two winch dyed lots.

1x1 Rib - Relaxed Weight

1/26's *Figures 43 and 44*

1/30's *Figures 45 and 46*

1/34's *Figures 47 and 48*

The relaxed weights obtained from the two jet dyeings are virtually the same over the three yarn counts. There is however a slight difference between the two winch lots - the latest lot tending to be slightly heavier.

4. Conclusions

1. The two jet dyeing machines investigated in the CP78 project do affect the fully-relaxed properties of 20 gauge interlock and 14 gauge 1 x 1 rib constructions to a different degree.

   On the whole, as regards courses/cm, weight, stitch density, these differences are not large and perhaps would not greatly affect the predictions of these properties. However, there is a large effect as regards relaxed wales/cm

   If allowance were not made for this difference, then serious errors of prediction of final finished width and residual width shrinkage would occur.

2. Ecosoft dyed fabrics would have to be finished to a width below that of winch dyed fabrics to give the same residual width shrinkage.

3. The two winch dyeing operations have shown very similar effects on the relaxed properties.

   On this evidence, the data from both winch dyeing operations could probably be combined to give a more accurate equation for inclusion in the STARFISH predictive model.

Table 1

PREDICTION OF FINISHED FULLY RELAXED TEX FROM TEX AS KNITTED

Model $y_{av\ Tex} = a + bx_{ac\ Tex}$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
Winch WD2	0.2739	0.9439	0.9999
Thies Ecosoft	0.1124	0.9565	0.9986
1 x 1 RIB			
Winch WD2	-1.3097	1.0396	0.9897
Thies Ecosoft EJD	-0.9133	1.0108	0.9952

Table 2

PREDICTION OF FINISHED FR STITCH LENGTH FROM STITCH LENGTH AS KNITTED

Model $y_{av\ SL\ A} = a + bx_{av\ SL\ K}$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
Winch WD2	0.00599	0.9725	0.9998
Thies Ecosoft EJD	0.00529	0.9728	0.9976
1 x 1 RIB			
Winch WD2	0.00257	0.9764	0.9992
Thies Ecosoft EJD	0.000974	0.99199	0.9995

Table 3

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

Model $y = a + b/l + c\sqrt{Tex}$

FABRIC & ROUTE	a	b	c	r^2
INTERLOCK				
Winch WD2	-6.2395	6.3866	0.6122	0.9814
Thies Ecosoft	-8.0456	6.07327	1.2283	0.9982
1 x 1 RIB				
Winch WD2	-7.0231	5.7572	0.9833	0.9832
Thies Ecosoft EJD	-7.3304	5.8710	0.9677	0.9944

Table 4

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

Model $y = a + b/l + c\sqrt{Tex}$

FABRIC & ROUTE	a	b	c	r^2
INTERLOCK				
Winch WD2	16.5811	2.1417	-2.1739	0.9527
Thies Ecosoft	17.1798	2.0766	-2.1551	0.9579
1 x 1 RIB				
Winch WD2	5.1983	1.9999	-0.2395	0.9462
Thies Ecosoft EJD	5.7504	2.1936	-0.4251	0.9886

Table 5

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

Model $y = a + b/l^2 + c\ \text{Tex}$

FABRIC & ROUTE	a	b	c	r^2
INTERLOCK				
Winch WD2	80.2640	21.0164	-3.1124	0.9820
Thies Ecosoft EJD	66.1825	20.5216	-1.7553	0.9843
1 x 1 RIB				
Winch WD2	5.1564	14.2290	0.7543	0.9980
Thies Ecosoft EJD	5.7118	15.2765	0.4573	0.9980

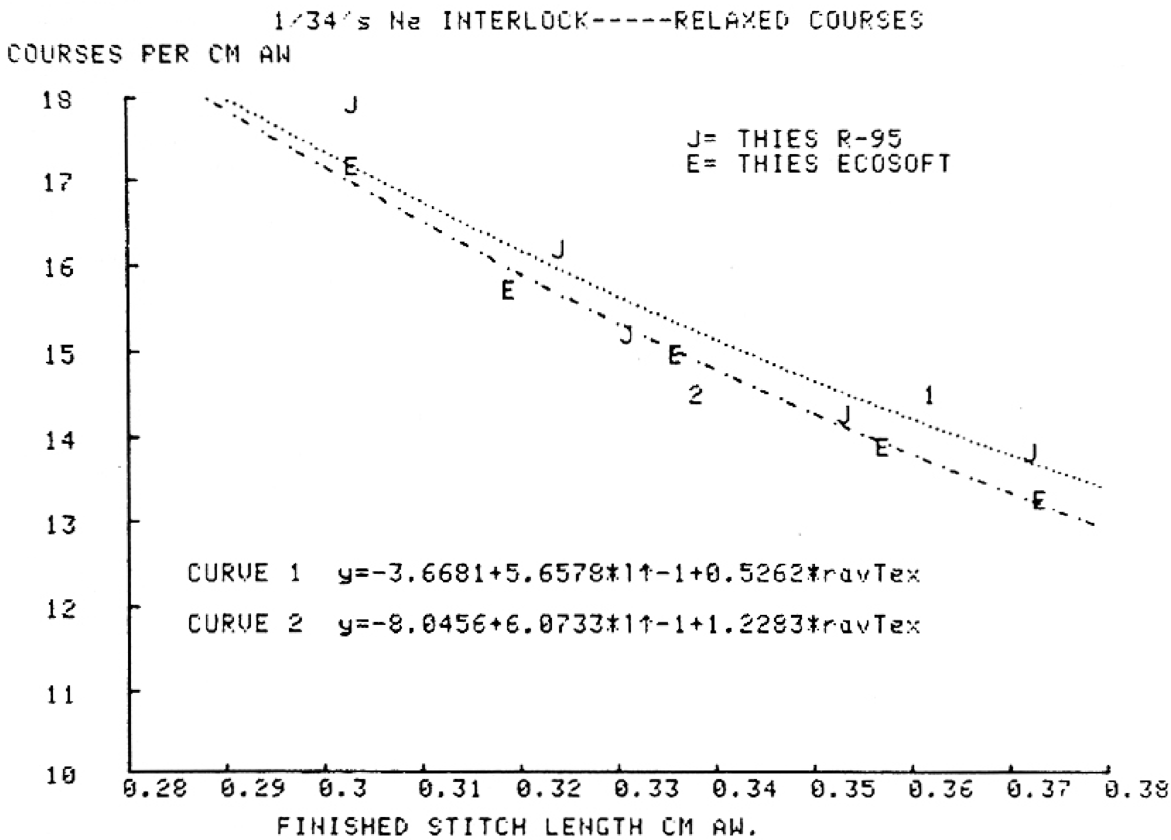
Table 6

PREDICTION OF FFR WEIGHT FROM FFR TEX AND FFR STITCH LENGTH

Model $y = a + b\ \text{Tex}/l$

FABRIC & ROUTE	a	b	r^2
INTERLOCK			
Winch WD2	31.0476	4.1774	0.9810
Thies Ecosoft EJD	45.2095	3.9554	0.9531
1 x 1 RIB			
Winch WD2	-6.3525	3.2201	0.9952
Thies Ecosoft EJD	-1.5553	3.2214	0.9931

Figure 1



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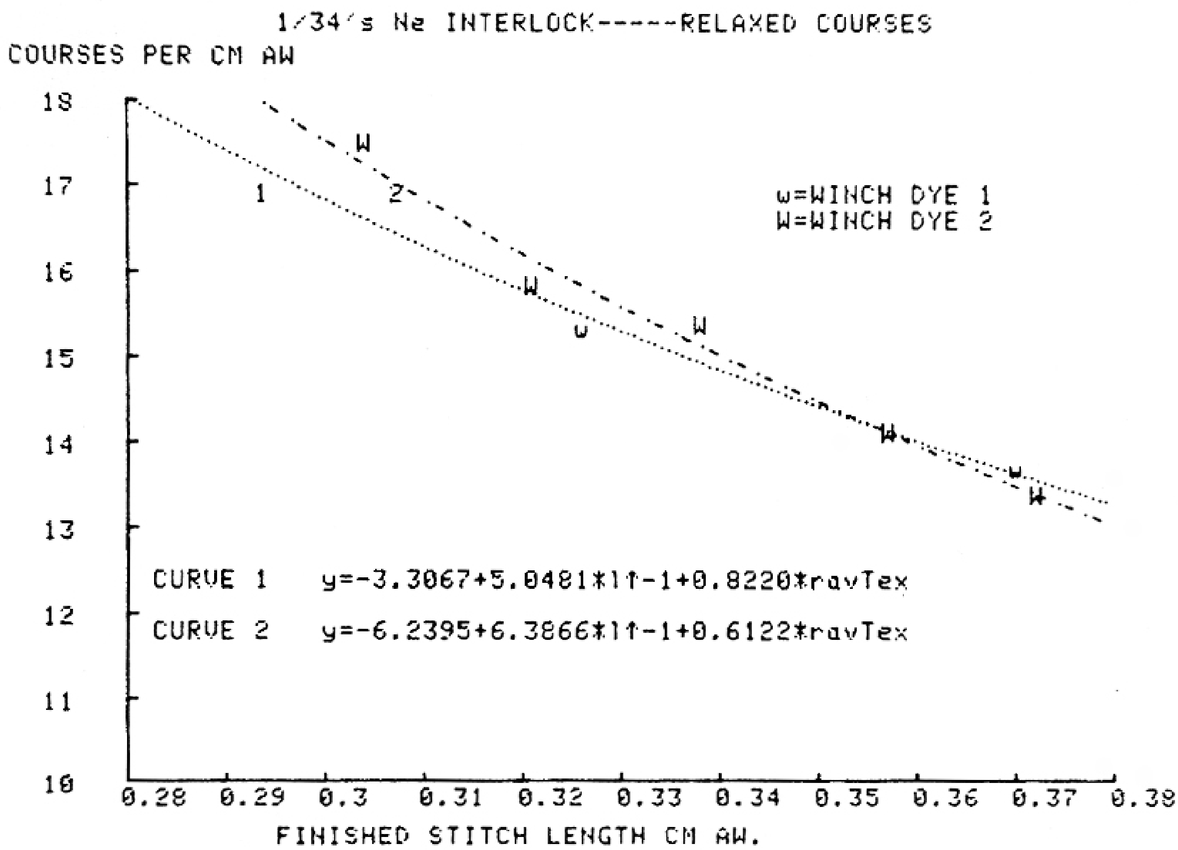

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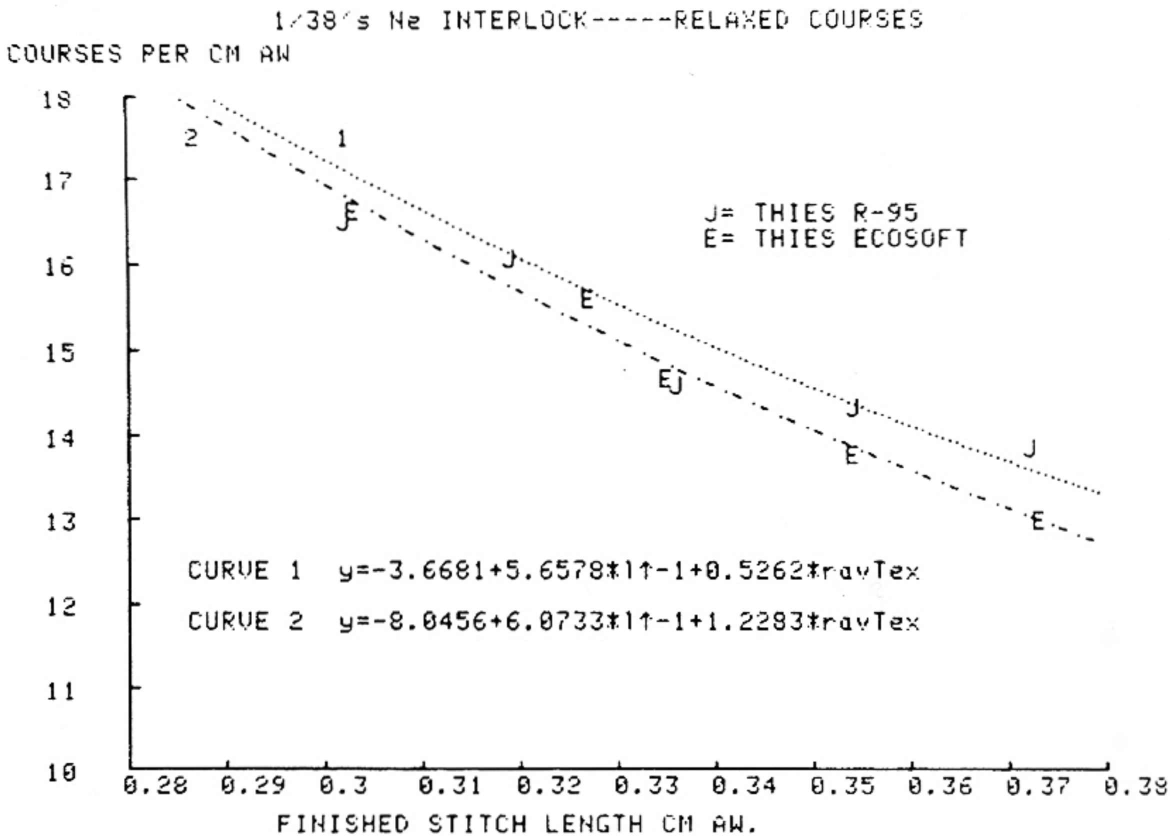

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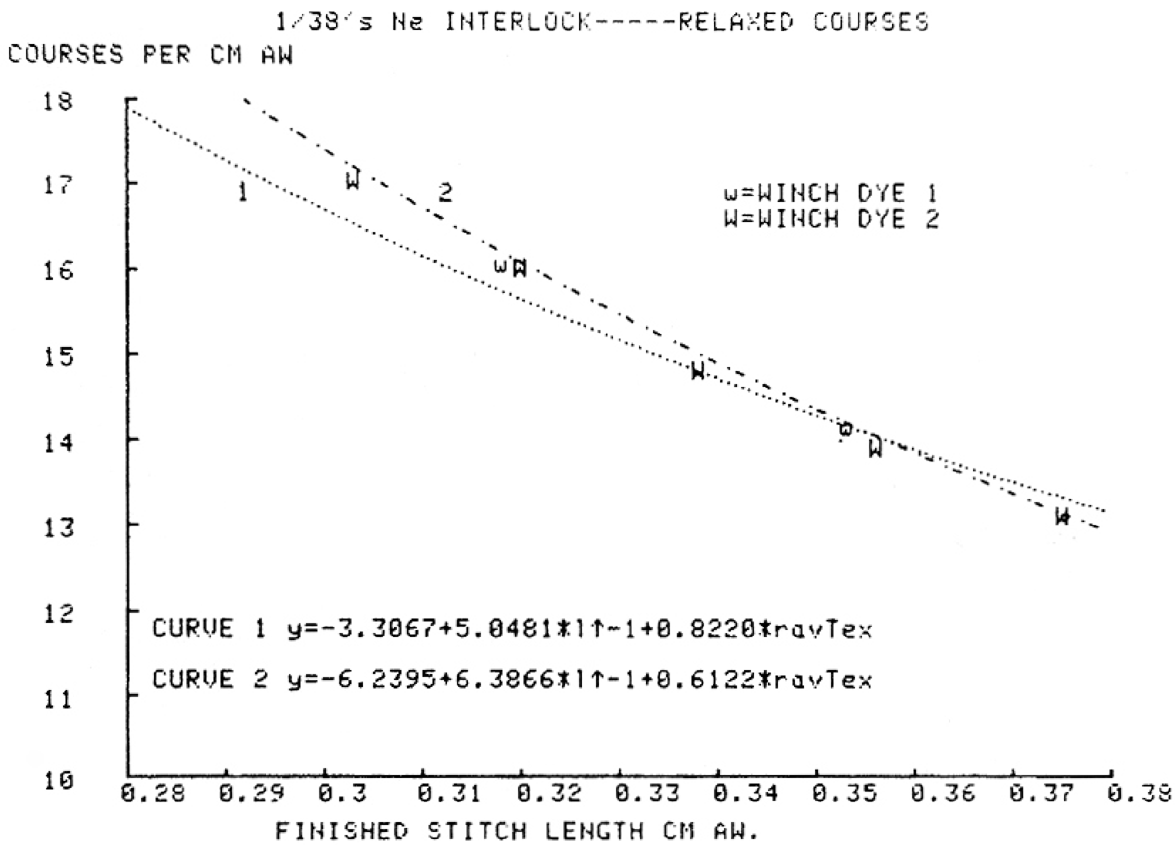

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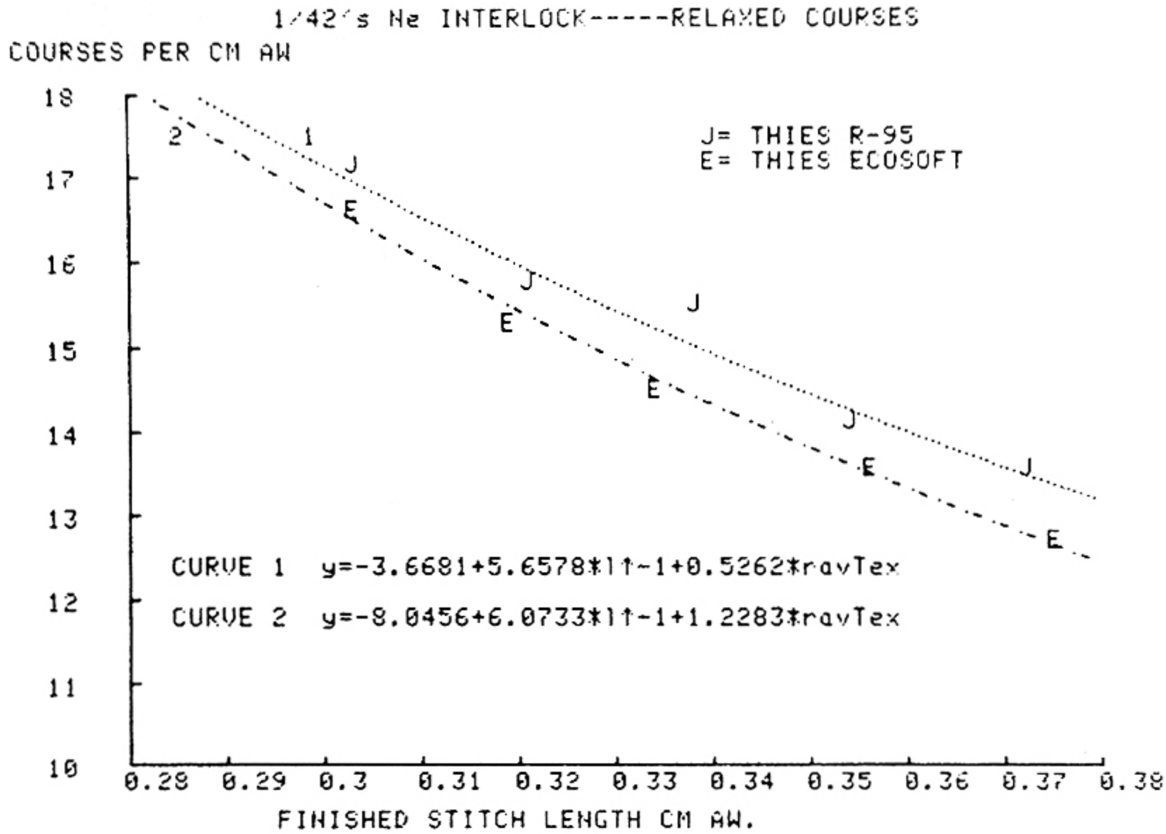

