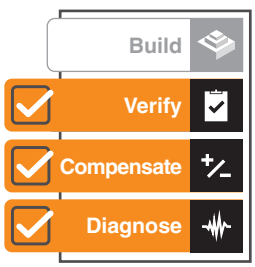
RENISHAW
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XM-60 multi-axis calibrator

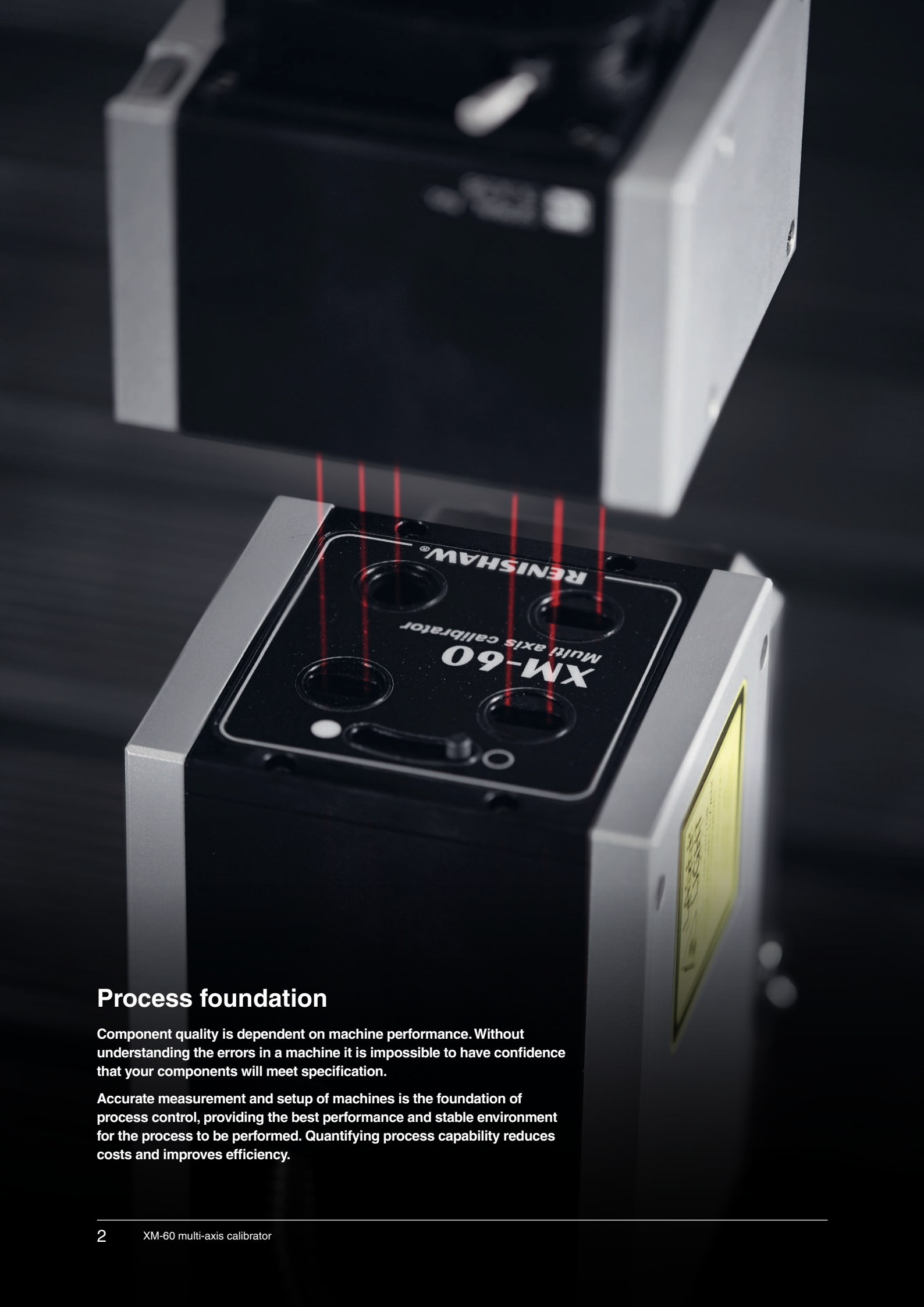
Why you need an XM-60 multi-axis calibrator

