



Institute of Paper Science and Technology

THE EFFECT OF TESTING PROCEDURES ON TENSILE STRENGTH AND TEAR RESISTANCE OF SHIPPING BAG KRAFT PAPER

A Progress Report

to

THE KRAFT AND PACKAGING PAPERS DIVISION

OF THE

THE AMERICAN FOREST AND PAPER ASSOCIATION

Project 3679

Report One

January 5, 1994



Atlanta, Georgia

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EXECUTIVE SUMMARY

Strength requirements for Shipping Bag Kraft Paper are given in Rule 40 of Uniform Freight Classification 6000. Present specifications require testing with an old style tear tester, and a pendulum type tensile tester. These have largely been replaced with new style tear testers and constant rate of elongation (CRE) tensile testers.

This project was undertaken to statistically define the differences in test results that are attributable to the change in test instrumentation. For this purpose, 50 samples including 40, 50, 60, and 70 lb. flat grades and 40, 50, 60, 70 and 100 lb extensible grades were submitted by member companies of KPPD. These were Tested in the laboratories of the Institute of Paper Science and Technology. Tests included basis weight, moisture content, tear resistance and tensile properties. Tear and tensile test were made with both old style and new style testers.

Basis weight results showed that the average weight of bag paper made today is about 1.5 lbs. higher than stated grade weights. The average moisture content (air-dry basis at 50% RH) is 7.30%, with West Coast paper at about 7.4% and East Coast paper at 7.0%.

The following are conclusions based on the strength data.

Tear Resistance

1. Results obtained with new-style tear testers are 6% lower than those obtained with the old style testers.
2. Results obtained with three new-style digital instruments (Thwing Albert, L & W, and TMI) and with a new style instrument equipped with a pointer are in good agreement.

Tensile Properties

1. When testing samples having a relatively high stretch (i.e. cross machine direction of flat grades and both directions of extensible grades), the tensile strength measured with CRE type instruments averaged 2.0% lower than that measured with a pendulum type instrument.
2. When testing samples having a relatively low stretch (i.e. machine direction of flat grades), the tensile strength measured with CRE type instruments is in good agreement with that measured with a pendulum type instrument.
3. Results obtained with two CRE instruments (Instron and L & W) are in good agreement.
4. Tensile properties measured using a test span of 7.1 inches are 3% lower for tensile strength, 2.0% lower for stretch, 4% lower for TEA, and 2% higher for tensile stiffness (Et) than those measured using a

INTRODUCTION

Paper used for the construction of multi-wall paper bags must be Shipping Bag Kraft paper, and must meet certain requirements of basis weight, tear resistance, and tensile properties. The strength level requirements and testing procedures are specified in Rule 40, Section 10, of Uniform Freight Classification 6000.

The present rule specifies the use of constant rate of loading (pendulum type) testers for the measurement of tensile strength; and an old-style tear tester (without the cutout which prevents specimens from rubbing against the sector during the test) for measuring tear resistance. Most modern laboratories no longer have these instruments available.

In today's laboratories, tensile properties are usually measured on strain-gage instruments which operate at a constant rate of elongation. These instruments not only measure tensile strength, but also provide information on elongation, tensile energy absorption, and tensile stiffness (Et). Tensile energy absorption is known to be an important performance related property of shipping bag paper.

All tear testers manufactured today have a cut out in the pendulum sector so that specimen do not rub against the sector during the test. It is well known that the test results obtained with these newer tear testers can be as much as 10% lower than those obtained with the older style, depending on the grade of paper being tested. All of the old style tear testers, and some of the new style , indicate tear resistance by means of a mechanical pointer, and clamping of the sample is accomplished with hand operated thumb screws. Many new style testers now include digital readout and pneumatic clamping.

This project was undertaken to statistically define the differences in test results that should be expected using the different methods of measurement.

SAMPLES

Member companies of KPPD were invited to submit production samples of 40, 50, 60, and 70 lb. flat grades; and 40, 50, 60, 70, and 100 lb. extensible grades. The total number of samples submitted for each grade was:

40 lb. flat	9	50 lb. flat	10
60 lb. flat	9	70 lb. flat	4
40 lb. extensible	2	50 lb. extensible	5
60 lb. extensible	5	70 lb. extensible	3
		100 lb. extensible	3

The number of samples submitted for the 40, 50, and 60 lb. grades is approximately the same as the number of participants in the KPPD baseline study (IPST Project 3710). Hence, the sample size is probably a good representation of industry production. All sample rolls, after receipt, were stored in a 20% RH environment until needed for testing.

TEST PROCEDURES

Samples for testing were preconditioned at 20% RH, 23 degrees C, for a minimum of 24 hours, and then conditioned at 50% RH, 23 degrees C for a minimum of 48 hours. All tests were conducted in the 50% RH atmosphere.

Basis weight was measured for each of the submitted samples. A few of the samples had weights significantly different than the stated grade. The results for these are tagged in this report, separate grade averages are reported including and excluding the results for the off-weight samples, and the results for these were omitted in further statistical calculations.

Moisture content (air-dry basis at 50% RH) was determined for each sample calculated from:

$$MC = 100 (w1-w2) / w1$$

where: MC = moisture content, %

w1 = weight of specimen at 50% RH

w2 = oven-dry weight of specimen

These data were obtained to provide an "industry average" for determining adjusted basis weight in the KPPD baseline.

The following strength tests were made. TAPPI test methods were followed except where noted. Ten replications were made for each test result.

Tensile strength using a Schopper (pendulum type) tensile tester following TAPPI method T404.

Tensile properties using an Instron (CRE type) tensile tester following TAPPI method T494.

Tensile properties using an L & W (CRE type) tensile tester following TAPPI method T494.

Tensile properties using the CRE testers and a test length of 4.8 inches rather than the 7.1 inches specified in TAPPI method T494. These tests were made for extensible grades only.

Tear resistance measured with an old-style tester, a new style tester equipped with a pointer, and digital new-style testers manufactured by Thwing-Albert (digi-tear), Testing Machines Inc. (TMI), and Lorentzen and Wettres (L & W).

TEST RESULTS

The test averages and standard deviations for each sample, and for each type of test, are given in the appendix. Each table in the appendix includes the basis weight of each sample. Test results for samples whose basis weight differed significantly from the stated grade are marked with an asterisk. Two separate grade averages were calculated for those grades including and excluding the off weight samples were used in the summary tables, graphs, and statistical calculations for the remainder of this report.

Tear Resistance

A summary of tear resistance results are given in Table 1. The results for each of the new style instruments are plotted against the results for the old style tester in Figure 1 through 4. Figure 5 is a composite graph of all test results. In each case regression coefficients were calculated so that the regression line passed through the origin. These coefficients, along with R squared values are given in the upper left of each graph. The standard error of the Y estimate for each graph are tabulated in Table 7.

Table 1
TEAR DATA

MACHINE DIRECTION SUMMARY

Code	Old	New	Digi	L&W	TMI
40 Lb Flat	93	84	86	86	86
50 Lb Flat	119	112	116	112	113
60 Lb Flat	152	141	142	142	144
70 Lb Flat	204	191	196	192	195
40 Lb Ext	115	104	106	110	108
50 Lb Ext	127	117	121	121	119
60 Lb Ext	158	154	150	154	151
70 Lb Ext	190	180	179	171	174
100 Lb Ext	285	261	269	272	269

CROSS DIRECTION SUMMARY

Code	Old	New	Digi	L&W	TMI
40 Lb Flat	104	97	99	98	99
50 Lb Flat	134	125	128	125	128
60 Lb Flat	167	160	159	160	161
70 Lb Flat	202	182	184	181	185
40 Lb Ext	108	103	108	108	105
50 Lb Ext	170	162	163	161	162
60 Lb Ext	195	187	187	183	185
70 Lb Ext	225	208	214	218	213
100 Lb Ext	328	309	319	308	312

Note: Average values exclude data for samples which were not of the normal weight for the stated grade.

