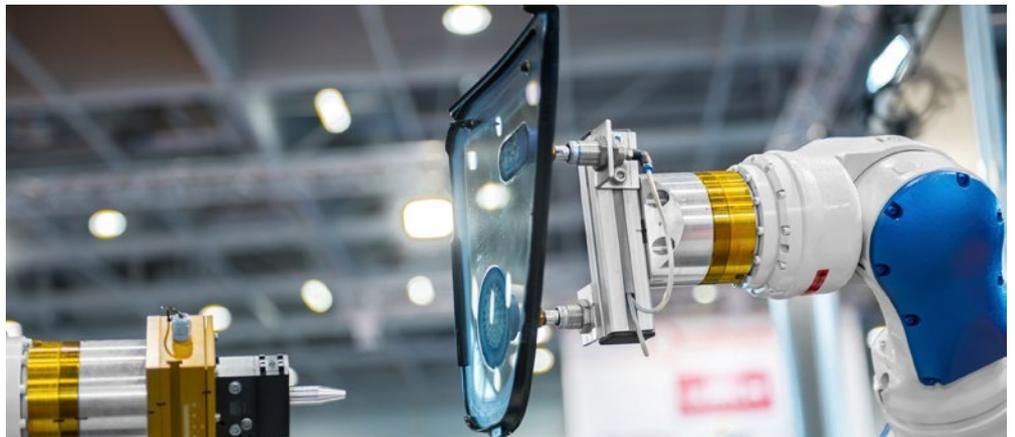


# Sensors & Applications Automotive Production



More Precision



## Sensors for automotive production

Today, sensors and measurement technology are indispensable for modern automotive engineering – especially in view of ever more stringent quality requirements. From the press shop to assembly and finishing, they ensure precise control of production processes, seamless monitoring of supplied parts and final quality control.

Micro-Epsilon supplies innovative sensor solutions for measuring distances, gaps, colors, temperatures and surfaces in almost all process steps of vehicle production. Leading car manufacturers around the world trust in the precision, reliability and versatility of our sensor products.



## scanCONTROL

Compact laser scanners for high-precision profile measurements

Inline measurement of gaps, profiles, steps and angles

Models with red or blue laser line

Measurement on numerous surfaces, even reflective and matt

Suitable for robots and drag chains

## colorSENSOR CFO

Sensors for color measurement of glossy and reflective surfaces

Ideal for integration into production lines thanks to high measuring rates

High accuracy

Various sensor models for reflective, textured & curved objects

## surfaceCONTROL 3D 3500

3D snapshot sensors with ultra-high precision

Precise inline inspection of geometry, shape and surfaces

Ultra-high repeatability of up to 0.25  $\mu\text{m}$

Up to 2.2 million 3D points per second

Suitable for robots and drag chains

## optoNCDT

Compact laser triangulation displacement sensors for fast and precise measurements

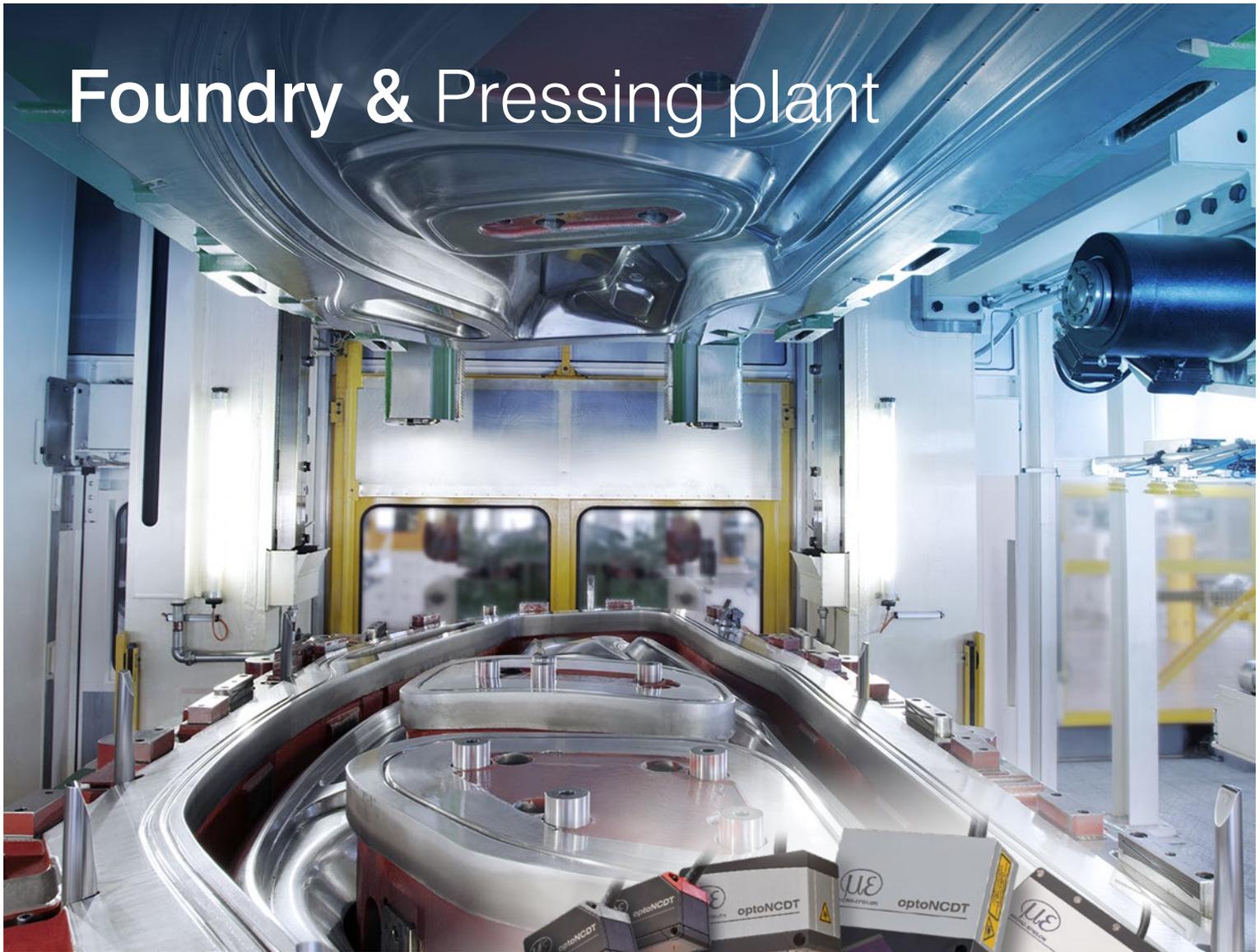
Non-contact displacement and distance detection with measuring ranges from 2 to 1000 mm

