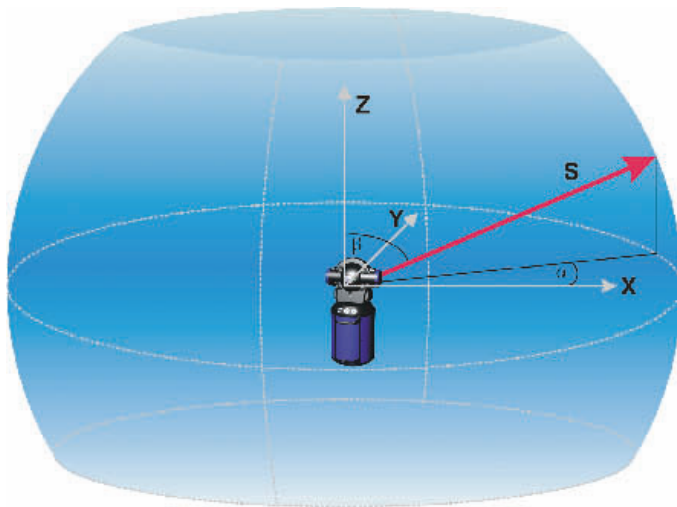


## Challenge

The instrumental measurement uncertainty of lasertrackers depends on a multitude of error contributions. This includes:

- Errors of all three measuring axes for length  $s$ , horizontal angle  $\alpha$  and vertical angle  $\beta$ ,
- Rectangularity deviations of rotational axes,
- Centricity deviations of axes,
- Nonparallelism and displacements between mechanical and optical axes,
- Deviations of retro-reflector and hand-held probe.



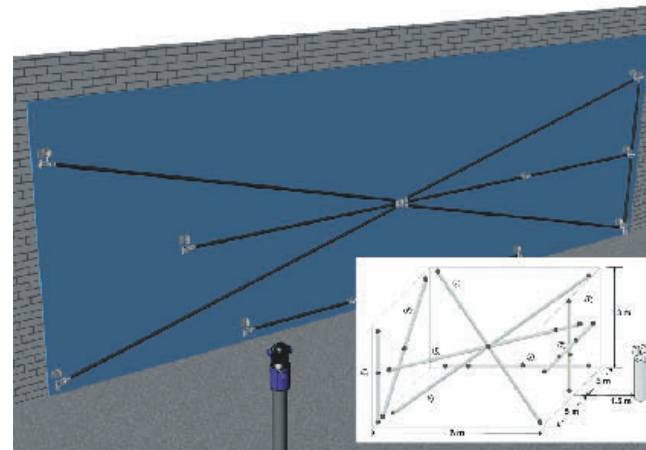
Spherical measuring volume of lasertrackers

Depending on the position of the measured point, the above-mentioned deviations superimpose differently so that a statement regarding the measurement uncertainty is hardly possible on the basis of the single deviations.

A simple method for verifying the accuracy of a lasertracker is to perform measurements on calibrated reference artifacts.

## Realization

For this purpose, a measuring and test location for lasertrackers is at present being established at PTB. The main item of the location will be a so-called “reference wall” consisting of length standards of up to 12 m in length. These reference lengths are made of temperature-stable CFK artifacts which are strainlessly attached to a wall. The reference lengths are measured from different lasertracker positions.



Reference wall

The verification of lasertrackers follows the well-known DIN EN ISO 10360 standard for acceptance tests of classical coordinate measuring machines and informs about the compliance with the maximum permissible length error MPE  $E$ . Performance and evaluation of the measurements are specified in the new VDI/VDE 2617-10 Guideline (under preparation).

A planar arrangement of the reference lengths facilitates the performance of measurements. Due to the changing positions of the lasertracker, the verification is equivalent to a three-dimensional measurement setup with a measuring volume of 10 m x 6 m x 3 m, consisting of spatially distributed reference lengths in different positions and orientations (see above figure, lower right).