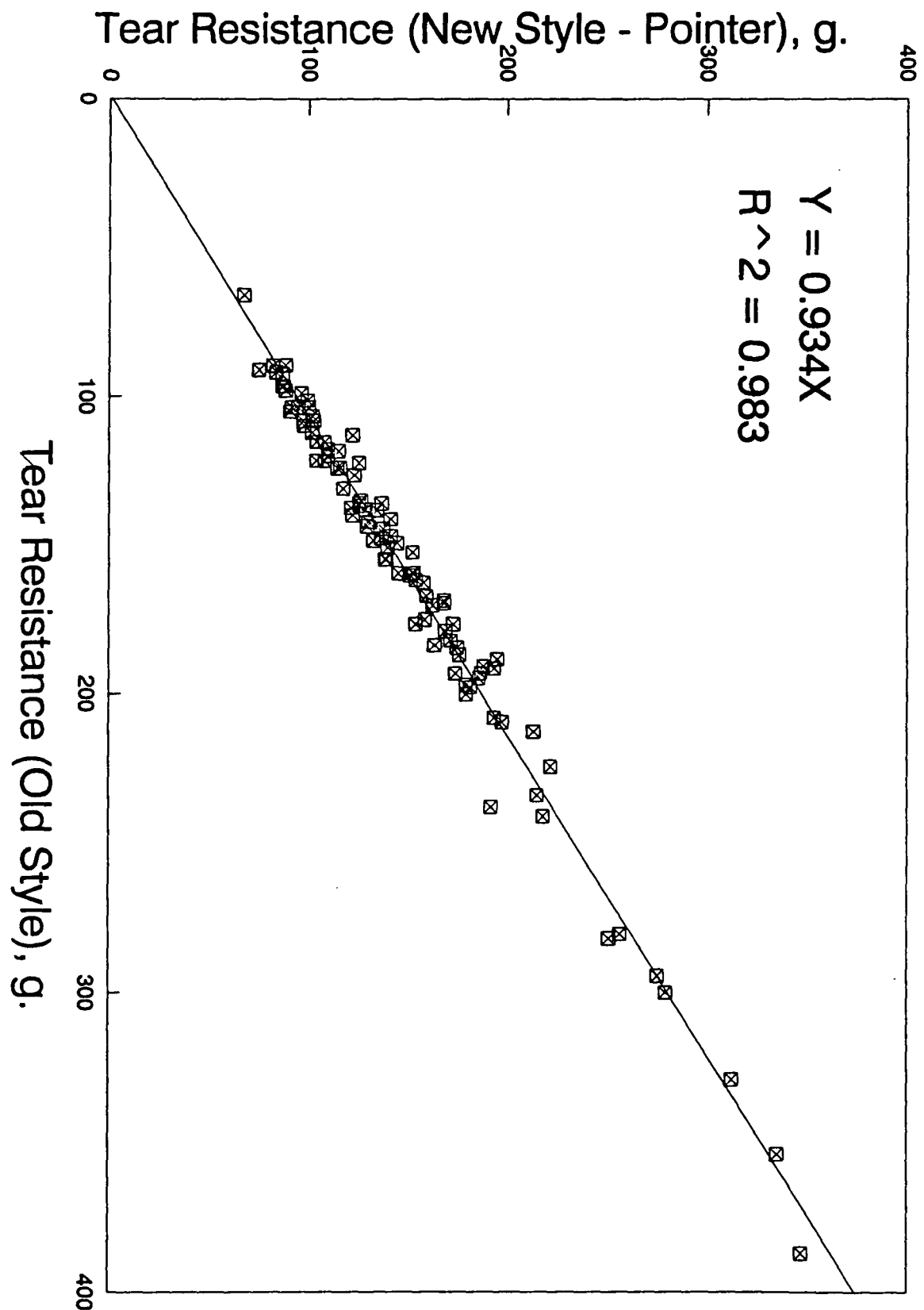


FIGURE 1

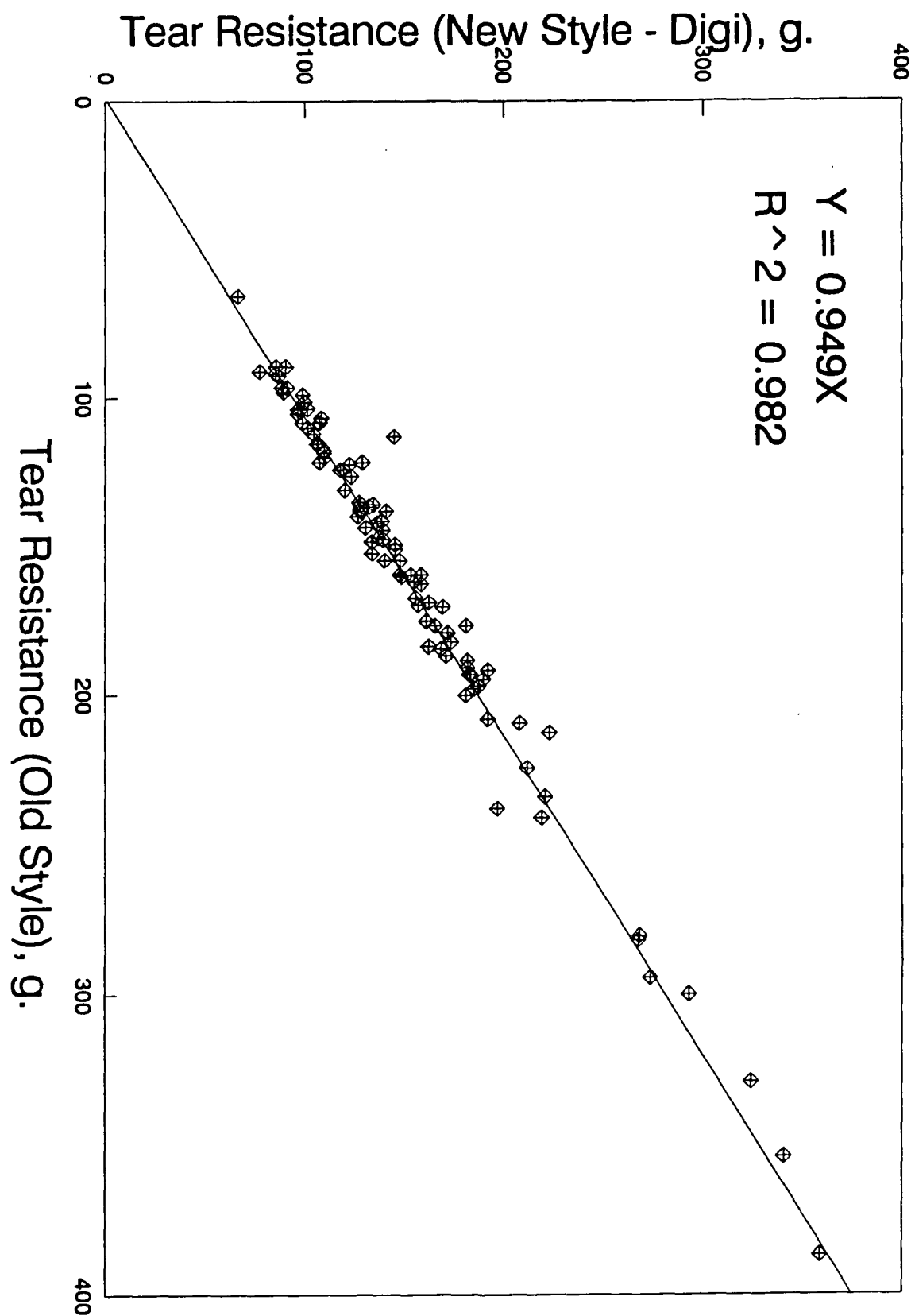


FIGURE 2

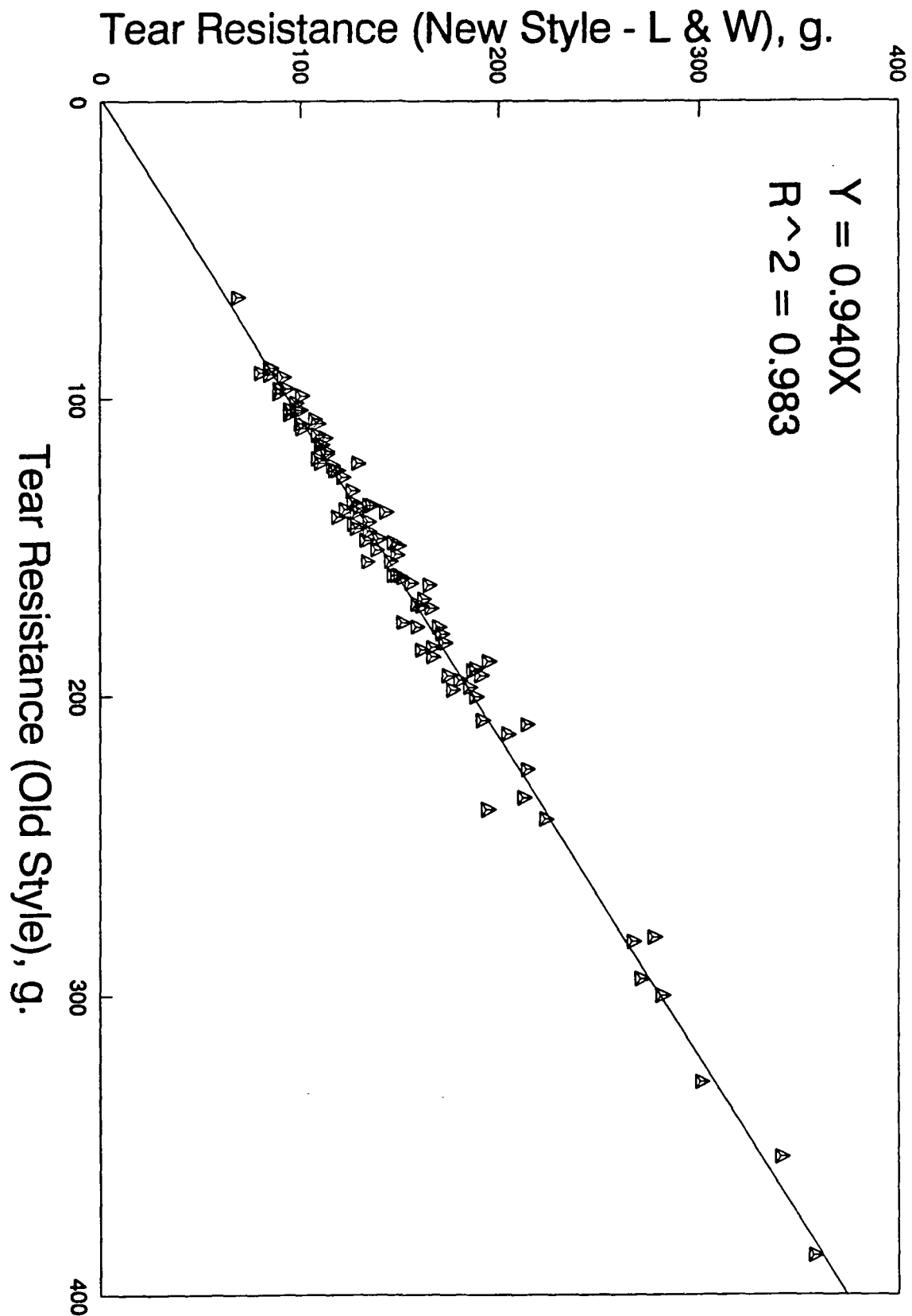


FIGURE 3

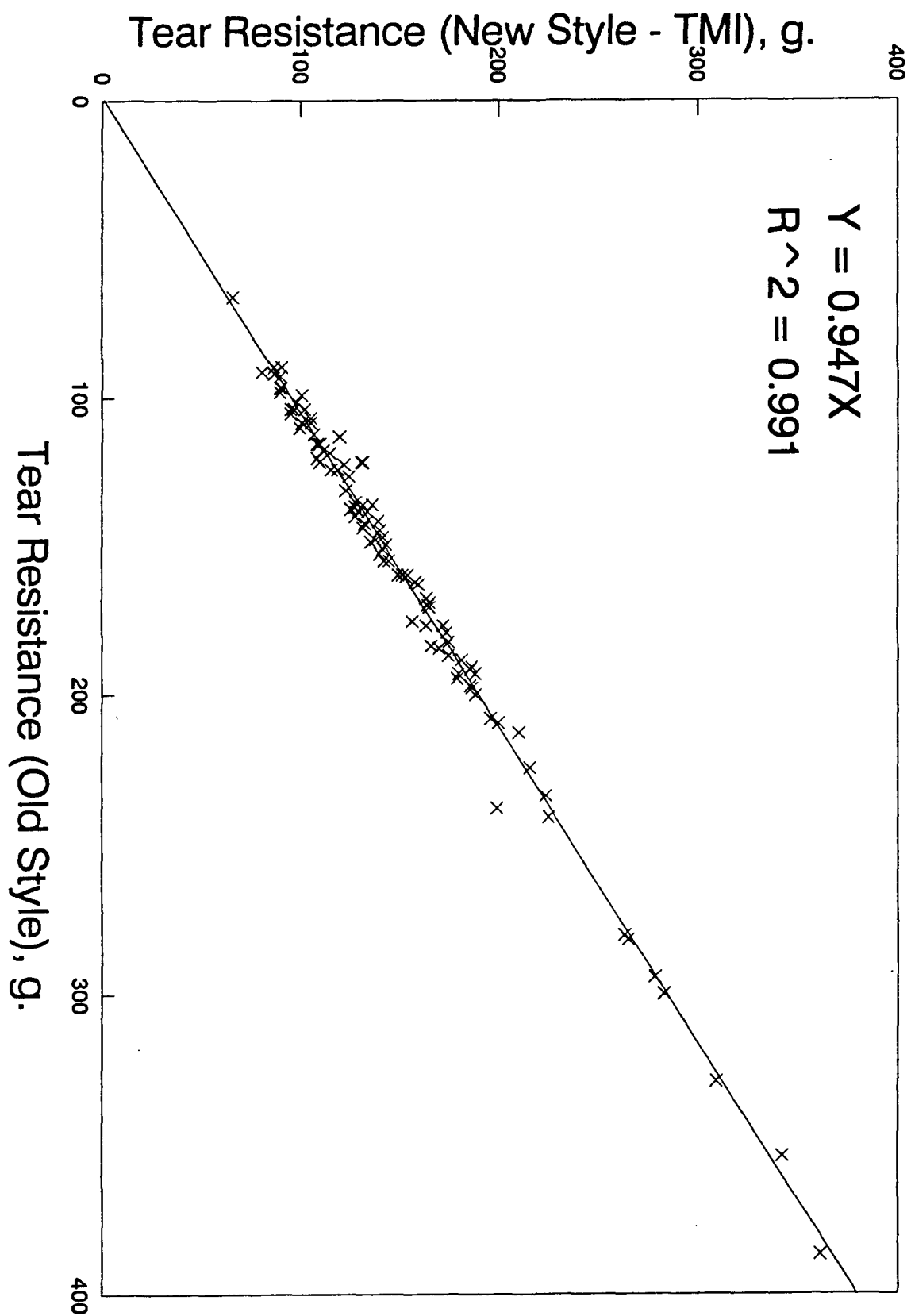


FIGURE 4

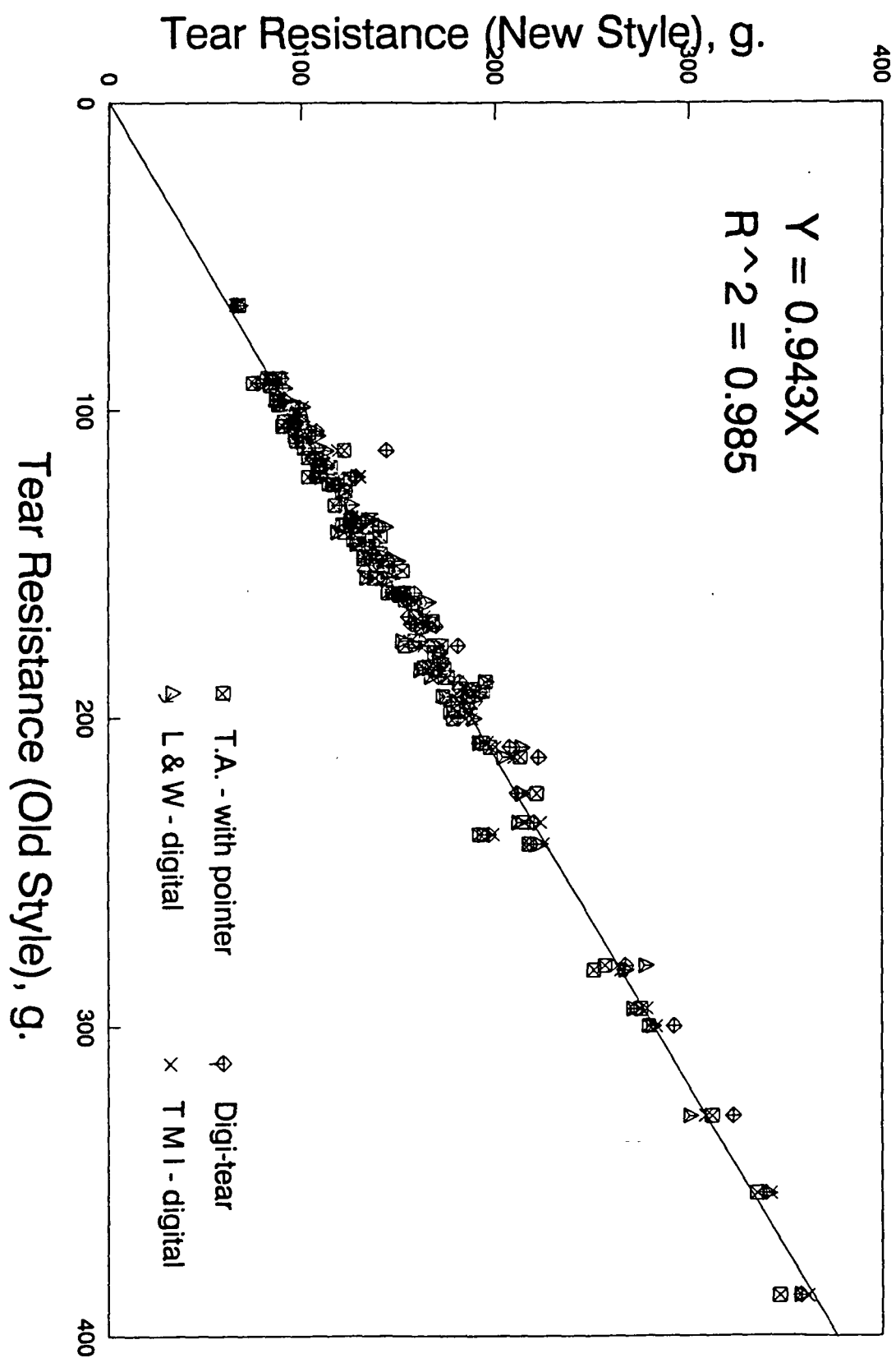


FIGURE 5

An analysis of variance of the tear data was made to determine if correlations between new and old instrument readings must include the effects of paper grade, basis weight, and test direction. The results are given below.

Analysis of Variance For New					
Source	df	Sum of Squares	Mean Square	F-ratio	Prob
Old	1	288068	288068	5802.6	0
TBW	1	57.3640	57.3640	1.1555	0.2852
GRD	1	147.812	147.812	2.9774	0.0878
DXN	1	189.282	189.282	3.8128	0.0539
Error	91	4517.64	49.6443		
Total	95	292980			

Using the normal criterion of 95% confidence, we find only old tear (OLD) to be significant ($p < 0.0001$). However, grade (GRD) has a p value of 0.0878, and direction (DXN) a p value of 0.0539. These deserve further examination, which was done by repeating the analysis after the clearly insignificant factor of basis weight (TBW) was removed. The result (shown below) now indicate that grade and direction have p values of 0.1261 and 0.2988, and can be discarded. Hence, the only significant remaining variable is the old tear value.

Analysis of Variance For New					
Source	df	Sum of Squares	Mean Square	F-ratio	Prob
Old	1	288068	288068	5599.1	0
GRD	1	122.598	122.598	2.3829	0.1261
DXN	1	56.1836	56.1836	1.0920	0.2988
Error	92	4733.31	51.4490		
Total	95	292980			

A subset of the analysis indicated that results obtained with the new style tester equipped with a mechanical pointer were significantly lower than those obtained with testers equipped with digital readout. However, the difference is only about one-half of one percent and is not regarded to be of any practical importance.

Hence, we can conclude that a single coefficient of 1.06 can be used for all instrument types, grades, weight, and test directions. Separately, it was determined that the R^2 parameter was not significantly improved by including in intercept constant.

Tensile Properties.

A summary of the tensile strength results are given in Table 2. Plots of these data are shown in Figure 6.

