LAWSON-HEMPHILL
Smart Quality Control

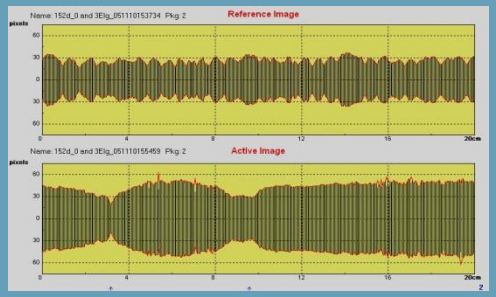
Lawson-Hemphill

EST

Entanglement

Strength

Tester



EST

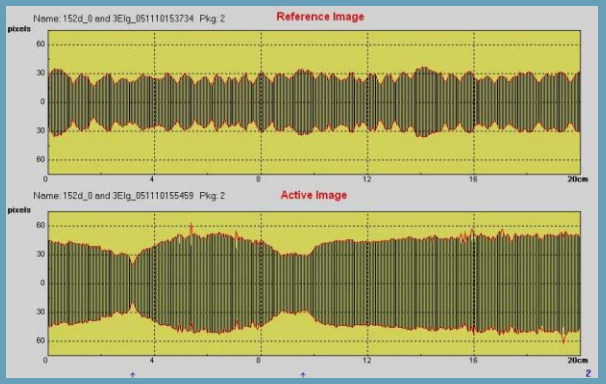
ENTANGLEMENT STRENGTH TESTER

NEW

HIGH SPEED AUTOMATED ENTANGLEMENT STRENGTH TESTING

GAIN THE ADVANTAGE FOR OPTIMIZING ENTANGLEMENT AIR JETS TO REDUCE AIR CONSUMPTION AND IMPROVE YARN PRODUCTION PERFOMANCE

EST Entanglement Strength Tester



Introduction to EST:

Drawing from years of experience in optical Entanglement measurement systems, engineers at Lawson Hemphill combined the Entanglement Test System and with Entanglement Strength measurement to have one, single system that automatically measures both Entanglements/meter and Entanglement Strength.

Synthetic yarns are comprised of multiple filaments forming a yarn. Entangling the yarn is one of the most common methods to provide cohesive structure to the filament bundle.

Soft Entanglements or Strong Entanglements are common terms to define the strength of the entanglements, whereas soft refers to the entanglements that are weak and can be easily removed and strong refers to the ones that resist removal.

EST Features:

- The EST is an Automated Yarn Entanglement Tester that will provide the end user with precise measurements at high speed relative to the yarn entanglements and their resistance to removal from the yarn.
- The EST consists of two zones; Draw Zone and Measurement Zone.
- The Draw Zone subjects the yarn to a specific draw condition (%Elongation) which will result in tension increase on the running yarn. This draw tension is required in order to pull the entanglements out of the test yarn.
- The Measurement Zone presents the yarn to a camera at a relaxed standard tension. The camera scans the test yarn to construct a profile of the yarn sample; this profile is analyzed to found the number of entanglements remaining after being subjected to high tension in the Draw Zone.

EST Entanglement Strength Tester

SAMPLES OF ENTANGLED YARNS

Entanglements are always applied to the yarn with compressed air.

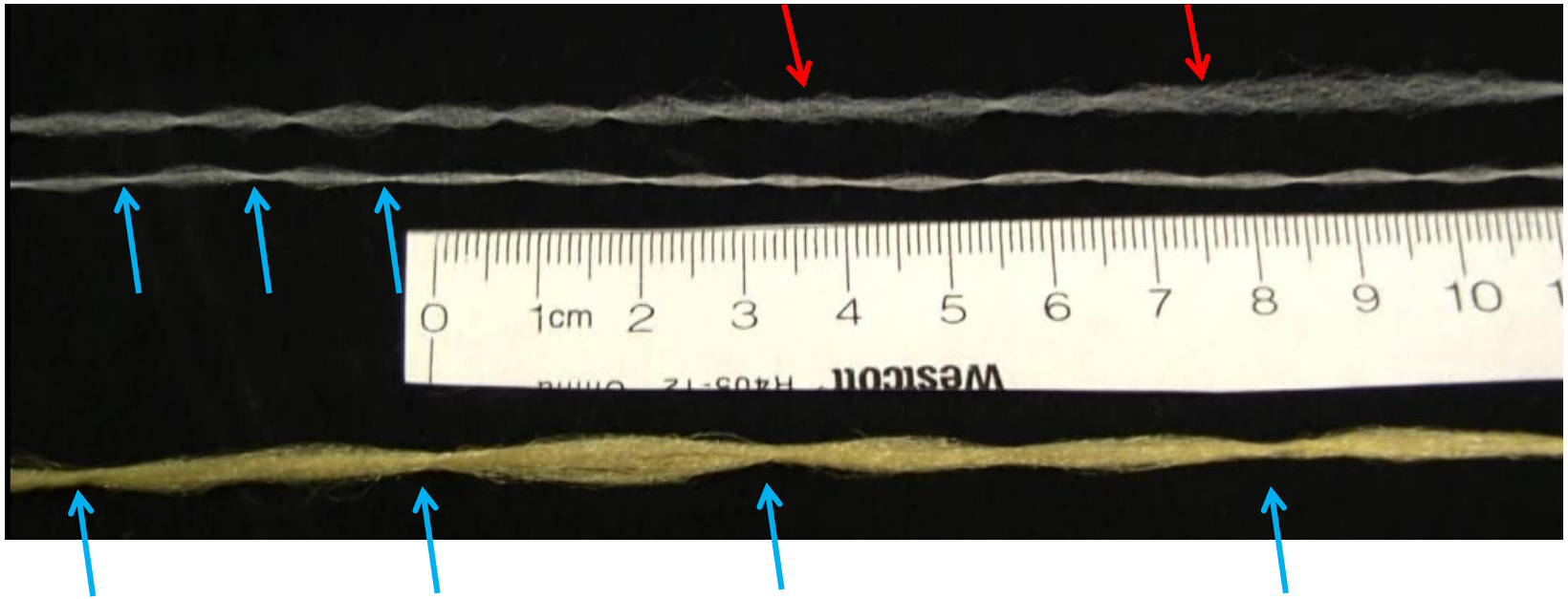
BOTTOM image = Carpet yarn with entanglements

MIDDLE IMAGE = Fine denier Polyester yarn with entanglements

TOP IMAGE = Same Polyester yarn after it lost some of its entanglements

Blue arrows = Entanglements

Red arrows = Open Entanglements



Why TEST Entanglement Strength ?

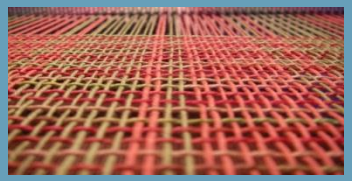
Beaming

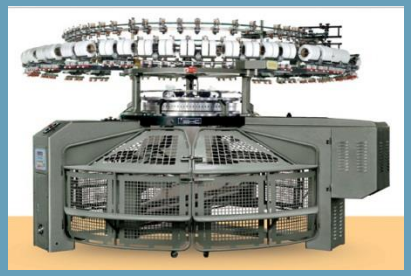
Yarn performance in a beaming process can be affected by the entanglement strength in the yarn. One important characteristic of the entangled yarn relates to the strength of the individual entanglements. The entanglements serve to provide the yarn bundle with cohesiveness so that the downstream conversion of the yarn into a fabric will occur with a minimum of defects.

In a typical production process the entangled yarn is utilized in a beaming process wherein the entangled yarn package or a series of packages are converted into beam or warp yarn. During the beaming process tension is applied to the yarn which tends to cause the entanglements to pull out or became unraveled. Moreover, as the beam yarn is supplied from the beam to the weaving or knitting machine the yarn again is subjected to tension. It is critical, therefore, that the entanglements be provided with sufficient strength to withstand this tension applied to the yarn during processing

Knitting & Weaving

Yarn performance related to fabric knitting and weaving processes are additionally affected by entanglement properties in the yarn. The unique distribution, strength and size of the entanglements are all properties that contribute to a yarn having dependable production performance. Entanglement strength is a key element in the knitting and weaving performance of an entangled yarn. This performance is most affected by the knitting machine or weaving loom having to stop frequently because the individual filament strands experiencing breaks or separation of the yarn filaments due to a loss of yarn cohesiveness. Proper entanglement strength will result in a yarn that will be able to achieve highly efficient knitting and weaving performance.





Why TEST Entanglement Strength ?