Knowing the capability of machine tools before metal cutting is the foundation of any machining process. The XM-60 multi-axis calibrator measures all six degrees of freedom from a single set-up, highlighting problems before they affect productivity.



www.renishaw.com/xm60

#renishaw



Process foundation

Component quality is dependent on machine performance. Without understanding the errors in a machine it is impossible to have confidence that your components will meet specification.

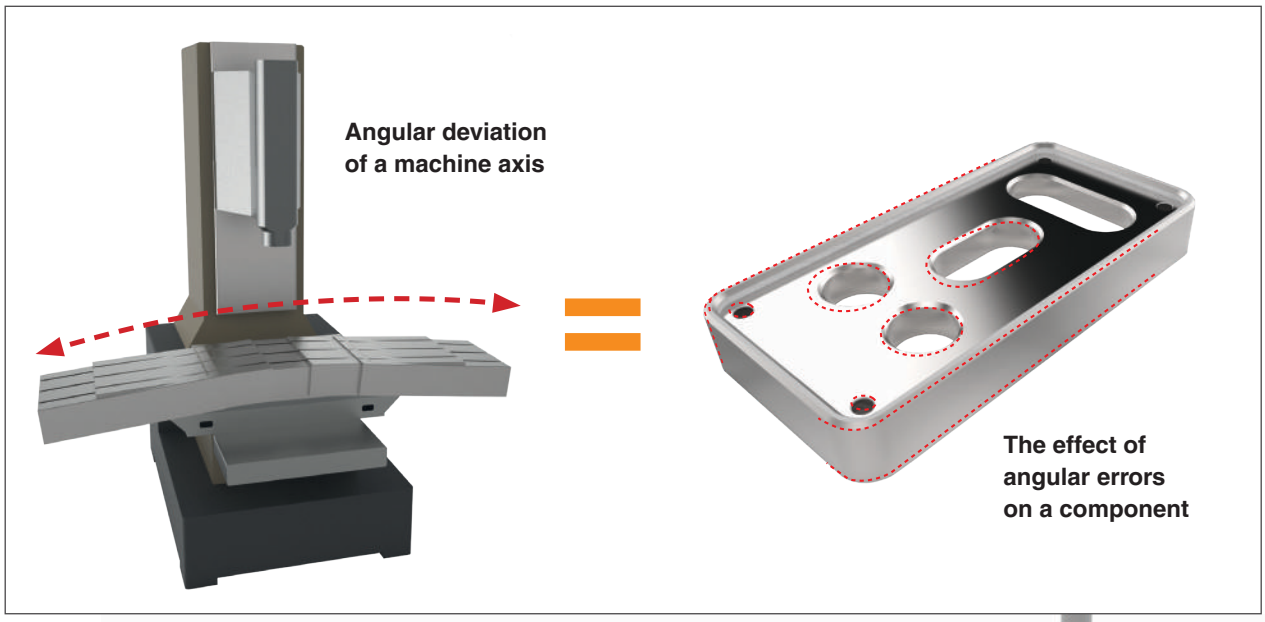
Accurate measurement and setup of machines is the foundation of process control, providing the best performance and stable environment for the process to be performed. Quantifying process capability reduces costs and improves efficiency.

Powerful machine diagnostic capability

Initiatives to improve efficiency, and reduce scrap and production costs have created the need to understand manufacturing processes better than ever before. Knowing the capability of machine tools before metal cutting is the foundation of any machining process.

