ENTANGLEMENT TESTER based on microprocessors with incorporated ELECTRONIC-TENSIOMETER and yarn tension MEASURING HEAD. Control and display of the entire measuring process by PC – with "WIN 98 / 2000". Entry of all parameters and specific measuring data in a dialog with the PC monitor.

AUTOMATIC - Fully automatic measuring of the entanglement-distance and number of compaction points per meter. Statistical evaluation of all registered measuring data. Display on the monitor and/or print-out. All data can be stored on harddisc or disc.

QUALITY of the KNOTS - The ENTANGLEMENT TESTER R-2072 is the only existing instrument, which has the feature to register not only quantitative, but also qualitative measurements of the entanglement knot.

"Weak or soft entanglements" are shown in the statistics and in the graphic display or print-out.
ENTANGLEMENT - TESTER
R-2072

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS
=================================================================

General Remarks
The production-control of intermingled yarns in spinning and texturizing calls for the latest measuring techniques to determine the distances between compaction points and their quality.

The old traditional method

The yarn was pierced by a needle inserted by hand, whereupon the needle was pulled through the yarn, parallel to the filaments, till it encountered a compaction point. The distance covered by the needle was then measured. By repeating this measurement several times, an average of the distances between compaction points was obtained.

Quite obviously this method has the following drawbacks:

- It is most time-consuming and demands a technician with excellent eyesight as well as deft hands.

- It is not very accurate, as when the needle is pulled through, minor compaction points can either be broken through or bunched up, so that the original distances between compaction points can no longer be ascertained and are distorted.

- After each test, the respective distance has to be measured and entered into the table, a time consuming part of the test.

- So as not to damage the individual filaments and to carry out tests in invariable conditions, both, the yarn tension and the trip level tension (which heralds a compaction point), must always be exactly maintained. This is not possible with this method.

- Mayor yarn lengths cannot be or are most impractical to be tested. On the other hand, the testing of short lengths often gives non-representative or distorted results.

- This measuring method is very labour-intensive. Measurement and evaluation take several minutes for each test and call for a skilled technician.

An other method works on the principle of measuring the thickness of yarn, accepting that an Entanglement - Knot has a slightly larger diameter than the average yarn. Problems with finer yarns and the presetting of the thickness for the reaction of the feelersprings slow down the tests and do not allow qualitative tests of the knot.
ENTANGLEMENT - TESTER  
R - 2 0 7 2

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS
=================================================================

So as to overcome the short-comings of the above methods and speed up measurement and evaluation considerably,

ROTHSCHILD MESSINSTRUMENTE, Zürich, Switzerland

have developed and brought on the market an instrument automating the whole measuring process within adaptable predefined principles, the

Measuring Process:

The yarn to be tested:
- first passes a yarn brake for pre-tensioning to 0,1 cN / den.

- It then passes the yarn piercing unit where it is pressed down by two yarn guides, spread into two grooves and pierced by the needle.

- It then advances at a speed, adjustable as required, while a measuring unit continuously controls the yarn tension.

- As soon as the needle encounters a compaction point, the yarn tension increases and at the preselected peak tension "TRIP LEVEL", the length measuring process between compaction points is triggered and the needle withdrawn. The data of the length and tension up to this point is registered and stored giving the QUANTITATIVE measurements.

- The measured yarn length is displayed on the monitor and printed. The measured values from the memory are being stored for statistical evaluation at the end of the measuring cycle along with other values.

- The yarn then advances by a short adjustable length corresponding to the length of the compaction point.

- "INTERTRIPS" which are weak or soft entanglement points and are opened up by the needle when the yarn tension is building up before the "TRIP LEVEL" is reached, are also registered when they reach the INTERTRIP - yarn tension level which can be preset at 20 - 90% of the TRIP-LEVEL, representing the QUALITATIVE measurements.

This process (needle piercing, yarn advancement, needle withdrawal etc.) is repeated till the pre-selected number of measurements (= 1 measuring cycle) has been registered. Such a measuring cycle can be repeated up to 200 times.

At the end of the measuring series, overall statistics, quantitative and qualitative frequency graphs and a histogram can be called up and printed.

