INNOVATORS OF INERTIAL ALIGNMENT

PRÜFTECHNIK

PARALIGN®

Roll alignment – now faster and more precise

The first inertial parallelism measurement system

Faster and more exact
PARALIGN® is an inertial measurement system that enables –for the first time– the parallelism of rolls or other structures to be measured without involving a lot of time, but with a high degree of precision and reproducibility.

How does PARALIGN® work?
PARALIGN® contains three perpendicularly arranged, highly-precise ringlaser gyroscopes as used in aircraft and spacecraft. Just like a spinning top, the ringlaser gyroscopes have an inherent inertia, i.e. they tend to resist any attempt to change the orientation of the rotational axis in space for a certain length of time. If PARALIGN® is then placed on the reference roll, it first "learns" its position in space and then compares this with the changes in direction that result when it is moved onto the roll to be measured. The deviations are measured and converted into correction values.

The PARALIGN® housing contains three high-precision laser-gyroscopes

PARALIGN® advantages:

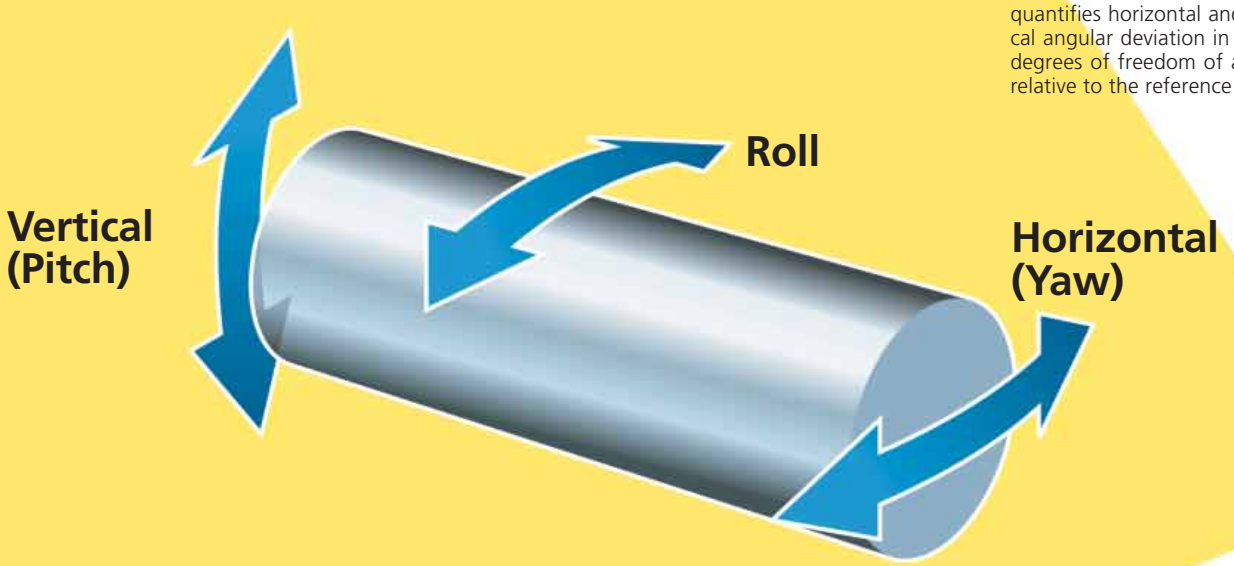
- **Setup takes only a few minutes**
- **Ready to measure immediately**
- **Resolution of 4µm/m (4µrad) !!**
- **Compact dimensions, low weight**
- **Graphic measurement report + documentation**
- **Patented 'Sweep' measurement procedure fits all roll diameters**

U.S. patents 6,195,615 and 6,591,218.
Other patents pending.