High accuracy

High measuring rate for dynamic measurements

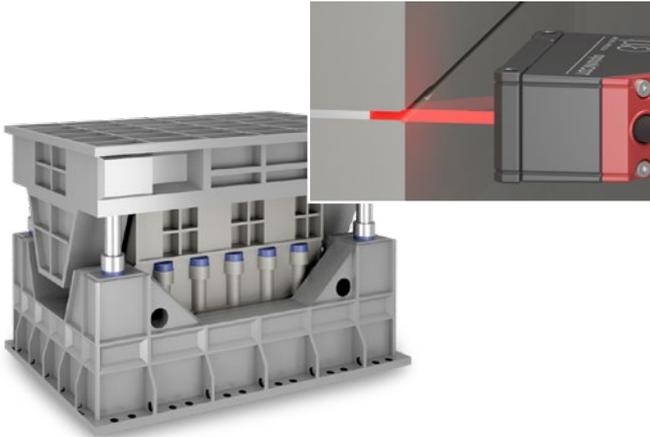
Compact design and easy installation, ideal for robots and drag chains

# Foundry & Pressing plant



## optoNCDT

- Laser triangulation sensors with measuring ranges up to 1000 mm
- Accurate measurement from a safe distance
- High measuring rate for monitoring fast processes
- High accuracy



### Monitoring of the sheet metal feed during pressing

During forming in the press shop, presence detection and the exact detection of the sheet position are crucial for an error-free production process. The optoNCDT 1420 laser sensors measure directly onto the sheet metal between the dies. In confined installation spaces, they achieve precise measurement results even with vibrations and shocks. Thanks to the compact laser beam, measurements can be taken directly between the two dies.

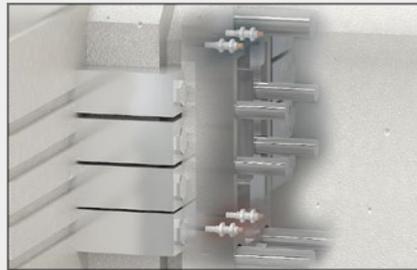
Sensor: *optoNCDT 1420*



### Monitoring of the embossing depth

Chassis numbers are stamped into the vehicle frame in embossing machines. The embossing depth must be within a defined tolerance range. During positioning of the embossing tool, laser triangulation sensors from Micro-Epsilon measure the distance between the embossing tool and the component. Once all the characters have been embossed, the sensor is used to measure the profile of the embossing. This ensures that all characters have been punched to the required depth.

Sensor: *optoNCDT 1420*



### Gap measurement in aluminum die casting

In aluminum die casting, liquid aluminum is poured into molds under high pressure and at high speed. The high pressure acts on the closed mold and pushes it apart, which can result in flakes and burrs on the cast part. Eddy current sensors measure the change in distance in order to measure the pressure-induced movement of the molds. The robust sensors deliver reliable measurement results despite high temperatures, ambient pressure and debris in the measuring gap.