An analysis of variance of the tensile data indicated a significant grade - direction interaction. Close examination of the data suggested that machine direction results for flat grades needed to be explored separately from the rest of the data. It should also be noted that the machine direction of flat grades has much less stretch than either the cross direction of flat grades or both directions of extensible grades. Separate plots for the low stretch and high stretch samples are shown in Figure 7 and 8 and we conclude that:

1. The MD tensile strengths of flat grades (i.e. samples having relatively low stretch) measured with CRE type instruments are in good agreement with that measured with a pendulum type instrument.
2. The CD tensile strength of flat grades, and that of extensible grades tested in both MD and CD, (ie: samples having a relatively high stretch) are 2.0% lower when tested with CRE instruments than when tested with a pendulum tester.
3. The regressions were not significantly affected by CRE instrument type or by basis weight, and were not significantly improved by using intercept constants.

Tensile results obtained at two different test spans (7.1 and 4.8 inches) are compared in Figure 9. On average, results obtained at a span of 7.1 inch are about 3% lower than those obtained at a span of 4.8 inch.

Elongation related properties (stretch, tensile energy absorption (TEA), and tensile stiffness (E_t) were only measured for the constant rate of elongation testers. These results are summarized in Tables 3-5, and Figures 10-12. The data show that stretch measured at a span of 7.1 inch is about 2% lower than that measured at a span of 4.8 inch (Figure 10). TEA is about 4% lower (Figure 11), and E_t is about 2% higher (Figure 12).

The standard error of the Y estimate for each of the tensile property graph is tabulated in Table 7.

Figure 13-16 show that test results obtained with the Instron and L & W are in reasonable agreement with each other.

Table 2
TENSILE DATA

MACHINE DIRECTION SUMMARY

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	27.1	27.4	----	26.4	----
50 Lb Flat	36.3	37.5	----	36.6	----
60 Lb Flat	41.1	41.1	----	40.8	----
70 Lb Flat	50.3	51.3	----	49.7	----
40 Lb Ext	19.5	18.0	19.0	17.4	17.9
50 Lb Ext	24.1	23.8	23.1	23.8	22.6
60 Lb Ext	27.9	26.7	26.0	26.3	25.4
70 Lb Ext	30.5	30.4	27.5	29.4	26.3
100 Lb Ext	43.7	44.7	48.5	43.1	44.4

CROSS DIRECTION SUMMARY

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	15.4	14.9	----	14.7	----
50 Lb Flat	20.9	20.2	----	19.3	----
60 Lb Flat	24.3	23.6	----	23.2	----
70 Lb Flat	29.1	27.4	----	27.1	----
40 Lb Ext	15.7	15.2	15.8	14.8	15.8
50 Lb Ext	17.7	17.4	18.6	16.9	18.2
60 Lb Ext	22.4	22.0	23.6	21.2	22.9
70 Lb Ext	23.7	24.7	25.7	21.8	25.6
100 Lb Ext	33.9	34.0	37.4	32.5	37.5

Note: Average values exclude data for samples which were not of the normal weight for the stated grade.

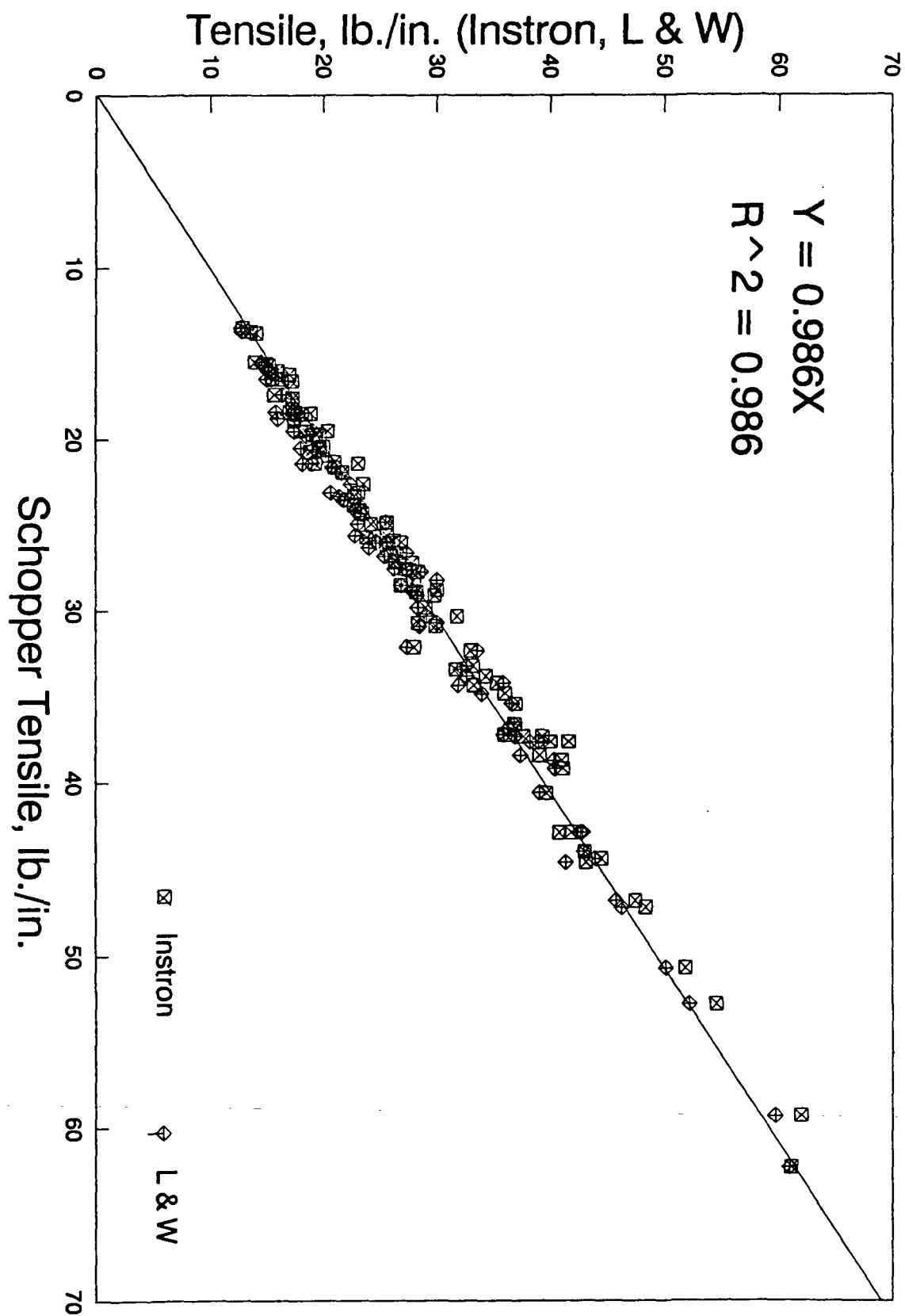


FIGURE 6

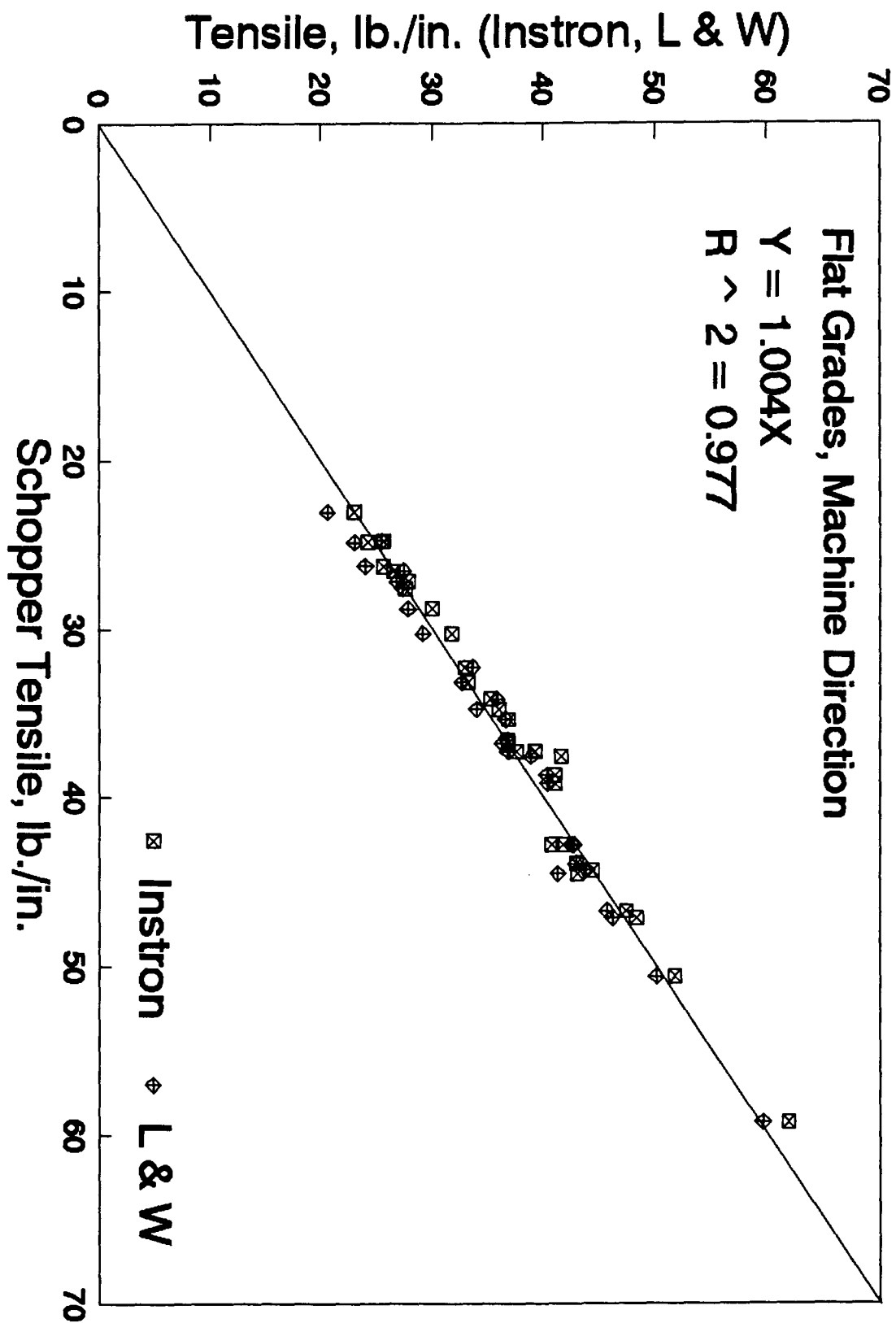


FIGURE 7

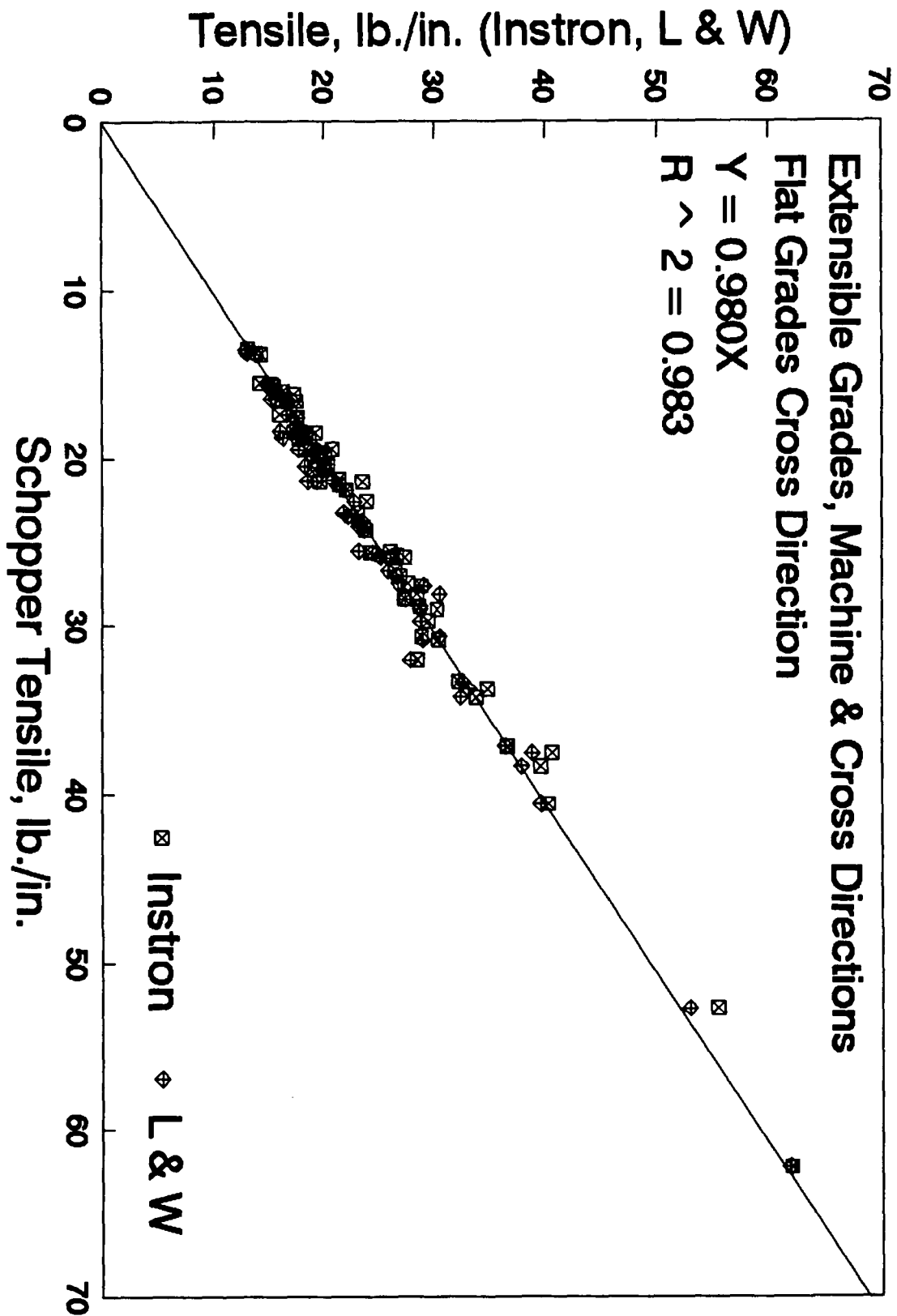


Figure 8

Table 3
STRETCH DATA

MACHINE DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	1.32	---	1.34	---
50 Lb Flat	1.48	---	1.53	---
60 Lb Flat	1.52	---	1.60	---
70 Lb Flat	1.58	---	1.62	---
40 Lb Ext	6.38	6.81	6.19	6.20
50 Lb Ext	6.71	6.76	6.79	6.86
60 Lb Ext	6.76	6.96	6.77	7.24
70 Lb Ext	6.09	7.00	6.23	7.14
100 Lb Ext	7.17	7.06	7.10	7.23

CROSS DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	3.29	---	3.42	---
50 Lb Flat	3.47	---	3.44	---
60 Lb Flat	3.59	---	3.65	---
70 Lb Flat	3.09	---	3.27	---
40 Lb Ext	6.67	6.96	6.58	7.15
50 Lb Ext	4.32	4.53	4.29	4.87
60 Lb Ext	4.95	5.06	4.97	5.29
70 Lb Ext	5.04	4.49	4.35	5.26
100 Lb Ext	4.04	4.45	4.25	4.90

Note: Average values exclude data for samples which were not of the normal weight for the stated grade.