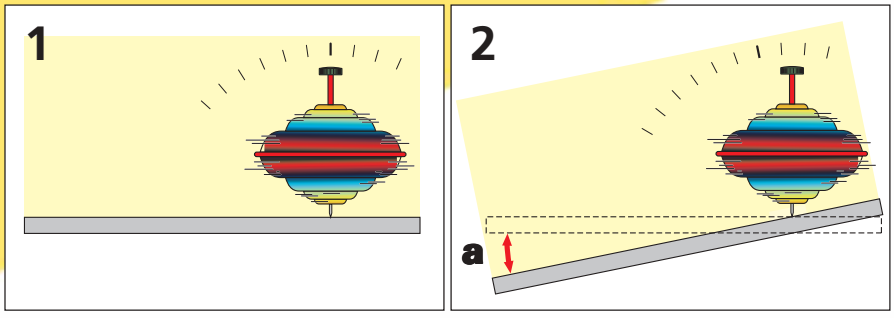
Rolls must be parallel

Cylinders and rolls in printing presses and paper machines, calanders and rolling mills need to be positioned parallel to one another with regard to their axis of rotation. Since the position of each roll is determined in space by 6 degrees of freedom, the precise alignment of all rolls to one another within a stand becomes a complex task. At the latest during bearing replacement or overhaul, the original alignment configuration is lost; Alignment corrections then frequently follow on a "trial and error" basis and are extremely time consuming.

PARALIGN® measures and quantifies horizontal and vertical angular deviation in the six degrees of freedom of a roll – relative to the reference roll.



From spinning top to parallelism measurement



A spinning top has so-called inertia and resists any attempts to change the orientation of its rotational axis in space. If the surface on which it is spinning is tilted - as shown in the graphic - the axis of the top remains stable and the inclination angle a can now be measured.
Precisely this spinning top principle is also used in PARALIGN®: Inside, three high-precision laser gyroscopes are arranged perpendicular to one another. Each of them is responsible for the relative rotation of a single spatial axis.

How are parallelism measurements currently done?

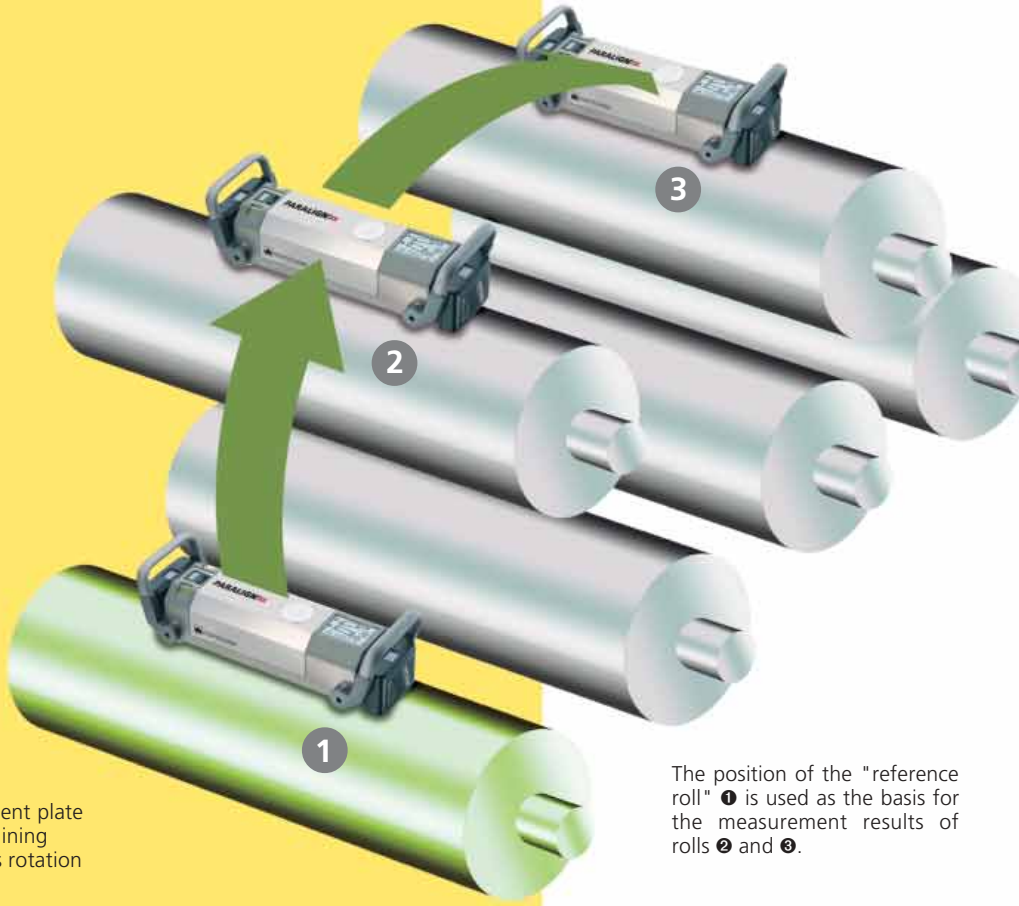
Theodolites, measurement telescopes, alignment telescopes, autocollimators and similar instruments are the traditional means of measuring the condition of rolling mills. Typically a datum line is set up along the machine by means of a laser beam, and bending mirrors and pentaprisms are used to determine the deviation from the perpendicular.
These classical measurement techniques frequently provide less than exact results because of the inaccuracy inherent from the optical errors due to thermal bending of the laser beam on the mirrors, and due to temperature fluctuations affecting the laser beam used for the datum line.
The lack in accuracy becomes apparent if measured values from both sides of the roll (drive side and non-drive side) are compared. The differences in alignment values are often dramatic. Traditional methods also necessitate considerable down times of the system to be measured - both for setting up and adjusting the measuring instrument as well as for determining any deviations.