Sensor: *eddyNCDT 3005*

# Body shop & Car body construction



## scanCONTROL

- Compact laser scanner with integrated controller
- High profile frequency for dynamic measurements
- Synchronizable for multi-scanner applications
- Different measuring ranges
- Compact design with integrated controller, ideal for robots and drag chains



### Distance measurement for robot positioning

During cockpit assembly, laser time-of-flight sensors determine the exact position at which the car body should stop. The distance sensors are suitable for measurement tasks in assembly lines due to their short response time and high signal stability.

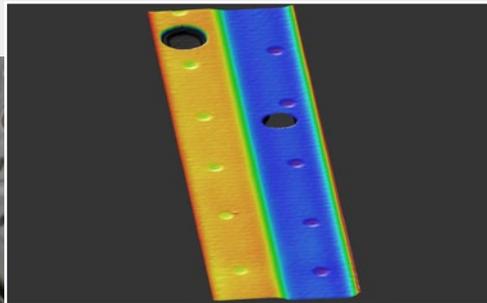
*Sensor: optoNCDT ILR1040*



### Position detection of the car body

For automated machining processes on car bodies, the exact position relative to the machining tool – e.g. for drilling, punching, or mounting assemblies – must be determined. Laser triangulation sensors are used for high-precision distance measurement on the metal surfaces.

*Sensor: optoNCDT 1420*



### Geometric inspection during spot welding

3D snapshot sensors are used to inspect the geometric features of spot welds during spot welding. They capture the 3D shape and position of the points with high accuracy in a single shot. Thanks to their ability to measure several spot welds simultaneously, the testing process is sped up significantly. In addition, the 3D characteristics of the individual spot welds can be checked relative to each other. The sensor is moved to the respective measuring position with the robot arm. This allows for 100% control without additional cycle time losses.

*Sensor: surfaceCONTROL 3D-240*

# Car body construction

## Surface inspection



### **surfaceCONTROL Automotive**

- Fully automatic defect detection on bodyshells
- Fast, precise and repeatable
- Group-wide transferability to all models
- High coverage on curved surfaces (door handles, design edges, edge regions)
- Complete integration: Sensors, robotics and automation from a single source





### Fully automatic surface inspection of bodyshells

The surfaceCONTROL Automotive measuring system is used for fully automatic defect detection on bodyshells. This system uses the principle of fringe projection on diffusely reflective surfaces. A learning process is used to reliably detect local shape defects such as pressure points, cracks, etc., taking permissible deviations into account.

### Flexible cell configuration with complete integration

The surfaceCONTROL systems consist of a sensor, robot, computer, and software and interface package. Different versions of the system are available depending on the requirements and are configured to suit the customer. The number of sensors and robots required is flexibly adapted to the required throughput.

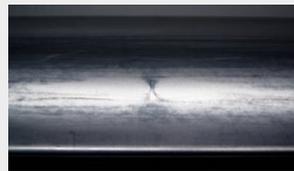


### Automatic 6D position correction

The surfaceCONTROL systems have integrated 6D offset correction, which makes it possible to automatically compensate for deviations in the position of targets. This allows measurements to be taken quickly, precisely and with high repeatability, even with slight positional deviations. Thanks to the fully automatic calculation of the car body position in space, the system adjusts the measuring positions accordingly and corrects the opening angles of doors and flaps.



Sink marks



Pressure points



Cracks



Ripples

### Individual defect classification with tolerance

By capturing real 3D data, detailed 3D features such as height, depth and volume are assigned to each defect. These errors are classified taking into account permissible deviations according to the user's specifications. This makes transfer to other plants and models quick and easy.

# Paint shop Surface inspection



## reflectCONTROL Automotive

- Automatic surface inspection of painted car bodies
- Fast and high-resolution
- Ultra-high detection rate – regardless of the car body color
- High positional accuracy of the defects
- Measurement also on design edges and contrasting roofs



### Surface inspection of painted car bodies

reflectCONTROL Automotive is used for the fully automatic inspection of painted car bodies. The robot-assisted systems enable the detection, three-dimensional measurement and classification of typical paint defects such as inclusions, craters and running paint. They stand out thanks to their high precision paired with high repeatability and can be easily combined with automatic processing and marking systems.



### Automatic setup of all car body colors

The reflectCONTROL inspection systems detect almost 100% of all relevant defects, regardless of the paint color. The innovative reflectCONTROL systems offer the option of automatic color calibration. This is an important advantage, particularly for individual paint finishes and new model ranges. If a new color code is transferred from production, the system automatically sets up the parameter sets and assigns them to the new color code.

