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Single Jersey Cotton Fabrics
Comparison Of Tubular And Open-Width Finishing

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Contents

1. Introduction

One of the objectives of the single jersey project is to investigate the effect on fabric properties of processing the fabric by both a tubular route and an open-width route. During the planning stage of the project, provision was made for the knitting of two identical sets of fabrics which included the full range of yarns, stitch lengths and gauges under investigation.

One set of fabrics was processed entirely in tubular form at Meridian Dyers. The precise processing details for this set are described in *Research Record No. 122*. The other set of fabrics was processed at the factory of the Strines Printing Co. Although the dyeing operations were carried out in tubular form, the fabric was slit after dyeing to enable the final finishing operation to be carried out in open-width on a stenter. The precise details for the processing of this set are described in *Research Record No. 132*.

The purpose of this report is to attempt to present preliminary observations and trends rather than a detailed statistical analysis of the test data. Two aspects are considered. Firstly, the actual ease of processing of fabrics and the effect the route undertaken has on this. Secondly, the effect of processing route on fabric properties both in the "as delivered" state (before wash, BW) and also the "fully-relaxed" or "Reference State" state (after wash, AW).

2. Ease Of Processing

Of the two processing routes, the tubular route was without a doubt the easier of the two to execute. There are several reasons for this, but it must be borne in mind that the very nature of this exercise created a number of problems which would not normally be encountered in normal production. The wide range of fabric weights, widths, and variable spirality, caused problems; more so with the open-width route than with the tubular route. These, coupled with the additional problem of the edge curl, made the open-width processing rather difficult.

Under normal production conditions, many of these problems would not be experienced and the processing of a batch of standard quality would not be expected to cause undue handling difficulties.

With the tubular route, it was possible to dry and calender each variant to a specific width and therefore attempt to optimise the processing conditions, whereas fabrics had to be grouped together for open-width finishing on the stenter. The fabric properties in the before-washed, or as-delivered state, are therefore probably not entirely representative of what would have been obtained if a larger batch of a particular quality had been processed under optimised conditions.

Although these before-washed properties are presented in this report, the author does not attach much significance to any trends shown by these results.

3. Effect On Properties

Because the two processing routes were carried out at different factories, there is an additional factor which could affect the interpretation of the test results. The dyeing of the fabrics at Meridian was carried out on the Thies R-Jet 95 machine, whereas the dyeing at Strines was carried out on the Thies RotoStream machine. At the time of preparing this

report the effect of dyeing machine on structure is still under investigation and therefore, at this stage, must still be considered an unknown entity.

The main fabric properties which are compared in this report are as follows.

- Residual length shrinkage.
- Courses per 3cm before and after wash.
- Wales per 3cm after wash.
- Fabric weight per unit area before and after wash.

Residual width shrinkage and wales per 3cm before wash have not been considered because these properties are more directly influenced by the width settings of the final finishing machine which, as has already been stated, may not have been optimal for a particular variant, particularly in the case of the open-width finished fabrics.

Test results from the fabrics made from singles yarn are given in *Tables 1-6* and from two-fold yarns in *Tables 7-12*. The results for a particular set of fabrics processed by the two routes are given on successive sheets to make comparisons of actual numbers easier.

3.1. Residual Length Shrinkage

Residual length shrinkage values for fabrics made from both singles yarn and two-fold yarns and from the two processing routes are illustrated in bar chart format in *Figures 1-9*. This enables trends to be easily spotted and allows not only comparisons to be made between the two processing routes but also between singles and two-fold yarns at any specific stitch length.

If the residual shrinkage figures from the two routes are compared for each of the 90 individual fabric variants, and a scoring system adopted, the following is observed.

	Lower Residual Length Shrinkage			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	43	95.5	29	64.4
Open-width	2	4.5	13	28.9
Equal	0		3	6.7
Total	45		45	

The trend with this particular fabric property is very obvious.

A tubular processing route produces fabrics with lower residual length shrinkage values. This appears more so in the case of fabrics made from singles yarns. Additionally, it can be seen from the bar charts that, overall, the fabrics made from two-fold yarns have a tendency to exhibit lower residual length shrinkages than the corresponding fabric made from singles yarn.

3.2. Courses per 3cm

Courses per 3cm, both before and after full relaxation, have been combined for the two processing routes in *Figures 10-27*. In the interest of clarity, it has been necessary to separate the singles and two-fold yarns. If the results from the 90 fabrics are compared, and a similar scoring system is adopted, the following is observed.

	Higher Number of Courses /3cm BW			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	36	80	32	71
Open-width	5	11	5	11
Equal	4	9	8	18
Total	45		45	

	Higher Number of Courses /3cm AW			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	29	64	23	51
Open-width	7	16	12	27
Equal	9	20	10	22
Total	45		45	

If the before-wash situation is considered, it is clear that the tubular processing route results in higher course counts than the open-width processing route. This is obviously to be expected since the course count is indicative of residual length shrinkage values and this, as has been shown, is higher in the case of the open-width processing route.

The situation after wash is obviously the one of major interest. The scoring system would indicate that there is a distinct trend towards the tubular route resulting in higher relaxed courses than the open-width route. If the bar charts are examined closely, however, it can be seen that the differences are rather small when compared with the corresponding unrelaxed figures. There is also a suggestion that these differences, where they exist, are predominantly at the shorter stitch lengths of the range.

3.3. Wales per 3cm

Due to the reasons outlined in the introduction, the before-wash situation has not been considered. The fully relaxed wales per 3cm of the singles and two-fold fabrics have therefore been combined in *Figures 28-36* for the two processing routes. The scoring system gives the following picture.

	Higher Number of Wales /3cm AW			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	16	35.5	20	44
Open-width	25	55.5	21	47
Equal	4	9	4	9
Total	45		45	

It would be difficult to argue a case for a distinct trend based on these figures.

3.4. Weight

The mean weight figures both in the before and after wash state are shown for all the fabric variants in *Figures 37-54*.

The scoring system was again adopted for the two states and yielded the following.

	Higher Weight, gsm BW			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	36	80	39	87
Open-width	4	9	1	2
Equal	5	11	5	11
Total	45		45	

	Higher Weight, gsm AW			
	Singles		Two-fold	
	No.	%	No.	%
Tubular	22	49	19	42
Open-width	13	29	12	27
Equal	10	22	14	31
Total	45		45	

Once again, the picture when relating to the unrelaxed fabrics is a particularly clear one. The open-width finished fabrics are predominantly lighter than the corresponding tubular finished fabrics. This ties up with the observations of residual length shrinkage and unrelaxed courses. When the weights after relaxation are considered it is once again difficult to argue a case that there are consistent differences.

4. Conclusions

The purpose of this report is to present the findings of a quick, and in some ways crude, evaluation of the data obtained from single jersey fabrics finished by both a tubular and an open-width route.

All the variants of machine gauge, yarn and stitch length, have been grouped together for the evaluation which was largely visual in nature to enable any obvious differences, if there are any, to be spotted.

Firstly, if the data from the unrelaxed fabrics are considered, it is very obvious that a tubular finishing route enables the finisher to produce fabrics with properties which are nearer to the fully relaxed properties than if an open-width route had been used. Even if it is accepted that the open-width finishing was not carried out under optimum conditions, it is still the opinion of the author that tubular finishing is the more controllable and reproducible of the two alternatives.

Considering the data from the fully-relaxed fabrics, it is also the opinion of the author that it would be very difficult to argue the case that there are any consistent differences in the fully relaxed properties of fabrics finished by the two routes.

Mathematical analysis might show consistent differences when considering individual gauges, yarns or stitch lengths, but in the context of a blanket analysis such as this, there do not appear to be any clear or consistent differences.

Bearing in mind that the effect on fabric properties of using different dyeing machines has still to be resolved it is felt that there is no conclusive evidence at this stage to suggest that tubular or open-width finishing produces fabrics with consistently different fully-relaxed properties.

Table 1

18 GAUGE S.J. SINGLES YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
18/1-16/344/	7.8	12.1	197.9	245.8	48.3	52.5	31.1	36.0
18/1-16/362/	8.8	12.8	190.9	226.0	44.8	48.3	29.6	34.0
18/1-16/380/	7.0	13.0	167.1	220.7	42.3	45.2	28.1	32.9
18/1-16/399/	12.5	8.4	168.3	209.7	37.9	42.3	29.0	31.6
18/1-16/419/	11.5	9.8	156.3	192.5	36.4	40.8	27.5	30.3
18/1-20/327/	9.3	9.5	168.7	204.4	49.5	53.3	34.4	37.5
18/1-20/344/	10.3	12.6	153.6	189.9	46.6	50.3	31.6	36.1
18/1-20/362/	13.4	11.6	145.8	182.3	41.9	47.4	30.7	35.1
18/1-20/380/	15.0	12.2	136.3	170.8	38.3	43.8	30.5	33.8
18/1-20/399/	17.5	9.4	123.3	164.9	34.8	41.6	29.5	32.7
18/1-24/311/	13.2	9.2	135.1	173.0	48.6	54.6	37.2	40.7
18/1-24/327/	14.1	9.8	126.3	159.3	45.5	51.0	34.8	38.7
18/1-24/344/	15.2	11.7	112.2	154.6	42.2	48.0	33.2	38.0
18/1-24/362/	16.4	10.5	107.0	155.4	39.8	46.0	31.5	37.1
18/1-24/380/	19.3	6.8	106.2	147.7	35.6	43.8	32.2	37.0

Table 2

18 GAUGE S.J. SINGLES YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
18/1-16/344/	13.6	16.0	163.1	229.1	43.8	51.2	29.4	35.9
18/1-16/362/	10.2	13.6	169.8	219.4	43.1	46.5	29.4	34.1
18/1-16/380/	11.2	13.6	157.7	211.5	40.4	44.9	28.1	31.6
18/1-16/399/	13.8	7.9	155.5	200.9	36.8	41.5	28.3	31.0
18/1-16/419/	15.4	13.9	142.6	197.7	35.4	40.3	26.6	30.0
18/1-20/327/	17.9	12.3	139.3	195.0	42.8	52.3	33.3	37.8
18/1-20/344/	18.3	11.7	130.3	179.6	40.3	49.5	31.8	36.8
18/1-20/362/	15.3	13.7	134.7	176.6	40.8	47.3	29.4	34.3
18/1-20/380/	17.9	11.7	120.6	172.0	37.1	44.4	29.4	33.4
18/1-20/399/	18.2	7.4	118.3	164.9	34.9	42.0	28.9	32.2
18/1-24/311/	19.7	10.5	113.8	164.6	42.7	53.8	36.7	41.2
18/1-24/327/	18.0	10.5	113.8	156.1	42.5	51.2	34.7	40.4
18/1-24/344/	24.7	9.3	99.0	149.4	36.0	47.0	33.4	38.4
18/1-24/362/	24.3	8.5	94.7	146.3	33.6	45.4	32.6	37.6
18/1-24/380/	25.8	2.8	94.7	141.5	31.3	42.5	33.4	37.2

Table 3

24 GAUGE S.J. SINGLES YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
24/1-24/306/	11.7	12.8	131.8	171.5	49.2	55.3	35.8	41.1
24/1-24/321/	13.4	10.8	128.2	165.0	45.8	53.2	34.6	38.9
24/1-24/337/	12.4	11.6	117.0	152.9	44.1	49.9	32.9	37.7
24/1-24/354/	14.7	10.3	114.1	149.5	39.9	47.2	33.6	37.0
24/1-24/372/	17.4	6.7	108.9	140.9	36.9	44.2	33.4	35.6
24/1-28/291/	11.7	11.7	126.0	160.7	52.7	58.5	37.7	43.6
24/1-28/306/	12.2	10.3	111.8	150.7	47.8	54.8	35.9	40.8
24/1-28/321/	15.8	11.6	109.9	147.1	44.1	52.6	35.2	40.1
24/1-28/337/	18.5	10.6	103.0	142.3	40.3	49.1	34.3	38.4
24/1-28/354/	18.6	8.7	92.2	129.2	37.4	45.5	32.6	37.8
24/1-32A276/	12.8	13.9	110.5	150.0	54.3	61.2	39.5	46.2
24/1-32A291/	14.4	12.5	106.1	137.8	49.7	57.2	37.2	44.1
24/1-32A306/	14.4	13.2	103.5	133.5	45.6	52.9	37.1	44.1
24/1-32A321/	15.0	12.6	97.1	126.0	43.1	49.6	36.2	40.6
24/1-32A337/	19.3	10.9	87.7	123.6	38.6	47.1	35.4	41.3

Table 4

24 GAUGE S.J. SINGLES YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
24/1-24/306/	12.1	14.3	133.9	175.2	49.5	56.3	35.1	40.9
24/1-24/321/	13.8	11.8	123.6	168.0	46.4	52.4	34.4	39.8
24/1-24/337/	15.4	12.6	115.3	154.1	43.2	48.9	33.2	38.3
24/1-24/354/	19.5	11.8	103.6	149.4	38.3	46.7	32.0	38.3
24/1-24/372/	19.2	11.4	97.4	146.6	35.5	45.7	31.3	37.1
24/1-28/291/	13.9	15.6	110.3	159.5	49.6	58.3	36.6	43.3
24/1-28/306/	13.8	12.1	112.9	154.5	46.8	54.7	36.3	41.5
24/1-28/321/	18.2	12.1	103.0	151.2	43.1	52.0	34.8	40.6
24/1-28/337/	19.1	12.7	97.9	134.5	40.3	48.1	33.9	38.9
24/1-28/354/	20.5	9.8	92.6	132.0	38.3	44.9	32.3	38.0
24/1-32A276/	16.3	10.9	105.0	142.7	50.3	59.7	40.0	46.2
24/1-32A291/	17.8	12.5	92.5	137.6	47.2	57.3	37.5	44.4
24/1-32A306/	19.9	10.9	88.0	127.6	43.2	55.0	37.1	42.2
24/1-32A321/	16.3	9.0	91.1	126.6	41.6	48.6	36.5	41.7
24/1-32A337/	22.0	11.5	81.7	125.0	37.5	47.3	34.6	41.7

Table 5

28 GAUGE S.J. SINGLES YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
28/1-32A273/	13.0	11.0	114.9	152.8	53.4	60.2	40.8	45.8
28/1-32A287/	14.1	12.6	106.6	143.0	50.5	58.6	38.3	43.9
28/1-32A301/	17.6	10.9	97.9	135.2	45.9	54.8	37.8	42.6
28/1-32A316/	16.6	8.6	96.4	125.5	43.2	51.6	37.5	41.1
28/1-32A332/	16.7	11.3	92.6	120.5	40.4	48.1	34.7	40.6
28/1-36/259/	13.5	10.0	106.4	133.0	56.2	63.5	43.8	48.7
28/1-36/273/	15.3	11.9	100.1	129.4	51.1	60.2	42.0	48.2
28/1-36/287/	15.0	12.8	86.4	122.7	47.9	54.6	39.4	45.9
28/1-36/301/	18.3	12.3	84.8	118.0	43.6	52.0	39.1	45.9
28/1-36/316/	20.8	8.8	81.1	115.1	40.9	50.6	39.2	44.2
28/1-40/246/	14.2	9.6	98.5	127.8	57.9	64.9	45.8	52.0
28/1-40/259/	14.6	14.4	91.9	124.2	54.9	63.3	42.4	49.3
28/1-40/273/	16.5	11.6	87.5	117.5	51.2	59.8	42.0	47.9
28/1-40/287/	17.4	9.6	90.1	116.0	46.4	55.4	41.6	48.0
28/1-40/301/	17.2	9.5	81.1	115.5	43.4	52.6	39.2	46.8

Table 6

28 GAUGE S.J. SINGLES YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
28/1-32A273/	13.3	14.5	107.0	145.9	52.4	60.9	39.6	45.7
28/1-32A287/	13.3	14.8	107.0	146.0	50.9	58.3	37.6	44.5
28/1-32A301/	15.0	12.8	100.4	137.8	46.0	54.0	37.6	43.7
28/1-32A316/	16.8	12.0	98.3	127.8	43.8	50.7	37.4	42.1
28/1-32A332/	17.3	12.1	83.0	124.2	40.0	48.0	34.6	41.9
28/1-36/259/	14.4	7.8	100.8	128.6	54.3	62.2	44.9	49.2
28/1-36/273/	22.3	12.4	85.6	123.9	46.5	59.0	40.9	47.0
28/1-36/287/	17.5	9.8	85.4	119.4	45.9	54.1	40.0	44.6
28/1-36/301/	20.2	10.9	87.4	120.3	43.6	54.8	38.6	44.1
28/1-36/316/	21.9	9.5	79.6	117.7	40.5	50.9	37.2	43.5
28/1-40/246/	20.5	11.3	84.6	126.7	51.3	64.0	45.8	51.0
28/1-40/259/	17.6	12.4	86.8	117.6	51.3	61.8	44.1	49.6
28/1-40/273/	18.1	13.0	86.0	116.6	48.0	58.9	41.9	48.4
28/1-40/287/	20.5	10.3	77.3	111.4	44.3	55.7	41.1	45.8
28/1-40/301/	19.1	9.0	73.7	107.2	41.8	51.3	39.4	43.9

Table 7

18 GAUGE S.J. TWO FOLD YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
18/2-32/344/	6.6	12.0	205.3	244.4	49.2	51.1	32.3	35.5
18/2-32/362/	8.1	12.3	190.5	228.5	43.9	47.5	29.9	34.0
18/2-32/380/	4.0	9.1	186.7	220.3	42.6	45.4	29.3	31.8
18/2-32/399/	7.4	7.9	170.7	203.4	38.6	41.9	28.2	30.1
18/2-32/419/	11.3	11.8	150.5	186.7	35.6	39.8	26.8	29.9
18/2-40/327/	9.8	10.9	157.5	195.5	48.0	53.4	32.4	37.9
18/2-40/344/	10.8	11.0	146.4	181.6	43.8	48.7	32.1	36.1
18/2-40/362/	11.7	14.0	138.3	170.7	40.5	45.6	30.7	34.8
18/2-40/380/	12.8	11.8	124.1	162.5	36.8	42.7	30.0	32.8
18/2-40/399/	14.8	13.3	114.8	151.3	34.0	40.6	28.6	32.6
18/2-48/311/	9.9	13.3	131.9	173.2	48.9	54.7	34.6	40.2
18/2-48/327/	11.3	12.7	130.5	160.1	45.1	50.7	34.6	37.8
18/2-48/344/	13.4	13.3	121.0	154.7	41.5	47.3	32.3	36.3
18/2-48/362/	13.0	13.9	110.9	139.8	40.0	43.9	30.6	34.6
18/2-48/380/	14.5	14.7	99.2	139.1	35.3	41.7	28.9	34.1

Table 8

18 GAUGE S.J. TWO-FOLD YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
18/2-32/344/	13.8	16.1	159.2	224.7	42.7	49.8	29.3	35.4
18/2-32/362/	7.2	14.3	170.6	227.3	43.7	47.7	29.3	34.3
18/2-32/380/	11.6	14.1	157.1	215.1	38.3	44.2	28.6	32.4
18/2-32/399/	10.8	10.3	158.3	202.1	36.7	42.0	27.7	31.3
18/2-32/419/	11.0	14.0	147.4	191.1	35.7	39.0	25.6	29.9
18/2-40/327/	16.4	11.8	137.5	179.3	42.2	51.5	33.5	38.4
18/2-40/344/	15.6	12.6	124.2	170.1	39.5	47.8	31.6	36.6
18/2-40/362/	14.4	13.6	121.5	164.8	39.6	46.3	29.2	33.4
18/2-40/380/	15.2	13.9	112.5	158.0	35.8	41.8	29.0	32.6
18/2-40/399/	15.6	12.7	115.2	161.0	34.9	41.1	27.9	32.1
18/2-48/311/	14.7	15.4	119.2	164.8	45.4	53.6	33.7	39.6
18/2-48/327/	20.0	11.4	109.1	152.5	39.1	49.5	33.8	38.5
18/2-48/344/	15.5	13.3	108.7	147.2	39.1	47.4	32.2	37.5
18/2-48/362/	17.7	13.9	95.5	141.1	37.2	45.2	29.5	34.2
18/2-48/380/	18.3	13.9	94.6	135.2	33.7	41.3	29.2	32.3

Table 9

24 GAUGE S.J. TWO-FOLD YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
24/2-48/306/	9.6	12.8	139.5	177.1	49.7	54.5	35.6	40.9
24/2-48/321/	12.9	11.9	128.9	162.0	45.8	51.2	33.8	38.5
24/2-48/337/	9.8	12.7	121.9	154.3	43.0	47.6	32.6	37.7
24/2-48/354/	13.9	10.8	113.3	146.9	38.9	45.4	32.0	36.4
24/2-48/372/	13.7	10.4	109.0	136.9	37.4	43.0	31.1	34.6
24/2-56/291/	8.7	10.3	125.6	156.8	51.5	56.6	36.3	42.0
24/2-56/306/	12.3	13.4	113.7	146.8	47.2	53.3	35.4	40.4
24/2-56/321/	15.3	12.0	106.8	135.5	43.6	50.3	34.6	39.1
24/2-56/337/	14.2	14.0	97.4	129.0	40.8	46.7	33.0	38.4
24/2-56/354/	16.1	12.1	93.7	119.1	38.6	44.4	31.3	35.2
24/2-64/276/	9.8	15.7	113.8	139.4	54.6	60.7	38.4	44.9
24/2-64/291/	12.7	14.0	99.2	138.8	48.5	54.6	37.0	42.1
24/2-64/306/	14.3	16.3	95.2	131.8	44.7	52.1	35.8	42.1
24/2-64/321/	16.4	12.8	90.4	115.5	42.4	49.7	33.8	39.6
24/2-64/337/	14.4	15.7	80.9	106.4	40.2	46.1	30.8	37.3