Measurement examples:
1. Roll parallelism

Measurements with PARALIGN® require very little setup time – PARALIGN is ready to measure as soon as the system stops! This means that measurements and alignments of individual rolls can be performed, on a paper machine for example, during brief shut-downs for cleaning or felt replacement. This is an unprecedented benefit which applies just as well to steel and nonferrous rolling mills where downtimes have to be restricted to the few hours when the material is changed.

[1] The "reference roll" does not have to be a roll. Ideally, a calibration plate is attached close to the machine, which is used by the PARALIGN® as a reference and can remain in place for later measurements. PARALIGN® is "zeroed" on the calibration plate before beginning measurement, i.e. the laser gyroscopes are adjusted for the earth's rotation.

Measurement plate for determining the earth's rotation



The position of the "reference roll" ❶ is used as the basis for the measurement results of rolls ❷ and ❸.

Ready to measure as soon as the system comes to a stop!

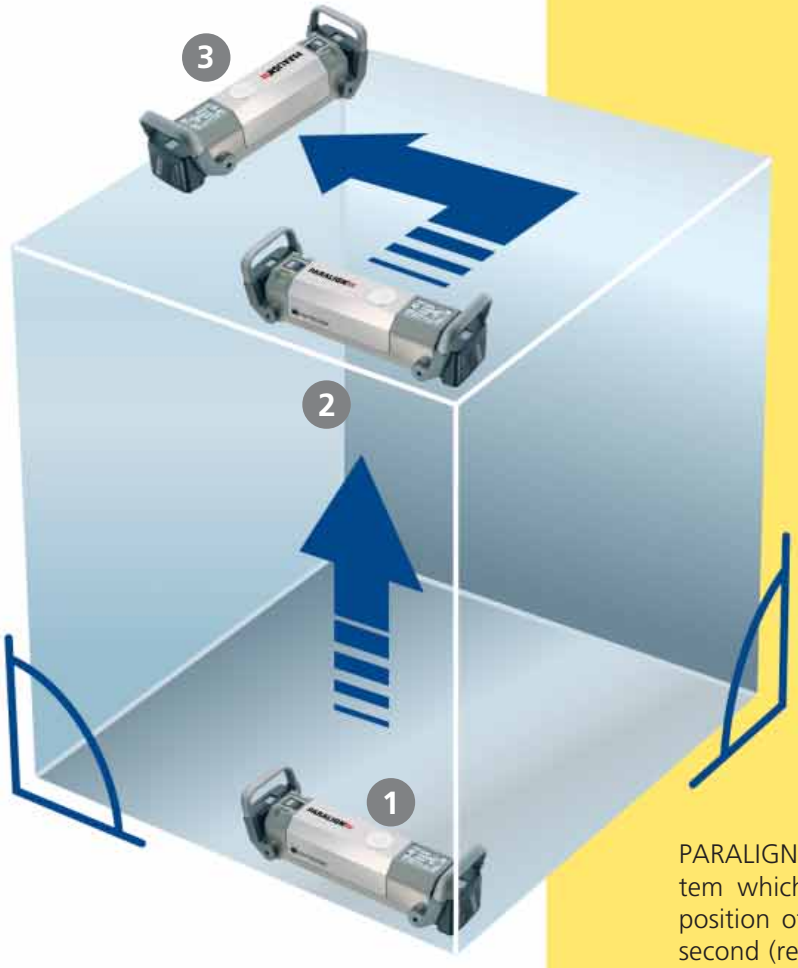
How it's done – step by step

In order to determine whether several rolls are positioned parallel to each other, PARALIGN® is first placed on the "reference roll[1]" ❶ and zeroed by pressing the button. The measurement system is then simply placed on the roll to be measured ❷ and –after a few seconds– the deviation from the reference roll can be read – simultaneously displayed as the main degrees of freedom of a roll: pitch and yaw. The third roll ❸ is then measured, etc.

