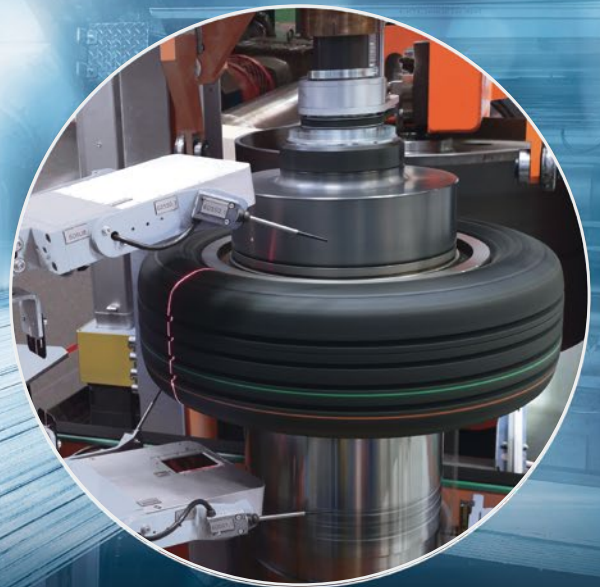




More Precision.

Inspection and production systems // Tire industry



Inspection and production systems for the tire industry

References

References (extract)



Best Efficiency, by Mastering Microns

Performance, quality and the reliability of products and services provided over many years establishes Micro-Epsilon as a leading supplier of inspection systems for the tire industry. More than 400 installations in 29 countries all over the world, placed in the preparation, final finishing and wheel assembly areas, speak for themselves.

Generating all the required core components like sensors, software and measurement specific mechanical construction within the company group provides unique, innovative system solutions which are mirrored in the product portfolio of Micro Epsilon.



About Micro-Epsilon



Micro-Epsilon has been a reliable industrial partner for precision measurement technology applied in inspection, monitoring and automation. Systems and components from Micro-Epsilon are used in the rubber and tire industry in order to develop efficient production.

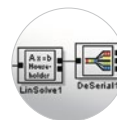
Micro-Epsilon employs more than 1500 people throughout the world and provides Europe's most comprehensive range of measuring technology for measuring thickness, width, profile and surface. In addition temperature, colour, 3D geometry, vibration, deformation, gap, weight and many other factors are also measurable using sensor technology.

Whilst the company specializes in measurement technology, it is also known for developing unique solutions where requirements have to be strictly observed in processing lines. Innovative solutions can be developed quickly to meet or exceed the customers specifications.



Sensors

Worldwide market and proven sensors as base of the systems, with the possibility for adaptation increasing the precision



Software

Graphical software development environment guarantees groupwide synergetic development



Mechanics

High quality mechanical design, mechanical manufacturing and assembly



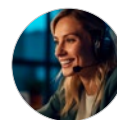
Machinery

for tire industry, tire wheel assembly and automotive



Automation

Electrical design, PLC programming and assembly



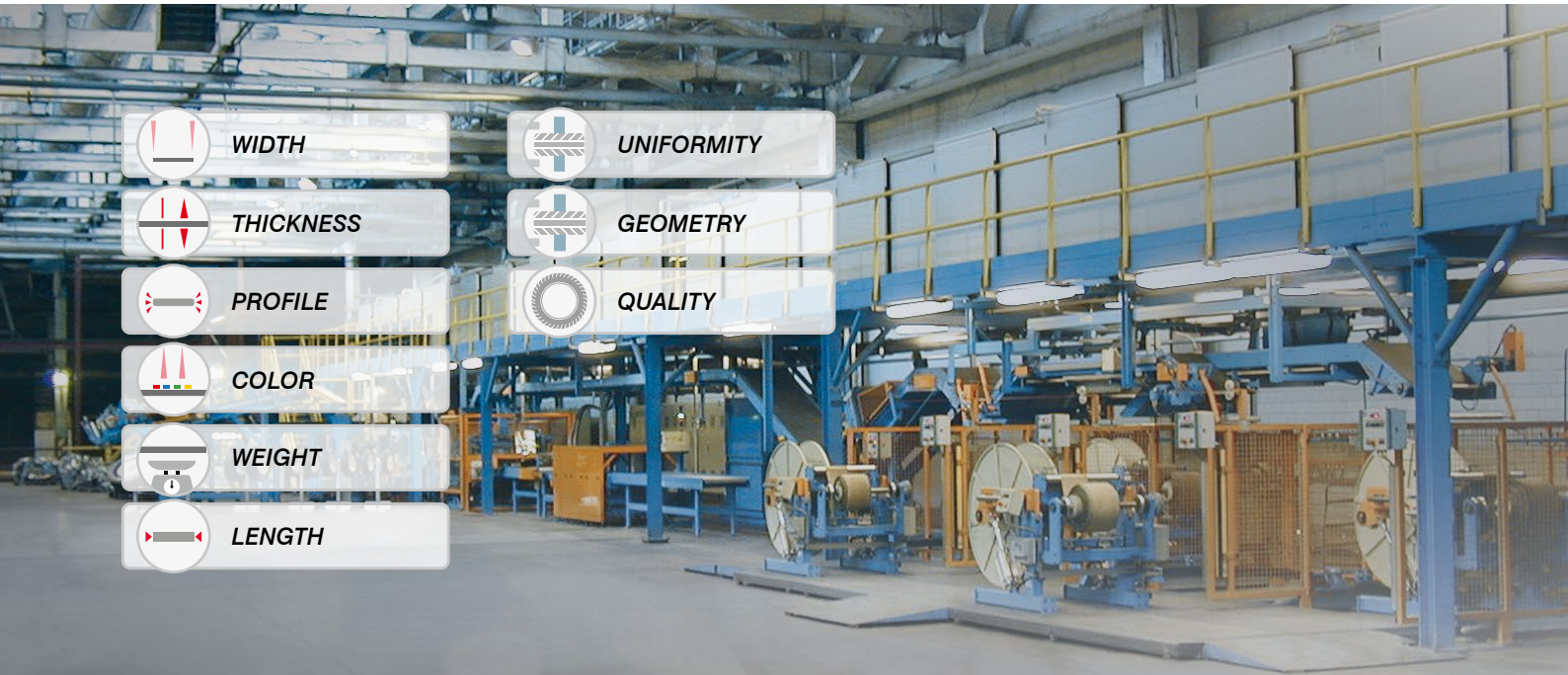
Service

Technical support
7days, 24 hours

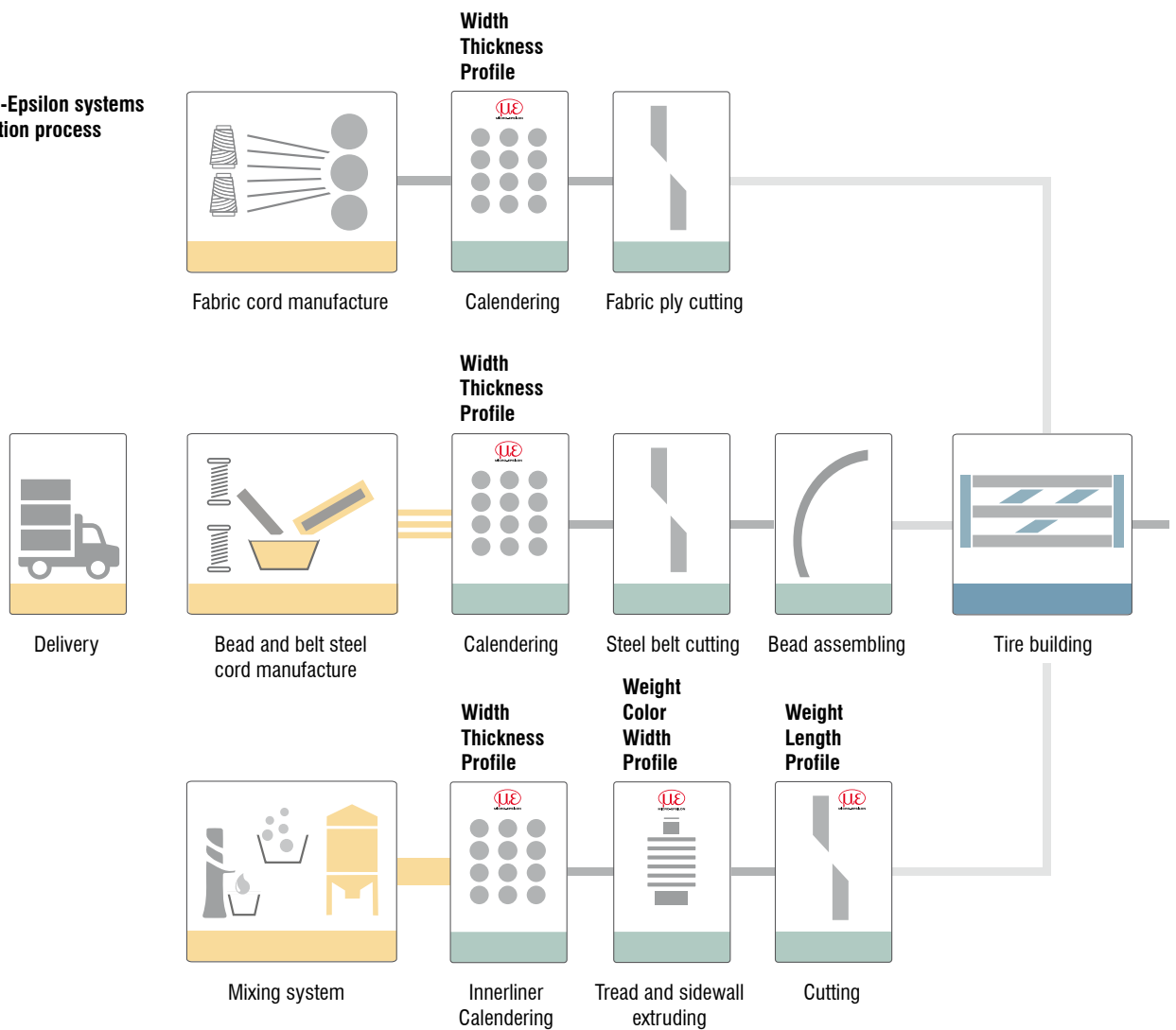


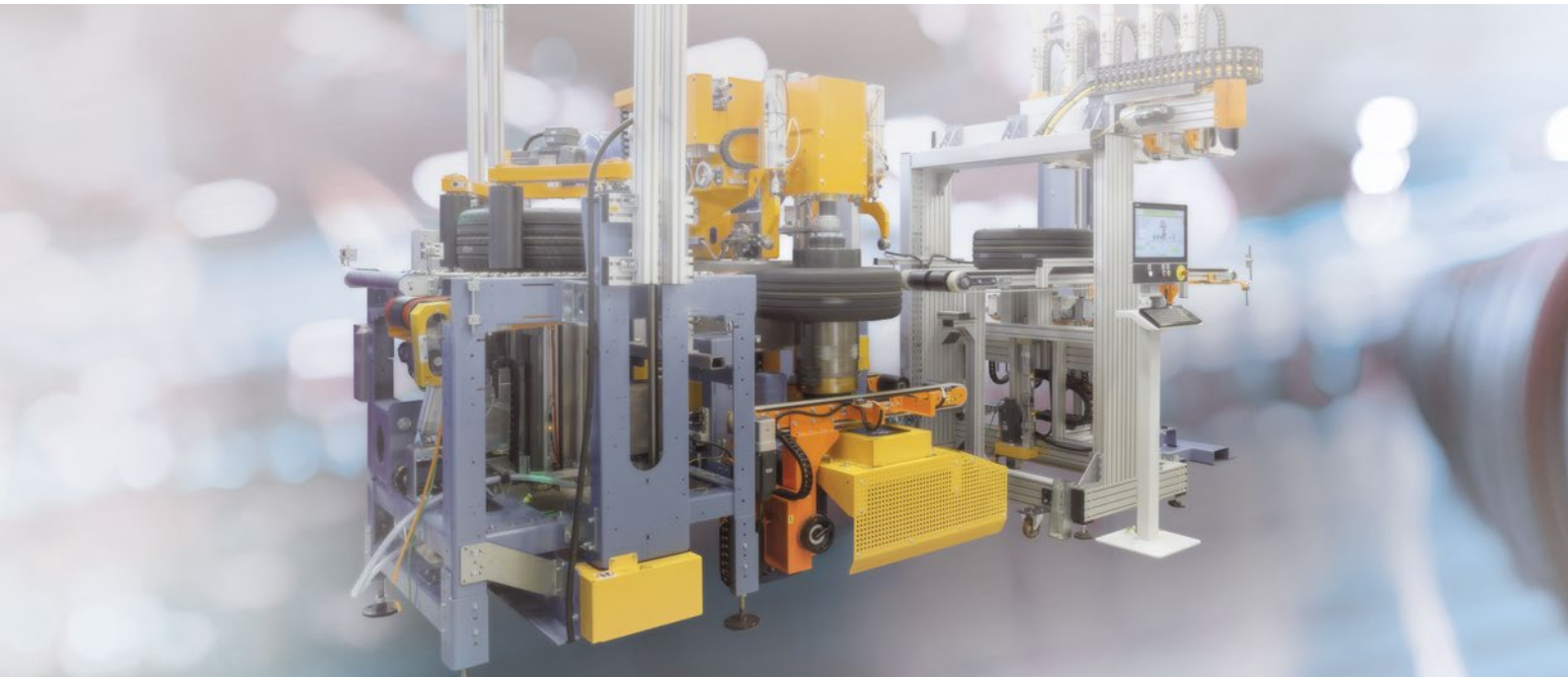
Inspection and production systems for the tire industry




Fields of application

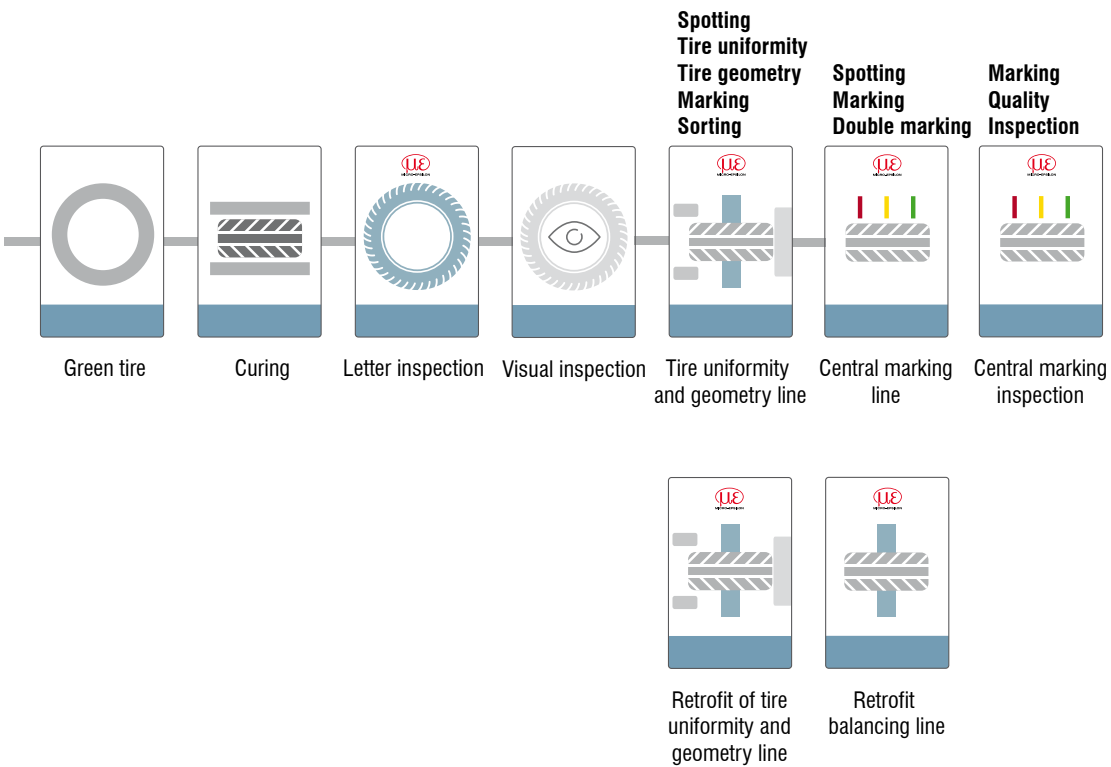


Location of Micro-Epsilon systems in the tire production process



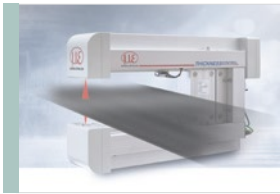


-  Preparation area
-  Tire components
-  Tire building and final inspection





Overview



Tire component profilometer
thicknessCONTROL TCP 8302.T/LLT
Calandring, extruding
Page 8 - 9



Tire component profilometer
thicknessCONTROL TCP 8303.I
Innerliner, extruding
Page 20 - 21



Tire component profilometer
thicknessCONTROL TCP 7303.ET
Calandring
Page 10 - 11



Tire meter weight inspection
weightCONTROL TMWI 8302.LC
Extruding
Page 22 - 23



Tire component profilometer
thicknessCONTROL TCP 8301.EO
Calandring
Page 12 - 13



Tire length inspection
dimensionCONTROL TLI 8303.I
Extruding
Page 24 - 25



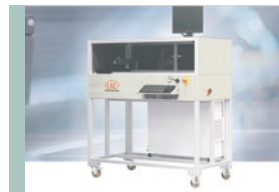
Tire component profilometer
thicknessCONTROL TCP 8301.CT/CLLT
Innerliner, calandring
Page 14 - 15



Tire piece weight inspection
weightCONTROL TPWI 8302.LC
Extruding
Page 26 - 27



Tire color inspection
dimensionCONTROL TCI 8303.I
Extruding
Page 16 - 17



Tire component offline profilometer
thicknessCONTROL TCP 8302.T-Offline
Tire components
Page 28 - 29



Tire width inspection
dimensionCONTROL TWI 7303.I
Extruding
Page 18 - 19

- Tire components
- Tire building and final inspection



**Tire surface inspection
Letter inspection TSI-LI**
Page 30 - 31



**Central marking inspection CMI
markingCONTROL CMI 8303.I**
Page 38 - 39



**Tire uniformity and geometry line
uniformityCONTROL Titan.21**
Page 32 - 33



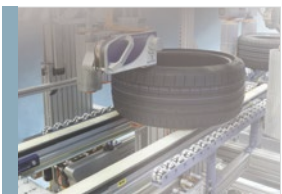
**Retrofit of tire uniformity
and geometry line RTUG**
Page 40



**Tire geometry inspection
dimensionCONTROL TGI 8302.PLT/TT**
Page 34 - 35



**Retrofit of balancing line
RTB**
Page 41



**Central marking line
CML**
Page 36 - 37



Tire component profilometer thicknessCONTROL TCP 8302.T/LLT



The modular, yet robustly, designed C-frame systems of the thicknessCONTROL TCP 8302 series convince due to their flexibility and performance in the long term. Their compact design enables the ability to introduce precise inspection technology even in lines with limited installation space.

