OptoWorm

opto surf

Surface Measurement of Worms

Optical Measurement

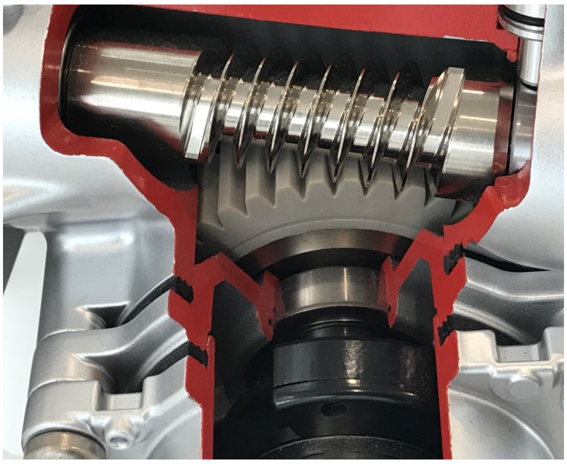
- Roughness
- Waviness

Measuring machine for recording roughness and waviness of worm flanks in the production environment for quality assurance and tool monitoring .

Application

In a worm gear in steering systems, a motor-driven worm moves a plastic gear wheel and thus supports the effort required to steer a vehicle. The aim is to transfer the electrical power of the gear into the mechanical movement of the rack with a high degree of efficiency. This should be the same in both steering directions and should not make any audible noises.

It is known that the surface of the worm causes friction losses and, if there are still waviness on the surface, can also cause noise. Since there was previously no reliable measuring devices with which one could measure the friction properties and the waviness, the OptoWorm measuring machine was developed .



Worm gear

Roughness Measurement with scattered light

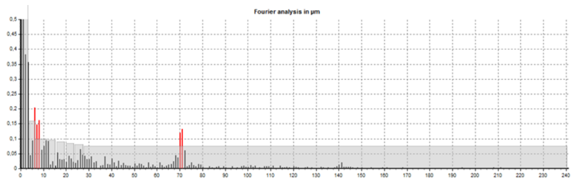
The scattered light method (VDA 2009) measures the slope distribution of the microstructure angle with its special parameter Aq. It is known that the distribution of the slope also directly describes the friction behavior. The advantage of the OptoWorm measuring machine is the fast data acquisition of up to 2000 Aq measurements / s, so that several paths can be measured on the entire helix between the base and head circle. This makes it possible to describe the smoothing process (e.g. burnishing) and to carry out quality assurance.

Above: Roughness along the entire helix milling

Below: Roughness after burnishing.

Waviness measurement

If the preprocessing is milling, grooved structures are created on the surface. These should then disappear after a burnishing process. But the waviness does not always disappear so minimal ripples in the sub-micrometer range remain, which lead to noise. The scattered light method also allows these ripples (waviness) to be measured precisely by scanning the helix path with a small measuring spot. With the help of an FFT analysis, both the number of waves and the amplitude can be calculated.



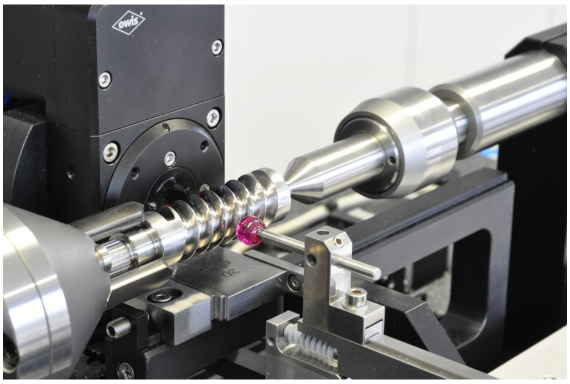
Waviness with FFT analysis.

OptoWorm

Specifications

Measurement procedure

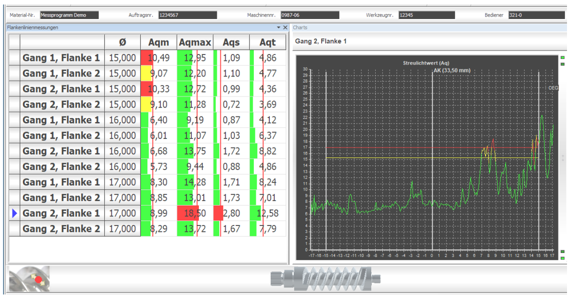
The worm is placed in a holder and fixed with the help of a mechanical or optionally a pneumatic clamping device. With the help of a barcode scanner, the screw type is identified and the correct measuring program is called up. A mechanical ball device ensures the correct orientation of the inserted screw. The measuring beam is automatically aligned perpendicular to the screw flank with a mirror and moved along the surface line. Both flanks can be measured by swiveling the mirror. The number of profiles on certain diameter can be free selected in the measuring program.