PARALIGN® Alig

At the moment Qualified Service Centers of the PRÜFTECHNIK group offer and carry out the PARALIGN® Alignment Service in many European countries – from the alignment of individual rolls to the first-time alignment of entire machine systems. The purchase of

2. Plane parallelism and right angles



The "reference surface" ❶ is used as the basis for the measurement results of the structural parts ❷ and ❸.

PARALIGN® is a measurement system which compares the relative position of a body with that of a second (reference) body. The bodies may also be physically separated because, once the reference has been stored at the start, even objects that are spatially far apart, e.g. other rotating bodies or other construction elements or structures, can be measured (although subject to time constraints). Line of sight to the new object to be measured is not necessary –any more than other measuring aids (e.g. laser beams). PARALIGN® is simply carried to the next object and placed there for the next measurement.

Unlike all classical measurement techniques, this measurement system is exceptionally fast - and provides the highest level of reproducibility.

Naturally, PARALIGN® can also be used to measure right angles or any other angular deviations.

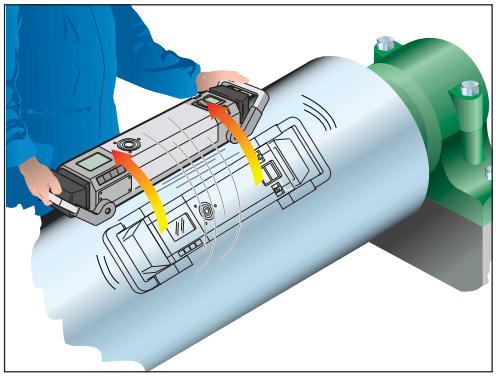
gnment Service for your machine

a PARALIGN® would be practical for those customers where a large number of measurements are carried out frequently, e.g. roll manufacturers.

Please direct queries regarding parallelism measurement to:
PRÜFTECHNIK AG
Tel. +49 (0)89 996160 oder
eMail: info@pruftechnik.com
More information and a request form are available on the Internet under www.paralign.de.

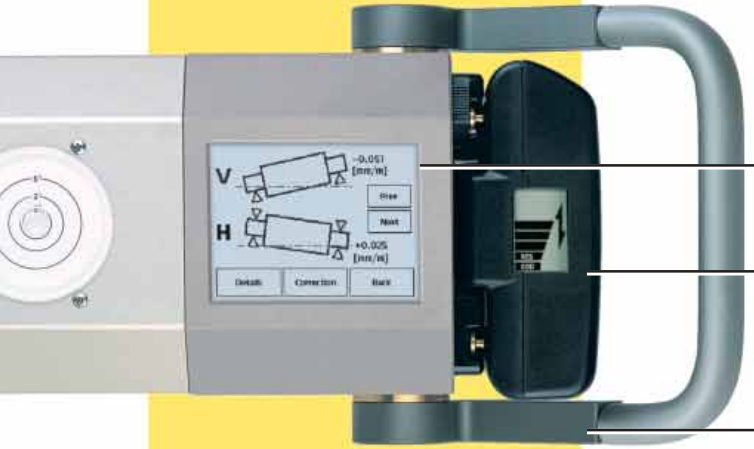
PARALIGN® method – the patented 'sweep'

Early trials with prismatic contact surfaces or special three-point supports did not achieve the required precision and, consequently, often resulted in insufficient reproducibility. Also, prismatic contact surfaces proved to be unsuitable for large roll diameters.
The final foot design is not actually a 'foot' at all: PARALIGN® now has two hardened rails on its underside which it uses to slide tangentially along the rolls during measurement. This short distance or 'sweep' then triggers a patented, mathematical calculation to arrive at the exact result.
Thanks to the sweep measurement method, it is not necessary to position PARALIGN® absolutely tangential to the roll. Even if it is positioned at an angle, an exact and reproducible result is achieved.



