HEXAGON | ETALON

PRODUCT BROCHURE

Etalon X-AX LASERBAR

The system solution for calibration, compensation and verification of small and midlle size machine tools

Before

After

Volumetric compensation

Depending on the machine and environmental conditions, the axis errors can be reduced by 50% to 90%.

Etalon X-AX LASERBAR

In shortest time to the geometrical fingerprint of your machine

Unlike the tried and tested Etalon LaserTRACER-NG, which is primarily used on large processing machines and coordinate measuring equipment, the Etalon X-AX LASERBAR is designed specifically for small and medium-sized machine tools.

The X-AX LASERBAR represents a ground-breaking solution for machine tool manufacturers and users. We have combined the latest laser technology and the entire metrological expertise of Etalon in a highly compact and user-friendly system. In an automated process, it can generate the complete geometric fingerprint of a 3- to 5-axis machine tool in 1 to 2 hours and thus replaces an entire set of conventional devices for linear and rotary axes.

The basic component is a laser interferometer, which tracks the machine via a telescopic tube to ensure quick and simple detection of geometric deviations. The X-AX LASERBAR is mounted on precision balls in magnet nests on both the tool and workpiece side. This ensures straightforward use and provides a highly stable pivot point for the measurements. All geometric parameters established for the machine are based solely on interferometric measurements.

Advantages

- Easy check of the current condition of machine tools
- Quick checks, calibrations and volumetric compensations of machine tools
- Minimal time compared to conventional measuring equipment (test standards or conventional laser interferometers)
- Secure and automatic transmission of correction data to the control (Conventional or volumetric)
- Flexible use on machines of different sizes and types

Etalon X-AX LASERBAR

Application cases

Manufacturers of machine tools are enabled to efficiently and reliably create a complete geometric fingerprint of their produced machine before use at the customer. As proof of machining ability, the test can be repeated directly on site at the customer or regularly as service offering.

Users of machine tools are provided with a tool with which machines of different types can be geometrically monitored. If necessary, volumetric compensation can significantly increase the machine's accuracy throughout the machining area to meet demanding tasks.

Benefits

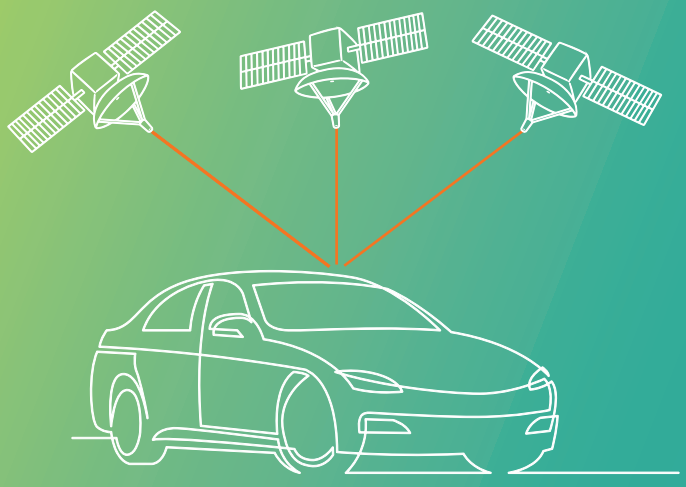
- Efficient testing and calibration of machine tools
- Standardized monitoring of machine tools
- Accuracy improvement of multi-axis machines by volumetric compensation

The Etalon principle

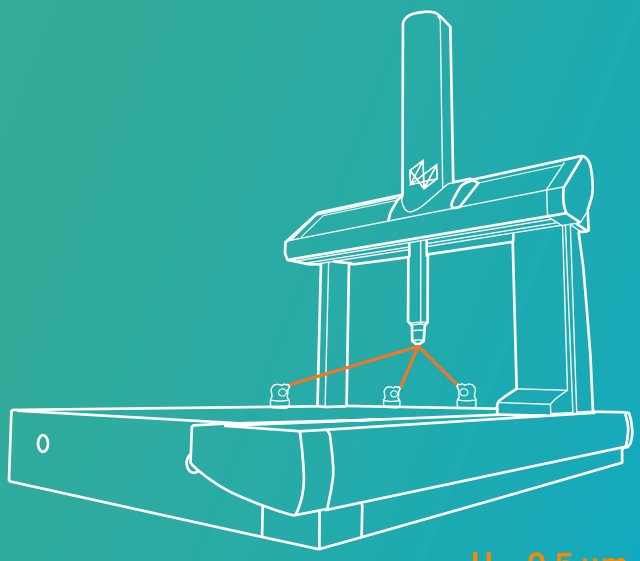
Easy and quick calibration monitoring and accuracy enhancements

The unique principle of the measurement: As with the Global Positioning System (GPS), spatial information is obtained by pure distance measurements in space.