High data volume

In the upper and lower arms of the C-frame, either laser triangulation point (ILD) or laser triangulation line (LLT) sensors are integrated. The target material thickness profile is calculated using the difference of the added amount of the sensor signals and the calibrated working gap. In combination with highly-efficient signal processing algorithms of the analysis and visualization software, accuracies in the micrometer range are achieved.

A fully-automatic in-situ calibration ensures the measurement to be independent from temperature influences, thus the system can be installed even in harsh industrial environments and maintain the highest inline precision. The sensor technologies measure without contact, are wear-free and do not use isotopes or X-rays. This use of optical technology provides long-term reliable measurement data while avoiding consequential costs.

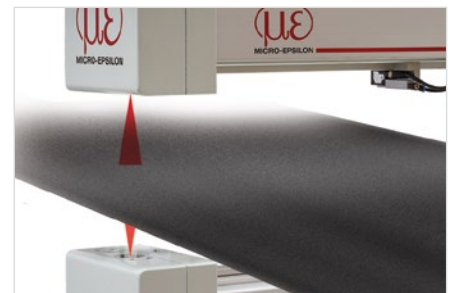
Using integrated laser line sensors, generating a high data volume of 128.000 data points per second, the thicknessCONTROL TCP 8302.LLT offers a unique range of solvable applications regarding profile thickness measurement in the tire industry.

Thickness profile measurement in:

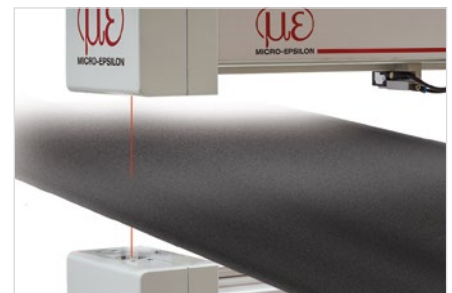
- Banding lines
- Small extrusion lines

Thickness measurement of:

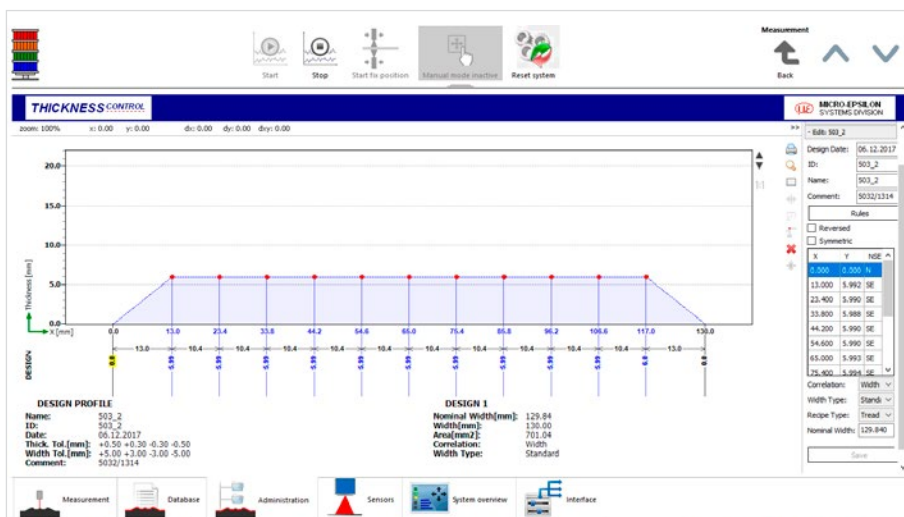
- Pressure marks in inner liner applications



TCP8302.LLT
Laser line triangulation



TCP8302.T
Laser triangulation



Profile editor

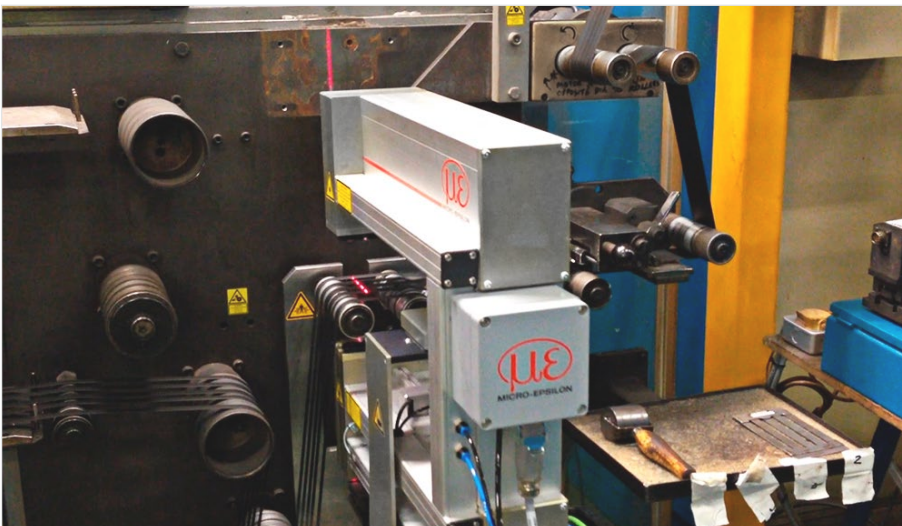
thicknessCONTROL TCP 8302.T/LLT

Description	-20/500	-50/500	-20/800	-50/800	-25/500	-50/500	-25/800	-50/800
Article no.	4350127.230	4350127.231	4350127.232	4350127.233	4350127.234	4350127.235	4350127.236	4350127.237
Sensor	Laser Point Sensor				Laser Line Sensor			
Measuring width	500 mm		800 mm		500 mm		800 mm	
Operating range	70 mm	156 mm	70 mm	156 mm	190 mm	420 mm	190 mm	420 mm
Measuring range	20 mm	50 mm	20 mm	50 mm	60 mm	100 mm	60 mm	100 mm
Resolution	0.45 μm	1.1 μm	0.45 μm	1.1 μm	1 μm	2 μm	1 μm	2 μm
Accuracy*	$\pm 4 \mu\text{m}$	$\pm 10 \mu\text{m}$	$\pm 4 \mu\text{m}$	$\pm 10 \mu\text{m}$	$\pm 3 \mu\text{m}$	$\pm 7.5 \mu\text{m}$	$\pm 3 \mu\text{m}$	$\pm 7.5 \mu\text{m}$
Sampling rate	20 kHz				128 kHz			
Protection class	IP54							
Ambient temperature	$+15 \text{ }^\circ\text{C}$ up to $+40 \text{ }^\circ\text{C}$							
Relative air humidity	max. 75 % within the specified temperature range without condensation							

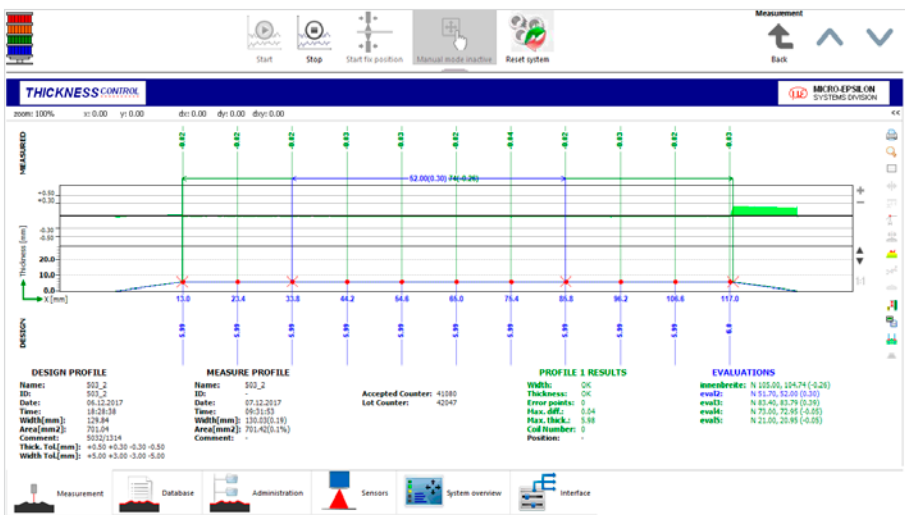
*3 sigma

** width without linear axis

Further technical parameters are available on request.



C-frame profilometer in production environment



Profile view



Tire component profilometer thicknessCONTROL TCP 7303.ET



Realized as a gantry, thicknessCONTROL TCP 7303 is a cost-effective and precise way to measure the thickness, in a fixed position, as a length profile inside tire component lines.

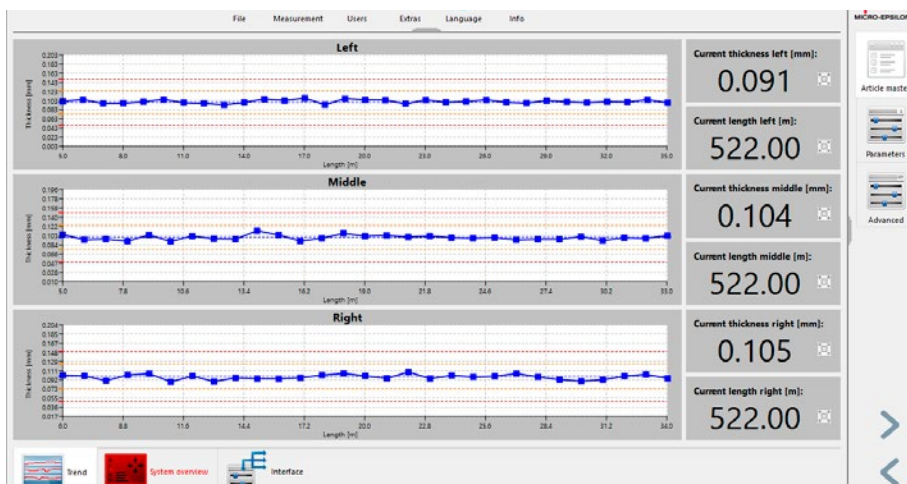
Flexibility in several variations

thicknessCONTROL TCP 7303.ET can be equipped with up to three sensor combinations. One of these combinations consists of a laser triangulation sensor and an eddy current sensor. The eddy current sensor features an opening, where the light spot and the reflection of the triangulation sensor pass through, forming a concentric measurement spot. These sensors are combined with a roller that guides the material. This roller is not necessarily a special measurement roller, it can also be a calender roller. The eddy current sensor detects the surface of the roller and therefore the lower side of the tire component, whereas the laser triangulation sensor measures the upper side. The thickness of the target is the difference between the two displacement sensor signals. Due to the fact that the result is always based on the measured displacement between the gantry and the roller, effects on the frame caused by temperature gradients do not influence the gauge.

The sensors are mounted on a linear guiding and can be adjusted manually in the X direction to the desired measurement position.

Thickness measurement in:

- Innerliner calender
- Fly calender
- Textile or fabric cord calenders



Longitudinal trend for 3 fixed tracks



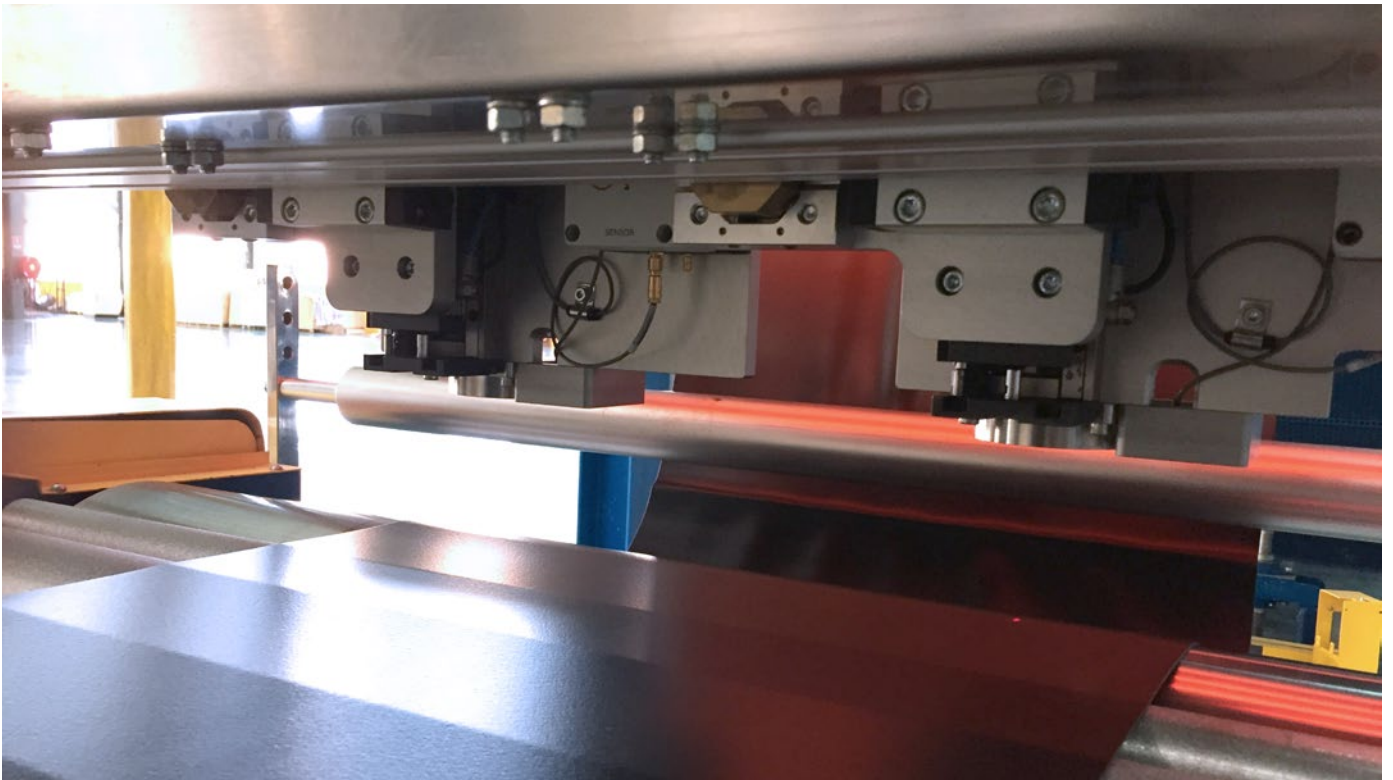
combiSENSOR of thicknessCONTROL TCP 7303.ET

thicknessCONTROL TCP 7303.ET

Description (no. of tracks)	-8/900(1)	-8/900(2)	-8/900(3)
Article no.	4350288.20	50288.21	50288.22
Measuring width		700 mm	
Threading range		80 mm	
Operating range		10 mm	
Measuring range		8 mm	
Resolution		2 μ m	
Accuracy*		\pm 0.01 mm	
Roller diameter		\geq 200 mm	
Band angle		>60°	
Sampling rate		2.5 kHz	
Protection class		IP54	
Ambient temperature		+15 °C up to +40 °C	
Relative air humidity		max. 75% within the specified temperature range without condensation	