Measuring Speed:

Up to 2' 500 measurements - corresponding to an average distance of 20 - 60 mm (between compaction points) - can be carried out per hour.
ENTANGLEMENT - TESTER
R - 2 0 7 2

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS

The PC with "Windows 98 / 2000 (and following)"

The ENTANGLEMENT TESTER R - 2072 is connected to the PC and printer. With the programmed software based on "WINDOWS 98 / 2000 (and following)", all commands, displays and evaluations can be operated from the keyboard and shown on the monitor and a protocol giving the resulting data is printed.

Also all data can be exported in ASCII Code.

Test values and Evaluation:

- Distance between Entanglements
- Number of Compaction Points per meter,
- MAXimum entanglement distance
- MINimum entanglement distance
- Average Value
- Number of INTERTRIPS (weak or soft entanglements)
- Coefficient of variations
- Histogram
- Frequency graphs
- Static - Cycles
- Static - Overall
- "NO - SHOW" - Trips

The Print-out of the protocol can contain all or only specific selected values. The attached protocols show part of the possible evaluations. (Refer to enclosed Annex.)

Measuring Parameters to be preselected:

- Yarn Tension Measurement
  Yarn tension of 0.1 to 1'000 cN or 40 (30) - 8000 den can be measured with corresponding interchangeable Measuring Heads

- Yarn speed
  Setting of 0.02 - 50 m / min

- Intermediate Yarn Transport length
  Length of free yarn-run between Measuring Cycles 0.001 - 100 m

- Yarn Pre - Tension
  Standard Compensation Brake 3 - 50 cN
  Reinforced Compensation Brake 15 - 150 cN

- Number of measurements and Measuring Cycle
  1 - 250 Individual measurements can be preselected per measuring cycle.
  1 - 200 Measuring Cycles can be repeated automatically.

- TRIP - LEVEL and the Yarn Piercing Unit:
  The Yarn piercing unit is an electro-mechanical system of the highest precision. The piercing process is controled by two program-disks and the TRIP - LEVEL - tension can be set at 0.1 - 1'000 cN. The appropriate interchangeable Measuring Head has to be fitted.
  When the needle encounters a compaction point at the preset TRIP - LEVEL it is withdrawn and the yarn released for free passage of the length of the compaction knot.
ENTANGLEMENT - TESTER
R - 2 0 7 2

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS

(Cont.: PRE SELECTION OF MEASURING PARAMETERS)

- Length of compaction knot:
The setting of the estimated length of the compaction knot is to be made within the range of 1 - 50 mm.

- INTER - TRIP - LEVEL
  For the registration of QU A L I T A T I V E measurements the INTER - TRIP - LEVEL has to be set at 20 - 90 % of the preselected value of the TRIP - LEVEL.

- "NO - SHOW", False Measurement - No compaction
  It may happen that no measurement is being registered during a yarn passage and this may be the result of one of the following causes:
  
  1. The filaments remain parallel over some length of yarn with no compaction and no build-up of yarn tension being registered.
  
  2. For one reason or another (e.g. very fine yarn is being tested) the needle did not pierce the yarn and it is pulled past the needle.

To prevent a distortion of the measurements, a "NO - SHOW" value is to be preselected out of a yarn length of between 0.1 and 10 m, after which this particular measurement is broken off, the needle withdrawn and the measuring process continues. Such "NO - SHOW" incidents are being recorded and show up in the protocol.
ENTANGLEMENT - TESTER
R - 2072

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS

COMPLETE SCOPE OF SUPPLY

1 ENTANGLEMENT TESTER R - 2072 with built-in Electronic Tensiometer and Measuring Head (Standard = 100 cN)

1 PC with "WINDOWS 98/2000 (and higher)" installed with Monitor and Keyboard

1 PRINTER

1 SOFTWARE PACKAGE

TECHNICAL DATA

Measuring Method: - Rothschild needle-piercing-system for yarns of 40 (30) - 8'000 dtex.