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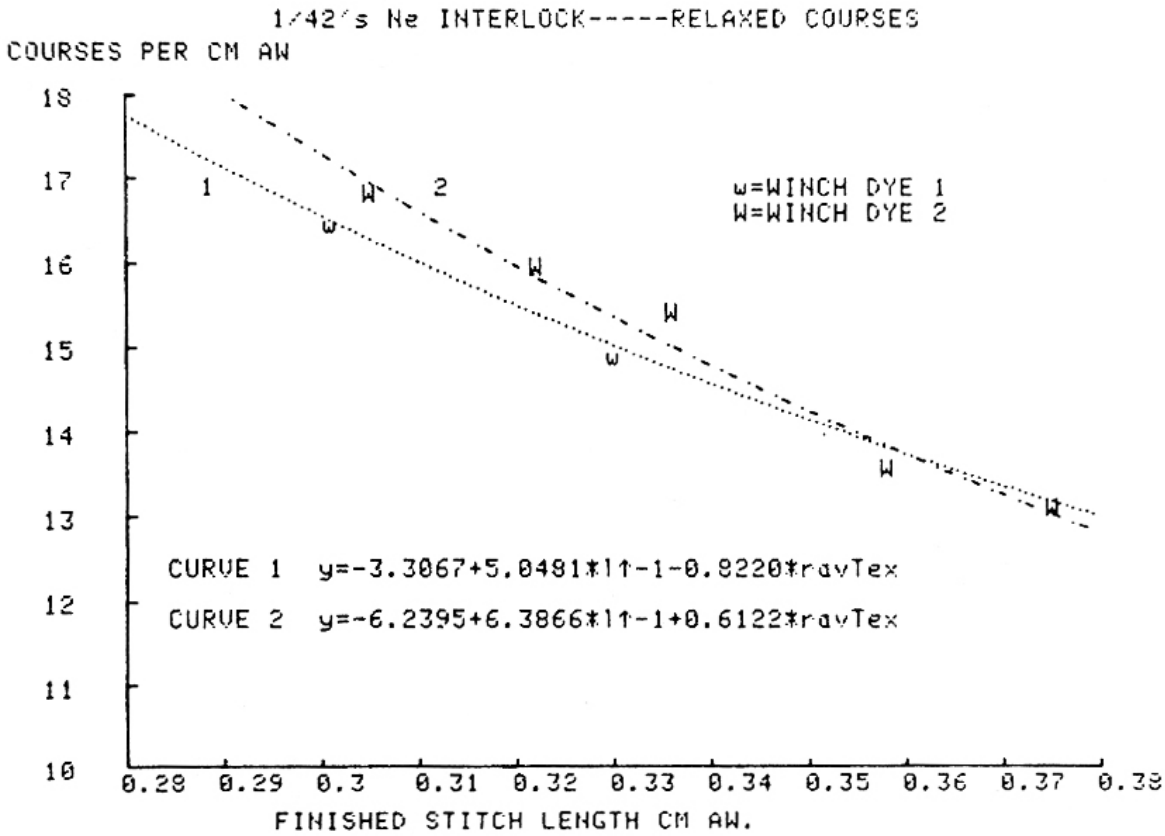

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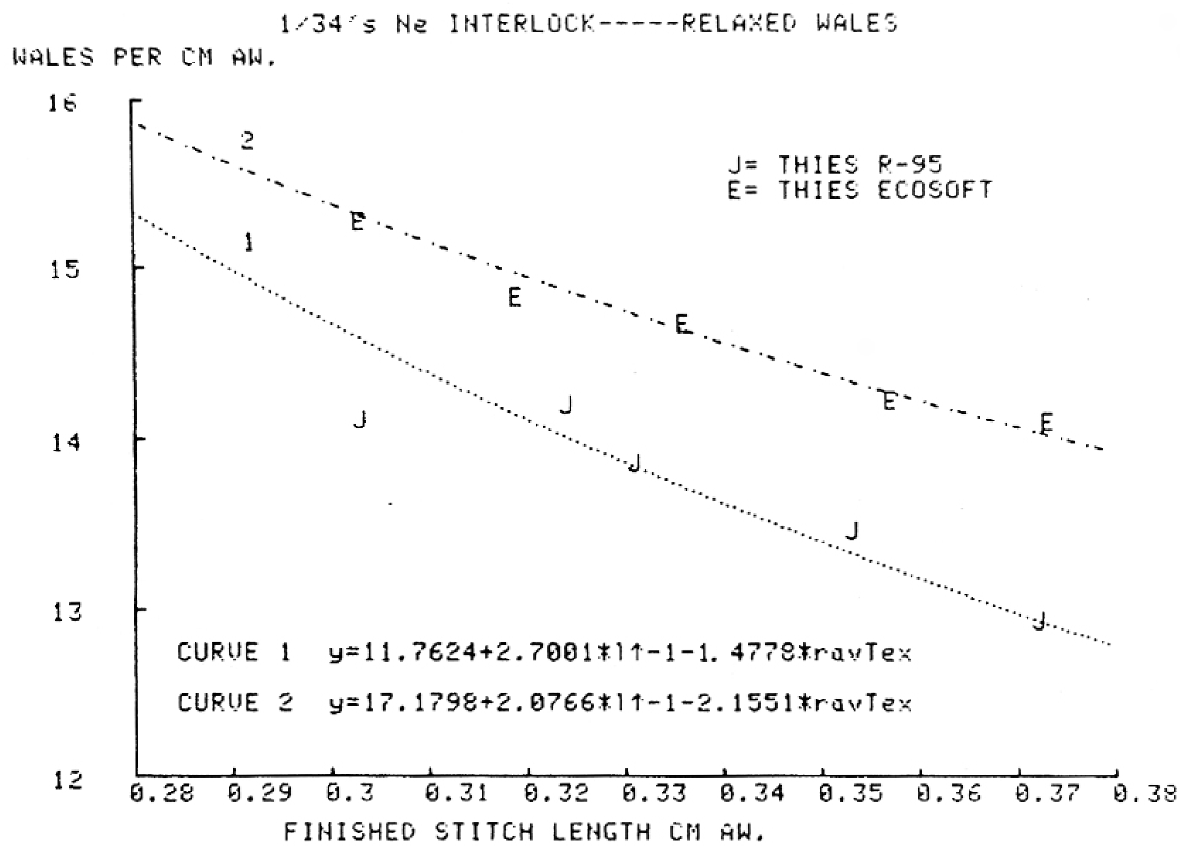

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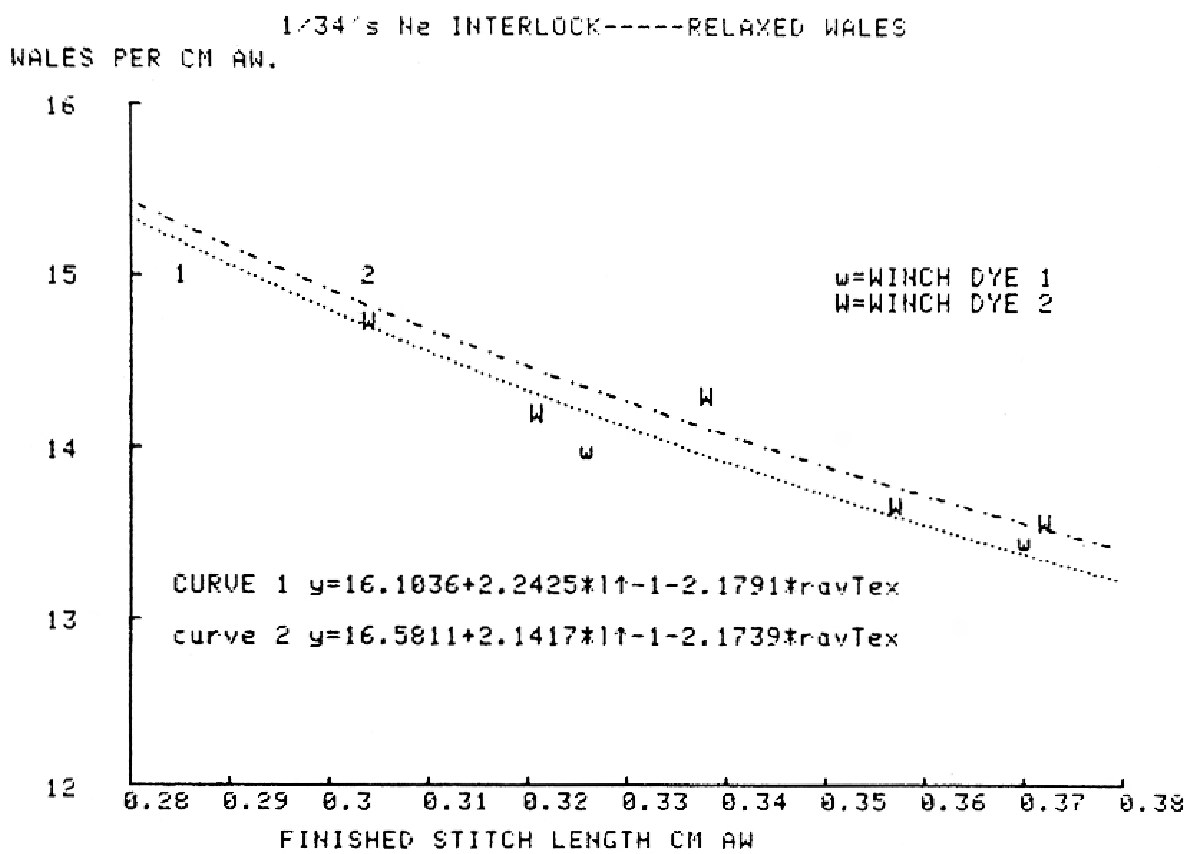

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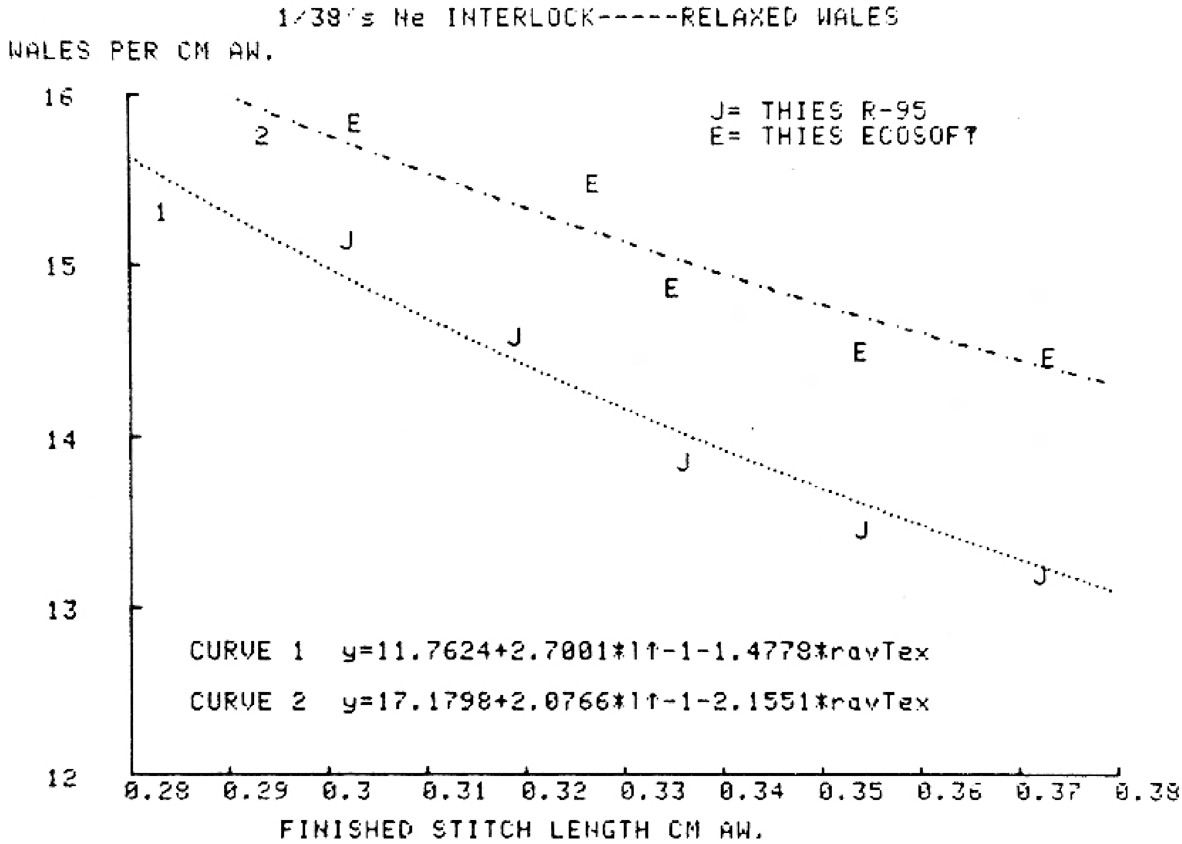

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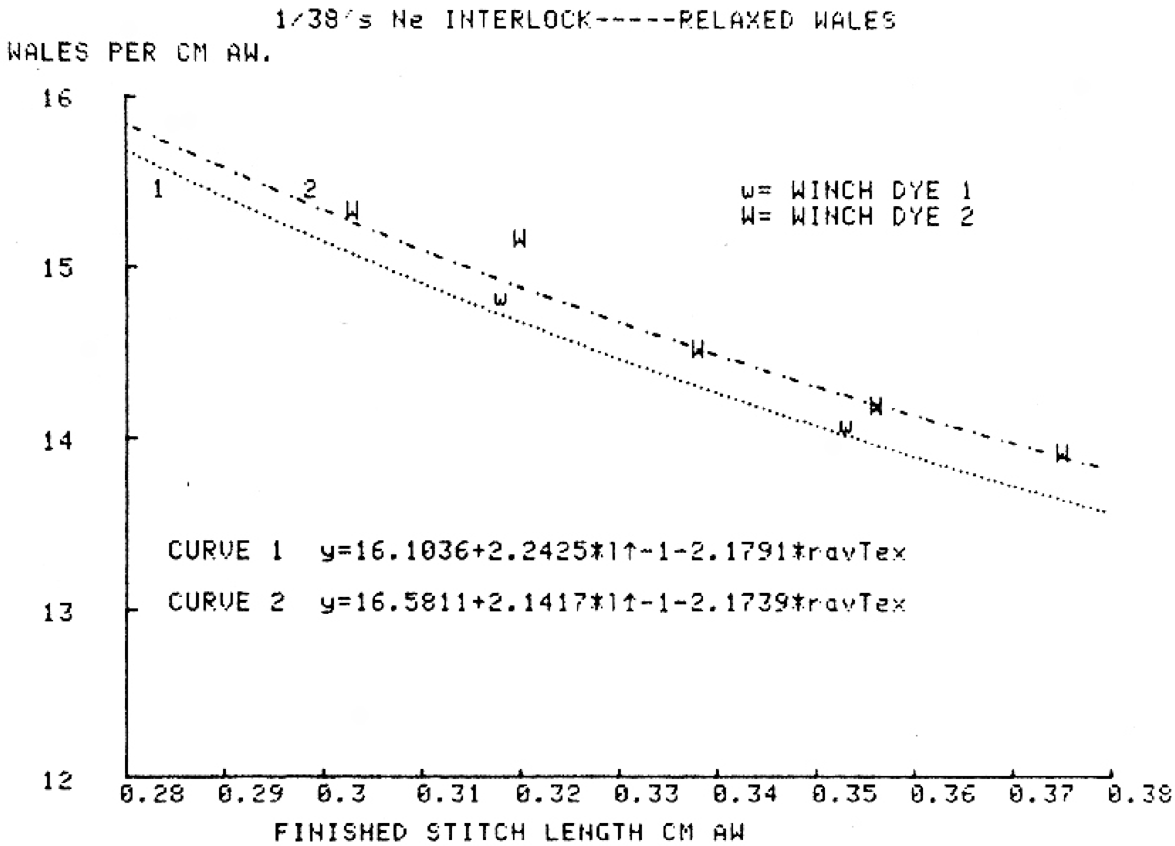

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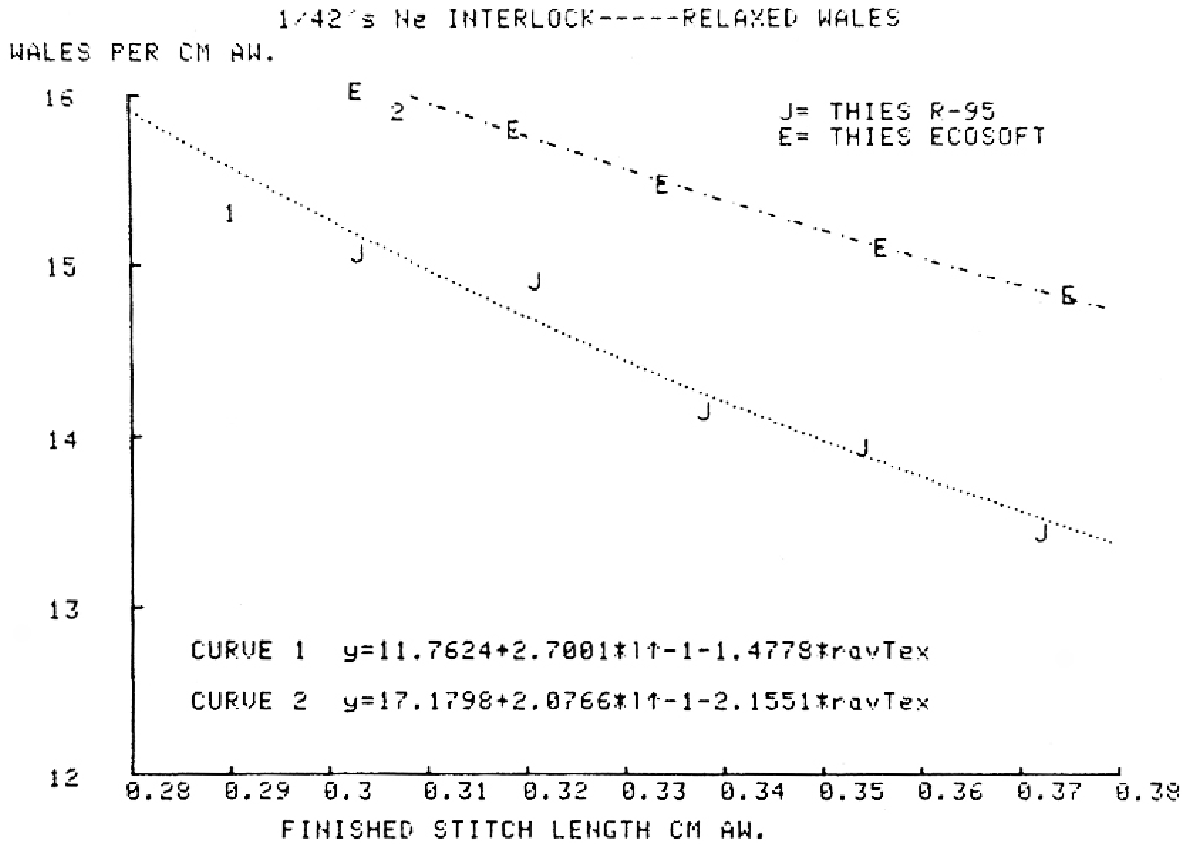

