Sensors & Applications
Machine Tools

MICRO-EPSILON

More Precision

Sensors and measuring systems for machine tools

Modern machine tools comprise numerous sensors. Compact design, longevity and high economic efficiency are major requirements that sensors should meet.

Micro-Epsilon offers a comprehensive product range and sensors, which are integrated into the machine tool. The portfolio includes standard sensors for displacement and position measurements, as well as OEM solutions for large volumes.

eddyNCDT SGS

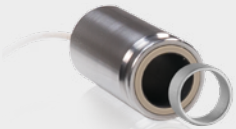
Sensor system developed for measuring the thermal extension of milling spindles

- Measuring range of 500 µm
- Resolution of 0.5 µm
- High temperature range

wireSENSOR

Robust draw-wire sensors for position measurements

- Ideal for difficult-to-access positions
- High operational safety & long service life
- Analog and digital outputs



induSENSOR LVP

Inductive displacement sensors to detect the clamping stroke

- Linear position detection with high accuracy
- High temperature stability
- Robust and compact design

optoNCDT 1420

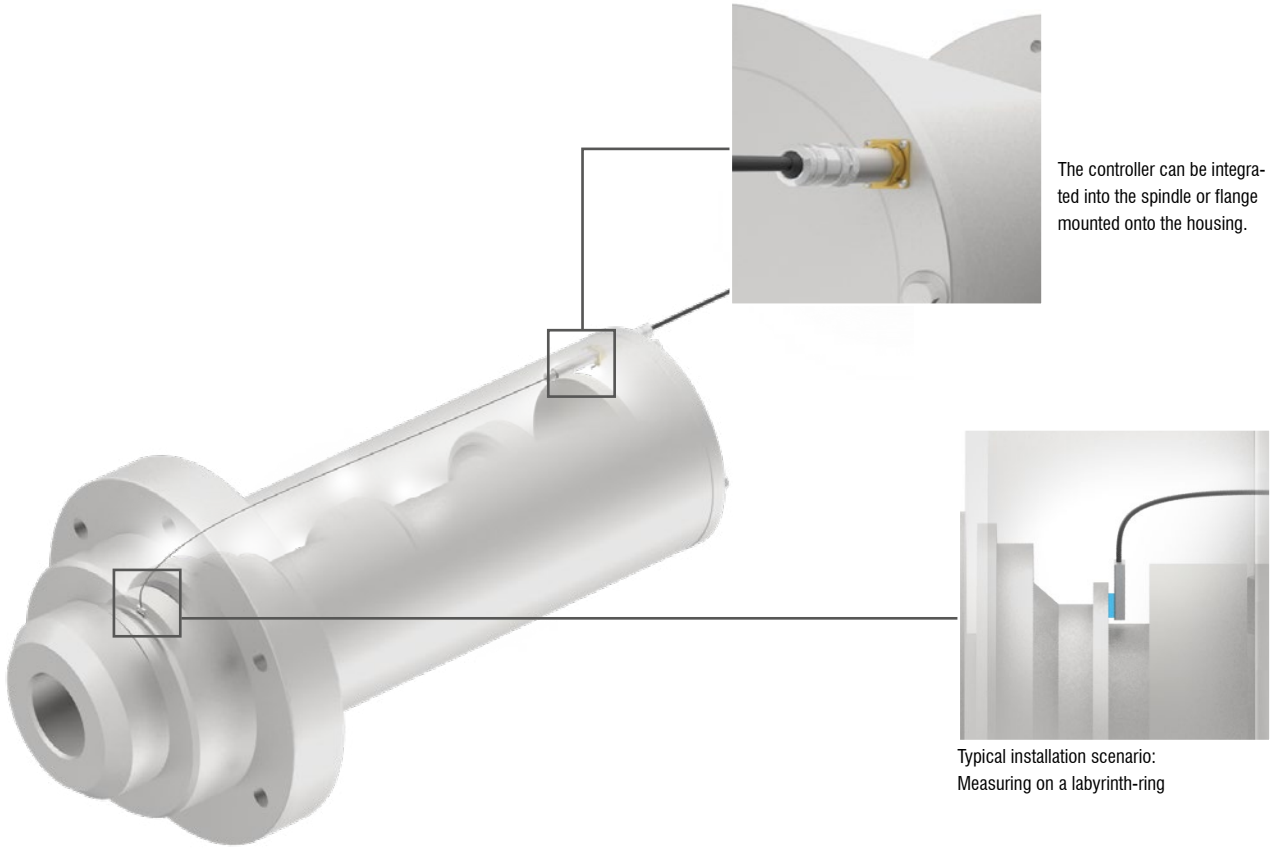
Compact laser displacement sensor for high speed, precision measurements