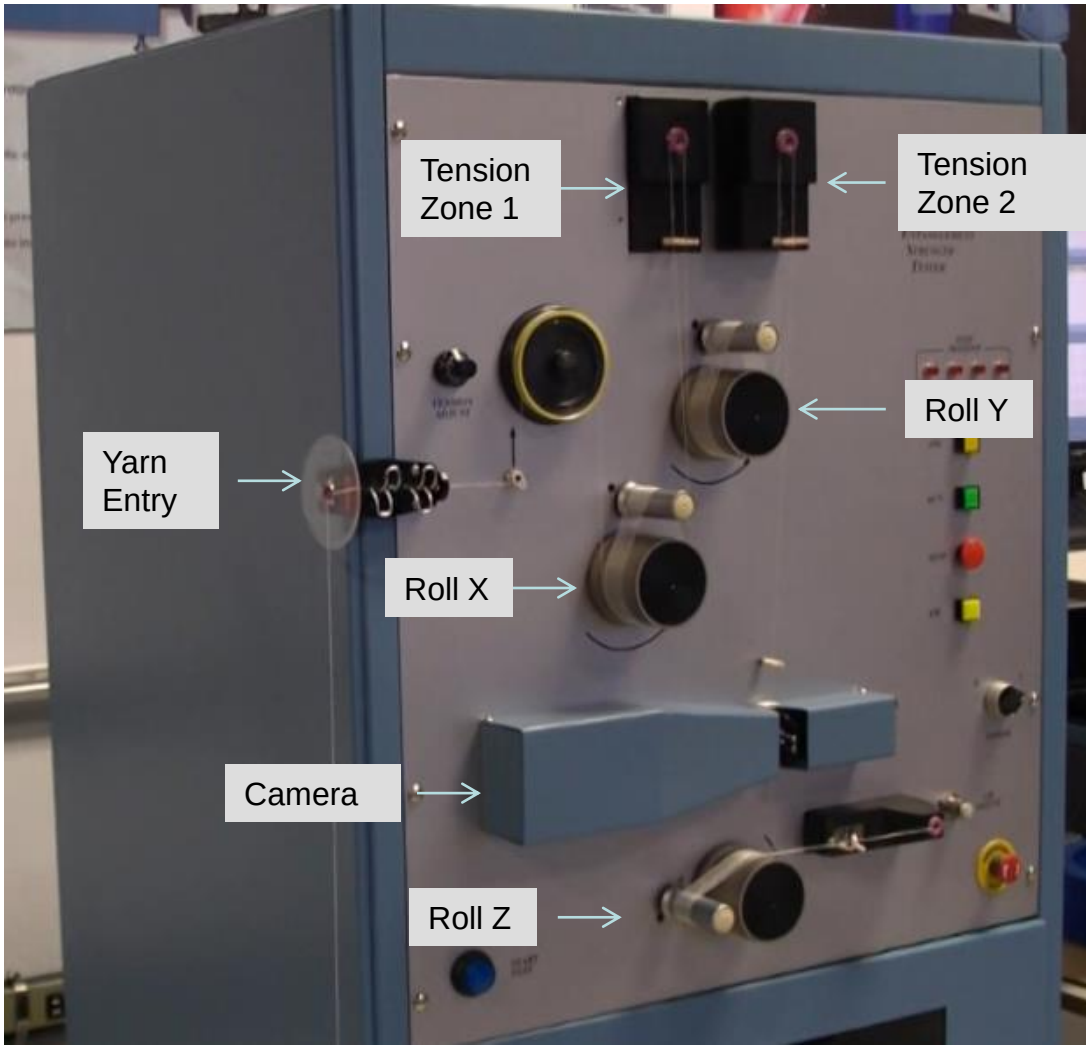
Optimize Air Consumption

Yarn Production Cost for entangled yarns is affected by entangling proficiency. One of the biggest expenses in fiber production is energy cost associated with the production process. Compressed air is one key factor in this production cost equation. Optimization of the compressed air consumption in the production process will reduce the energy expense and overall production cost associated with the process. As described earlier, entanglement strength is a key element in the beaming as well as knitting and weaving performance of an entangled yarn. The entanglements are produced by means of compressed air on the draw twist machine.

Production Parameters can be optimized, with the ability to measure and define entanglement strength in the yarn. This will allow the fiber producer to optimize the air consumption at the entanglement jets, thereby economizing the process by adjusting the air entanglement jets to consume just enough air to provide proper entanglement strength in the yarn without wasting additional air in the process. By defining, measuring and controlling the entanglement strength property of the yarn, we can optimize the compressed air requirement to reduce waste and decrease cost for operating the compression system and also the incidence of the power quota on production of the entangled yarns, to obtain an entangled yarn of a particular count and strength with the minimum consumption of compressed air, or better, to attempt to have a consumption of compressed air that is as low as possible, for a given quantity of entangled yarn produced and for a specific quality requirement.

It is clear that the immediate effect of a reduction in the consumption of compressed air, in whatever way it is obtained, is an improvement in the general performance of the entangled yarn production operation, with definite advantages both in technical terms and economic terms.

EST Entanglement Strength Tester



EST DRAW & MEASUREMENT ZONES

ROLL Y = TEST SPEED

ROLL X = DRAW ROLL

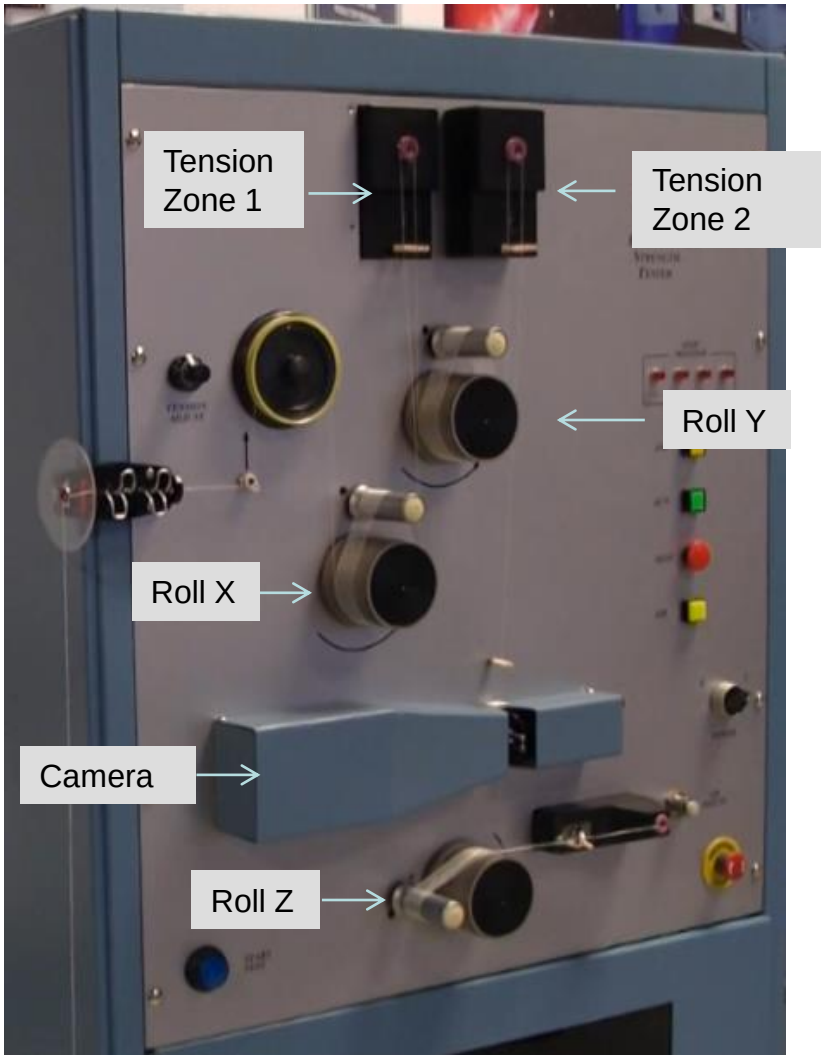
ROLL Z = CAMERA TENSION ROLL

The EST consists of two zones; Draw Zone and Measurement Zone.

Draw Zone subjects the yarn to a specific draw condition (%Elongation) which will result in tension increase on the running yarn. This draw tension is required in order to pull the entanglements out of the test yarn. (Roll X and Y.)

Measurement Zone presents the yarn to a camera at a relaxed standard tension. (Roll Y and Z.)The camera scans the test yarn to construct a profile of the yarn sample; this profile is analyzed to found the number of entanglements remaining after being subjected to high tension in the Draw Zone.

