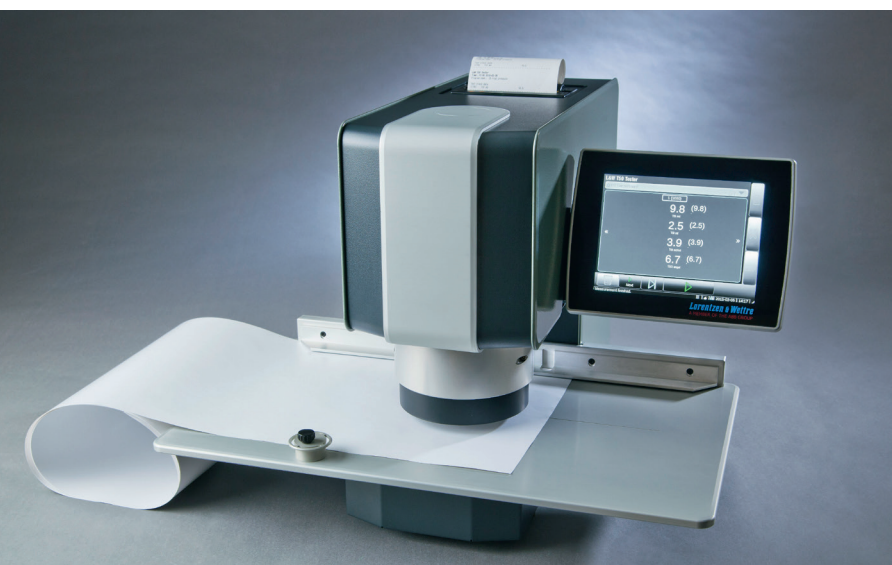


PULP AND PAPER

## L&W TSO Tester

Lorentzen & Wettre Products | Process Optimization



L&W TSO Tester is an ideal tool for process optimization as it allows early action in the headbox, press, and dryer – saving raw material, as well as time. It uses ultrasonic technique to measure Tensile Stiffness Index (TSI) and Tensile Stiffness Orientation (TSO) and the results can be used to predict the performance of paper in; a sheeting process, a multi-colour printing process, laser copying machines, and when manufacturing corrugated board.

L&W TSO Tester measures TSI/TSO-properties on sheets and machine- or cross-machine profile paper samples cut out from the jumbo reel. Measurement data is used for optimizing the performance of important stages in the production process, such as forming at the headbox as well as the performance in the press and drying sections. A TSI/TSO-optimized paper machine makes it easier to achieve specifications for compressive, tensile, and bursting strength.

A typical application is troubleshooting problems related to the headbox, such as pressure pulsations or a deviating pressure profile. The goal for a strip cut in CD is a symmetrical profile at a certain TSI- and TSI-MD/CD ratio level with a TSO-angle as minimal as possible. A profile measurement is usually performed within five minutes, and provides complete information on the full web width (including edges). Thus, the TSI/TSO profiles can be determined at every reel change.

Early actions can be made to avoid deviations in the succeeding reel, keeping the TSI/TSO-values within pre-determined limits. L&W TSO Tester can also be used for predictions of the runnability of a paper in applications like sheeting, copying, and printing

operations. In a multicolour printing process the orientation of hygro-expansion (related to the TSO-angle) needs to be under control. In corrugated board manufacturing matching liner single facer and double backer with the same TSI/ TSO-value is important to avoid twist or warp.