The image displays a 3D model of a car hood with several defects highlighted and labeled with callouts:

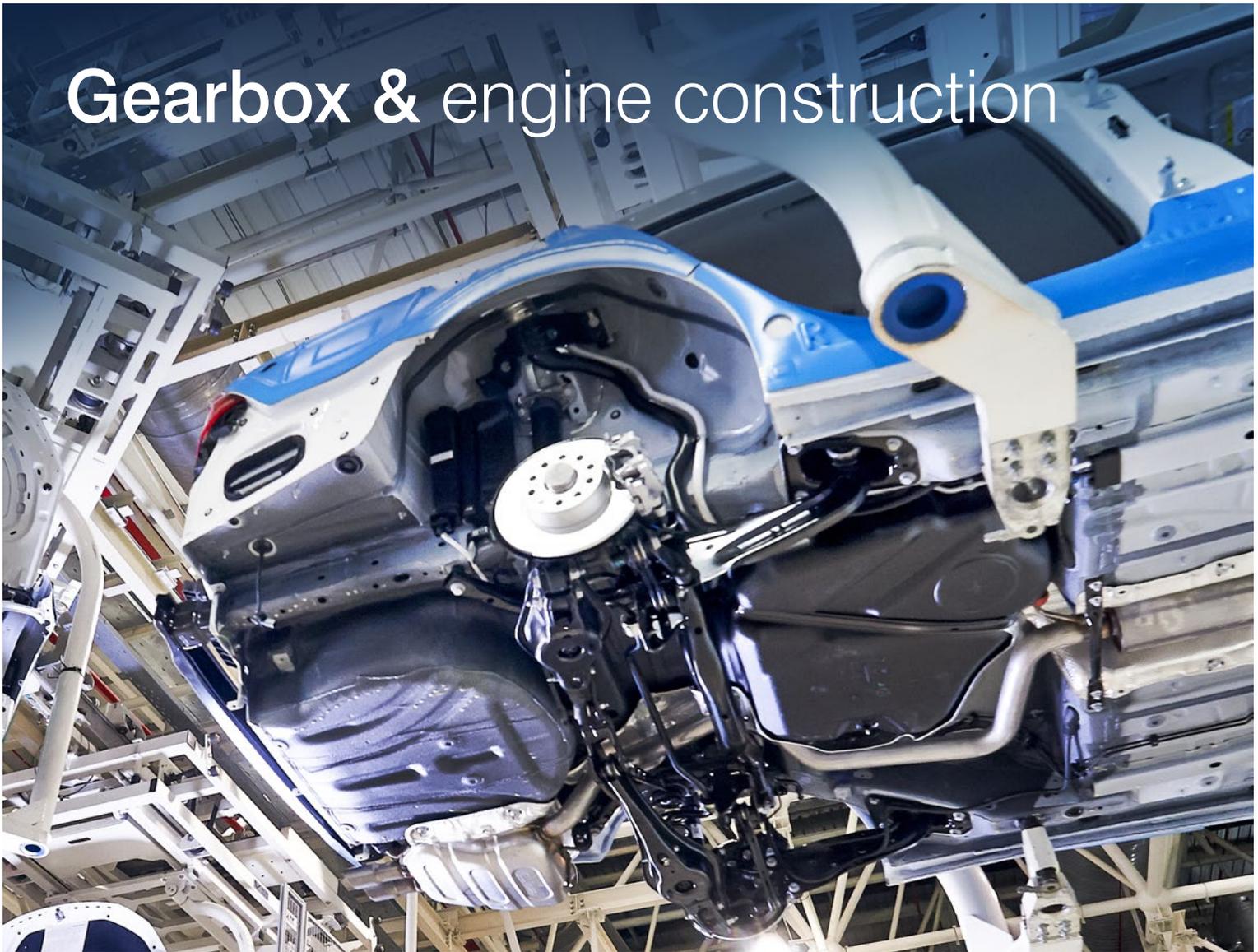
- Dust:** A small, irregular white spot on the surface.
- Inclusion:** A sharp, vertical spike protruding from the surface.
- Crater:** A deep, circular depression in the surface.
- Subsurface:** A large, irregular white area beneath the surface, indicating a defect that is not visible from the top.
- Small inclusion:** A small, irregular white spot on the surface.

Next to the 3D model is a screenshot of the reflectCONTROL software interface, showing a 3D visualization of the car body with evaluation zones and a list of detected defects. The interface includes a sidebar with various settings and a main window displaying the 3D model and a list of defects.

### Powerful software

In addition to the measurement hardware, the reflectCONTROL systems include a powerful software platform. This includes tools for setup and path planning as well as 3D visualizations of the defects and views of the entire car body and its evaluation zones. An integrated appearance viewer offers options for viewing and evaluating the defined surface evaluations.

# Gearbox & engine construction



## optoCONTROL 2700

- Measuring ranges 10 / 40 mm
- Sampling rate 15 kHz for fast measurements
- Micrometer-precise measurement of diameters, gaps and segments



### Presence check of bearing shells

During connecting rod assembly, bearing shells are pressed into the bearing shell covers. Before the connecting rod is fitted, it is checked that the bearing shells are in the bearing shell cover. Optical micrometers from the optoCONTROL series, which measure the diameter of the bearing shell covers, are used for presence checks.