EST Entanglement Strength Tester



EST hardware

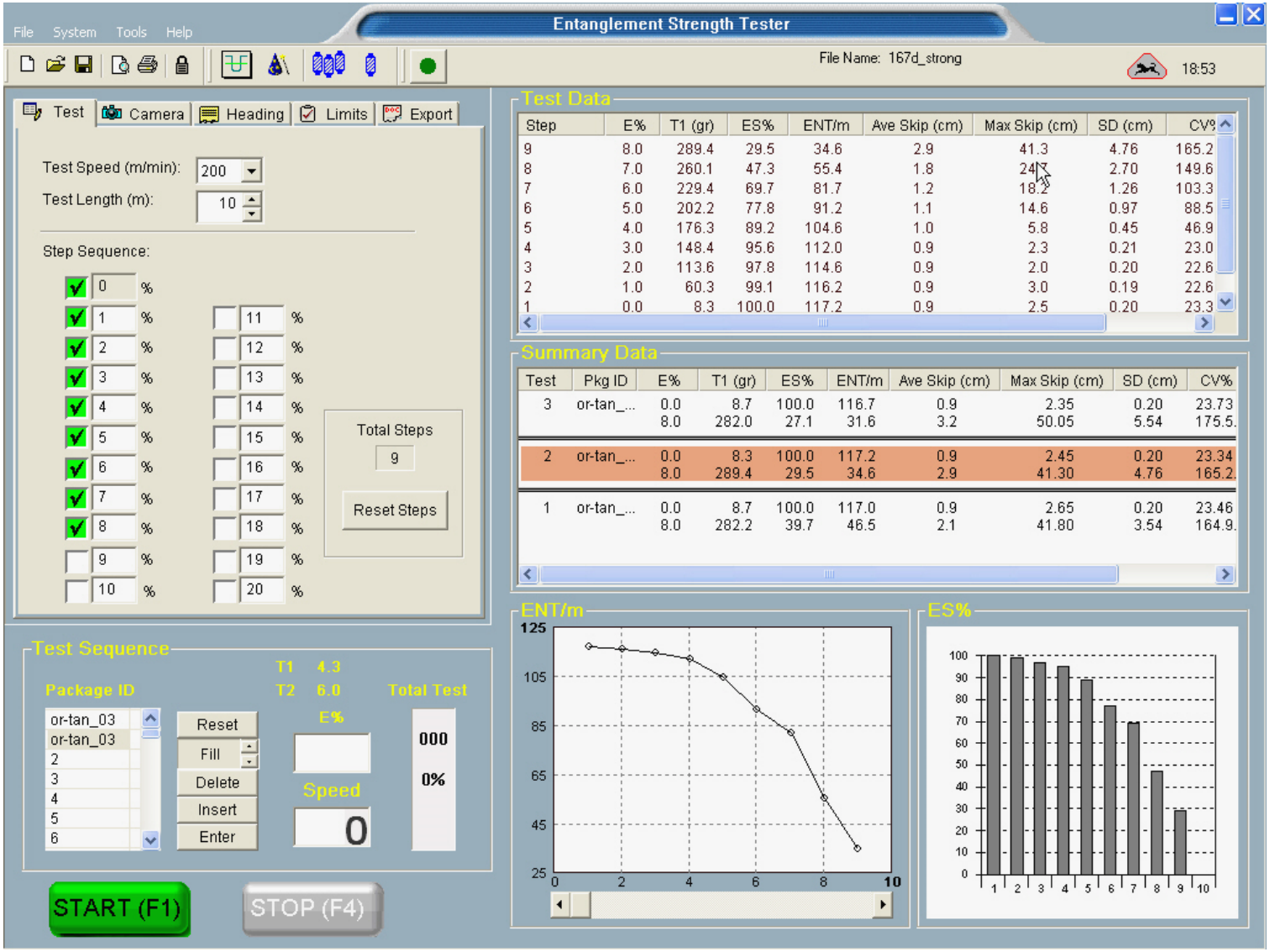
Camera: CCD camera, 3.5micron

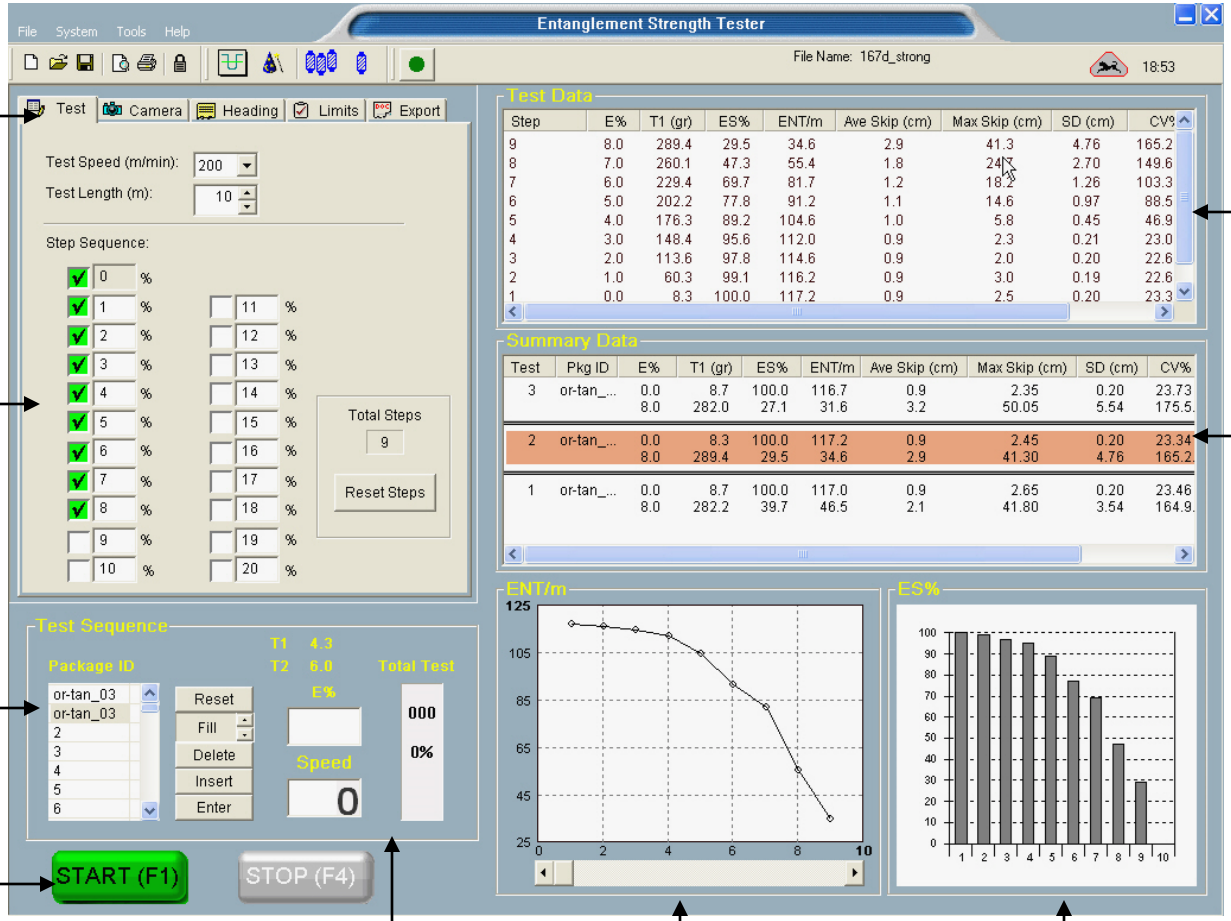
Load Cells: Full active bridge load cell
Tension Zone 1 & 2
Max Capacity 1000g and 500g