*3 sigma

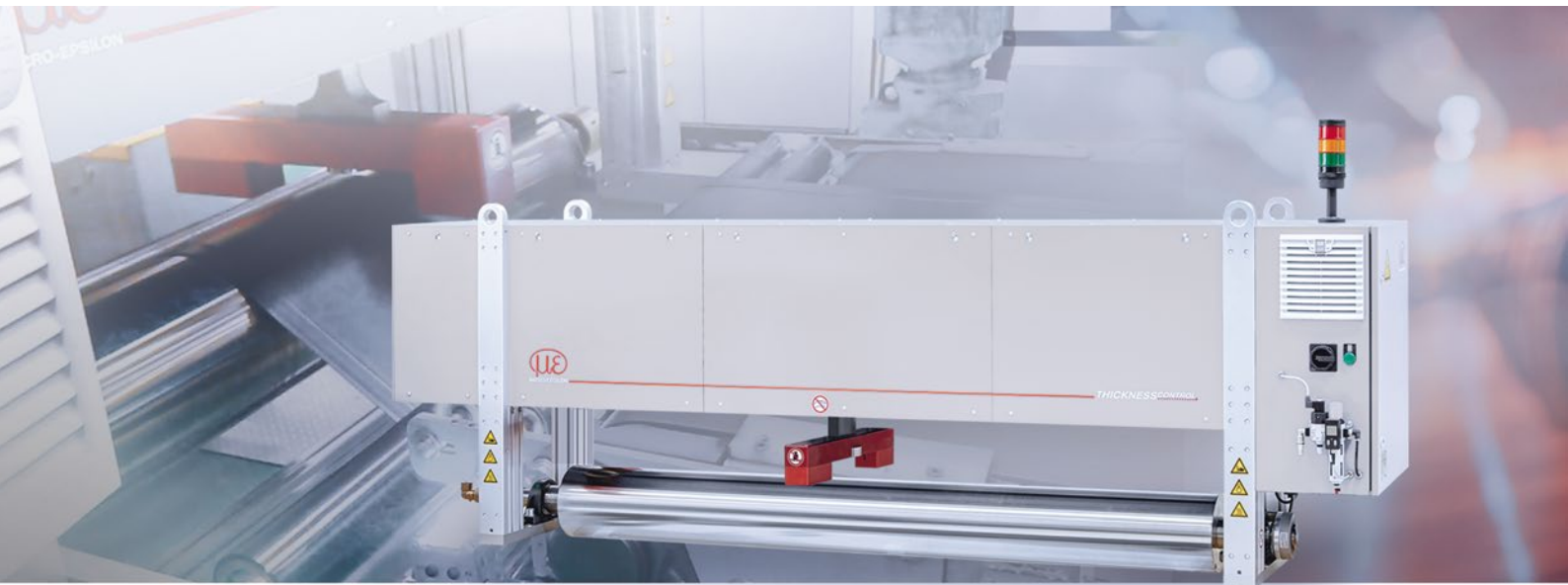
Further technical parameters are available on request.



thicknessCONTROL TCP 7303.ET view in product direction



Tire component profilometer thicknessCONTROL TCP 8301.EO



The thicknessCONTROL TCP 8301.EO family is manufactured in an O-frame configuration and offers outstanding capability for measurement of large material width and stability, as well as high precision during thickness profile measurements.

Application-specific sensors

The system measures differentially, i.e. the thickness of the material is calculated from two distance signals. The combination of an eddy current sensor and a Thru-Beam optical micrometer is mounted on one side of the thicknessCONTROL TCP 8301.EO whereas the material is guided over a measuring roller. The thickness of the target material is the difference between the sensors to each other and the amount of change in the signals.

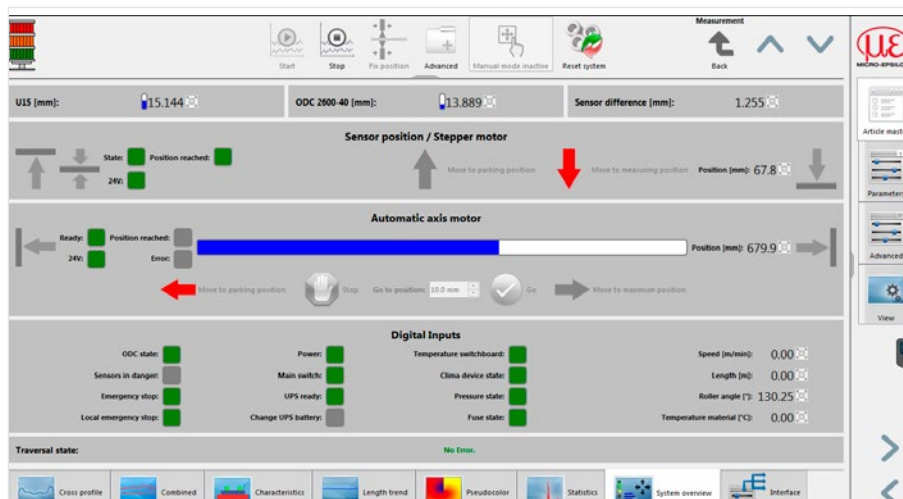
With the color-independent measurement function of the integrated Thru-Beam micrometer measuring the upper edge of the rubber, and the eddy current sensor measuring the roller surface at the same position, the system supplies results in extraordinary precision. It is also equipped with an efficient cleaning mechanism providing high resistance against steam and particles. Therefore, the system is ideal for applications in harsh industrial environments.

Furthermore, its efficient operation, due to large maintenance-free intervals, allows optimal running of the production line.

Using application-specific customized sensors the thicknessCONTROL TCP 8301.EO is, amongst other things, impressive due to its excellent ratio of measuring range and accuracy.

Thickness and width profile measurement in:

- Innerliner calender
- Ply calender
- Textile or Fabric cord calender



Overview of sensors and actuators

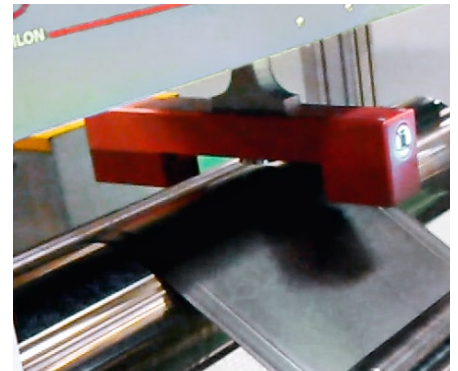
thicknessCONTROL TCP 8301.EO

Description	-10/1000	-10/1500	-10/2000	-10/2500	-20/1000	-20/1500	-20/2000	-20/2500
Article no.	4350039.100	4350039.101	4350039.102	4350039.103	4350039.104	4350039.105	4350039.106	4350039.107
Measuring width	1000 mm	1500 mm	2000 mm	2500 mm	1000 mm	1500 mm	2000 mm	2500 mm
Threading range	100 mm							
Operating range	12 mm				21 mm			
Measuring range	10 mm				20 mm			
Resolution	2 μm				2 μm			
Accuracy*	± 1 μm				± 3 μm			
Roller diameter	≥200 mm							
Band angle	>60°							
Sampling rate	4 kHz							
Traversing speed	6000 to 40000 mm/min							
Protection class	IP54							
Ambient temperature	+15 °C up to +40 °C							
Relative air humidity	max. 75 % within the specified temperature range without condensation							

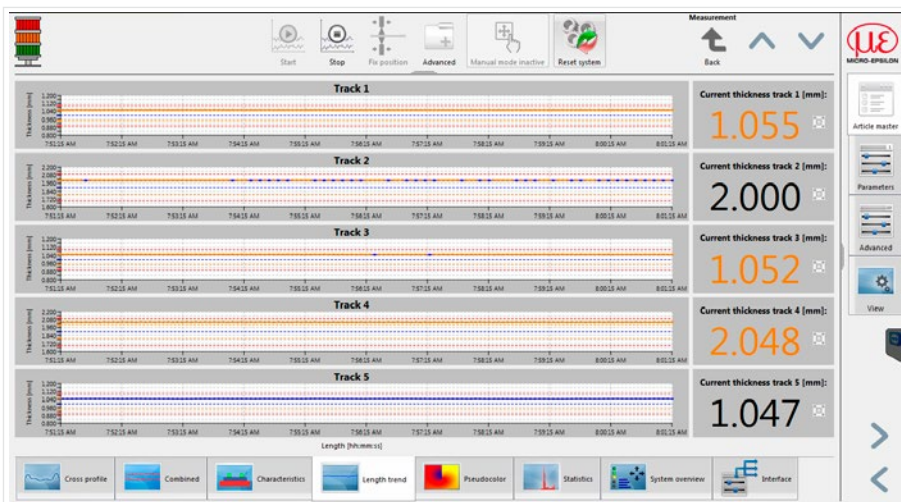
*3 sigma

**height without base frame

Further technical parameters are available on request.



Thickness measurement with TCP 8301.EO



Longitudinal trend for 5 fixed tracks



Tire component profilometer thicknessCONTROL TCP 8301.CT/CLLT



The systems of the thicknessCONTROL TCP 8301.CT/CLLT family are developed in the form of an O-frame where the sensors are integrated in the upper and the lower boom. They measure while traversing and achieve high precision through an innovative coordinated package consisting in sensors, mechanics and software.

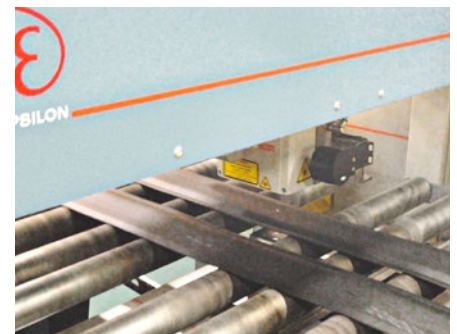
Closed-loop temperature compensation

The systems measure differentially, i.e. the thickness of the material is calculated from two displacement signals. Two sensors are integrated on the upper and lower boom of the O-frame on a mechanical carriage. The thickness of the target material is the displacement between the sensors to each other and their measured values. Offering an efficient cleaning mechanism, high resistance against steam and particles is provided. Therefore, the devices are ideal for applications in harsh industrial environments. Furthermore, they enable efficient operation of the production facilities, due to large maintenance-free intervals, that allow the production lines to run uninterrupted for longer. Thanks to integrated in-situ calibrations which do not vary with temperature, they can be also applied under harsh climate environmental conditions, e.g., in the rubber processing industry.

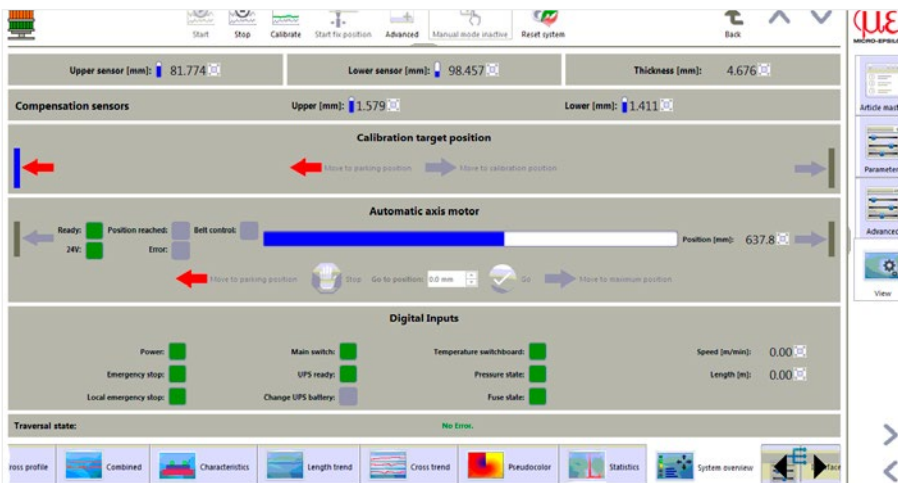
All sensor technologies used measure with out contact, are wear-free and without isotopes or X-rays. This process provides long-term reliable measured data while avoiding consequential costs. Using a patented closed-loop concept for compensation of temperature driven expansion effects on the mechanics, the thicknessCONTROL TCP 8301.CT and thicknessCONTROL TCP 8301.CLLT present a revolutionary stability in the running production process.

Thickness profile measurement in:

- Innerliner calender
- Ply calender
- Steel cord calender
- Textile or fabric cord calender



Thickness measurement with TCP 8301.CT



Overview of sensors and actuators

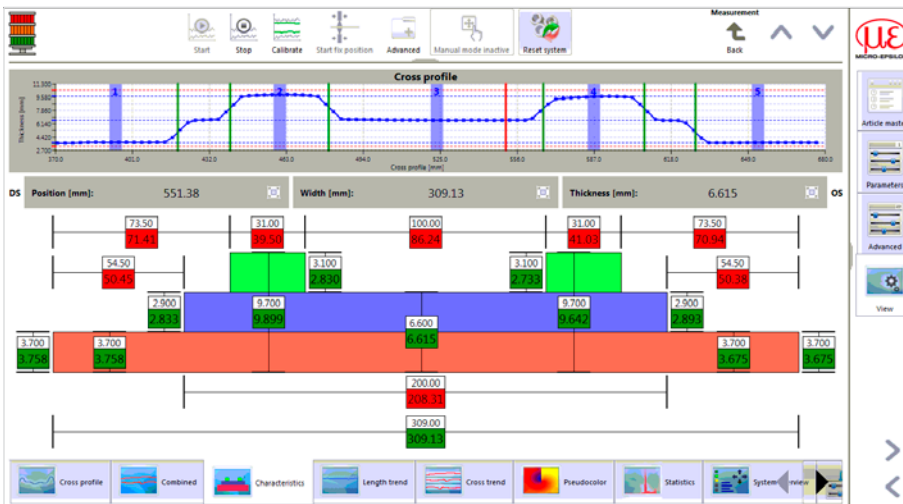
thicknessCONTROL TCP 8301.CT/CLLT

Description	-50/700	-50/1200	-50/1700	-50/2200	-75/700	-75/1200	-75/1700	-75/2200
Article no.	4350133.100	4350133.101	4350133.102	4350133.103	4350006.520	4350006.520	4350006.520	4350006.520
Measuring width	700 mm	1200 mm	1700 mm	2200 mm	700 mm	1200 mm	1700 mm	2200 mm
Threading range	400 mm							
Operating range	169.5 mm				179 mm			
Measuring range	50 mm				75 mm**			
Resolution	thickness				1 μ m			
	width				10 μ m			
Accuracy*	thickness				\pm 5 μ m			
	width				\pm 50 μ m			
Sampling rate	20 kHz				128 kHz			
Traversing speed	6000 to 40000 mm/min							
Protection class	IP54							
Ambient temperature	+ 15 °C up to + 40 °C							
Relative air humidity	max. 75 % within the specified temperature range without condensation							

*3 sigma

**minimum material thickness 15 mm

Further technical parameters are available on request.



Cross profile and display for special features



Combined cross profile and average longitudinal profile



Tire color inspection dimensionCONTROL TCI 8303.I



The fully equipped dimensionCONTROL TCI 8303.I Tire Color Inspection system provides comprehensive color coding, color code inspection and width inspection of extruded tread. The system therefore represents a powerful component in a modern extrusion line.

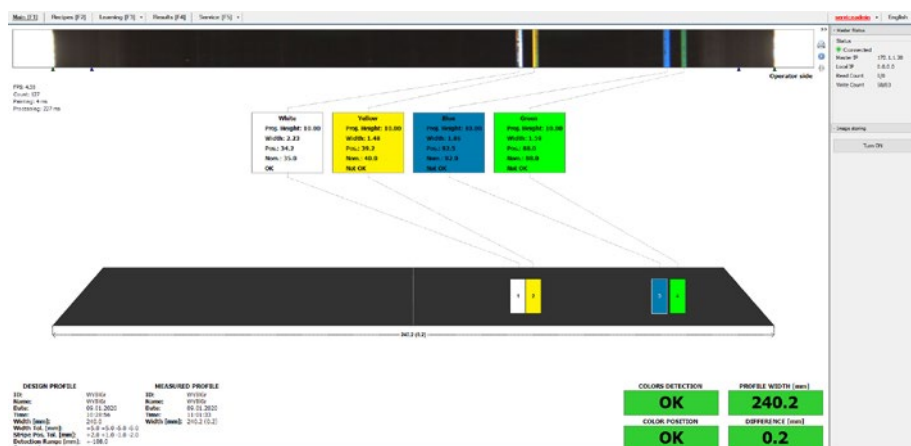
The basic model of dimensionCONTROL TCI 8303.I (Camera box solution) is designed for inspection of the color code applied on running profiles after extrusion. As the correct width and position of the color code has to be checked, the system also measures the complete width of the tread. The inspection is based on a vision system, containing one color camera and two surface light sources. During the continuous measurement process, the average value of the position and width of respective colors in one image are calculated.