'Sweep' measurement: To record the measured values PARALIGN simply slides a short distance along the surface while the roll is stationary.

Detailed view



LCD display with touchscreen

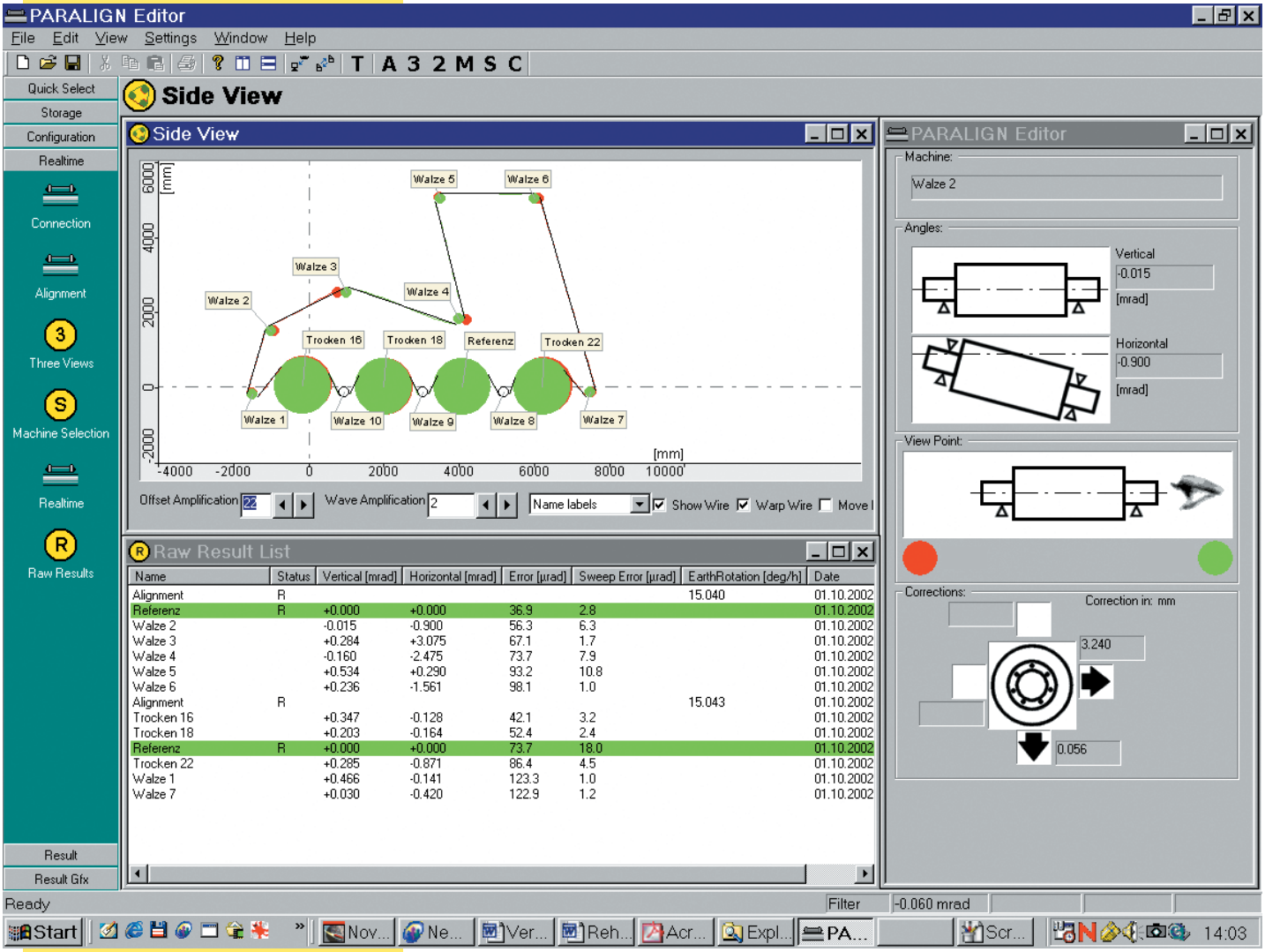
Rechargeable battery with charge indicator

Hinged handles

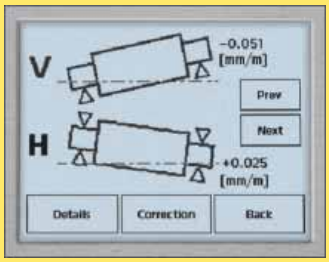
Wireless communication

PARALIGN can communicate remotely with the PC or Laptop (Bluetooth technology).
So completed measurements can be downloaded from PARALIGN onto the PC - or measurements can be displayed in real-time on the PC.
If Bluetooth transmission is not possible, a transmission cable can be used instead.