- The interplay of the axes is added to each other and with the proven ETALON method, the 6 degrees of freedom (DOF) of all axes and their squareness to each other are determined.
- In the entire working volume of a measuring machine or machine tool, spatial accuracies in the submicrometer range can be achieved with largely automated measuring routines. The principle is scalable to different machine sizes.
- The Etalon X-AX LASERBAR can be used both for the calibration of linear axes and for rotary axes. A fine alignment for the measurements is not required. This makes the application easy, reduces user impact and saves time.
- All results are based on spatial interferometric measurements. This ensures the highest accuracy and metrological traceability, and the recalibration requirement of sensors is kept to a minimum.
- A log for the output of the axis deviations in different representations and, if necessary, correction data can be output at the push of a button.
- A machine acceptance according to current, international standards can also be carried out without fine alignment.



U = 5 m

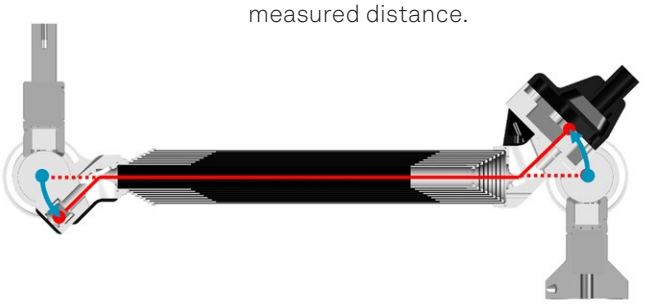


U = 0,5 µm

Etalon X-AX LASERBAR

System for verification and calibration of linear and rotating axes

The X-AX Laserbar combines maximum accuracy, short measuring times, universal application and complete deviation detection. To achieve the high level of precision, the X-AX Laserbar employs patented technology: Thanks to a sophisticated optical layout, the start and end points of the measuring beams are positioned virtually at the centres of the ball joints. This ensures full compliance with the “Abbe principle”, whereby no offset should exist between the scale and the measured distance.



To safeguard the precision alignment of the interferometric measuring beam, it is automatically tracked by piezo elements with extreme accuracy, thus ensuring that the shortest distance between the ball centres is measured at all times, even in the case of unavoidable, minimal deformation of the telescopic extension or incorrect alignment of the measuring elements

During the measuring process, the X-AX LASERBAR tracks the movement of the machine within the machining area. In doing so, it records highly accurate measurements, which allow the software packages Trac-Cal and Trac-Check to calculate and analyse the deviations of the machine down to fractions of a micrometer.

Trac-Cal

Analysis of geometrics and calibration of all axes

The clearly arranged Trac-Cal software guides the user through the individual steps of the measuring process. In conjunction with the X-AX LASERBAR, the software determines all systematic geometric deviations of measuring machines and machine tools. This includes positional deviations, straightness deviations, rotational deviations (pitch, yaw, roll) and the squareness of the axes to each other.

The result is a detailed analysis of all geometrical axis deviations. At the push of a button, Trac-Cal generates compensation tables for a wide variety of control systems.
Many controllers have direct online.

Trac-Check

Fast, standard-compliant condition-checks of linear axes

By using the X-AX LASERBAR with the Trac-Check software, it can be determined in less than 30 minutes a machine tool meets the requirements or a compensation or even mechanical maintenance has to be carried out. The patented method for automatic alignment of the measuring beam drastically shortens the measuring time.

The software controls the machine, captures the measurement data, calculates machine deviations and, if needed, creates correction data for different control types.

A ball joint is placed in the spindle and on the table of the machine. Thanks to three-point mounting, the Etalon X-AX LASERBAR can be inserted without fine-adjustment.

Laser source and all electronics needed for the analysis of the measurement data are built into an external sensor unit. This way, the Etalon X-AX LASERBAR has a light-weight and compact design.

The status display provides information about the ongoing measurement process.

Radio-based temperature sensors can optionally record and assess the thermal expansion of the machine axes.