As well as overflow and interruption of color strips, the system also detects incorrect colors in defined positions. Due to its robust construction, the inspection system is ideally suited to harsh environments especially behind the extrusion head. In addition to the camera box solution (CB), a full-automatic solution (FA) with a multi-axis positioning system is available.

Based on motion control, the FA system inspects every color track separately. An advantage over manual adjustment of tracks during recipe changings or standstill is that the inspection system significantly reduces the material waste.

Color coding, color code inspection, width measurement in:

- Extrusion lines for tread profiles

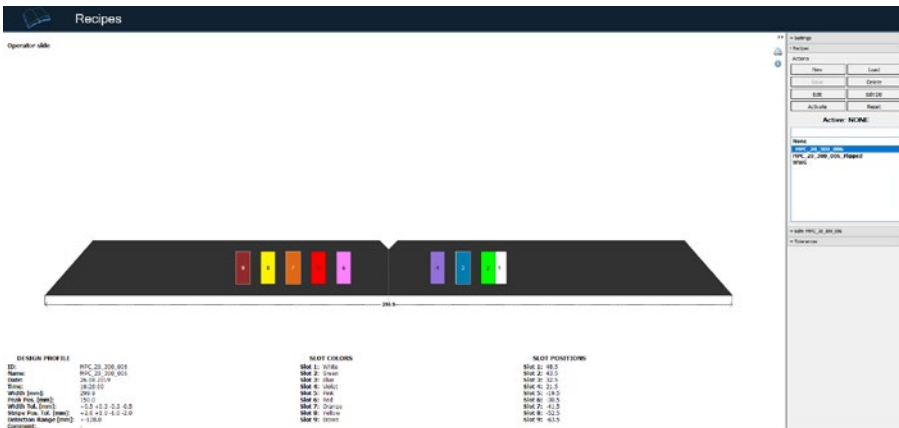


Main screen

dimensionCONTROL TCI 8303.I

Description	-450-CB (Camera box solution)	-450-FA (Full automatic solution - multi axis positioning system)
Article no.	4350148.02	4350148.03
Measuring width	450 mm	
Measuring range (D x W)	470 mm x 40 mm	
Resolution	50 μ m	
Accuracy*	\pm 150 μ m	
Sampling rate (adjustable based on the material speed)	20 - 30 fps	
Max. material speed	55 m/min	
Minimum width of color detected	1 mm	
Number of color lines	up to 10	up to 6
Stroke of electrical axis	-	\pm 200 mm from the middle of conveyor
Protection class	IP42	
Ambient temperature	min. +15 °C max. +45 °C	
Relative air humidity	max. 75 % within the specified temperature range without condensation	

*3 sigma
Further technical parameters are available on request.



Recipe screen



Statistics screen





Tire width inspection dimensionCONTROL TWI 7303.I



Tire Width Inspection dimensionCONTROL TWI 7303.I is designed for profile width measurement in extrusion lines.

This measuring system is based on camera vision technology involving two cameras inside one measurement box. These cameras are angle mounted to each other and operate according to stereo vision technology which enables high precision measurements in the whole calibration range.

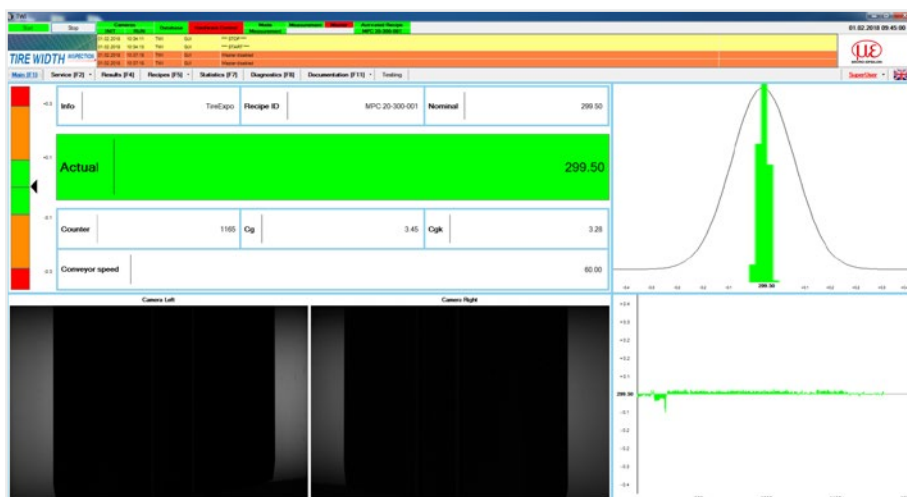
The main advantage of stereo vision technology is a precise measurement in harsh environmental conditions (e.g. vibrations, unpredictable material movements on conveyor in material flow direction, in vertical directions or even combined).

Tire width inspection enables the measurement of either one or two simultaneously produced profiles (tread or sidewalls). The number of profiles present is automatically detected, measured and evaluated.

The software interface and visualization contains a database of measured profiles, recipes, tools for statistical processing, and exportation of measured results for further processing in different formats.

Width measurement in:

- Extrusion lines for treads and sidewalls
- Further type of lines up to request



Current result



dimensionCONTROL TWI 7303.I

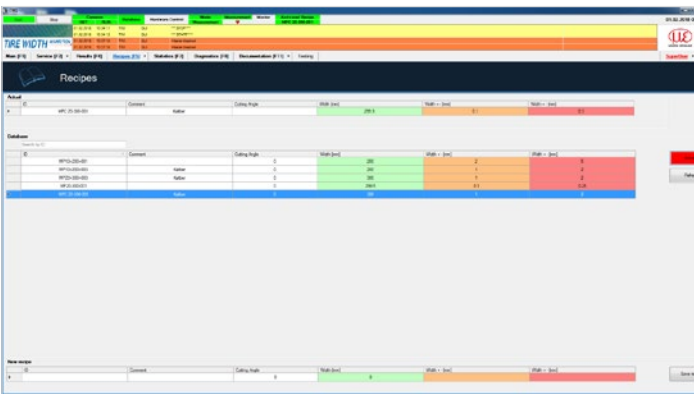
dimensionCONTROL TWI 7303.I

Description	-350	-450	-550
Article no.	4380001.01	4380001.02	4380001.03
Measuring width	350 mm	450 mm	550 mm
Measuring range**	370 x 100 mm	470 x 100 mm	570 x 100 mm
Resolution	10 μm	15 μm	20 μm
Accuracy*	$\pm 50 \mu\text{m}$	$\pm 65 \mu\text{m}$	$\pm 80 \mu\text{m}$
Number of cameras	2		
Sampling rate	50 Hz		
Protection class	IP54		
Ambient temperature	+15 °C up to +40 °C		
Relative air humidity	max. 75 % within the specified temperature range without condensation		

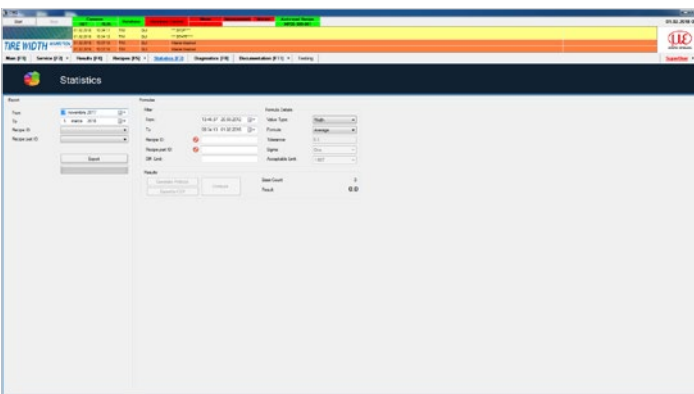
*3 sigma

**size of scanned image W x D

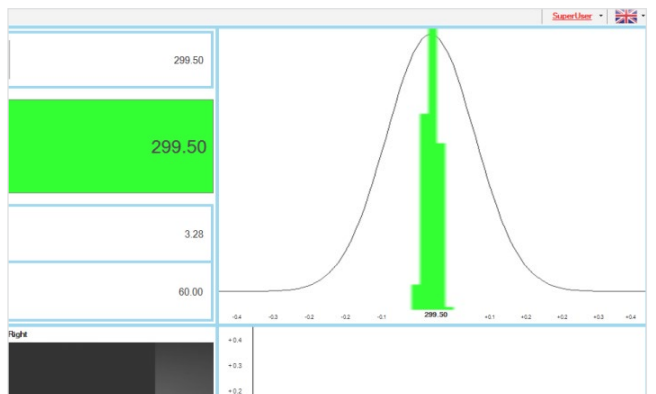
Further technical parameters are available on request.



Recipe database

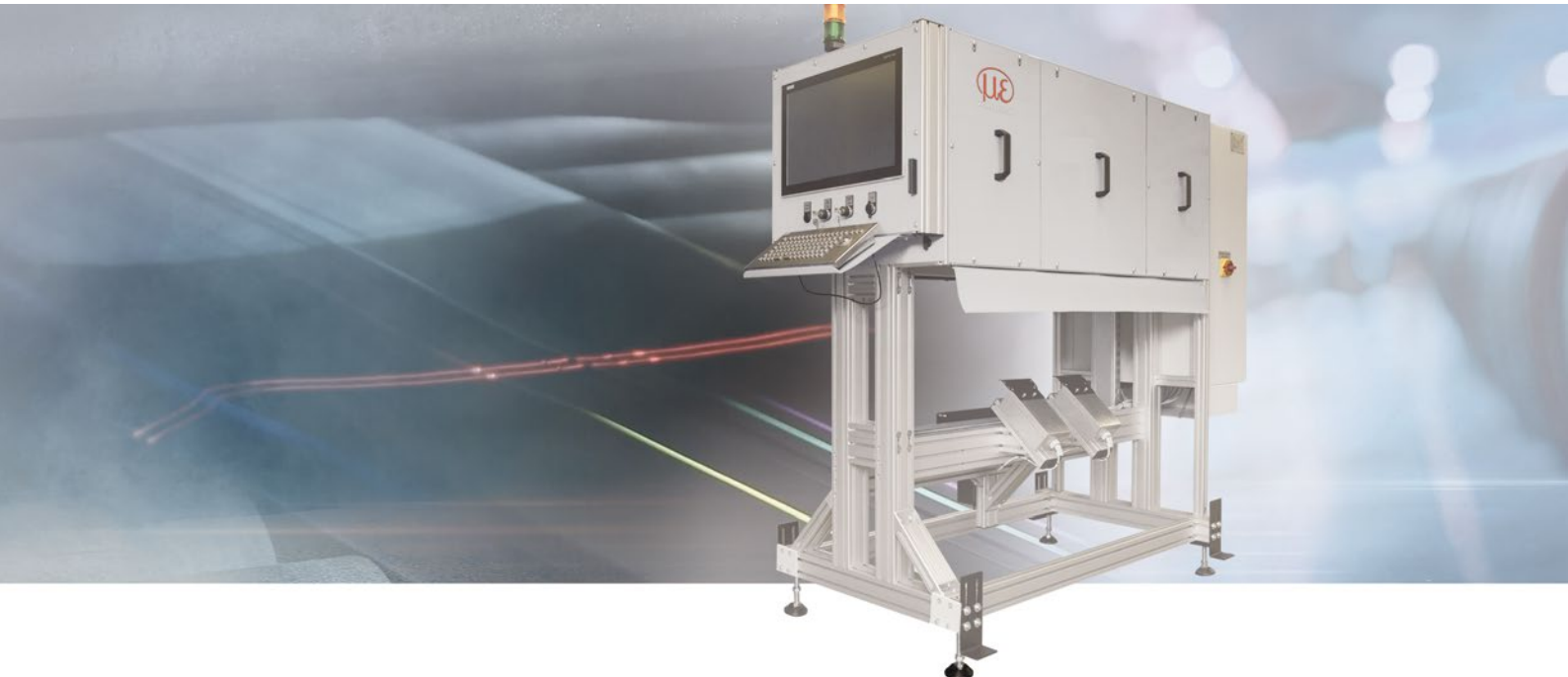


Statistics





Tire component profilometer thicknessCONTROL TCP 8301.I



The non-traversing profilometers of the thicknessCONTROL TCP 8301.I series are impressive in their ability to perform complete profile measurements in just one shot. Working almost without any moving parts the systems provide a solution where low maintenance requirements are essential.

Prepared for additional control

Based on the optical triangulation principle, two parallel laser lines are projected onto the upper and lower sides of the material. The reflection of the laser light is detected by cameras. The measuring system contains fully automated integrated calibrations. The patented calibration process typically takes approximately 5 minutes.

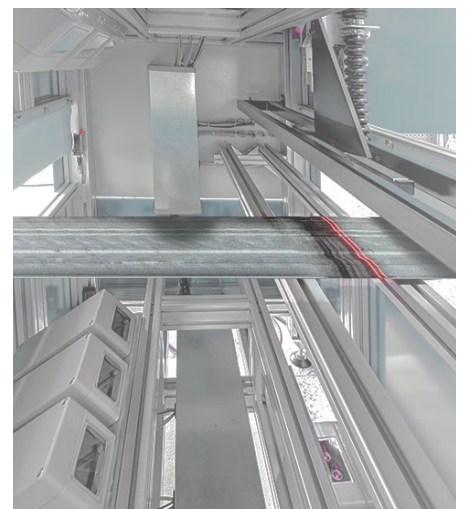
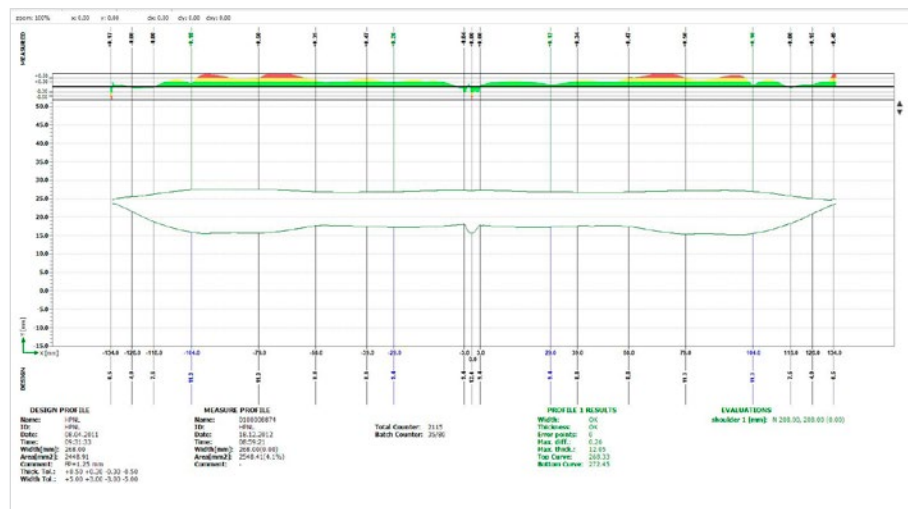
The visualization software of the profilometer includes tools for statistical processing and for exporting measurement results in various formats. The measuring system is completely covered, thereby minimizing the impact of external light on the measurement process and the occurrence of unwanted reflections.

Prepared for additional control

Prepared for additional integration of the length inspection dimensionCONTROL TLI 8303.I and the dimensionCONTROL TPWI 8302.LC, the profilometer is the efficient base for the complete quality control of an extrusion line.

Thickness and width profile measurement in:

- Extrusion lines
- Innerliner calender
- Cap strip lines



Profile shape mode

thicknessCONTROL TCP 8301.I

Description	-10/170	-10/350	-10/450	-10/550	-20/550	-20/750	-20/860	-20/1220	
Article no.	4350121.105	4350121.106	4350121.107	4350121.108	4350121.101	4350121.102	4350121.103	4350121.104	
Measuring width	170 mm	350 mm	450 mm	550 mm	550 mm	750 mm	860 mm	1220 mm	
Measuring range	20 mm	40 mm			50 mm				
Resolution	thickness	1 μ m							
	width	10 μ m				20 μ m			
Accuracy*	thickness	\pm 12 μ m				\pm 20 μ m			
	width	\pm 100 μ m	\pm 150 μ m			\pm 200 μ m			
Sampling rate					40 Hz**				
Max. material tilt					\leq 50°				
Protection class					IP42				
Ambient temperature					+15 °C up to +40 °C				
Relative air humidity					max. 75 % within the specified temperature range without condensation				

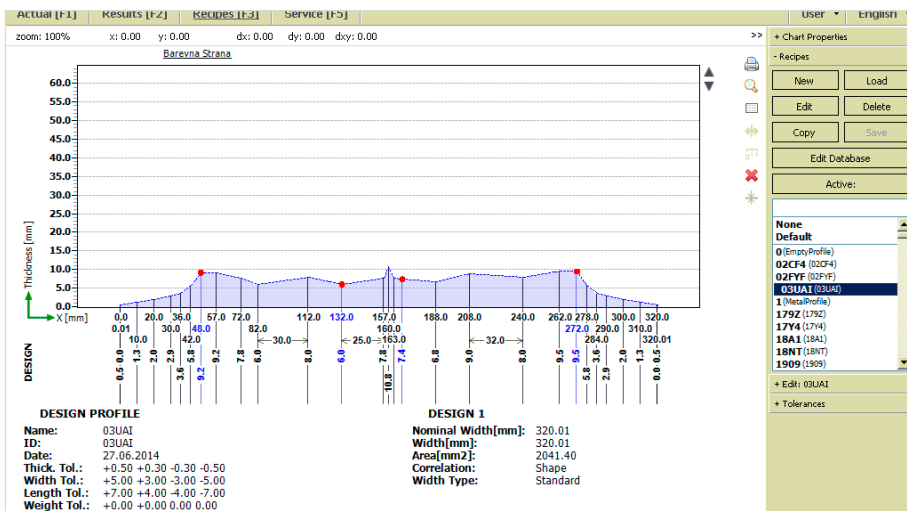
*3 sigma

**profiles per second

Further technical parameters are available on request.



