A NEW METHOD FOR GRADING AND CLASSIFYING YARN APPEARANCE USING LAWSON-HEMPHILL'S ELECTRONIC INSPECTION BOARD

Avishai Nevel and Filiz Avsar
Lawson-Hemphill, Inc.
Central Falls, RI

Abstract
1, 2, 3

A new instrument to evaluate (1) yarn appearance and to replace taper board has been developed. The system relies on Lawson-Hemphill's EIB which optically scans the yarn at a high scanning rate. Using this and multiple pieces of information, a correlation and calibration was found to grade cotton yarn. Three groups of ring-spun yarn were pre-classified by USDA, graded A, B, C, and D, were tested and a correlation was found.

Introduction

For many years people have graded yarn using conventional methods such as evenness testing. However, it was found by many studies that yarn evenness does not necessarily correlate with yarn appearance. Therefore, a method was desired which would allow entering a parameter in order to come up with a closer definition of yarn appearance and thus to automate yarn grading simulating human judgment, which currently relies on ASTM Standard 2255-90 for Grading of Yarn for Appearance (4).

This new method uses multiple pieces of information in order to generate a grade. Currently, the method relies on only three parameters; 1) EIB events of yarn, thick spots above a certain threshold level, 2) optical CV % which relies on measurements every l/2 mm, and 3) average yarn diameter.

The instrument can also generate a simulation of a taper board or a rectangular inspection board at different widths (2).

The use of the *A Neural Network* theory formula was developed in order to simulate human evaluation.

The EIB logic follows the direction in input logic and EIB grade output (3).

Result and Discussion

For the purpose of the test, the USDA has provided three groups of cotton ring-spun yarn, Ne 20/1, Ne 30/1 and 40/1. For each group there were 4 classes of bobbins; Grade A, Grade B, Grade C and Grade D. In each class there were 10 bobbins or 40 for each group; thus 120 bobbins were studied.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1666-1671 (1997)
National Cotton Council, Memphis TN

Step One **-** All packages were tested at 10 meter lengths and 100 meter lengths to see whether there were significant diameter differences for a short or a long sample (4).

A very small difference was found. Each group was the average of 20 bobbins for that group. For example, for Ne 20/1, Grade A, a difference of 1.1% was shown. All other groups were at a similar deviation.

The next step was to look at optical CV % which was obtained simultaneously for each package at 20 meter and 100 meter lengths. Both tests showed the same trend, where Grade A had, in general, lower CV % and Grade D the highest CV % values (5).

Then we looked at events at a specific threshold level where the events in different levels were then combined with a formula and the events lengths were assigned importance. Against those we plotted and significant event levels were obtained (6).

Using the logic formulas that were developed (Fig. 7), all three sets of information were put together where every package was evaluated and a numeric result was established.

For each group of yarn, numeric and letter yarn grades were established. Also, the grades were plotted on a log basis and a grade level was developed. The grade level was established and introduced to the EIB. For example, Ne 30/1 (8).

Then yarn was selected randomly and the EIB was able to successfully grade the yarn (9,10,11,and 12).

Further, with the ability to grade yarn, simulation of a different method is available or taper board for future reference.

Conclusion

A new method to combine multiple measurements which were done with Lawson-Hemphill's EIB allowed us to grade the yarn successfully and thus laid the ground for a complete new way of grading the yarn by an optical instrument. By using this method the system relies on numerous input and their combined effect and an important and new method was established.

Future Work

Adding other parameters to the measuring system to give more input of information about the yarn will make the method even better in classifying and grading yarn using one device for simultaneous methods.

References

Bragg, C.K. and Wessinger, J.D., 1995. Instrument Measurements of Yarn Appearance. 1995 Beltwide Cotton Conference. Pg. 1432.

Nevel, A., Avsar, F. and Rosales, L., 1995. New Technology to Measure Yarn Appearance and Random Defects Using New Invented Electronic Inspection Board (EIB).

Brakenwagen, R, Jr., 1995. NEW! Entanglement Tester with Statistical Report.

ASTM Standard 2255- 90 for Grading of Yarns and Appearance.