Table 10

24 GAUGE S.J. TWO-FOLD YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
24/2-48/306/	7.2	16.2	136.5	177.1	50.3	54.1	34.5	40.9
24/2-48/321/	13.3	16.8	118.2	160.6	44.1	50.0	33.3	39.0
24/2-48/337/	10.1	15.6	113.4	153.6	42.7	47.4	32.2	38.1
24/2-48/354/	13.7	12.5	106.8	148.3	39.2	46.5	31.5	35.8
24/2-48/372/	12.9	15.1	99.7	135.2	37.6	43.6	29.3	33.8
24/2-56/291/	10.9	15.0	114.5	153.6	49.4	54.8	36.4	41.6
24/2-56/306/	12.2	17.4	108.0	146.9	46.4	52.3	34.8	41.6
24/2-56/321/	13.0	12.9	104.0	142.5	44.1	50.8	34.0	38.8
24/2-56/337/	12.1	14.0	102.6	129.3	42.2	47.1	32.9	37.3
24/2-56/354/	10.5	18.1	89.7	122.3	39.8	44.7	30.3	36.7
24/2-64/276/	14.9	14.1	97.8	128.4	51.9	59.2	37.4	42.8
24/2-64/291/	15.2	15.5	97.5	129.2	46.5	54.4	36.8	43.4
24/2-64/306/	14.2	14.8	93.9	125.0	46.0	52.5	35.5	40.9
24/2-64/321/	14.1	15.8	86.7	119.3	42.3	48.2	33.9	40.6
24/2-64/337/	14.0	19.6	74.3	114.6	39.8	48.5	31.3	38.9

Table 11

28 GAUGE S.J. TWO-FOLD YARNS TUBULAR PROCESSED

SAMPLE	%Shr.L R-95	%Shr.W R-95	Mean Weight MnWtBW R-95	Mean Weight MnWtAW R-95	C/3cmB R-95	C/3cmA R-95	W/3cmB R-95	W/3cmA R-95
28/2-64/273/	6.9	16.2	110.3	147.3	55.1	59.3	38.2	45.2
28/2-64/287/	12.9	13.0	106.6	134.2	49.4	56.2	38.0	44.1
28/2-64/301/	14.7	12.1	98.0	135.4	46.1	52.6	37.2	42.1
28/2-64/316/	13.6	11.7	94.1	119.0	43.6	48.6	36.6	41.1
28/2-64/332/	16.8	11.6	87.0	113.7	40.6	46.4	34.4	38.7
28/2-72/259/	10.1	13.3	112.0	135.0	58.6	63.9	43.1	48.5
28/2-72/273/	11.2	12.6	100.5	134.8	51.8	57.9	41.2	47.5
28/2-72/287/	15.1	13.9	91.3	117.7	47.3	55.6	39.2	43.9
28/2-72/301/	12.1	15.5	92.4	109.6	46.4	51.7	36.2	42.8
28/2-72/316/	14.3	15.7	79.1	106.5	42.6	48.4	34.9	41.9
28/2-80/246/	9.9	14.8	105.1	124.4	60.7	66.3	43.7	51.2
28/2-80/259/	11.4	15.0	95.1	119.5	56.4	62.4	42.1	49.3
28/2-80/273/	10.4	17.1	81.0	111.8	50.4	56.7	38.5	47.7
28/2-80/287/	15.5	15.8	78.3	109.6	45.4	53.2	38.0	45.9
28/2-80/301/	13.6	14.8	72.7	97.8	44.8	51.4	35.3	42.4

Table 12

28 GAUGE S.J. TWO-FOLD YARNS OPEN WIDTH PROCESSED

SAMPLE	%Shr.L RS-OW	%Shr.W RS-OW	Mean Weight MnWtBW RS-OW	Mean Weight MnWtAW RS-OW	C/3cmB RS-OW	C/3cmA RS-OW	W/3cmB RS-OW	W/3cmA RS-OW
28/2-64/273/	10.9	14.0	107.9	144.9	52.1	57.5	39.8	46.4
28/2-64/287/	10.7	14.3	103.7	135.4	49.6	55.3	37.5	43.9
28/2-64/301/	13.5	15.9	92.9	132.5	45.8	51.8	36.4	42.6
28/2-64/316/	15.3	13.6	90.2	120.6	43.5	49.5	35.2	40.6
28/2-64/332/	12.7	14.7	83.1	114.1	40.7	47.8	33.5	41.7
28/2-72/259/	10.9	15.4	98.8	138.5	56.3	63.5	41.3	47.5
28/2-72/273/	11.7	13.8	96.0	124.5	50.9	58.0	41.4	45.7
28/2-72/287/	13.7	16.9	93.7	123.7	48.4	55.2	37.3	45.7
28/2-72/301/	13.4	16.7	83.5	111.3	45.8	51.8	35.9	42.1
28/2-72/316/	15.3	15.4	73.7	106.3	41.7	50.1	35.0	40.9
28/2-80/246/	16.3	10.5	90.6	120.6	54.6	64.3	45.3	51.5
28/2-80/259/	14.0	15.8	83.8	115.4	53.5	62.4	41.4	48.4
28/2-80/273/	15.1	16.4	82.0	113.9	47.9	56.2	40.9	47.7
28/2-80/287/	18.9	11.6	79.4	109.1	44.7	54.1	40.3	44.9
28/2-80/301/	16.1	19.1	72.5	100.4	44.4	51.1	36.0	43.2

Figure 1

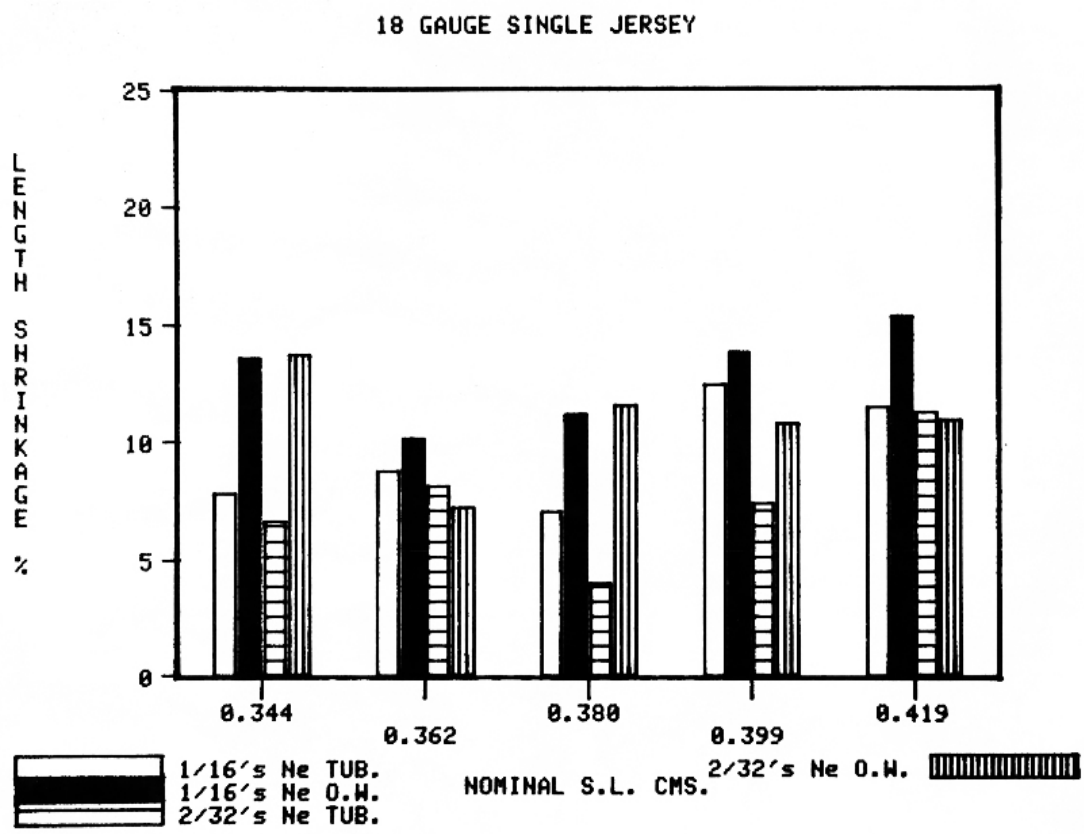


Figure 2

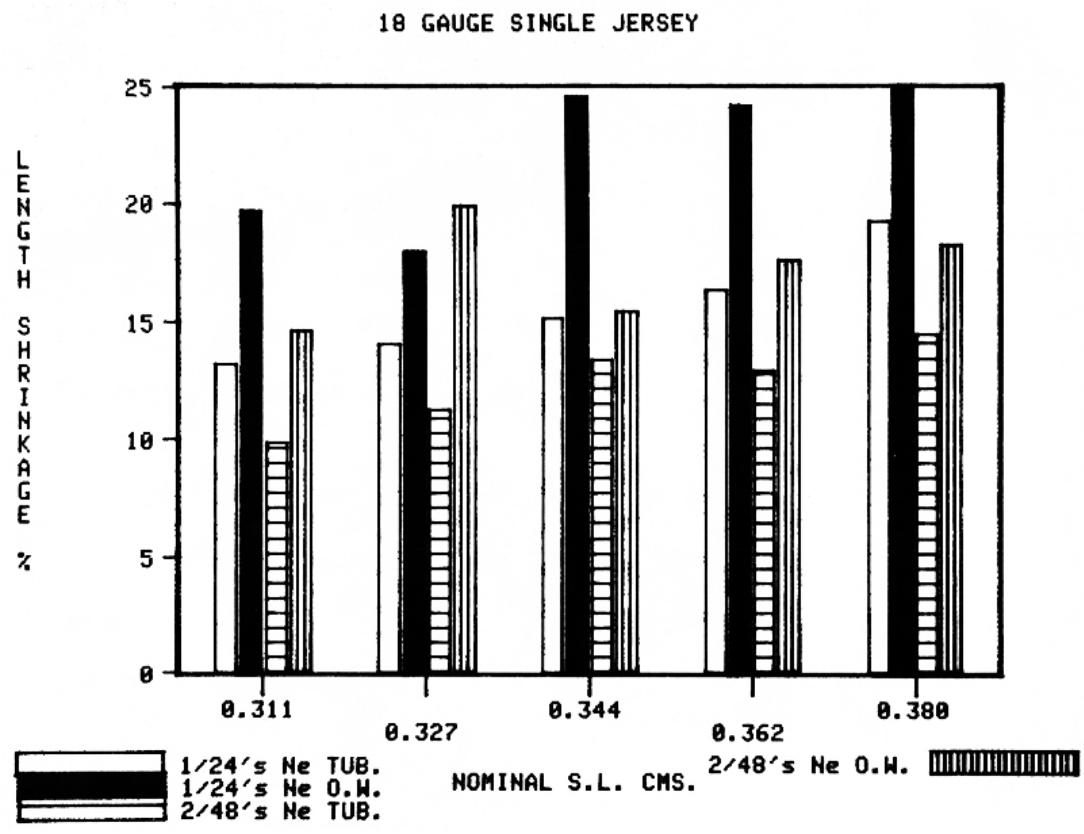
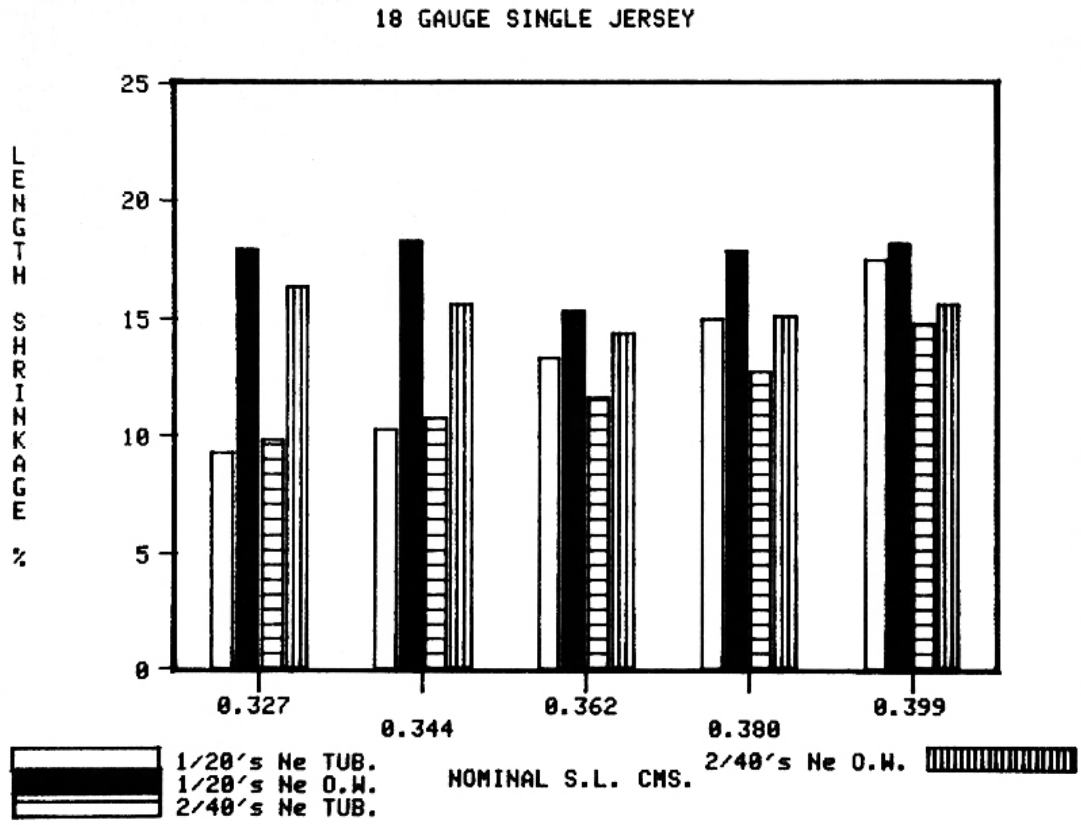


Figure 3



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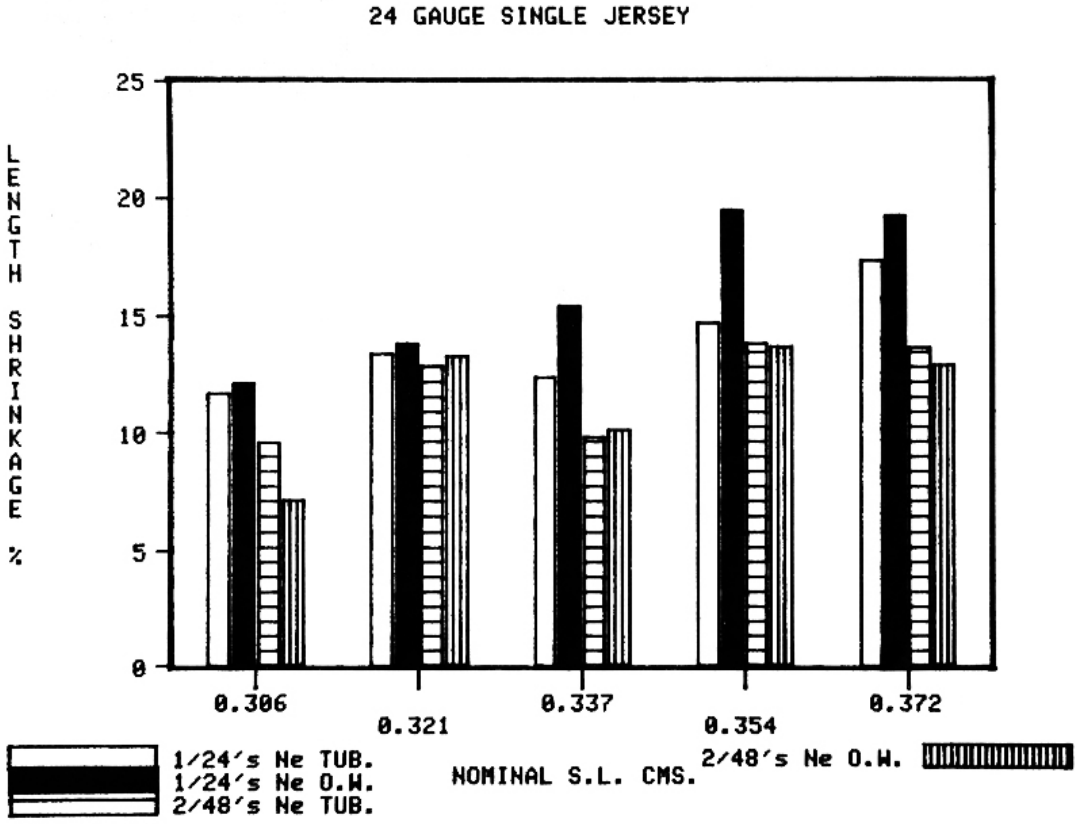


Figure 5

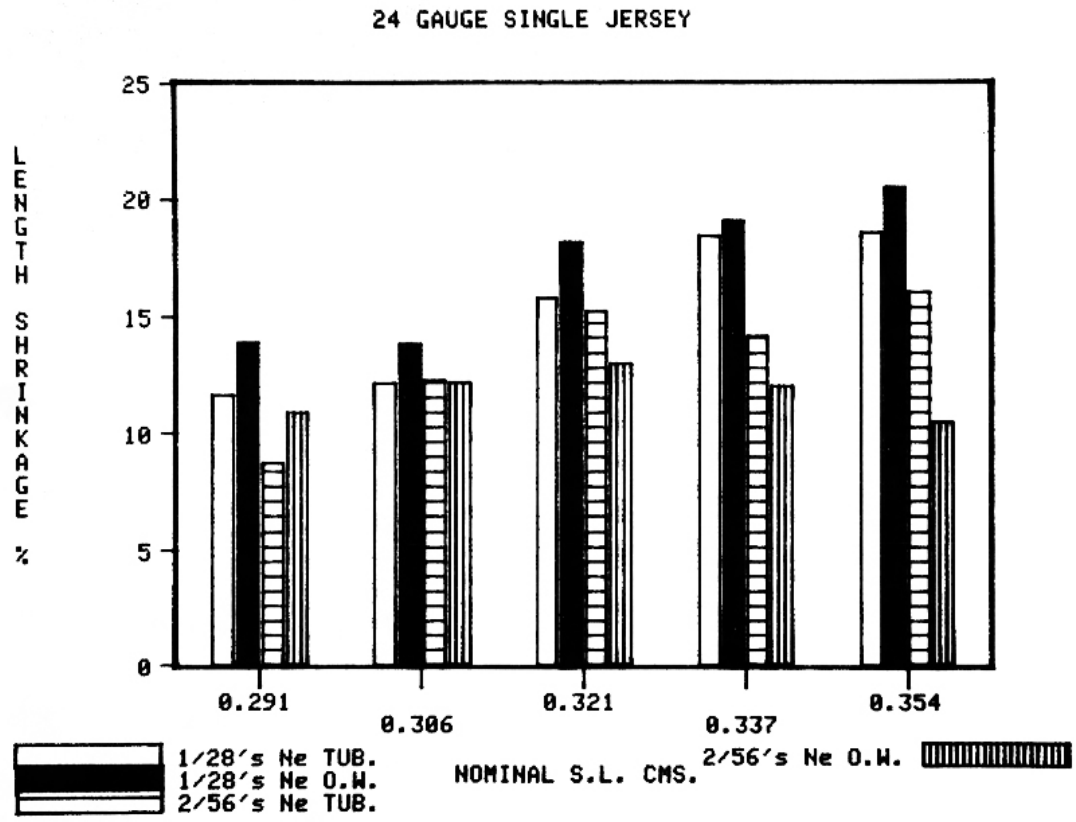
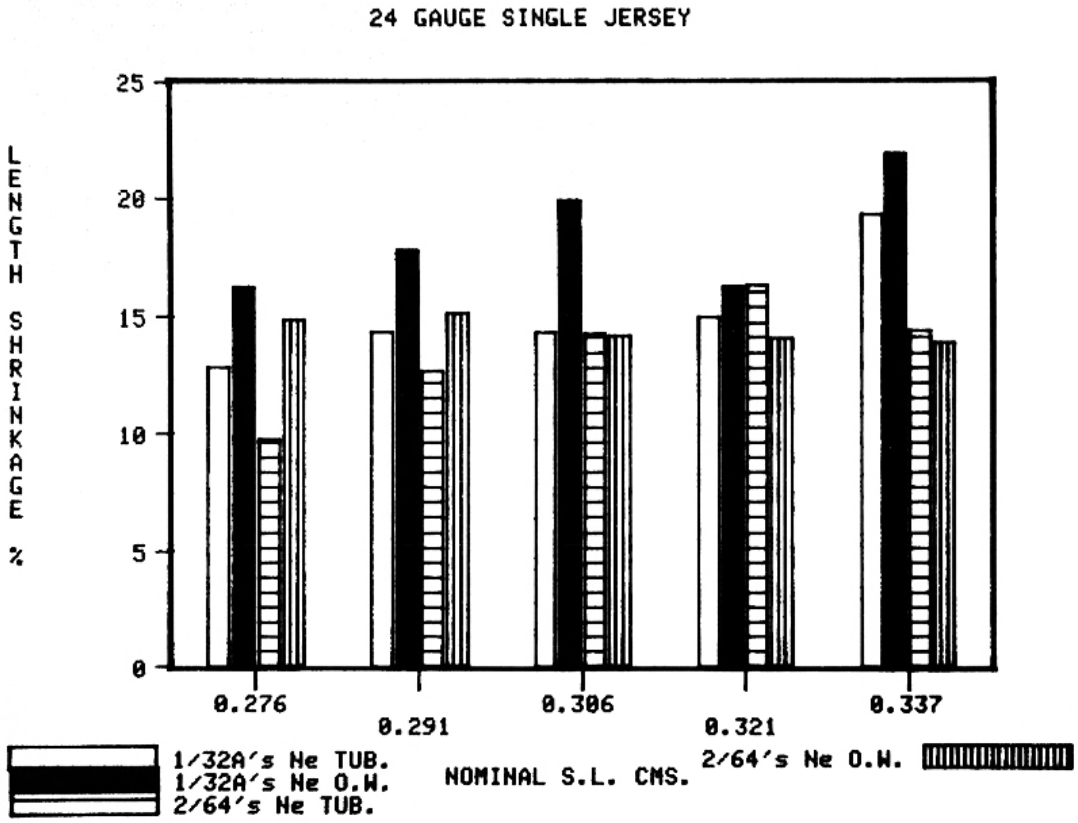