*Sensor: optoCONTROL*



### Position monitoring during the marriage process

Laser point sensors from the optoNCDT series monitor the "marriage" of body and engine. The device is equipped with laser triangulation sensors that monitor the distance between the car body and the engine so that the car body can be positioned precisely on the drivetrain.

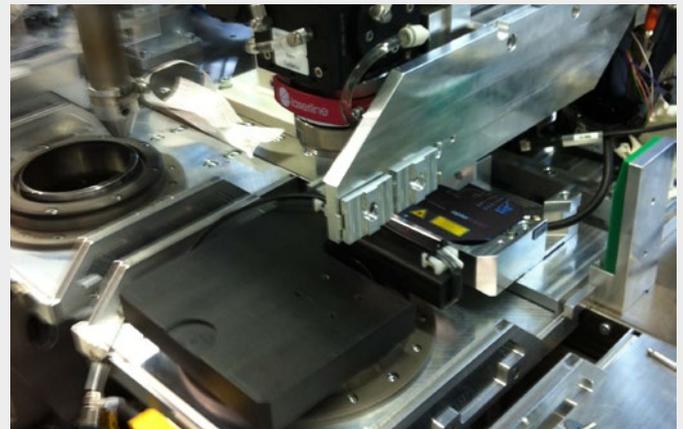
*Sensor: optoNCDT 1420*



### Differentiation of brake discs

In order to assign the correct brake disk to the respective car model, the disks are checked with laser profile scanners before installation. To detect and classify the brake discs, the gap between the ventilation ribs is measured with scanCONTROL laser scanners. Thanks to the high accuracy, the brake discs can be reliably differentiated.

*Sensor: scanCONTROL*



### Automatic positioning of the synchronizer rings

When manufacturing synchronizer rings, the end faces are deburred with a laser. Laser triangulation sensors from Micro-Epsilon are used to detect the exact position of the synchronizer rings.

*Sensor: optoNCDT 1900*

# Vehicle assembly



## **optoNCDT 1900**

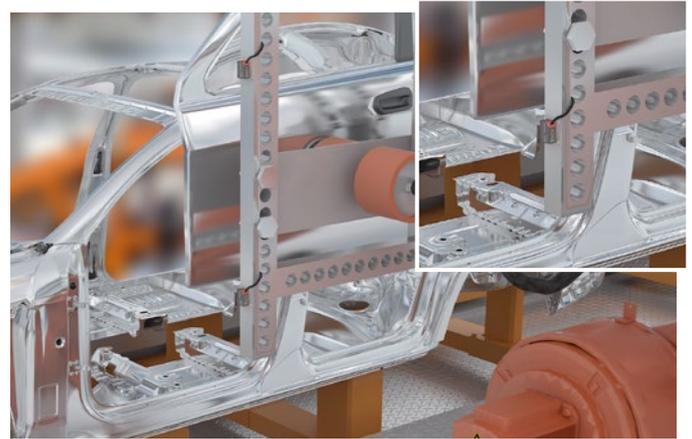
- High-performance laser displacement sensor for industry and automation
- Measuring rate of 10 kHz for precise and fast measurements
- Measuring ranges: 2 mm - 500 mm
- Compact sensor design with integrated controller
- Robust and durable design



### Highly accurate cockpit positioning

For fully automatic installation in the vehicle, the cockpit must be positioned precisely. For this purpose, a frame with two grippers is mounted on a robot arm. scanCONTROL profile sensors are also attached to this frame to monitor the centering of the cockpit. Thanks to surface compensation, the scanners can also be used with different reflections that occur due to the different paint finishes.