### Features/Benefits

- Tool for paper machine tuning and for predicting end use performance at printers and box makers:
  - Automatic measurement of cross directional and machine directional TSI- and TSO-profiles
- Ease of use:
  - Large touch screen for good overview
- Quick and non-destructive testing:
  - Using ultrasonic technique makes it possible to do quick and non-destructive TSI measurement in all directions of the paper's plane
  - Rapid measurement – six seconds per test point

## Easy to use

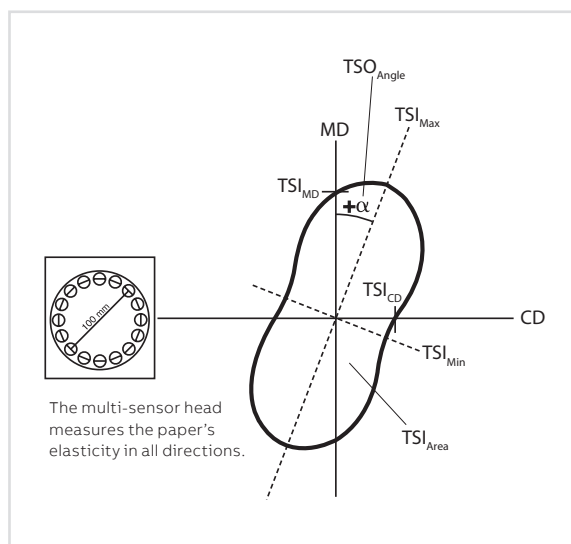
The colour touchscreen has intuitive menus, user-friendly interface, and a protective surface for easy cleaning and durability. A quick measurement sequence can be performed on a test strip cut from the reel (with the optional profile sample cutter from Lorentzen & Wettre). The strip is then attached to the instrument and measurement begins when pressing the start button.

## Strip feeder

With the integrated strip feeder each position is measured at a fixed interval and continues until the strip ends. Defined position measurements ensures repeatable testing. The measurement speed is about six seconds per measuring point. Thus, the total time required for a complete profiling sequence, will depend on the length of the sample and the distance between measuring points.

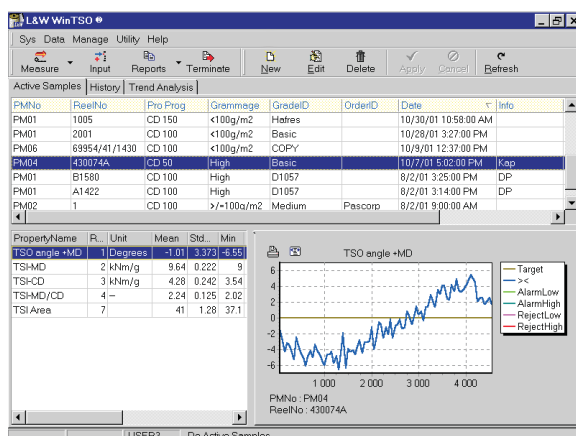
## Measurement results

TSI- and TSO-values are presented on the touchscreen, either in tabular or graphic form. Results can also be printed on the built-in printer, on a network printer or exported via Ethernet. The instrument acts as an FTP-server and test results can be retrieved by an FTP-client.

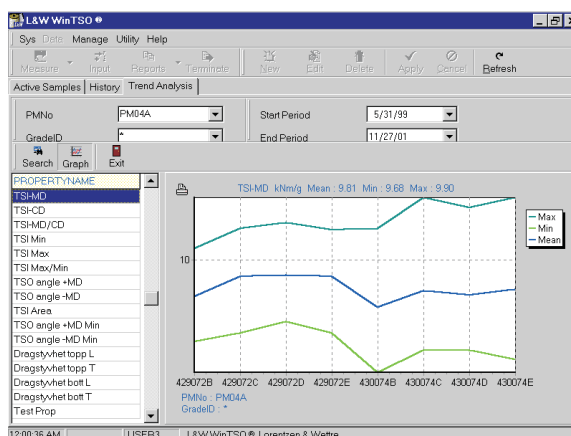


The measurement results can be presented as a polar plot, which provides a complete picture of the paper sheet's elastic properties.  $\alpha$  = TSO angle.

PROPERTY	RELATES TO
1. TSI <sub>Area</sub>	- Furnish preparation
2. TSO & TSI <sub>MD/CD</sub>	- Forming
3. TSI <sub>MD</sub>	- Pressing
4. TSI <sub>CD</sub>	- Drying



Measurements are displayed in an easy-to-grasp way.