Figure 6



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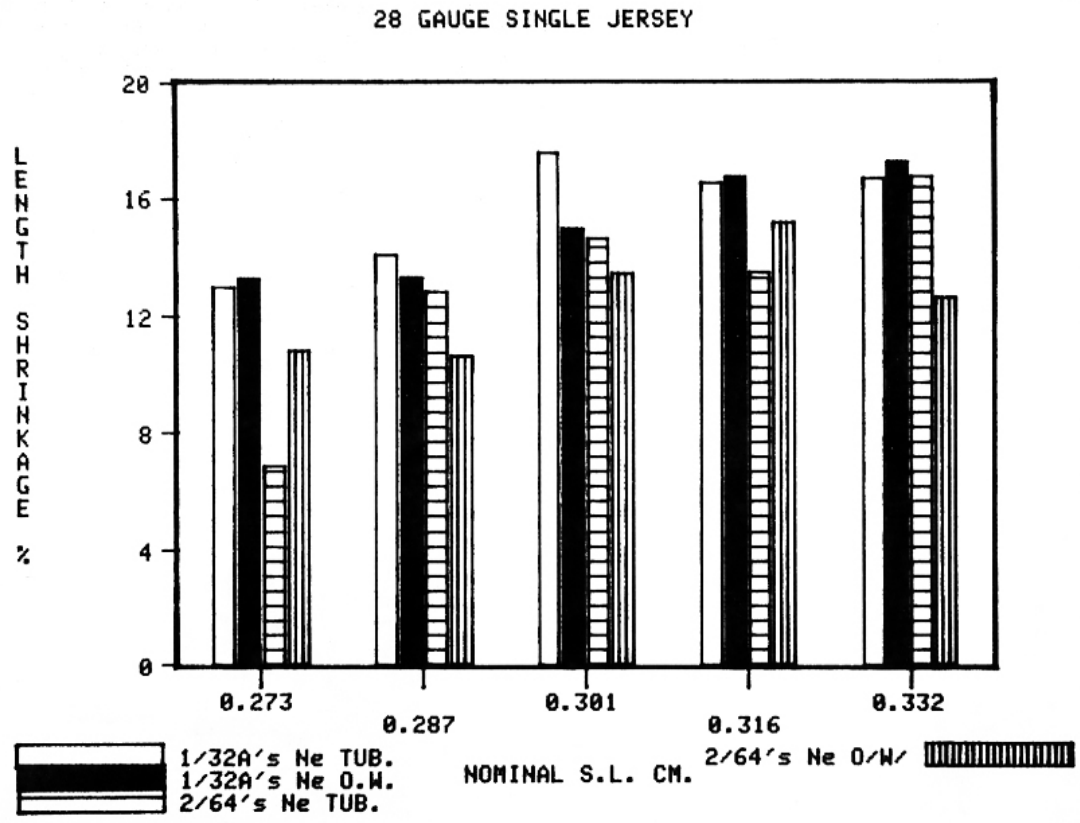

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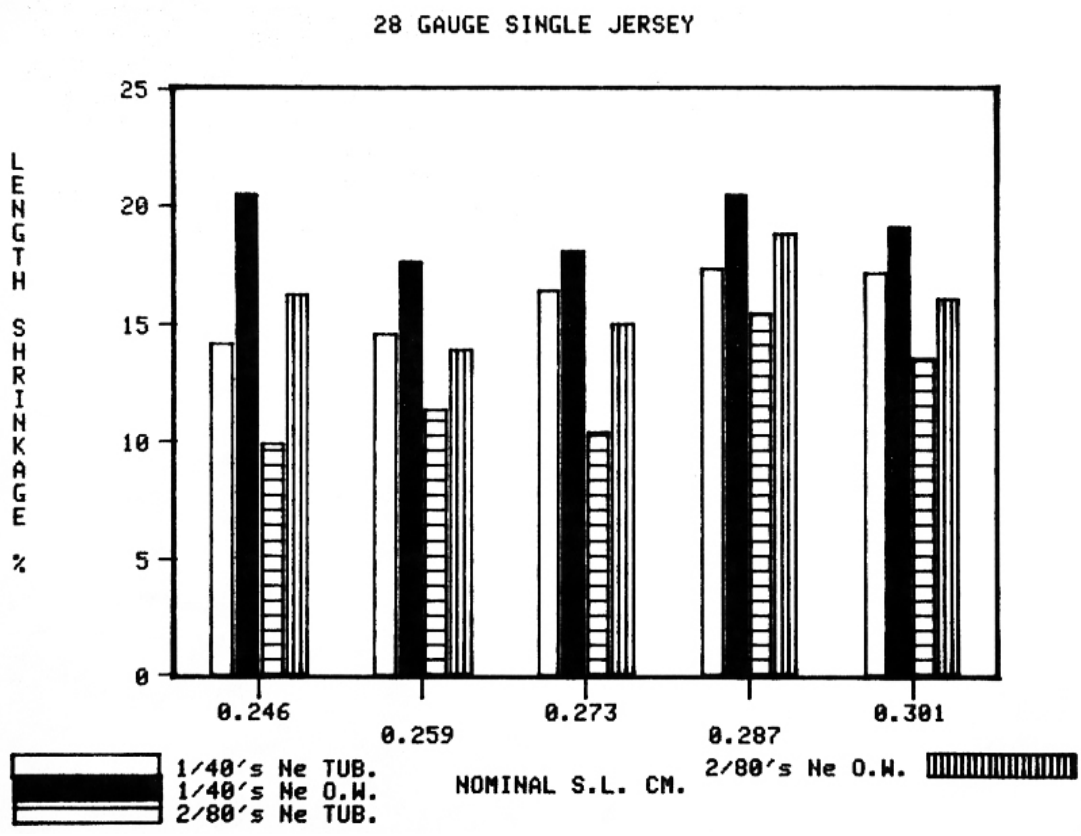
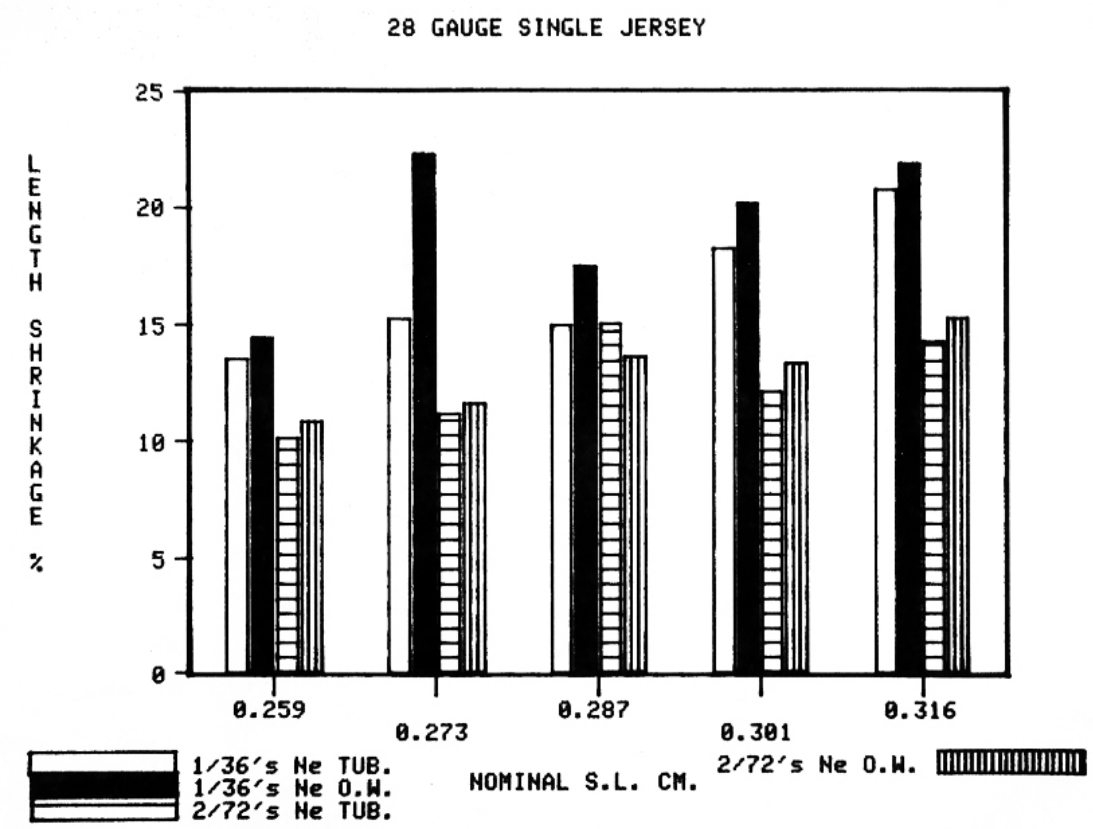


Figure 9



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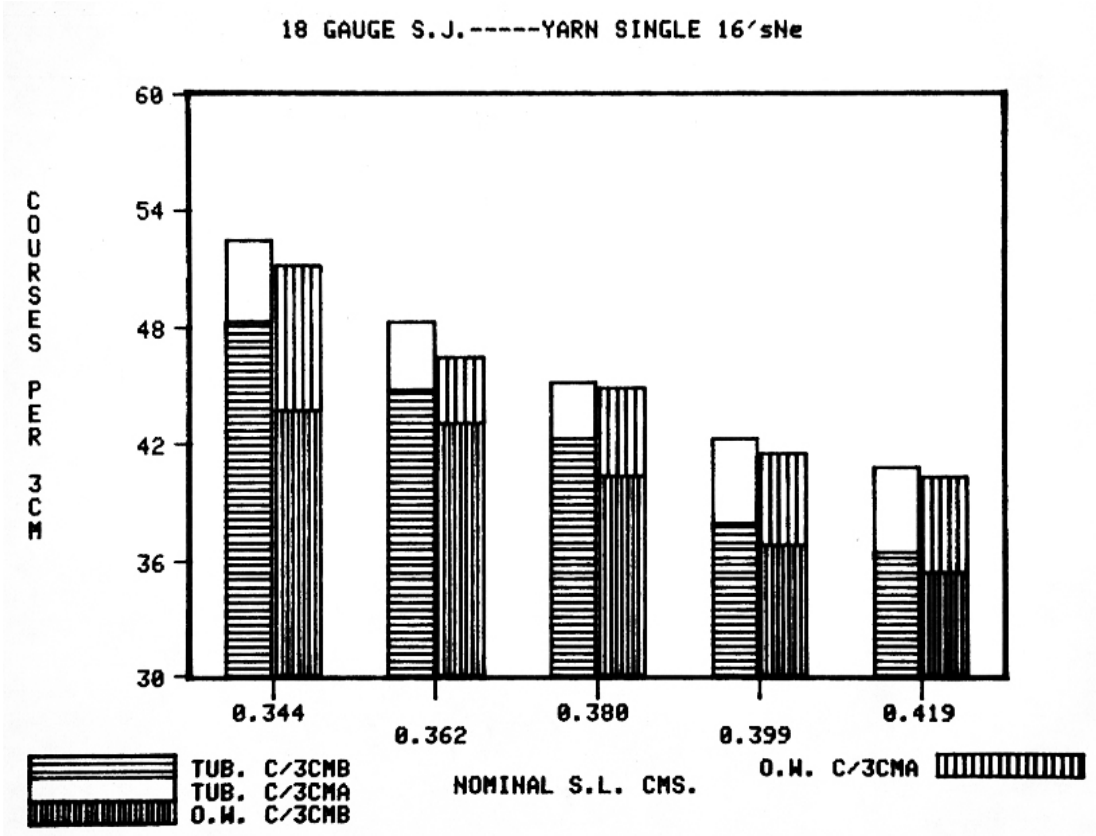


Figure 11

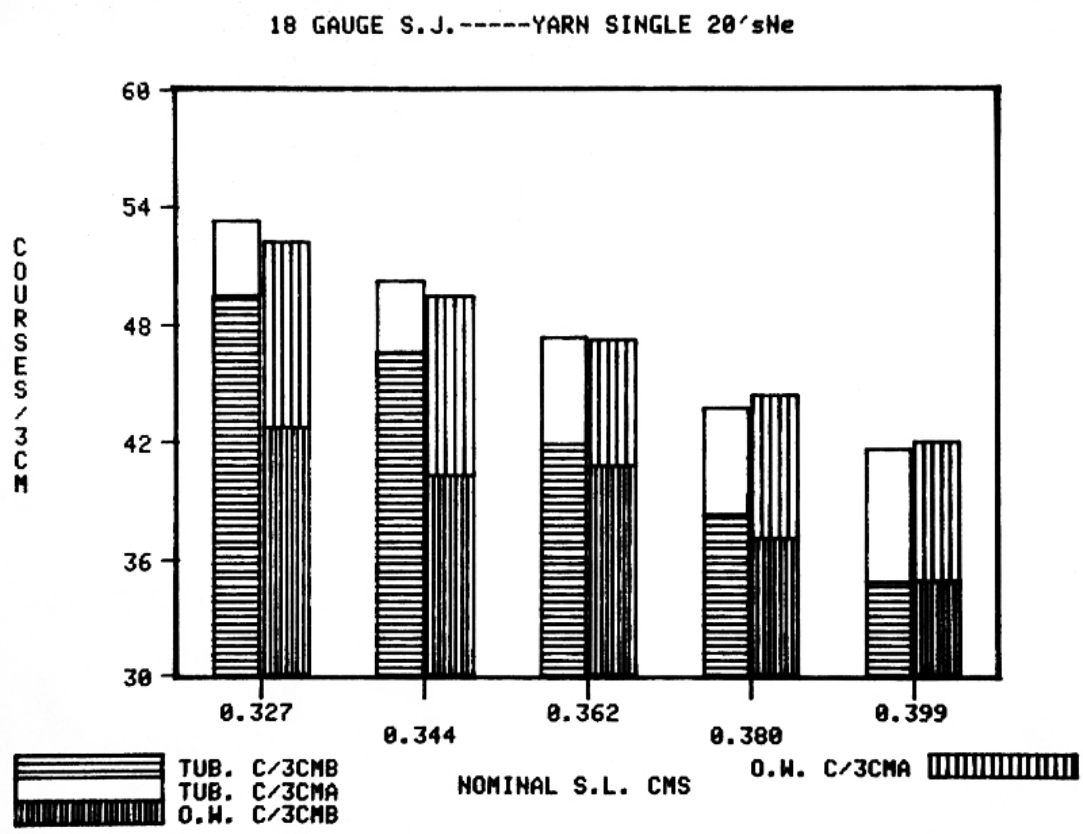
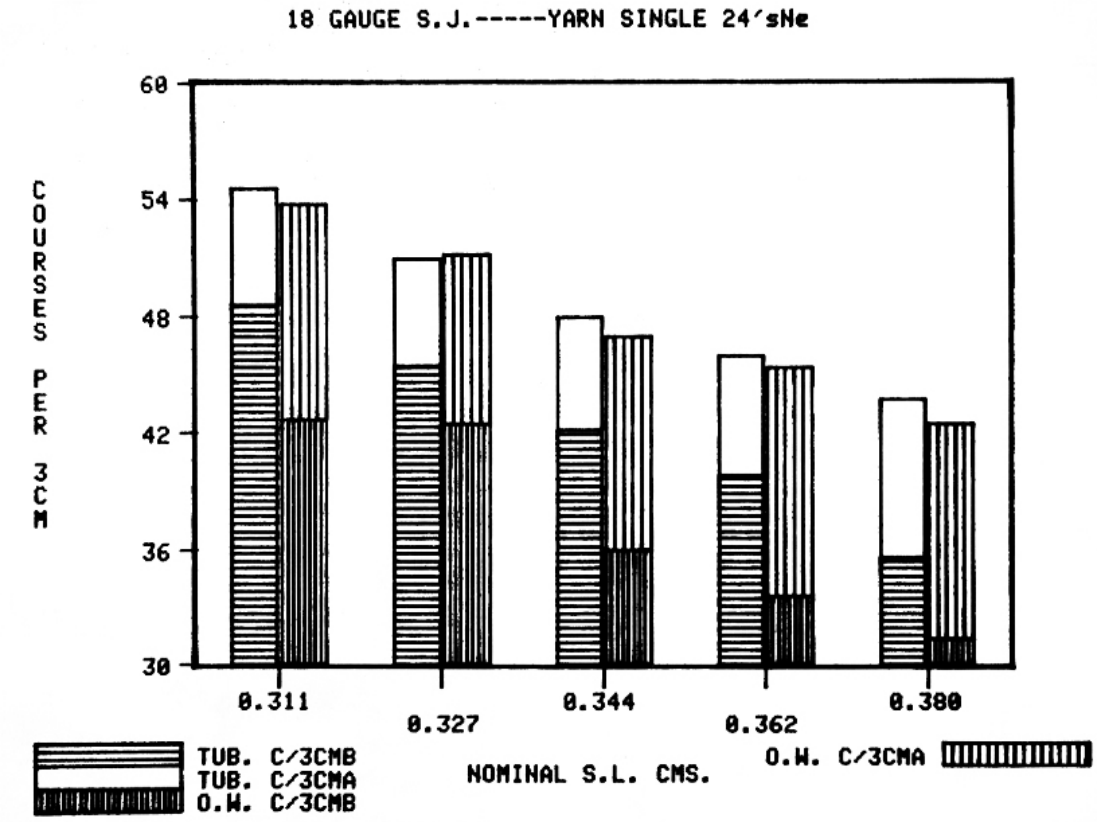


Figure 12



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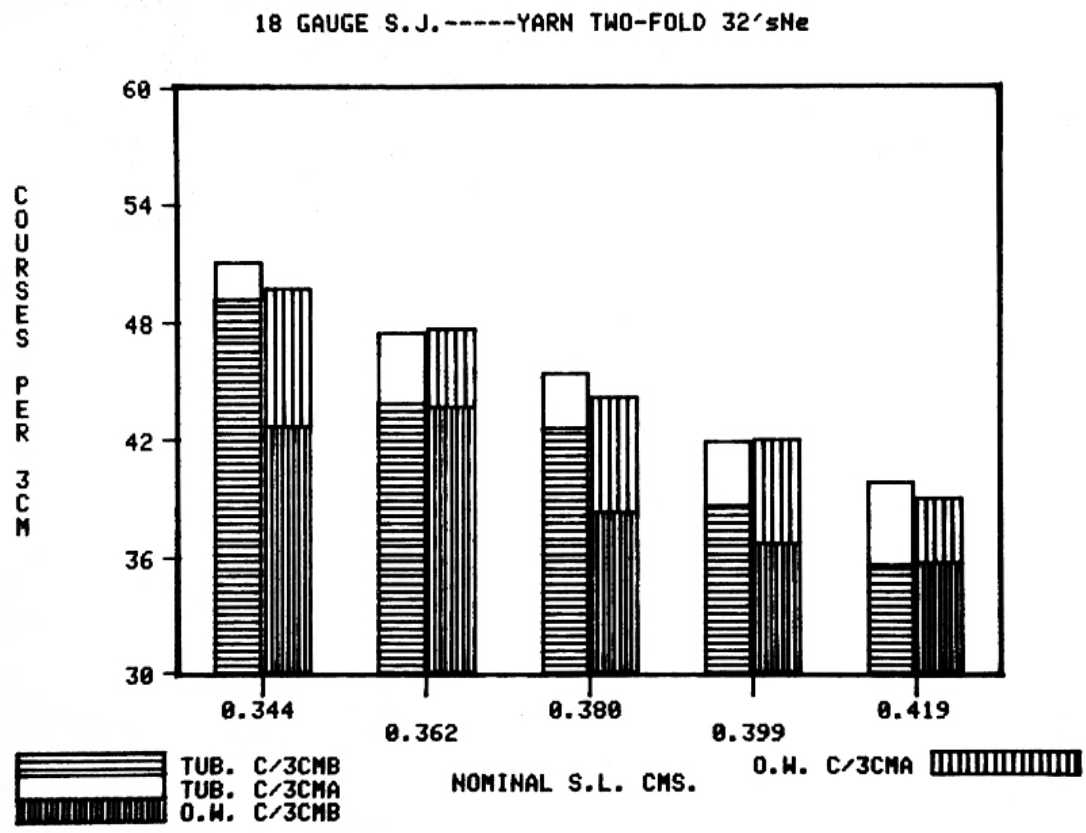
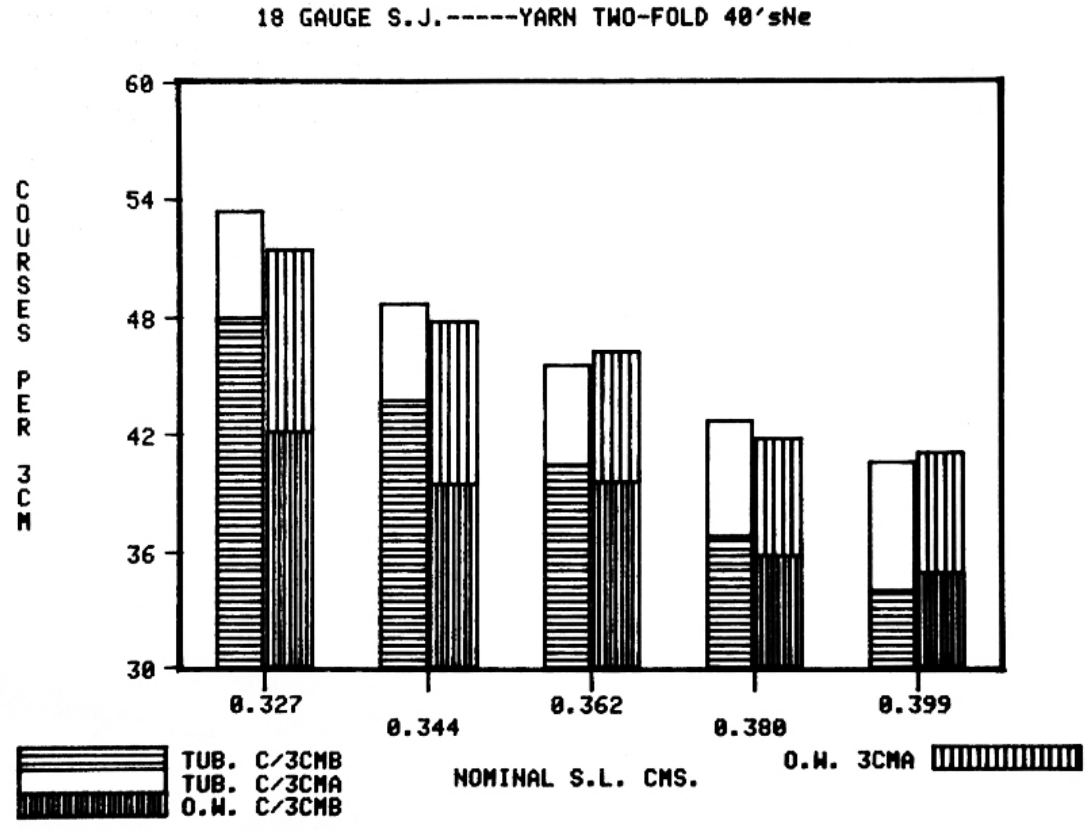


