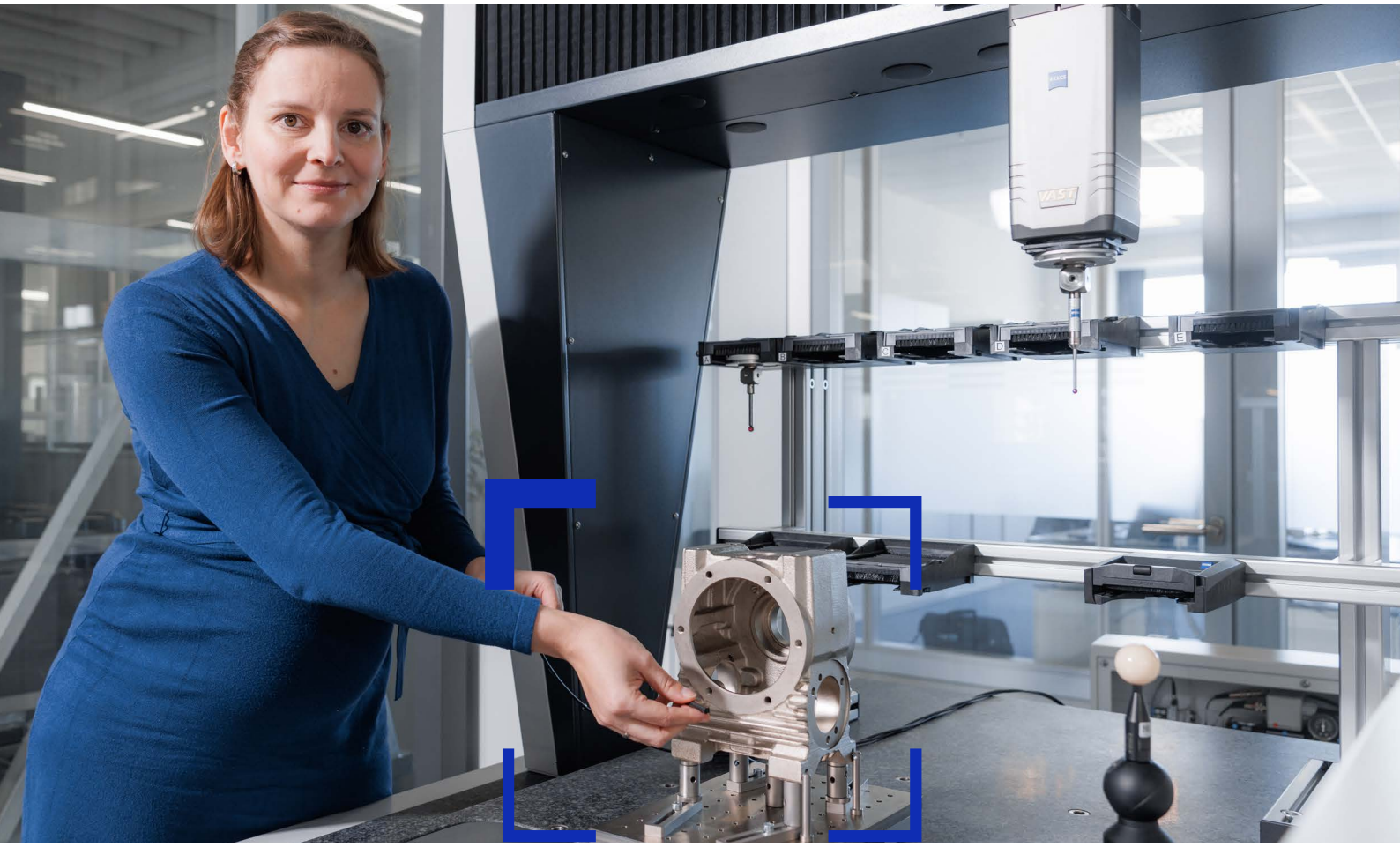
Seeing beyond

ZEISS Metrology Expert Tip



Detection of Workpiece Temperature

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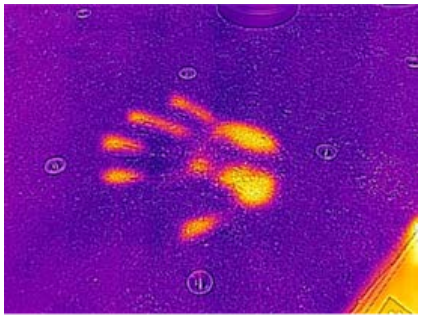
Temperature Influences on the Measurement Result

One of the biggest influences on the measurement result is not visible to us – temperature. Whether it is the ambient temperature, the temperature of the machine, the workpiece to be measured or accessory components, temperature influences all components involved in the measuring process.