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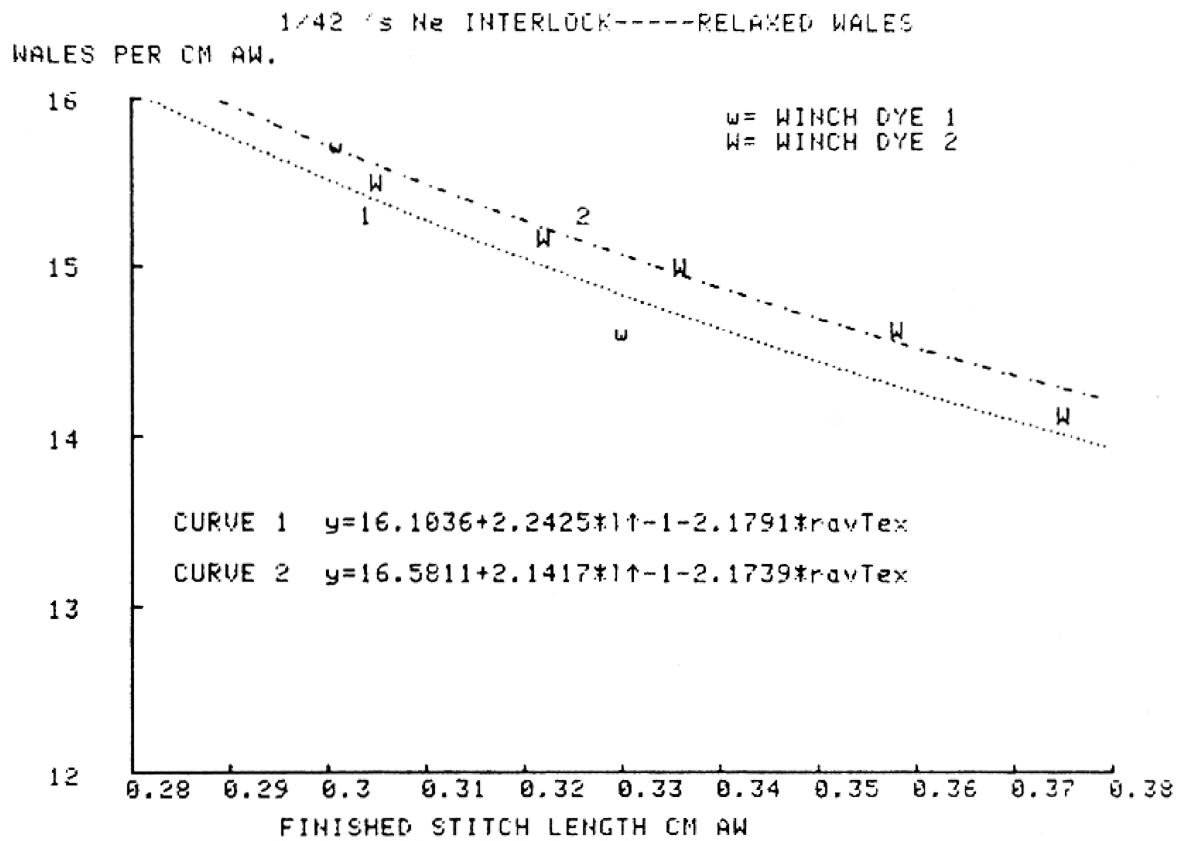

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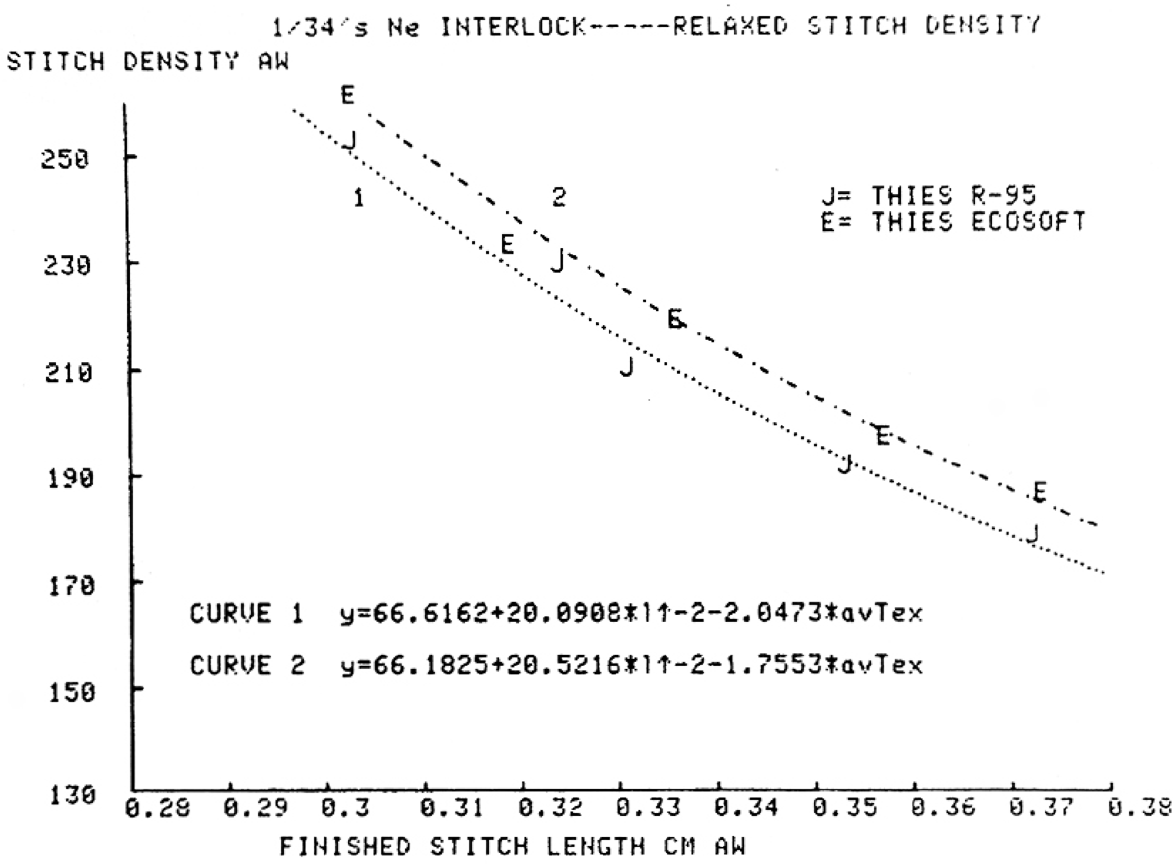

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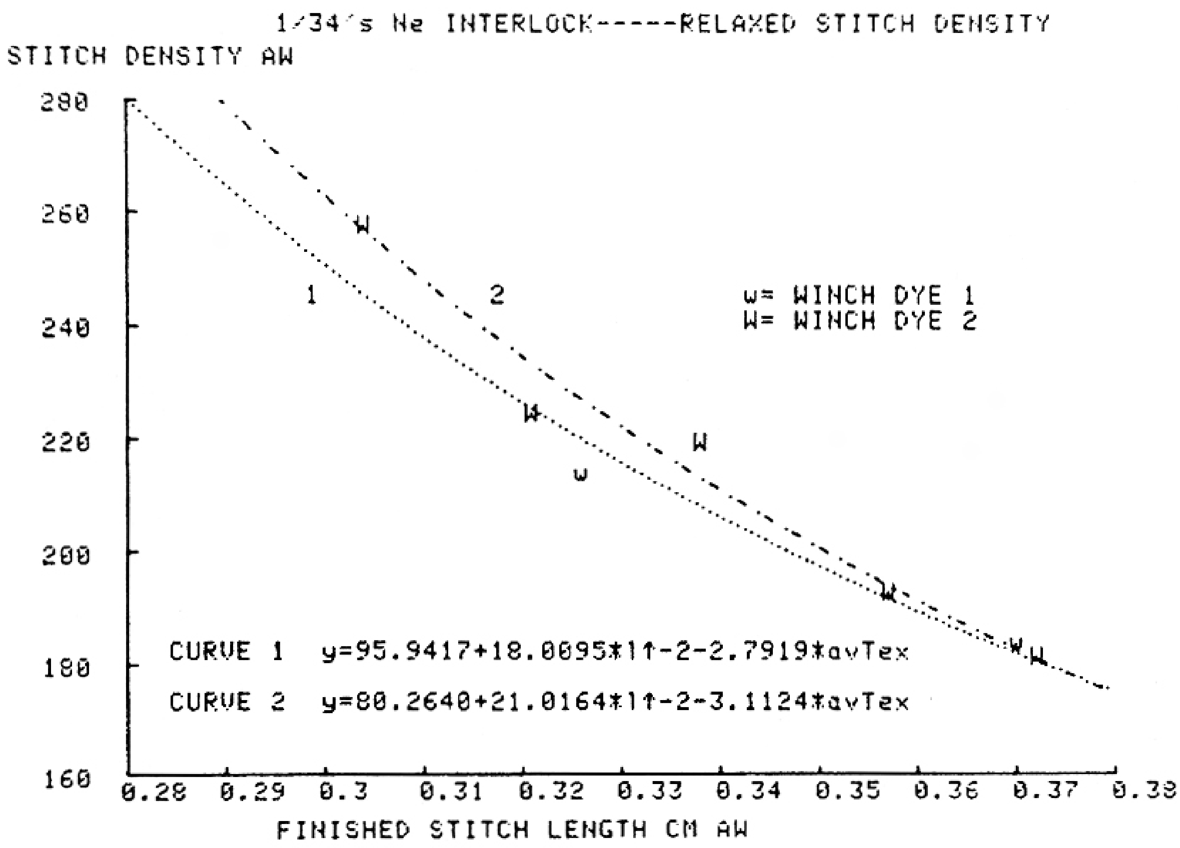

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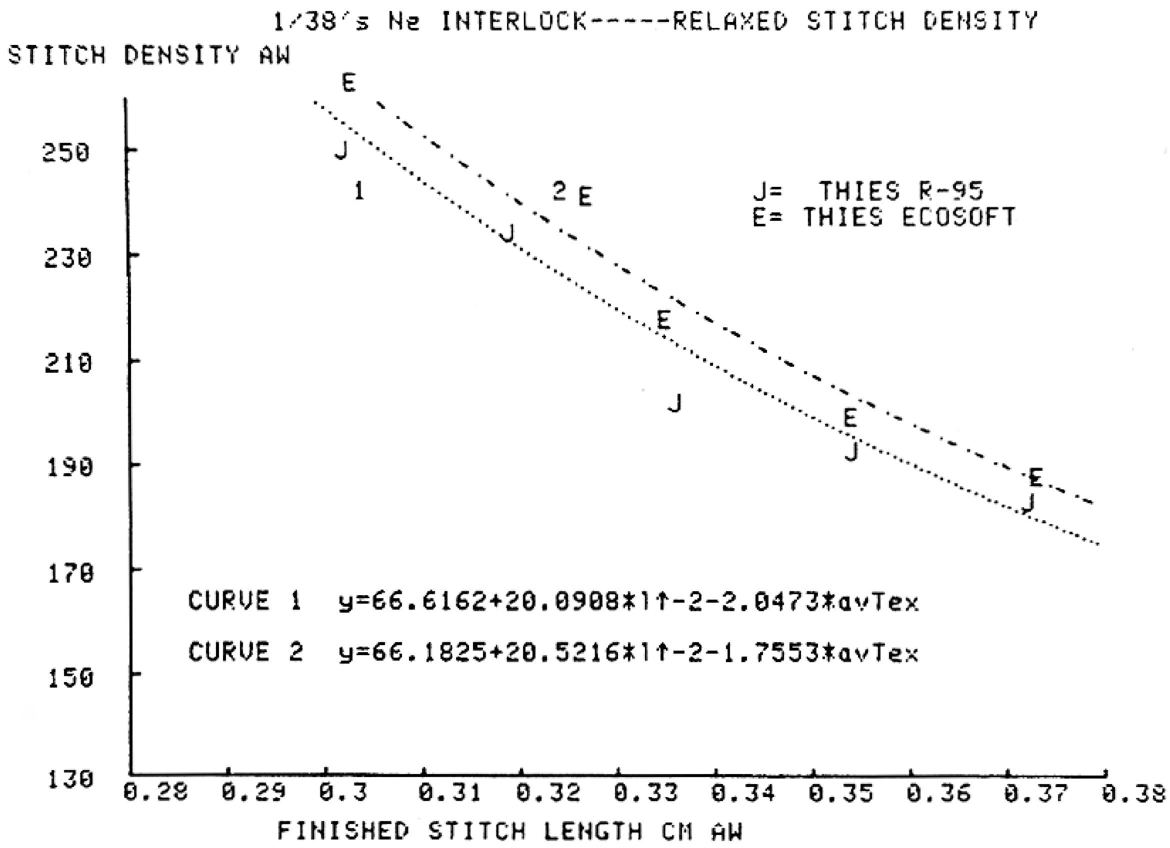

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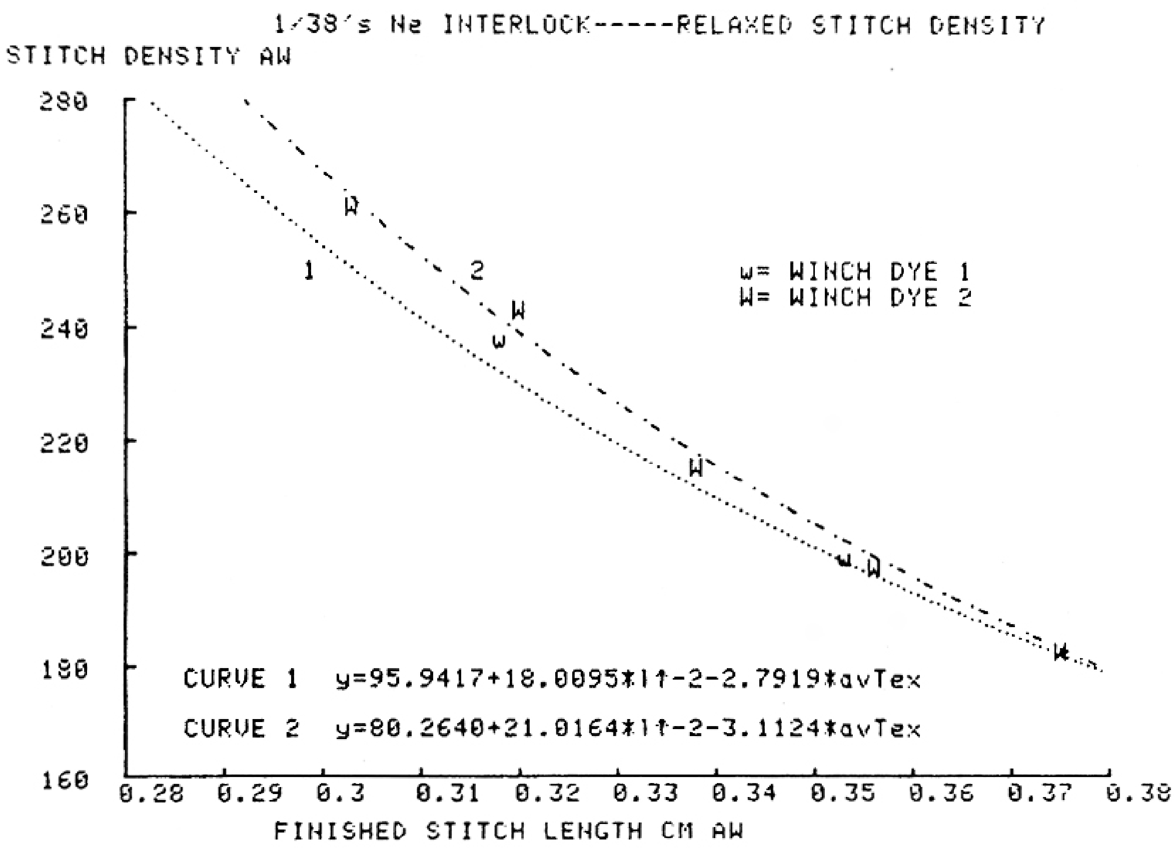

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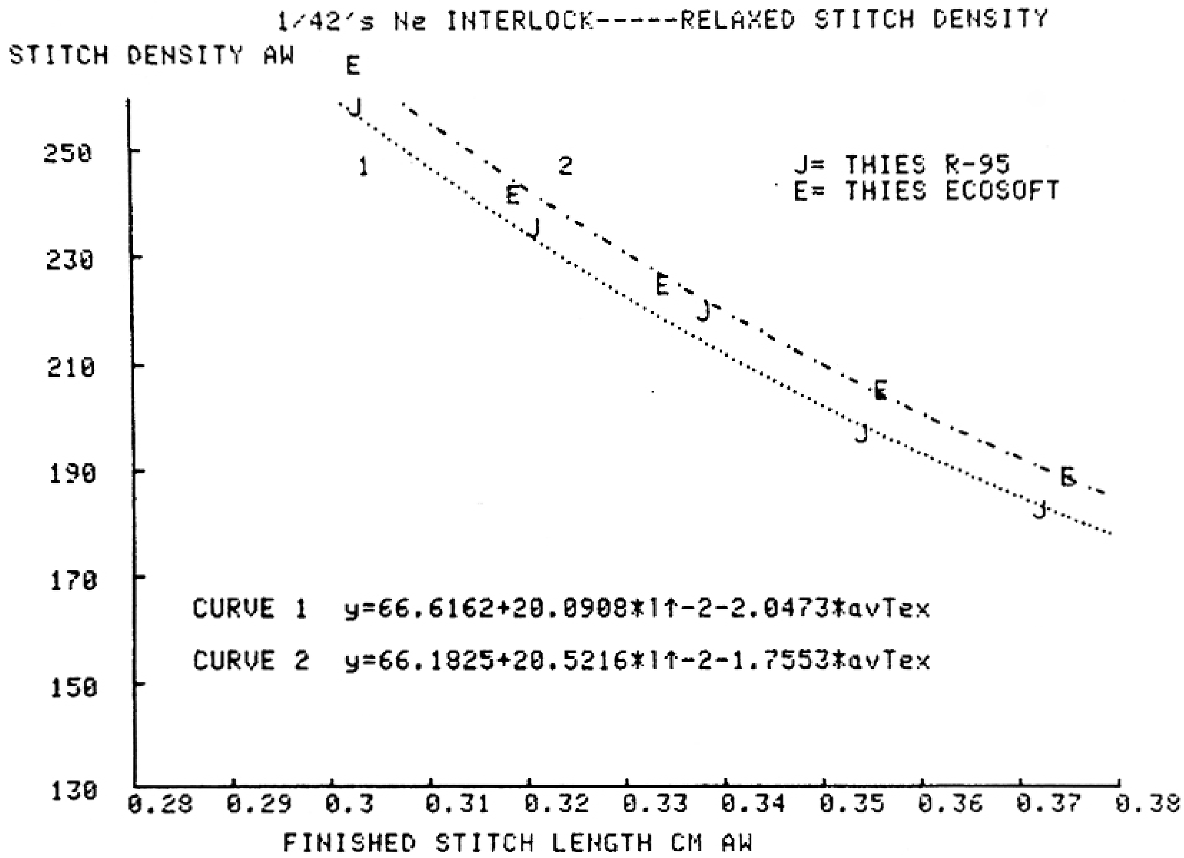