Evaluation of measured values: - By PC and special software-program based on "WINDOWS 98/2000 (and higher)" , in metric- or inch - system

Measuring speed: - approx. 2'500 measurements / hour

Measuring results:
- Compaction points per meter or inch
  - Entanglement distance with:
    - Number of compaction points
    - Number of Intertrips (weak or soft entanglement points)
    - Distance of compaction points
    - No-show
  - Measuring cycle information:
    - MAX. value
    - MIN. value
    - Average value
    - Standard differences
    - Coefficient of variations
  - Overall statistic with:
    - Printout histogram
    - Frequency graphs
    - Cycles graphs
    - Intertrip statistic
    - Intertrip graph

Preselection of measuring parameters:
- Measuring Cycles 1 - 250 individual measurements
- Cycles per series 1 - 200
- Measuring speed 1 - 20 m / Min.
- No - Show distance 0,1 - 10 m
- Compaction knot-length 1 - 50 mm
- Nom. value measuring head 10 - 1'000 cN
- Trip - level 0,1 - 1'000 cN
- Intermediate Yarn Transport 0,001 - 100 m
- Needle speed 10 - 200 p. min.
- Data - setting in meter or inch
- Print-out monitor / printer
- Yarn pre-tension 1 - 60 cN
- Intertrip 20 - 90 % of trip-level

Weights:
- ENTANGLEMENT TESTER 25 kg
- PC, Monitor and Printer approx.: 20 kg

Dimensions:
- ENTANGLEMENT TESTER 52 x 45 x 35 cm
AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS
=====================================================================

IMPROVEMENTS TO THE FORMER MODEL R-2071
=====================================================================

ACCURACY OF MEASUREMENTS:

Quantitative Measurements:

Both, the distances between the individual entanglement knots, as well as the number of knots per meter are recorded, statistically evaluated and graphically displayed.

In order to obtain reliable measuring values over great yarn lengths, any number of measuring cycles (with up to 250 individual measurements each) can be set. Between the cycles, the yarn passes at a fast pace (settings between 0.001 and 100 m).

The statistical values of every single cycle are processed and printed. The overall statistic, the result of the combined data from the total number of cycles, is also displayed and can be printed.

Qualitative Measurements

The ROTHSCCHILD ENTANGLEMENT TESTER is the only instrument capable of measuring the KNOT QUALITY (mechanical strength of the knot).

On each trip the inserted needle checks the stability of the knot. Only when it withstands a pre-set testforce, is it considered as "good".

As a new criterion we introduced the measuring unit "INTERTRIP". An INTERTRIP occurs when the pre-set testforce of the Trip-Level is not reached as a result of a soft or weak entanglement. This information is stored and statistically evaluated. The parameter value of the "INTERTRIP" can be set at any value within the range of 20 - 90% of the Trip-Level tension value.

The progress of the yarn tension of each trip is stored and after the measurement it is shown on the monitor. The yarn tension diagram of a whole cycle or of each individual trip can be shown and printed.

OPERATION OF THE ENTANGLEMENT - TESTER R-2072

- The operation of the instrument has become extremely easy. All settings are entered by following a dialog with the programmed display on the monitor.

- 14 different measuring parameters can be set and the whole group of parameters can be entered in the memory for repeat application at any later date.

- It is now possible to block individual parameters to prevent unwanted changes.
ENTANGLEMENT - TESTER
R - 2072

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS

Cont.: of IMPROVEMENTS TO THE FORMER MODEL R - 2071

- Data limits are shown on the display when setting parameters. Entries outside these limits are not accepted.

- Presetting for different print-systems

- Option to display and print measured data in "inches" or "meters"

- Option to print in columns or line by line

- Fast setting of yarn-specific IDENTIFICATOR data.

- The system is prepared for the programming of an automatic knotter system.