Table 4
TEA DATA

MACHINE DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	2.78	---	2.70	---
50 Lb Flat	4.32	---	4.31	---
60 Lb Flat	4.87	---	5.01	---
70 Lb Flat	6.19	---	6.09	---
40 Lb Ext	9.56	10.62	8.96	9.31
50 Lb Ext	12.56	12.43	12.36	12.15
60 Lb Ext	14.59	14.14	15.15	14.99
70 Lb Ext	14.64	15.27	14.32	14.84
100 Lb Ext	22.44	23.21	21.23	22.60

CROSS DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	4.53	---	4.53	---
50 Lb Flat	6.25	---	5.83	---
60 Lb Flat	7.72	---	7.59	---
70 Lb Flat	7.38	---	7.69	---
40 Lb Ext	8.94	9.68	8.42	9.72
50 Lb Ext	6.75	7.64	6.28	7.62
60 Lb Ext	9.51	10.55	9.05	10.17
70 Lb Ext	10.94	10.12	8.46	11.25
100 Lb Ext	12.23	14.60	12.08	15.31

Note: Average values exclude data for samples which were not of the normal weight for the stated grade.

Table 5
TENSILE STIFFNESS DATA

MACHINE DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	3.43	----	3.44	----
50 Lb Flat	4.39	----	4.44	----
60 Lb Flat	4.77	----	4.88	----
70 Lb Flat	5.53	----	5.68	----
40 Lb Ext	1.20	1.22	1.33	1.42
50 Lb Ext	1.54	1.39	1.59	1.58
60 Lb Ext	1.89	1.74	2.00	1.88
70 Lb Ext	2.06	1.43	2.19	1.68
100 Lb Ext	2.04	1.83	2.05	1.93

CROSS DIRECTION SUMMARY

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
40 Lb Flat	1.59	----	1.60	----
50 Lb Flat	2.05	----	2.14	----
60 Lb Flat	2.32	----	2.47	----
70 Lb Flat	2.79	----	2.90	----
40 Lb Ext	1.08	1.09	1.16	1.22
50 Lb Ext	1.49	1.48	1.59	1.55
60 Lb Ext	1.79	1.72	1.89	1.87
70 Lb Ext	2.10	2.06	2.24	2.12
100 Lb Ext	2.88	2.80	3.04	2.96

Note: Average values exclude data for samples which were not of the normal weight for the stated grade.