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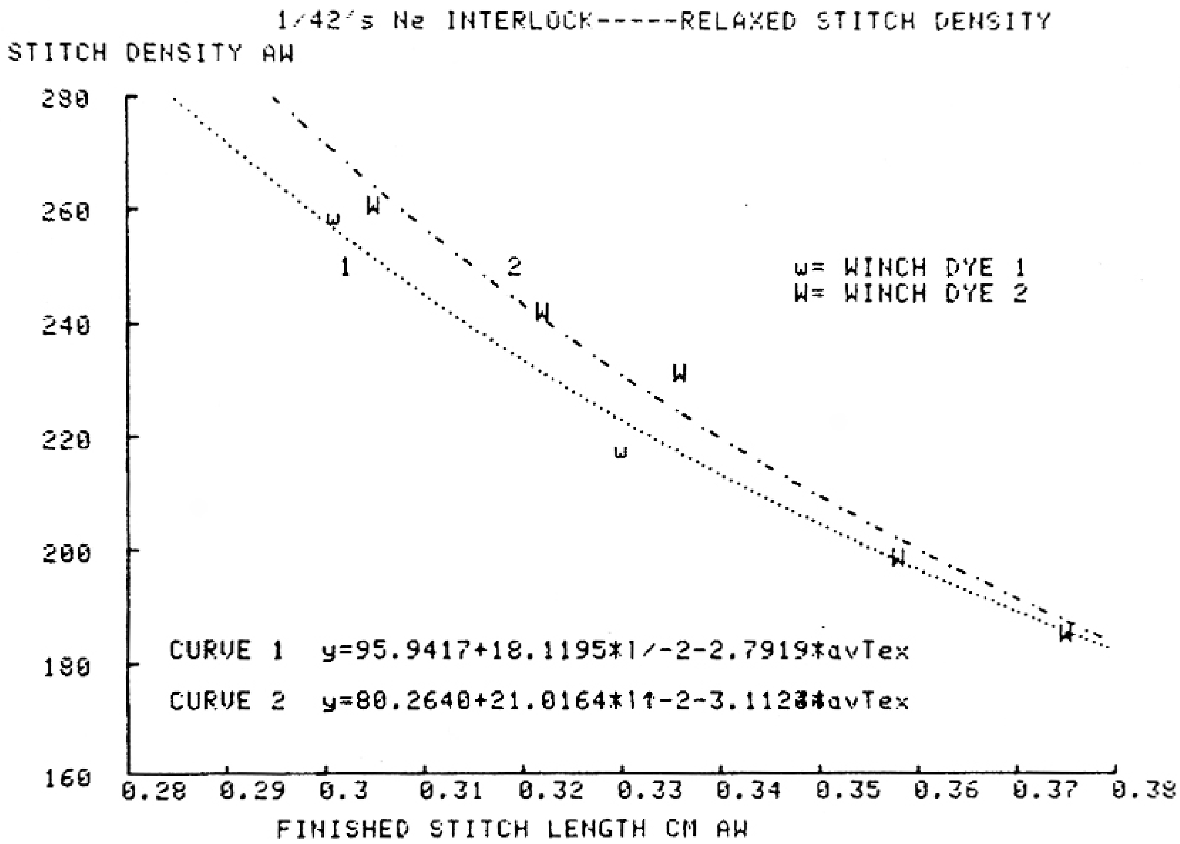

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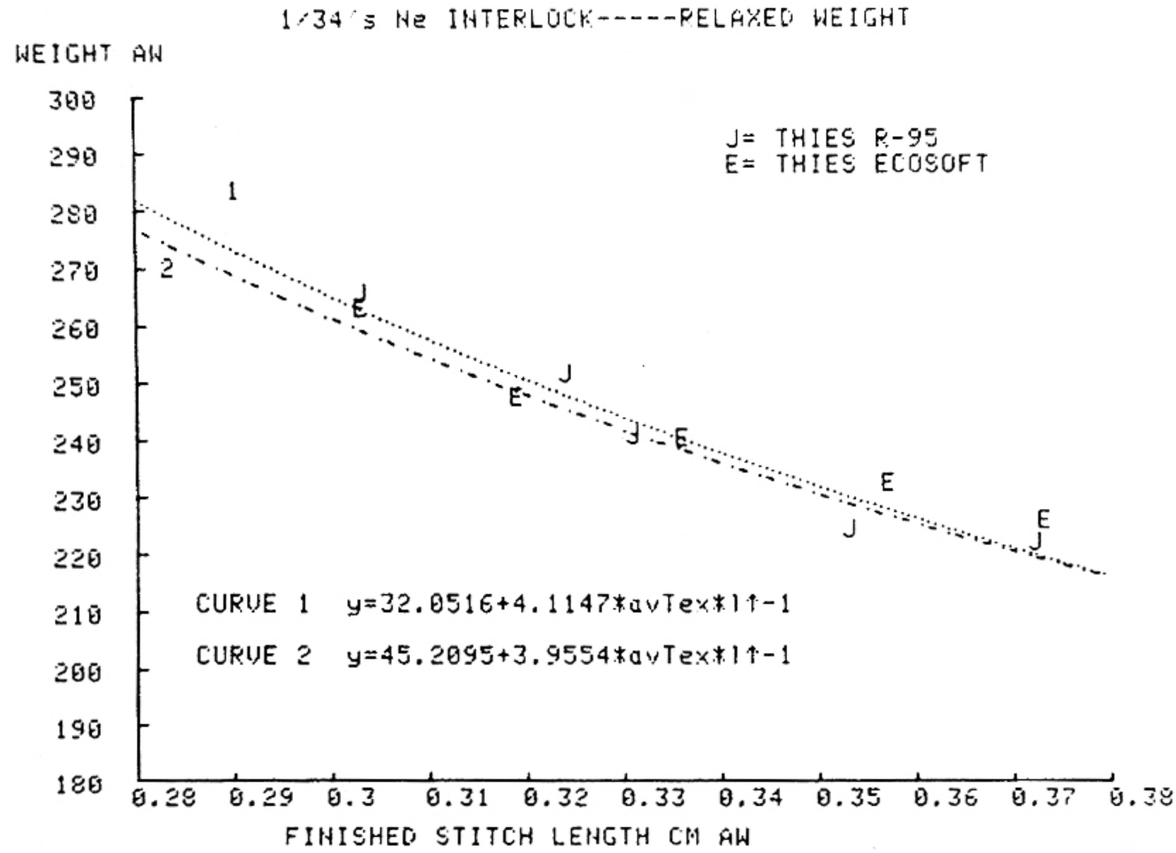

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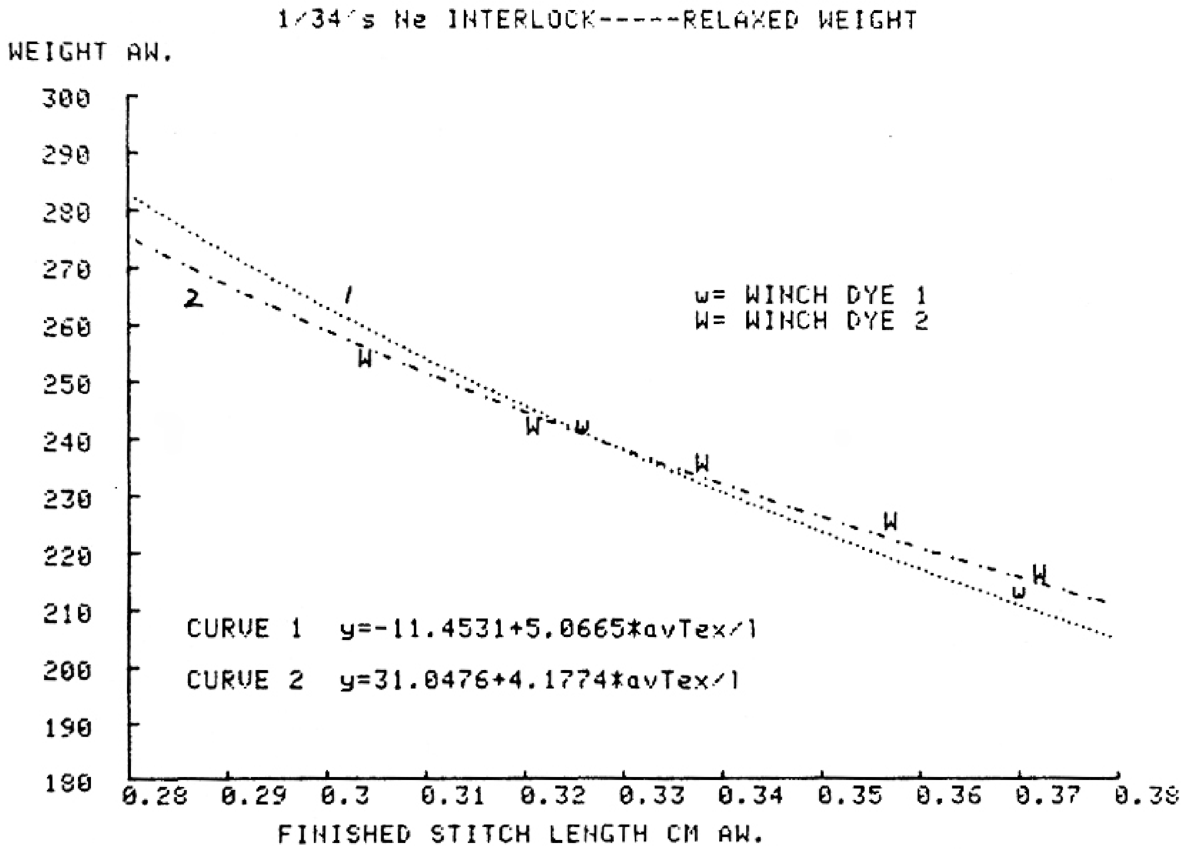

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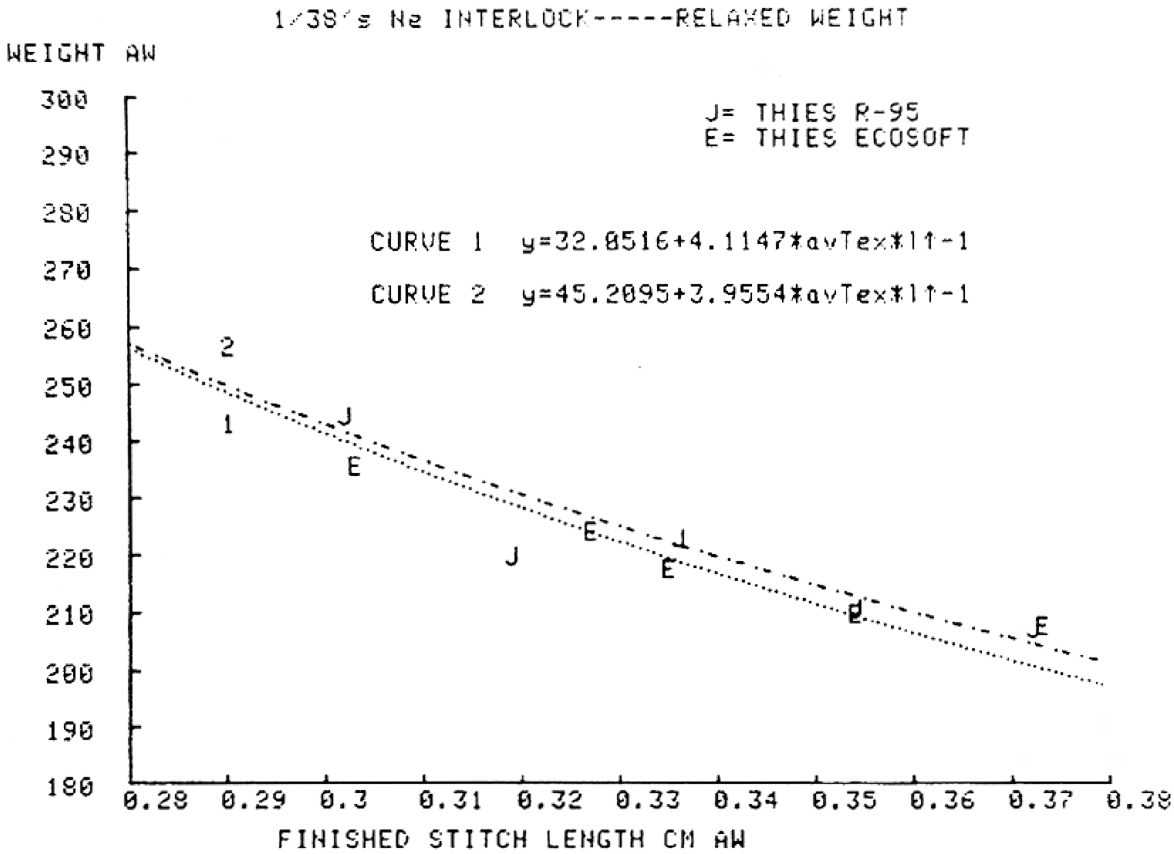

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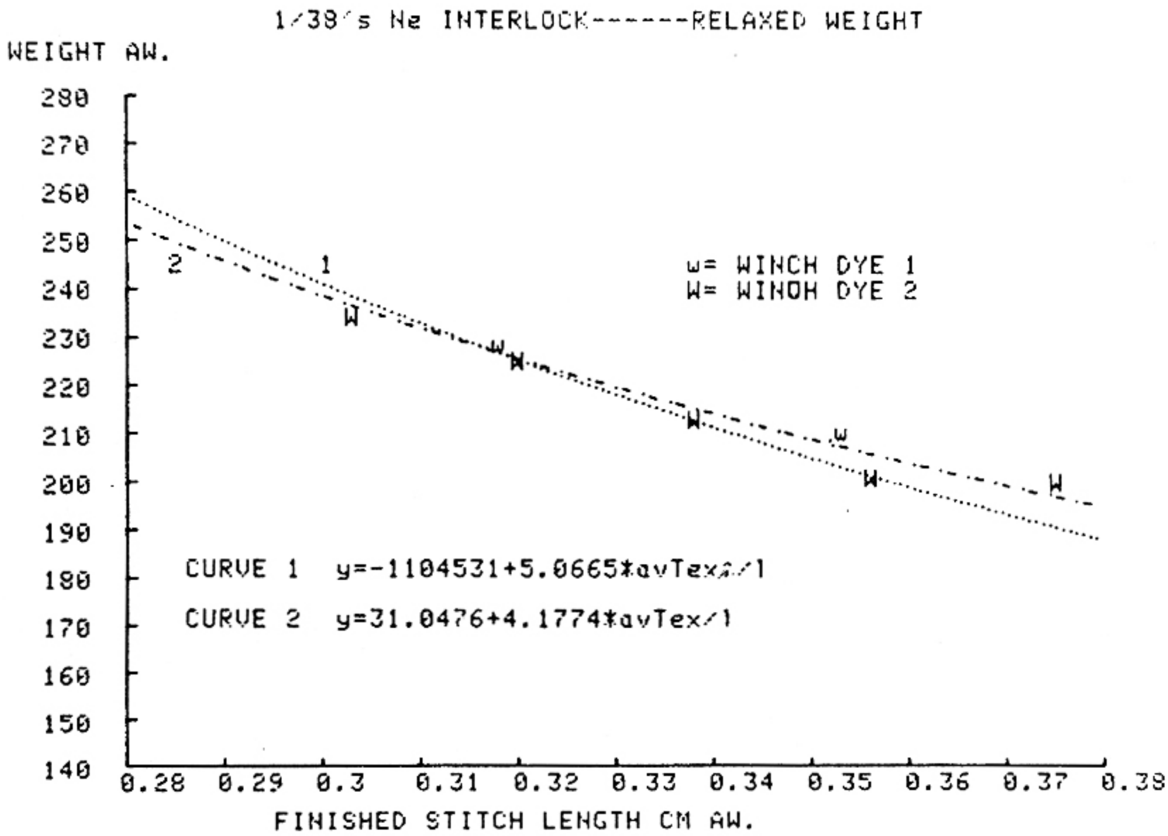

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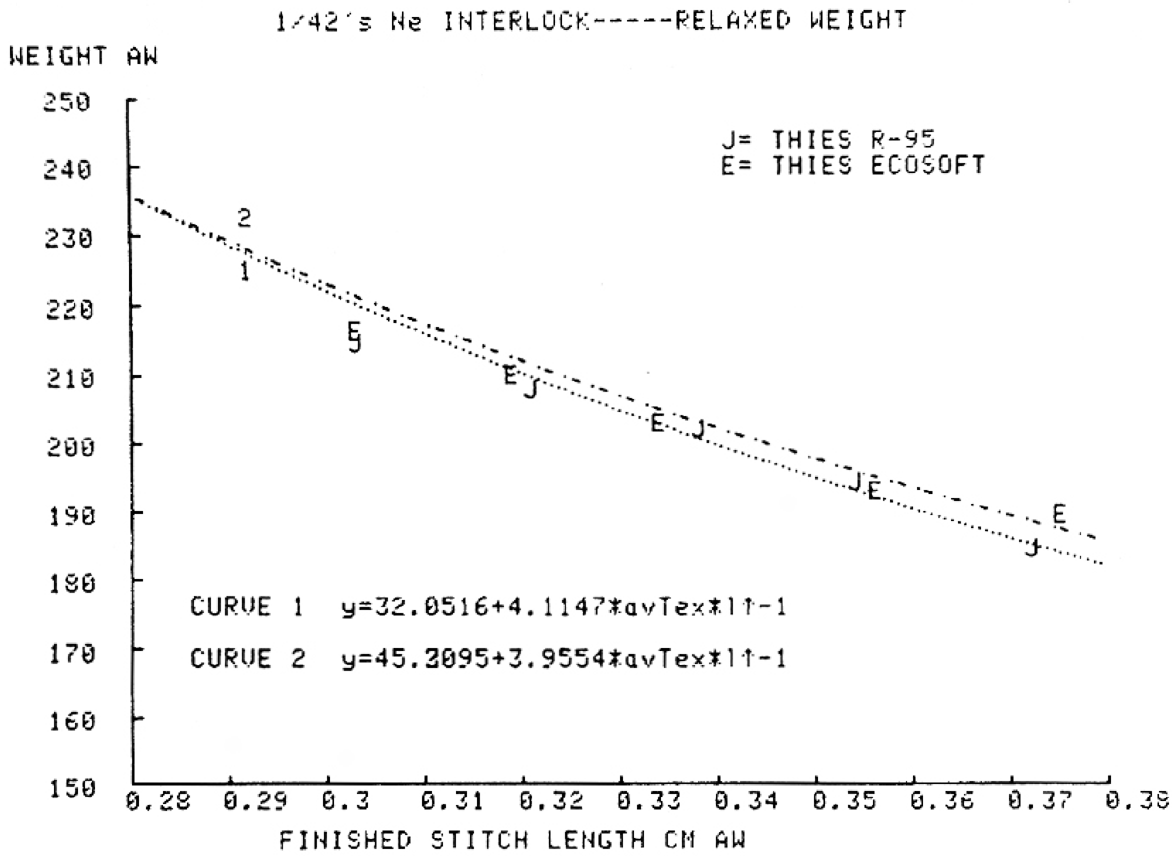