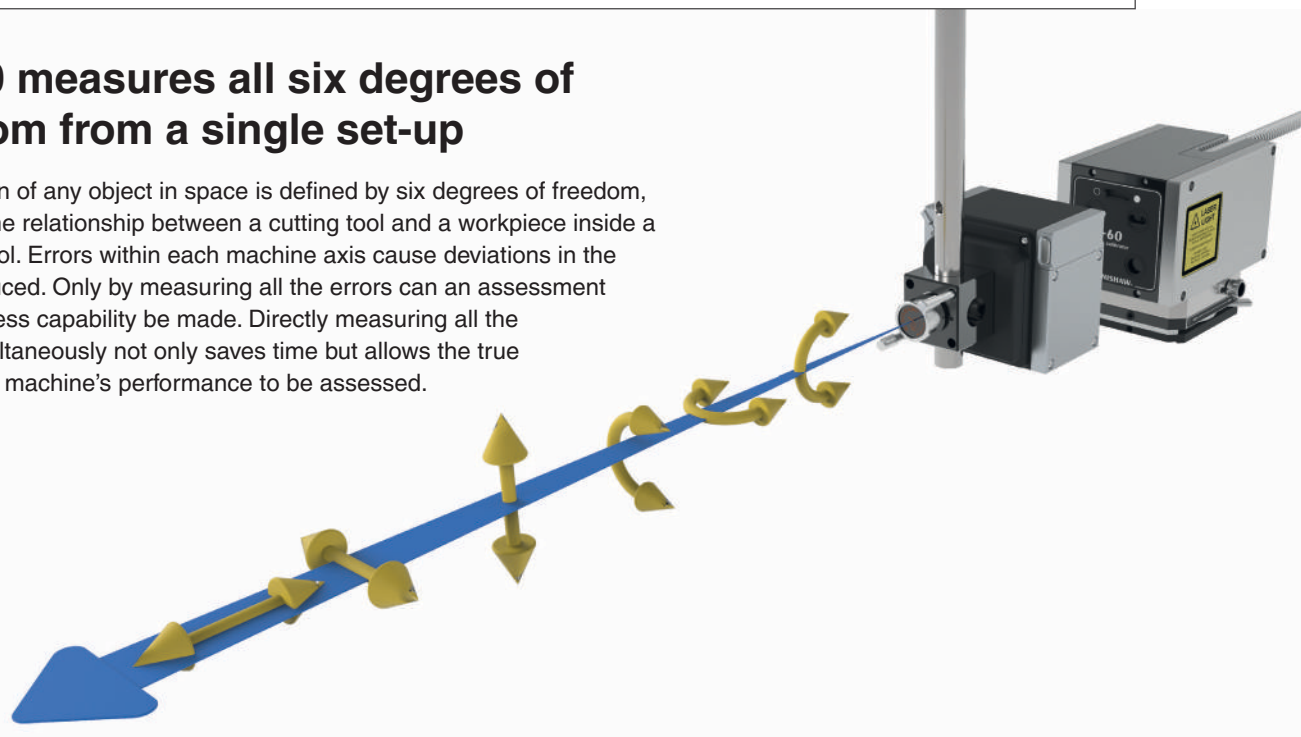
Laser interferometry, the globally recognised approach for machine calibration, offers the ultimate in accuracy. However, measuring one error per set-up is time consuming for users who wish to measure more than linear errors. With complex machine structures and more intricate components being manufactured, measuring linear performance alone is not enough.