Coefficient of Linear Expansion

In particular, the different behavior of materials with temperature changes plays a significant role. The decisive factor here is the so-called coefficient of thermal expansion, which describes how strongly a material expands with increasing heat. The higher this coefficient, the greater the expansion of the material. In terms of machine and accessories, ZEISS products are already optimized for temperature changes and guarantee the best possible measurement results when used accordingly. The material and therefore, the temperature behavior of the workpiece is predetermined and cannot be changed. The workpiece therefore has a considerable influence on the the measurement results, as temperature changes affect the component geometry and thus the dimensions depending on the material. In particular, a change in temperature during the measurement has a negative effect on the measurement results and should therefore be avoided wherever possible.

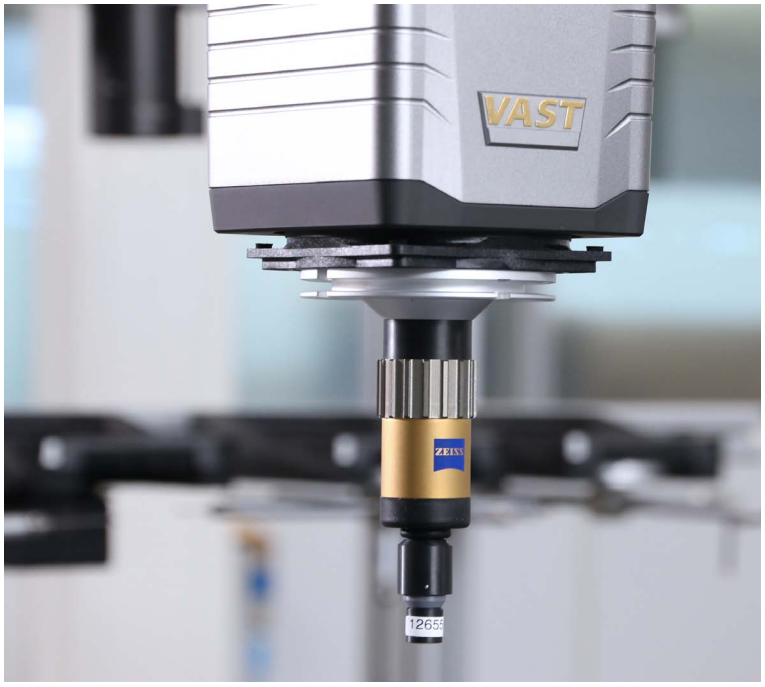
Coefficient of linear expansion

Material	alpha in 10^{-6}/K at 20 degrees
Aluminium	23,1
Diamond	1,2
Iron	11,8
Glass	8,5
Carbon fiber	~ 0,0
Invar	0,6-1,2
PVC	52
Silicon	2,6
Steel	11,0-13,0
Technical ceramics	2,0-13,0
Titanium	8,6
Tungsten	4,5
Zerodur	0,0-0,1

Digital Recording of the Temperature

Recording the temperature and offsetting it with the measuring points is therefore essential. This becomes important the more the actual temperature deviates from the target temperature of 20 °C. This calculation of the temperature data is called temperature compensation, whereby the measured values are calculated back to the theoretical value at 20 °C using an algorithm. Or in other words, the changes in the geometry of the component temperature deviations are taken out of the measurement result.