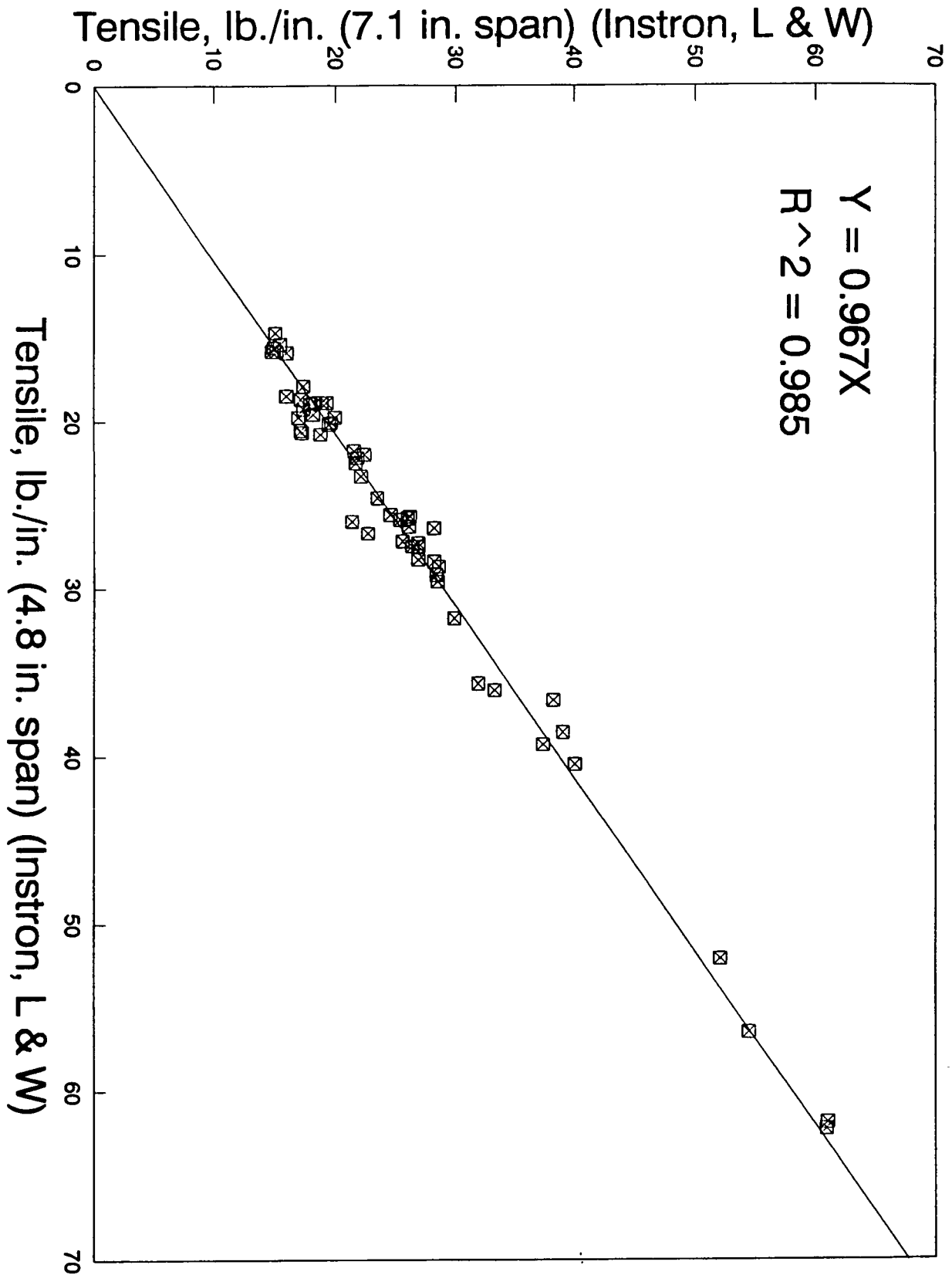


Figure 9

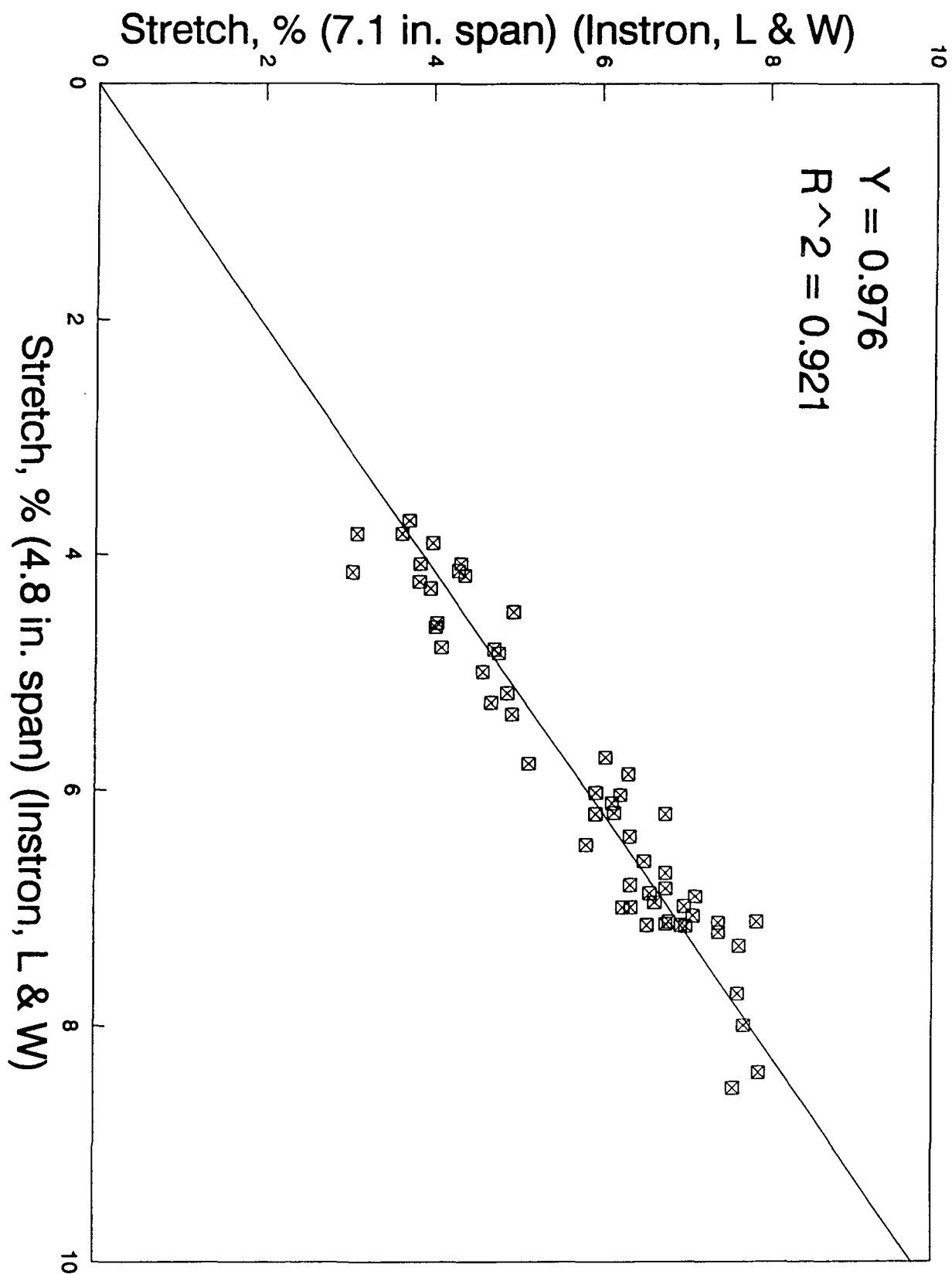


Figure 10

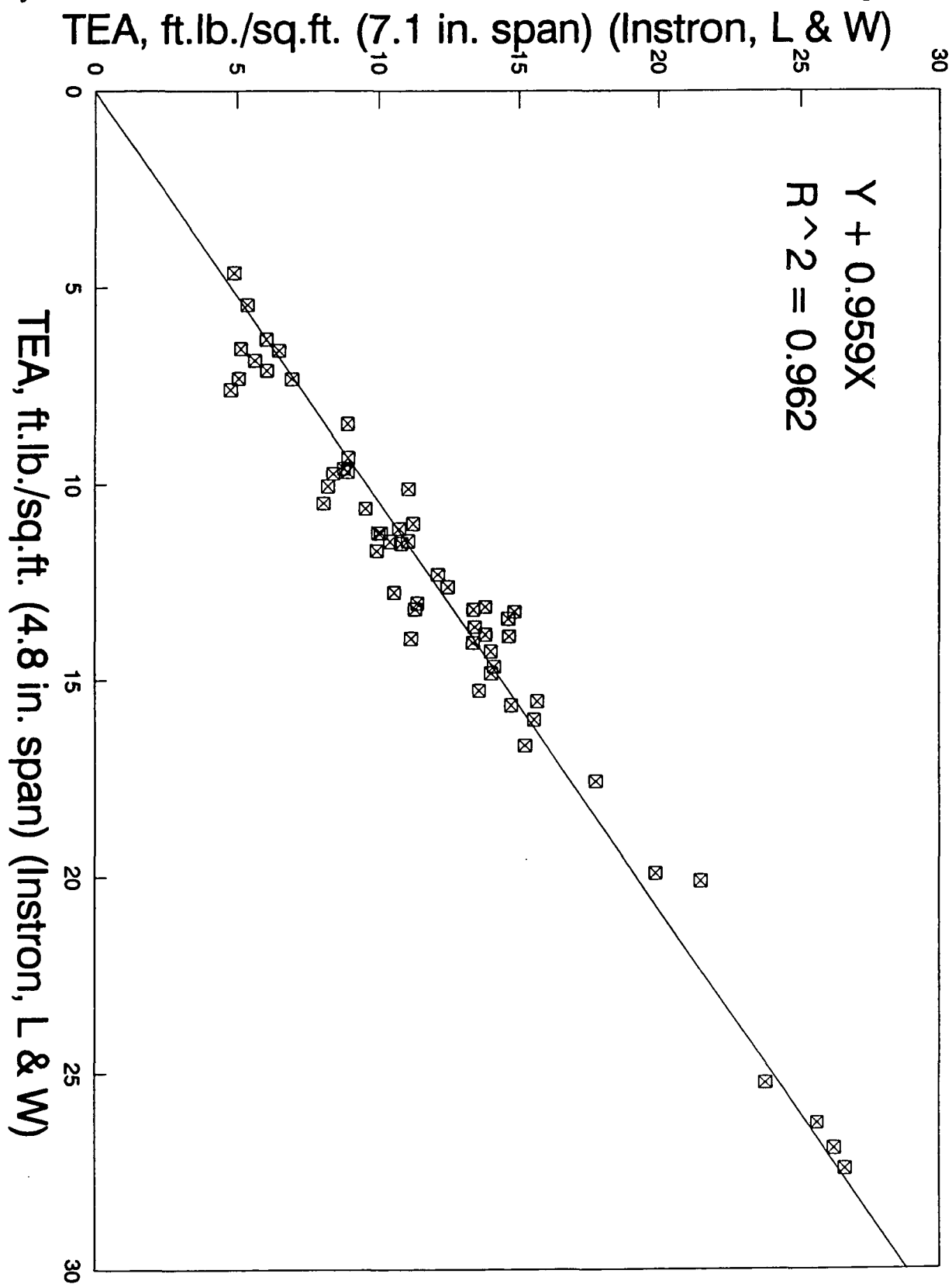


Figure 11

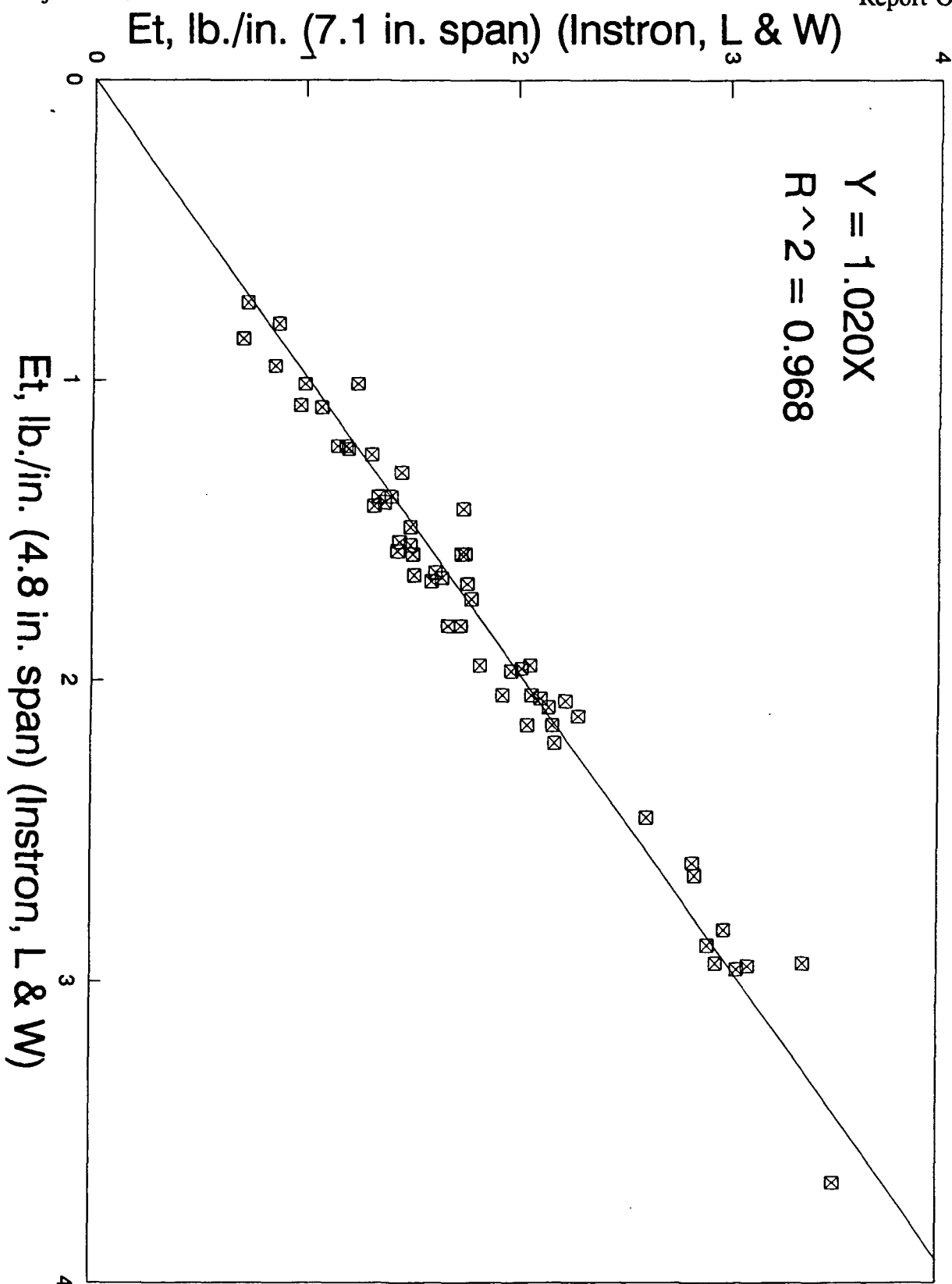


Figure 12

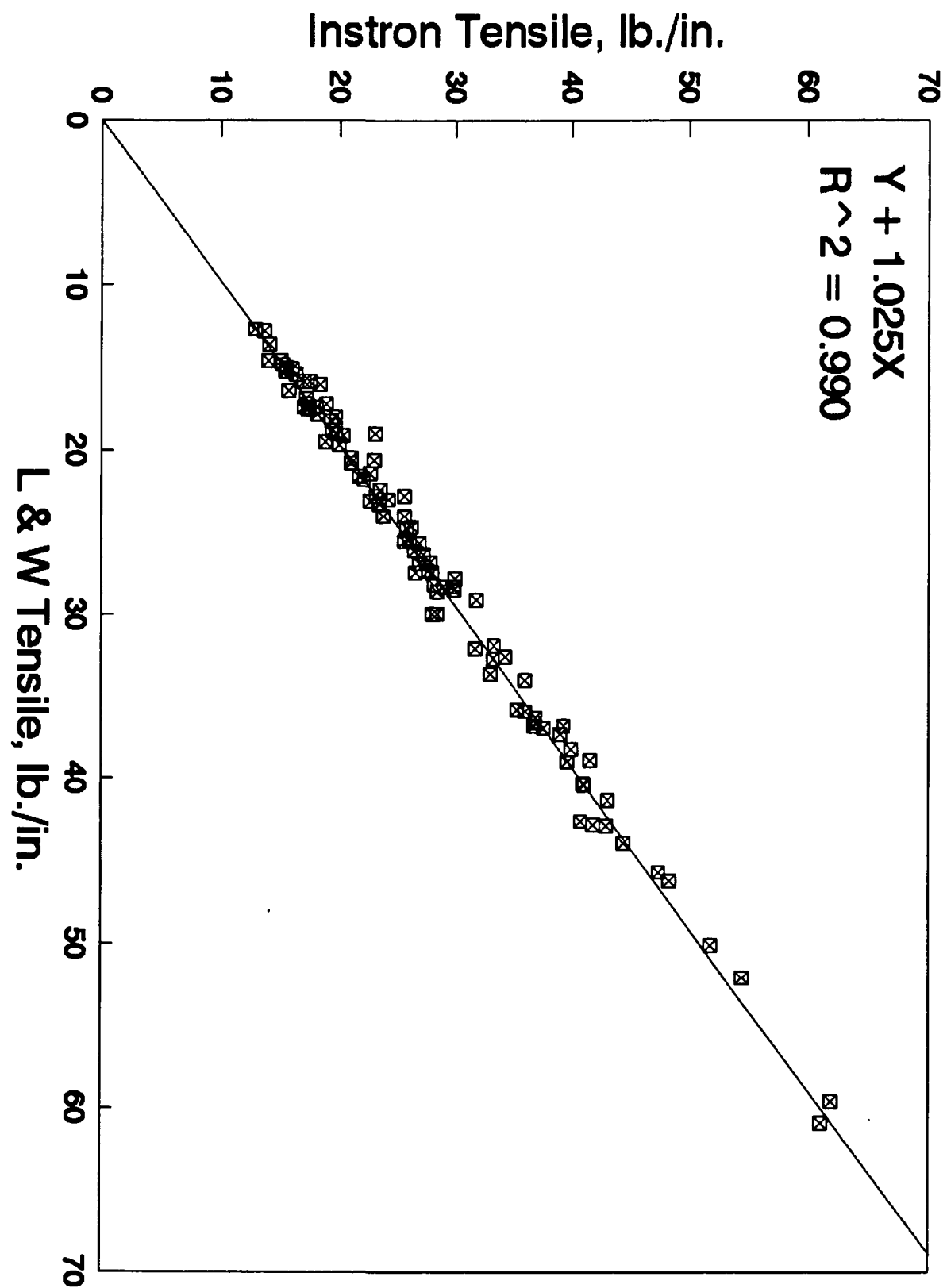


Figure 13

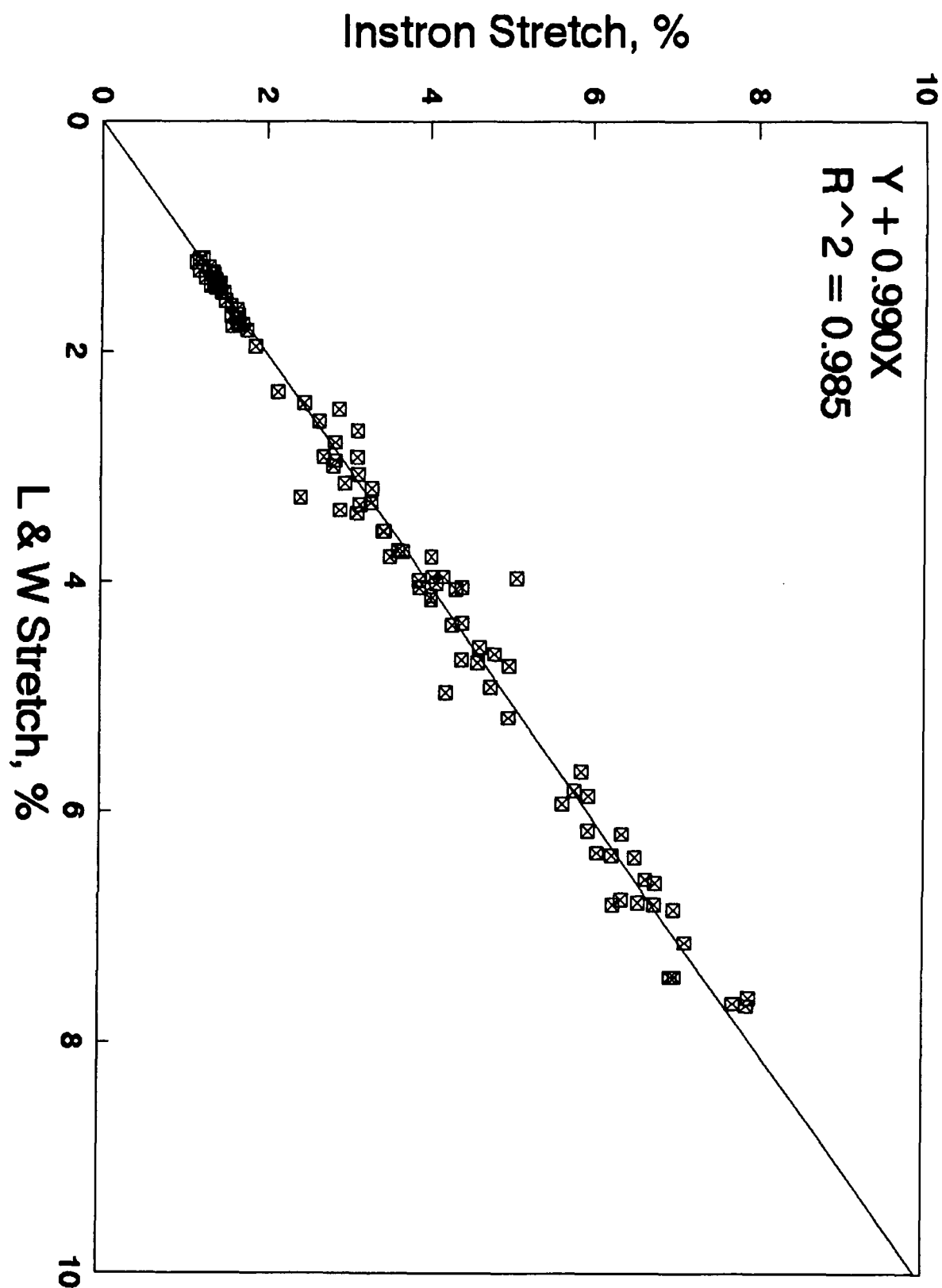


Figure 14

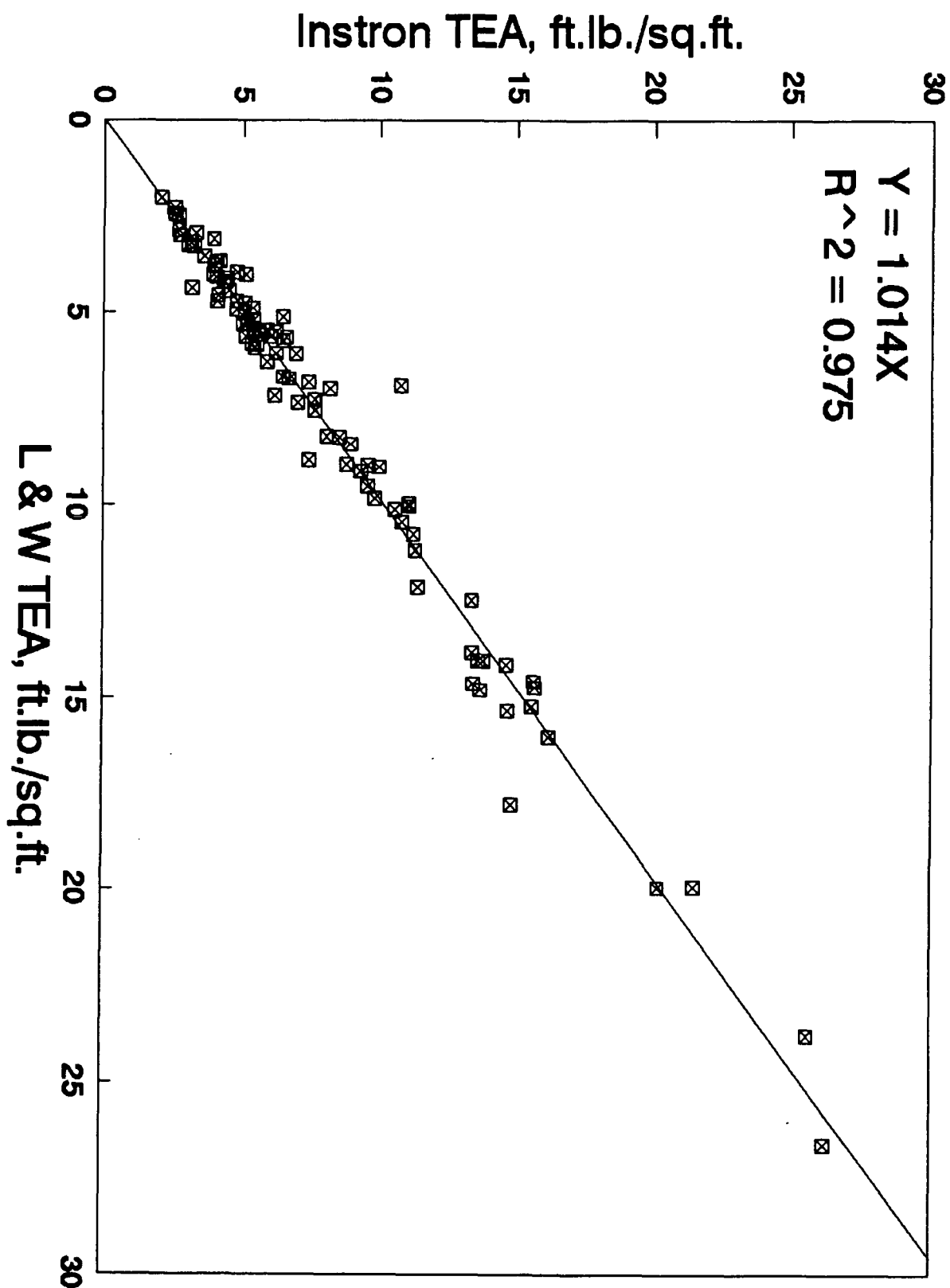


Figure 15

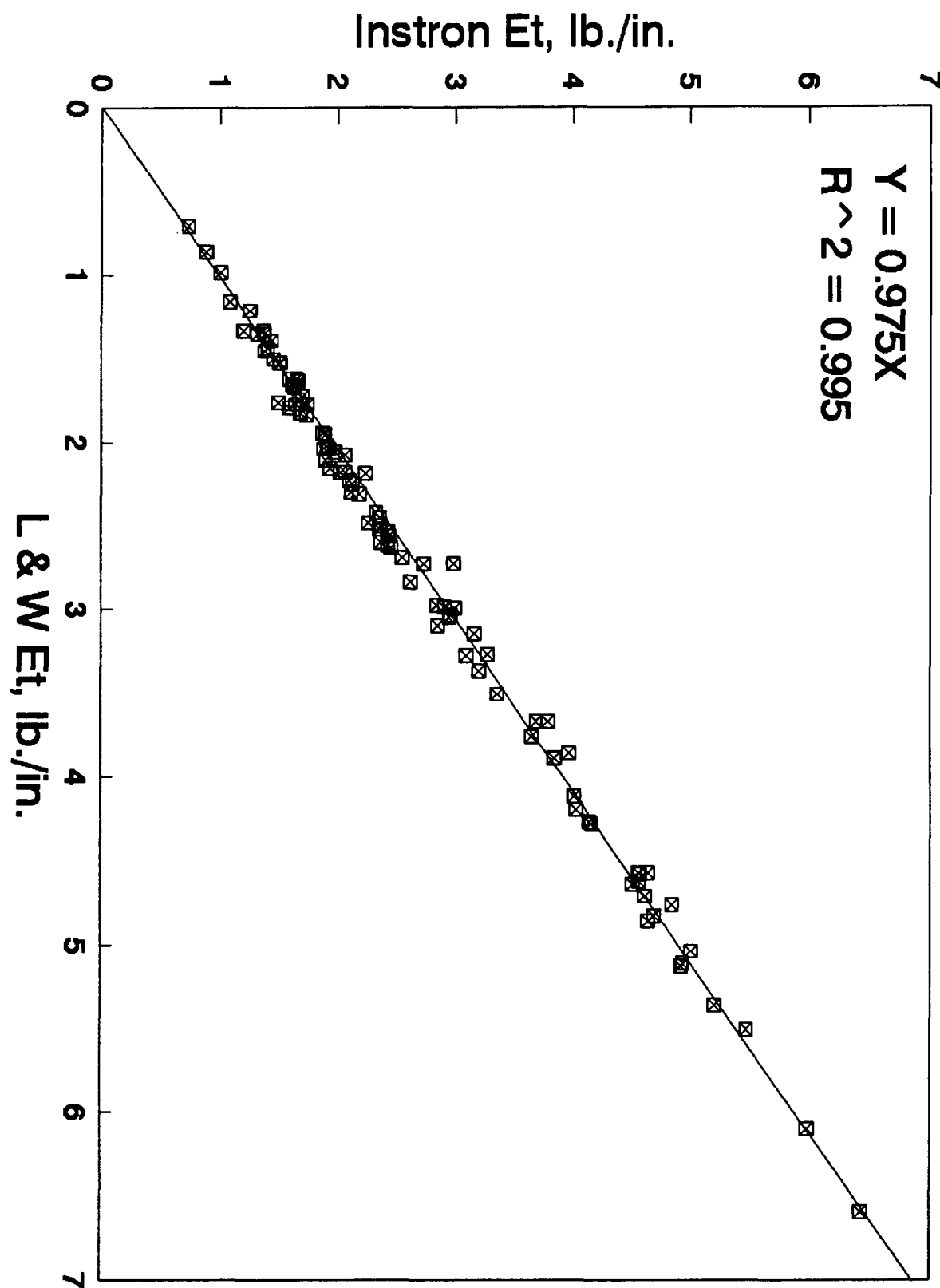


Figure 16

Moisture Content

The measured moisture content for each sample is tabulated in Table 6. The average moisture content for all samples is 7.3%. Comparison of results obtained for different geographic areas (not shown) indicate that the moisture content of bag paper manufactured in East Coast mills is 7.4%, whereas that for paper manufactured in West Coast mills is 7.0%. Presumably this difference is attributable to differences in fiber sources. The average moisture content of 7.3% will be used to calculate adjusted basis weight values for data submitted for the KPPD sponsored baseline program.

Table 6
MOISTURE CONTENT DATA

Sample Code	Moisture %	Sample Code	Moisture %	Sample Code	Moisture %
40 LB FLAT		50 LB FLAT		60 LB FLAT	
122	7.5	104	7.6	130	7.5
108	7.1	127	7.1	101	7.2
115	7.4	106	7.4	125	6.9
132	6.7	110	6.9	103	7.8
		129	7.4		
114	7.7	133	7.5	105	7.2
117	7.3	128	7.2	102	7.3
121	7.3	109	7.3	123	7.2
131	6.9	126	6.8	135	7.8
		119	7.2		
70 LB FLAT		40 LB EXT		50 LB EXT	
112	7.6	201	7.3	207	7.5
120	7.3	213	6.7	209	7.3
136	6.8			217	7.2
116	8.0			204	7.6
				220	7.5
60 LB EXT		70 LB EXT		100 LB EXT	
215	7.7	203	7.3	212	7.3
218	7.1	214	7.4	206	7.3
211	7.4	219	7.7	208	7.3
210	6.8				
202	7.2				

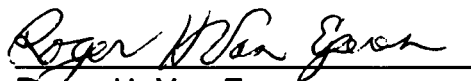
Grand Average = 7.30

Table 7
Statistical Data for Figures

Figure Number	X Coefficient	R. Squared	Standard Error of Y Estimate	Degrees of Freedom
1	0.934	0.983	7.178	95
2	0.949	0.982	7.537	95
3	0.940	0.983	7.173	95
4	0.947	0.991	5.316	95
5	0.943	0.985	6.910	383
6	0.986	0.986	1.275	191
7	1.004	0.977	1.329	59
8	0.980	0.983	1.094	131
9	0.967	0.985	1.326	55
10	0.976	0.921	0.388	55
11	0.959	0.962	1.035	55
12	1.020	0.968	0.122	55
13	1.025	0.990	1.062	95
14	0.990	0.985	0.242	95
15	1.014	0.975	0.778	95
16	0.975	0.995	0.095	95

THE INSTITUTE OF PAPER
SCIENCE AND TECHNOLOGY

Submitted by:

A handwritten signature in cursive script, reading "Roger H. Van Eperen", written over a horizontal line.

Roger H. Van Eperen
Principal Associate Technologist

Table A-I
TEAR DATA - 40 LB FLAT

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
122	42	93	87	87	91	89
108	43	92	84	86	84	86
115	40	104	92	97	97	95
132	41	98	89	89	89	89
114	40	91	75	78	79	80
117	42	105	91	97	94	95
121	44	97	87	89	89	89
131	41	66	68	67	68	66
Average		93.1	84.1	86.1	86.4	86.4
Std. Dev.		12.2	8.4	9.9	9.5	9.5

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
122	89	82	86	85	86
108	101	100	100	97	98
115	124	115	118	117	119
132	115	108	107	111	110
114	97	88	91	93	90
117	110	98	101	100	100
121	108	97	99	100	100
131	89	89	90	84	90
Average		104.3	97.1	98.9	99.2
Std. Dev.		12.4	10.8	10.3	11.5

Table A-2
TEAR DATA - 50 LB FLAT

Code	B.WT. LB.	MACHINE DIRECTION				
		Old	New	Digi	L & W	TMI
104	50	113	122	114	112	119
127	54	137	126	132	130	127
106	51	122	104	108	110	110
110	50	120	110	110	108	108
129*	43	112	102	104	108	107
133	54	118	110	110	113	111
128	53	140	122	126	119	127
109	52	104	100	101	100	102
126	53	119	115	110	113	115
119	51	99	97	99	100	100
Average		118.2	110.9	111.4	111.3	112.7
Std. Dev.		12.8	10.2	10.4	8.6	9.4
Average*		118.9	111.9	112.2	111.6	113.4
Std. Dev.*		13.3	10.3	10.7	9.0	9.7

CROSS DIRECTION						
Code		Old	New	Digi	L&W	TMI
104		126	123	123	121	124
127		142	130	136	126	132
106		131	118	120	126	122
110		135	126	127	126	127
129*		122	108	129	129	130
133		144	130	130	128	131
128		122	108	129	129	131
109		141	141	138	134	139
126		122	126	122	116	122
119		137	122	128	122	125
Average		132.3	123.2	128.3	125.8	128.3