- Non-contact measurements with large measuring ranges from 10 mm to 500 mm
- High measuring rates for dynamic measurements
- Compact design and easy to install

Monitoring
length expansion

eddyNCDT SGS

- Cost-optimized design
- Miniature sensor design
- Miniature controller
- Sensor can be completely integrated into the spindle
- For ferromagnetic and non-ferromagnetic materials
- Sensor with integrated temperature measurement



The controller can be integrated into the spindle or flange mounted onto the housing.

Typical installation scenario:
Measuring on a labyrinth-ring

Measuring thermal length expansion of spindles

The SGS 4701 displacement measuring system (Spindle Growth System) is developed specifically for high speed milling machine applications. Due to high machining speeds and the heat generated, the linear thermal expansion of the spindle in the precision machine tool must to be compensated for in order to keep the tool in a defined position at all times. The SGS sensor measures the thermal and centrifugal force expansion of the spindle. These measurement values are fed into the CNC machine tool as correctional values, compensating for any positioning errors.

The SGS 4701 operates on the eddy current measuring principle. This non-contact measurement method is wear-free. Furthermore, the measurement procedure is resistant to disturbances such as heat, dust and oil.

System design

The SGS 4701 consists of a sensor, a sensor cable and a controller, factory calibrated for ferromagnetic and non-ferromagnetic measurement objects. Two miniature sensors enable it to be installed directly in the spindle, where the measurements take place, typically on the labyrinth-ring of the spindle. As well as measuring linear thermal expansion, the temperature of the sensor is also detected and output. The compact controller can be installed on the spindle housing via a flange or directly in the spindle.

Monitoring
the clamping position
of tools

Today, modern high-performance machine tools achieve accuracies in the micrometer range. Realizing these levels of precision requires all components to be perfectly matched - from the drive to the release device via the tool clamp to the tool itself.

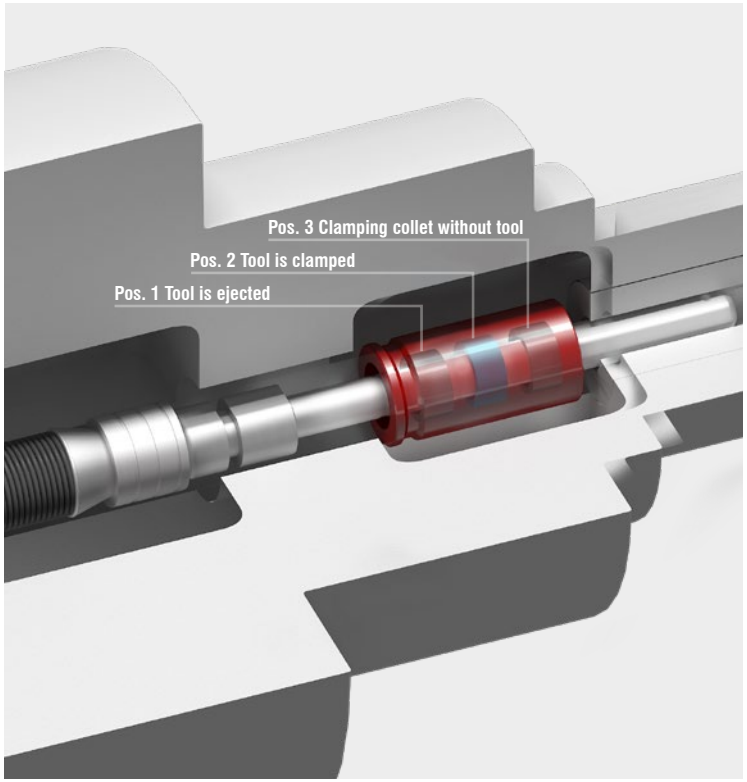
Since most of the components are permanently installed on the machine, the highest precision can only be achieved if these were installed correctly. Only the tool is changed with each new operation and so can cause critical deviations.