Drive System: 3-axis servo drive
Rolls X, Y and Z
25-400m/min

This slide shows the Main Screen for the EST Software

On the next slides we will detail the software and the test data





Test Setup Elongation Test Selection

Elongation Selection and E% steps

Package Queue for the Test Packages

Testing Controls

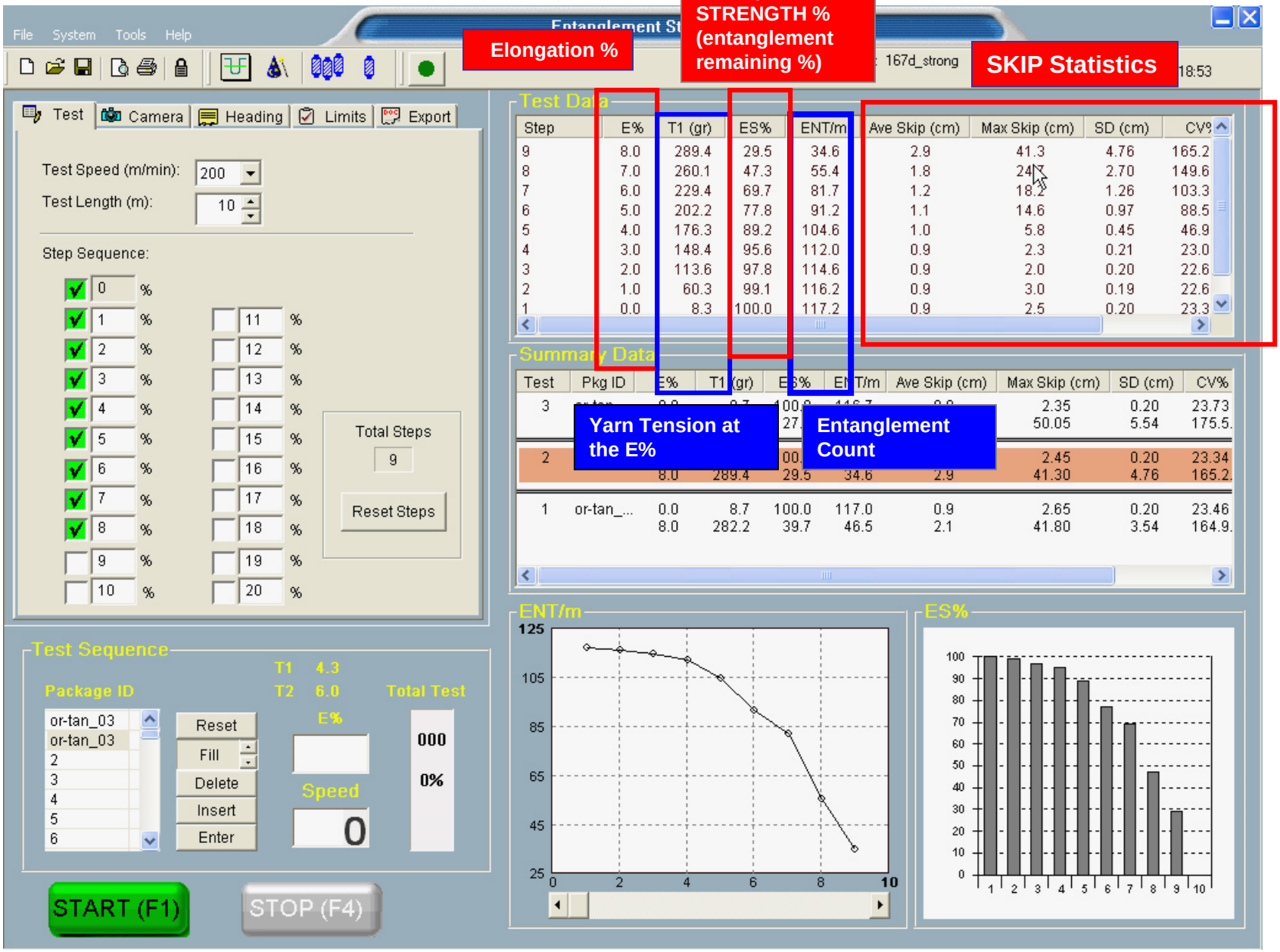
Test Data for the E% steps 0% thru 9%

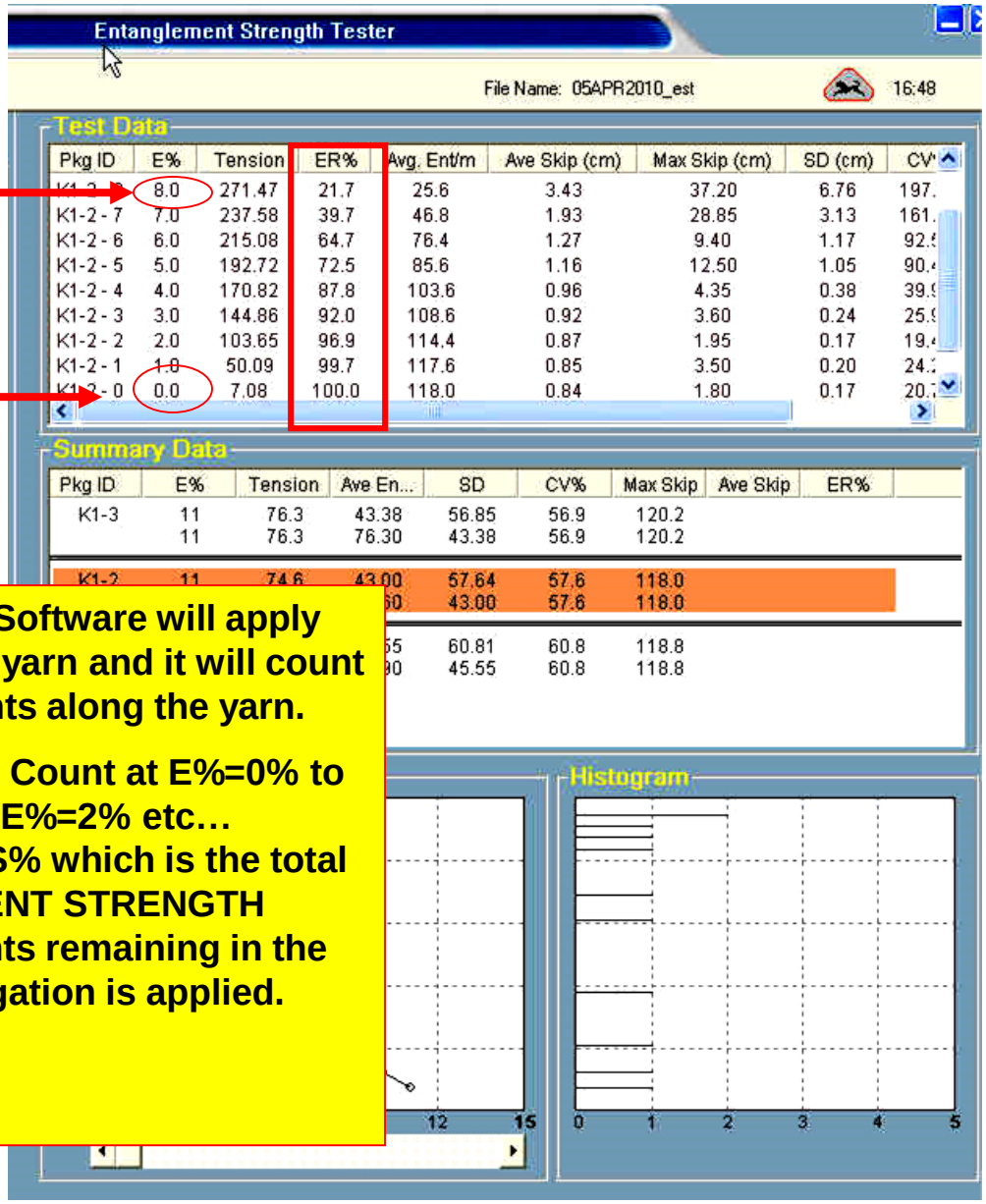
Test Data Statistical Summary

Testing Status for Speed, E% Tension and Test Progress

Entanglement Count Graph

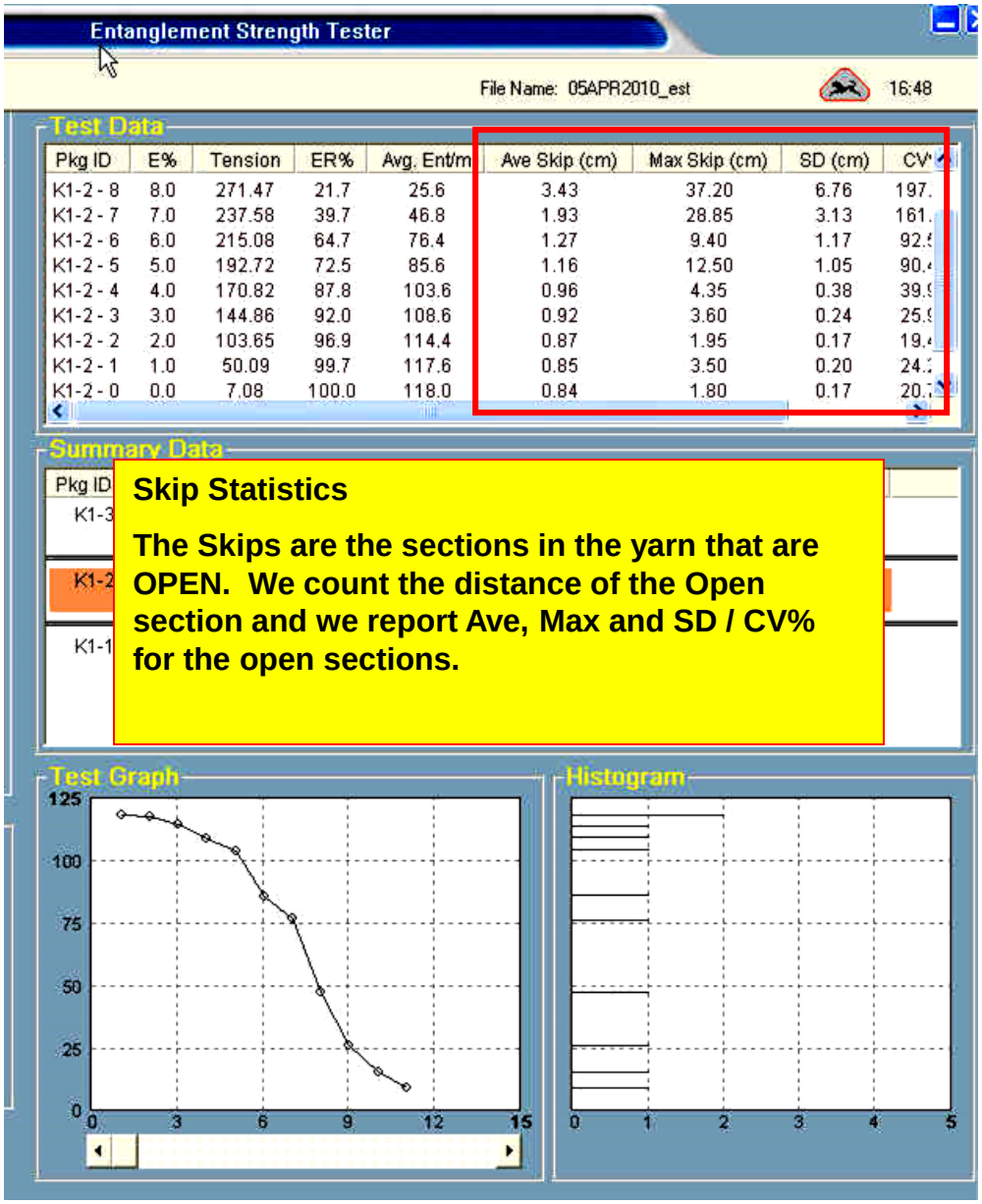
Entanglement Strength Graph


Entanglement STRENGTH % (entanglement remaining %)
Elongation %
SKIP Statistics
Yarn Tension at the E%
Entanglement Count
File System Tools Help
167d_strong
18:53
Test
Camera
Heading
Limits
Export
Test Speed (m/min): 200
Test Length (m): 10
Step Sequence:
Total Steps
9
Reset Steps
Test Data
Step E% T1 (gr) ES% ENT/m Ave Skip (cm) Max Skip (cm) SD (cm) CV%
9 8.0 289.4 29.5 34.6 2.9 41.3 4.76 165.2
8 7.0 260.1 47.3 55.4 1.8 24.7 2.70 149.6
7 6.0 229.4 69.7 81.7 1.2 18.2 1.26 103.3
6 5.0 202.2 77.8 91.2 1.1 14.6 0.97 88.5
5 4.0 176.3 89.2 104.6 1.0 5.8 0.45 46.9
4 3.0 148.4 95.6 112.0 0.9 2.3 0.21 23.0
3 2.0 113.6 97.8 114.6 0.9 2.0 0.20 22.6
2 1.0 60.3 99.1 116.2 0.9 3.0 0.19 22.6
1 0.0 8.3 100.0 117.2 0.9 2.5 0.20 23.3
Summary Data
Test Pkg ID E% T1 (gr) ES% ENT/m Ave Skip (cm) Max Skip (cm) SD (cm) CV%
3 2.35 0.20 23.73
50.05 5.54 175.5
2 2.45 0.20 23.34
8.0 289.4 29.5 34.6 2.9 41.30 4.76 165.2
1 or-tan_... 0.0 8.7 100.0 117.0 0.9 2.65 0.20 23.46
8.0 282.2 39.7 46.5 2.1 41.80 3.54 164.9
ENT/m
125
105
85
65
45
25
0 2 4 6 8 10
ES%
100 90 80 70 60 50 40 30 20 10 0
1 2 3 4 5 6 7 8 9 10
Test Sequence
Package ID
T1 4.3
T2 6.0
E%
Total Test
000
0%
Speed
0
or-tan_03
or-tan_03
2
3
4
5
6
Reset
Fill
Delete
Insert
Enter
START (F1)
STOP (F4)