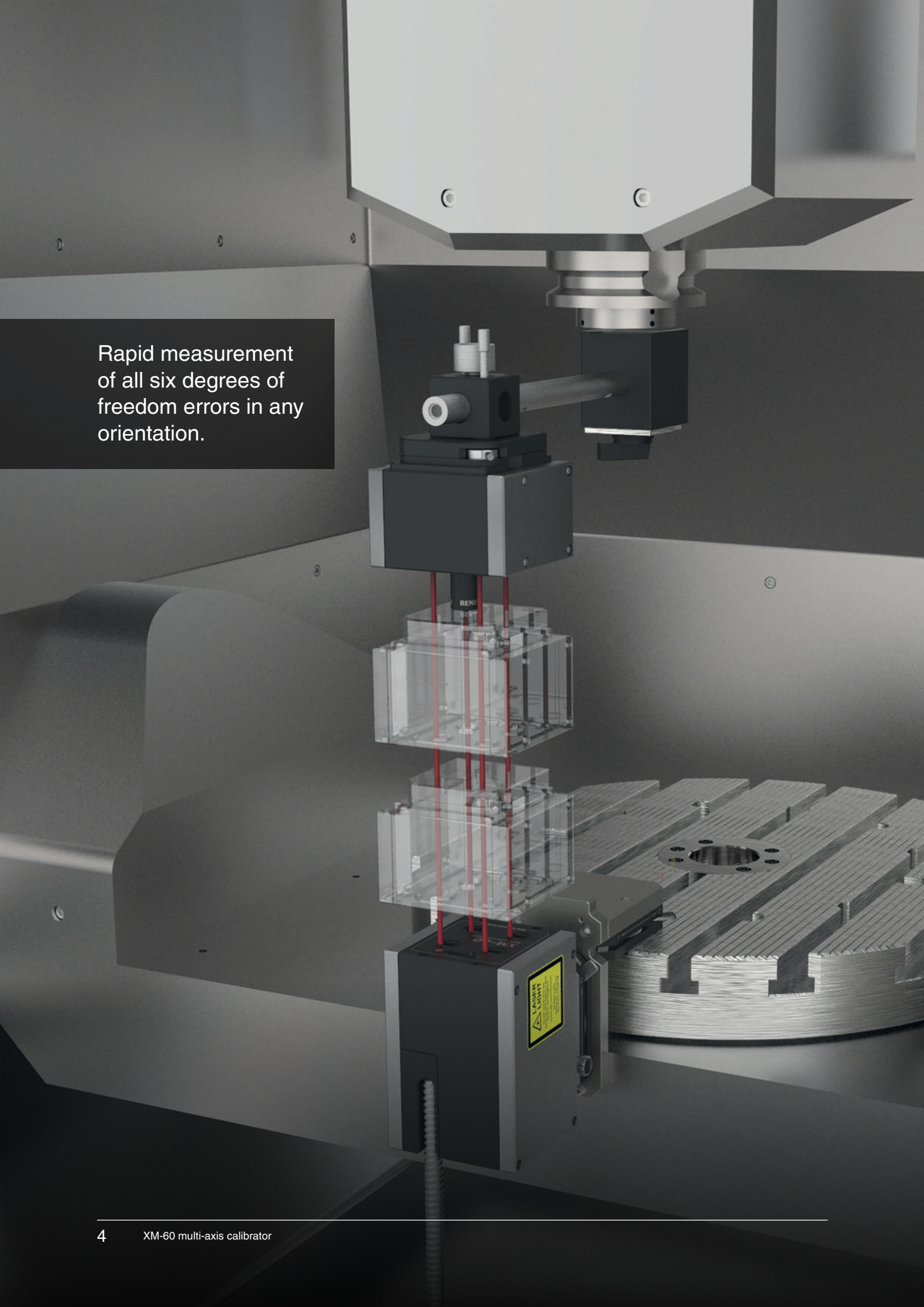
Frictional effects and other faults in the axis construction can cause the axis to rotate as it moves, creating a difference between the indicated and actual positions of machine elements. These 'angular' and 'straightness' effects can cause significant feature position errors, or profile and surface deviation, resulting in out-of-tolerance components.



XM-60 measures all six degrees of freedom from a single set-up

The position of any object in space is defined by six degrees of freedom, similar to the relationship between a cutting tool and a workpiece inside a machine tool. Errors within each machine axis cause deviations in the parts produced. Only by measuring all the errors can an assessment of the process capability be made. Directly measuring all the errors simultaneously not only saves time but allows the true picture of a machine's performance to be assessed.