Integration:
TPWI 8302.LC
TLI 8303.I
TCP 8301.I



Cross profile



Tire meter weight inspection weightCONTROL TMWI 8302.LC



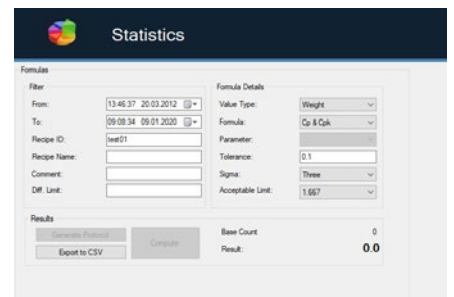
The TMWI 8302.LC (Load Cell) Tire Meter Weight Inspection is designed for inline weight inspection of running tread profiles intended for passenger and truck tires. Based on the force measurement principle, the measuring system uses two high precision load cells which measure the deflection of the measurement conveyor.

These sensor elements are attached to a massive construction, which ensures a long-term mechanical stability of the system. The measurement conveyor uses precise and balanced aluminum rollers with special surface treatment. This ensures a low deadweight, avoids influence of unbalance and eliminates material sticking.

Due to its robust design, the system is ideally suited to harsh environments prevailing in the preparation area. Data obtained from the load cells are processed in the implemented PLC cards which determine the measured weight mathematically. The included software offers a variety of measurement data processing, definition of design profiles, statistical analysis of measured profiles and diagnostic tools.

Weight measurement in:

- Extrusion lines for tread or sidewall profiles



Statistics screen

Actual										
Weight 1 [g]	Weight 2 [g]	Speed [mpm]	Weight 1 - [g]	Weight 1 + [g]	Weight 2 - [g]	Weight 2 + [g]	Weight 1 - [g]	Weight 1 + [g]	Weight 2 - [g]	Weight 2 + [g]
Database										
40	50	0	-0.6	0.6	-0.8	0.8	-0.8	0.8	-1	1
200	0	0	-3	3	0	0	-4	4	0	0
100	0	0	-1.5	1.5	0	0	-2	2	0	0
100	0	0	-1.5	1.5	0	0	-2	2	0	0
200	0	0	-3	3	0	0	-4	4	0	0
100	0	0	-1.5	1.5	0	0	-2	2	0	0
2000	0	0	-30	30	0	0	-40	40	0	0
5000	0	0	-75	75	0	0	-100	100	0	0

Recipe screen

dimensionCONTROL TMWI 8302.LC

Description	-500-5-single (Tread production)	-500-2.5-double (sidewall production)
Article no.	4380294.01	4380294.02
Measuring range - weight	5 kg/m	2.5 kg/m per sidewall
Resolution	0.1 g	
Static accuracy*	±1 g	
Dynamic accuracy*	± 5 g	
Sampling rate	600 Hz	
Max. material speed	50 m/min	50 m/min
Protection class	IP42	
Ambient temperature	min. +15 °C max. +45 °C	
Relative air humidity	max. 75 % within the specified temperature range without condensation	

*3 sigma

Further technical parameters are available on request.



weightCONTROL TMWI 8302.LC



Main screen



Tire length inspection dimensionCONTROL TLI 8303.I



Highly efficient image processing algorithms award the dimensionCONTROL TLI 8303.I for precisely mapping the needs of later process steps in the tire building.

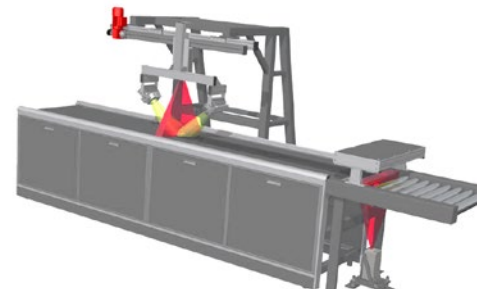
Optimized process mapping

The vision system dimensionCONTROL TLI 8303.I contains two cameras for profile length inspection in extrusion lines. The first camera is mounted on an electrical axis at the beginning of the profile - above the scale, the second is installed at the end of the profile.

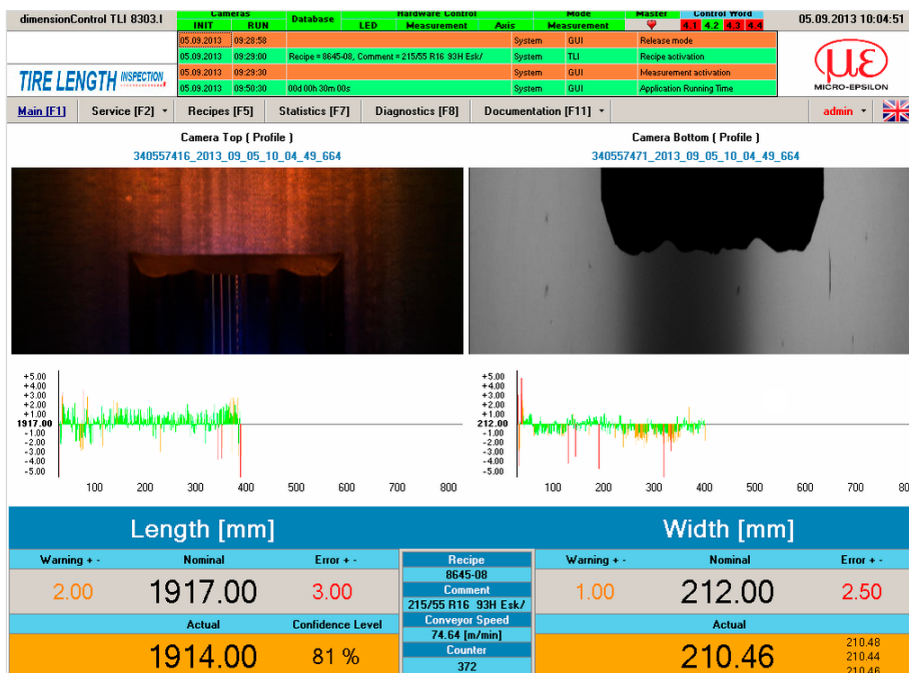
Depending on the concept it is either under the rollers at the end of the scale or above the scale. The moveable camera is positioned according to the nominal length received from the master of the extrusion line. The calculation of the profile length is based on the form of the cuts at each edge. To optimize the mapping of the inspection result and the real profile fit in the building machine, the edges are connected virtually to each other according to the scanned surfaces. Based on these values and the position between the cameras the final length is calculated.

Length measurement in:

- Extrusion lines for sidewall or tread



Principle of measurement



Visualization of the cutted edges, the length and the width

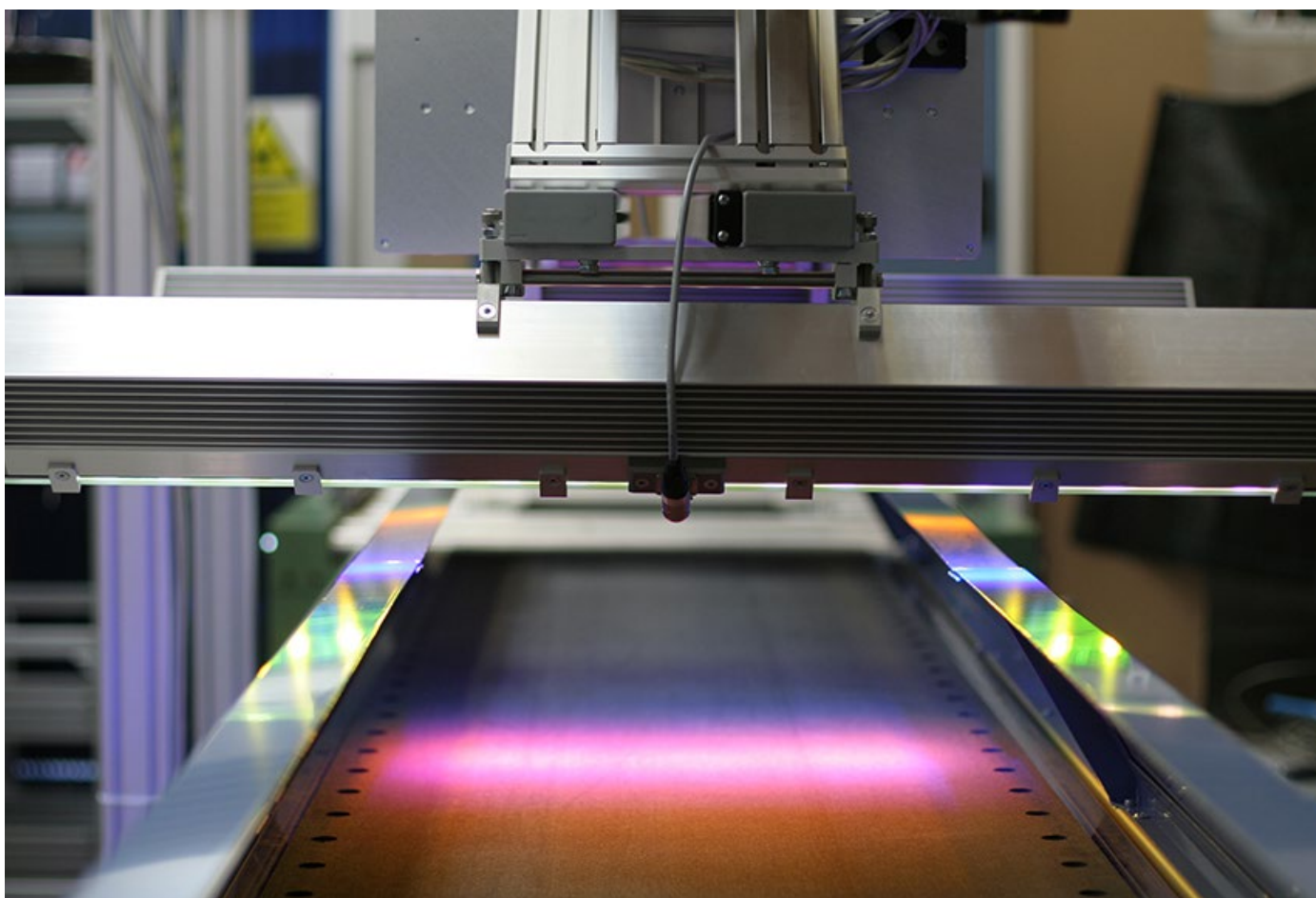
dimensionCONTROL TLI 8303.I

Description	-1000(DU)	-1000(UU)	-2700(DU)	-2700(UU)
Article no.	4350149.02	4350149.03	4350149.04	4350149.05
Measuring length	1500 mm to 2500 mm		1300 mm to 4000 mm	
Measuring range**	5 mm to 50 mm			
Resolution	100 μm			
Accuracy*	$\pm 100 \mu\text{m}$	$\pm 200 \mu\text{m}$	$\pm 200 \mu\text{m}$	$\pm 30 \mu\text{m}$
Max. material speed	110 m/min			
Evaluation area of profile width	350 mm			
Permissible vertical material movement	10 mm			
Permissible material rotation	10 mm			
Protection class	IP42			
Ambient temperature	+15 °C up to +40 °C			
Relative air humidity	max. 75 % within the specified temperature range without condensation			

*3 sigma

** thickness

Further technical parameters are available on request.



Illumination for the upper side



Tire piece weight inspection weightCONTROL TPWI 8302.LC



The TPWI 8302.LC Tire Piece Weight Inspection system is designed for inline weight inspection of cut running tread profiles used for passenger and truck tires. Based on the force measurement principle, the measuring system uses four high precision load cells which measure the deflection of the measurement conveyor.

These sensor elements are attached to a massive construction, which ensures a long-term mechanical stability of the system. Due to its robust design, the inspection system is ideally suited to harsh environments prevailing in the preparation area.

Data obtained from the load cells are processed in the implemented PLC cards which determine the measured weight mathematically. The software included offers a variety of measurement data processing, definition of design profiles, statistical analysis of measured profiles and diagnostic tools.

Weight measurement in:

- Extrusion lines for tread profiles

Actual													
ID	Description	Weight [g]	Width [mm]	Speed [rpm]	Weight - [g]	Weight + [g]	Width - [mm]	Width + [mm]	Weight - [g]	Weight + [g]	Width - [mm]	Width + [mm]	
test01	-	5359	1000	25	-80.4	80.4	-1	1	-107.2	107.2	-3	3	

Database													
ID	Description	Weight [g]	Width [mm]	Speed [rpm]	Weight - [g]	Weight + [g]	Width - [mm]	Width + [mm]	Weight - [g]	Weight + [g]	Width - [mm]	Width + [mm]	
Calibration ruler	Calibration	2010.01	0	0	1	0	2	0	0	0	0	0	Activate
GBC0052	Repeatability	1658.32	0	0	1	0	2	0	0	0	0	0	Refresh
Repeatability t...	Repeatability	1799	0	0	1	0	3	0	0	0	0	0	
test01	-	5359	1000	25	-80.4	80.4	-1	1	-107.2	107.2	-3	3	Accept From Master

Recipe screen

dimensionCONTROL TPWI 8302.LC

Description	-3500-10/20-PLT (Passenger and light truck tires)	-4500-50/80-TT (Truck and agriculture tires)
Article no.	4380293.01	4380293.02
Max. length of the profiles	3000 mm	4000 mm
Measuring range - weight	10/20 kg	50/80 kg
Resolution	0.1 g	
Accuracy*	± 10 g/ ± 20 g	± 30 g/ ± 50 g
Sampling rate	1 kHz	
Max. material speed	120 m/min	80 m/min
Protection class	IP42	
Ambient temperature	min. +15 °C max. +45 °C	
Relative air humidity	max. 75 % within the specified temperature range without condensation	

*3 sigma
Further technical parameters are available on request.



Integration:
TLI 8303.I
TCP 8301.I

Statistics screen

Main screen



Tire component offline profilometer thicknessCONTROL TCP 8302.T-Offline



With the thicknessCONTROL TCP 8302.T-Offline, a line-independent tool for measuring profile thickness and width is available. Offline profilometer offers the capability to control multiple lines semi-automatically and in a highly cost-effective manner.

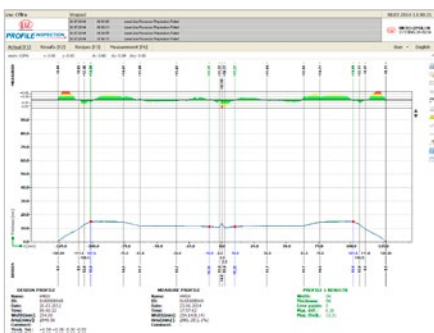
Improving quality control

An integrated, traversing C-Frame with two optical laser triangulation sensors carries out the inspection of the entire profile. The system includes fully automated and integrated calibration. The calibration and control measurement process takes around 10 seconds. The profilometer's visualization software includes tools for statistical processing of measured profile results and for exporting measurement results in various formats for further evaluation.

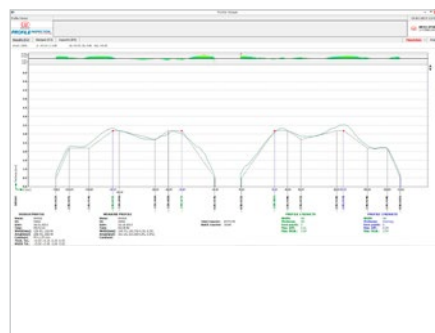
The measuring system is fully covered; therefore the influence of external light on the measurement process and the creation of unwanted reflections is minimized. This is a cost-effective solution for conducting profile measurements outside the production line.