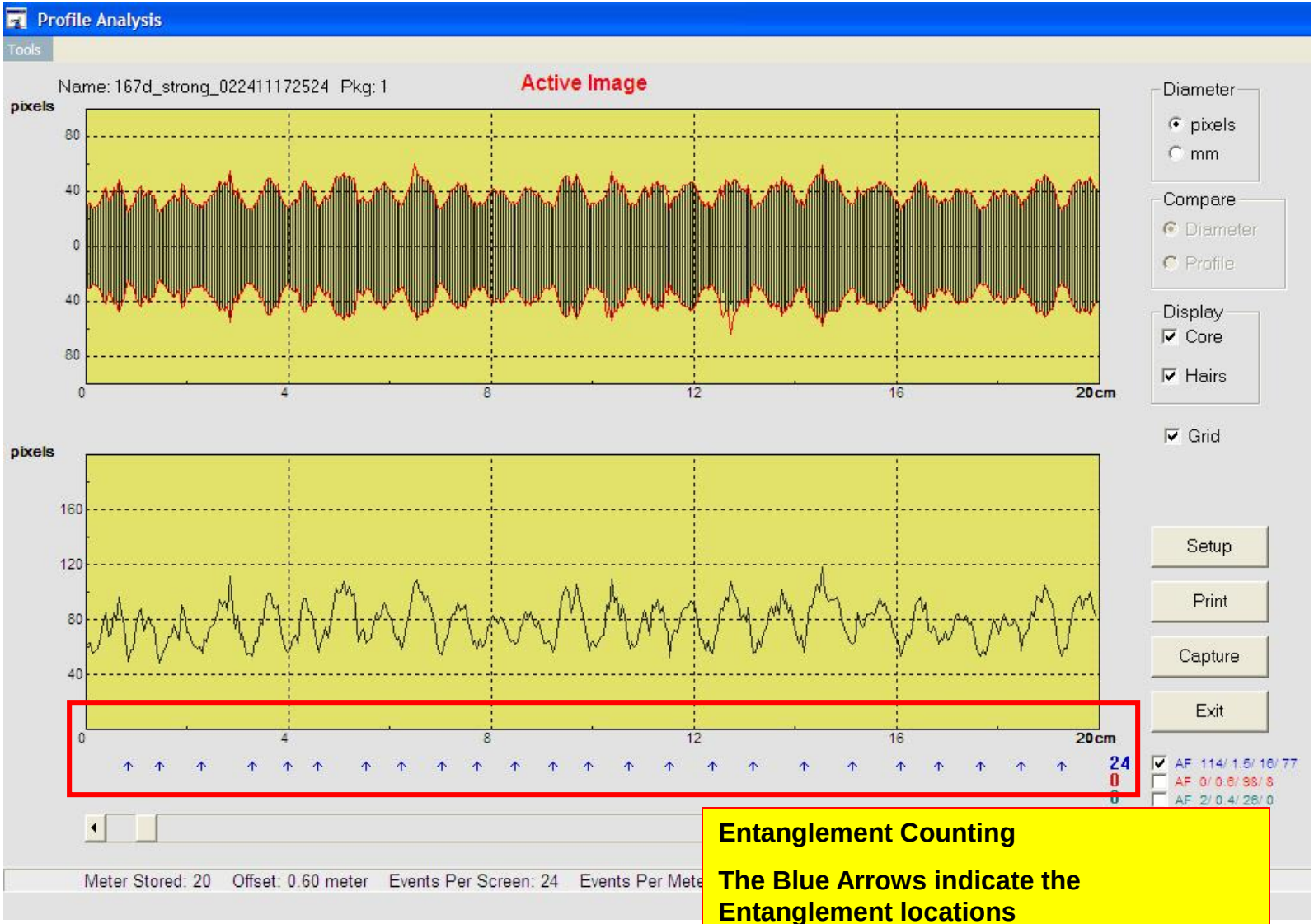


The EST and the Software will apply Elongation % to the yarn and it will count the Entanglements along the yarn.

It will compare the Count at E%=0% to the E%=1% E%=2% etc…
and will give the ES% which is the total ENTANGLEMENT STRENGTH
or % entanglements remaining in the yarn after Elongation is applied.


Entanglement Strength Tester
File Name: 05APR2010_est
16:48
Test Data
Pkg ID | E% | Tension | ER% | Avg. Ent/m | Ave Skip (cm) | Max Skip (cm) | SD (cm) | CV
K1-2 - 8 | 8.0 | 271.47 | 21.7 | 25.6 | 3.43 | 37.20 | 6.76 | 197.
K1-2 - 7 | 7.0 | 237.58 | 39.7 | 46.8 | 1.93 | 28.85 | 3.13 | 161.
K1-2 - 6 | 6.0 | 215.08 | 64.7 | 76.4 | 1.27 | 9.40 | 1.17 | 92.
K1-2 - 5 | 5.0 | 192.72 | 72.5 | 85.6 | 1.16 | 12.50 | 1.05 | 90.
K1-2 - 4 | 4.0 | 170.82 | 87.8 | 103.6 | 0.96 | 4.35 | 0.38 | 39.
K1-2 - 3 | 3.0 | 144.86 | 92.0 | 108.6 | 0.92 | 3.60 | 0.24 | 25.
K1-2 - 2 | 2.0 | 103.65 | 96.9 | 114.4 | 0.87 | 1.95 | 0.17 | 19.
K1-2 - 1 | 1.0 | 50.09 | 99.7 | 117.6 | 0.85 | 3.50 | 0.20 | 24.
K1-2 - 0 | 0.0 | 7.08 | 100.0 | 118.0 | 0.84 | 1.80 | 0.17 | 20.
Summary Data
Pkg ID
K1-3
K1-2
K1-1
Skip Statistics
The Skips are the sections in the yarn that are OPEN. We count the distance of the Open section and we report Ave, Max and SD / CV% for the open sections.
Test Graph
125
100
75
50
25
0
0
3
6
9
12
15
Histogram
0
1
2
3
4
5

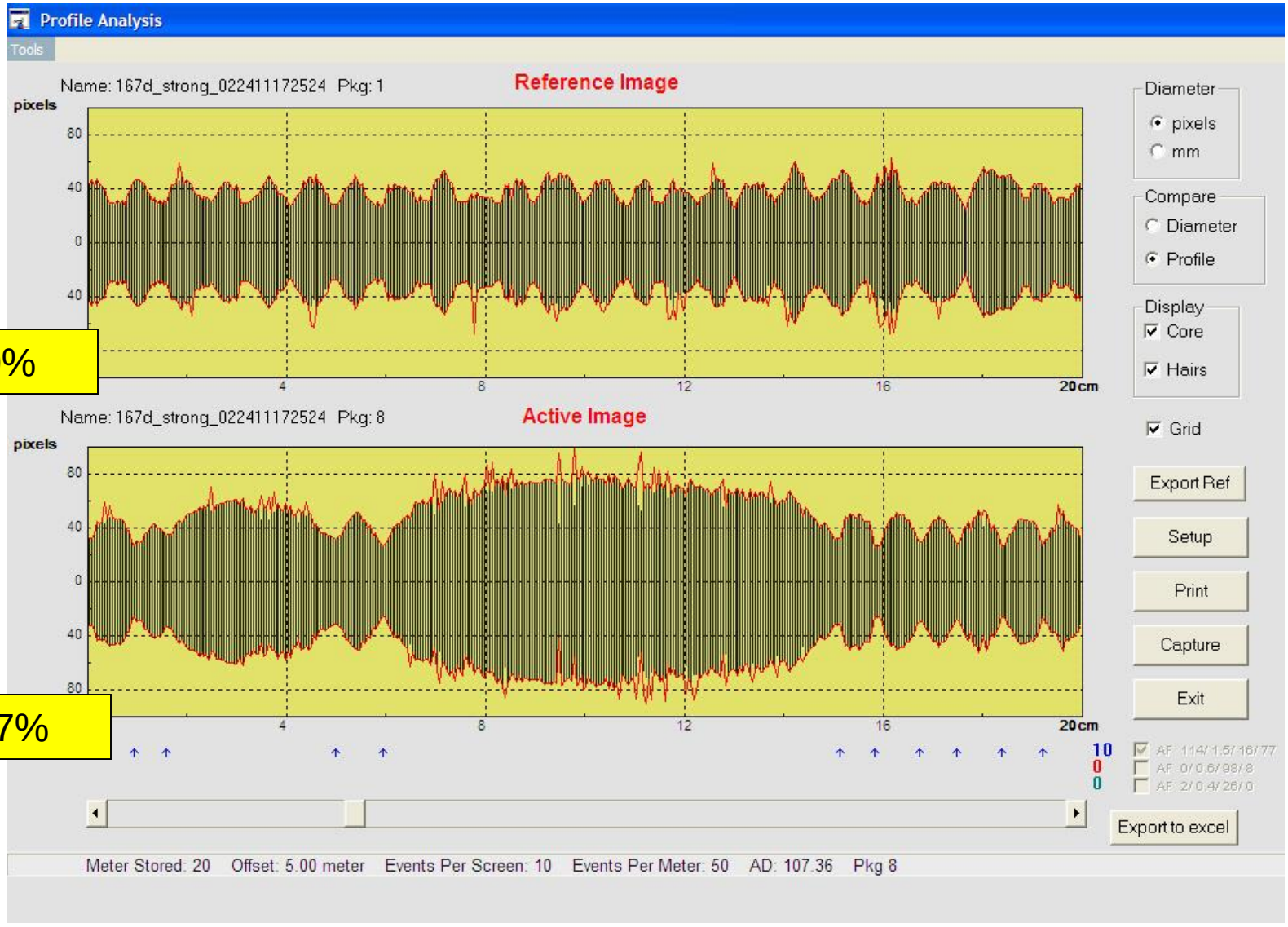
This slide shows the Yarn Profile with 0% Elongation