- For R + D applications, measurements of up to 50'000 trips per sample can be taken. All measured values are stored and evaluated.
ENTANGLEMENT TESTER
R - 2072

AUTOMATIC NEEDLE PULL TESTER FOR INTERMINGLED YARNS

EXAMPLES of MEASURING PROTOCOLS
based on "WINDOWS 98/2000 (and higher)" - Software

<table>
<thead>
<tr>
<th>Pro Memoria:</th>
<th>Cycle</th>
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<td></td>
<td>Trip</td>
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<tr>
<td></td>
<td>Intertip</td>
<td>a single measurement</td>
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<tr>
<td></td>
<td></td>
<td>encountering a weak knot</td>
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<tr>
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<td>Intertip-level</td>
<td>a tension limit preset</td>
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<tr>
<td></td>
<td></td>
<td>in percentage of the Trip-level (60%)</td>
</tr>
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Page TP - 2
A Typical Measuring Protocol listing the Final-Results

A - Parameters
B - Results of Cycle-measurements (5 cycles of 20 trips each)
C - Overall Statistics

Page TP - 3
A Measuring Protocol listing in addition the single trip data

A - Parameters
B - Single data per Cycle
C - Cycle Statistics
D - Overall Statistics

Page TP - 4
A - Histogram of the total measurements (5 cycles of 20 trips ea = 100 measurements)
B - Graph showing deviation of measurements per cycle with
   Maxi - Mini values (represented by the upper and lower lines of the rectangles)
   - Mean - values (represented by the black line)

Page TP - 5
A graphic display of the measuring procedure

A - Cycle Nr. 5 = 20 trips
   The mark below the line at trip Nr. 11 signals an INTERTRIP
   - Line "TL" shows the TRIP-LEVEL limit
   - Line "IT" shows the setting of the INTERTRIP - limit (60% of TRIP-LEVEL)

Page TP - 6
TRIPS projected in ZOOM mode

A - Trip Nr. 12 projecting a normal entanglement knot
B - Trip Nr. 11 projecting a weak entanglement knot
   (3 x INTERTRIP, 3 x weak knot was opened)
## ENTANGLEMENT - TESTER R-2072

### ROTHSCILD INSTRUMENTS ZUERICH

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| MEASURING SPEED | 10.00 m / Min |
| NO-SHOW LENGTH  | 0.50 m        |
| KNOT LENGTH     | 0.005 m       |

| TRIP LEVEL     | 16.0 cN        |
| INTER TRIP     | 90 %           |
| TRIPS PER CYCLE| 20             |

| NUMBER OF CYCLES | 5          |
| INTER CYCLE LENGTH | 10.00 m |

### A

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<th>CYCLE NR</th>
<th>TRIPS NO</th>
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<th>INTER TRIPS</th>
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| MAX      | 20       | 0             | 7           | 33     | 411    | 114  | 15.71     | 90   | 99.51|
| MIN      | 20       | 0             | 2           | 15     | 259    | 82   | 13.24     | 55   | 87.46|
| X        | 20       | 0             | 3           | 26     | 315    | 97   | 14.30     | 76   | 78.41|

| OVERL    | 100      | 0             | 15          | 15     | 411    | 97   | 14.30     | 77   | 78.72|
# ENTANGLEMENT - TESTER R-2072

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| MEASURING SPEED | 10.00 m / Min |
| NO-SHOW LENGTH  | 0.50 m        |
| KNOT LENGTH     | 0.005 m       |

| TRIP LEVEL   | 18.0 cN |
| INTER TRIP   | 80 %    |
| TRIPS PER CYCLE | 20    |

| NUMBER OF CYCLES | 5          |
| INTER CYCLE LENGTH | 10.00 m   |

## STATISTIC

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## CYCLE NR

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| MAX      | 20       | 0       | 7           | 33     | 411    | 114   | 15.71      | 90   | 96.51|
| MIN      | 20       | 0       | 2           | 15     | 258    | 82    | 13.24      | 55   | 87.40|
| X        | 20       | 0       | 3           | 26     | 315    | 97    | 14.30      | 78   | 78.41|

| OVRL 100 | 0       | 15      | 411        | 97     | 14.30  | 77    | 78.72      |      |     |
ENTANGLEMENT - TESTER R-2072

HISTOGRAM

DEVIAITION
ENTANGLEMENT - TESTER R-2072

ROTHSCHILD INSTRUMENTS ZUERICH

GRAPHIC

YARN    POLYESTER
LOT      160/7
OPERATOR MOSBACHER
ID       DERA
DATE     11:03:1998 / 16:30