Thickness profile measurement in:

- Extrusion lines
- Innerliner calender
- Ply calender
- Steel cord calender
- Textile or Fabric cord calender



Cross profile - single inspection



Cross profile - parallel inspection



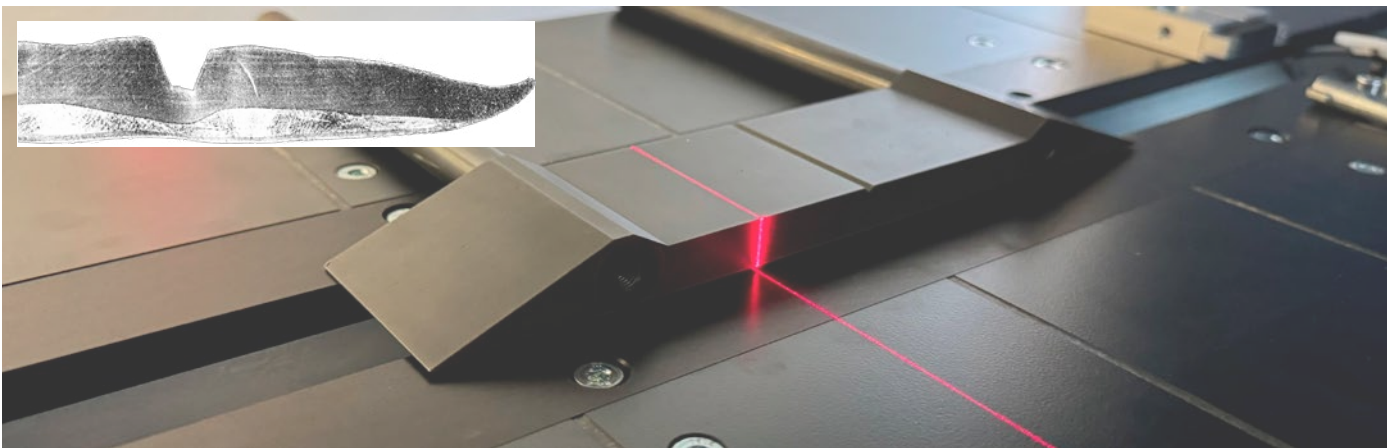
Recipe editor

thicknessCONTROL TCP 8302.T-Offline

Description		-10/600	-10/800	-10/1000
Article no.		4350142.01	4350142.02	4350142.03
Measuring width		580 mm	780 mm	980 mm
Measuring range			47 mm	
Resolution	width		$\pm 10 \mu\text{m}$	
	thickness		$\pm 1 \mu\text{m}$	
Accuracy*	width		$\pm 100 \mu\text{m}$	
	thickness		$\pm 20 \mu\text{m}$	
Sampling rate			20 kHz	
Traversing speed			600 mm/min	
Protection class			IP42	
Ambient temperature			+15° C up to +40 °C	
Relative air humidity			max. 75 % within the specified temperature range without condensation	

*3 sigma

Further technical parameters are available on request.



Material compound measurement in offline profilometer



Tire surface inspection Letter inspection TSI-LI



Tire surface inspection systems

The readability and completeness of the sidewall text and features of a tire such as lettering, glyphs and slugs is of utmost importance for final quality approval and release to a customer. The first tire check of a new batch, as well as random tire quality checks, have always been time-consuming, manual, and tedious tasks.

The tire surface inspection system is capable of fully replacing human work in checking the correctness and completeness of the sidewall and bead lettering, as well as sidewall glyphs, while ensuring incredible repeatability and stability of the results.

Compared to human inspection, the system additionally checks the quality and layout of the text on the sidewall of the tires and provides information on the dimensions of the letters. The inspection of the quality of letters and glyphs reveals frequent imperfections and anomalies caused by a dirty mold, errors in the mold, such as wear, as well as poorly installed inserts (such as weak stamps, snow flags, etc.).

Tire surface inspection - offline and online

The tire surface inspection system can be used as an offline or online tool.

The offline tire surface inspection system is suitable for increasing the effectiveness and reducing nonconformities during the initial tire inspection.

The online tire surface inspection system, which is connected to the conveyor system, is suitable for a fully automatic system with tire sorting for systematic control of production. This highly efficient system prevents defective tires from leaving the finishing area.

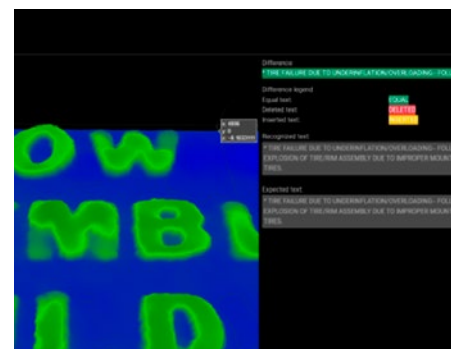
The web-based visualization, accessible directly on the machine or via the factory network on a cell phone or tablet, includes an online monitoring system, a complete results database, and a predictive maintenance module.

Installation possibilities:

- Offline system
- Online system

Inspection

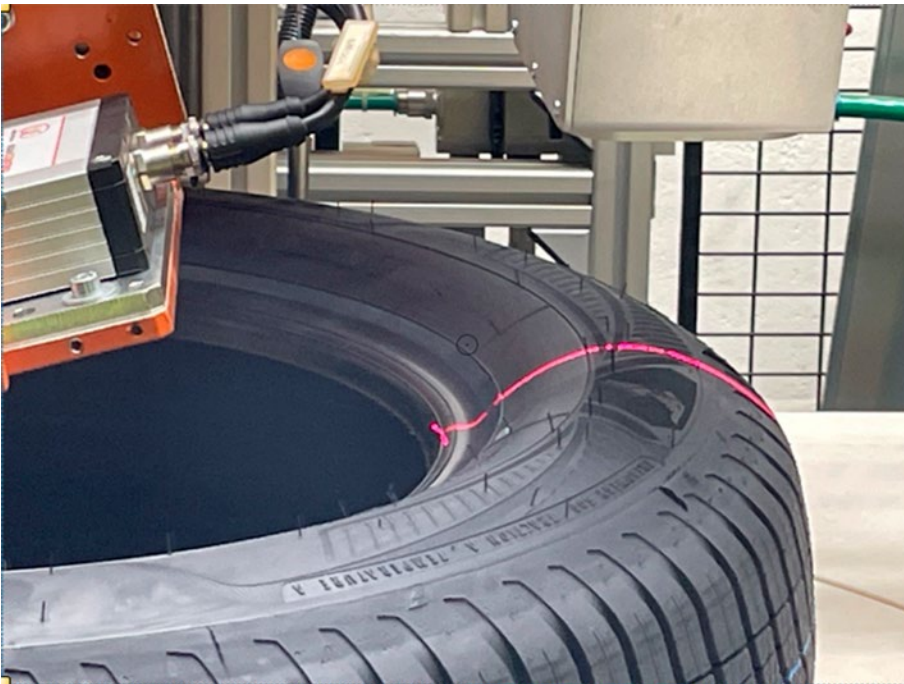
- Success of text recognition
- Letter completeness
- Glyph completeness
- Glyph correlation
- Glyph and letters defects
- Glyph and letters position
- Glyph and letters size
- Rim protector and bead area inspection



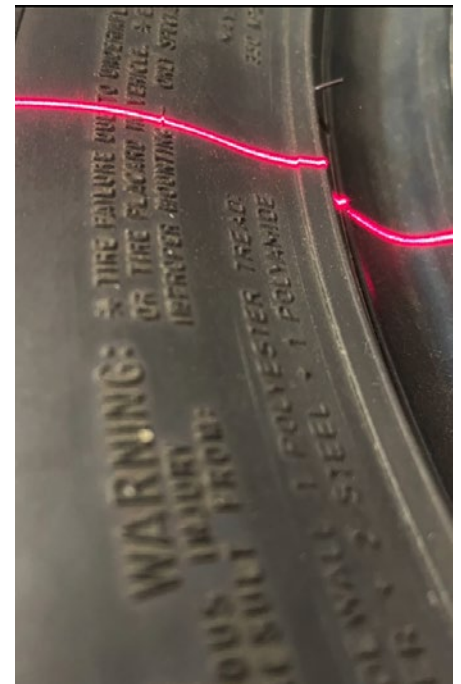
Scan of safety instruction

Tire	
Tire diameter	550 - 1100 mm
Tire width	95 - 480 mm
Tire rim diameter	13" - 25"
Tire rim width	4" - 15"
Weight	5 - 50 kg

Inspection parameters	
Minimum letter height	1.5 mm
Minimum line width characters	0.3 mm
Minimum letter spacing	0.35 mm
Minimum letter and logo elevation	0.2 mm
Minimum letter and logo recess	0.2 mm
Maximum glyph height	90 mm
Maximum glyph width	840 mm
Evaluation of single letter in size of safety instruction letters	



Sidewall and bead area scanning



Safety instruction scanning

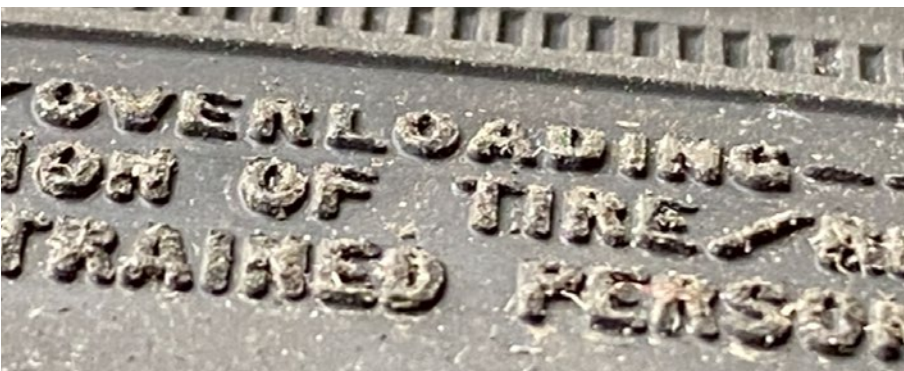


Photo of safety instruction



Tire uniformity and geometry line uniformityCONTROL Titan.21



Tire Uniformity and Geometry line Titan.21

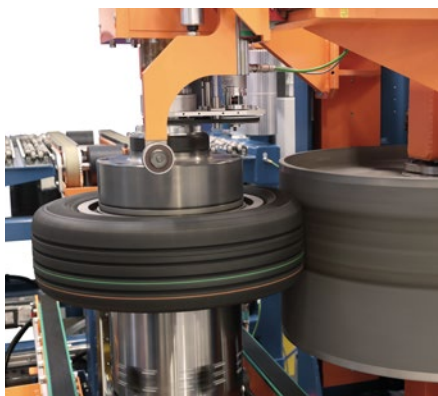
The uniformityCONTROL Titan.21 combines the advantages of uniformity testers based on a hydraulic spindle and mechanical locking spindle. It offers benefits such as reduced cycle time, narrow bead compensation, low consumption, small machine footprint, high production stability, and minimal maintenance breaks. Efficiency and return on investment were the key parameters considered during the development of the machine.

The combination of advantages and production statistics make uniformityCONTROLTitan.21 the most cost-effective machine on the market, especially due to the high number of tires tested per year and machine stability. The web-based visualization allows access directly on the machine or via the factory network on a cell phone or tablet. It includes an online monitoring system, complete results database and predictive maintenance module.

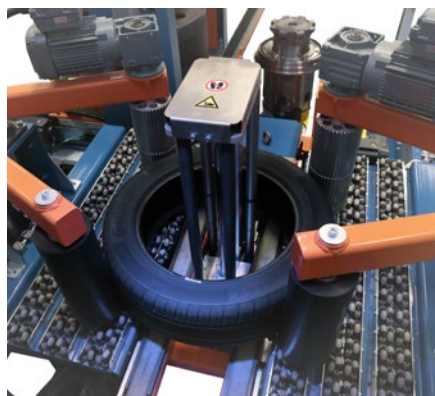
Further optional measurements can be added to the system, such as tire temperature measurement during uniformity measurement, online monitoring of load wheels, and the predictive maintenance module, which help maintain the machine at a high performance level. They also provide further relevant information about the measurement characteristics and machine status.

Advantages:

- High machine production stability
- Full automatic configuration of test sequence
- High measurement repeatability
- Adaptive machine cycle time
- External spotting
- Low footprint
- Energy efficient
- Without hydraulic unit
- Recipe controlled inflation
- Small transportation dimensions
- Fast start up machine in factory
- Maintenance friendly
- Predictive maintenance



Uniformity measurement



Tire spotting



Geometry measurement

Tire	
Tire diameter	550 - 950 mm
Tire width	95 - 400 mm
Tire rim diameter	14" - 24" (ETRTO)
Tire rim width	5" - 14"
Weight	5 - 50 kg

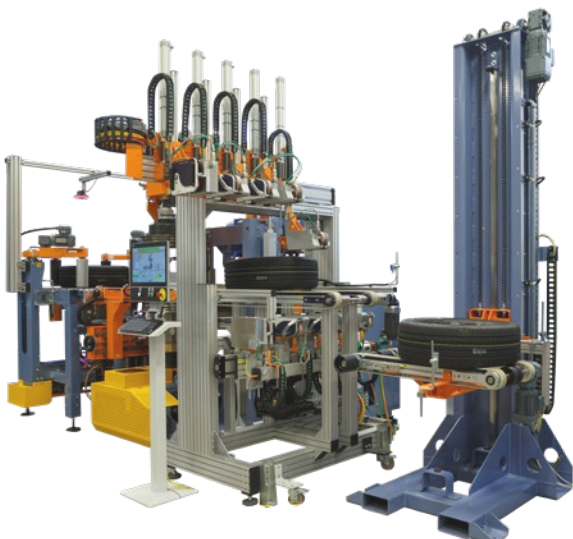
Machine parameters	
Cycle time TG	<20 s
Cycle time TU	<20 s
Cycle time TUG	<24 s
Rim width range	6"
Rim range	14-24" (ETRTO)
Max load	1800 daN
Inflation	1 - 5.5 bar
Collapsed bead compensation	up to 2"
Harmonics analysis	up to 16-th harmonics
Measuring speed	60 rpm
Production capacity	up to 3000 tires/day (in TUG LOT mode)
Radial forces repeatability*	<2 N
Lateral forces repeatability*	<2 N
Conicity repeatability*	<2 N
Measuring load repeatability*	<20 N
Inflation accuracy*	<10 mBar
Inflation repeatability*	<20 mBar

* Reference tire: 205/55 R15, Load 500 daN, springrate 166 daN, measuring pressure 2 bar
Further technical parameters are available on request.

Machine Characteristic	
Electric supply	3x400V, 63 A
Electric power	5.5 kW
Air supply	6 - 10 bar, 2" (connection)
Average air consumption	0.768 m³/min
Radial and lateral run-out of (mounted) top and bottom rims	≤ 0.025 mm
Radial and lateral run-out of top / bottom spindle assembly (without rims)	≤ 0.008 / 0.013 mm
Spindle end play	0.020 < x < 0.050 mm



Loadwheel monitoring



Sorting



Marking



Tire geometry inspection dimensionCONTROL TGI 8302.PLT/TT



With the precise inspection of radial and axial runout, as well as bulges and constrictions on the tire, the dimensionCONTROL TGI 8302.PLT/TT series make an important contribution regarding quality during the production of the tire.

Compatible for various TG/TU types

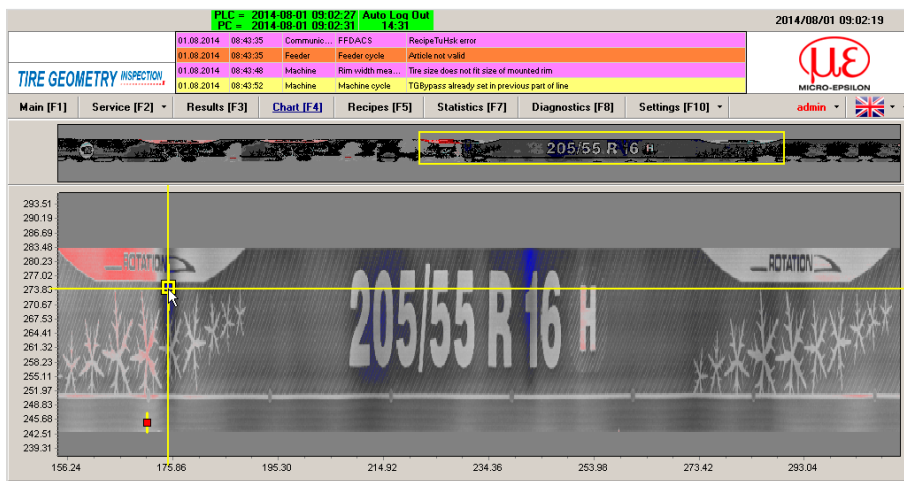
Using customized laser line triangulation sensors, located on a solid and precisely positioned frame which ensures optimal reading of the sides and patterns, dimensionCONTROL TGI 8302.PLT/TT measures the size of defects (bulges, depressions) and evaluates the radial and lateral runout. The system processes displacement data in relationship to angular positions, detected by an encoder, to create a partial 3D model of the shell. It can eliminate imprinting, detect positions of defects and state the size. During the inspection of the runout, the system creates a harmonic analysis and applies filtrations for the suppression of high frequency noise.