Entanglement Counting

The Blue Arrows indicate the Entanglement locations

This slide shows the Comparison of the Yarn Profile with 0% + 7% Elongation



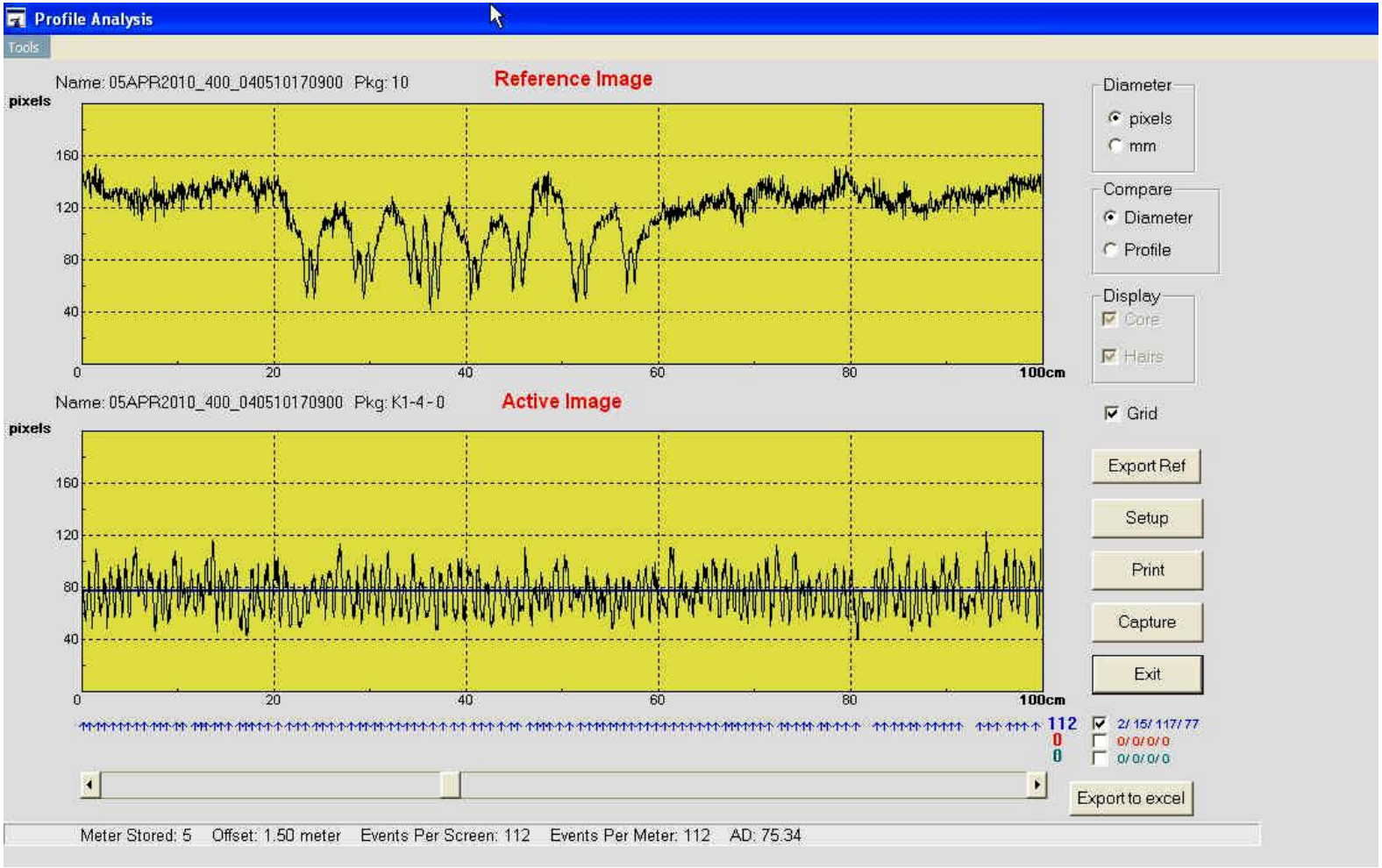
E=0%

E=7%

This slide shows the Affect of the Elongation on the entanglements

Bottom is 0% Elongation

TOP 5%Elongation



Lawson-Hemphill EST Version 1.0 April 24, 2010 Page 1

EST REPORT

File name: 300d_Strong
Timestamp 10/06/10, 17:27

Test Info

Test:
Operator:
Shift:
Producer:
Machine:
Yarn
Merge:
Lot:
Material:
Comments:

Test Conditions

Test Speed (m/min) 200
Test length (m): 20

Entanglement Setup

Threshold Type: Active Filter
Threshold: 25.0
Ent. Length: 2.0
Ent/meter: 101
Max diameter: 132.0
Light level: 200
LightThreshold: 96

Limits

Ent/m	E%	Min	Max
	0	0.0	0.0
	10.0	0.0	0.0

ES%	E%	Min	Max
	0.0	0.0	0.0

Max	E%	Length	SD
	0	0.0	0.0
	0.0	0.0	0.0

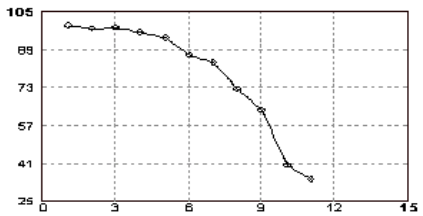
SUMMARY (SINGLE PACKAGE)

				Entanglement		Skip Statistics (cm)				
Tes	Pkg ID	E%	T1 (gr)	ES%	ENT/m	Average	Max	SD	CV%	Date/Time
1	4W 300d/32	0.0	9.5	100.0	99.1	1.0	4.1	0.31	30.89	
		10.0	583.6	34.3	34.0	2.9	25.8	3.51	119.55	

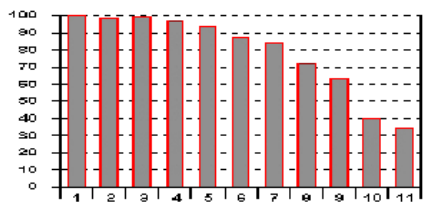
SINGLE PACKAGE

Step	E%	T1 (gr)	ES%	ENT/m	Ave Skip	Max Skip	SD(cm)	CV%	Reject
1	0.0	9.5	100.0	99.1	1.0	4.1	0.31	30.89	
2	1.0	54.9	98.5	97.6	1.0	3.6	0.31	30.11	
3	2.0	155.6	99.1	98.2	1.0	3.5	0.31	30.43	
4	3.0	255.4	97.1	96.2	1.0	3.5	0.31	30.13	
5	4.0	325.5	94.8	93.9	1.1	3.5	0.34	31.98	
6	5.0	362.7	87.4	86.6	1.2	5.9	0.47	41.06	
7	6.0	415.0	84.2	83.4	1.2	6.3	0.58	48.44	
8	7.0	453.1	72.8	72.1	1.4	9.9	0.95	68.23	
9	8.0	494.2	63.8	63.2	1.6	13.9	1.33	84.06	
10	9.0	534.6	40.4	40.0	2.5	32.2	3.24	129.42	
11	10.0	583.6	34.3	34.0	2.9	25.8	3.51	119.55	

Entanglements/Meter (ENT/m)



Entanglement Strength (ES%)



Printed Time: 10/06/10 ,

Test Report for Single Bobbin

Lawson-Hemphill EST version 1.0 April 24, 2010 Page:

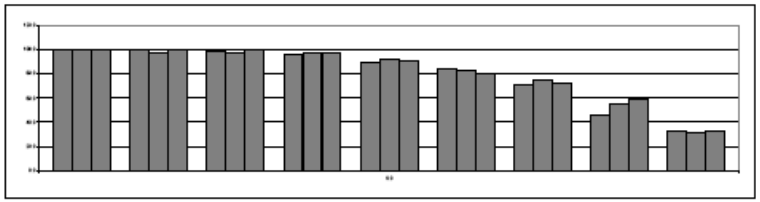
EST REPORT

Filename: Kor-Orn
Timestamp: 10/06/10, 15:11:02

Test Info	Test Conditions	Entanglement Setup
Test:	Test Speed (m/min):	Threshold Type:
Operator:	Test Length (m):	Threshold:
Shift:		Ent. Length:
Producer:		Ent/meter:
Machine:		Max diameter:
Yarn Count:		Light level:
Merge:		Light Threshold:
Lot:		
Material:		
Comments:		

Summary ALL DATA

				Entanglement		Skip Statistics (cm)				
TEST	Pkg ID	E%	T1(gr)	ES%	ENT/m	Average	Max	SD	CV%	Reject
1	O+T_165_1	0.0	8.6	100.0	117.5	0.9	2.30	0.19	22.19	
2	O+T_165_2	0.0	8.1	100.0	116.8	0.9	2.00	0.19	22.29	
3	O+T_165_3	0.0	8.5	100.0	115.1	0.9	2.50	0.21	24.31	
1	O+T_165_1	1.0	53.7	99.9	117.4	0.9	2.50	0.20	22.93	
2	O+T_165_2	1.0	58.4	97.8	114.2	0.9	2.50	0.21	23.63	
3	O+T_165_3	1.0	56.4	100.5	115.7	0.9	2.20	0.20	22.73	
1	O+T_165_1	2.0	109.3	98.7	116.0	0.9	2.30	0.20	23.69	
2	O+T_165_2	2.0	114.8	97.5	113.9	0.9	2.00	0.19	22.10	
3	O+T_165_3	2.0	109.4	100.3	115.5	0.9	2.20	0.20	22.99	
1	O+T_165_1	3.0	148.7	96.3	113.2	0.9	2.70	0.22	24.83	
2	O+T_165_2	3.0	149.7	98.1	114.6	0.9	3.30	0.21	24.18	
3	O+T_165_3	3.0	146.1	97.7	112.4	0.9	6.60	0.29	32.08	
1	O+T_165_1	4.0	175.1	89.4	105.1	1.0	9.30	0.53	56.16	
2	O+T_165_2	4.0	169.7	92.9	108.5	0.9	8.90	0.40	43.16	
3	O+T_165_3	4.0	173.9	91.6	105.4	0.9	7.00	0.45	47.42	
1	O+T_165_1	5.0	200.2	84.6	99.4	1.0	5.80	0.45	44.79	
2	O+T_165_2	5.0	197.7	82.8	96.7	1.0	11.60	0.75	72.24	
3	O+T_165_3	5.0	205.4	80.5	92.6	1.1	13.60	0.84	78.23	
1	O+T_165_1	6.0	223.7	71.6	84.1	1.2	11.40	0.95	79.94	
2	O+T_165_2	6.0	219.0	75.3	87.9	1.1	14.80	0.88	77.45	
3	O+T_165_3	6.0	224.9	73.0	84.0	1.2	14.90	1.11	93.39	
1	O+T_165_1	7.0	256.0	45.5	53.5	1.9	27.20	2.79	149.77	
2	O+T_165_2	7.0	252.6	54.6	63.8	1.6	23.90	2.12	135.47	
3	O+T_165_3	7.0	249.8	59.3	68.2	1.5	25.30	2.03	138.81	
1	O+T_165_1	8.0	279.3	32.6	38.3	2.6	30.20	4.28	164.27	
2	O+T_165_2	8.0	288.4	31.8	37.2	2.7	33.30	4.35	162.25	
3	O+T_165_3	8.0	278.5	32.3	37.2	2.7	39.50	4.32	161.15	