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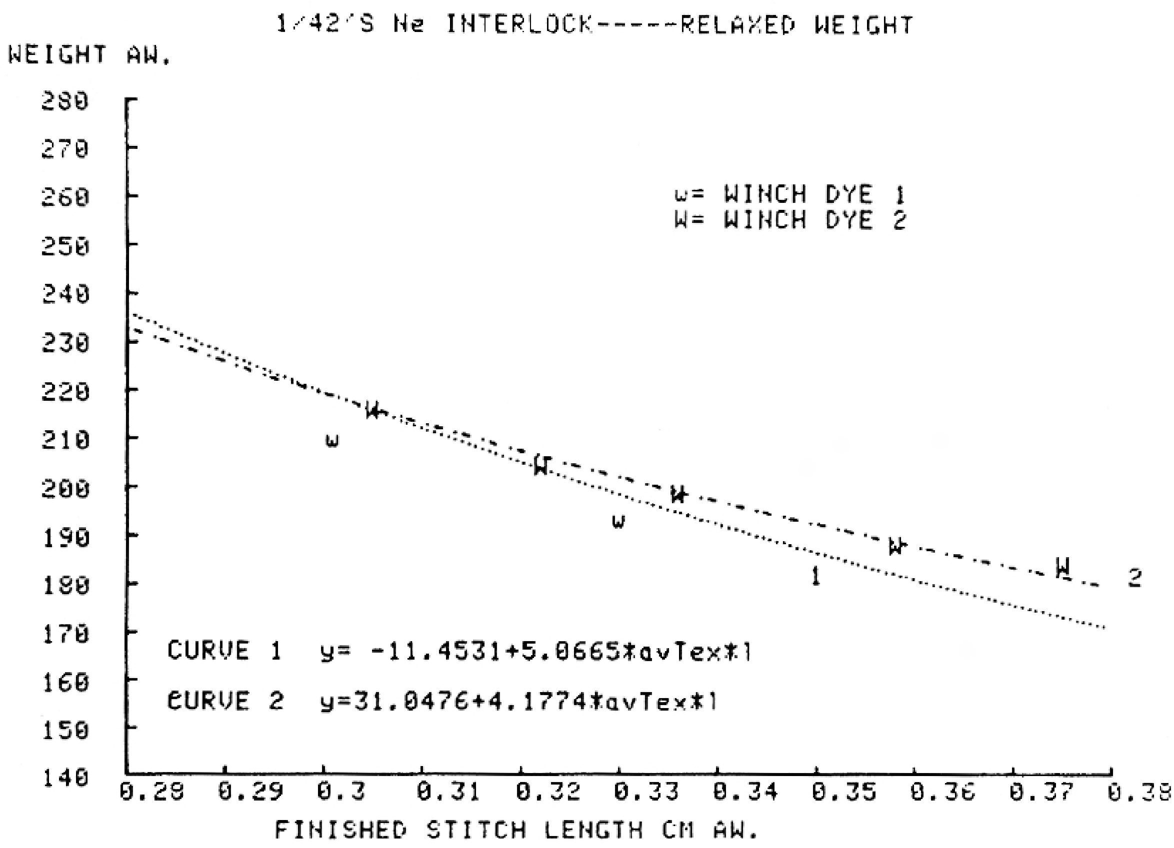

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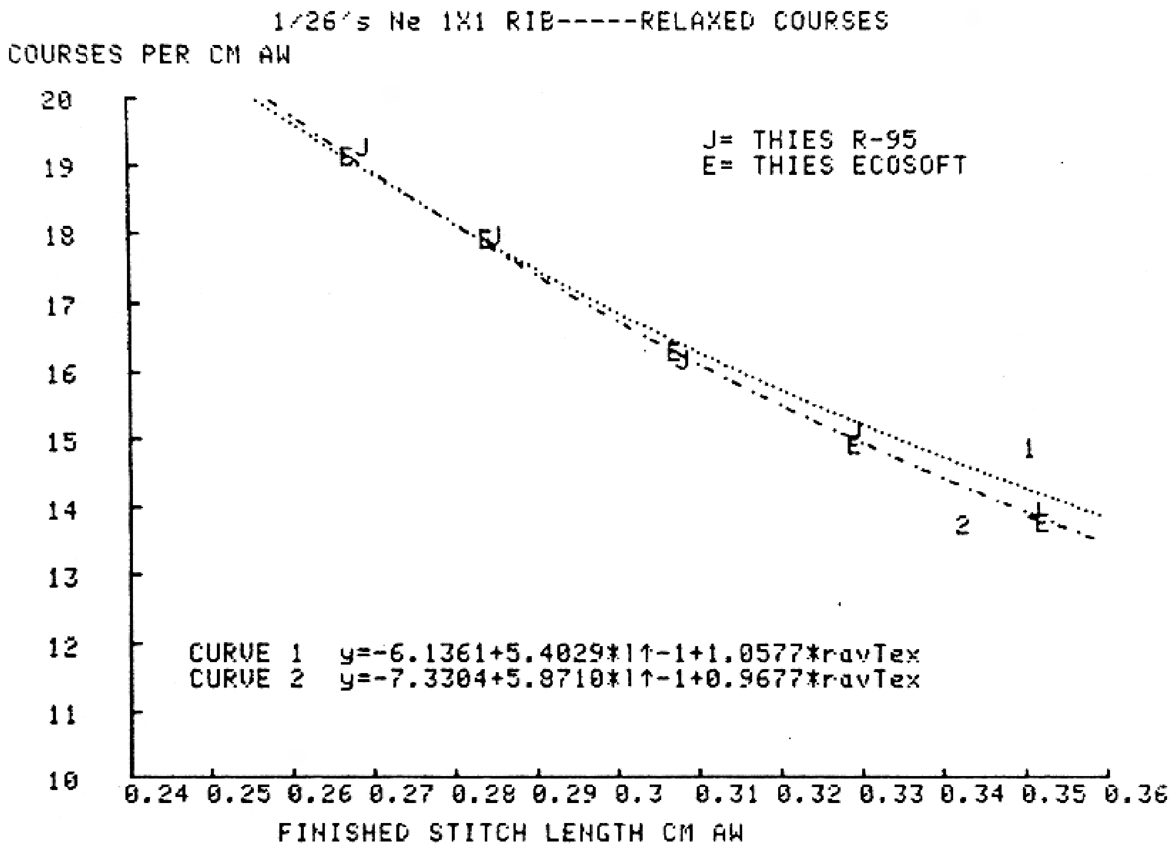

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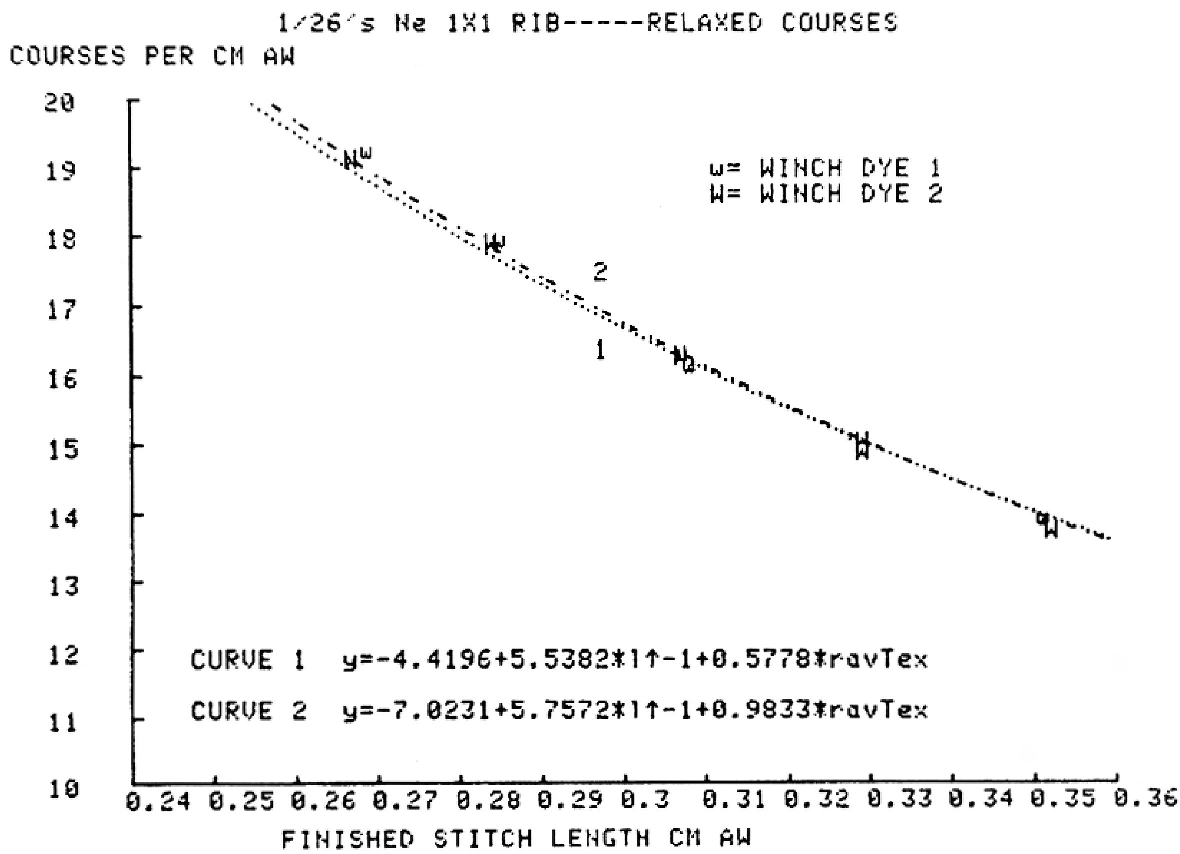

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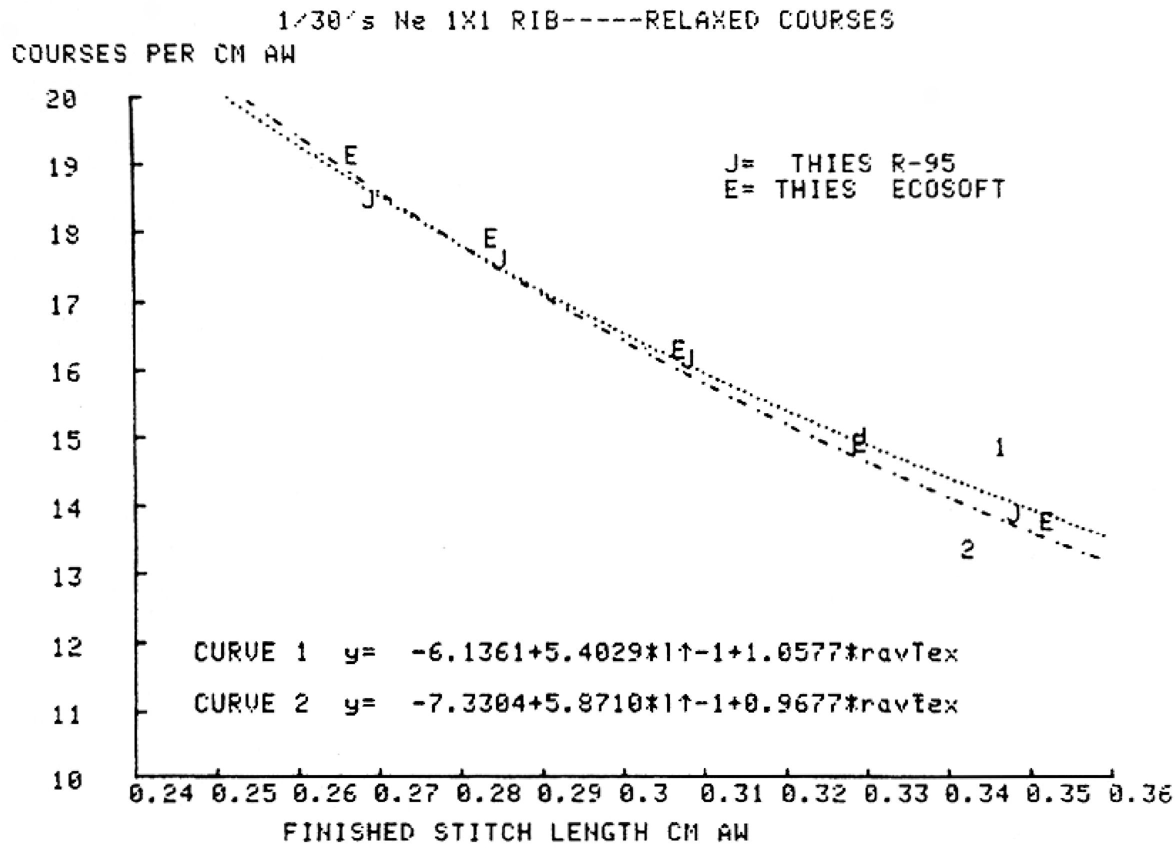

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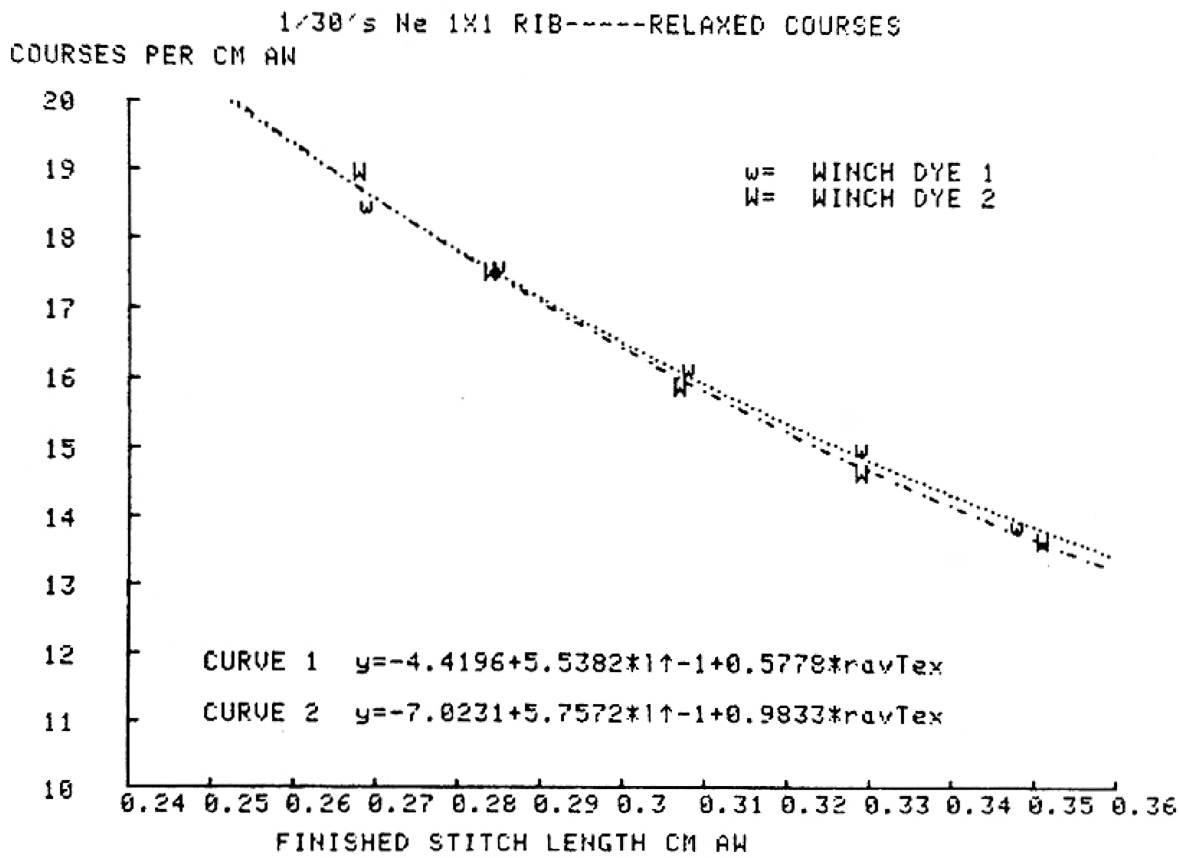

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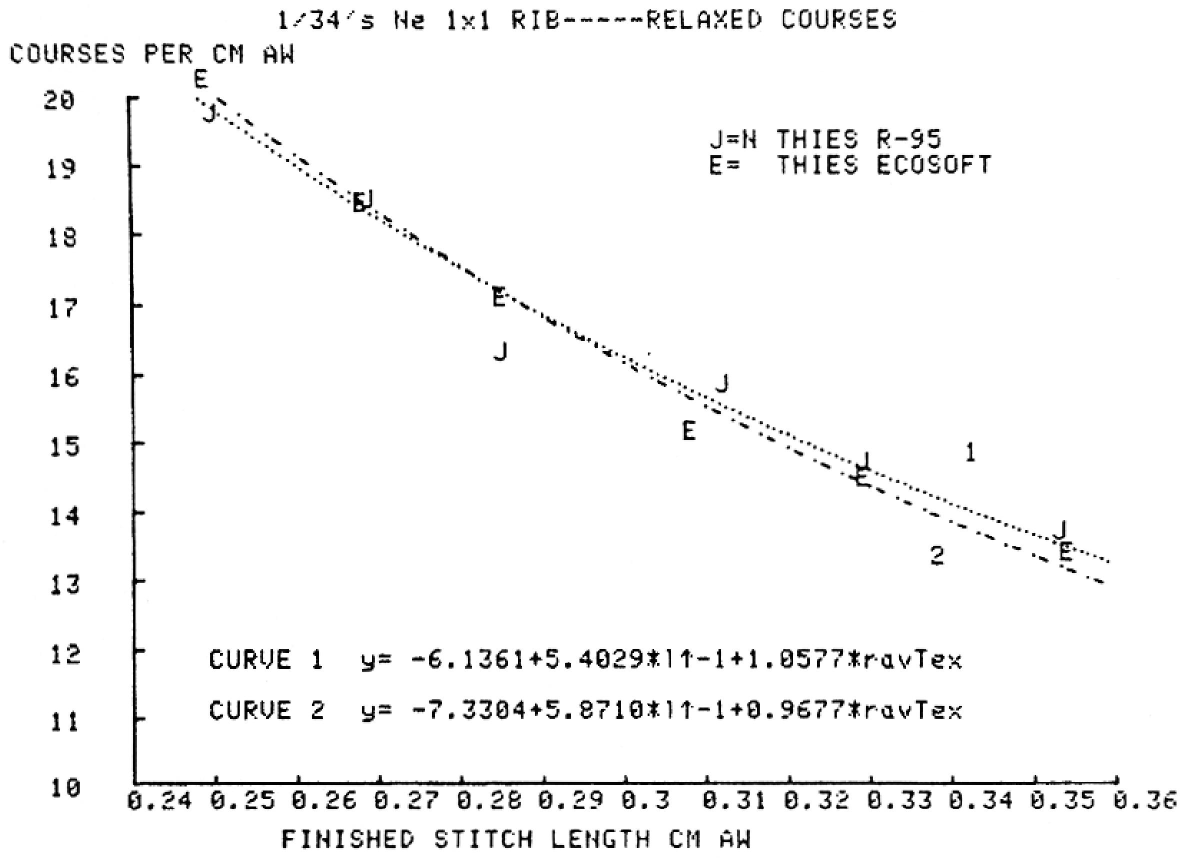