Std. Dev.		8.8	9.1	6.0	5.1	5.6
Average*		133.5	124.9	128.2	125.4	128.1
Std. Dev. *		8.5	9.1	6.0	5.1	5.6

* Average and Standard deviation calculated omitting samples which werenot of the normal weight for this grade.

Table A-3
TEAR DATA - 60 LB FLAT

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
130	64	170	162	170	166	165
101	63	160	151	148	152	153
125	61	147	141	137	140	141
103	61	159	145	148	147	149
105	64	155	138	140	133	142
102	61	148	137	139	133	137
123	60	138	129	128	128	129
135	62	136	126	128	136	131
Average		151.6	141.1	142.1	141.7	143.5
Std. Dev.		11.7	11.9	13.5	12.4	11.9

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
130	167	159	155	162	163
101	193	187	183	191	188
125	159	153	153	150	152
103	136	137	134	134	136
105	182	171	173	173	174
102	162	154	155	155	158
123	175	159	161	152	156
135	162	158	159	165	159
Average	167.1	159.6	159.2	160.1	160.8
Std. Dev.	17.1	14.6	14.5	16.9	15.6

Table A-4
TEAR DATA - 70 LB FLAT

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
112	72	213	214	223	204	210
120	70	208	194	192	192	196
136	69	197	179	188	185	186
116	74	200	179	181	188	188
Average		204.5	191.3	196.1	192.3	195.3
Std. Dev.		7.2	16.4	18.5	8.3	11.0

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
112	191	188	182	188	187
120	238	192	197	194	199
136	187	176	171	166	174
116	193	173	184	174	180
Average	202.1	182.5	183.5	180.7	185.1
Std. Dev.	24.0	9.3	10.6	12.6	10.8

Table 5
TEAR DATA - 40 EXTENSIBLE

Code	B. WT. LB.	MACHINE DIRECTION				
		Old	New	Digi	L&W	TMI
201	40	115	104	106	110	108
213*	52	92	84	86	84	86
Average		80.5	73.1	74.3	75.4	75.6
Std. Dev.		34.1	31.0	31.4	32.3	32.1
Average*		115.4	104.4	106	109.9	108.3
Std. Dev.*		---	---	---	---	---

CROSS DIRECTION						
Code		Old	New	Digi	L&W	TMI
201		108	103	108	108	105
213		144	137	139	134	140
Average		126.4	120.1	123.2	121.3	122.5
Std. Dev.		25.5	24.4	22.2	18.3	24.4
Average*		108.3	102.8	107.5	108.3	105.2
Std. Dev.*		---	---	---	---	---

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-6
TEAR DATA - 50 EXTENSIBLE

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
207	53	124	116	119	119	115
209	53	148	133	133	147	135
217	50	151	140	145	138	141
204	51	104	95	98	94	97
220	50	107	102	108	107	105
Average		126.7	117.1	120.9	120.9	118.7
Std. Dev.		22.3	19.2	18.9	21.7	19.1

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
207	159	152	159	148	154
209	188	195	182	195	181
217	177	154	166	159	163
204	155	139	148	145	144
220	169	168	162	159	165
Average	169.6	161.7	163.3	161.1	161.6
Std. Dev.	13.5	21.5	12.5	19.7	13.8

Table 7
TEAR DATA - 60 EXTENSIBLE

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
215	62	138	134	141	143	133
218	63	170	168	157	161	164
211	58	179	169	172	171	173
210	63	152	152	133	148	140
202	62	149	144	145	149	143
Average		157.6	153.5	149.6	154.5	150.7
Std. Dev.		16.4	15.0	15.1	11.4	17.2

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
215	177	173	181	170	172
218	225	222	212	214	216
211	184	163	162	166	166
210	198	181	185	177	187
202	192	194	192	187	186
Average		194.8	186.7	182.6	185.3
Std. Dev.		18.4	22.8	19.0	19.4

Table A-8
TEAR DATA - 70 EXTENSIBLE

		MACHINE DIRECTION				
Code	B. WT. LB.	Old	New	Digi	L&W	TMI
203	70	184	174	169	161	170
214	68	195	186	190	181	179
219	96	234	215	221	212	224
Average		204.4	191.8	193.1	184.5	190.8
Std. Dev.		26.1	21.0	26.0	25.7	28.9

		CROSS DIRECTION				
Code		Old	New	Digi	L&W	TMI
203		210	198	208	214	200
214		241	218	219	223	225
219		387	347	358	357	361
Average		279.2	254.3	261.7	264.5	262.2
Std. Dev.		94.7	80.9	83.6	80.4	86.6

Table A-9
TEAR DATA - 100 EXTENSIBLE

MACHINE DIRECTION

Code	B. WT. LB.	Old	New	Digi	L&W	TMI
212	93	280	257	268	277	264
206	101	294	276	273	271	279
208	104	282	251	267	267	265
Average		285.5	261.1	269.3	271.6	269.3
Std. Dev.		7.7	12.8	3.4	5.1	8.2

CROSS DIRECTION

Code	Old	New	Digi	L&W	TMI
212	300	279	293	281	283
206	329	312	323	301	309
208	354	335	340	341	342