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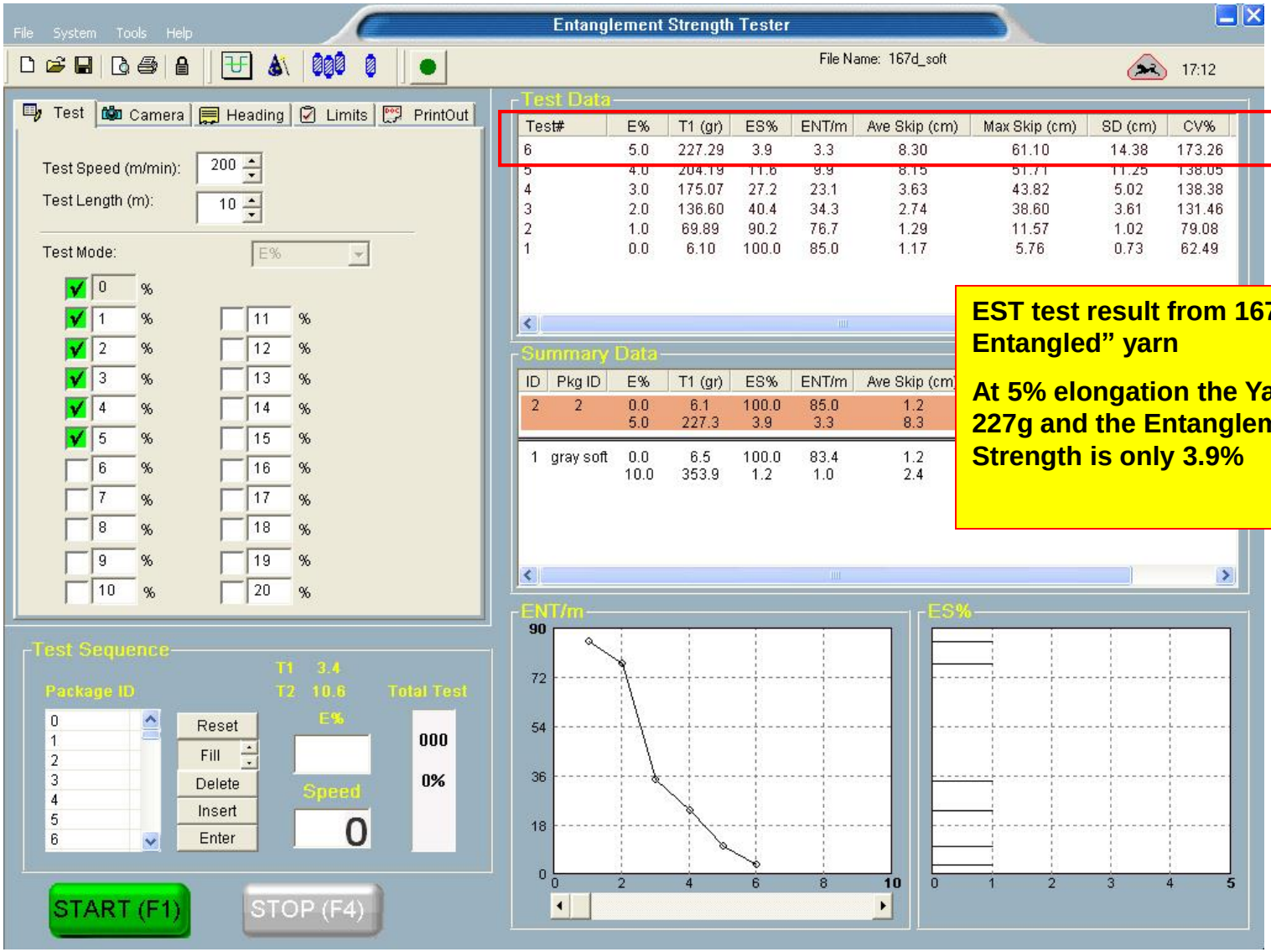
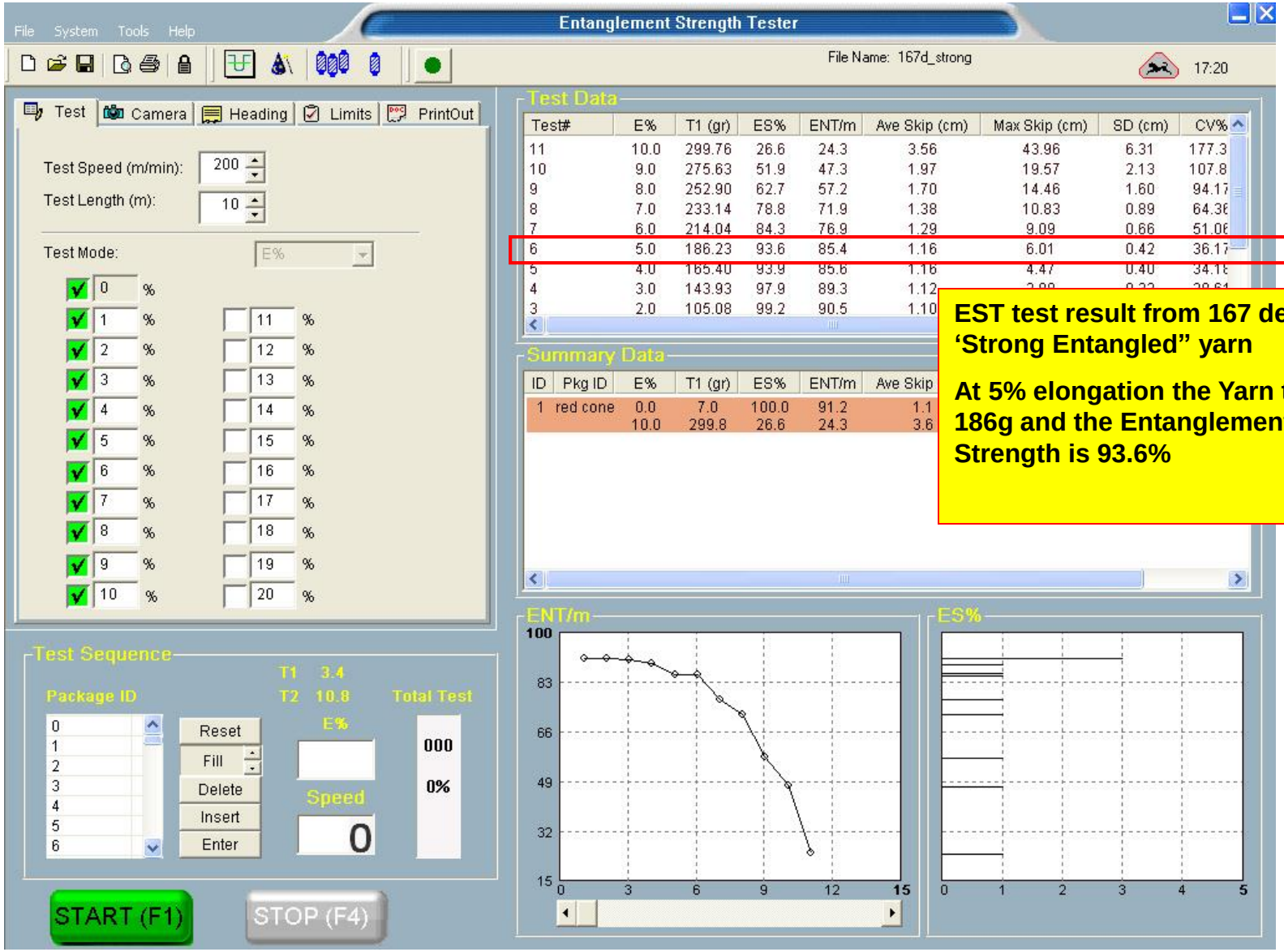
Test Report for Multi-Tests All Data



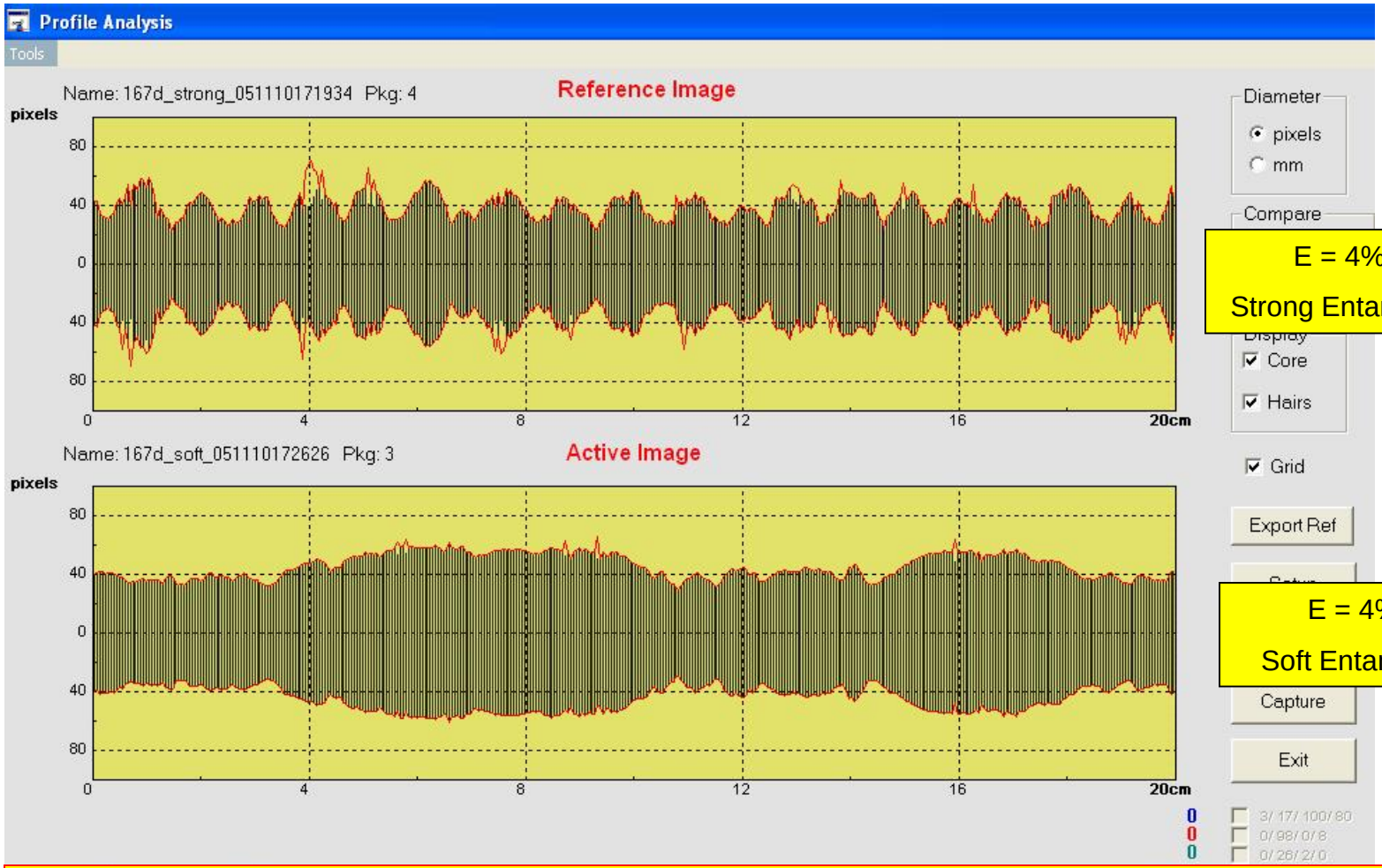
EST test result from 167 denier ‘Soft Entangled” yarn