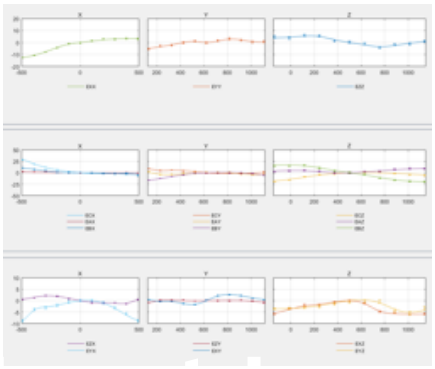
Trac-Cal results

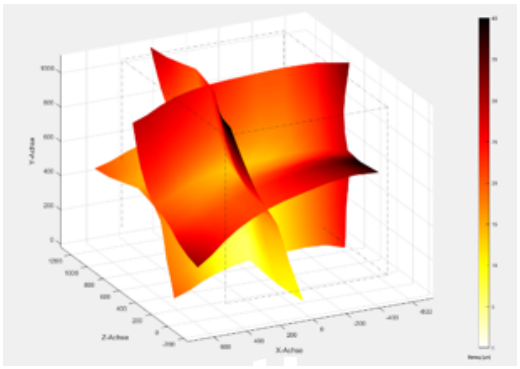
Based on the measured data, the deviations of the machine in space and the temperature profile can be checked Trac-Cal then outputs the individual deviations of the machine axes by a press of a button. In multiple visualizations, the 6 degrees of freedom (DOF) of the axes are displayed.

For linear axes, these are the deviations of positioning, straightness in both directions, pitch, yaw and roll. For rotary axes these are the deviations of the positioning, axial movement, radial movement and the wobbling in both directions.

The squareness deviations of the axes to each other or orientation of the axis of rotation to the linear axes is also output evaluated.

Selectable views illustrate the geometric actual state of the machine. A measurement report for documentation is automatically generated.

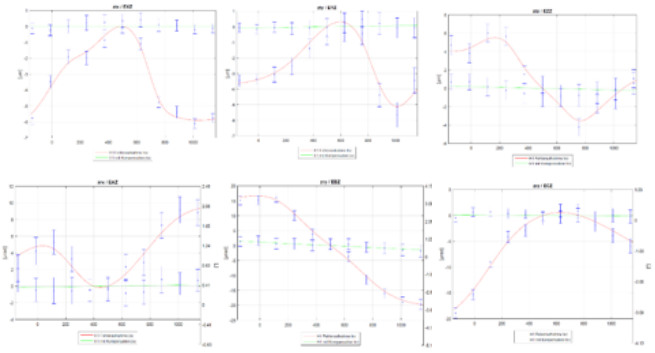


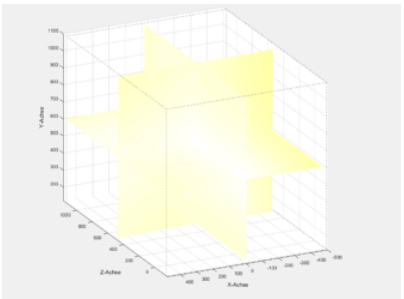


If the geometric deviations of a machine are determined by measurement, they can be compensated numerically. Volumetric compensation has been indispensable in coordinate measuring machines for a quarter of a century to achive an accuracy beyond mechanical precision.

With the latest control technology, this technique is available for machine tools since several years to meet the highest accuracy requirements. In addition to the tables for the complete numerical axis correction, conventional formats can be exported.

User of Etalon-technology can reduce axis errors by 50% to 90%, depending on the machine and environmental conditions.





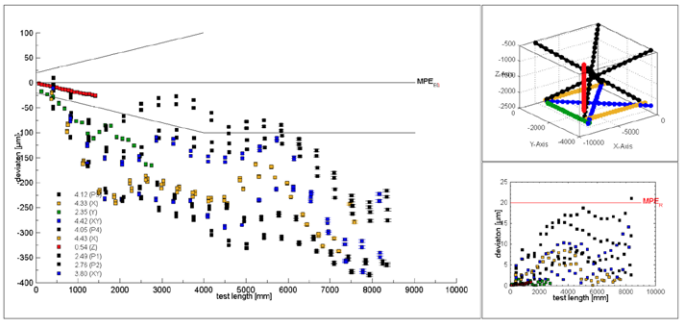
Trac-Check results

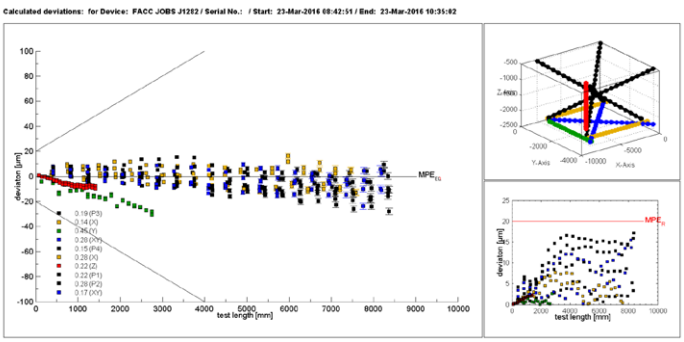
If it is less about a detailed analysis of the axis errors, but about a simply comparable, standard-compliant machine inspection or acceptance, Trac-Check provides the necessary information. The software is based on the following current standards.

