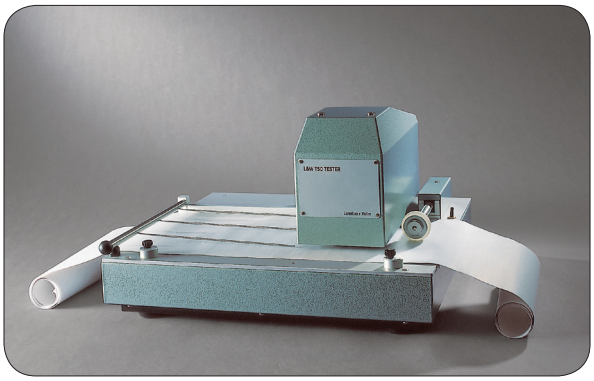
L&W TSO TESTER

L&W TSO Tester is an ultrasonic instrument for measuring Tensile Stiffness Index (TSI) and the Tensile Stiffness Orientation (TSO) properties on sheets and cross machine paper samples. In the QC shift laboratory the results are used to predict the performance of paper, in a sheeting process, in a multicolour printing process, in laser copying machines, and when manufacturing corrugated board. It is also an ideal tool for process optimization, as it allows you to take early action in the head box, press and dryer, saving raw material, as well as time. Correlation to strength properties such as RCT and SCT can also be performed.



The ultrasonic L&W TSO Tester measures the Tensile Stiffness Index (TSI) and the Tensile Stiffness Orientation (TSO) properties on sheets and cross machine paper samples.

BENEFITS

- Measures with the ultrasonic technique
- Automatic measurement of cross directional and machine directional TSI and TSO profiles
- Rapid measurement – six seconds per test point
- Additional values can easily be entered by operator, to determine correlations between TSI and other properties

L&W TSO Tester measures TSI- and TSO-properties on sheets and cross-machine paper samples. The acquired measurement data is used for optimizing the performance of important stages of the machine process, such as headbox, press section and dryer.

A typical cross-directional measurement is usually performed within five minutes, and provides complete information on the full web width, including edges. Thus, the TSI and TSO profiles can be determined at every reel change. Early action can be taken against possible deviations in the following reel, keeping the TSI and TSO values as well as any calculated strength properties within pre-determined limits.

L&W TSO Tester is also an ideal instrument for troubleshooting of headbox problems such as pressure pulsations or a deviating pressure profile. With the help of correlation data the TSI value can also be used for calculating strength properties such as SCT and RCT. In the laboratory, L&W TSO Tester is a flexible tool for reliable predictions of the runnability of a paper in applications like copying, printing or board conversion.

Easy to use

L&W TSO Tester is easy to use. The test strip is quickly cut from the reel, using the profile sample cutter from Lorentzen & Wettre.

The strip is then attached to the instrument's feeder, and the measurement sequence is automatically performed at the push of a button. 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. This distance can be 10–2 000 mm.

Frequency analysis

L&W TSO Tester consists of a tabletop ultrasonic measuring unit with feeder attachment and a PC with printer and software.

The complete measuring station can be placed either in the machine control room or in the laboratory. All results can be stored for further analysis or for transfer to other computers. TSO and TSI properties can also be measured in the automatic L&W Autoline 400.

By cutting long strips of paper it is also possible to do a frequency analysis of machine directional variations.

The measurements can be displayed on a computer screen or printed as profile graphs for TSI_{MD}, TSI_{CD}, $TSI_{MD/CD}$, TSI_{AREA}, TSO_{ANGLE} or other machine-specific characteristics. Once all the measurements have been made they can be either archived in a special area of the database or transferred as XLS or HTML files to other systems via e-mail or FTP. The measuring program can display superimposed or three-dimensional graphs that make the measurements easier to understand.

DEFINITION
The speed of an ultrasonic pulse in the plane of the 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 1depending 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. The other properties reported by the TSO Tester are:

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

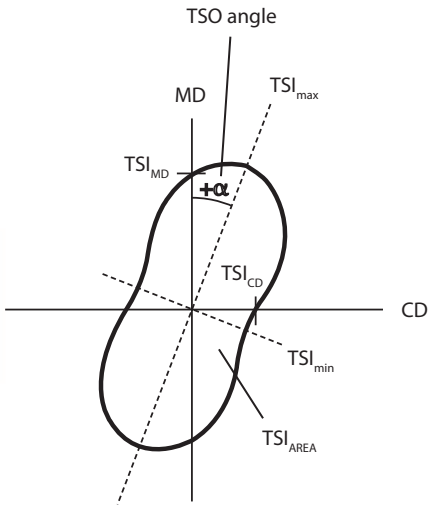
TSI_{CD} – tensile stiffness index in the cross direction

$TSI_{MD/CD}$ – 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



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

Specification	
L&W TSO Tester – Code 150	
Inclusive	PC, printer, software and test film
Measurement	
Method	Ultrasound propagation speed in the plane of the sheet
Measuring time	6 s per test point
Distance between measuring points	10–2000 mm
Sample	
Grammage	30–500 g/m²
Instrument and program	
Results	*Measurement values* - TSI_{MD} - TSI_{CD} - $TSI_{MD/CD}$ - TSI_{MIN} - TSI_{MAX} - $TSI_{MIN/MAX}$ - TSI_{AREA} - TSO_{ANGLE} - calculated properties *Graphical reports* - Polar diagram and profile graphs on the screen and printer *Statistics* - mean value - max. and min. value - standard deviation/coefficient of variation - number of values
Settings	Targets, grade targets, alarm limits
Installation requirements	
Power	900 W
Instrument air	0,6 MPa
Air consumption	0.3 l/min NTP for 10 measurements per min
Options	L&W Profile Sample Cutter (code 148) and L&W Sample Trimmer (code 149)

Dimensions		Volume
L&W TSO Tester	0.6 × 0.6 × 0.4 m 24 × 24 × 16 in	0.31 m³ 11 ft³
PC	0.5 × 0.7 × 0.4 m 20 × 27 × 16 in	0.6 m³ 21 ft³
Printer	0.4 × 0.4 × 0.3 m 16 × 16 × 12 in	
Net weight		**Gross weight**
L&W TSO Tester	38 kg 84 lb	58 kg 128 lb
PC and printer	41 kg 90 lb	62 kg 137 lb

	Property	Relates to
1.	TSI_{AREA}	- Furnish prep.
2.	TSO & $TSI_{MD/CD}$	- Forming
3.	TSI_{MD}	- Pressing
4.	TSI_{CD}	- Drying
5.	FFT	- Machine Mechanics