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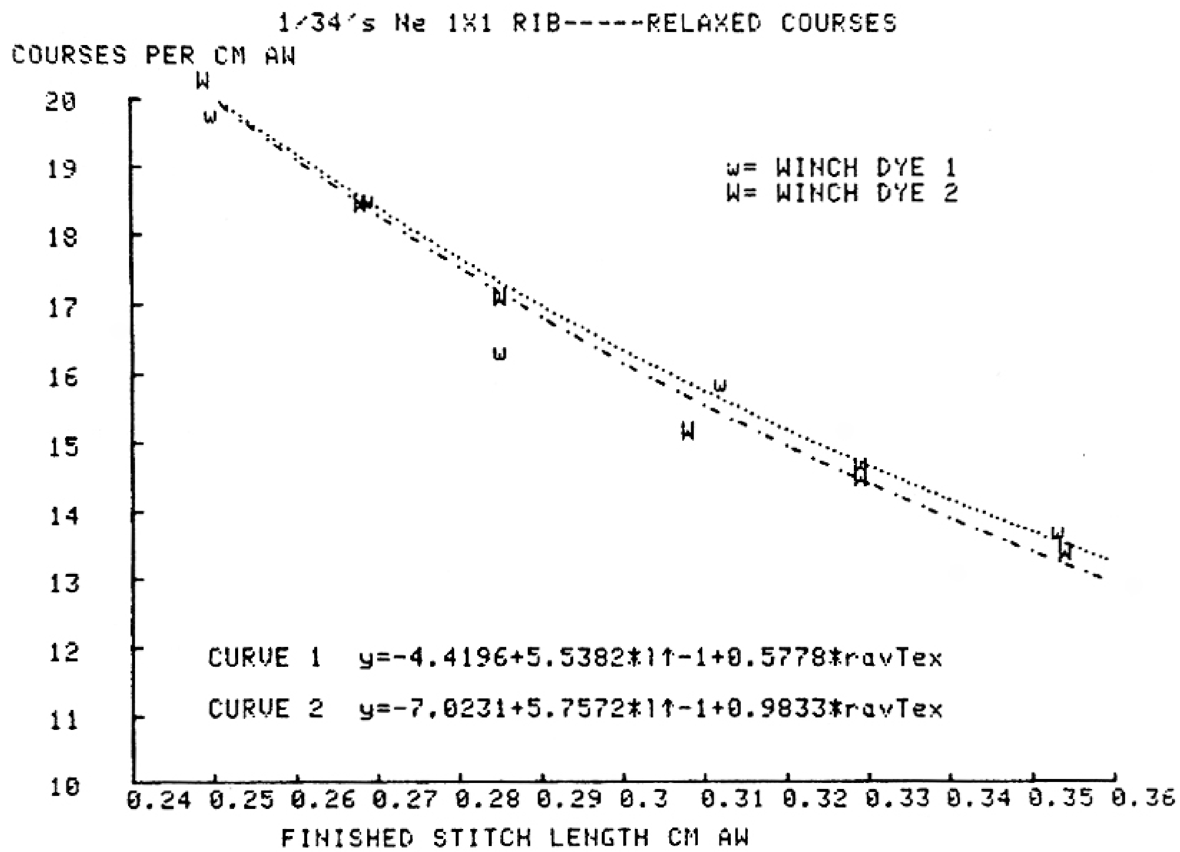

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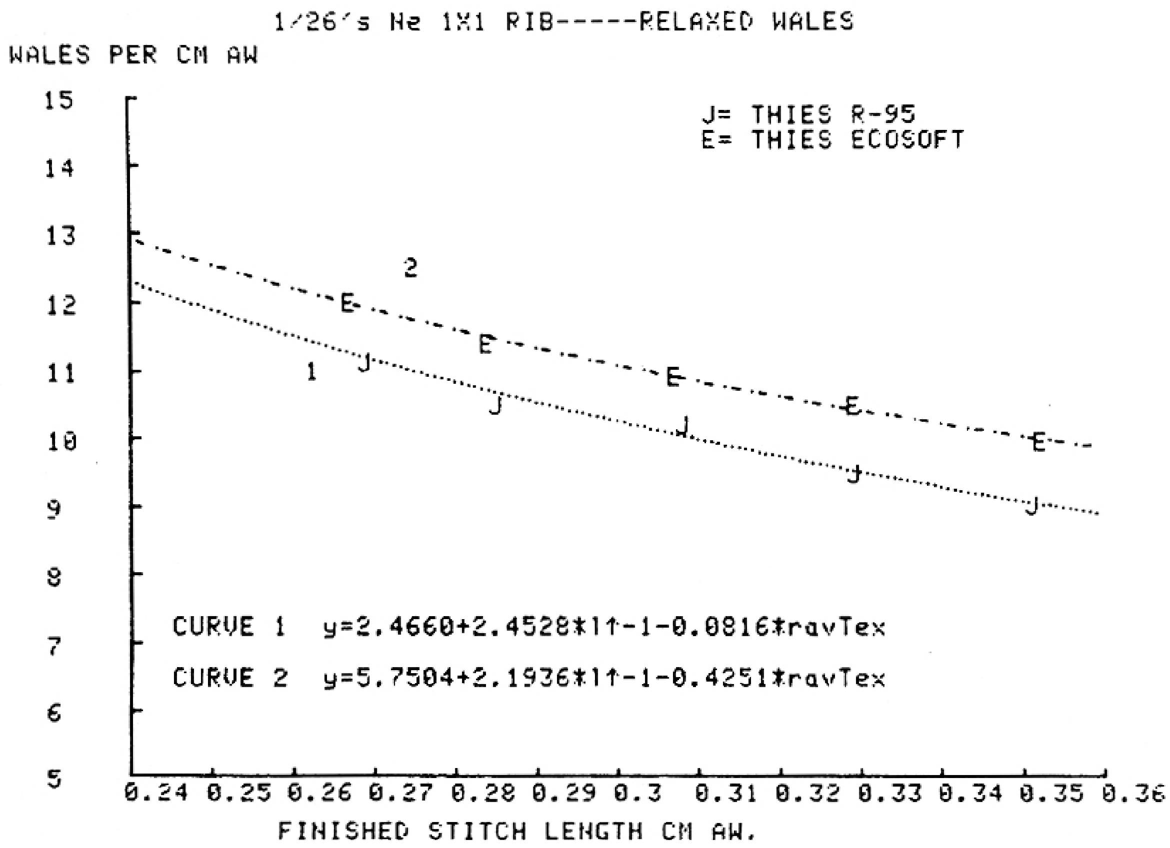

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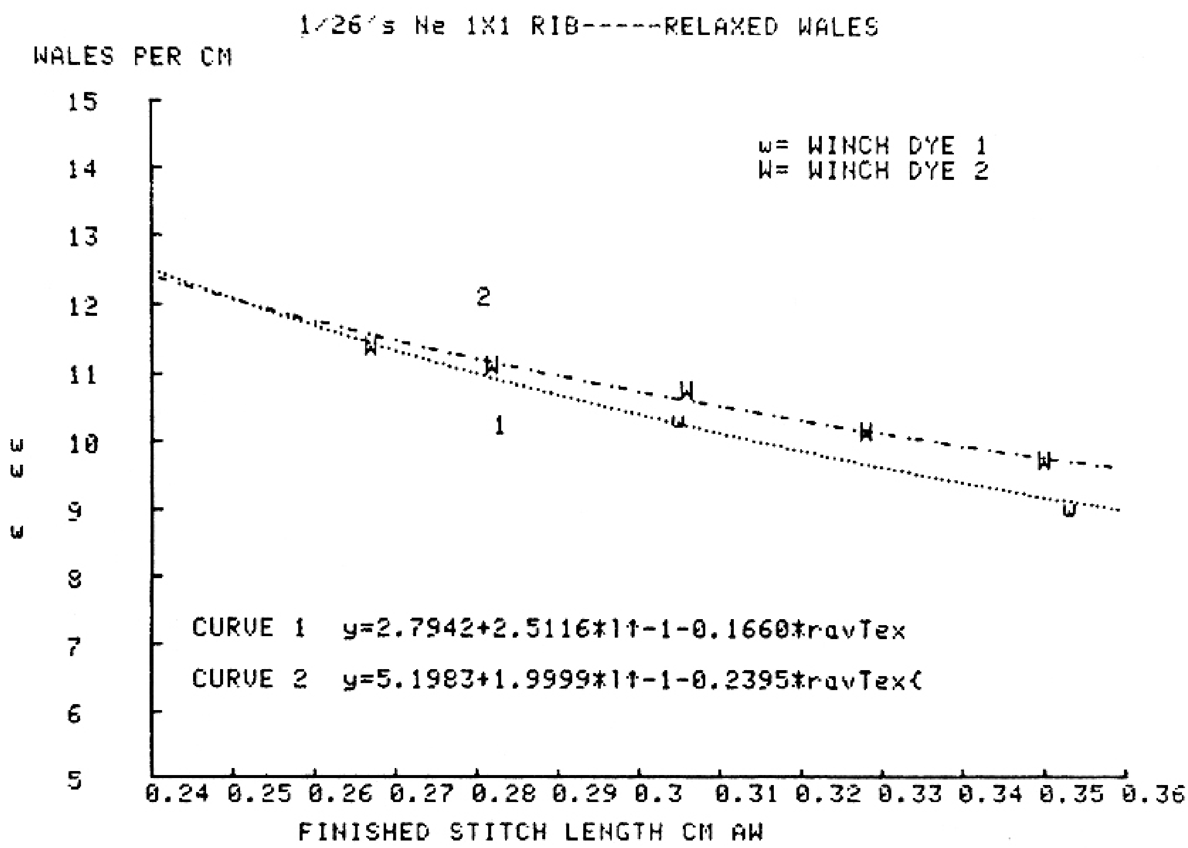

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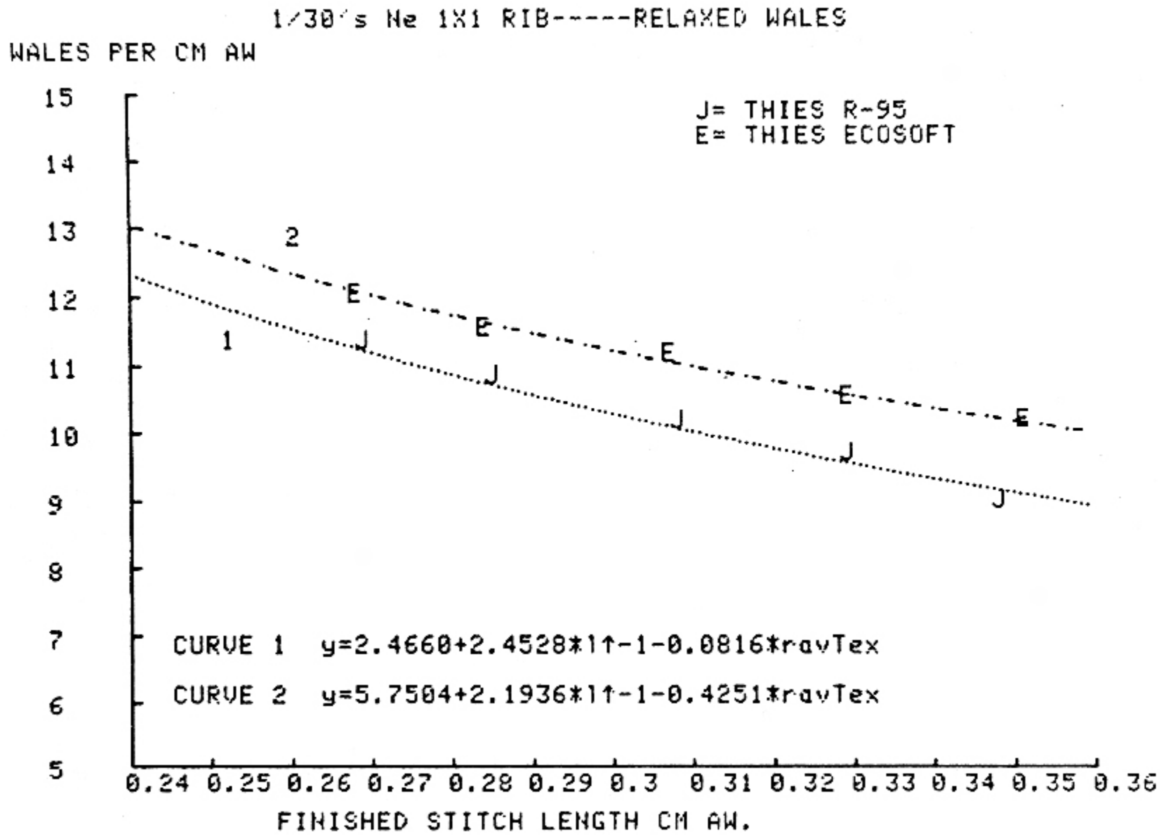

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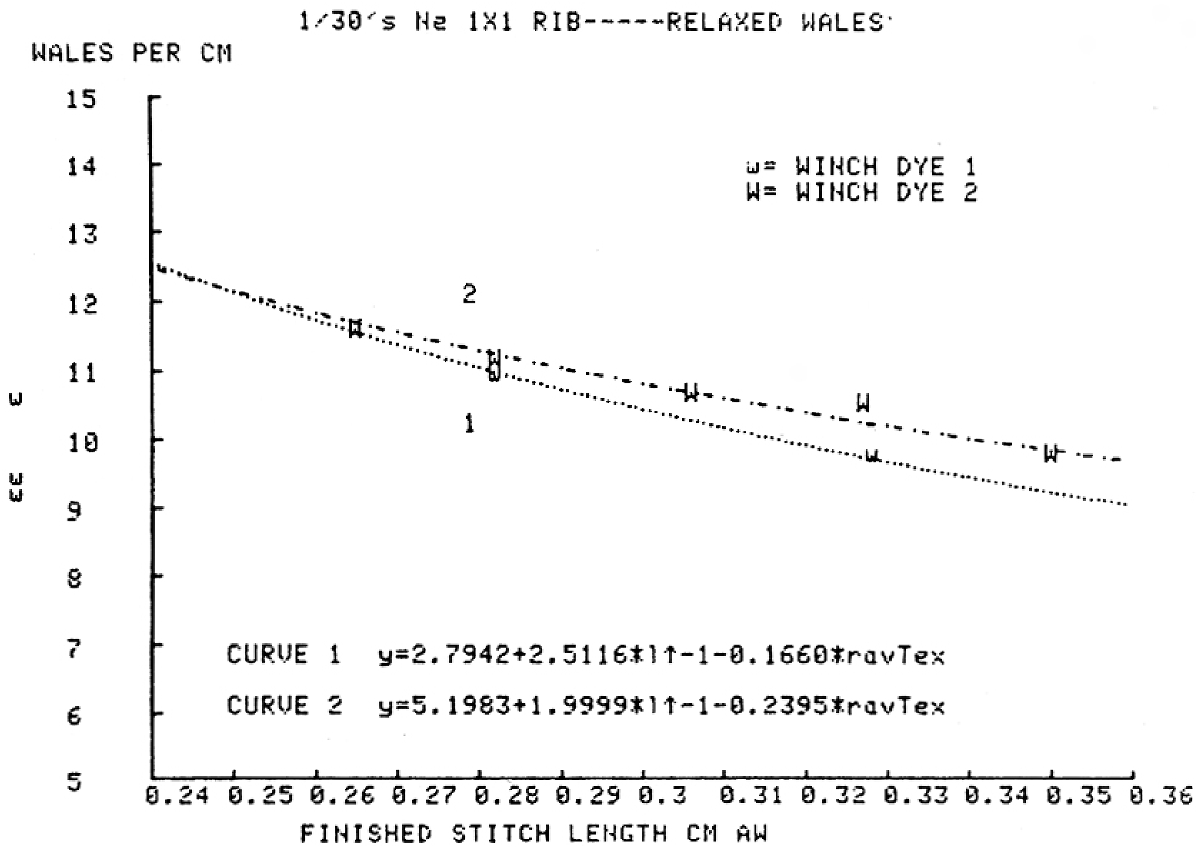

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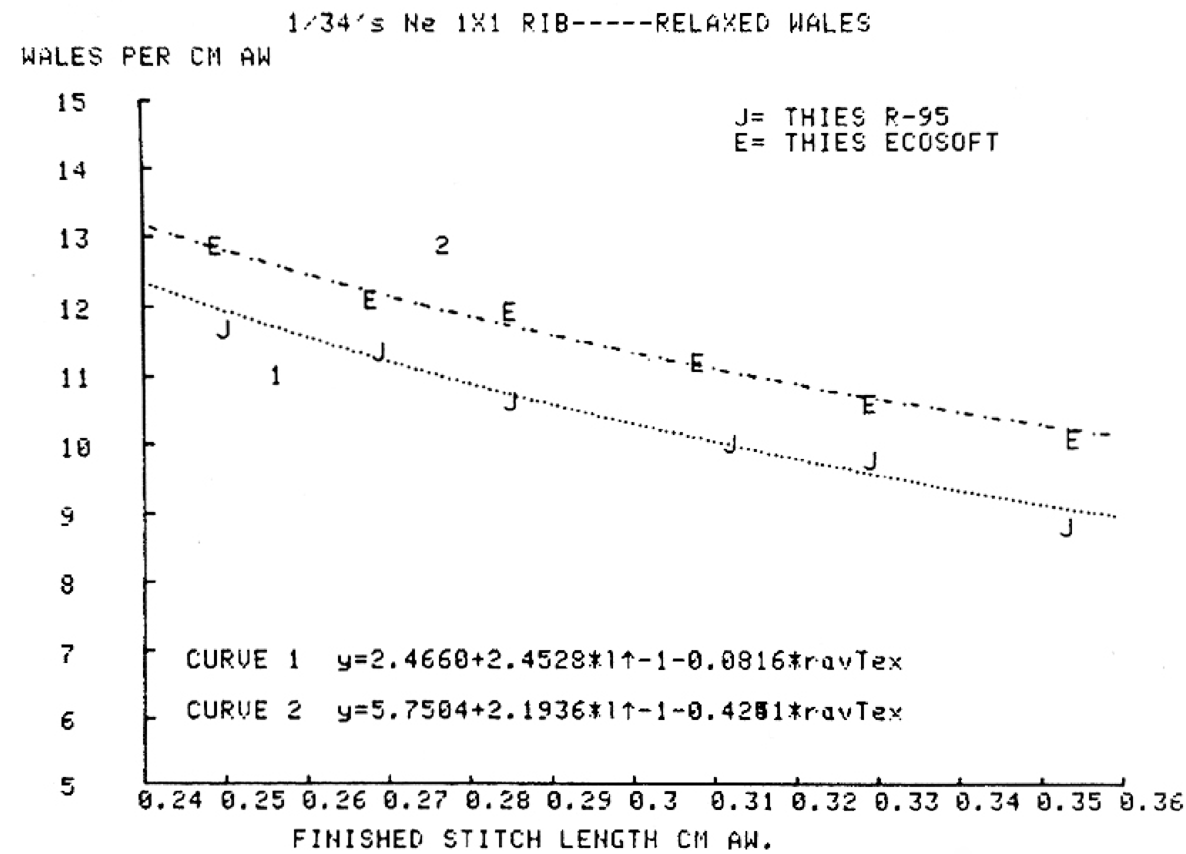