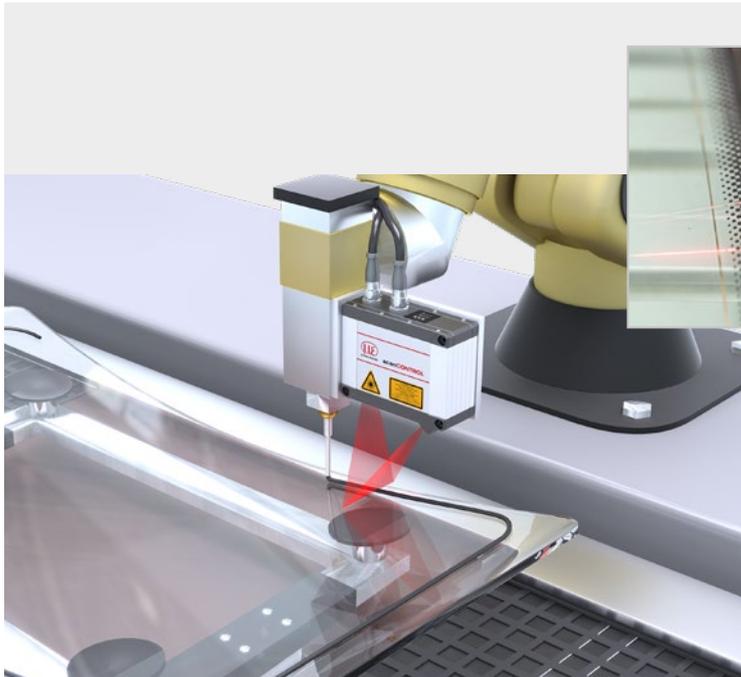
*Sensor: scanCONTROL*



### Position detection of the car body

For automated machining processes on car bodies, the exact position relative to the machining tool (drilling, punching, mounting of assemblies) needs to be determined. Laser triangulation sensors are used for high-precision distance measurement on the metal surfaces.

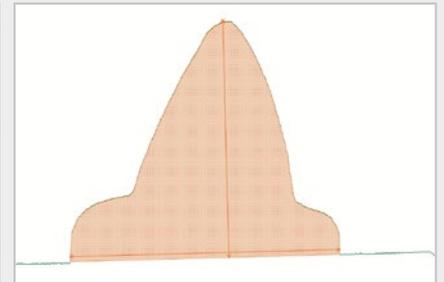
*Sensor: optoNCDT 1420*



### Adhesive bead inspection

When gluing glass panes in automotive production, it is important that the adhesive bead has a constant track. scanCONTROL laser scanners are used to check the application of the adhesive. The scanner determines the surface profile of the adhesive bead and transmits the measured values to the control unit.

*Sensor: scanCONTROL*



# Interior fittings



## surfaceCONTROL

- Measurement & inspection of diffusely reflective targets
- Continuous process monitoring
- Detection of a wide range of shape defects
- Clear definition of defect criteria in supplier relationships
- Objective evaluation of deviations
- Reduction of work steps, minimization of rework and scrap costs
- Visual identification of defects on the component by reprojection





### Defect detection on interior parts

In addition to the stringent visual requirements, instrument panels must also meet functional and safety requirements. A laser is often used to weaken the area of the front passenger airbag in order to create a predetermined breaking seam that allows the airbag to open safely. This predetermined breaking seam can result in tiny sink marks that are visible under certain lighting conditions. surfaceCONTROL inspection systems are used to detect these defects. These enable the quick and objective assessment of surface deviations on both grained and smooth surfaces.

*Inspection system: surfaceCONTROL*



### Position of decorative seams on airbags

The aesthetic requirements placed on the cockpit, seats, interior trim and steering wheel also apply to airbags. For this reason, decorative seams are checked at an early stage using scanCONTROL laser scanners, which are guided over the decorative seam by a robot. Several parameters of the seam contour – height, width and offset – are evaluated simultaneously.

*Sensor: scanCONTROL*



### Color recognition of seams in automotive interiors

The assignment of automotive interior parts in the assembly line is often based on the seam colors. For fully automated color detection, color sensors from the colorSENSOR CFO series are used, which reliably detect the various colors.

*Sensor: colorSENSOR CFO*



### Checking the gaps of automotive trim strips

The trim strips in premium vehicles are glued from different materials. Precise handling is required when gluing or welding the trim strips, as even a slight shift causes large deviations in the gap dimensions in between. For this reason, all trim strips are checked before delivery in order to rework any missing parts. For this purpose, scanCONTROL laser scanners are used to reliably and precisely measure the gap dimensions of the trim strips.

*Sensor: scanCONTROL*

# Exterior fittings



## colorSENSOR / colorCONTROL

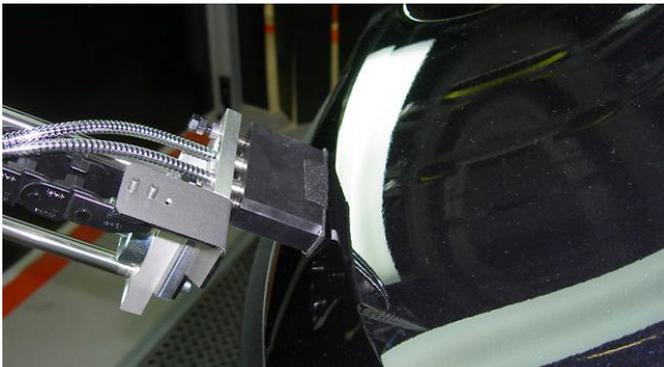
- Sensors for color detection and color measurement
- Ideal for integration into production lines thanks to high measuring rates
- High accuracy
- Continuous line production
- Robust and suitable for industrial use



### **Color measurement of painted car bodies and attachments**

The high-precision colorCONTROL ACS color measuring systems offer exceptional accuracy and reliability for inline measurement. They enable immediate identification of color deviations and ensure that only vehicles with perfect color accuracy leave the production line. Thanks to advanced sensor technology and intelligent software solutions, manufacturers can detect color deviations in real time and make immediate adjustments, which significantly increases production efficiency.