The mechanical basis of dimensionCONTROL TGI 8302.PLT/TT is a C-frame where the upper and the lower sidewall sensor as well as the tread sensor are controlled according to the tire size due to fully automatic controlling methods. The actuators can be alternatively operated by servo or stepper motors. The controlling parameter can be written in a database.

With the laser line triangulation sensors, optimized regarding packaging situation of the application, the system is compatible to be applied in various existing TU machines. Due to the special arrangement of optics, they have an excellent ratio of line length and measurement range to installation space.

Application area in tire industry or tire wheel assembly:

- Bulge and dents measurement
- Radial and lateral runout measurement
- Automatic selection of measuring range
- Optimized design for TU machines retrofit
- Applicable in various TU machines
- Reliable letter elimination
- Integrated system for tread monitoring



Visualization of sidewall inspection

dimensionCONTROL TGI 8302	.PLT	.TT
Article no.	4350136,04	4350136,05
Area of use	Passenger and light truck tires	Truck tires
Tire tread width	min. 95 mm max. 400 mm	min. 135 mm max. 610 mm
Tire outside diameters	min. 500 mm max. 900 mm	min. 700 mm max. 1500 mm
Bead diameters	min. 13 inch max. 24 inch	min. 16 inch max. 24 inch
Tire rotation speed	max. 60 rpm	max. 60 rpm
Sensor technology	sheet-of-light sensors	sheet-of-light sensors
Sidewall measuring width in one rotation	max. 120 mm	max. 120 mm
Tread measuring width in one rotation	max. 350 mm	max. 600 mm
Measurement speed	2000 measurements / second	2000 measurements / second
Laser class sensors	3B	3B
Number of sensors	2 sidewall sensors 1 tread sensor	2 sidewall sensors max. 2 tread sensors
Repeatability (1 σ)	< 0.02 mm	< 0.02 mm
Protection class	IP43	IP43
Ambient temperature	min. +15 °C max. +40 °C	min. +15 °C max. +40 °C
Relative air humidity	max. 75 % within the specified temperature range without condensation	max. 75 % within the specified temperature range without condensation
Machine interface	OPC UA	OPC UA

Further technical parameters are available on request.



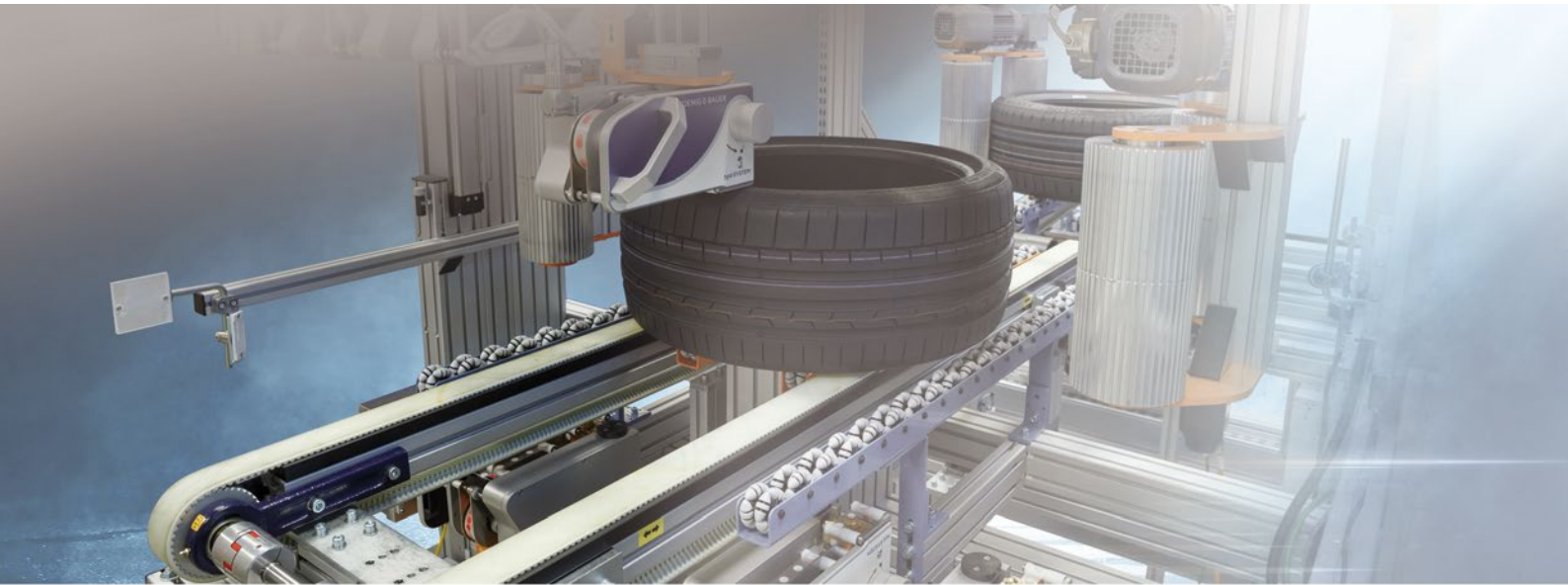
Integration to tire uniformity machine



Integration to balancing machine



Central marking line CML



Central marking line

The central marking line increases the efficiency of the marking process in the finishing area. Less effective marking stations installed as part of the tire uniformity line and the balancing line are replaced by central marking modules where all markings are applied in one station, significantly increasing the efficiency of the marking head usage.

The central marking line is also suitable for applying a second marking. In cases where an additional marking is required and the marking stations in the tire uniformity line or the balancing line are not capable or available, the second marking can be applied in the central marking line.

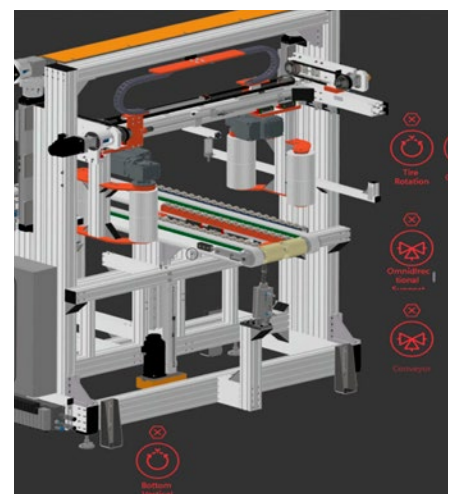
The marking process is determined by the position of the barcode or the existing mark as a reference point for the second or next mark. This spotting functionality is provided in the spotting station, which is typically used to obtain the correct position of the first mark based on the barcode or the position for the second mark based on the existing mark. For the next mark request, the marking module also includes a spotting function that allows for defining the next angles for the mark, regardless of whether the mark is applied to the bottom or top sidewall.

The entire marking process is fully controlled by a PLC based on information from the customer's factory network, including parameters such as temperature, marking time, and marking pressure. The central marking line can also be equipped with a camera to check the quality of the marking in the marking area. The central marking inspection system can be utilized for quality inspection of the entire upper and lower sidewall.

The web-based visualization, which can be accessed directly at the machine or via the factory network on a cell phone or tablet, includes an online monitoring system, a complete results database and a predictive maintenance module.

Central marking line

- Prices tire spotting in spotting station
- Up to 5 marking heads for top sidewall
- Up to 5 marking heads for bottom sidewall
- Different types of marking technologies: Hot stamp / LTA / Inkjet
- Different types of marking heads
- Inkjet marking for top and bottom sidewall
- Second tire spotting in marking unit
- Marking quality inspection

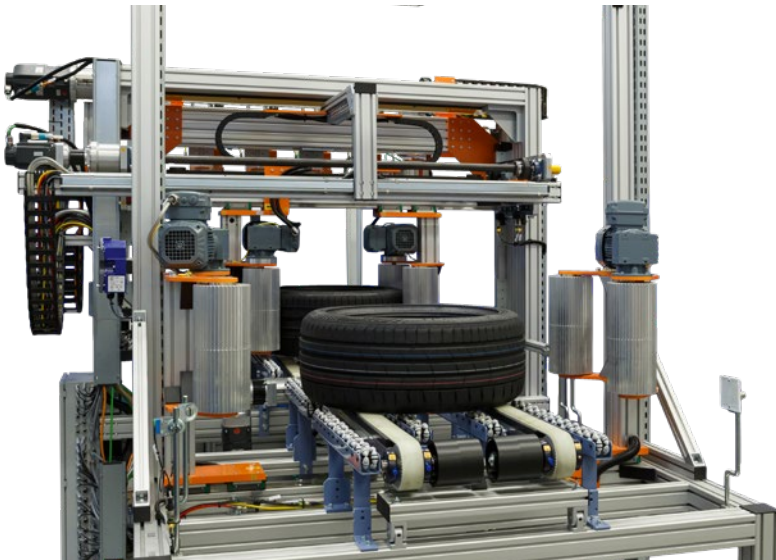


Web based visualization

CML Central marking line

Area of use	Passenger and light truck tires
Tire tread width	min. 95 mm max. 400 mm
Tire outside diameters	min. 500 mm max. 900 mm
Bead diameters	min. 13 inch max. 24 inch
Weight	up to 50 kg
Marking precision based on barcode spotting	±2.5 o
Cycle time	14 sec. one mark / 18 sec. double marking
Marking technology	Label transfer application (LTA) Hot stamp Inkjet or combination of technology *
Protection class	IP43
Ambient temperature	min. +15 °C max. +40 °C
Relative air humidity	max. 75 % within the specified temperature range without condensation
Machine interface	OPC UA

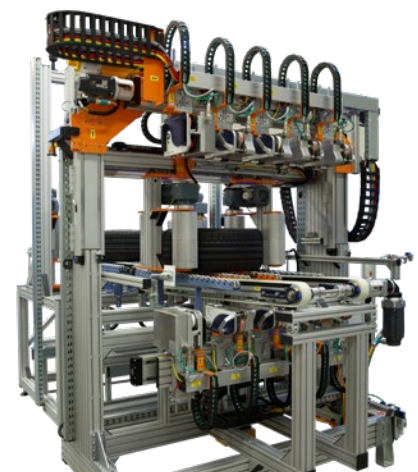
* Marking station is designed for combination of marking technology like LTA / Hot stamp / Inkjet in one station.
OEM solution up to request



Tire spotting



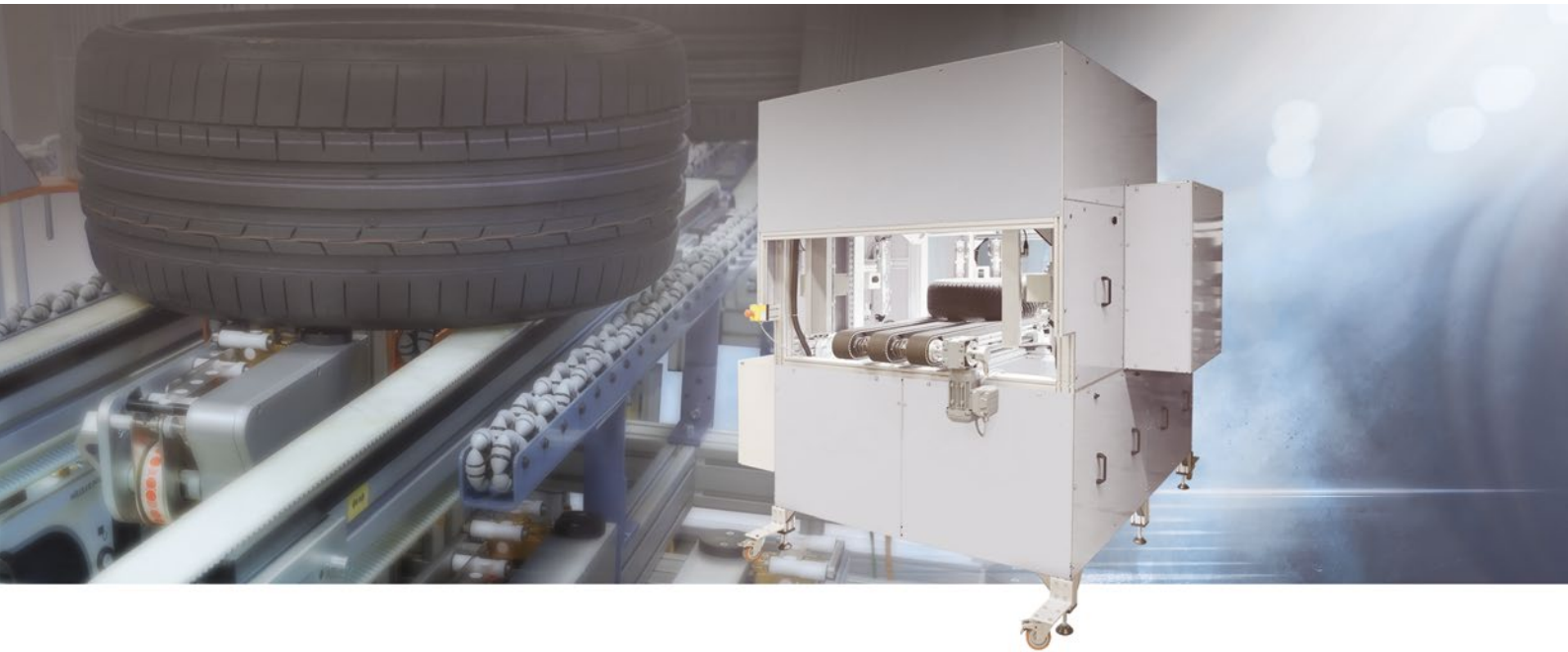
Applied marking



Marking module



Central marking inspection CMI markingCONTROL CMI 8303.I



To complete quality assurance, markingCONTROL CMI 8303.I secures with efficient vision technology the documentation of the classification of tires or wheels displayed by marks on the sidewall.

Closed loop quality assurance

High-speed cameras are the central component of the markingCONTROL CMI 8303.I. They read the illuminated surface at the sidewall by analyzing the images in each instance. The imprinting of the sides and reflections originating on the surface are eliminated. The detected marks are qualitatively evaluated of depending on type, physical dimensions, turning towards the barcode, deformation and color.

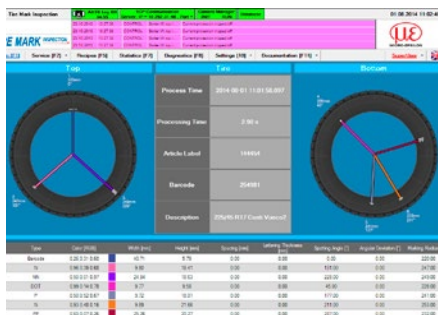
Checking even the quality of marks and showing the quality classification, the markingCONTROL CMI 8303.I closes the loop of a modern quality assurance.

Installation possibilities:

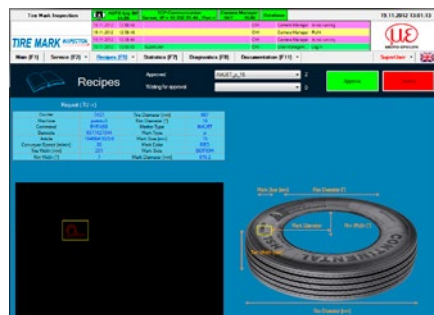
- Next module after Central marking line
- Online independent module on conveying system

Inspection:

- Type of marks
- Geometry of marks
- Color of marks
- Quality of marks
- Marking diameter
- Reference angles
- Fill rate



Position and classification of inspected marks



Recipe editor

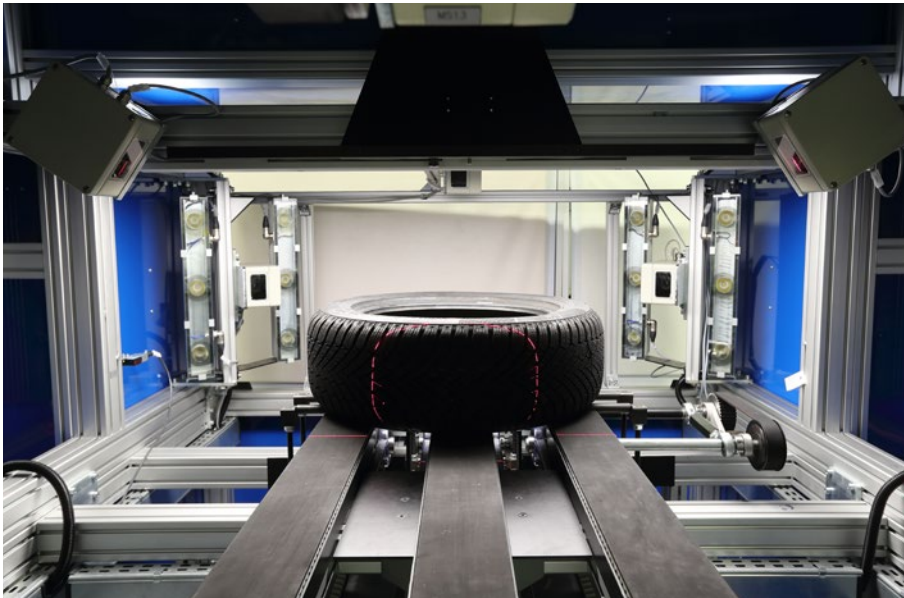


Machine details

markingCONTROL CMI 8303.I

Article no.	4350290,01
Area of use	Passenger and light truck tires
Tire tread width	min. 95 mm max. 400 mm
Tire outside diameters	min. 500 mm max. 900 mm
Bead diameters	min. 13 inch max. 24 inch
Conveyor speed	max. 30 m / sec.
Sensor technology	Cameras / Sheet-of-light sensor
System measuring range - Tire width parameter	min. 90 mm max. 405 mm
System measuring range - Tire outside parameter	min. 500 mm max. 950 mm
Laser class sensors	3B
Mark / Label height repeatability (1 σ)*	< 0.4 mm
Mark / Label width repeatability (1 σ)*	< 0.4 mm
Marking radius repeatability (1 σ)*	< 0.4 mm
Spotting angle repeatability (1 σ)*	< 1 o
Fill rate repeatability (1 σ)	< 5 %
Cycle time	< 5 sec
Type of marks	LTA, HotStamp Premium, Labels, InkJet
Protection class	IP43
Ambient temperature	min. +15 °C max. +40 °C
Relative air humidity	max. 75 % within the specified temperature range without condensation
Machine interface	OPC UA

* Repeatability test realized with not damaged marks.
Further technical parameters are available on request.