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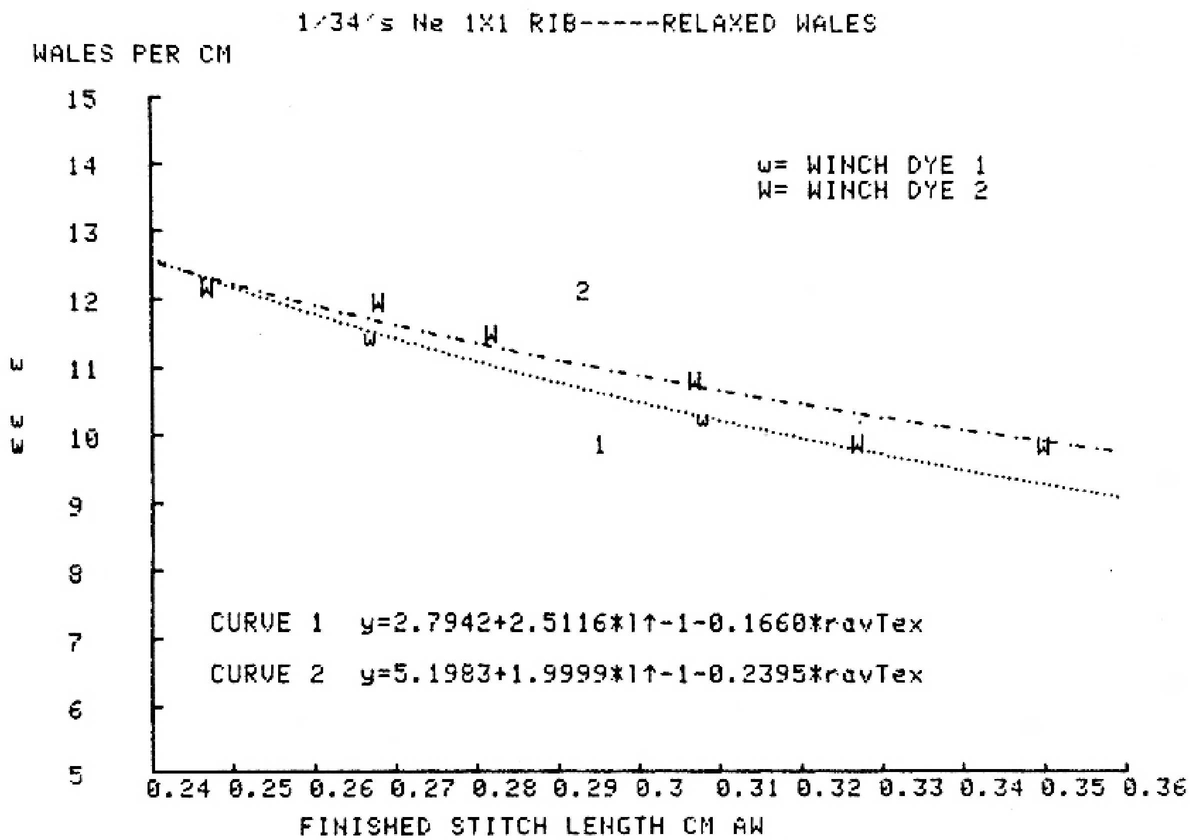

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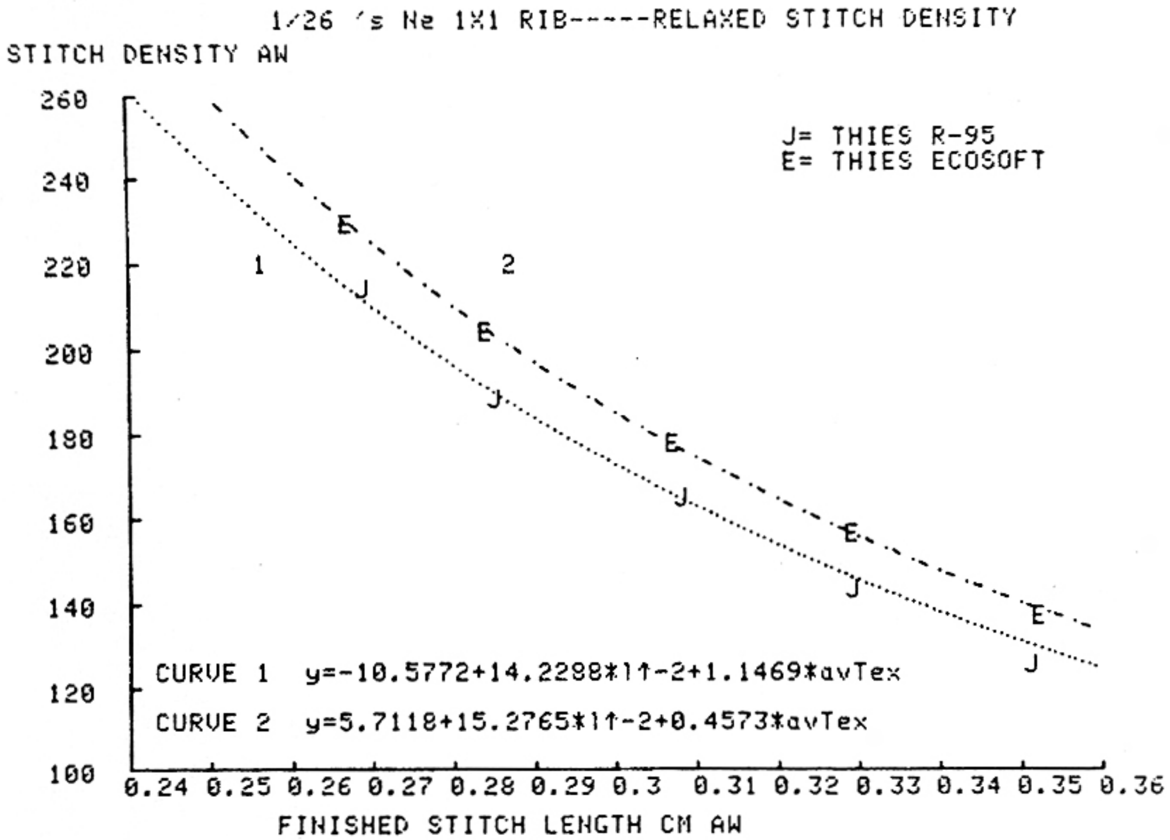

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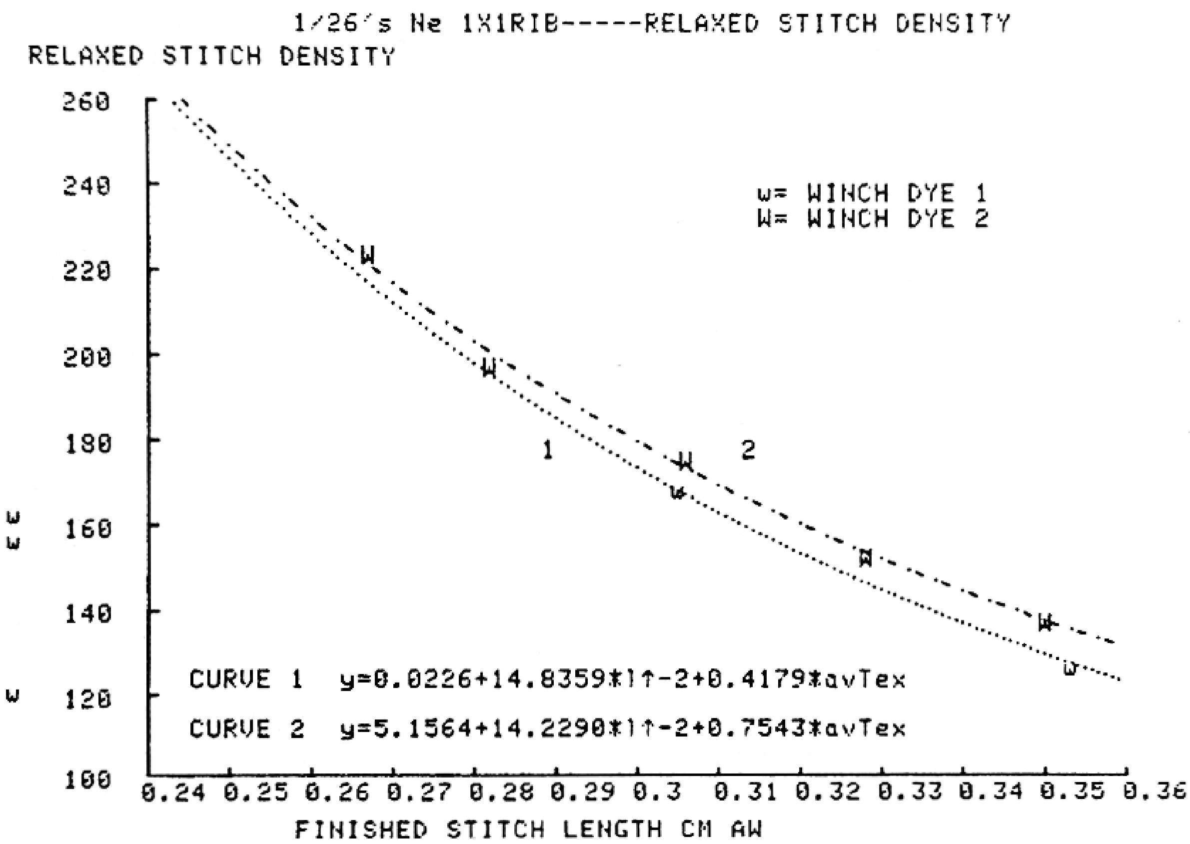

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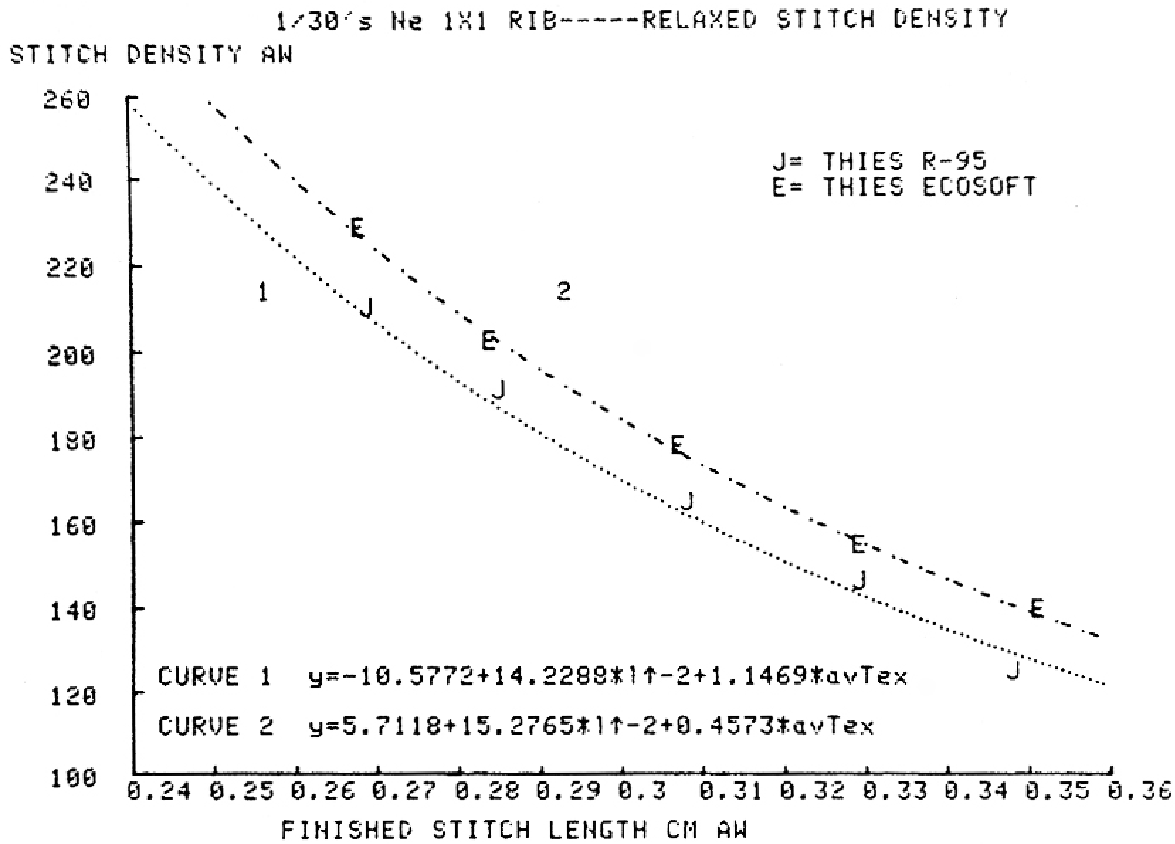

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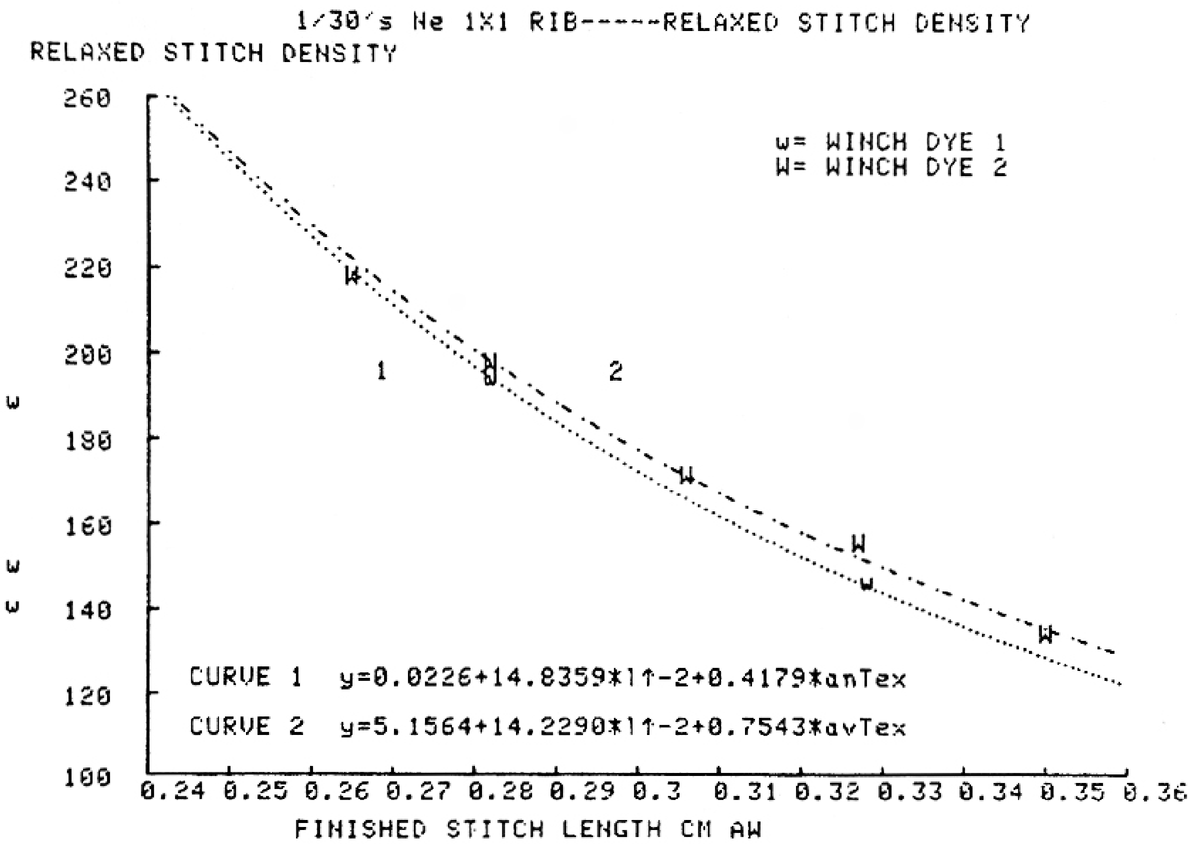

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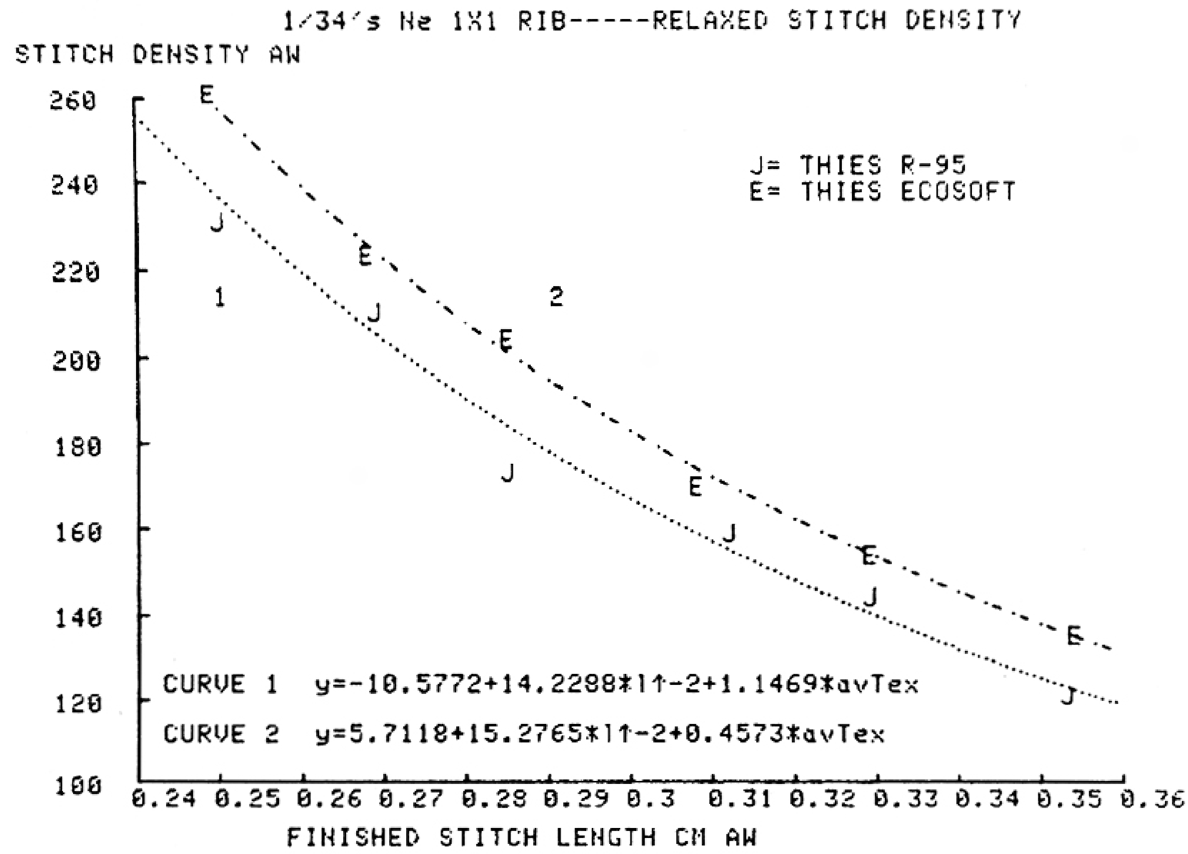