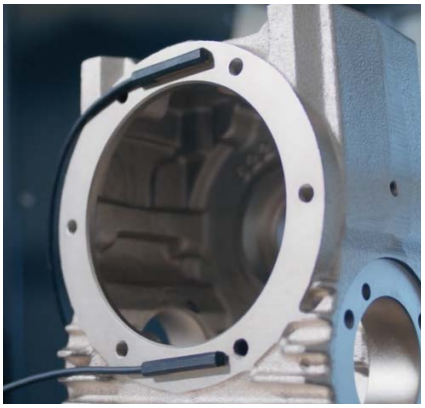
In order to use the temperature compensation functionality, the temperature must be measured as accurately as possible. The digital temperature measurement ensures this and automatically transfers the values to the measuring software. Up to 6 temperature sensors can be connected to the system. Different types of the sensor allow reliable attachment to different workpieces and materials and can be exchanged flexibly at any time. In addition, the sensor contains essential metadata and is resistant to environmental influences.
Compared to using the RST-T measuring head, the measuring time can be significantly reduced, as the use of a separate sensor, a probe change can be avoided.



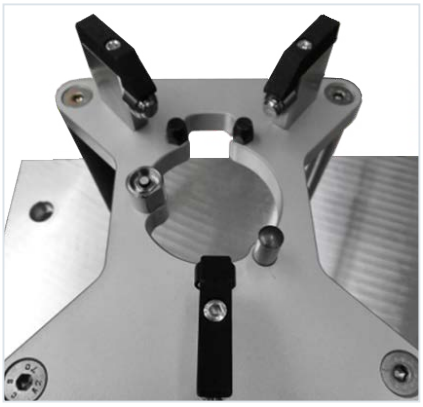
ZEISS RST-T sensor on ZEISS VAST probe head

Sensor Types for Different Applications

ZEISS offers various sensor types for different applications as an alternative to the magnetic sensor. These digital sensors can be easily integrated into individual holders (e.g. in clamping fixtures). Or – if you are not using one - handle with an articulated arm. The clamp-on sensor, which can be attached to thin surfaces, offers more flexibility.



ZEISS temperature sensors for magnetic components.



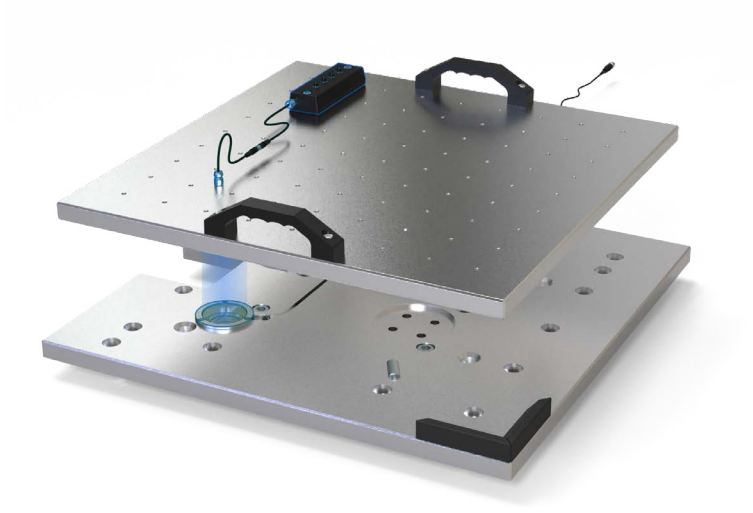
Clamping device with built-in temperature sensors

Workpiece temperature measurement with articulated arm.

The clamp-on sensor, which can be attached to thin surfaces, offers more flexibility.

Inductive Interface for Pallet Systems

The optional inductive interface for ZEISS pallet systems enables automatic contacting and recording of the temperature when changing workpieces and can therefore reduce set-up times.



At an ambient temperature of 20 °C and a workpiece temperature of around 20 °C, it is very difficult to distinguish between the emitting and reflecting parts of the radiation. The emission depends not only on the temperature, but also on the surface texture, color, roughness, etc. This means that the measurement error is high.

Tip: Non-Contact Temperature Detection

Every (measuring) body can emit radiation and reflect radiation.

Metal surfaces have a low emissivity, but high reflectivity for infrared radiation.

Therefore, non-contact temperature measurement is far too inaccurate for workpiece temperatures below 50 °C.

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