Rapid measurement of all six degrees of freedom errors in any orientation.

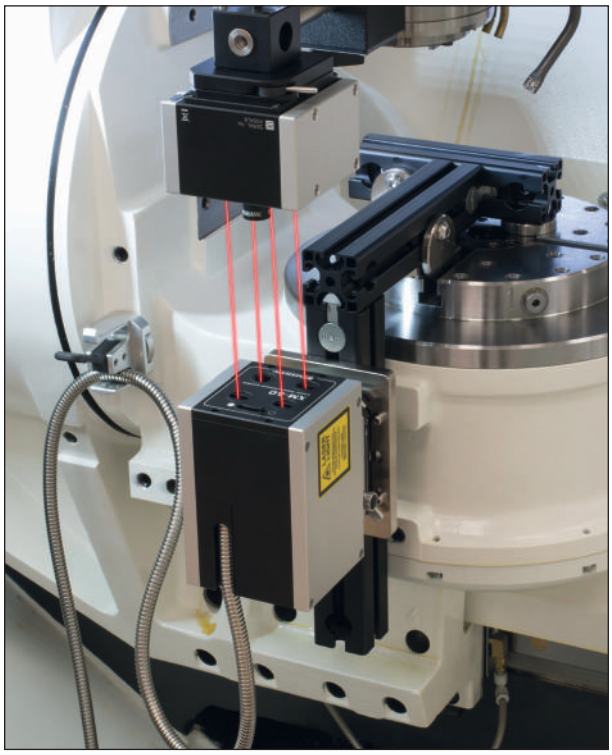
Direct measurement of errors

Reducing measurement uncertainties is important for any user



The XM-60 multi-axis calibrator provides users with powerful machine diagnostic capability through the measurement of all degrees of freedom from a 'single shot'. By capturing six degrees of freedom, users can discover the source of their errors, rather than the effect which is often seen when performing linear measurement alone.

Reducing measurement uncertainties is important for any user. The XM-60 has been designed to measure machine errors directly, by aligning the laser beams with a machine axis. This reduces the inaccuracies which can result from complex mathematics used in alternative measurement techniques. Direct measurement makes comparison before and after machine adjustments a quick and simple task.



Operation in any orientation

The pure optical system in the XM-60 allows operation in any orientation. The launch unit can be mounted on its side, upside down and on its back, useful for vertical axis testing, slant-bed lathes and more complex machine structures.

System overview



Laser/launch unit

Flexible – a separate laser unit enables the use of a remote compact fibre optic launch unit, reducing the size of the launch unit and minimising the impact on measurement volume.

Thermal stability – the laser heat source is located outside the machine environment. The use of an external laser source reduces thermal effects on the measurement optics and on the machine under test.



XM-60 receiver

Wireless communication – the roll and straightness data is communicated wirelessly back to the laser unit via an integrated wireless connection.

No cables – powered by rechargeable batteries avoiding trailing cables during machine moves.

Lightweight – designed to minimise the load on the machine spindle.

Key features and benefits

Quick

Linear, pitch, yaw, roll, horizontal and vertical straightness measurement in the same time as a single measurement with conventional laser techniques.

Simple

Easy set-up, familiar to users of other interferometric systems. Automatic sign detection and graphical alignment minimise human errors.

Reassuring

Measuring all errors directly allows the user to see results as the test is in progress.

Capable

Unique optical roll measurement system provides roll measurement in any orientation.



CARTO software suite

Intuitive – guides the user through the workflow of the measurement process. CARTO software suite provides data capture, analysis and compensation for the XM-60 multi-axis calibrator. This includes data captured from rotary axis testing with the XR20 rotary axis calibrator.



XC-80 environmental compensator

Reliable – XC-80 environmental compensator automatically corrects for the effect of the operating environment.

Accurate – maintains full measurement accuracy from 0 °C – 40 °C.