Particular attention should therefore be paid to the correct clamping of the tool in the holder. In any case, it needs to be detected whether the tool is correctly seated. When the position of the tool changes, this may result in poor machining quality, which would in turn lead to expensive workpieces that need to be scrapped. If the tool is tilted, it could become loose due to the high rotational speeds and cause a collision with other machine components.

Often, initiators and switching rings, which provide a switching signal, are used to monitor the clamping position. However, these require complex adjustment and set up. Analog sensors from the Micro-Epsilon LVP series offer significant improvements. The cylindrical sensor is integrated into the release device and directly measures the clamping stroke of the drawbar. On the drawbar, a ring is fastened, which acts as the target for the sensor.

The LVP sensor can be universally used with the most varied types of tool due to an extremely compact sensor design. The sensor supplies an analog signal according to the stroke motion of the drawbar when clamping the tool. Consequently, continuous monitoring is possible without the switching point having to be laboriously set mechanically.

The miniaturized sensor electronic unit can either be accommodated at the point of measurement or in the control cabinet. Thanks to its high accuracy, the LVP sensor contributes significantly to meeting the ever increasing demands on machine tool precision and availability.



induSENSOR LVP

- Short sensor design with a large measuring range (25 mm)
- Compact sensor for easy integration
- Non-contact and wear-free measuring principle
- No adjustment necessary
- High resolution

Tailstock position

wireSENSOR

- Robust draw-wire displacement sensors
- Displacement and position measurements with measuring ranges up to 30 m
- Analog and digital outputs
- Flexible measuring wire, ideal for difficult-to-access positions
- Compact design for integration into confined spaces

Position measurement of the tailstock

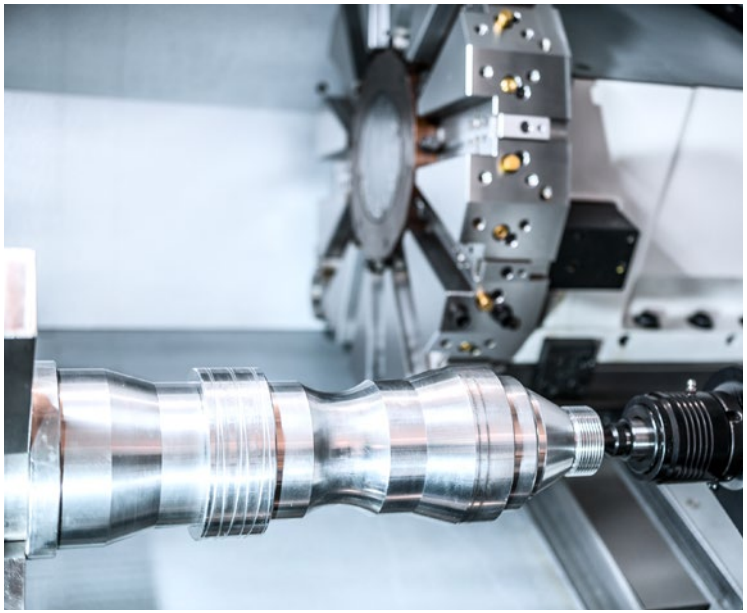
The tailstock is an important part of a lathe or milling machine. The tailstock is used to support long workpieces by means of a center, which catches in the center hole on the front side of the workpiece.