At 5% elongation the Yarn tension is 227g and the Entanglement Strength is only 3.9%



EST test result from 167 denier 'Strong Entangled" yarn

At 5% elongation the Yarn tension is 186g and the Entanglement Strength is 93.6%



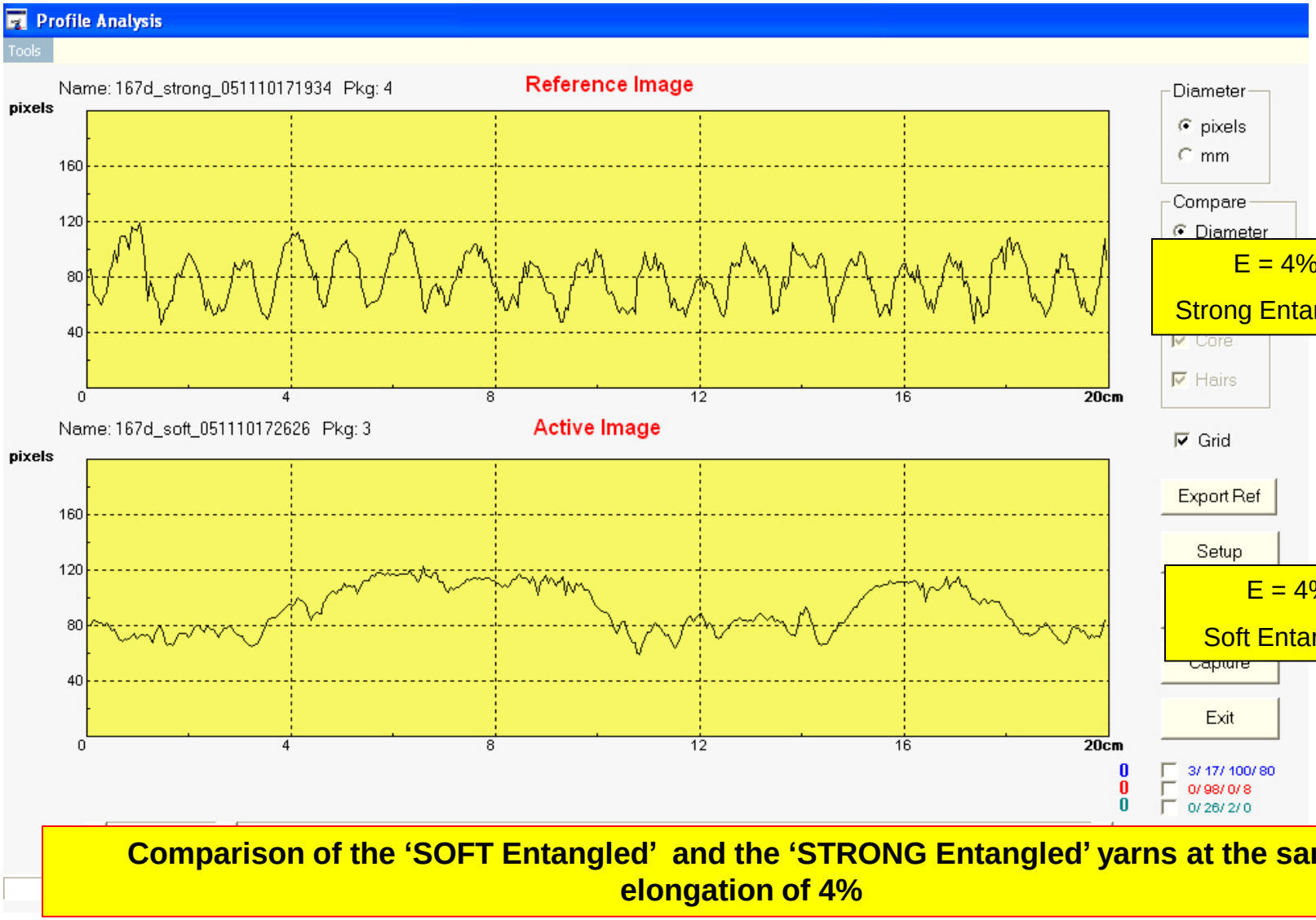
E = 4%

Strong Entangled

E = 4%

Soft Entangled

Comparison of the 'SOFT Entangled' and the 'STRONG Entangled' yarns at the same elongation of 4%



E = 4%

Strong Entangled

E = 4%

Soft Entangled

Comparison of the 'SOFT Entangled' and the 'STRONG Entangled' yarns at the same elongation of 4%

The Importance of Entanglement Strength Testing to improve yarn performance in downstream processes

During beaming, weaving or knitting, the yarn will be exposed to various levels of tension. It is important that the yarn has not only sufficient number of entanglements, but also has entanglements of certain strength to resist opening up, thus losing the cohesive yarn structure to complete the weaving or knitting process with minimum machine downtime.

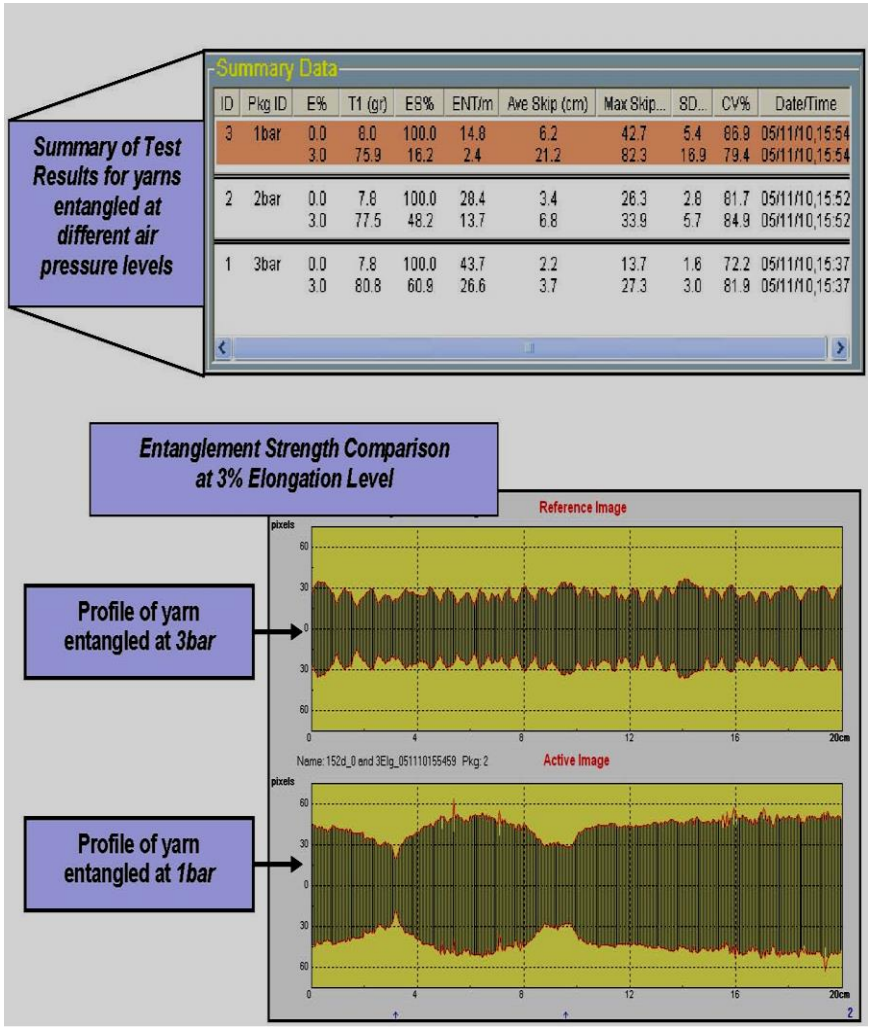
Soft Entanglements or Strong Entanglements are common terms to define the strength of the entanglements, whereas soft refers to the entanglements that are weak and can be easily removed and strong refers to the ones that resist removal.

To achieve high efficiency during fabric production, the entanglements need to be evenly distributed and of similar strength levels.

Problems develop when bobbins from the same lot have different entanglement strength levels or entanglement strength changes due to variations in air pressure through the entanglement jets within the same yarn package.

Missed or weak entanglements result in Entanglement Skips, where the yarn cohesiveness is no longer maintained. In addition to creating fabric production problems, Entanglement Skips are also known to cause streakiness in knit and woven fabrics.

Therefore, it is critical to measure the entanglement strength and skip distribution in the yarns to provide similar quality yarns to fabric process to minimize machine down time, thus resulting a highly efficient fabric production.



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For

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