Measurements from consecutive rolls can be analysed to reveal trends.

## DEFINITIONS

The speed of an ultrasonic pulse in the plane of a paper depends on the elastic properties of the paper – its tensile stiffness index (TSI). TSI can be compared with Young's modulus (or the "E" modulus) for other materials.

The relationship can be expressed as:

$$TSI = v^2 \times c$$

where:

TSI = tensile stiffness index (kNm/g or MNm/kg) of the paper measured using the ultrasonic method

v = propagation velocity (km/s) of the ultrasonic pulse

c = a dimensionless constant close to 1 depending on Poisson's ratio for the paper

Velocity is measured in eight directions. The result is converted by the processor using a Fourier transformation to an ellipse. The ellipse shows the elasticity in all directions of the plane of the paper. This allows the identification of the direction of the greatest stiffness. This property is known as  $TSI_{Max}$ .

The difference between the machine direction in the sheet and the direction for  $TSI_{Max}$  is referred to as the  $TSO_{Angle}$ .

Other properties reported by L&W TSO Tester are:

$TSI_{MD}$  – tensile stiffness index in the machine direction

$TSI_{CD}$  – tensile stiffness index in the cross direction

$TSI_{MD/CD}$  – tensile stiffness index ratio, i.e. the anisotropy in the sheet

$TSI_{Max}$  – tensile stiffness index, maximum value

$TSI_{Min}$  – tensile stiffness index, minimum value

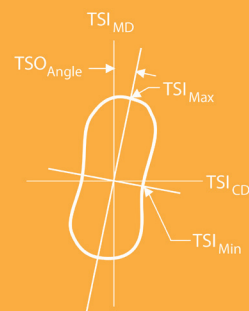
$TSI_{Area}$  – the tensile stiffness index, ellipse surface area

## Technical specifications – L&W TSO Tester, code 283

Inclusive	check film and PC-software for evaluation and logging of data		
<b>Measurement</b>			
Method	Ultrasound propagation speed in the plane of the sheet		
Measuring time	6 s per test point		
Distance between measuring points	> 20 mm		
<b>Sample</b>			
Grammage	30–500 g/m <sup>2</sup>		
<b>Instrument</b>			
Presentation	8.4 in colour touchscreen		
Results	Measurement values - TSI <sub>MD</sub> - TSI <sub>CD</sub> - TSI <sub>MD/CD</sub> - TSI <sub>Min</sub> - TSI <sub>Max</sub> - TSI <sub>Min/Max</sub> - TSI <sub>Area</sub> - TSO <sub>Angle</sub>  Statistics - mean value - max. and min. value - standard deviation/coefficient of variation - number of values		
<b>Installation requirements</b>			
Power	75 W		
Instrument air	0.6 MPa		
Air consumption	0.3 l/min NTP for 10 measurements per min		
Option	Strip holder (for guiding of long strips)		
<b>Connections</b>			
Data	Ethernet The instrument acts as an FTP-server. Test results can be retrieved by an FTP-client.		
Dimensions	0.6 × 0.6 × 0.5 m 24 × 24 × 20 in	Volume	0.31 m <sup>3</sup> 11 ft <sup>3</sup>
Net weigh	35 kg 77 lb	Gross weight	60 kg 133 lb

## The Ultrasonic Measuring Technology on Paper and Board

A handbook by Gunnar Lindblad and Thomas Furst



The Ultrasonic Measuring Technology on Paper and Board (by Gunnar Lindblad and Thomas Furst) – This book is the work of several L&W TSO Tester Product Managers who have collected knowledge and information from paper mills throughout the world spread out over a period of ten years. The book describes measurement methods for instruments and how measurement values may be used by the paper maker in order to achieve the best paper quality and to optimize the paper machine.

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