*Sensor: colorCONTROL ACS / Circular sensor ACS2*



### **Color comparison between parking sensor and car body**

The attachments on the vehicle, such as the parking sensors, are painted separately. However, the colors of the parts must be identical during assembly. Color sensors from the colorSENSOR CFO series are used to assign the colors and perform a direct color comparison between the parking sensor and the rear bumper.

*Sensor: colorSENSOR CFO*

### **Surface inspection of exterior plastic parts**

The surfaceCONTROL systems detect and evaluate shape deviations on injection-molded parts and composite parts.

They are able to measure relevant deviations of at least  $5\ \mu\text{m}$  within 0.5 ... 2.0 seconds and evaluate them objectively. Using special methods, even slide marks with a height of around  $1\ \mu\text{m}$  can be detected.

*Inspection system:  
surfaceCONTROL*



### **Color inspection on front aprons**

During the manufacture of ultrasonic parking sensors, the visible front (end cap) is painted in the same color as the vehicle. For the quality assurance, all end caps are checked with the colorCONTROL ACS7000 immediately after being painted. Thanks to the high accuracy and measuring rate, 100% inline control is ensured.

*Sensor: colorCONTROL ACS / Circular sensor ACS2*

# Finish & Quality control





### Best-fit measurement in quality control

During quality assurance, laser scanners check the gap dimensions and laser displacement sensors check the flushness.

The measurement is carried out at various points, e.g. on doors, on front, rear and side windows, as well as on glass modules in the car roof up to the sun roof. The laser sensors and profile scanners used have a surface compensation function and can therefore also be used on different surfaces such as glass, paint and plastic.

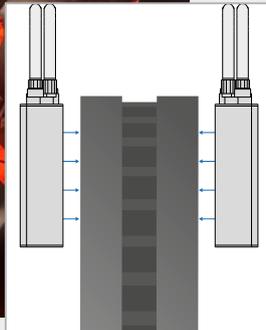
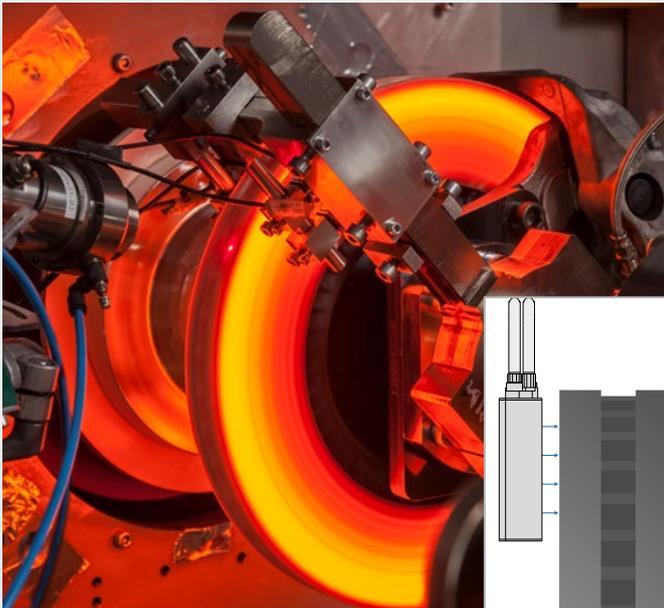
*Sensor: scanCONTROL*



### Color and intensity testing of vehicle lights

The color and intensity of vehicle lights must be tested 100% reliably before installation or delivery. The aim is to ensure homogeneous light distribution even with fluctuating LED batches. The colorCONTROL MFA is designed for testing inaccessible and widely spaced test specimens. The use of optical fibers allows up to 20 measuring points to be tested simultaneously.

*Sensor: colorCONTROL MFA*



### Thickness measurement of brake discs

The capaNCDT DTV is specially designed for measuring the thickness of brake discs. The high-precision, non-contact detection of the disk thickness means that even the smallest deviations are reliably detected. This allows brake judder, noise and power loss to be analyzed and detected at an early stage. The system can be used in a variety of contexts – from test bench to road test to workshop. The innovative multi-track sensor detects four tracks simultaneously and is designed for long-term stable use thanks to its robust design.

*Sensor: capaNCDT DTV*



### Inspection and production systems for the tire industry

Micro-Epsilon is a reliable partner for precise measurement technology for inspection, monitoring and automation in the tire industry. The service portfolio includes the development of turnkey systems, production and installation as well as comprehensive customer service – worldwide and from a single source.