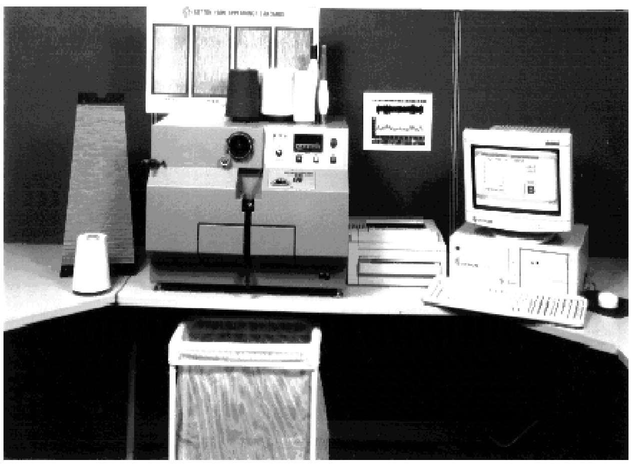
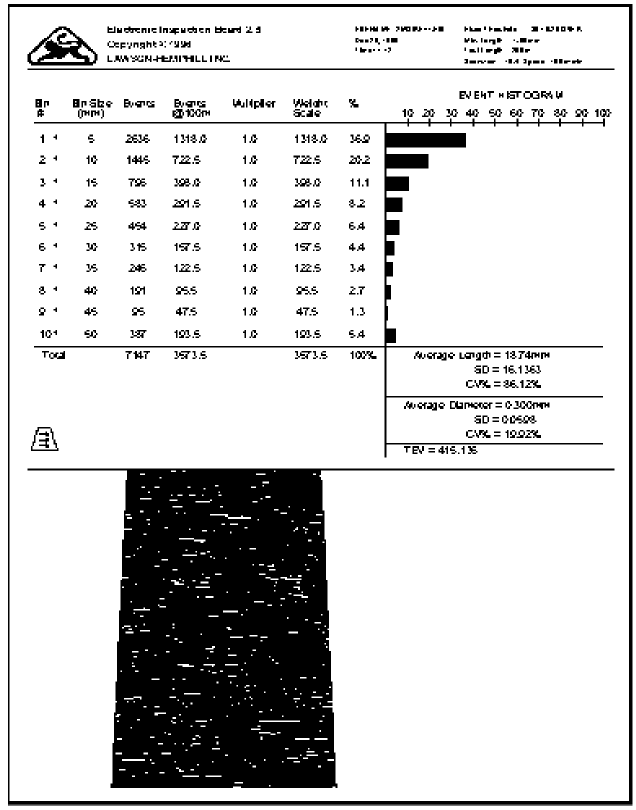


Figure 1 THE ELECTRONIC INSPECTION BOARD (EIB)



Electronic Inspection Board 2.5
LAWSON-HEMPHILL INC.

EVENT HISTOGRAM

Bin #	Bin Size (mm)	Events	Events @100m	Multiplier	Weight Scale	%
1	5	2636	1318.0	1.0	1318.0	36.9
2	10	1445	722.5	1.0	722.5	20.2
3	15	796	398.0	1.0	398.0	11.1
4	20	583	291.5	1.0	291.5	8.2
5	25	454	227.0	1.0	227.0	6.4
6	30	315	157.5	1.0	157.5	4.4
7	35	246	122.5	1.0	122.5	3.4
8	40	191	95.5	1.0	95.5	2.7
9	45	95	47.5	1.0	47.5	1.3
10	50	387	193.5	1.0	193.5	5.4
Total		7147	3573.5		3573.5	100%