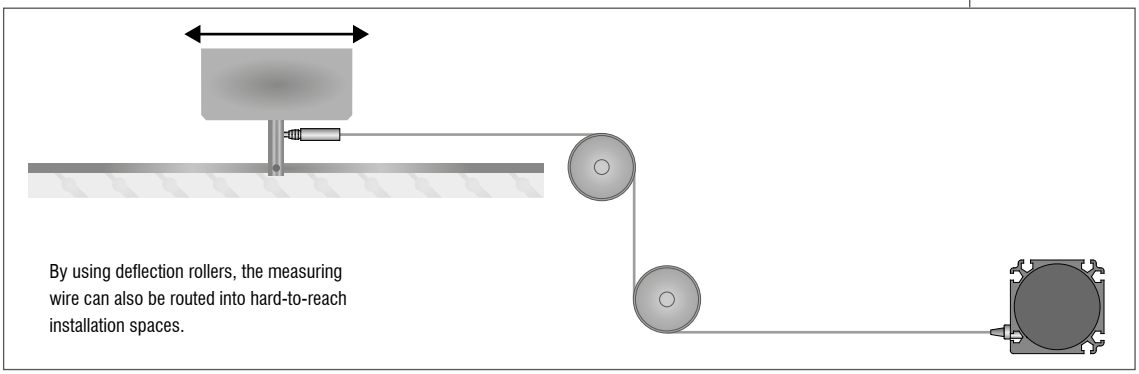
In order to detect the center tip, compact draw-wire sensors from Micro-Epsilon are used. The measuring wire is connected to the center tip and measures the displacement of the tailstock.

Compact draw-wire sensors

Draw-wire sensors offer outstanding price/performance ratios combined with compact designs. Due to their miniature design, the sensors can also be integrated into restricted installation spaces. Furthermore, the measuring wire can also be guided into difficult-to-access areas and can be deviated. Typically, sensors with measuring ranges from 300 mm to 2100 mm are used. Depending on requirements, larger measuring ranges can be selected.

Based on high-quality components, draw-wire sensors from Micro-Epsilon offer a long service life - even in continuous use under harsh industrial conditions. Either a robust plastic or aluminum housing protects the sensors from external influences. Depending on the signal connection, different output types are available.





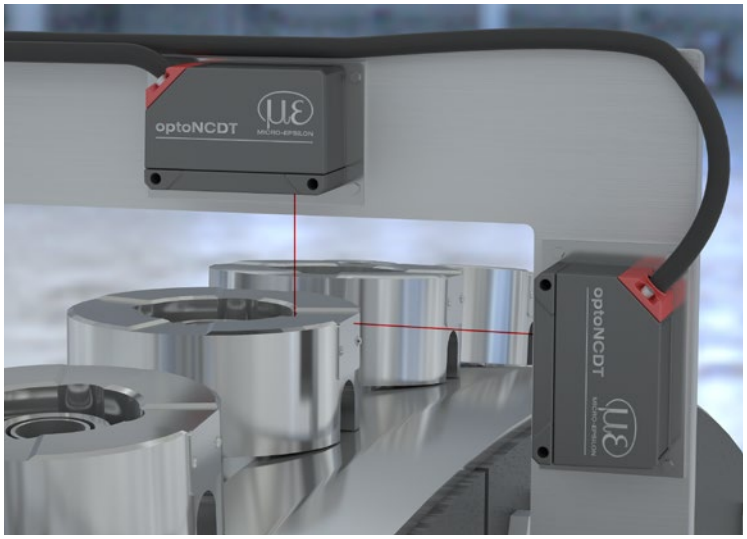
By using deflection rollers, the measuring wire can also be routed into hard-to-reach installation spaces.