Figure 14



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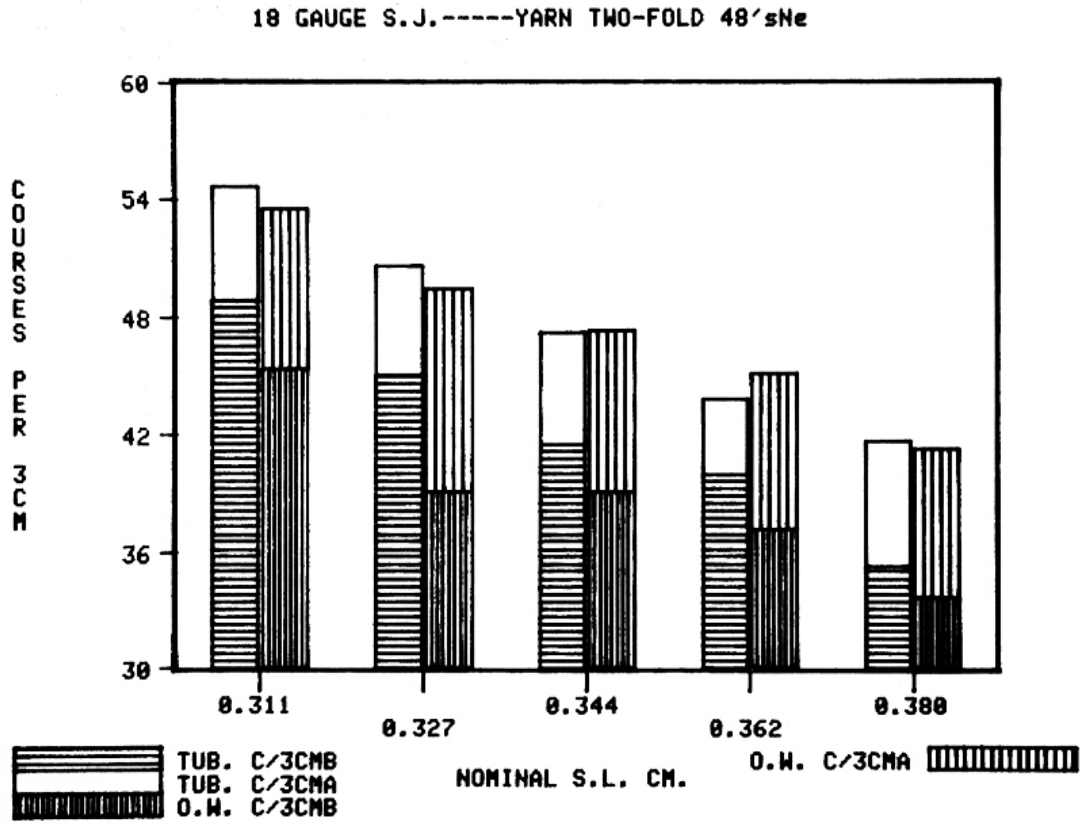