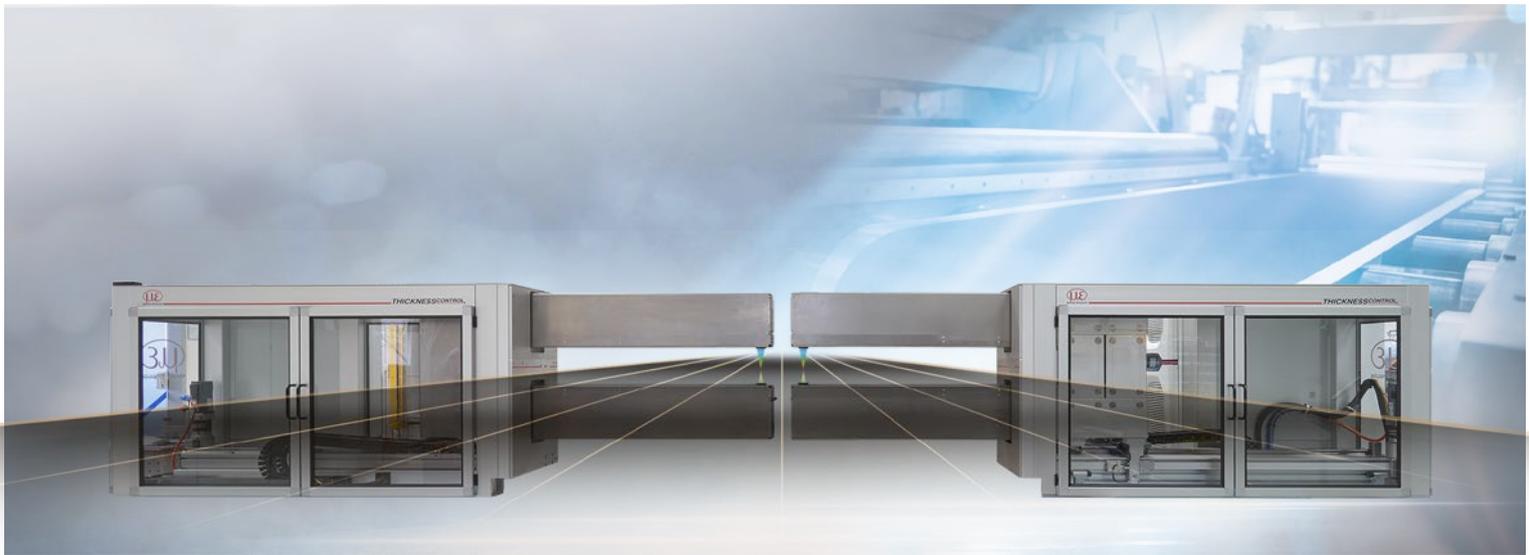
Micro-Epsilon's technologies ensure efficient production processes and the highest quality in component manufacturing, tire production and final inspection. Leading tire manufacturers worldwide achieve the lowest costs per meter of tire component material produced or per tire with the inspection and production systems.



Inline profilometer for tire components



Uniformity & geometry inspection system



### Sensors and systems for battery film production

Micro-Epsilon offers reliable solutions for numerous measurement tasks in battery production, from high-precision distance sensors to inline thickness measuring systems and 3D sensors.

The sensors are used at every stage of production, from electrode manufacturing to assembly and forming. Micro-Epsilon's extensive and diverse product portfolio offers the most suitable sensor product for every type of coating and all targets.

- |  |  |  |                                       |
|--|--|--|---------------------------------------|
|   | Thickness detection before coating     |   | Position measurement of the web edges |
|   | Temperature detection during drying    |   | Thickness detection after coating     |
|   | Roll gap measurement of calender rolls |   | Monitoring of the coil winding        |
|  | Heavy edge detection after coating     |  | 3D measurement of pouch cells         |



Measurement of battery expansion during charging



Inline thickness measurement of battery films

## Sensors and Systems from Micro-Epsilon



Sensors and systems for displacement, distance and position



Sensors and measurement devices for non-contact temperature measurement



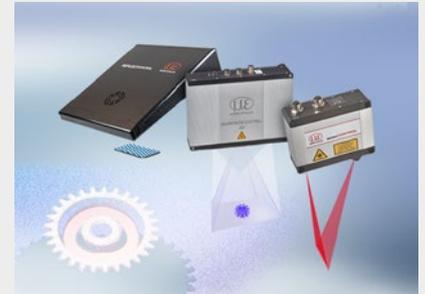
Measuring and inspection systems for metal strips, plastics and rubber



Optical micrometers and fiber optics, measuring and test amplifiers



Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection

## More Precision

Whether it is for quality assurance, predictive maintenance, process and machine monitoring, automation or R&D – sensors from Micro-Epsilon make a vital contribution to the improvement of products and processes. High precision sensors and measuring systems solve measurement tasks in all core industries – from machine building to automated production lines and integrated OEM solutions.



[www.micro-epsilon.com](http://www.micro-epsilon.com)