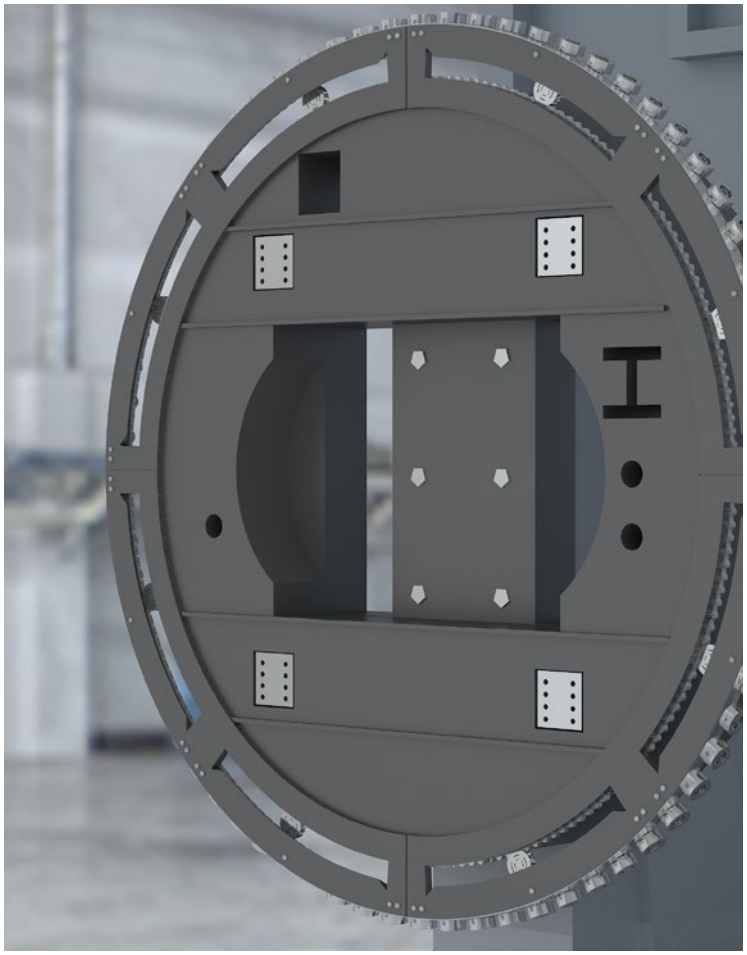
Measuring **tool holders**

Measuring tool holders in the magazine

Modern machine tools have complex magazines with various tools that are automatically picked up by the machine. In order for these tools to be accurately picked up, the tool holders must be precisely positioned.

To check the position of the tool holders, optoNCDT 1420 laser sensors are used, which measure the metallic holders from above and from the side. These smart laser sensors stand out due to their high measuring rates while providing precise measurement values, despite strongly reflecting, metallic surfaces.