## Benefit

The measurements at PTB’s “reference wall” allow the metrological performance of lasertrackers to be verified in compliance with the standards and under application-oriented conditions.

During the verification of the lasertrackers, all measuring axes constantly interfere. This ensures that all metrologically relevant error influences (e.g. deviations of single measuring axes, imperfections of adjustment of system components) are reflected proportionally in the result of the verification measurement.

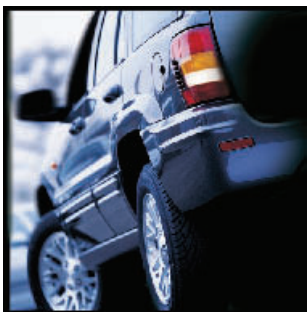
With the “reference wall”, users of lasertrackers are for the first time able to test the metrological performance according to a standardized procedure independent of manufacturers.

Service providers as well as users of lasertrackers will be able to use the “reference wall” installed at PTB to verify the specified accuracy of their own lasertrackers or of the lasertrackers of third parties and to determine the uncertainty of length measurement of the system under shop-floor environmental conditions.

## Task

Lasertrackers are mobile 3D coordinate measuring systems which are used in various sectors of industry (engineering, automotive industries, aviation and space industry) for the verification of large workpieces considering their measure, form and position. Today there is no method by which the user can verify the metrological performance of laser trackers. With the assembly of a high-precision “reference wall”, this deficiency is solved.

With the aid of the new measuring and test location, service providers and users will be able to verify their laser trackers in conformity with the standards and independent of manufacturers.



Leica Geosystems, wikipedia.de 3x

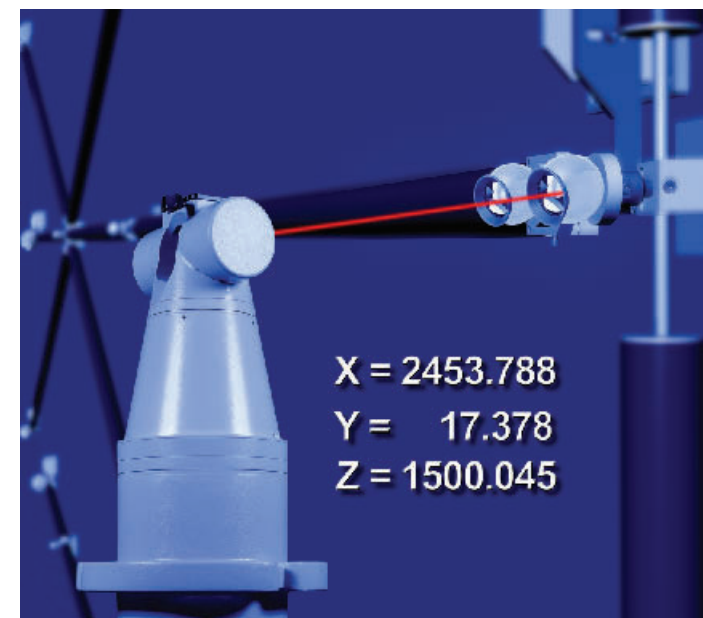


Fields of application for lasertrackers

## Contact information

Dr.-Ing. Klaus Wendt  
Working Group 5.32  
“Coordinate Measuring Machines”  
Phone: +49(531) 592-53 23  
Fax: +49(531) 592-53 05  
E-Mail: klaus.wendt@ptb.de

Physikalisch  
Technische  
Bundesanstalt  
Braunschweig und Berlin



Test location for traceability of  
lasertrackers

Physikalisch-Technische Bundesanstalt  
Presse- und Öffentlichkeitsarbeit  
Bundesallee 100, D-38116 Braunschweig  
Telefon: (05 31) 592-30 06, Telefax: (05 31) 592-30 08  
E-Mail: presse@ptb.de, Internet: <http://www.ptb.de/> 0,5/409

PTB