System case

Portable – robust Peli™ storm system case designed to provide safe storage and transportation of the laser system, with space for accessories and XC-80 compensator kit.

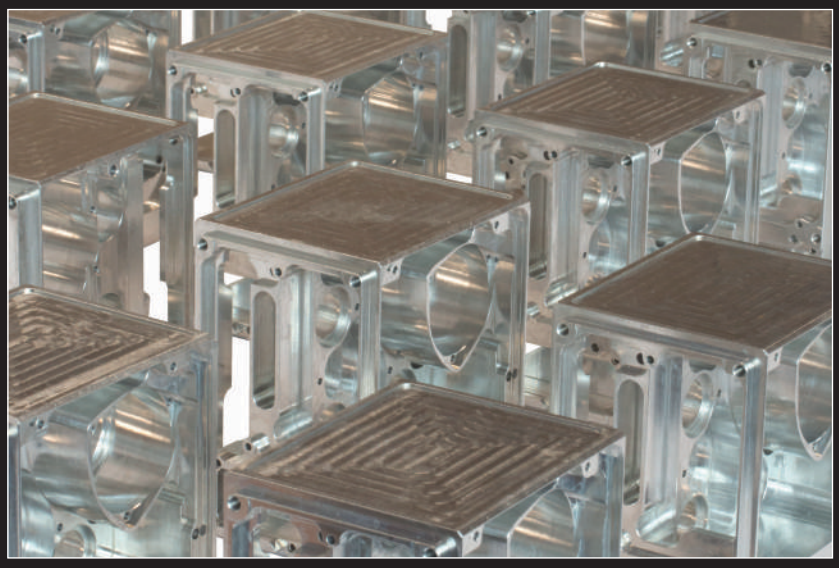


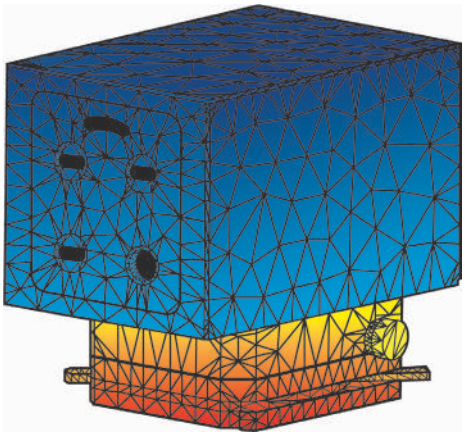
Precision engineered

Engineered by Renishaw

Renishaw laser measurement systems are manufactured to provide high performance and long operational lives.

The aluminium substructure provides lightweight yet strong construction, designed to give the smallest package to fit onto machine tools. The combined weight of the launch and receiver is only 2.5 kg.





Thermal design

The XM-60 employs thermal breaks between the magnetic mount and the product housing. This ensures changes in machine thermals do not affect the device and temperature variation in the XM-60 does not affect machine performance.



Roll detection

The XM-60 provides a highly accurate laser system that incorporates unique technology with a patented optical roll measurement and fibre optic launch system. The compact launch unit is remote from the laser unit, reducing heat effects at the point of measurement. It can be mounted directly to the machine on its side, upside down and even on its back, which is particularly beneficial in areas with difficult machine access.

Four-beam system

Easy, flexible set-up using any of the four beams during visual alignment. The only four-beam system on the market, matching interferometric accuracy of angular and linear measurement with the simplicity of Position Sensitive Device (PSD) straightness measurement. Allows a greatly reduced package size.



Proven performance

The laser tube in the XM-60 is developed from technology used in Renishaw's RLE laser encoder system, produced for over 20 years, and found in the most demanding applications in the semiconductor industry.



Attention to detail

The standard XM-60 kit is supplied with magnetic conduit clamps to tidy and control the conduit during a test.

A comprehensive user guide is available in multiple languages for local support. The whole system can be transported in a portable 'wheelie-case' with an attachable fixturing kit.