Table A-10
TENSILE DATA

MACHINE DIRECTION 40 LB FLAT

Code	B. WT. LB.	Schopper	Instron	L & W
122	42	24.9	24.2	23.0
108	43	27.2	27.8	26.8
115	40	24.8	25.6	25.5
132	41	30.3	31.8	29.1
114	40	26.6	26.5	27.4
117	42	26.3	25.6	24.0
121	44	28.8	30.0	27.8
131	41	27.6	27.6	27.3
Average		27.1	27.4	26.4
Std. Dev.		1.87	2.50	2.05

CROSS DIRECTION 40 LB FLAT

Code	Schopper	Instron	L & W
122	18.2	17.3	17.5
108	15.6	15.0	14.6
115	13.8	14.1	13.6
132	13.5	12.9	12.7
114	13.7	13.6	12.8
117	16.6	17.2	16.9
121	15.5	14.0	14.6
131	16.0	15.4	15.2
Average		15.4	14.9
Std. Dev.		1.64	1.62

Table A-11
TENSILE DATA

MACHINE DIRECTION 50 LB FLAT

Code	B. Wt. Lb.	Schopper	Instron	L & W
104	50	35.4	36.9	36.6
127	54	33.2	33.2	32.7
106	51	37.3	37.6	36.9
110	50	37.3	39.3	36.8
129*	43	23.1	23.0	20.6
133	54	32.3	33.0	33.6
128	53	34.2	35.3	35.8
109	52	44.4	44.4	43.9
126	53	34.8	36.0	34.0
119	51	37.6	41.6	38.9
Average		35.0	36.0	35.0
Std. Dev.		5.36	5.80	5.96
Average*		36.3	37.5	36.6
Std. Dev.*		3.6	3.8	3.4

CROSS DIRECTION 50 LB FLAT

Code	Schopper	Instron	L & W
104	20.5	19.7	18.0
127	24.3	23.4	23.3
106	25.7	23.8	24.0
110	18.4	17.5	15.8
129*	17.4	15.7	16.4
133	25.6	25.6	22.8
128	18.9	17.4	17.4
109	19.8	19.7	18.5
126	18.5	18.1	17.8
119	16.2	17.0	15.8
Average		20.5	19.8
Std. Dev.		3.45	3.35
Average*		20.9	20.2
Std. Dev.*		3.5	3.2

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-12
TENSILE DATA

MACHINE DIRECTION 60 LB FLAT

Code	B. WT. LB.	Schopper	Instron	L & W
130	64	39.2	41.1	40.4
101	63	38.7	41.0	40.3
125	61	46.8	47.4	45.7
103	61	36.6	36.8	36.8
105	64	42.9	41.8	42.8
102	61	36.8	36.9	36.3
123	60	44.6	43.1	41.3
135	62	42.9	40.8	42.6
Average		41.1	41.1	40.8
Std. Dev.		3.77	3.39	3.12

CROSS DIRECTION 60 LB FLAT

Code	Schopper	Instron	L & W
130	29.8	29.0	28.3
101	24.1	23.2	22.8
125	21.6	21.0	20.8
103	33.4	31.7	32.1
105	23.8	22.7	23.1
102	20.6	19.7	19.0
123	21.3	21.0	20.5
135	19.5	20.4	19.1
Average		24.3	23.6
Std. Dev.		4.87	4.39
			23.2
			4.67

Table A-13
TENSILE DATA

MACHINE DIRECTION 70 LB FLAT

Code	B. WT. LB.	Schopper	Instron	L & W
112	72	47.2	48.3	46.2
120	70	50.7	51.8	50.1
136	69	59.3	61.9	59.6
116	74	44.0	43.0	42.9
Average		50.3	51.3	49.7
Std. Dev.		6.59	7.97	7.23

CROSS DIRECTION 70 LB FLAT

Code	Schopper	Instron	L & W
112	30.7	28.4	30.0
120	27.5	27.2	26.3
136	26.0	25.8	24.7
116	32.1	28.0	27.4
Average		29.1	27.1
Std. Dev.		2.81	2.23

Table A-14
TENSILE DATA

MACHINE DIRECTION 40 LB EXT

B. WT. Code LB.	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	19.5	18.0	19.0	17.4	17.9
213*	20.7	18.8	20.8	19.5	20.2
Average	20.1	18.4	19.9	18.5	19.1
Std. Dev.	0.85	0.57	1.27	1.48	1.63
Average*	19.5	18.0	19.0	17.4	17.9
Std. Dev.*	---	---	---	---	---

CROSS DIRECTION 40 LB EXT

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	15.7	15.2	15.8	14.8	15.8
213*	18.5	18.9	18.9	17.2	18.7
Average	17.1	17.1	17.4	16.0	17.3
Std. Dev.	1.98	2.62	2.19	1.70	2.05
Average*	15.7	15.2	15.8	14.8	15.8
Std. Dev.*	---	---	---	---	---

* Average and standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-15
TENSILE DATA

MACHINE DIRECTION 50 LB EXT

B. Wt. Code LB.	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207	53	28.2	28.0	30.0	
209	53	21.4	19.3	18.9	18.2
217	50	20.4	20.0	19.8	19.7
204	51	27.7	28.4	29.2	28.6
220	50	22.6	23.5	24.6	22.4
Average		24.1	23.8	23.1	23.8
Std. Dev.		3.64	4.29	4.76	5.28

CROSS DIRECTION 50 LB EXT

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207	16.5	16.3		15.4	
209	16.5	15.5	15.4	15.0	15.6
217	21.9	21.7	22.5	21.6	21.8
204	17.6	17.3	20.7	17.2	20.6
220	16.0	16.0	15.9	15.1	14.7
Average	17.7	17.4	18.6	16.9	18.2
Std. Dev.	2.42	2.51	3.52	2.80	3.55

Table A-16
TENSILE DATA

MACHINE DIRECTION 60 LB EXT

B. WT. Code	LB.	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	62	37.2	36.0		35.9	
211	63	23.5	22.1	23.3	21.8	22.2
210	58	28.5	26.9	28.3	26.9	27.5
202	63	23.3	22.7	26.7	21.4	26.0
218	62	26.8	26.0	25.8	25.4	25.9
Average		27.9	26.7	26.0	26.3	25.4
Std. Dev.		5.67	5.57	2.09	5.86	2.26

CROSS DIRECTION 60 LB EXT

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	19.7	19.4		18.8	
211	26.0	26.9	27.3	25.6	27.2
210	28.9	28.2	28.4	28.2	26.4
202	18.8	18.4	18.9	16.0	18.5
218	18.4	17.0	19.8	17.4	19.3
Average		22.4	22.0	21.2	22.9
Std. Dev.		4.78	5.18	5.38	4.58

Table A-17
TENSILE DATA

MACHINE DIRECTION 70 LB EXT

B. WT. Code LB.	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203 70	33.8	34.3		32.6	
214 68	27.1	26.4	27.5	26.1	26.3
219* 96	62.3	61.0	61.9	60.9	62.3
Average	41.1	40.6	44.7	39.9	44.3
Std. Dev.	18.7	18.1	24.3	18.5	25.5
Average*	30.5	30.4	27.5	29.4	26.3
Std. Dev.*	4.7	5.6	---	4.6	---

CROSS DIRECTION 70 LB EXT

Code	Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203 70	21.4	23.1		19.0	
214 68	25.9	26.2	25.7	24.6	25.6
219* 96	30.9	29.9	31.8	28.5	29.6
Average	26.1	26.4	28.8	24.0	27.6
Std. Dev.	4.75	3.40	4.31	4.78	2.83
Average*	23.7	24.7	25.7	21.8	25.6
Std. Dev.*	3.18	2.19	---	3.96	---

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-18
TENSILE DATA

MACHINE DIRECTION 100 LB EXT

B. WT. Code LB.		Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	40.6	39.6		39.0	
206	101	37.6	40.0	40.5	38.2	36.7
208	104	52.8	54.5	56.5	52.1	52.1
Average		43.7	44.7	48.5	43.1	44.4
Std. Dev.		8.05	8.49	11.31	7.80	10.89

CROSS DIRECTION 100 LB EXT

Code		Schopper 7.1 in	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	29.1	29.8		28.3	
206	101	38.4	39.0	38.6	37.3	39.3
208	104	34.3	33.3	36.1	31.9	35.7
Average		33.9	34.0	37.4	32.5	37.5
Std. Dev.		4.66	4.64	1.77	4.53	2.55

Table A-19
STRETCH DATA

MACHINE DIRECTION 40 LB FLAT

Code	B. WT. LB.	Instron	L & W
122	42	1.36	1.37
108	43	1.21	1.18
115	40	1.56	1.59
132	41	1.35	1.32
114	40	1.35	1.42
117	42	1.28	1.26
121	44	1.18	1.19
131	41	1.25	1.35
Average		1.32	1.34
Std. Dev.		0.119	0.133

CROSS DIRECTION 40 LB FLAT

Code	Instron	L & W
122	4.40	4.68
108	3.44	3.56
115	3.42	3.56
132	2.81	3.00
114	3.11	2.69
117	2.64	2.61
121	2.42	3.27
131	4.04	3.96
Average		3.29
Std. Dev.		0.684
		3.42
		0.687

Table A-20
STRETCH DATA

MACHINE DIRECTION 50 LB FLAT

Code	Instron	L & W
104	1.44	1.48
127	1.39	1.41
106	1.71	1.75
110	1.47	1.48
129*	1.18	1.29
133	1.58	1.78
128	1.14	1.22
109	1.86	1.95
126	1.42	1.40
119	1.33	1.30
Average	1.45	1.51
Std. Dev.	0.221	0.241
Average*	1.48	1.53
Std. Dev.*	0.21	0.24

CROSS DIRECTION 50 LB FLAT

Code	Instron	L & W
104	2.88	2.50
127	3.27	3.32
106	4.62	4.57
110	3.10	2.92
129*	4.21	4.96
133	2.83	2.79
128	2.95	3.15
109	4.28	4.38
126	3.14	3.33
119	4.17	3.96
Average	3.55	3.59
Std. Dev.	0.689	0.831
Average*	3.47	3.44
Std. Dev.*	0.69	0.72

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-21
STRETCH DATA

MACHINE DIRECTION 60 LB FLAT

Code	B. WT. LB.	Instron	L & W
130	64	1.57	1.69
101	63	1.41	1.42
125	61	1.49	1.55
103	61	1.76	1.81
105	64	1.64	1.75
102	61	1.37	1.44
123	60	1.64	1.70
135	62	1.31	1.42
Average		1.52	1.60
Std. Dev.		0.155	0.159

CROSS DIRECTION 60 LB FLAT

Code	Instron	L & W
130	4.02	3.79
101	3.60	3.73
125	3.10	3.41
103	5.65	5.93
105	2.69	2.92
102	2.46	2.45
123	2.83	2.95
135	4.40	4.05
Average		3.59
Std. Dev.		1.068
		3.65
		1.063

Table A-22
STRETCH DATA

MACHINE DIRECTION 70 LB FLAT

Code	B. WT. LB.	Instron	L & W
112	72	1.65	1.68
120	70	1.37	1.38
136	69	1.63	1.63
116	74	1.66	1.77
Average		1.58	1.62
Std. Dev.		0.139	0.167

CROSS DIRECTION 70 LB FLAT

Code	Instron	L & W
112	2.90	3.38
120	4.02	4.16
136	3.29	3.19
116	2.14	2.35
Average		3.09
Std. Dev.		0.784
		3.27
		0.743

Table A-23
STRETCH DATA

MACHINE DIRECTION 40 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	40	6.38	6.81	6.19	6.20
213*	52	6.98	7.15	7.43	7.21
Average		6.68	6.98	6.81	6.71
Std. Dev.		0.424	0.240	0.877	0.714
Average*		6.38	6.81	6.19	6.20
Std. Dev.*		---	---	---	---

CROSS DIRECTION 40 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	6.67	6.96	6.58	7.15
213*	4.81	4.84	4.63	5.00
Average	5.74	5.90	5.61	4.05
Std. Dev.	1.315	1.499	1.379	3.668
Average*	6.67	6.96	6.58	7.15
Std. Dev.*	---	---	---	---

* Average and standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-24
STRETCH DATA

MACHINE DIRECTION 50 LB EXT

Code	B. Wt. LB.	Instron		L & W	
		7.1 in	4.8 in	7.1 in	4.8 in
207	53	6.38		6.75	
209	53	6.54	6.61	6.39	7.00
217	50	6.79	6.71	6.8	6.84
204	51	6.08	5.73	6.35	5.87
220	50	7.74	8.00	7.66	7.73
Average		6.71	6.76	6.79	6.86
Std. Dev.		0.633	0.935	0.527	0.765

CROSS DIRECTION 50 LB EXT

Code	Instron		L & W	
	7.1 in	4.8 in	7.1 in	4.8 in
207	4.08		4.02	
209	4.02	3.90	4.12	4.79
217	5.97	6.21	5.86	6.47
204	3.12	3.82	3.07	4.15
220	4.41	4.18	4.36	4.08
Average		4.32	4.53	4.29
Std. Dev.		1.039	1.132	1.007

Table A-25
STRETCH DATA

MACHINE DIRECTION 60 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	62	5.79		5.81	
211	63	7.04	7.16	7.43	7.13
210	58	6.26	6.05	6.37	6.40
202	63	7.92	8.40	7.61	8.53
218	62	6.79	6.21	6.61	6.88
Average		6.76	6.96	6.77	7.24
Std. Dev.		0.809	1.081	0.750	0.915

CROSS DIRECTION 60 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	4.60		4.71	
211	7.16	6.91	7.13	7.07
210	3.66	3.82	3.74	3.71
202	4.33	4.14	4.07	4.58
218	4.98	5.36	5.18	5.78
Average	4.95	5.06	4.97	5.29
Std. Dev.	1.328	1.402	1.332	1.462

Table A-26
STRETCH DATA

MACHINE DIRECTION 70 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	5.88		5.65	
214	68	6.29	7.00	6.80	7.14
219*	96	5.97	6.03	6.16	6.12
Average		6.05	6.52	6.20	6.63
Std. Dev.		0.22	0.69	0.58	0.72
Average*		6.09	7.00	6.23	7.14
Std. Dev.*		0.29	---	0.81	---

CROSS DIRECTION 70 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	5.08		3.97	
214	68	4.99	4.49	4.73	5.26
219*	96	3.86	4.23	3.99	4.29
Average		4.64	4.36	4.23	4.78
Std. Dev.		0.68	0.18	0.43	0.69
Average*		5.04	4.49	4.35	5.26
Std. Dev.*		0.06	---	0.54	---