Average Length = 13.74mm
SD = 16.1363
CV% = 86.12%

Average Diameter = 0.300mm
SD = 0.0598
CV% = 19.92%

TEV = 415.136

Figure 2 A Typical EIB Print-out

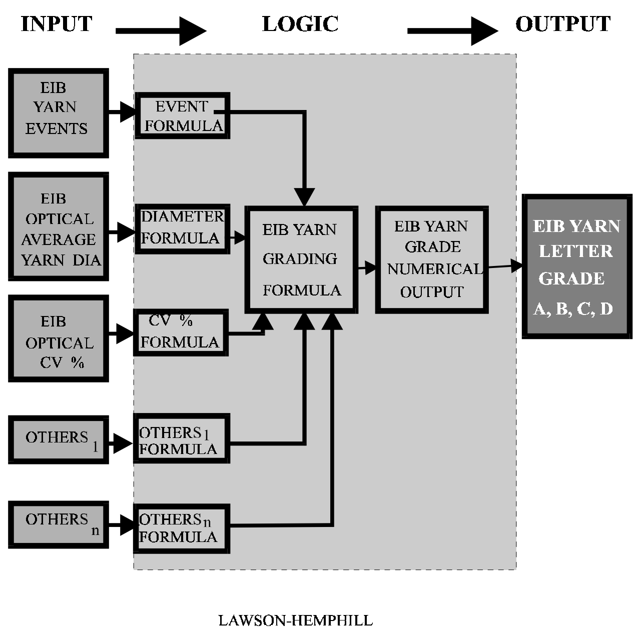


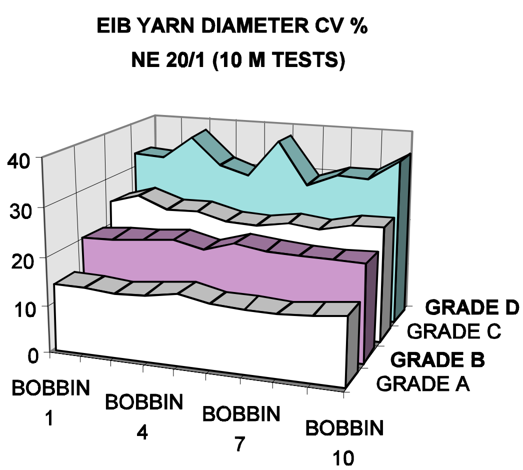
Figure 3 The EIB Logic Process for Yarn Appearance Grading

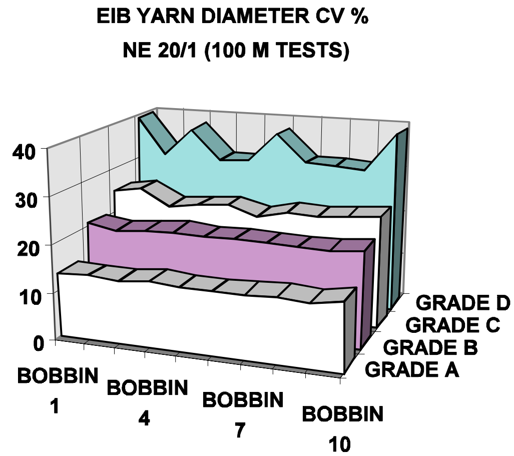
Ne 20/1	OBSERVED YARN DIAMETER (mm)		CHANGE IN YARN DIAMETER	
	10 M TEST	100 M TEST	(mm)	(microns)
GRADE A	0.2281	0.2254	-0.0027	-2.7
GRADE B	0.2635	0.2625	-0.001	-1
GRADE C	0.2668	0.2643	-0.0025	-2.5
GRADE D	0.3244	0.3246	0.0002	0.2

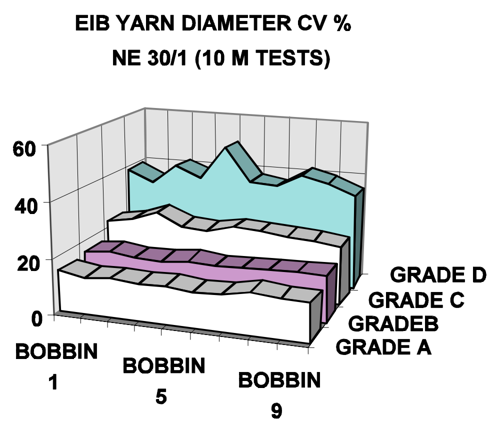
Ne 30/1	OBSERVED YARN DIAMETER (mm)		CHANGE IN YARN DIAMETER	
	10 M TEST	100 M TEST	(mm)	(microns)
GRADE A	0.1899	0.1866	-0.0013	-1.3
GRADE B	0.1953	0.1948	-0.0005	-0.5
GRADE C	0.2123	0.2087	-0.0036	-3.6
GRADE D	0.2423	0.2421	-0.0002	-0.2