Figure 16

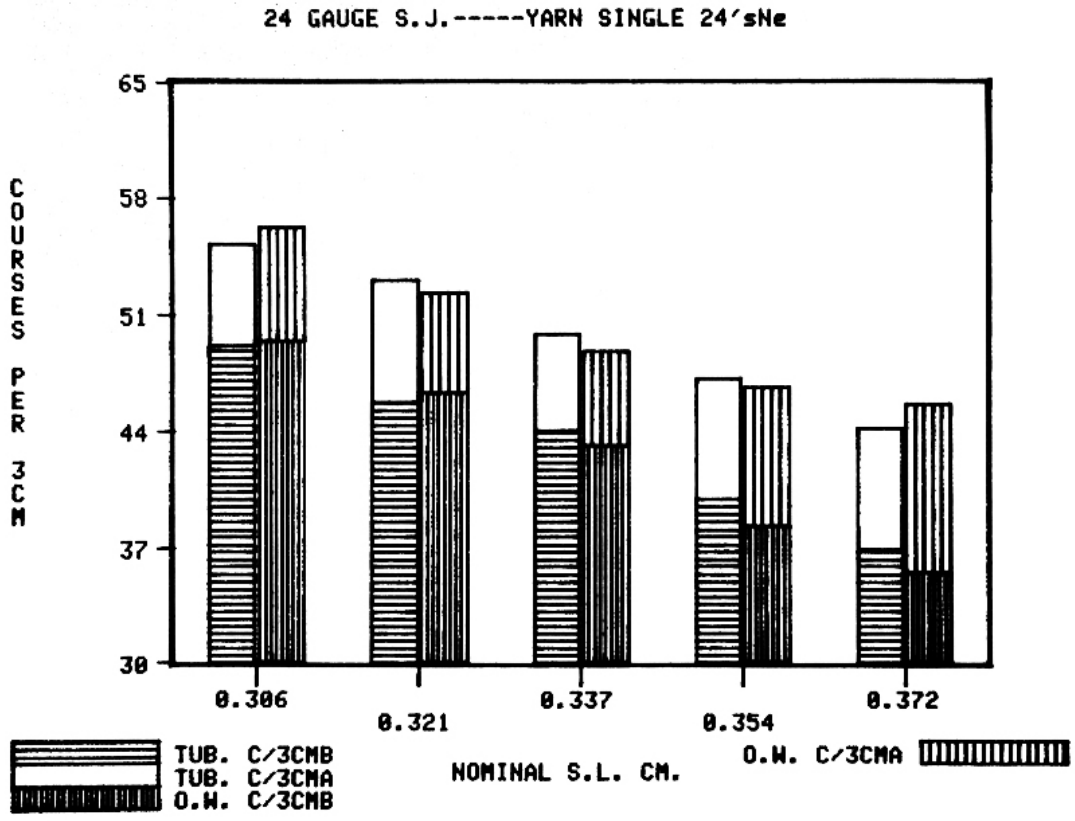

Figure 17

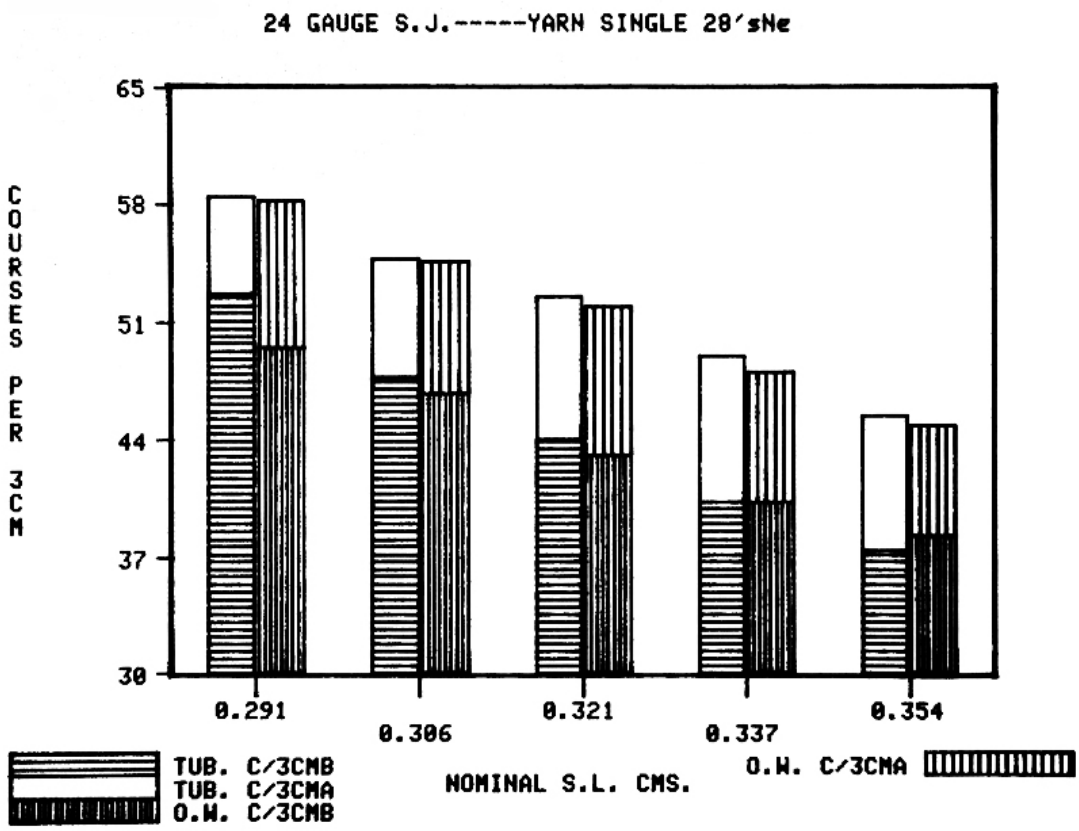

Figure 18

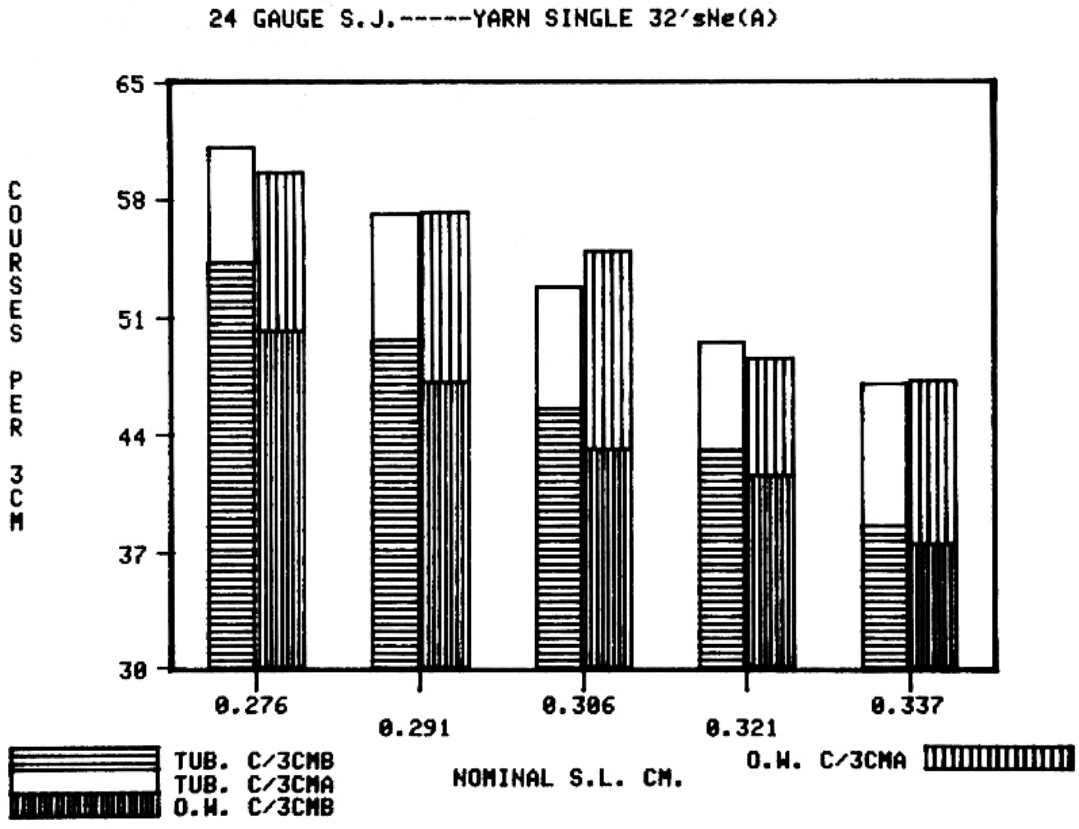

Figure 19

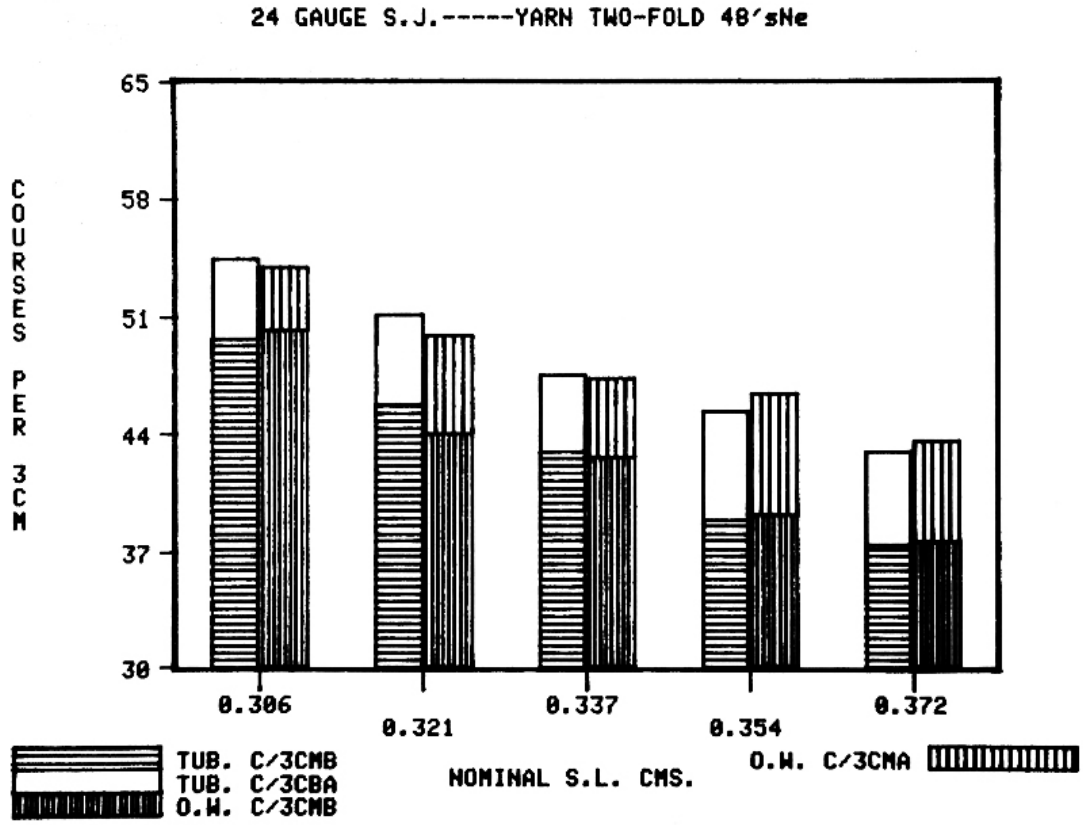

Figure 20

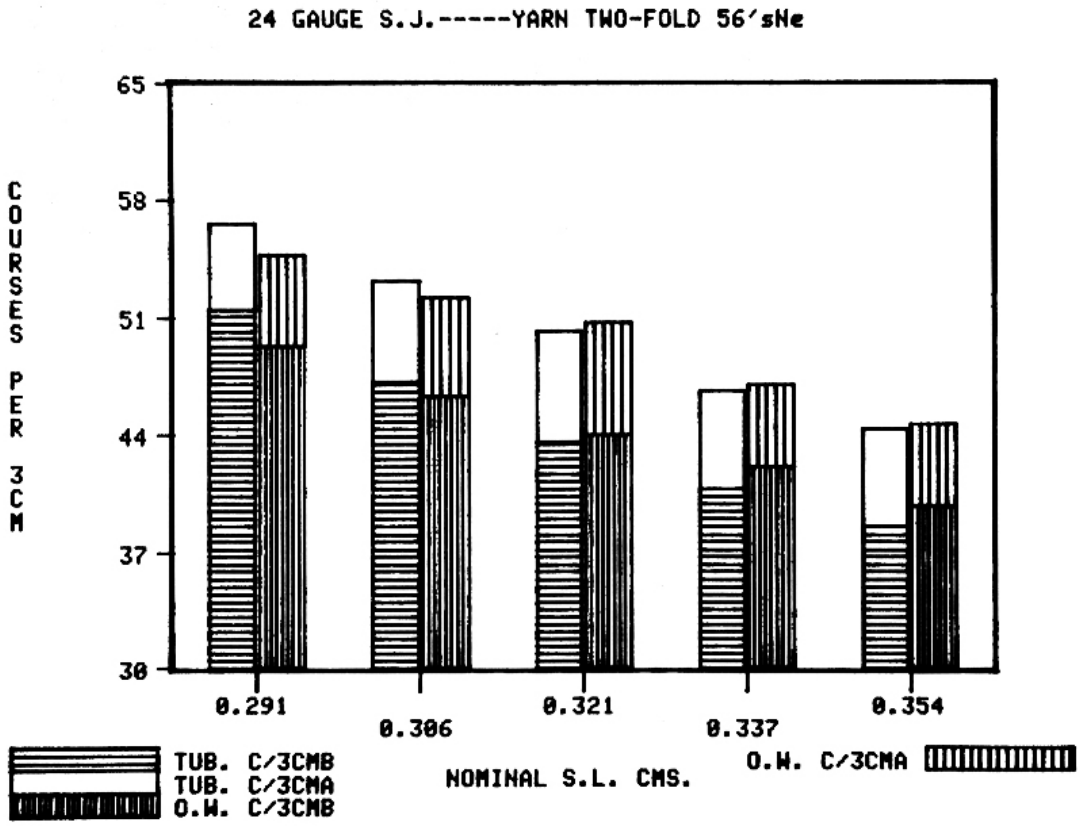

Figure 21

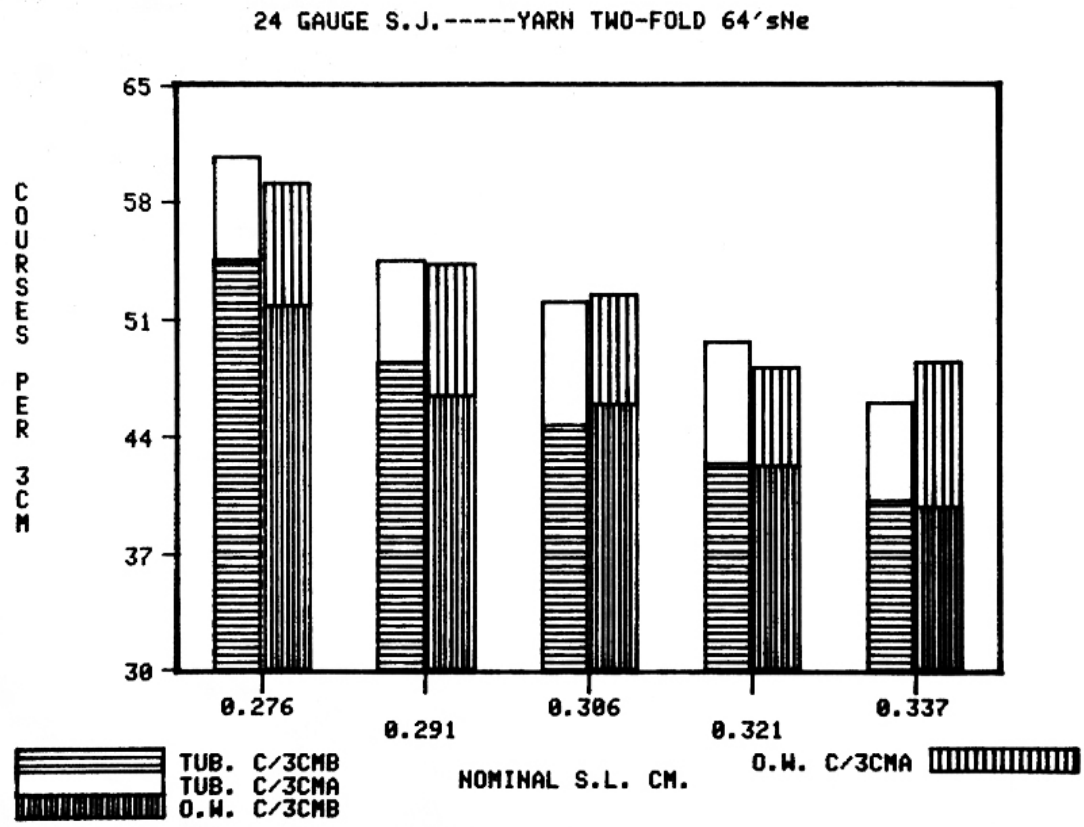

Figure 22

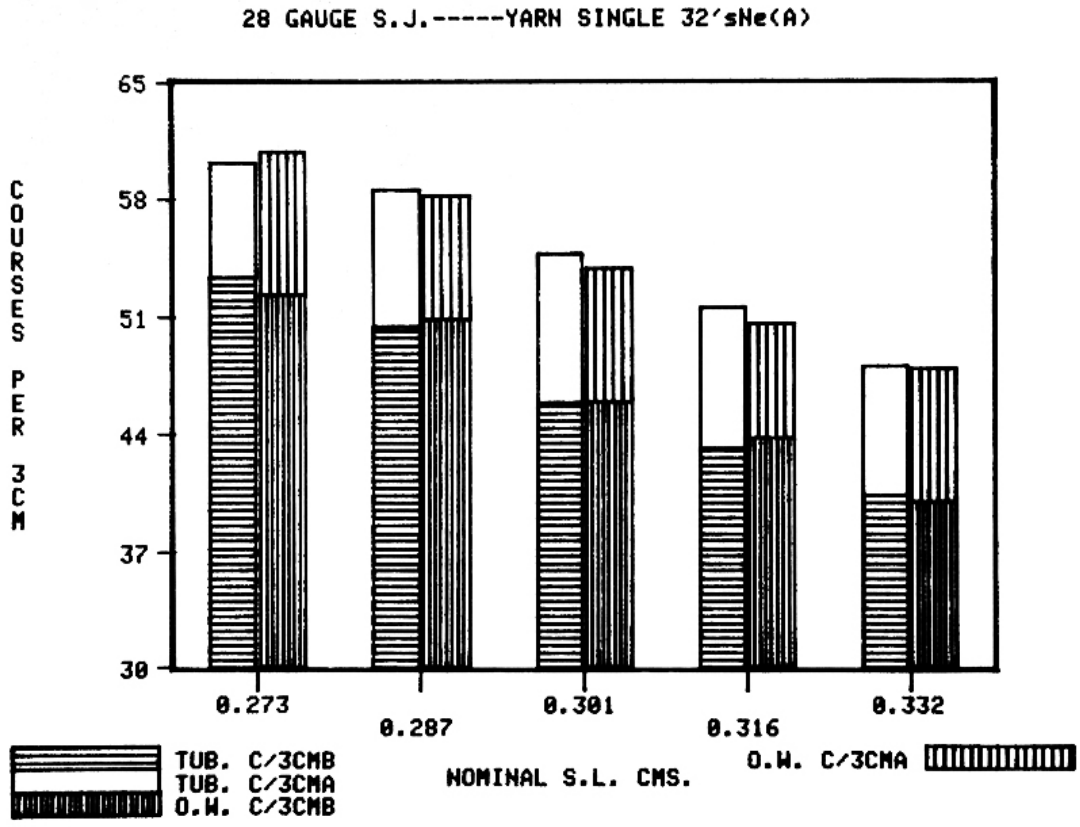

Figure 23

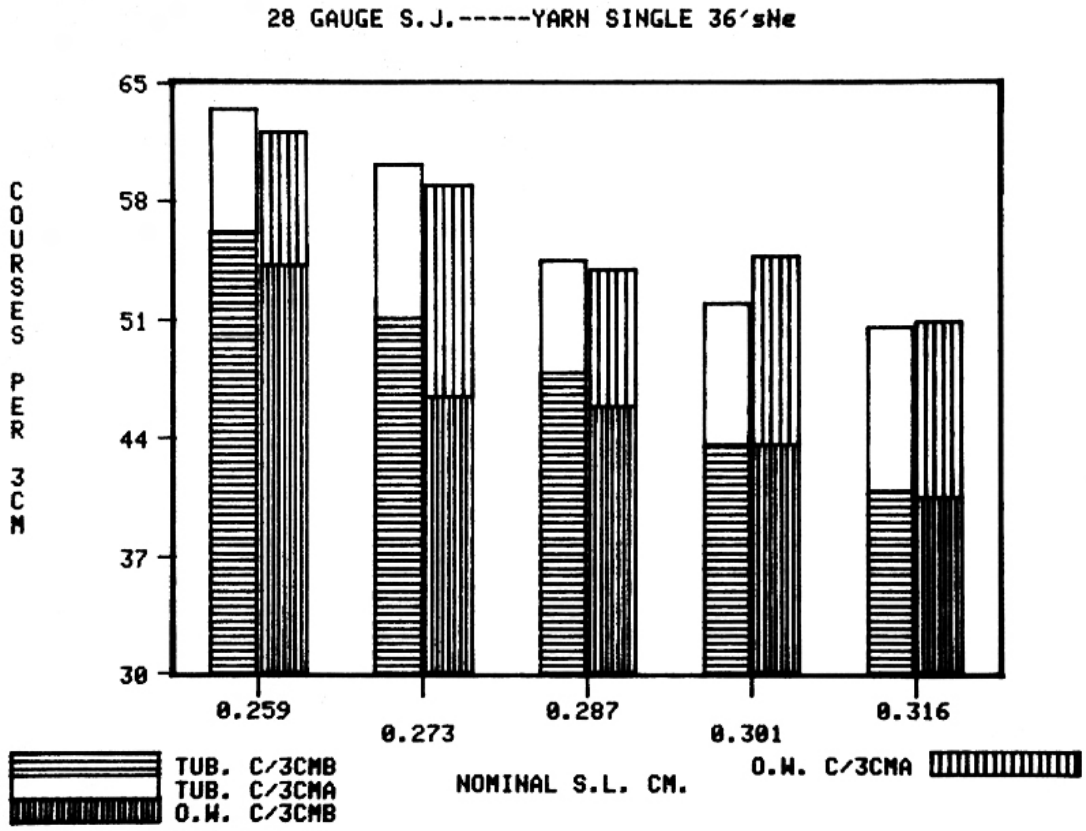

Figure 24

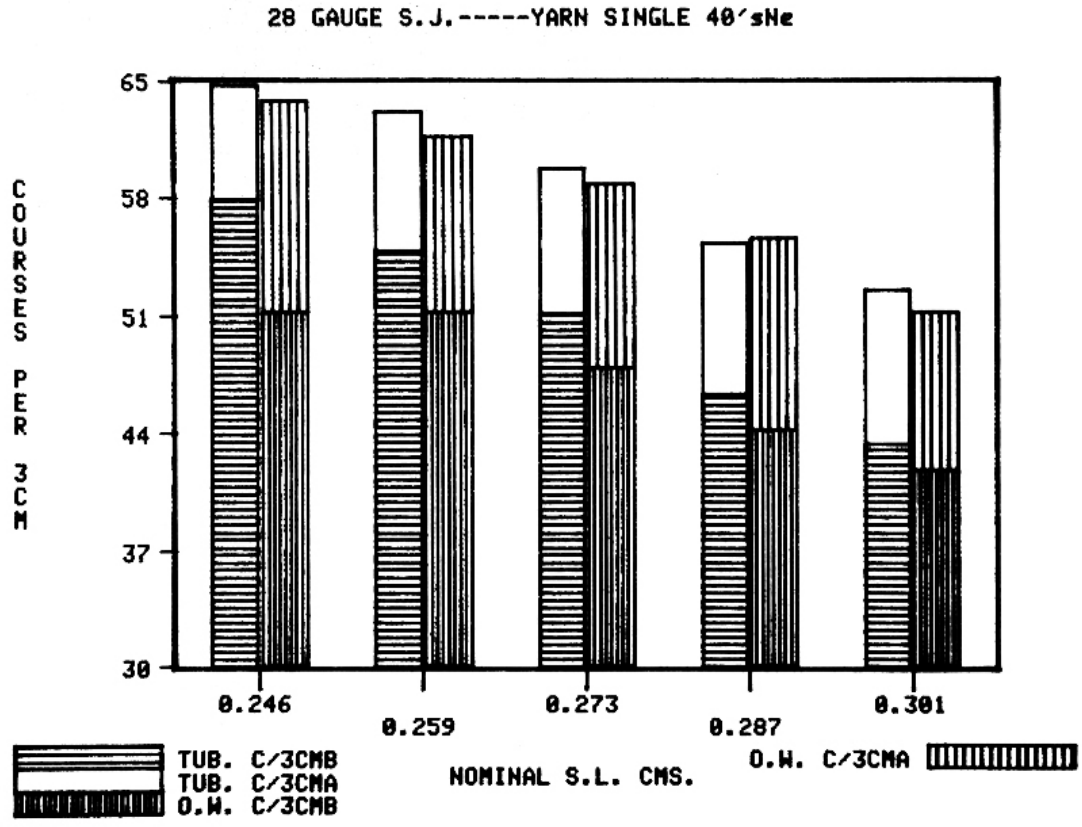

Figure 25