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-27
STRETCH DATA

MACHINE DIRECTION 100 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	6.59		6.78	
206	101	7.89	7.12	7.68	7.33
208	104	7.02	6.99	6.84	7.12
Average		7.17	7.06	7.10	7.23
Std. Dev.		0.662	0.092	0.503	0.148

CROSS DIRECTION 100 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	3.50		3.79	
206	101	4.76	4.81	4.92	5.18
208	104	3.87	4.08	4.05	4.62
Average		4.04	4.45	4.25	4.90
Std. Dev.		0.648	0.516	0.592	0.396

Table A-28
TEA DATA

MACHINE DIRECTION 40 LB FLAT

Code	B. WT. LB.	Instron	L & W
122	42	2.58	2.44
108	43	2.58	2.43
115	40	3.13	3.17
132	41	3.29	2.93
114	40	2.74	3.00
117	42	2.52	2.27
121	44	2.66	2.47
131	41	2.70	2.85
Average		2.78	2.70
Std. Dev.		0.281	0.330

CROSS DIRECTION 40 LB FLAT

Code	Instron	L & W
122	7.03	7.34
108	4.75	4.71
115	4.29	4.22
132	3.22	3.28
114	3.94	3.09
117	3.96	3.79
121	3.17	4.36
131	5.87	5.46
Average		4.53
Std. Dev.		1.330
		1.368

Table A-29
TEA DATA

MACHINE DIRECTION 50 LB FLAT

Code	Instron	L & W
104	4.04	4.08
127	3.59	3.55
106	5.05	5.00
110	4.42	4.12
129*	2.06	2.01
133	4.06	4.72
128	3.04	3.26
109	6.48	6.67
126	4.03	3.69
119	4.16	3.68
Average	4.09	4.08
Std. Dev.	1.166	1.225
Average*	4.32	4.31
Std. Dev.*	0.98	1.05

CROSS DIRECTION 50 LB FLAT

Code	Instron	L & W
104	5.10	4.03
127	6.70	6.72
106	9.30	9.11
110	4.78	3.97
129*	6.18	7.16
133	6.22	5.50
128	4.78	4.93
109	7.63	7.26
126	5.18	5.29
119	6.60	5.65
Average	6.25	5.96
Std. Dev.	1.427	1.603
Average*	6.25	5.83
Std. Dev.*	1.51	1.64

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-30
TEA DATA

MACHINE DIRECTION 60 LB FLAT

Code	B. WT. LB.	Instron	L & W
130	64	4.99	5.31
101	63	4.47	4.44
125	61	5.40	5.40
103	61	5.14	5.26
105	64	5.32	5.80
102	61	3.92	4.03
123	60	5.66	5.57
135	62	4.10	4.54
Average		4.87	5.01
Std. Dev.		0.638	0.666

CROSS DIRECTION 60 LB FLAT

Code	Instron	L & W
130	9.96	9.01
101	7.64	7.55
125	5.87	6.27
103	14.71	15.35
105	5.42	5.92
102	4.35	4.20
123	5.58	5.44
135	8.19	6.96
Average	7.72	7.59
Std. Dev.	3.354	3.449

Table A-31
TEA DATA

MACHINE DIRECTION 70 LB FLAT

Code	B. WT. LB.	Instron	L & W
112	72	6.20	6.05
120	70	5.39	5.19
136	69	7.66	7.27
116	74	5.52	5.84
Average		6.19	6.09
Std. Dev.		1.041	0.869

CROSS DIRECTION 70 LB FLAT

Code	Instron	L & W
112	7.43	8.84
120	9.56	9.50
136	7.42	6.80
116	5.11	5.63
Average		7.38
Std. Dev.		1.817
		7.69
		1.792

Table A-32
TEA DATA

MACHINE DIRECTION 40 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	40	9.56	10.62	8.96	9.31
213*	52	11.40	13.04	12.13	12.30
Average		10.48	11.83	10.55	10.81
Std. Dev.		1.301	1.711	2.242	2.114
Average*		9.56	10.62	8.96	9.31
Std. Dev.*		---	---	---	---

CROSS DIRECTION 40 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	8.94	9.68	8.42	9.72
213*	6.94	7.31	6.06	7.10
Average	7.94	8.50	7.24	8.41
Std. Dev.	1.414	1.676	1.669	1.853
Average*	8.94	9.68	8.42	9.72
Std. Dev.*	---	---	---	---

* Average and standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-33
TEA DATA

MACHINE DIRECTION 50 LB EXT

B. Wt. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207	53	13.71		14.80	
209	53	11.07	11.45	9.94	11.69
217	50	11.25	11.01	10.75	11.14
204	51	13.39	13.20	13.82	13.14
220	50	13.38	14.06	12.48	12.62
Average		12.56	12.43	12.36	12.15
Std. Dev.		1.286	1.441	2.034	0.900

CROSS DIRECTION 50 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207		6.46		5.71	
209		6.04	6.31	5.63	6.84
217		10.82	11.51	10.43	11.46
204		5.06	7.30	4.76	7.58
220		5.36	5.43	4.88	4.61
Average		6.75	7.64	6.28	7.62
Std. Dev.		2.342	2.692	2.358	2.853

Table A-34
TEA DATA

MACHINE DIRECTION 60 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	62	16.20	16.03	16.03	
211	63	13.44	13.65	14.64	13.44
210	58	13.81	13.85	14.03	14.28
202	63	14.86	13.26	17.79	17.59
218	62	14.66	13.90	14.14	14.66
Average		14.59	14.14	15.15	14.99
Std. Dev.		1.072	1.087	1.780	1.805

CROSS DIRECTION 60 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
215	8.54		8.25	
211	15.68	15.54	14.75	15.64
210	8.80	9.59	8.93	8.44
202	6.48	6.59	5.12	6.55
218	8.07	10.48	8.22	10.05
Average	9.51	10.55	9.05	10.17
Std. Dev.	3.563	3.720	3.510	3.917

Table A-35
TEA DATA

MACHINE DIRECTION 70 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	15.67		14.59	
214	68	13.61	15.27	14.04	14.84
219*	96	26.22	26.92	26.62	27.44
Average		18.50	21.10	18.42	21.14
Std. Dev.		6.76	8.24	7.11	8.91
Average*		14.64	15.27	14.32	14.84
Std. Dev.*		1.46	---	0.39	---

CROSS DIRECTION 70 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	10.79		6.90	
214	68	11.09	10.12	10.01	11.25
219*	96	10.57	12.76	10.10	11.24
Average		10.82	11.44	9.00	11.25
Std. Dev.		0.26	1.87	1.82	0.01
Average*		10.94	10.12	8.46	11.25
Std. Dev.*		0.21	---	2.20	---

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-36
TEA DATA

MACHINE DIRECTION 100 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	20.21		19.95	
206	101	21.51	20.13	19.94	19.93
208	104	25.61	26.28	23.79	25.26
Average		22.44	23.21	21.23	22.60
Std. Dev.		2.818	4.349	2.220	3.769

CROSS DIRECTION 100 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	9.83		9.82	
206	101	15.56	16.01	15.24	16.67
208	104	11.31	13.19	11.17	13.95
Average		12.23	14.60	12.08	15.31
Std. Dev.		2.974	1.994	2.821	1.923

Table A-37
TENSILE STIFFNESS DATA

MACHINE DIRECTION 40 LB FLAT

Code	B. WT. LB.	Instron	L & W
122	42	3.00	3.00
108	43	3.66	3.76
115	40	2.96	3.04
132	41	3.97	3.86
114	40	3.20	3.37
117	42	3.16	3.15
121	44	3.80	3.67
131	41	3.70	3.67
Average		3.43	3.44
Std. Dev.		0.394	0.344

CROSS DIRECTION 40 LB FLAT

Code	Instron	L & W
122	1.65	1.77
108	1.59	1.62
115	1.38	1.35
132	1.37	1.33
114	1.52	1.52
117	1.88	1.94
121	1.67	1.63
131	1.64	1.67
Average		1.59
Std. Dev.		0.166
		1.60
		0.204

Table A-38
TENSILE STIFFNESS DATA

MACHINE DIRECTION 50 LB FLAT

Code	Instron	L & W
104	4.16	4.28
127	4.14	4.27
106	4.01	4.12
110	4.56	4.57
129*	2.99	2.73
133	3.85	3.89
128	4.61	4.71
109	4.69	4.83
126	4.64	4.57
119	4.85	4.76
Average	4.25	4.27
Std. Dev.	0.553	0.621
Average*	4.39	4.44
Std. Dev.*	0.35	0.32

CROSS DIRECTION 50 LB FLAT

Code	Instron	L & W
104	2.10	2.23
127	2.43	2.62
106	1.90	2.11
110	1.71	1.72
129*	1.44	1.39
133	2.73	2.73
128	1.93	2.04
109	1.90	1.95
126	2.13	2.25
119	1.66	1.62
Average	1.99	2.07
Std. Dev.	0.377	0.422
Average*	2.05	2.14
Std. Dev.*	0.34	0.37

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade.

Table A-39
TENSILE STIFFNESS DATA

MACHINE DIRECTION 60 LB FLAT

Code	B. WT. LB.	Instron	L & W
130	64	4.56	4.62
101	63	4.94	5.11
125	61	5.48	5.51
103	61	4.03	4.20
105	64	4.64	4.86
102	61	4.57	4.58
123	60	5.01	5.04
135	62	4.92	5.13
Average		4.77	4.88
Std. Dev.		0.425	0.407

CROSS DIRECTION 60 LB FLAT

Code	Instron	L & W
130	2.55	2.69
101	2.43	2.61
125	2.19	2.31
103	2.27	2.48
105	2.46	2.63
102	2.33	2.42
123	2.44	2.56
135	1.91	2.02
Average		2.32
Std. Dev.		0.202
		2.47
		0.218

Table A-40
TENSILE STIFFNESS DATA

MACHINE DIRECTION 70 LB FLAT

Code	B. WT. LB.	Instron	L & W
112	72	5.21	5.36
120	70	5.98	6.10
136	69	6.43	6.60
116	74	4.51	4.64
Average		5.53	5.68
Std. Dev.		0.848	0.858

CROSS DIRECTION 70 LB FLAT

Code	Instron	L & W
112	3.09	3.28
120	2.43	2.54
136	2.37	2.50
116	3.27	3.27
Average		2.79
Std. Dev.		0.457
		2.90
		0.436

Table A-41
TENSILE STIFFNESS DATA

MACHINE DIRECTION 40 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	40	1.20	1.22	1.33	1.42
213*	52	1.38	1.41	1.45	1.54
Average		1.29	1.32	1.39	1.48
Std. Dev.		0.127	0.134	0.085	0.085
Average*		1.20	1.22	1.33	1.42
Std. Dev.*		---	---	---	---

CROSS DIRECTION 40 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
201	1.08	1.09	1.16	1.22
213*	0.88	0.81	0.86	0.95
Average	0.98	0.95	1.01	1.09
Std. Dev.	0.141	0.198	0.212	0.191
Average*	1.08	1.09	1.16	1.22
Std. Dev.*	---	---	---	---

* Average and standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-42
TENSILE STIFFNESS DATA

MACHINE DIRECTION 50 LB EXT

B. Wt. Code LB.	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207 53	1.69		1.82	
209 53	1.46	1.31	1.50	1.55
217 50	1.32	1.25	1.35	1.39
204 51	1.98	1.97	2.06	2.15
220 50	1.25	1.01	1.21	1.23
Average	1.54	1.39	1.59	1.58
Std. Dev.	0.298	0.411	0.348	0.402

CROSS DIRECTION 50 LB EXT

Code	Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
207	1.64		1.66	
209	1.62	1.64	1.65	1.66
217	1.50	1.49	1.76	1.58
204	1.94	2.05	2.16	2.09
220	0.73	0.74	0.71	0.86
Average	1.49	1.48	1.59	1.55
Std. Dev.	0.453	0.547	0.533	0.510

Table A-43
TENSILE STIFFNESS DATA

MACHINE DIRECTION 60 LB EXT

B. WT. Code	LB.	Instron		L & W	
		7.1 in	4.8 in	7.1 in	4.8 in
215	62	2.36		2.52	
211	63	1.60	1.67	1.79	1.73
210	58	2.03	1.96	2.18	2.15
202	63	1.41	1.39	1.44	1.57
218	62	2.07	1.95	2.08	2.05
Average		1.89	1.74	2.00	1.88
Std. Dev.		0.383	0.271	0.408	0.271

CROSS DIRECTION 60 LB EXT

Code	Instron		L & W	
	7.1 in	4.8 in	7.1 in	4.8 in
215	1.89		2.04	
211	1.74	1.58	1.83	1.95
210	2.62	2.46	2.84	2.61
202	1.00	1.01	0.98	1.08
218	1.68	1.82	1.74	1.82
Average		1.79	1.72	1.89
Std. Dev.		0.578	0.600	0.667

Table A-44
TENSILE STIFFNESS DATA

MACHINE DIRECTION 70 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	2.37		2.60	
214	68	1.75	1.43	1.77	1.68
219*	96	3.36	2.94	3.51	3.67
Average		2.49	2.19	2.63	2.68
Std. Dev.		0.81	1.07	0.87	1.41
Average*		2.06	1.43	2.19	1.68
Std. Dev.*		0.44	---	0.59	---

CROSS DIRECTION 70 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
203	70	2.07		2.18	
214	68	2.12	2.06	2.30	2.12
219*	96	2.91	2.88	2.99	2.83
Average		2.37	2.47	2.49	2.48
Std. Dev.		0.47	0.58	0.44	0.50
Average*		2.10	2.06	2.24	2.12
Std. Dev.*		0.04	---	0.08	---

* Average and Standard deviation calculated omitting samples which were not of the normal weight for this grade

Table A-45
TENSILE STIFFNESS DATA

MACHINE DIRECTION 100 LB EXT

B. WT. Code LB.		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	2.36		2.45	
206	101	1.51	1.58	1.52	1.65
208	104	2.24	2.07	2.19	2.21
Average		2.04	1.83	2.05	1.93
Std. Dev.		0.460	0.346	0.480	0.396

CROSS DIRECTION 100 LB EXT

Code		Instron 7.1 in	Instron 4.8 in	L & W 7.1 in	L & W 4.8 in
212	93	2.84		2.98	
206	101	2.85	2.65	3.10	2.95
208	104	2.95	2.94	3.05	2.96
Average		2.88	2.80	3.04	2.96
Std. Dev.		0.061	0.205	0.060	0.007

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