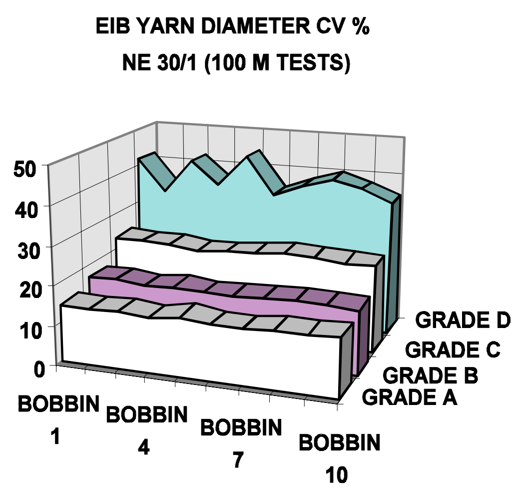
Ne 40/1	OBSERVED YARN DIAMETER (mm)		CHANGE IN YARN DIAMETER	
	10 M TEST	100 M TEST	(mm)	(microns)
GRADE A	0.1657	0.1637	-0.002	-2
GRADE B	0.1668	0.1687	0.0019	1.9
GRADE C	0.1656	0.1666	0.001	1
GRADE D	0.1827	0.1851	0.0024	2.4

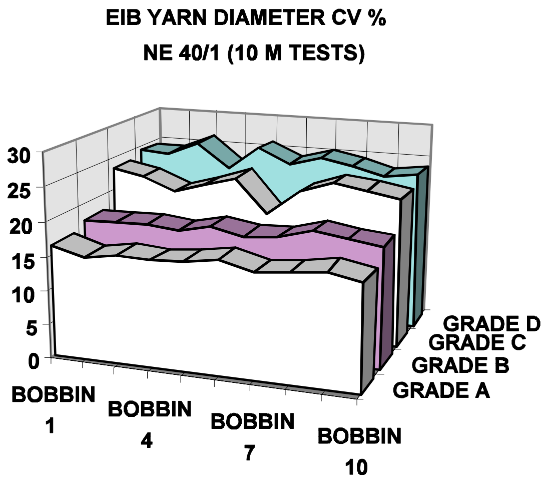
Figure 4 EIB Yarn Diameter Test Results for 10m and 100m Tests











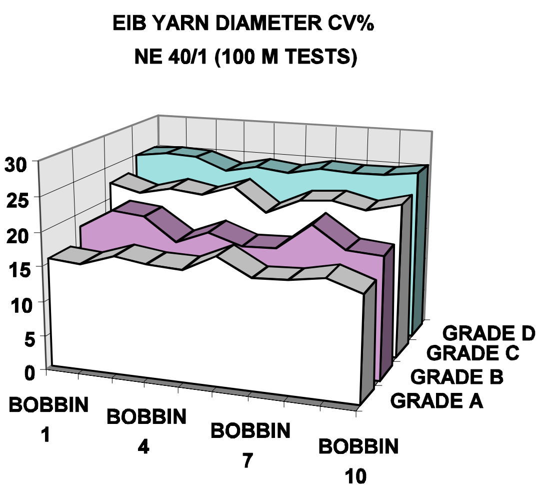
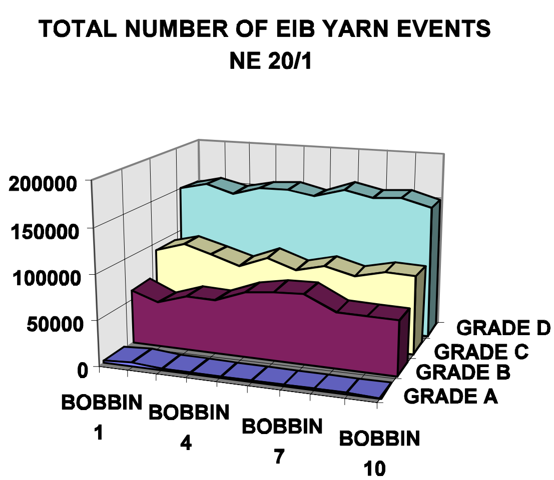
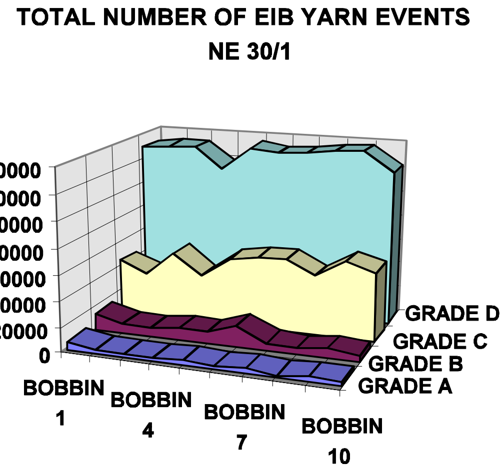