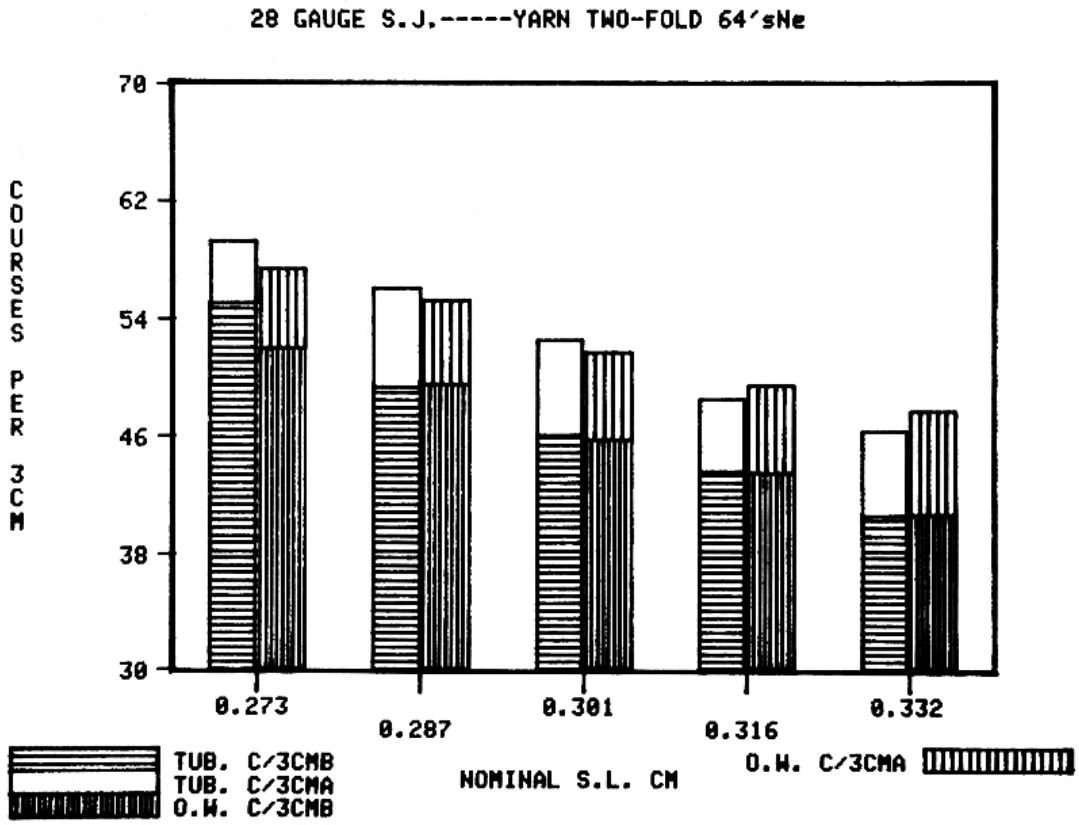

Figure 26

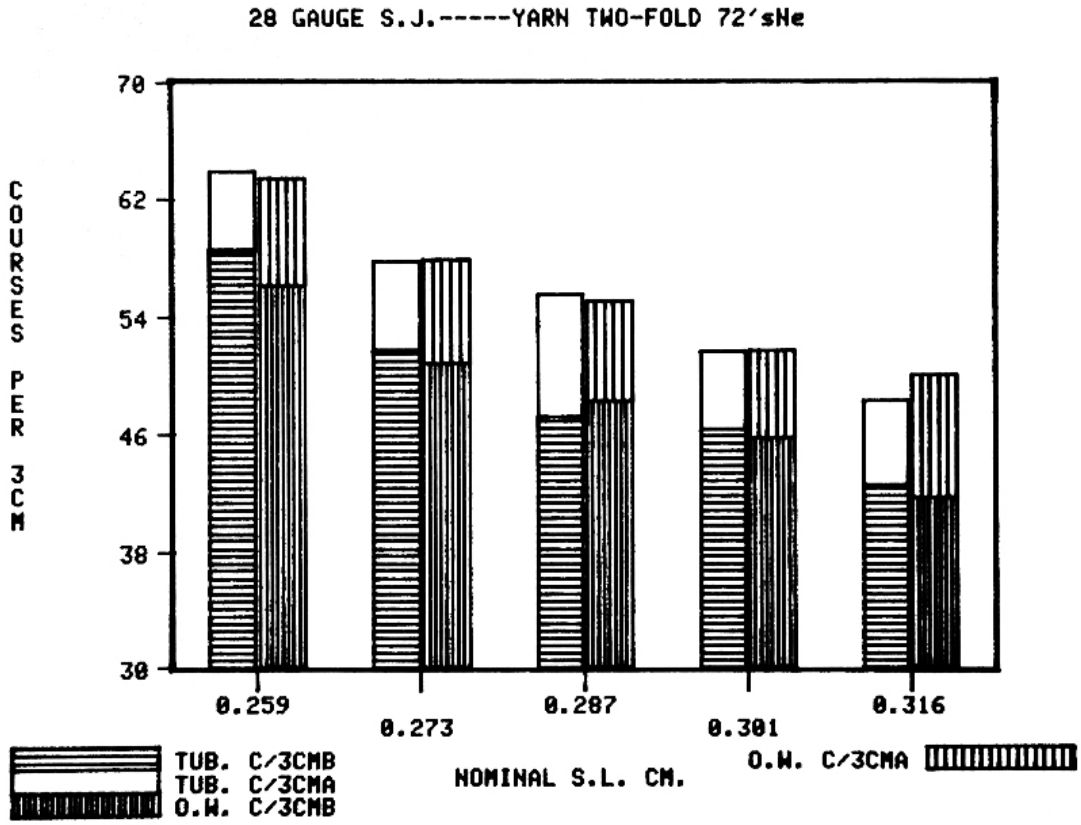

Figure 27

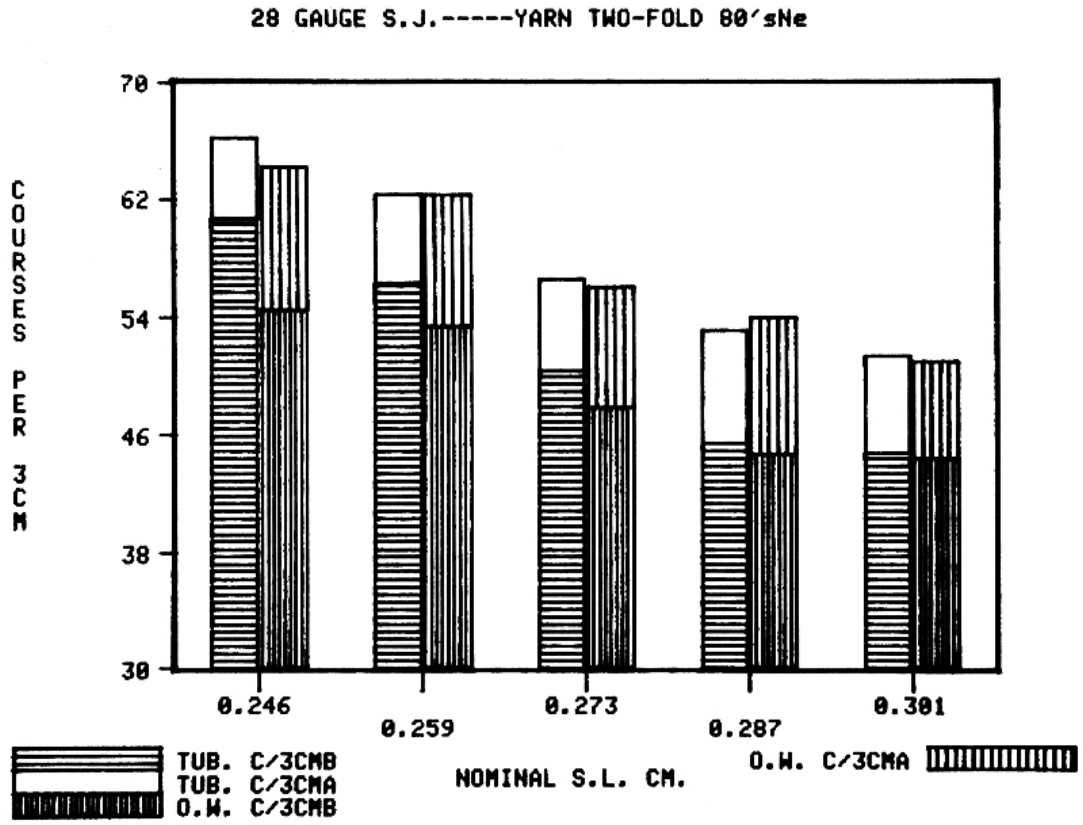

Figure 28

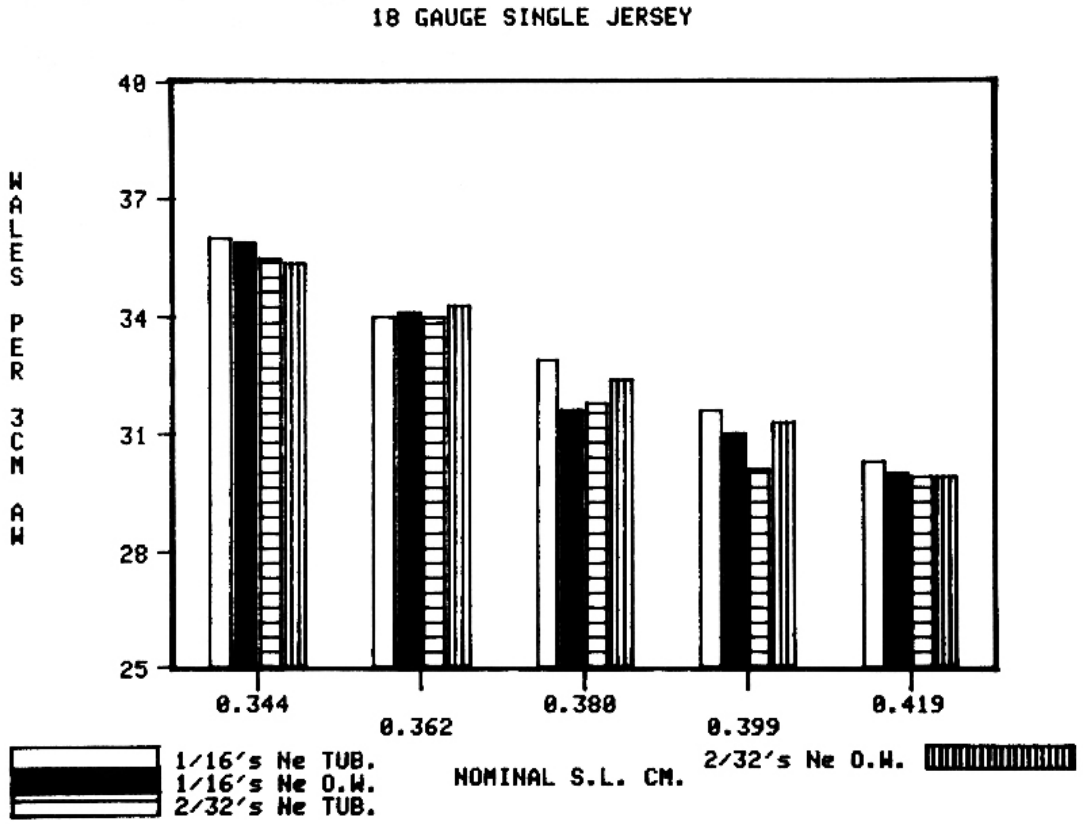

Figure 29

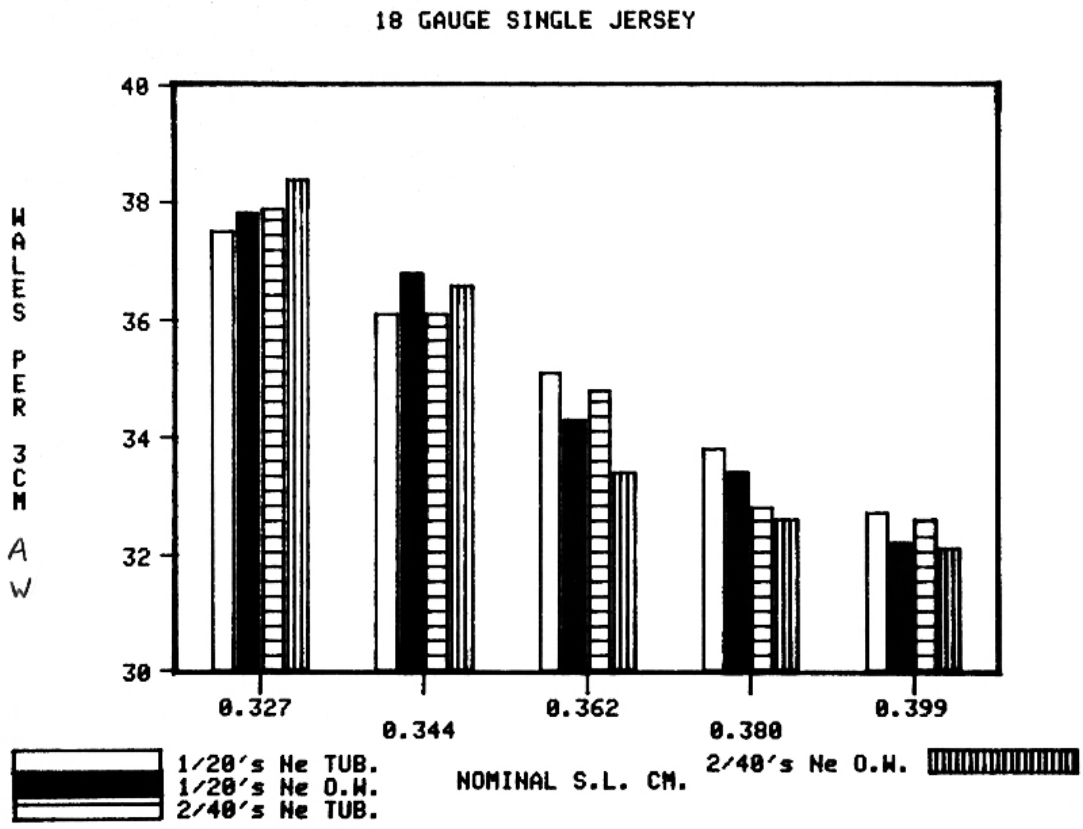

Figure 30

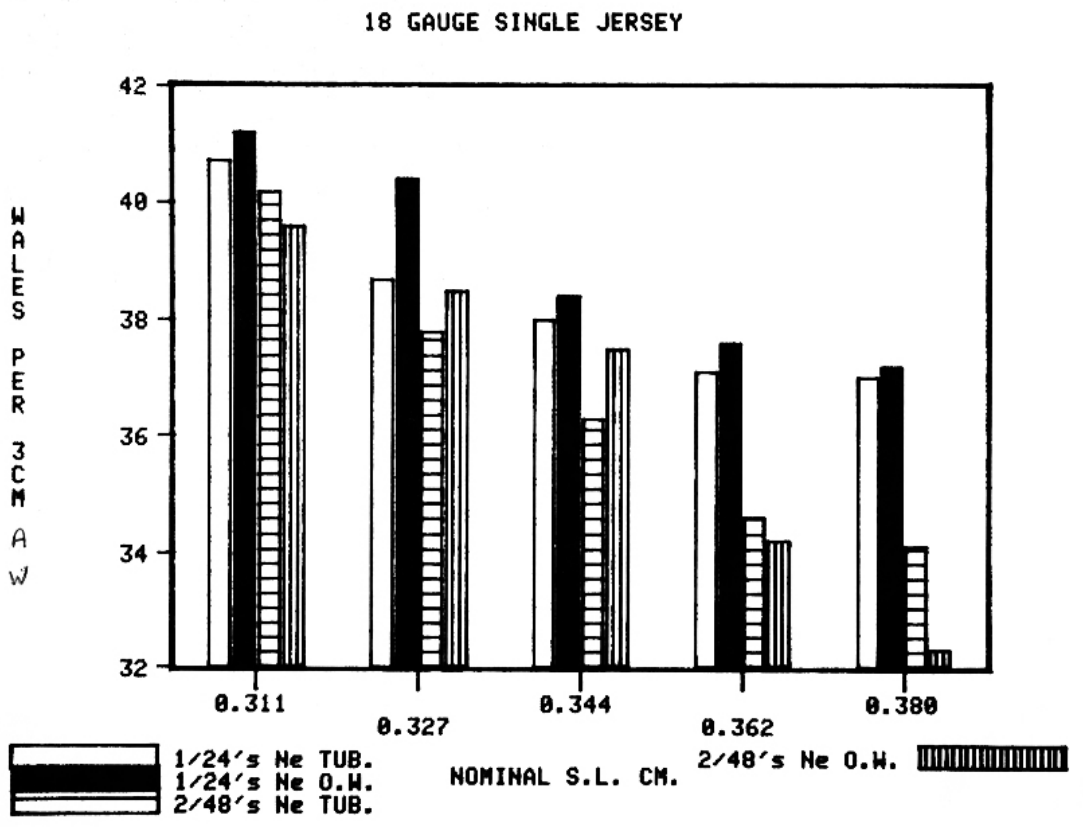

Figure 31

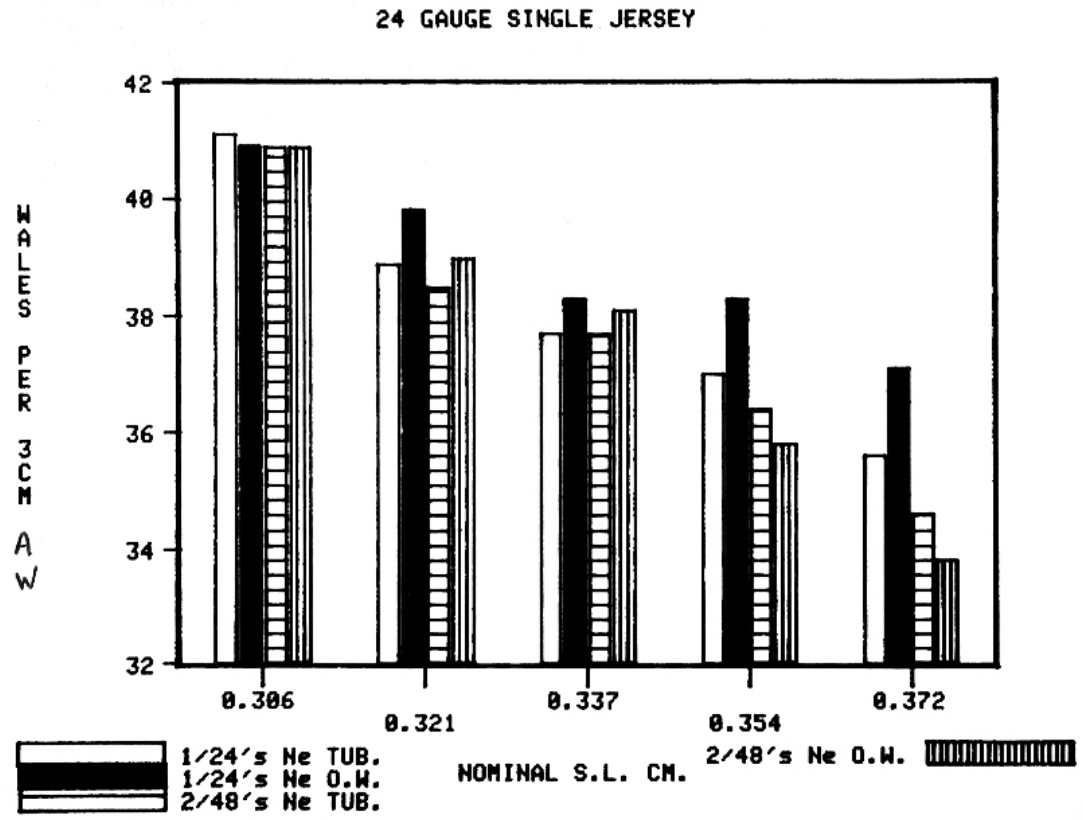

Figure 32

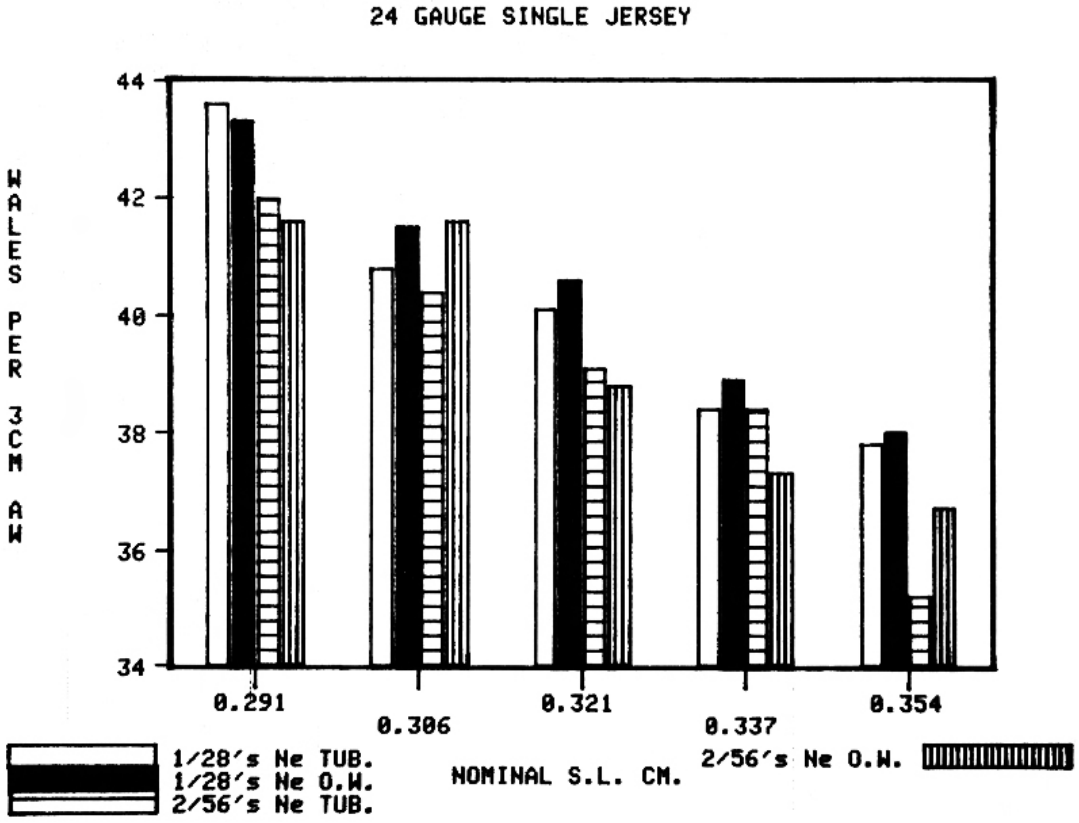

Figure 33

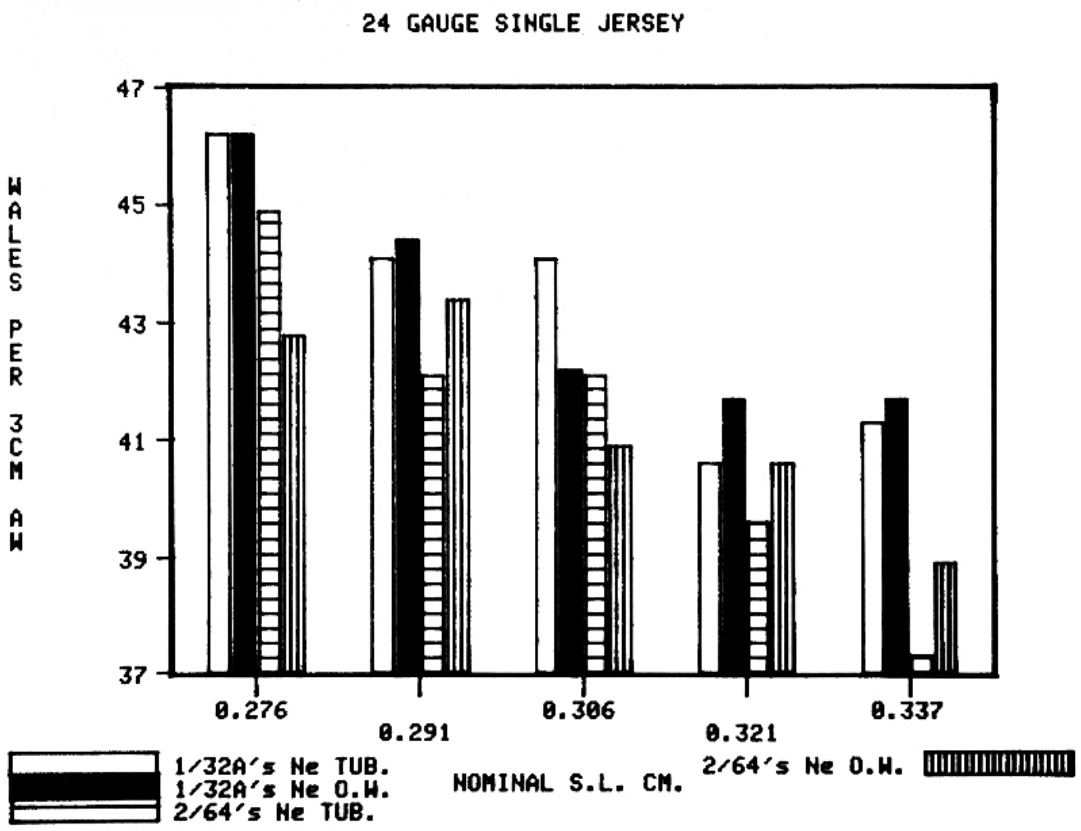

Figure 34

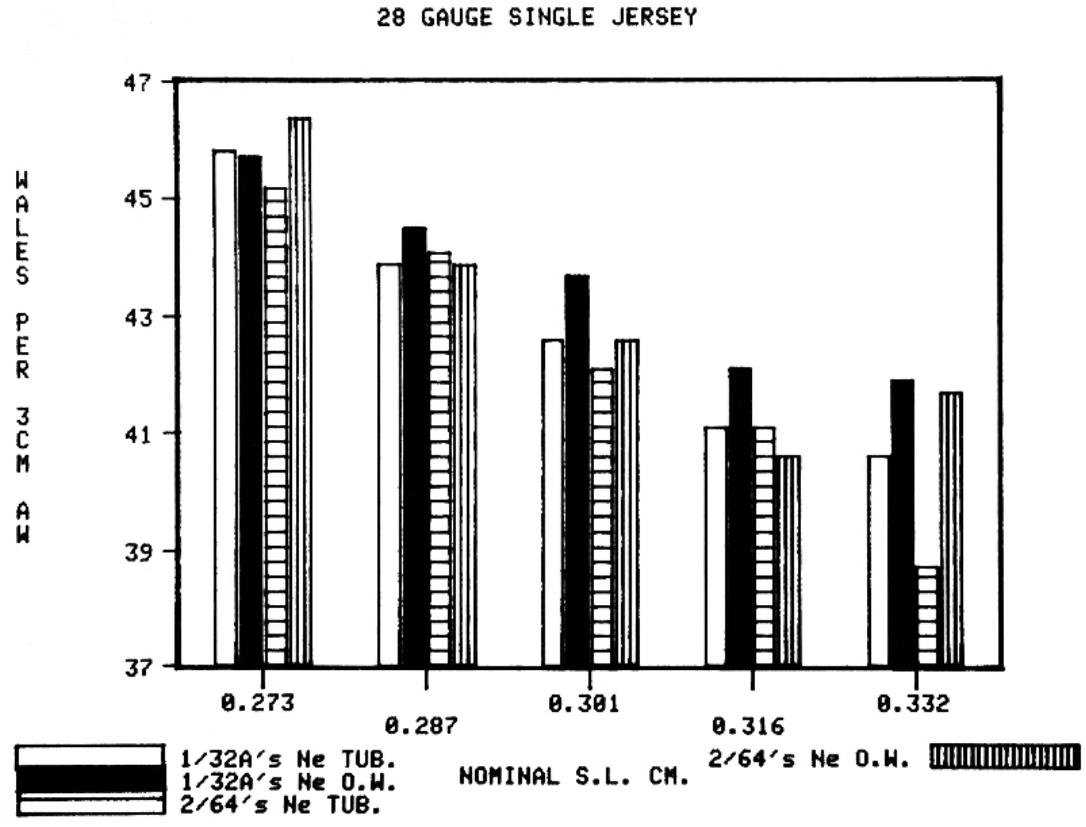