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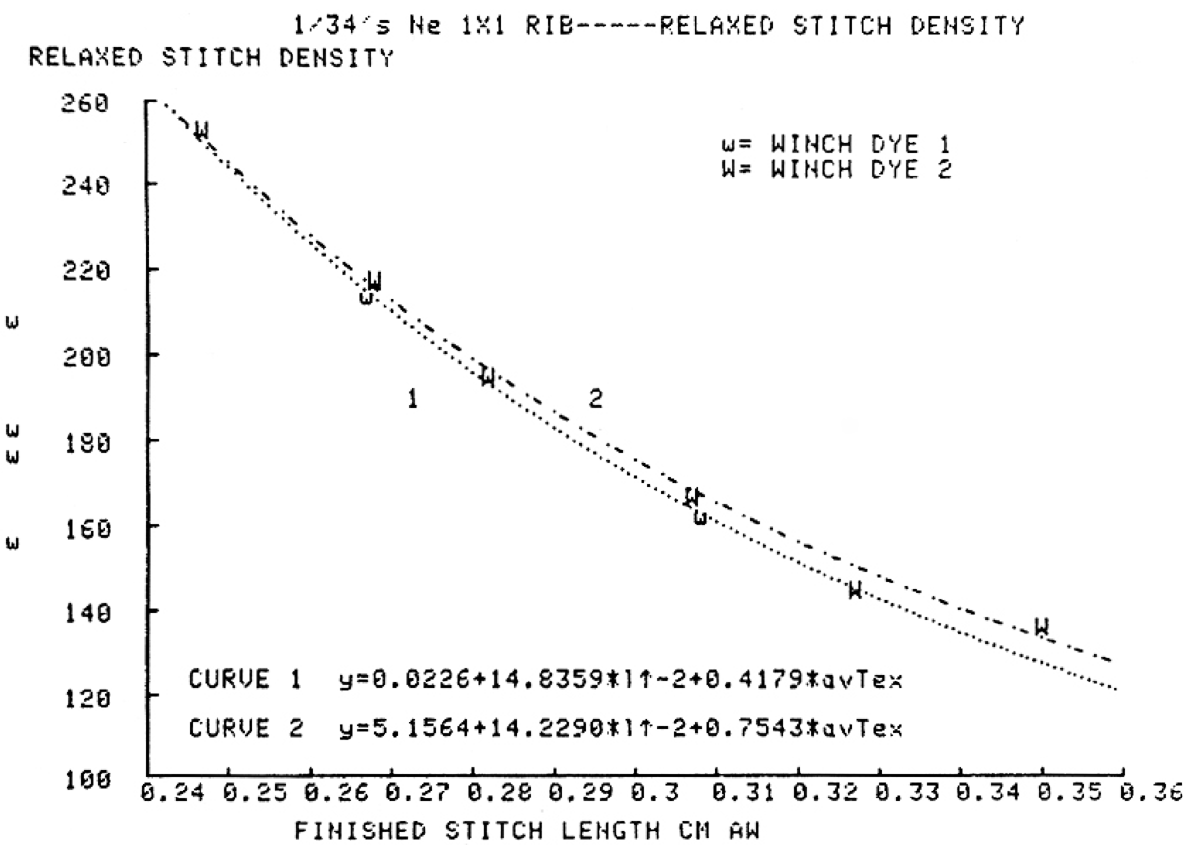

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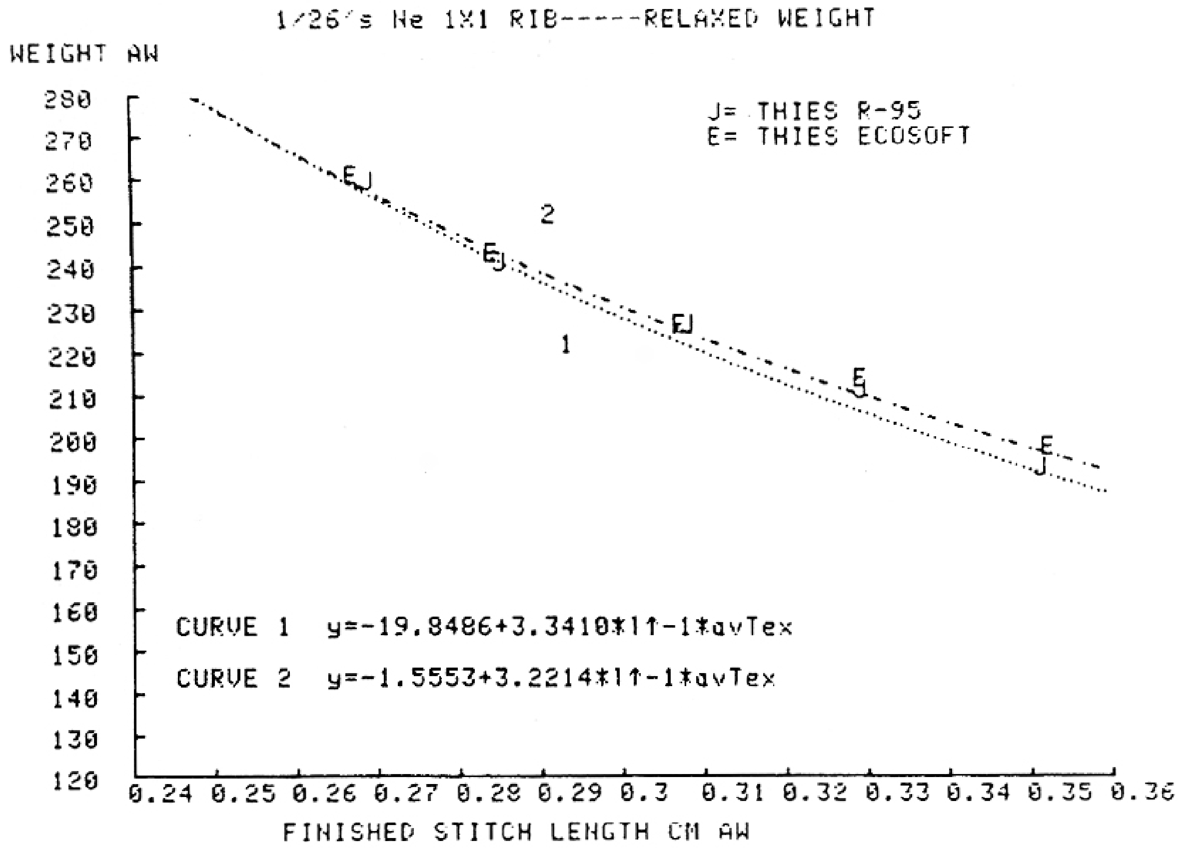

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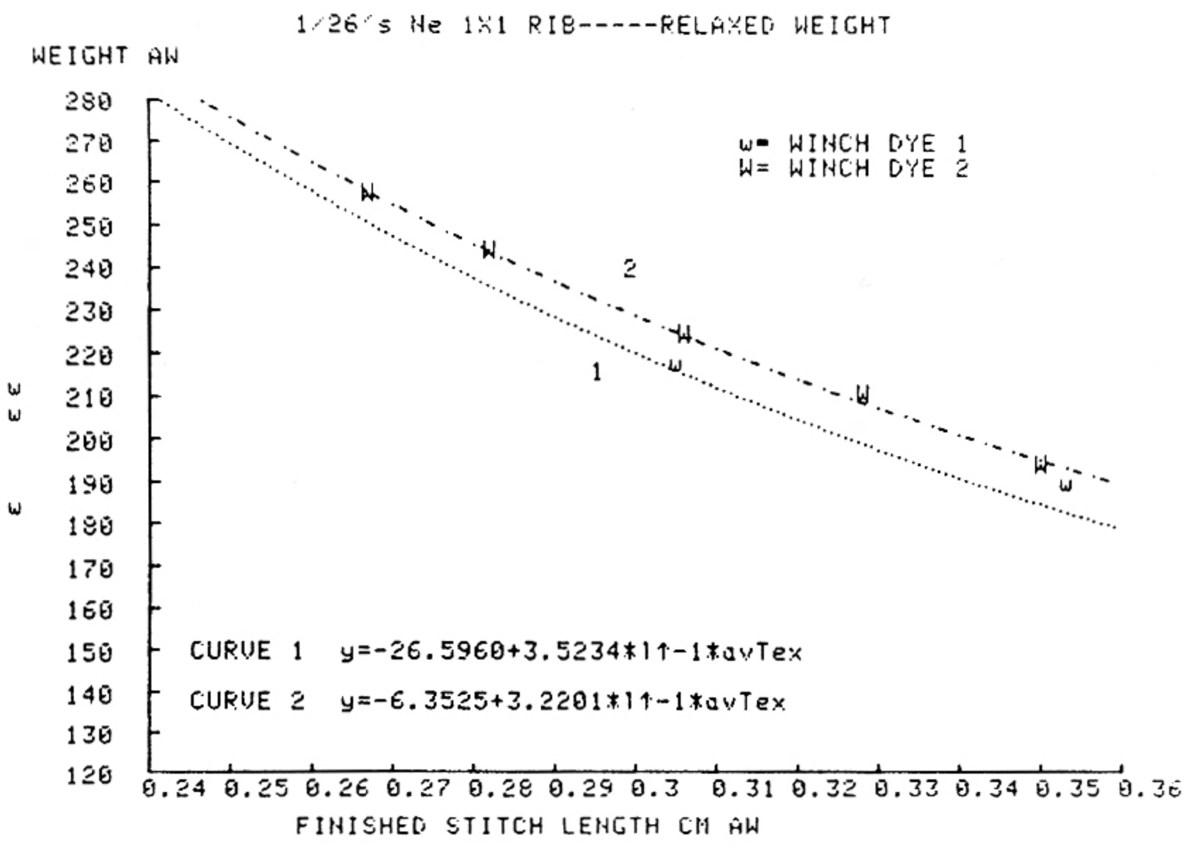

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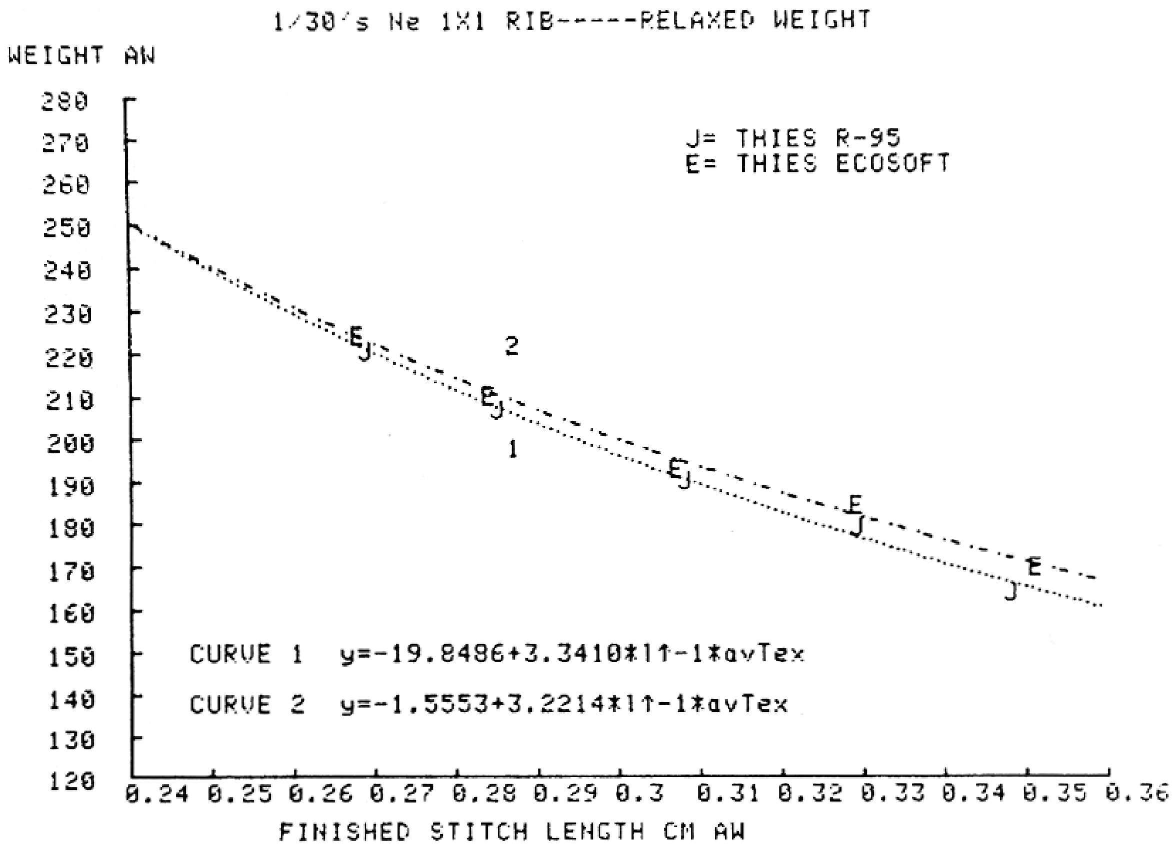

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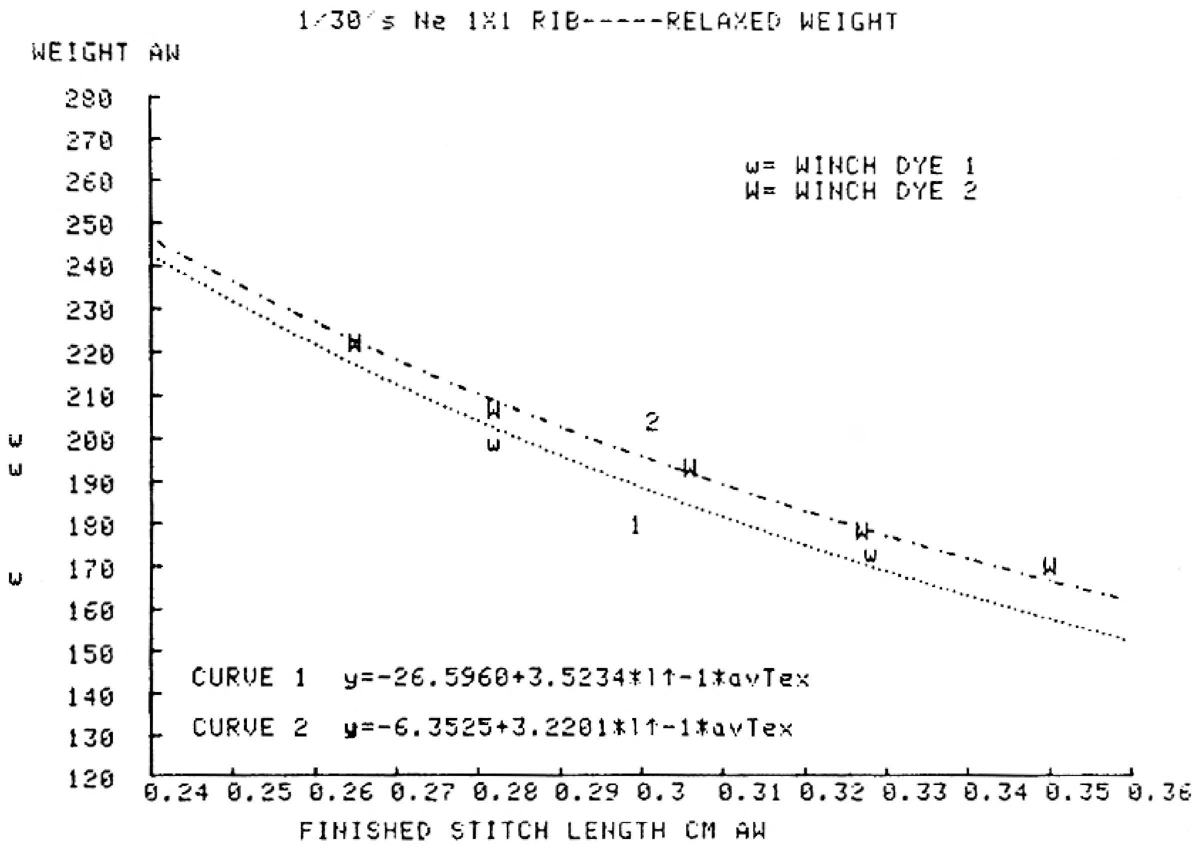

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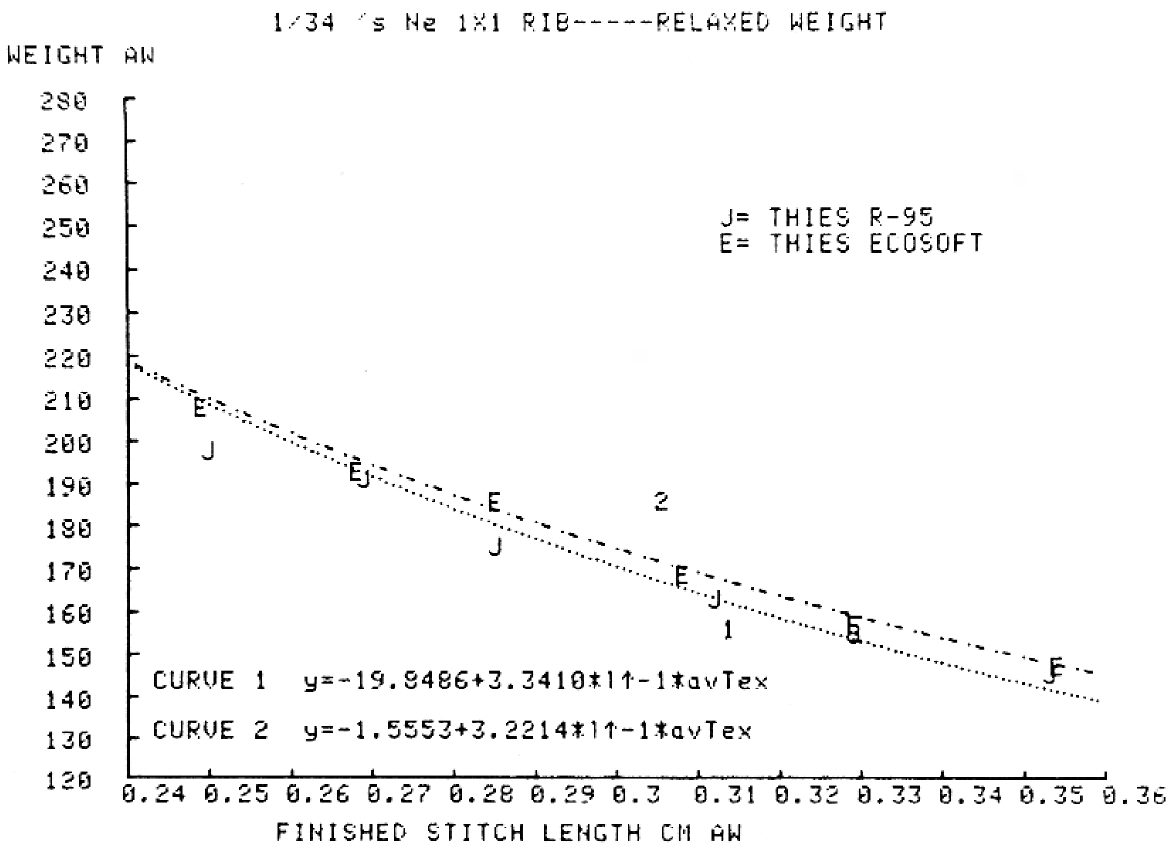

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