Operation via voice control
If it is difficult to operate the touchscreen in particularly cramped spaces, the PARALIGN® is very easy to operate by voice control.



Your results on the screen



PARALIGN display
The PARALIGN display shows measurements, simple graphics and operating instructions.

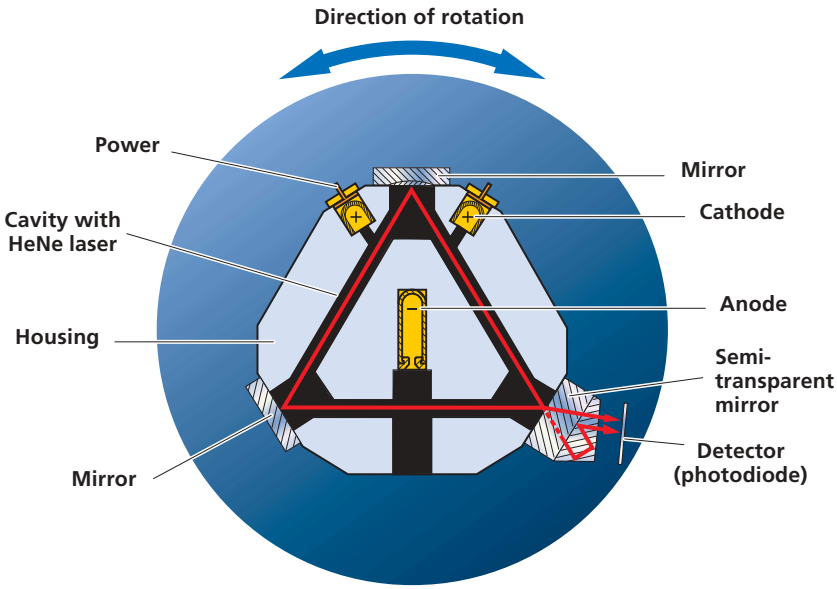
PARALIGN PC software
The display of the measurement and correction values in the PARALIGN® PC software is extremely clearly arranged and easy to interpret (see figure above). The deviations of the rolls are immediately obvious from the graphic. The necessary corrections for each individual roll appear on the display (at the bottom right of the screen-shown above).
The PARALIGN PC software provides a number of options for evaluating, displaying and archiving measurements.

MS EXCEL export
All measured data and results can be exported to an MS EXCEL file.

For our inquisitive readers:

How the ringlaser gyroscope works

The measurement principle of the ring laser gyroscope is based on two laser beams that are deflected by three mirrors along a triangular route. One beam runs in a clockwise direction, and the other counterclockwise. As long as this construction remains at rest, both laser beams require exactly the same time for the cycle. If, however, the system is rotated, the rotational path for one of the two laser beams is then shortened, while the path of the other beam lengthens. From the differences in the travel time of the two beams, the smallest rotation angle can be measured.



Technical Data

Measurement range	360° around all 3 axes
Resolution	4µm/m (0.00027°)
Linear deviation	< 16 µm/m (0.001°) for 1 min.
	< 28 µm/m (0.002°) for 5 min.
	< 44 µm/m (0.003°) for 10 min.
Drift (bias)	0.003°/h
Scale factor error	10 ppm
Noise (Random Walk)	< 0.003°/√h
Self-test	automatic
Housing (L x W x H)	approx. 680 mm x 180 mm x 125 mm (with batteries and handles)
Weight	7.9 kg (without batteries) 9.8 kg (with 2 batteries)
Battery (L x W x H)	approx. 135 mm x 55 mm x 90 mm
Battery weight	0.95 kg
Operating temperature	-20°C to +70°C (+22°F to +184°F)
Shock resistance	50 g, 11 ms
HeNe laser power	< 1.0 mW
Voltage	11-18 V
Power consumption	approx. 20W (1.4 A @ 14 V)

Visit us at www.pruftechnik.com

CE Printed in Germany ALI 9.626.03.03.2G

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