Figure 35

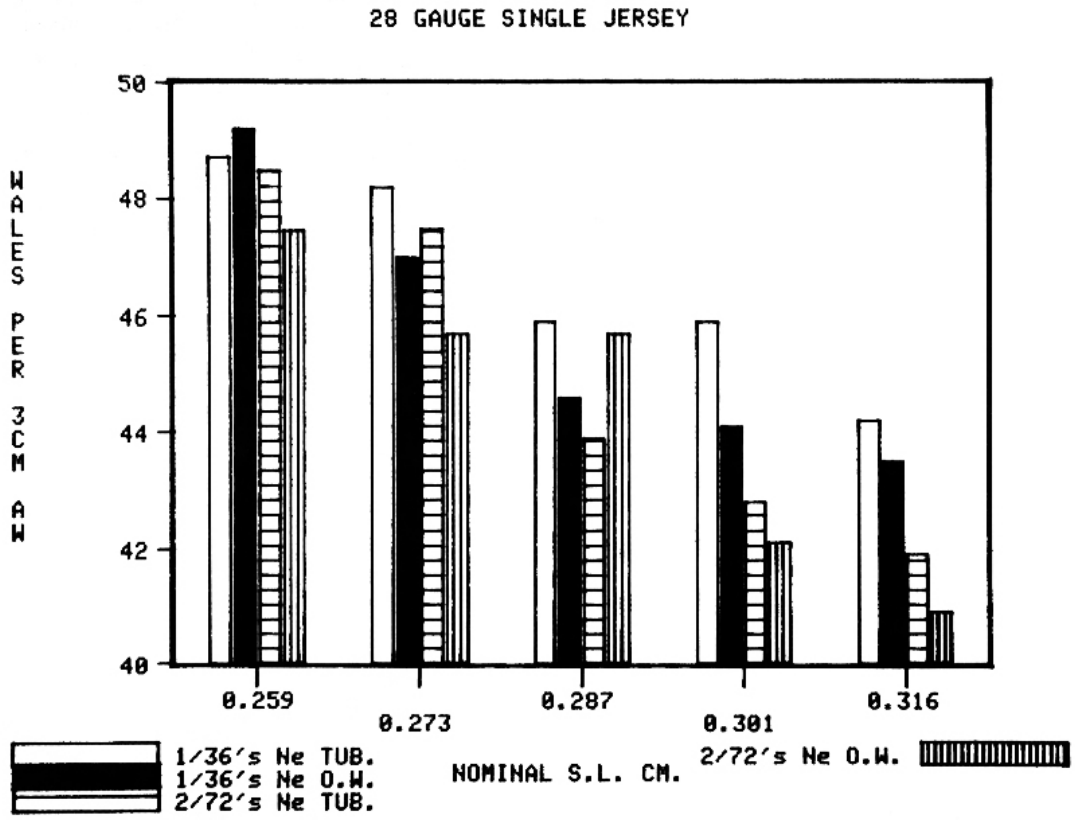

Figure 36

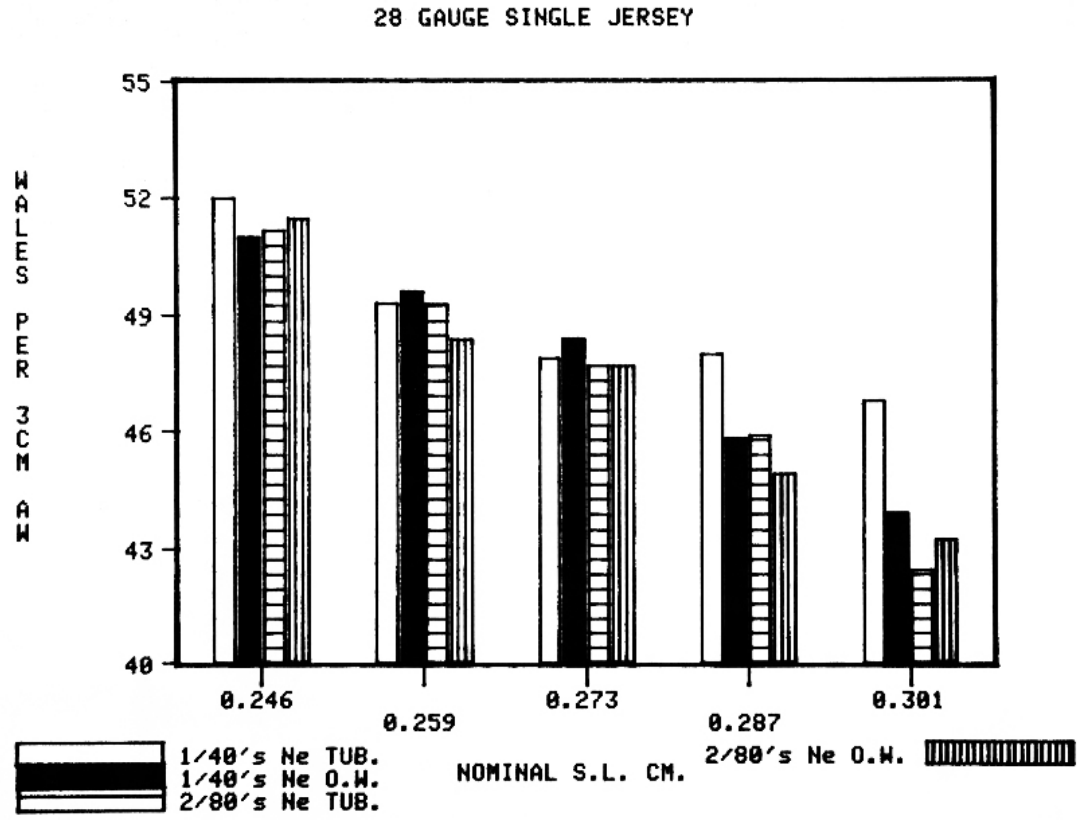

Figure 37

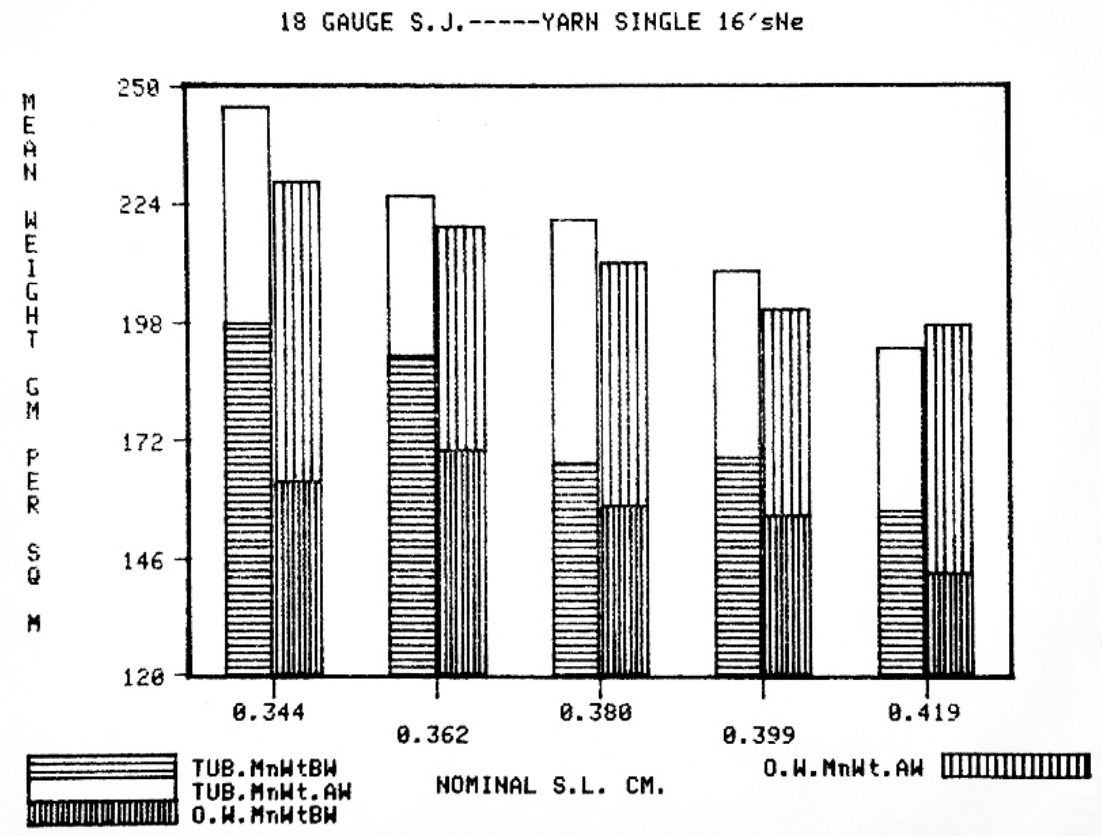

Figure 38

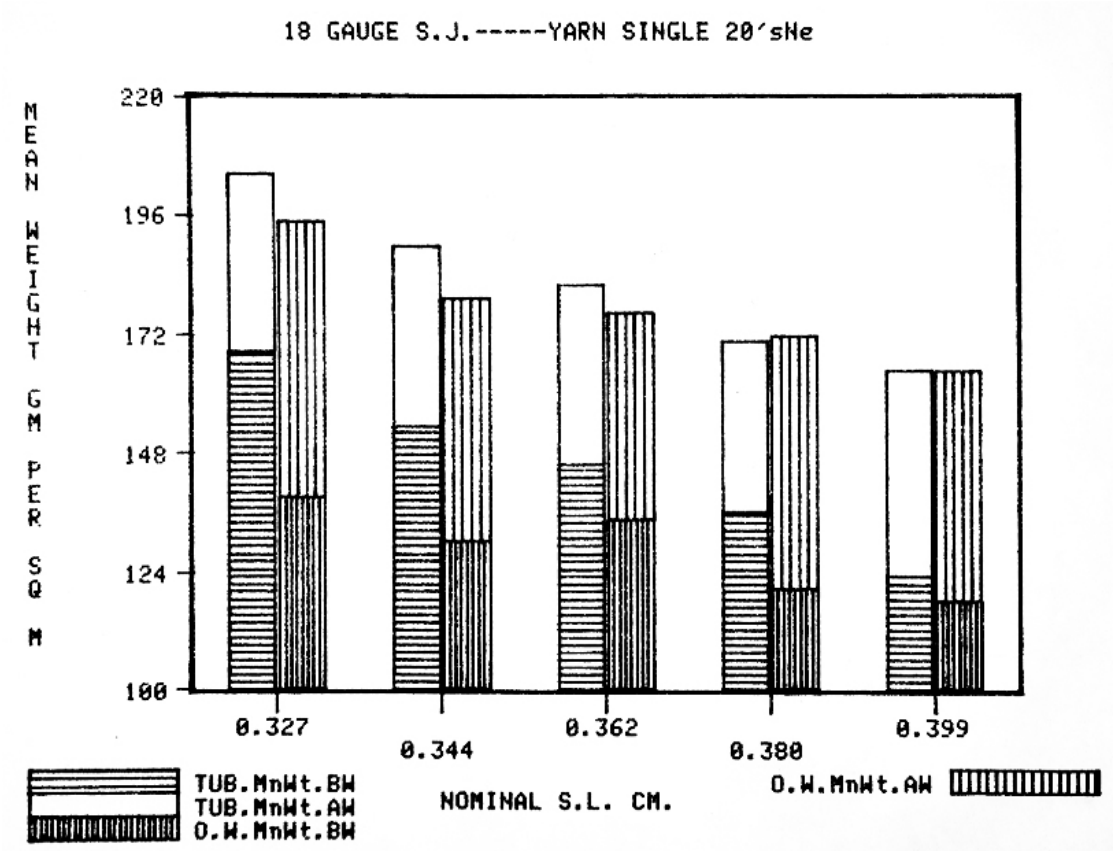

Figure 39

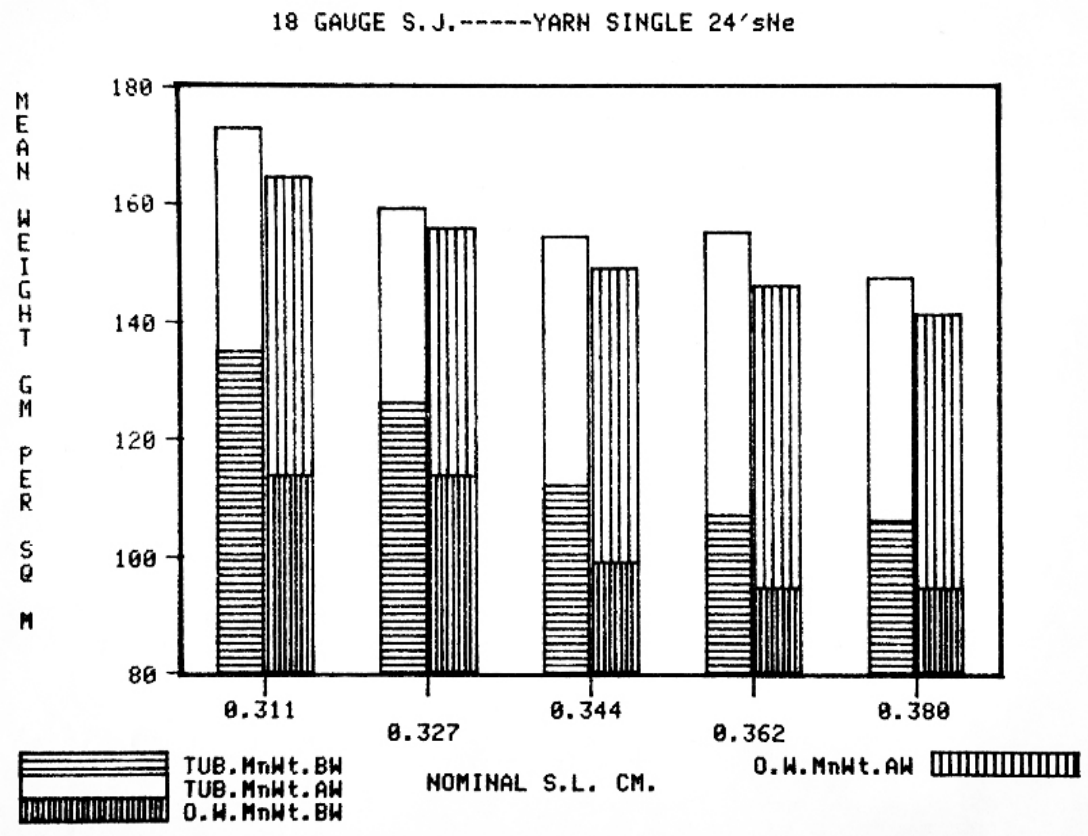

Figure 40

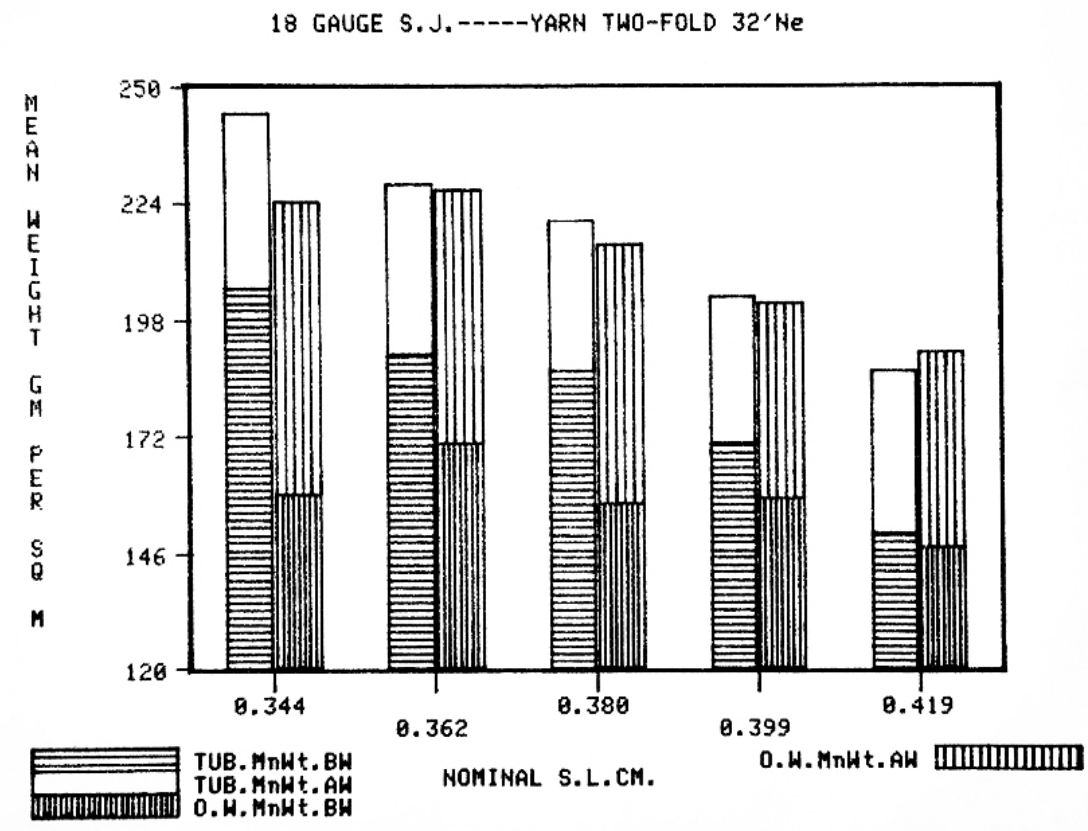

Figure 41

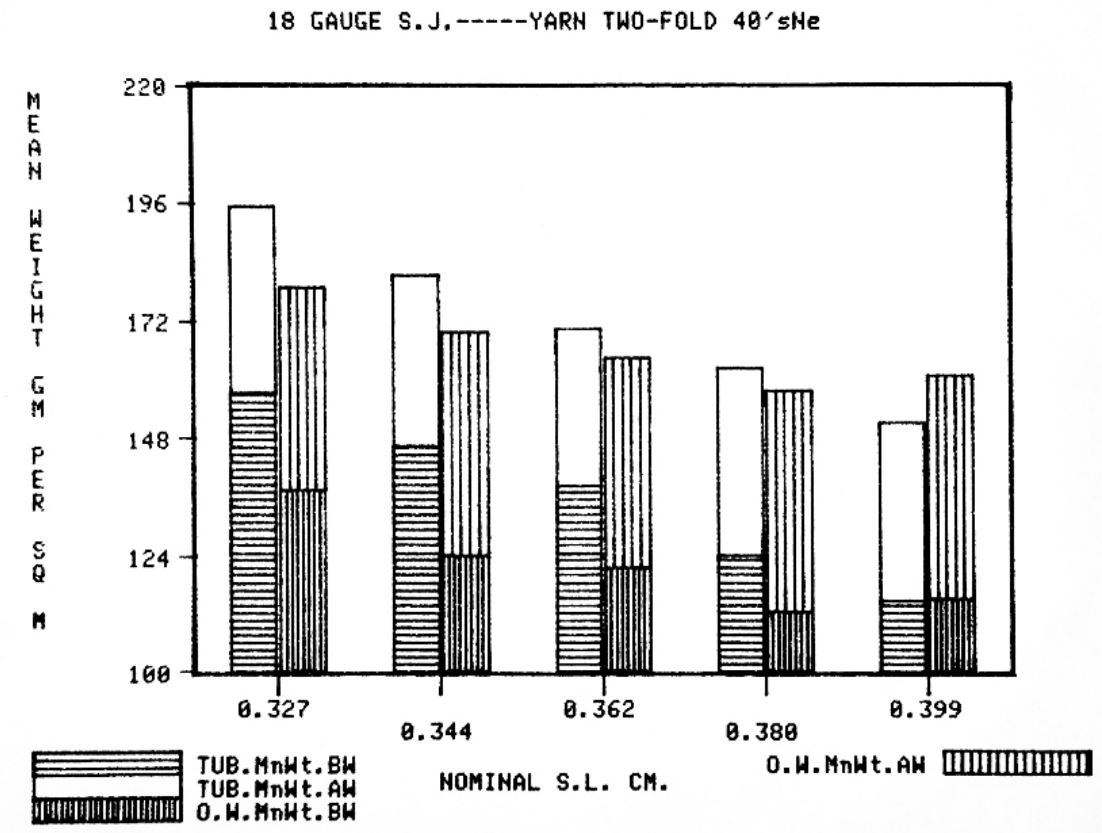

Figure 42

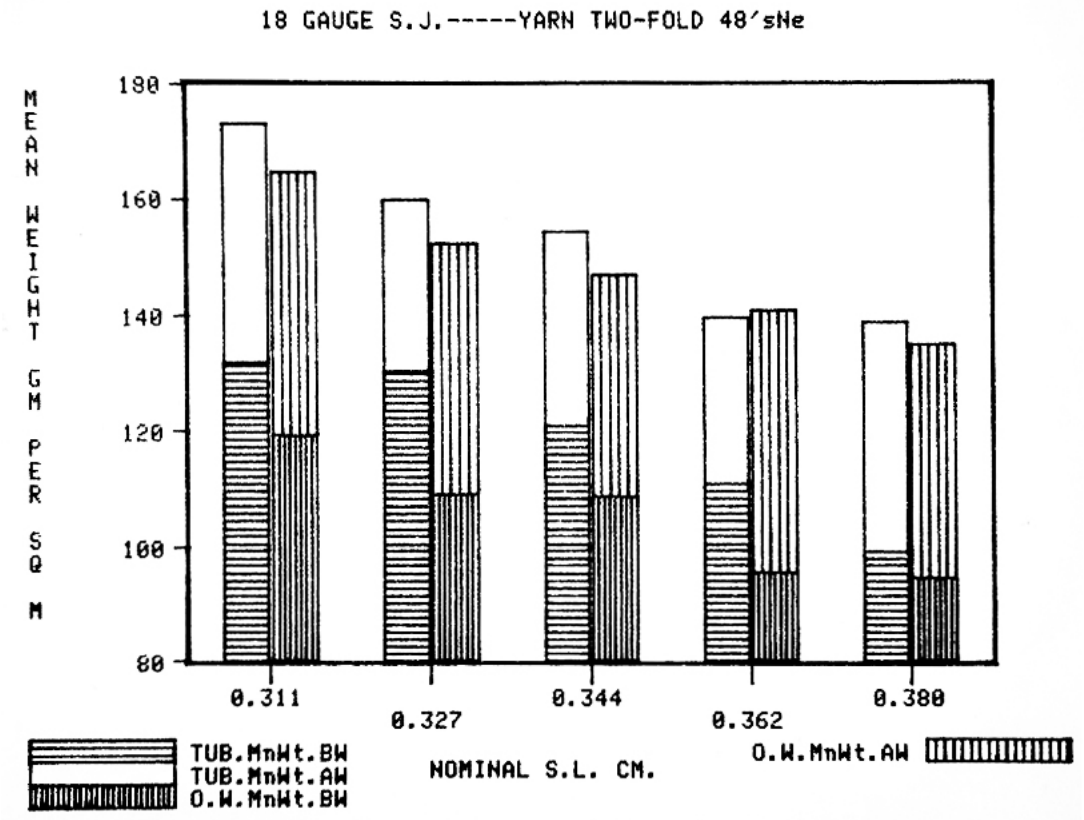

Figure 43

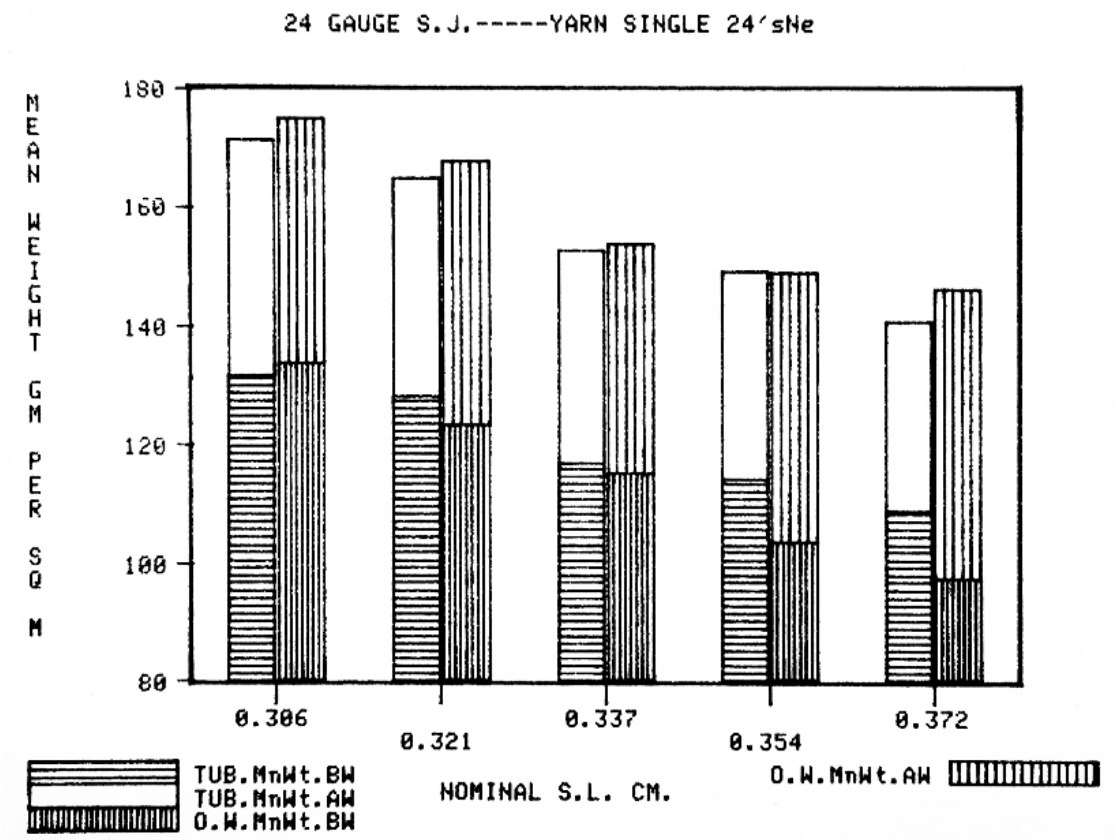

Figure 44

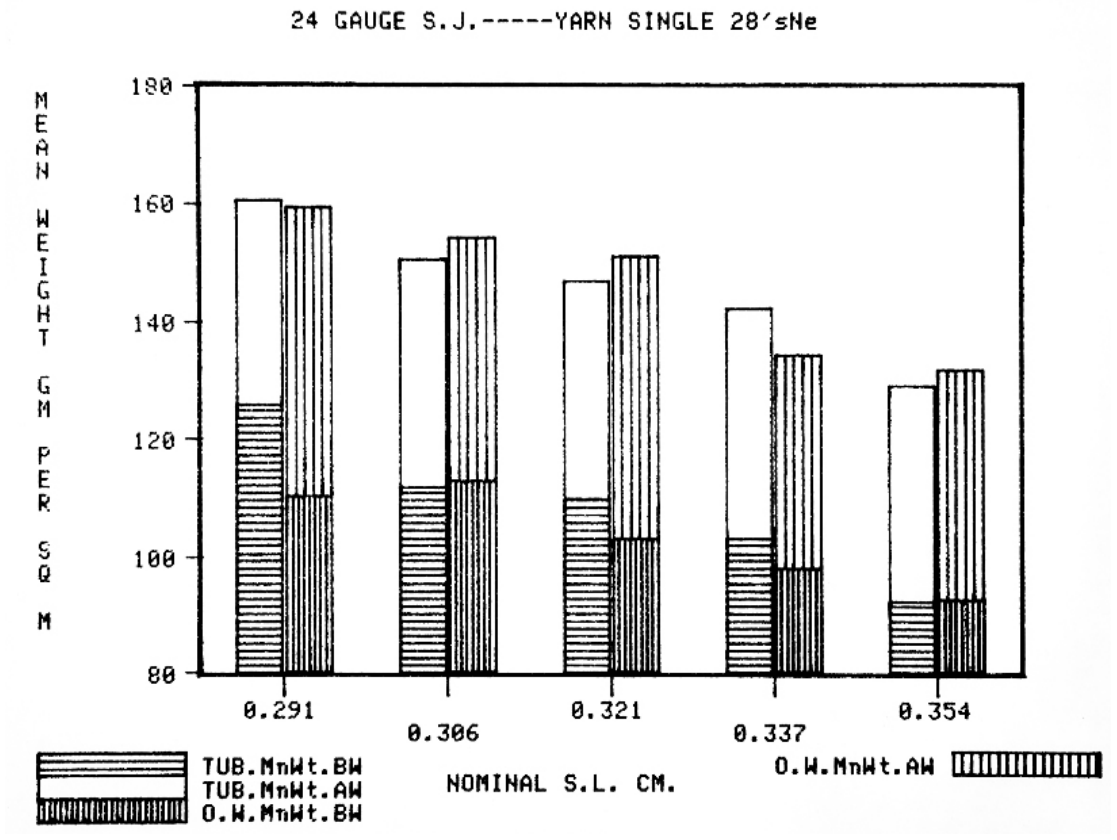