Figure 5 Ne 20/1, Ne 30/1, and Ne 40/1 Yarn Diameter CV % Results





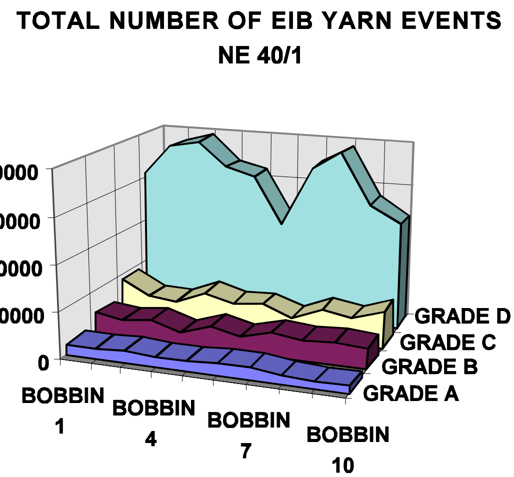
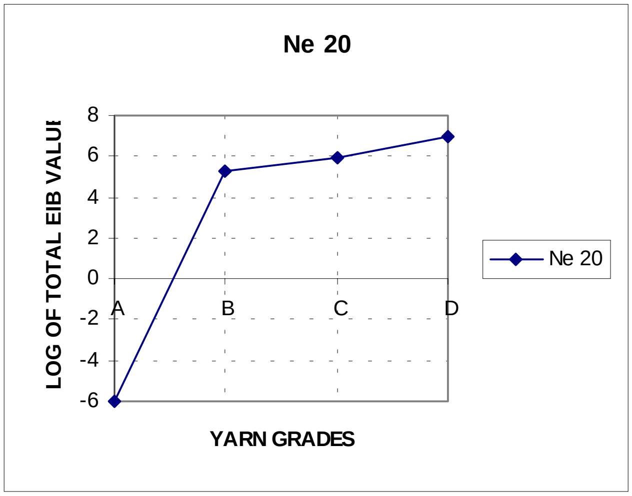
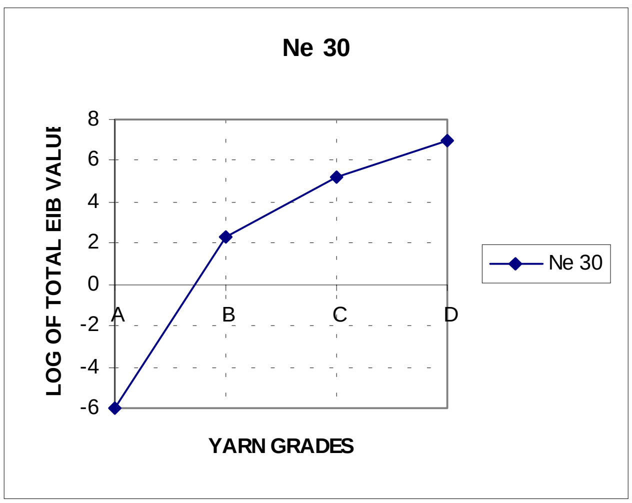