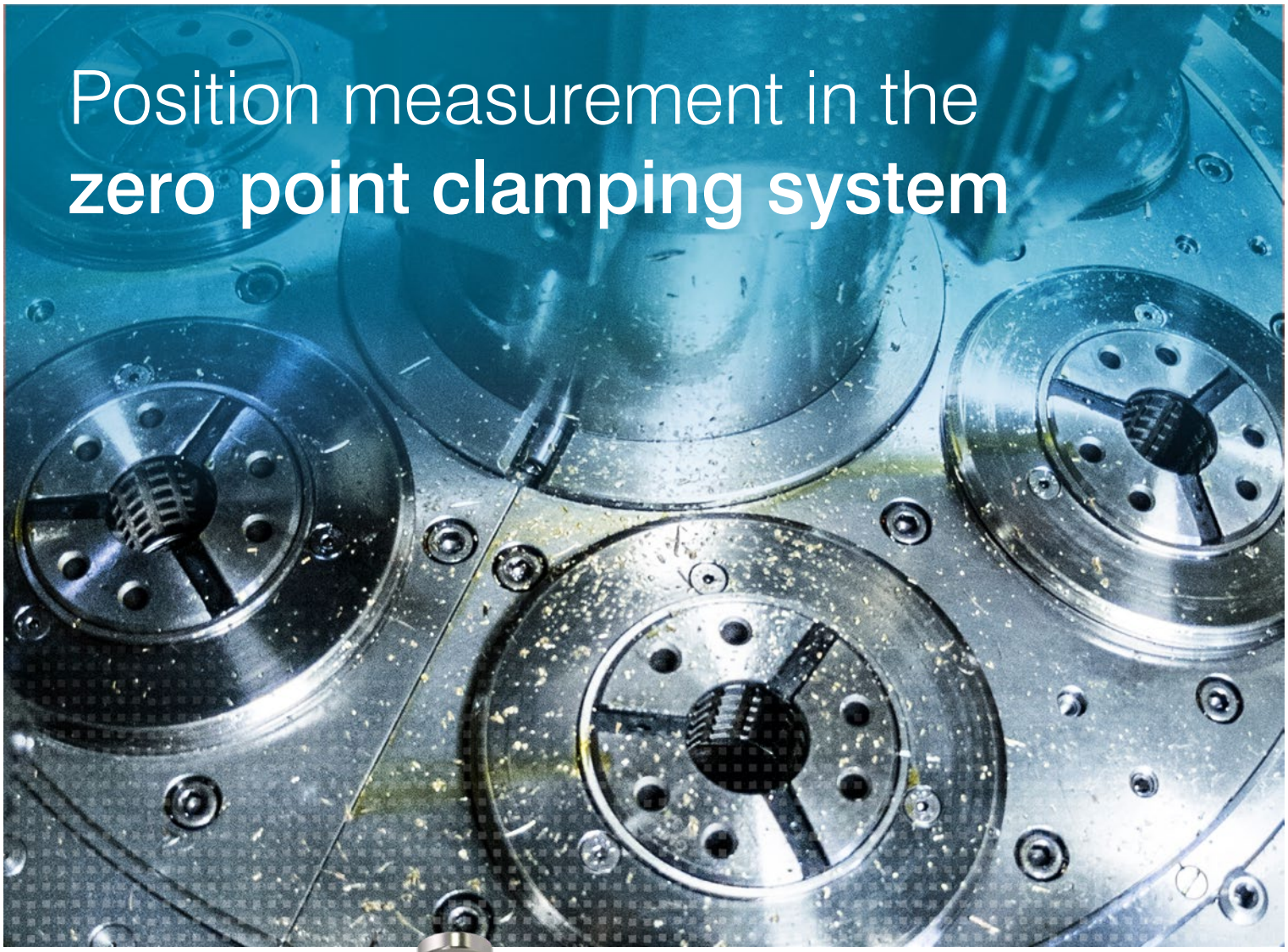


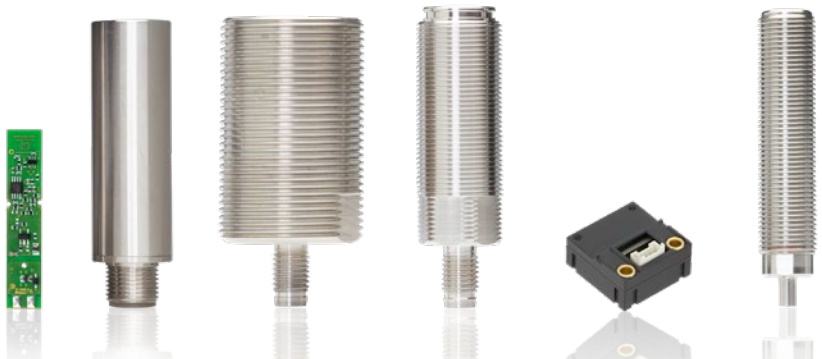


optoNCDT 1420

- Compact laser triangulation displacement sensor for high speed, precision measurements
- Non-contact displacement and distance measurements with large measuring ranges from 10 mm to 500 mm
- High accuracy
- High measuring rate for dynamic measurements
- Compact design and easy to install

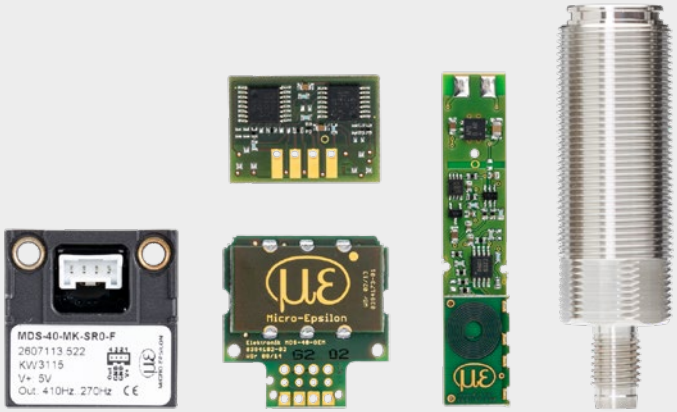
Position measurement in the **zero point clamping system**





mainSENSOR

- Magneto-inductive sensors for non-contact and linear displacement measurements
- Selectable measuring ranges up to 55 mm
- High basic sensitivity and temperature stability
- Non-contact and wear-free
- Available in any quantity