Worm between centers and the ball device. Behind is the sensor with the mirror rotation module.

Data evaluation

The data are all saved in an SQL database and can be exported if necessary (q-das). The output of a good and bad measurement (traffic light) is intended for quality assurance. For the production-related measurement, programs with the respective Aq drawing values are defined for each screw type and called up automatically via the presettings.



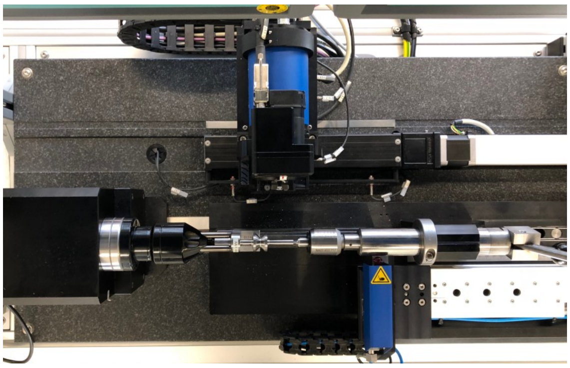
Display of the measurement program. Green marked OK values and red marked bad values.

Calibration procedure

The sensor and the measuring system do not have to be calibrated in normal operation. The use of nickel-plated master parts (screws) is recommended for regular functional checks. OptoSurf issues a test certificate for this.

A clampable standard supports the calibration of the measuring device and ensures correct positioning of the sensor and the mirror attachment.

The sensor can be calibrated using a standard certified according to ISO 17025.

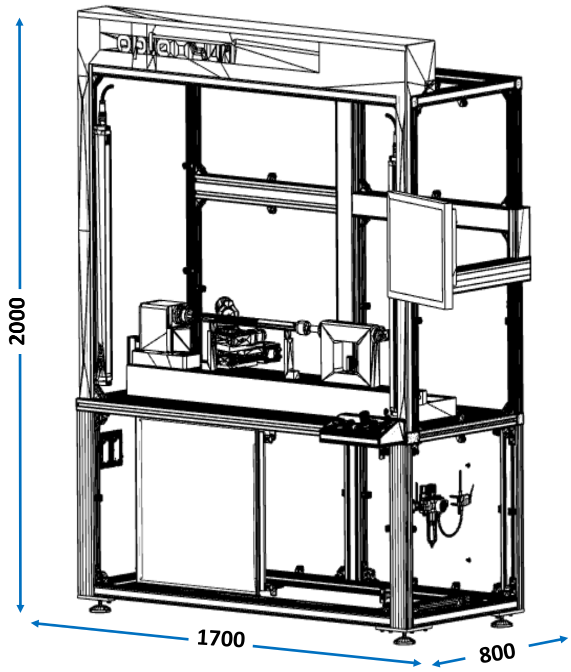


Measurement of the standard for the alignment procedure

Specifications

SYSTEM

Measurement parts	Worms for steering systems
Measurement principle	Scattered light acc. to VDA 2009
Light source	LED 670 nm mit 0,9 mm spot , switchable 2. spot with ∅ 0,03 mm (Laser c1)
Measurement values*:	Roughness Aq, Waviness FFT-Analysis
Measurement speed:	Sensor: 2.000 measurements / s worm orientation: 10 s, 2 s (optional)
Accuracy:	Roughness: acc to Ra < 0,002 µm Waviness: < 0,02 µm
Axes:	CNC axes Rotary axis Excenter < 1 µm
Sensor movement	Rotation module for mirror, accuracy < 0,01°
PC	Industrial -PC fanless (Win 10)
Power:	230V / 50 Hz, 1 kVA
Data Export:	qs-Stat
Calibration:	Sensor CS 3 kit with ISO 17025 certificate; Master piece and alignment standard



* Measurement values

Roughness	The roughness value Aq is recorded permanently. The roughness is measured both in the running direction and across the running direction. The mean value (Aqm), the standard deviation (Aqs) and the maximum value (Aqmax) are calculated.
Waviness	ISO filters are used for waviness measurement. The amplitude spectrum is represented by an FFT. Smallest measurable wavelength: 0.04 mm