Figure 6 Total Number of EIB Yarn Events

Ne 20	TOTAL EIB VALUE	LOG OF TOTAL EIB VALUE
grade A	0.000001	-6
grade B	176917.5	5.248
grade C	793502.2	5.889
grade D	9806680	6.991



Ne 30	TOTAL EIB VALUE	LOG OF TOTAL EIB VALUE
grade A	0.000001	-6
grade B	193.5048	2.287
grade C	165933.3	5.22
grade D	9356163	6.971



Ne 40	TOTAL EIB VALUE	LOG OF TOTAL EIB VALUE
grade A	0.000001	-6
grade B	159.857	2.2037
grade C	2651.167	3.4234
grade D	251235.8	5.4

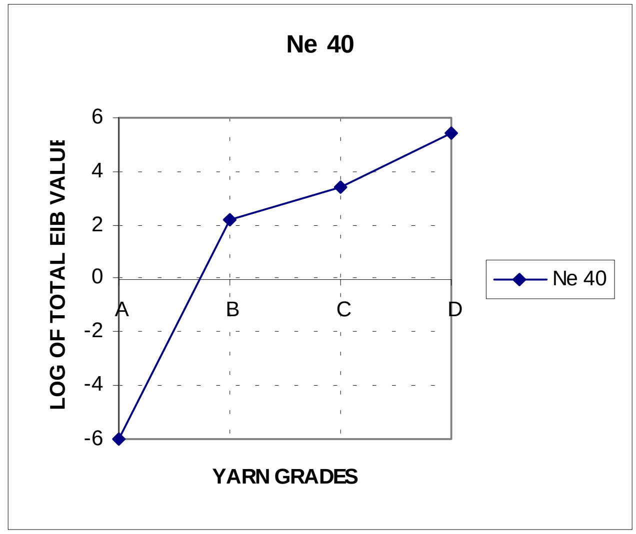


Figure 7 EIB Values vs. Yarn Grades

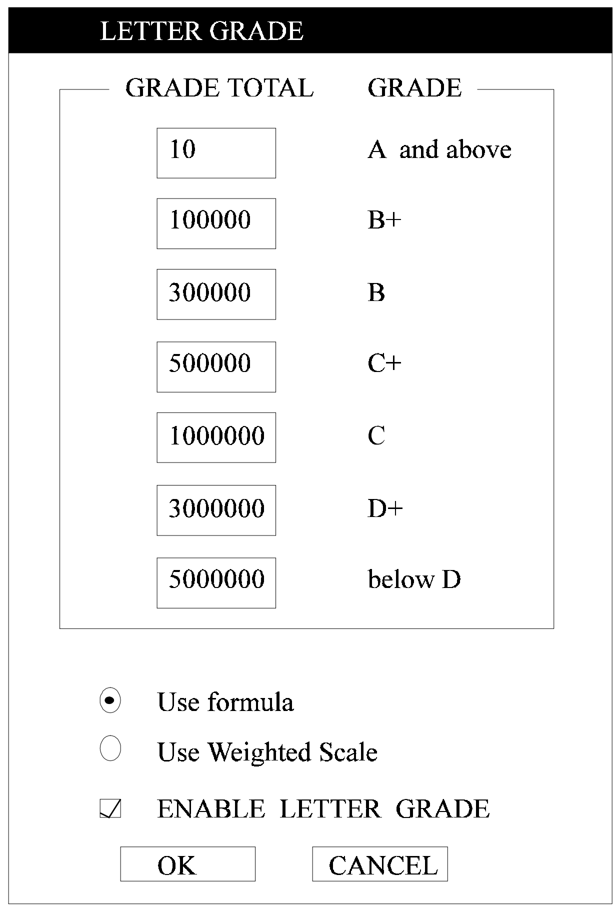


Figure 8 EIB Letter Grade Table for Ne 30/1

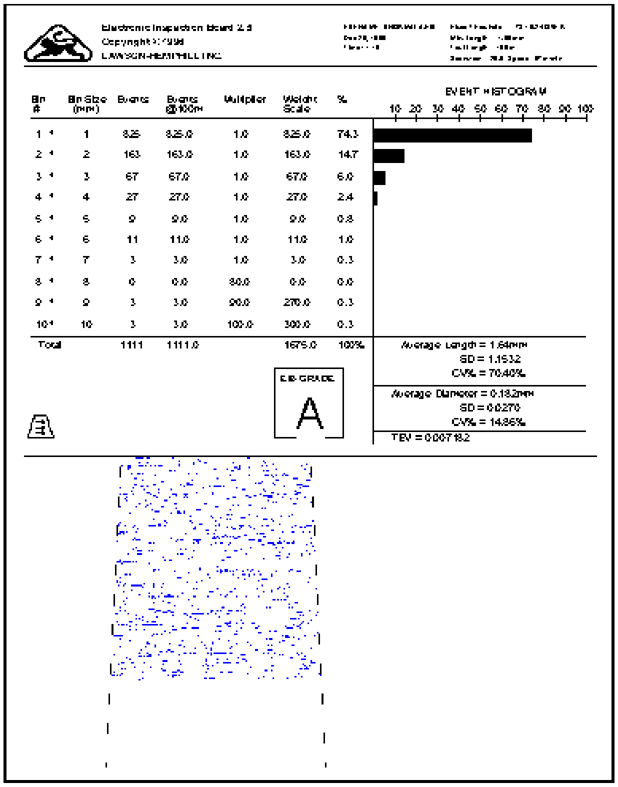


Figure 9 Ne 30/1 Grade A Yarn

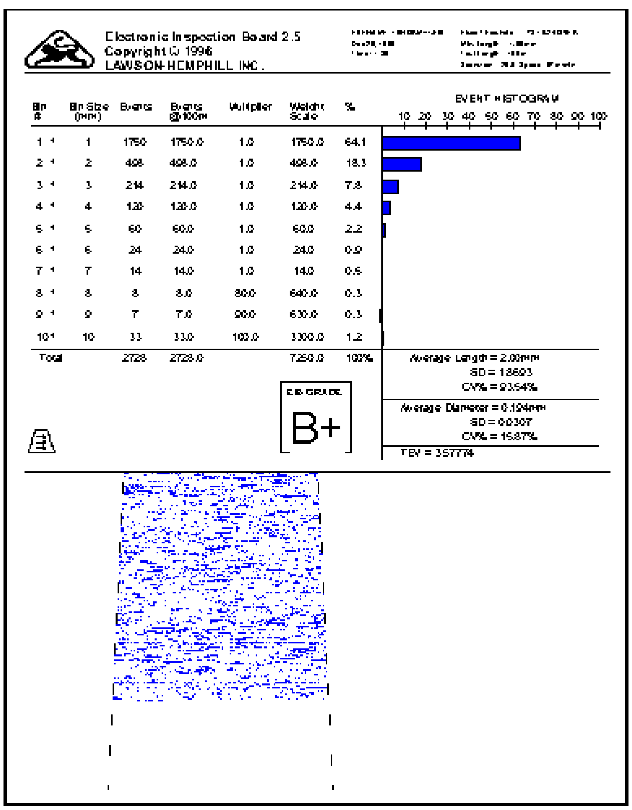


Figure 10 Ne 30/1 Grade B Yarn

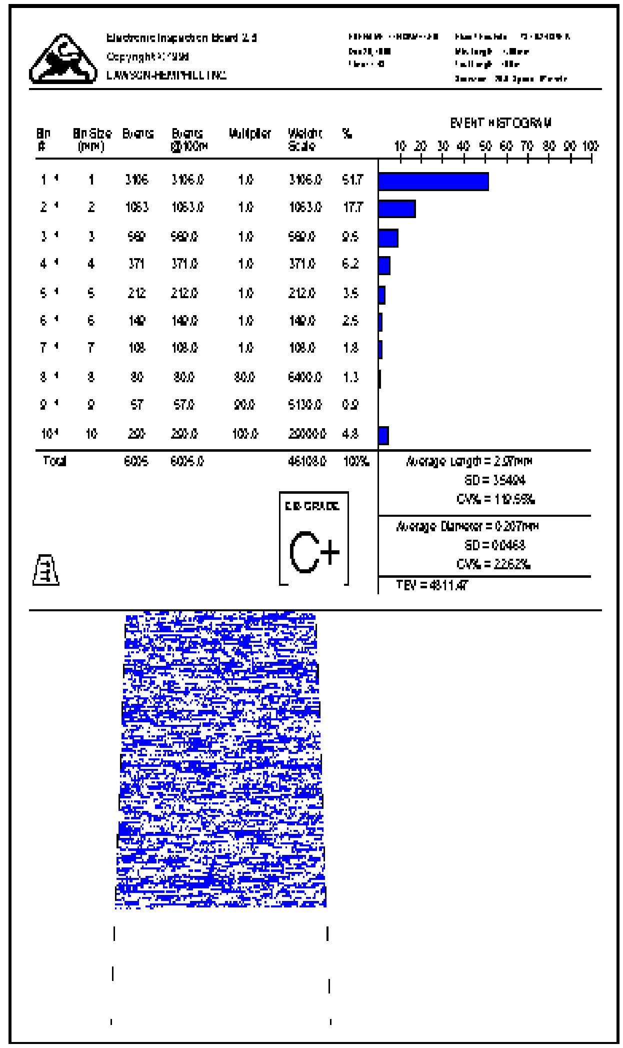
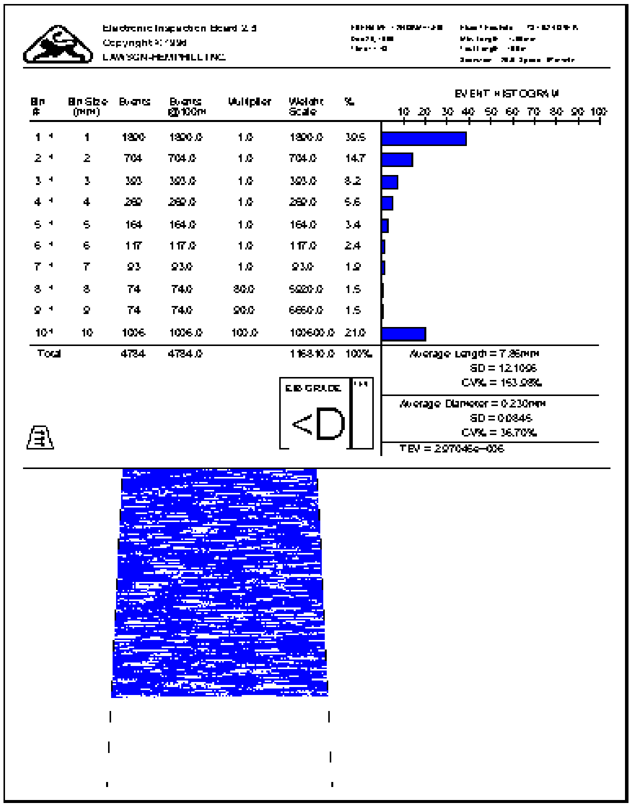


Figure 11 Ne 30/1 Grade C Yarn



Electronic Inspection Board 2.5
Copyright © 1994
LAWSON-HEMPHILL INC.

Bin #	Bin Size (mm)	Events	Events @100m	Multiplier	Weight Scale	%
1	1	1890	1890.0	1.0	1890.0	39.5
2	2	704	704.0	1.0	704.0	14.7
3	3	393	393.0	1.0	393.0	8.2
4	4	269	269.0	1.0	269.0	5.6
5	5	164	164.0	1.0	164.0	3.4
6	6	117	117.0	1.0	117.0	2.4
7	7	93	93.0	1.0	93.0	1.9
8	8	74	74.0	80.0	5920.0	1.5
9	9	74	74.0	90.0	6660.0	1.5
10	10	1006	1006.0	100.0	100600.0	21.0
Total		4784	4784.0		116810.0	100%

Figure 12 Ne 30/1 Grade D Yarn