Central marking inspection



markingCONTROL CMI 8303.I



Retrofit of tire uniformity line RTUG



One of the most cost-effective ways for increasing productivity is upgrading an existing TU line with a new control system including a comprehensive interface to the measuring system.

Precision by elimination of unwanted influences

The reconstruction of TU lines is composed of replacing electric and pneumatic components as well as the measuring system for detecting the tensiometric forces. Coming up with an efficient control system the reliability of the whole line is ensured. Also the communication with other parts such as conveyors, master systems for control and collection of data is performed by this renewed system.

The measuring system, recording the values of radial and lateral forces (absolute values, peak to peak values, harmonic analysis and calculating conicity and plysteer), is calibrated by a set of certified ballasts.

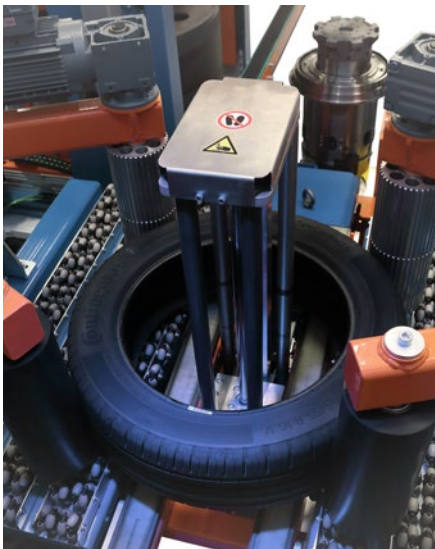
The dimensionCONTROL TGI 8302.PLT/T measuring system ensures the measurement of the size of defects (bulges, depressions) and the evaluation of the value of the radial and lateral runout with the use of laser line sensors. It's characteristics can be seen on the previous pages.

Retrofit includes:

- Mechanical retrofit
- Electrical retrofit
- Control&Drive retrofit
- New software for control of line and visualization
- Integration of TGI 8302.PLT
- Integration of tread color inspection
- Delivery of new lubber station
- Delivery of feeding device station
- Delivery of conveyors
- Delivery of marking station
- Delivery of sorter/lift
- Delivery of computer controlled inflation system

Type of retrofit lines:

- TUG Akron D70/DX75
- TUG Astec
- TUG Kobelco
- TUG Hofmann



Lubber station



Geometry inspection

- Up to 5 marker heads on top
- Up to 5 marker heads on bottom
- Marking quality inspection for sidewalls



Marking station



Retrofit of balancing line RTB



The renewing of the measurement technology of a balancing line is an investment with an outstanding cost to service relationship to provide new evidence about the production

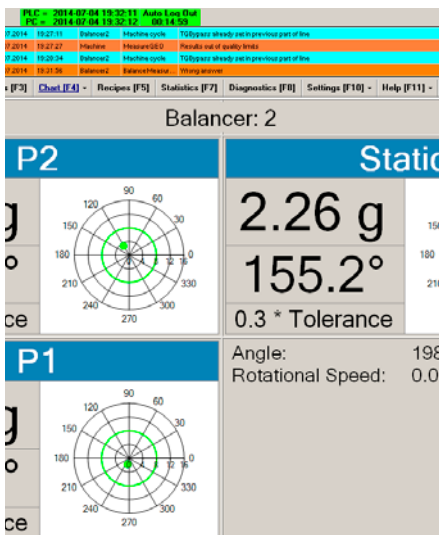
New performance until the marking

For the revision of the balancing lines new electric and pneumatic components are installed together with an up-to-date measuring system for reading the forces. Another important module is a new control system, which runs the whole line and coordinates the communication of the single subsystems. The static imbalance and the dynamic imbalance are measured in two areas.

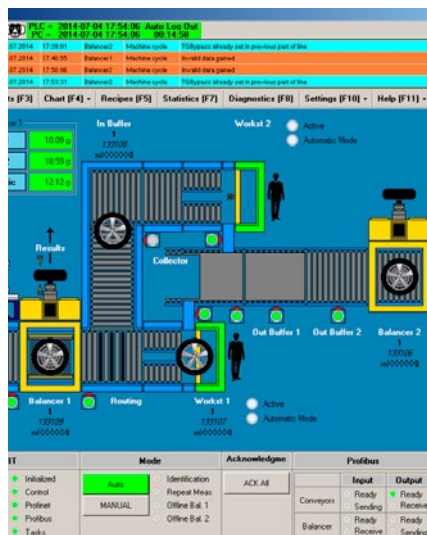
Due to fact, that the monitored characteristics have a significant influence on the tire quality, a quality classification based on the results of the inspection is carried out. The tire is marked in accordance with the above-mentioned quality classification at the end of line or in the central marking station. These items are also part of the machine retrofit, beside the possibility to install a new marking station.

Application area in tire industry or tire wheel assembly:

- Mechanical retrofit
- Electrical retrofit
- Control&Drive retrofit
- New software for control of line and visualization
- New PC based software for balancing measurement
- Integration of TGI 8302. T



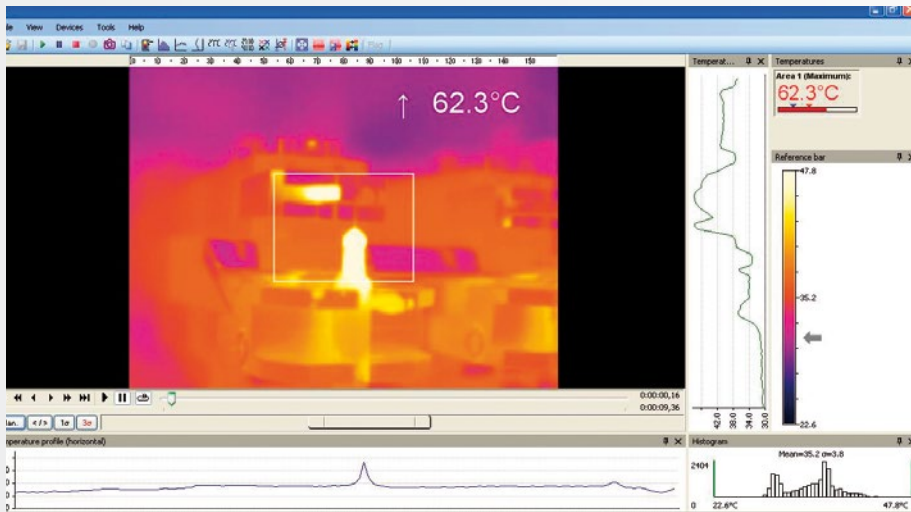
Graphical display of the result



Process visualization

Geometry	
	Sensor
1	TLRO Top Sidewall
1	BLRO Bottom Sidewall
1169	CRR0 Radial Tread
33107	CRH1
	WOBBLE
Balance Measurement	
	Balancer 1
1	P1 11.02
1	P2 12.41
1	Static 2.30
18.62	
0.00	Clear Data
14.53	

Result in table form



Temperature measurement in the tire industry

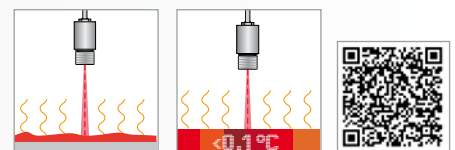
Micro-Epsilon offers a wide range of infrared thermometers, pyrometers and radiometric pyrometers as well as IR cameras which allow you to precisely measure the temperature of the object temperature.

High-Performance infrared pyrometer with laser spot marking CTL-SF75-C3 Non-contact measurement of the surface temperature

Each Micro-Epsilon IR sensor model incorporates different technologies that have a common denominator: non-contact temperature measurement. Due to this non-contact technology, measurement objects can be detected precisely and wear-free without physical influences.

Precise and stable measurements

The thermoMETER product group is renowned for its high accuracy and high resolution. Particularly in temperature-critical applications, IR sensors from Micro-Epsilon are the preferred choice for easy, precise measurements.

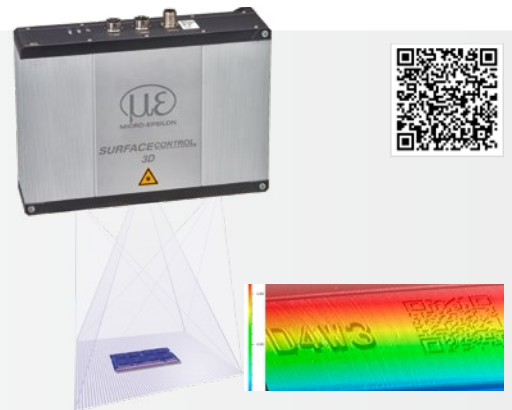




High precision 3D snapshot sensor SC3500-80

The high precision 3D snapshot sensor surfaceCONTROL 3D 3500 sensor is ideally suited to automated inline inspection of geometry shapes and surfaces on diffuse reflecting surfaces. The sensor works according to the principle of fringe projection, which allows direct 3D measurement. The surfaceCONTROL 3D 3500 stands out due to its compact design and high measurement accuracy combined with high data processing speed. With a z-axis repeatability of up to $0.4 \mu\text{m}$, the sensor sets new standards in high precision 3D metrology. This enables reliable detection of even the smallest deviations in flatness and height.

Application: QR code quality inspection, DOT code reading, Tread wear indicator quality inspection, Quality of sidewall glyphs



Thickness measurement by thicknessSENSOR

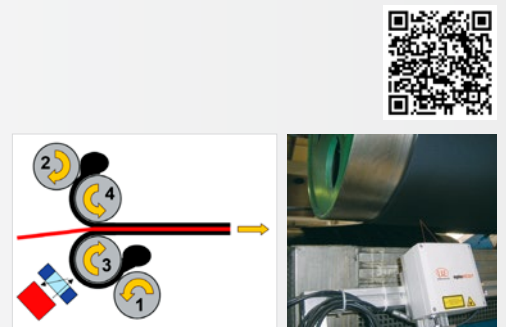
Compact design and high precision: the thicknessSENSOR enables turnkey thickness measurement along with an unmatched price/performance ratio. Due to its extremely compact design, this sensor system can also be integrated in a confined installation space. Several models with different measuring ranges and widths enable the detection of various object geometries. The integrated laser sensors are perfectly adjusted to each other in terms of their mounting conditions, therefore providing high measurement accuracy.

Application: thickness measurement



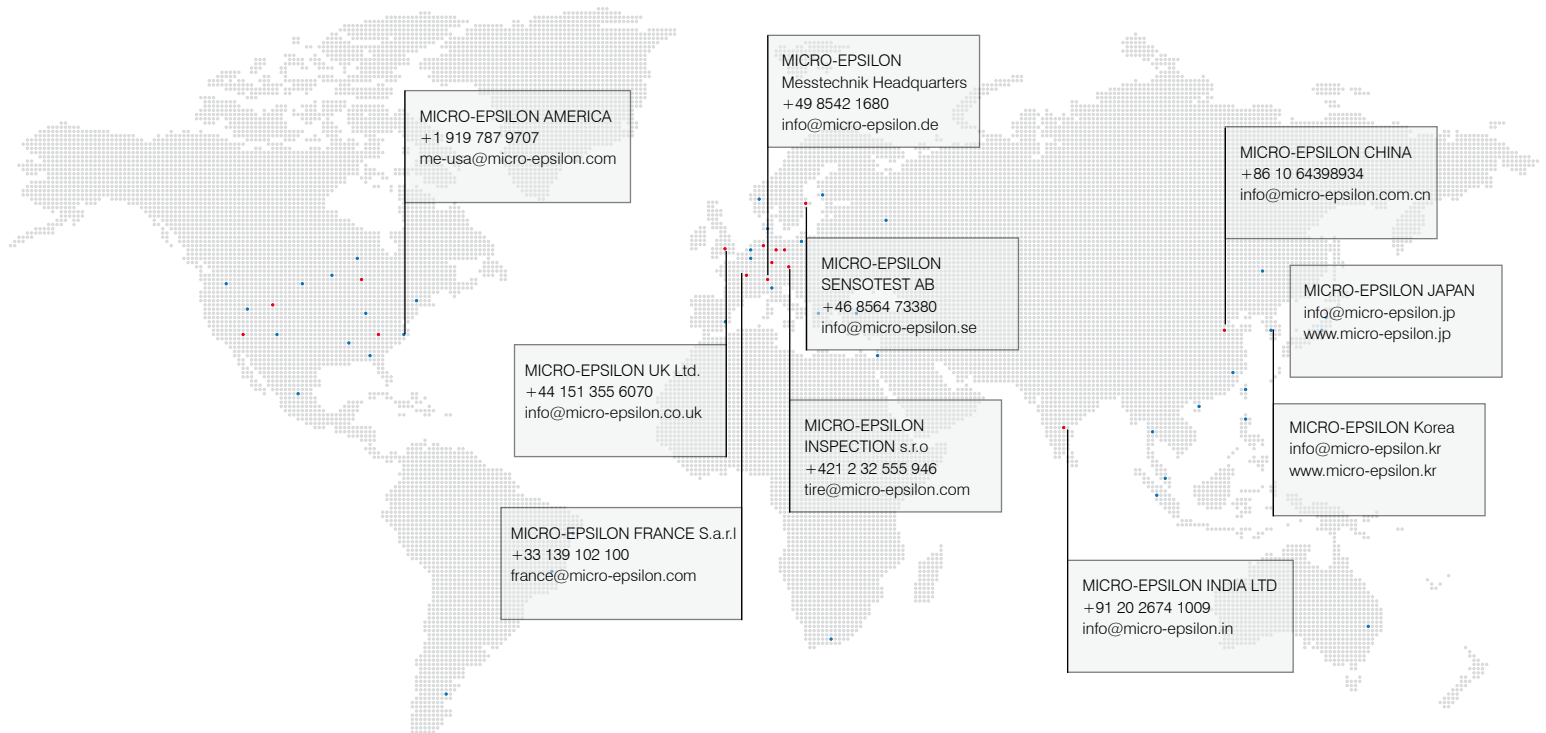
Thickness measurement on the calender

Rubber-coated textile and metal fabrics form the basis of tire manufacture. The rubber is applied to the fabric by calender rolling which demands a uniform layer thickness for the manufacture of high quality tires. The strength and the dimensional conformance of the tire directly depend on the coating process. Measurement of the thickness of the rubber on both rolls is often not possible due to the way the calender is constructed. Therefore, a special sensor arrangement from Micro-Epsilon is used. This sensor setup combines an eddy current sensor with a laser sensor. While the laser distance sensor detects the upper side of the material, the eddy current sensor measures the lower side indirectly by means of the surface of the roller. The material thickness results from the difference between the two signals. The sensors are protected against the high ambient temperatures by a protective housing cooled by compressed air.



Combi sensor with eddy current and laser triangulation

Your local support



Successful installations in following countries



More precision for added value

Performance, quality and the reliability of products and services provided over many years establishes Micro-Epsilon as a leading supplier of inspection systems for the tire industry. More than 400 installations in 29 countries all over the world, placed in the preparation, final finishing and wheel assembly areas, speak for themselves. Generating all the required core components like sensors, software and measurement specific mechanical construction within the company group provides unique, innovative system solutions which are mirrored in the product portfolio of Micro Epsilon.

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