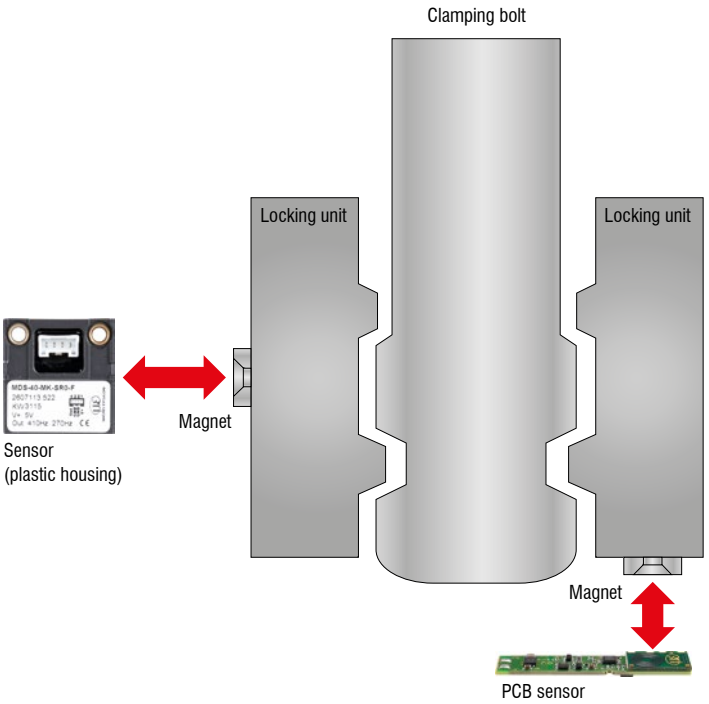
Magneto-inductive sensors are available in different variants. From the solid stainless-steel variant to the compact PCB model, the product range offers a suitable model for each operational site. The magnet determines the measuring range - the larger the magnet, the larger the measuring range (max. 55 mm).

Position measurement in the zero point clamping system

In modern machine tools, zero point clamping systems ensure reproducible positioning of the workpieces, clamping stations and workpiece carriers. The carriers are positioned via clamping bolts and then locked. Exact and reproducible positioning is a crucial factor for the safety and the quality of the processing work.

Magneto-inductive displacement sensors from Micro-Epsilon measure the position of the clamping cylinder. Inserting the clamping bolt into the cylinder causes the locking unit to move. The position of the lock provides information on whether the clamping bolt fits accurately. A magnet attached to the lock acts as a measurement object for the sensor. The sensor permanently measures the magnet's movement and transmits this to the control system.

Miniaturization and cost efficiency are two central requirements that sensors in clamping systems must fulfill. Magneto-inductive sensors from Micro-Epsilon are available in miniature size or as a PCB solution for high quantities. Particularly in serial applications, the mainSENSOR series impresses with an excellent price/ performance ratio.



Measuring the **spindle runout**

eddyNCDT 3005

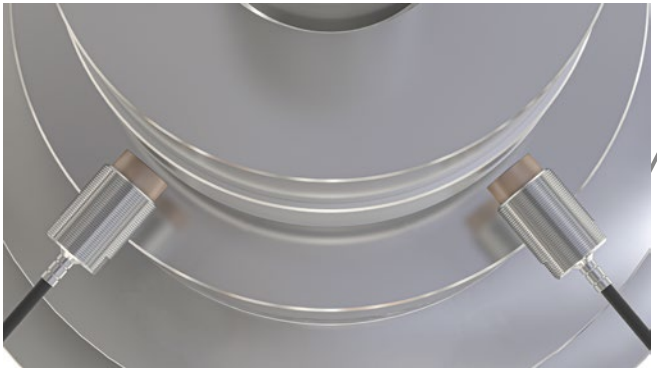
- Inductive sensors (eddy current) for displacement, distance, position
- Non-contact displacement and distance measurements with measuring ranges from 1 to 6 mm (customizable)
- High frequency response for dynamic measurements
- Insensitive to fluctuating temperatures
- Pressure-resistant models up to 10 bar (also available for higher pressures as customer-specific sensors)
- Resistant to oil, dust & dirt