For machine tools

- ISO 230-2 (paraxial lines)
- ISO 230-6 (area and space diagonals)
- VDI 3441
- ISO 230-4 (Circular test)

The diagrams show the comparison of the axis deviations without (top) and with compensation (bottom) measured at the tool centre point or probe point. Even with independent measuring lines or measuring instruments, the success of volumetric compensation can be clearly demonstrated.





Existing standards

For machine geometry

ISO 230-1
Basic document on machine tool errors and their measurement.
Also defines the volumetric accuracy.

ISO 230-2
International standard for linear verification along machine axes. Established worldwide in the industry. Often the main acceptance criterion for machines.

ISO 230-6
Extends the geometric verification according to ISO 230-2 to the plane and space diagonals. Gives good indication of volumetric accuracy. Increasingly adopted in the industry, especially for large machines.

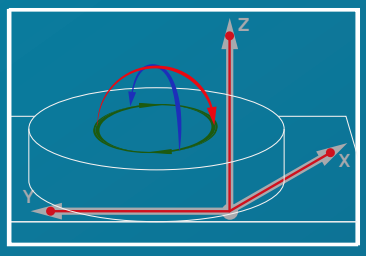
VDI 3441
Superseded German standard for linear verification along the machine axes (similar to ISO 230-2). Still in international use.

AMSE B5.54
American adoption of the ISO 230-2 and ISO 230-6. Combines the test of axis parallel lines with the diagonal lines – volumetric accuracy is covered.

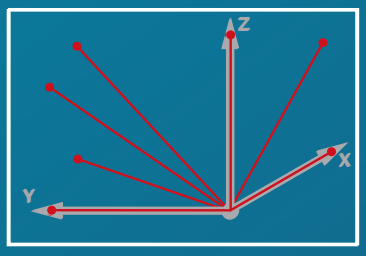
ISO 230-4
Ballbar test: Checking of the dynamic path accuracy based on circular paths.

ISO 16907
Technical guideline for numerical correction of machines.

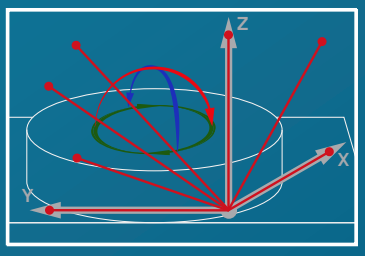
ISO 230-2



ISO 230-6



ISO 230-4



Volumetric compensation

Volumetric compensation corrects the deviation within the entire machining volume while taking into account all systematic deviations of the machine axes. In the case of the linear axes, this includes the positioning deviations along with the straightness deviations and the rotational deviations of all axes (pitch, yaw, roll) as well as the angle deviations between the axes.

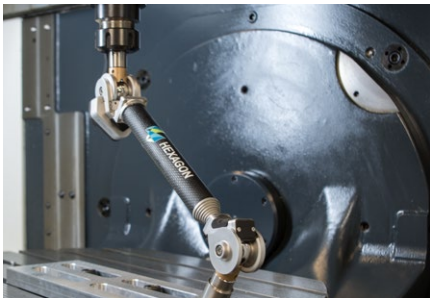
For rotational axes, the angular positioning deviations can be compensated along with the axial and radial deviations. Wobble can also be compensated as well as any variation in the position of the axes within the machine volume.

Volumetric compensation has been a feature of coordinate measuring devices for around 20 years and now enables a level of measuring accuracy that would not be achievable on the basis of mechanical precision alone.

A detailed description of volumetric compensation, its application and limits of use is provided in ISO/TR 16907. [ISO/TR 16907:2015. Machine tools – Numerical compensation of geometric errors].

Application example

Etalon systems demonstrate their accuracy, efficiency and versatility in many applications. Renowned CMM and machine tool manufacturers, users and service providers benefit from their unique capability in daily use.



Examples of traversing movements when testing linear and rotational axes and performing ballbar tests.

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