Figure 45

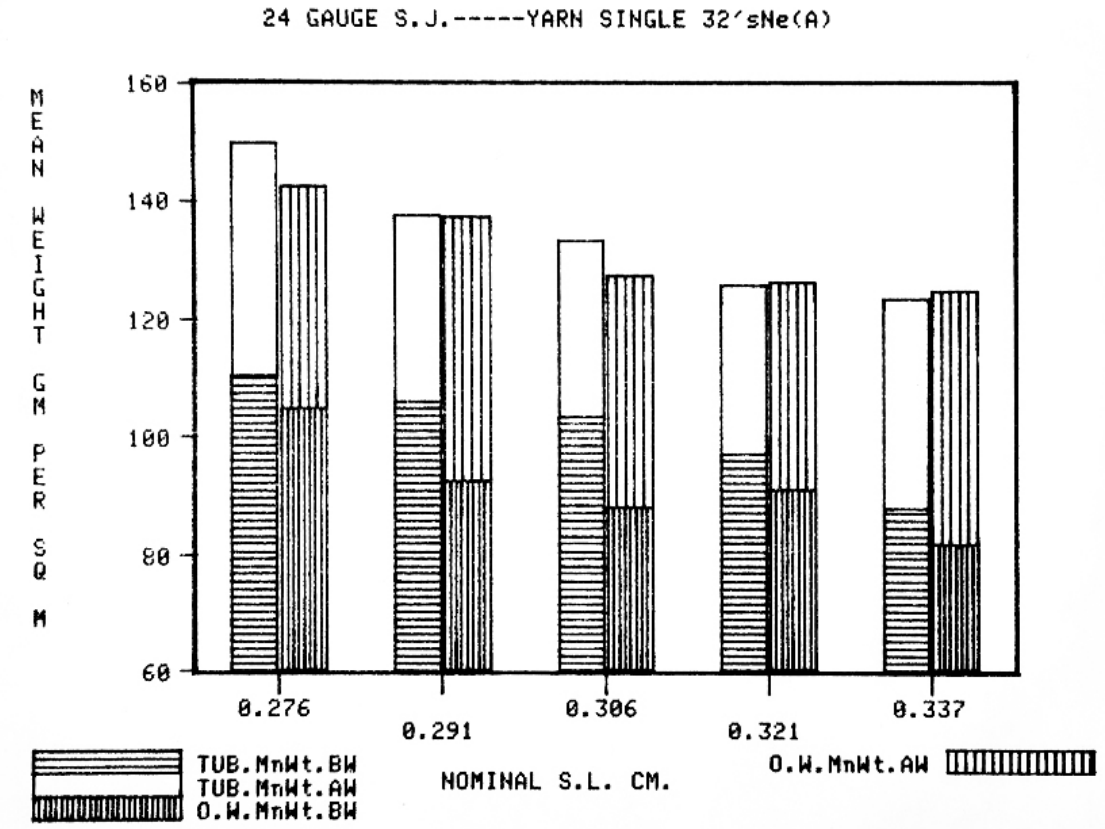

Figure 46

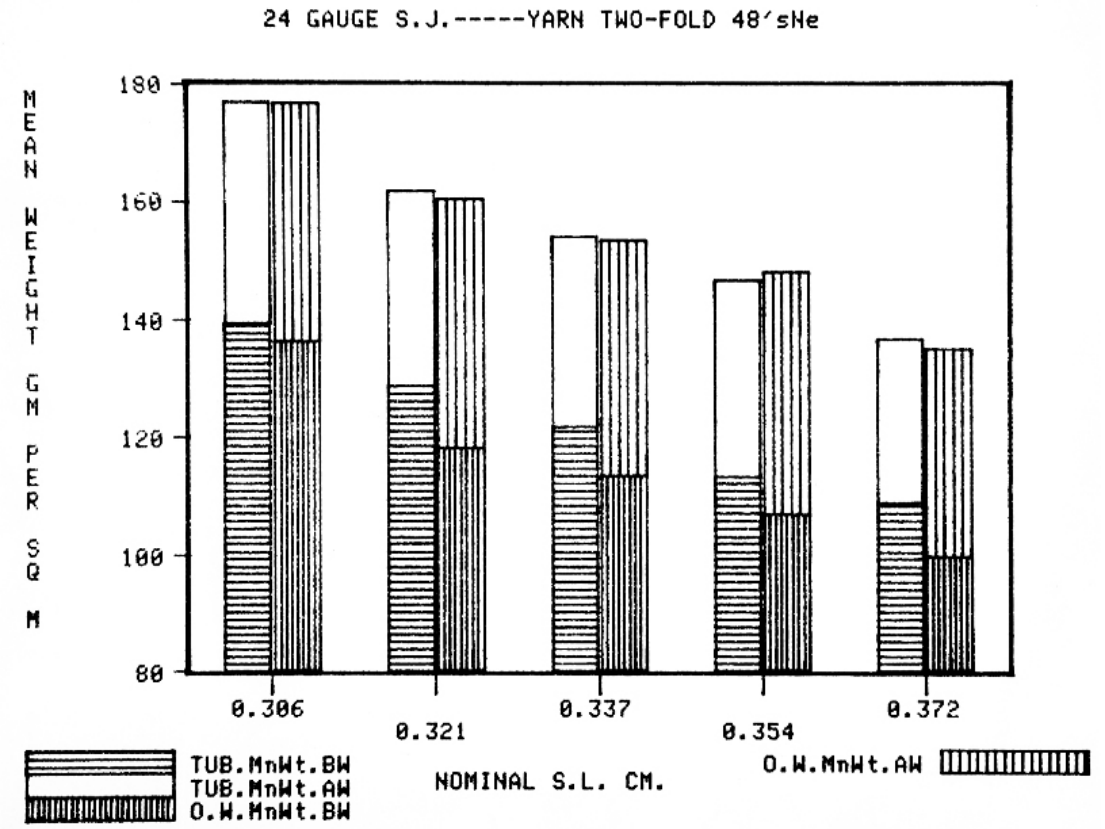

Figure 47

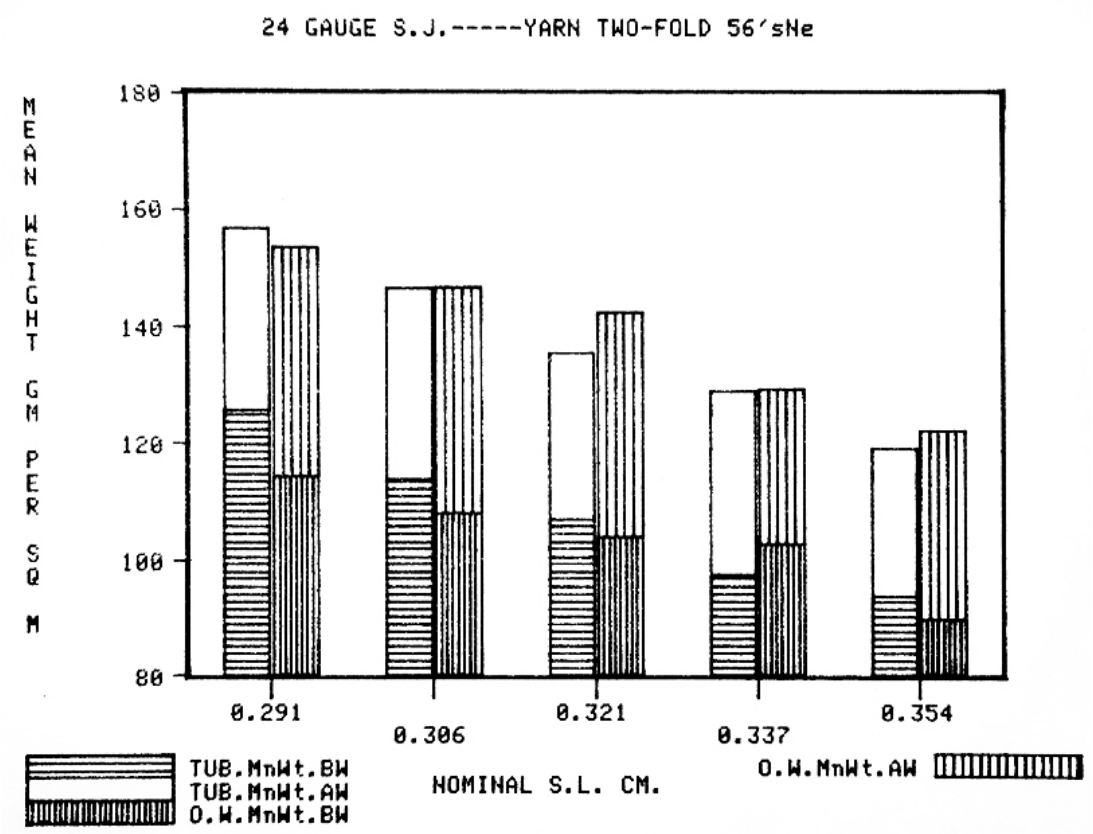

Figure 48

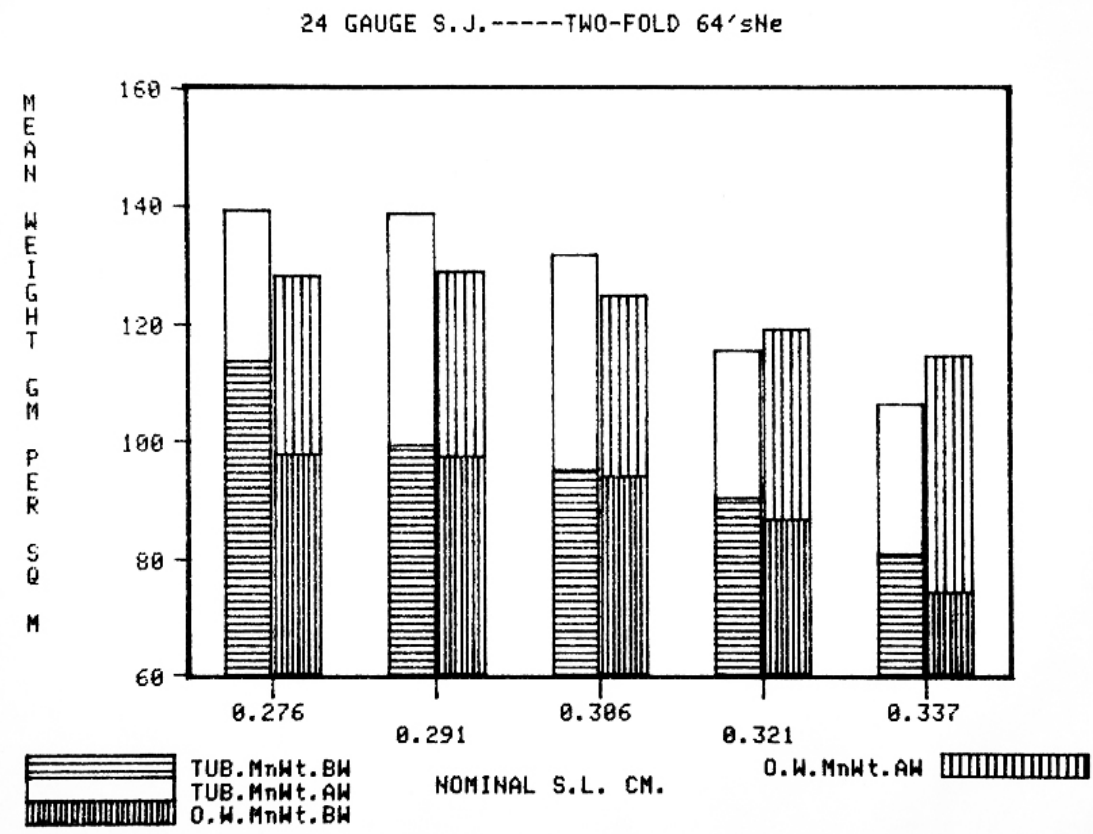

Figure 49

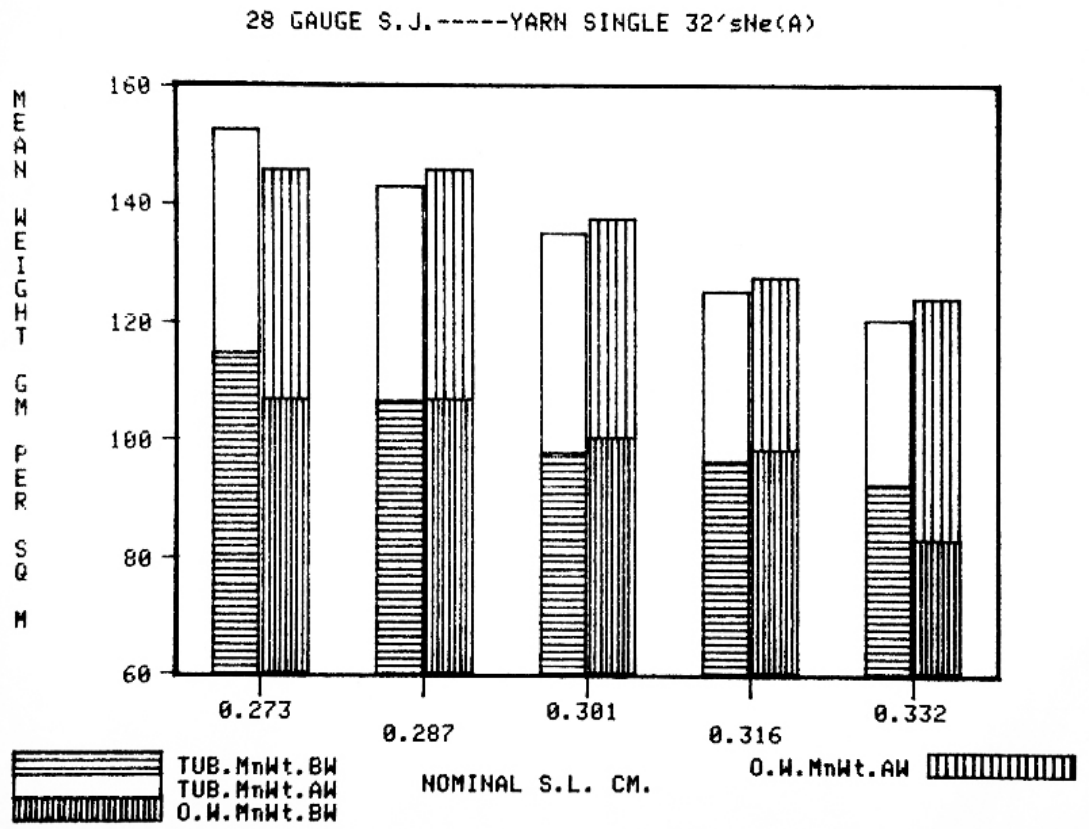

Figure 50

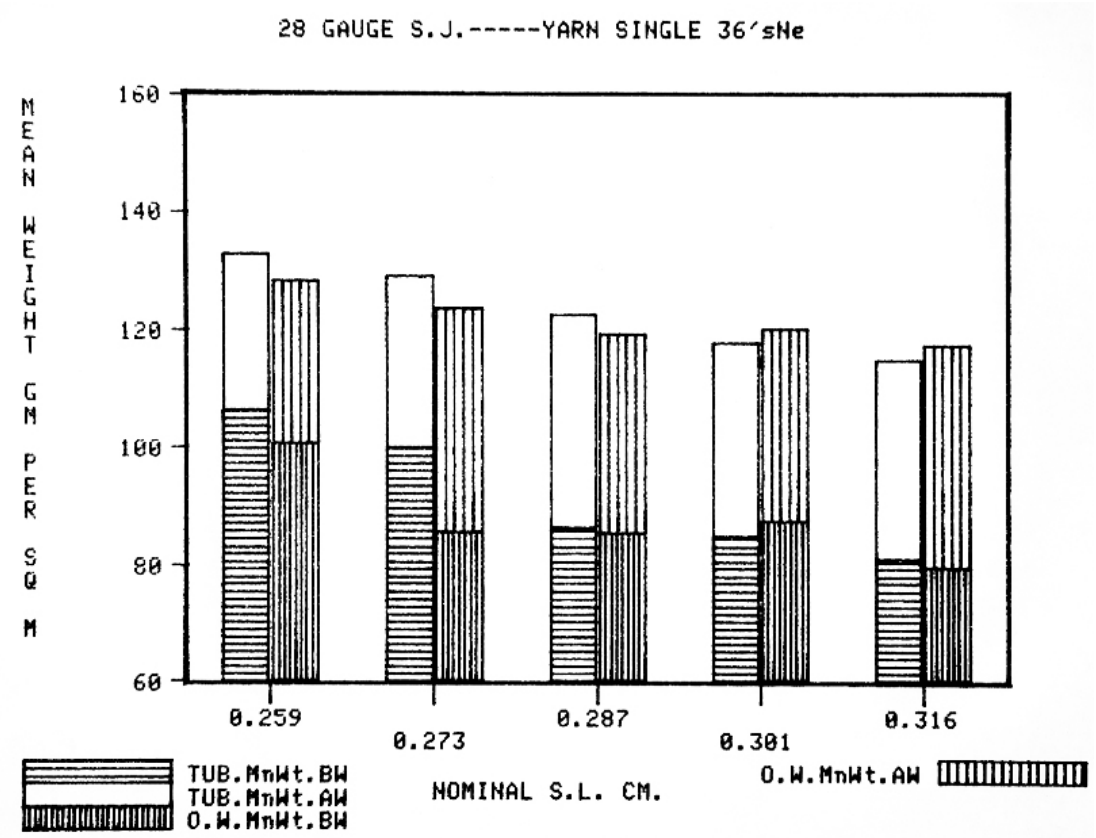

Figure 51

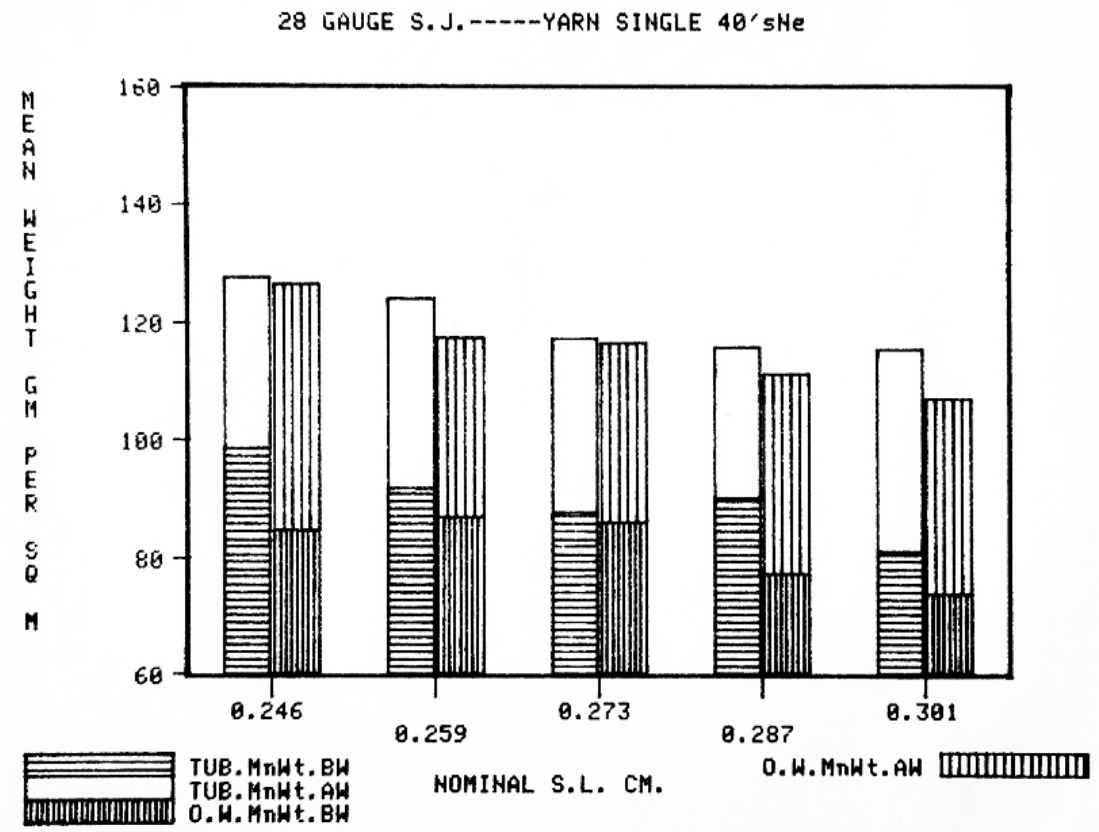

Figure 52

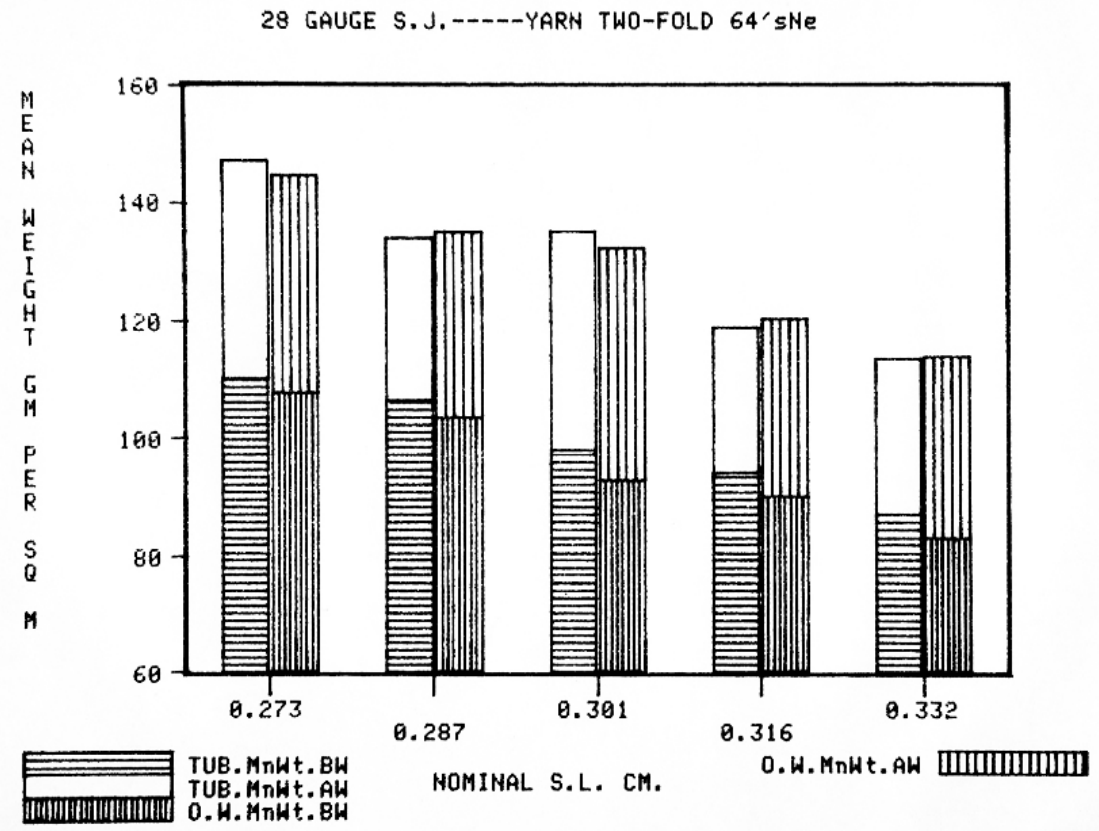

Figure 53

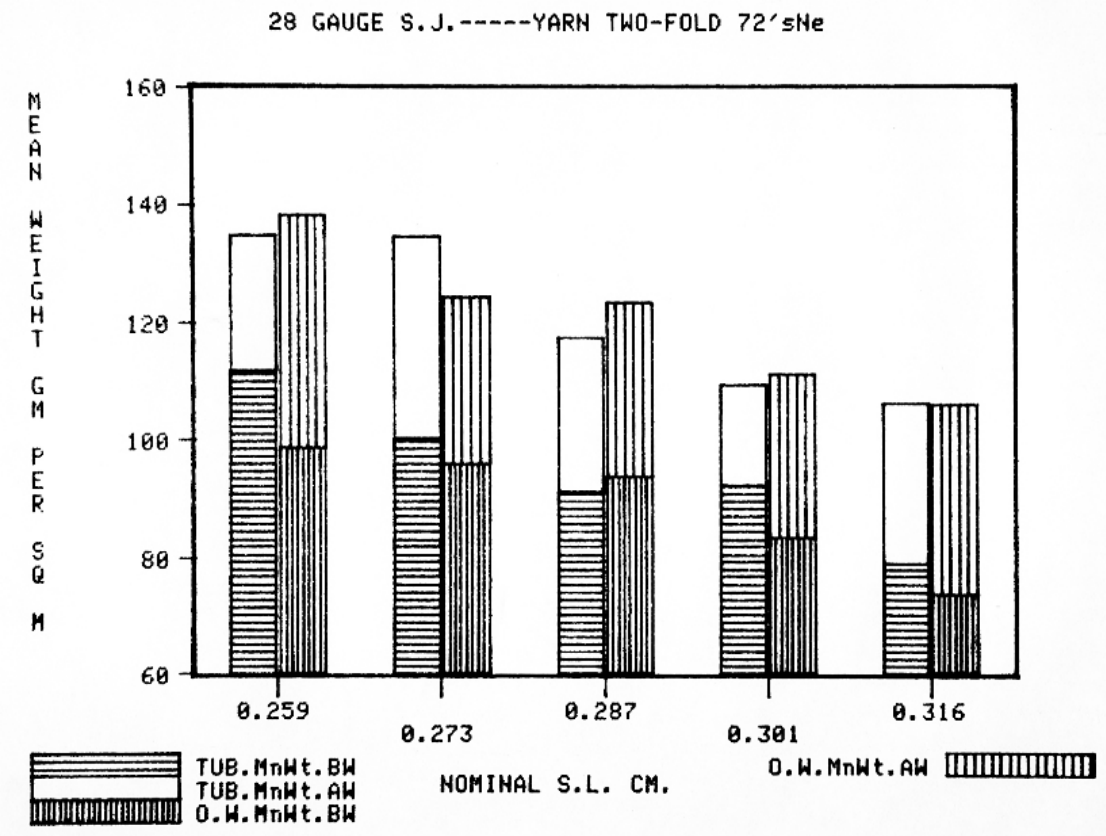

Figure 54