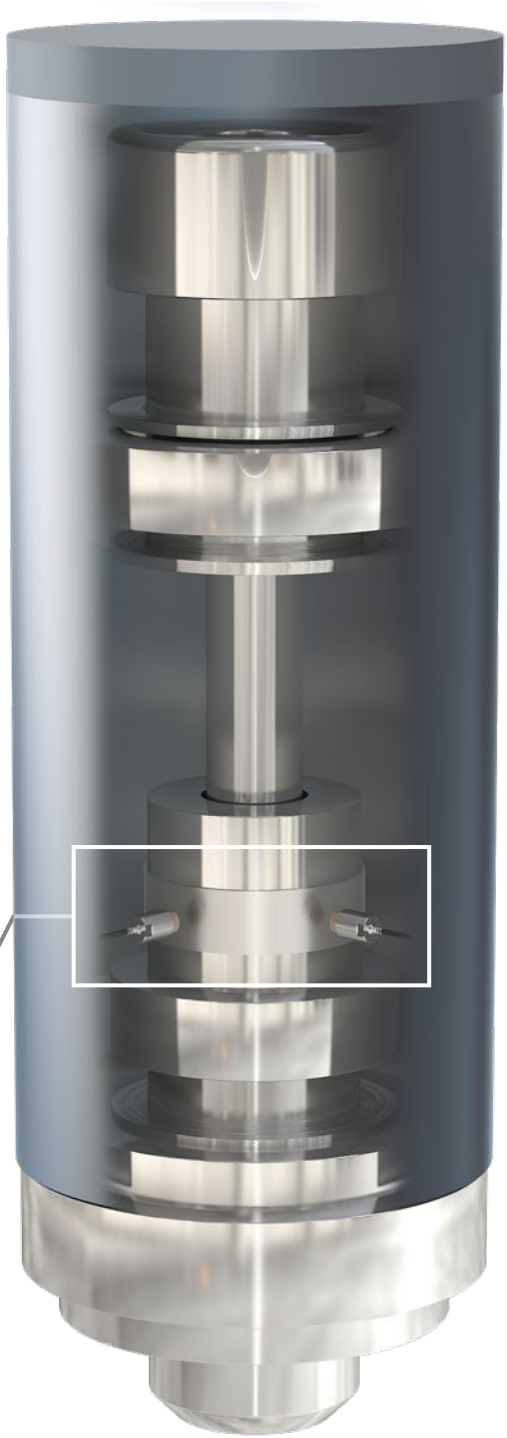
Concentricity/Shaft runout of spindles

Many factors influence the processing quality of machine tools. Particularly in high-frequency spindles, the accurate concentricity or shaft runout of the tool play a decisive role.

Non-contact, inductive displacement sensors from Micro-Epsilon are used for continuous monitoring of concentricity or shaft runout. Based on the eddy current technology, these sensors provide extremely high resolution even when oil and dirt contaminate the installation space. This is how the measurement accuracy in the micrometer range is achieved. The high frequency response even enables the monitoring of high-frequency spindles with rotational speeds > 120,000 rpm.

The measurement process involves the eddyNCDT 3005 measuring system, which is ideally suited to non-ferromagnetic targets. The measuring system performs a non-contact measurement onto an aluminum ring which is shrunk onto the axis. Two sensors shifted radially by 90° measure the distance from the spindle in order to transmit the values to the control system. Due to their high temperature stability, the sensors provide reliable measurement results even when surrounded by fluctuating ambient temperatures.

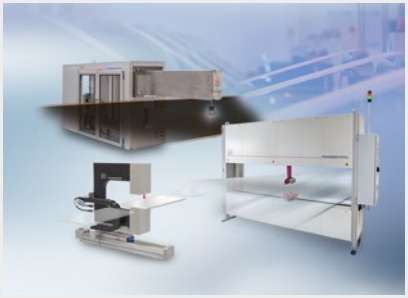




Sensors and Systems from Micro-Epsilon

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.

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