CARTO software suite

The CARTO software suite provides data capture, analysis and compensation applications, simplifying the process for monitoring and improving position performance.



CARTO is made up of three applications:

Capture
to collect laser measurement data.

Explore
for powerful analysis to international standards.

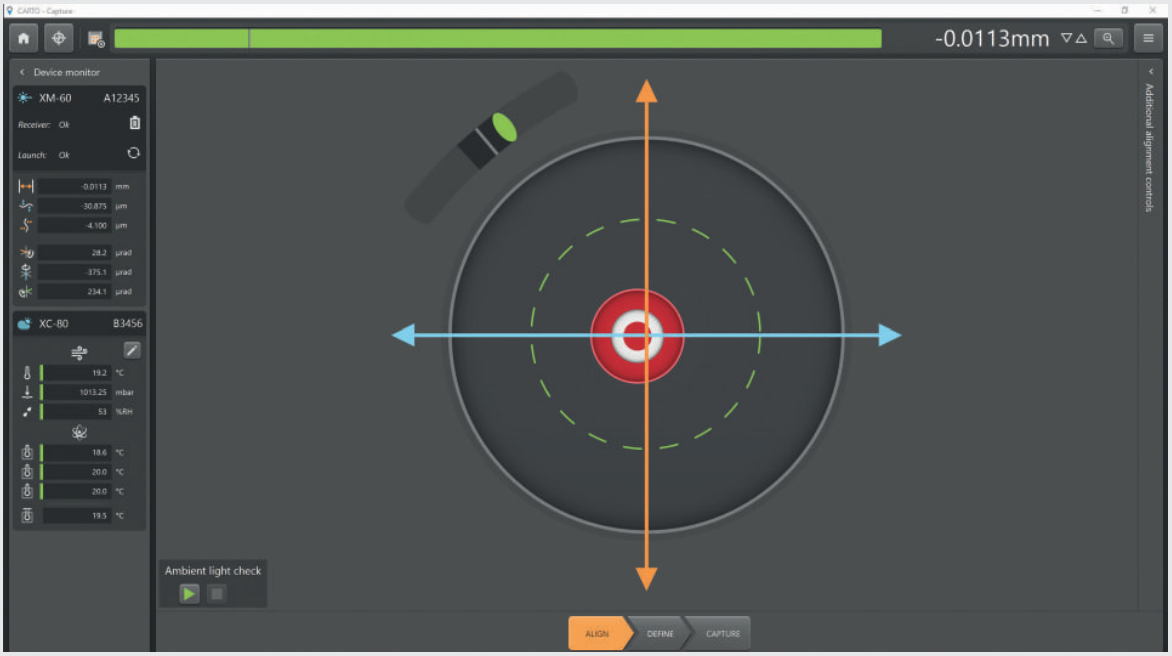
Compensate
for quick and easy error correction.

The CARTO user interface provides a simple process flow that enables users to easily capture and manage their data.

Built in functions such as ‘automatic sign detection’ and ‘first target pre-set’ give confidence that collected data is right first time. This approach allows for greater productivity whilst using Renishaw calibration products.

Capture

Positioning performance – captured



Graphical alignment

Easy laser alignment using the graphical interface with direct positional feedback from the XM-60 laser.

Long range measurement

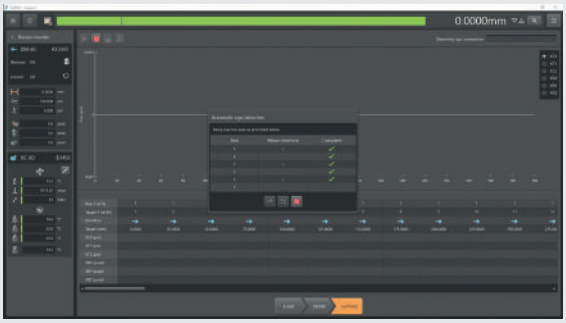
Define sub test methods, create part programs and capture data sets for unlimited measurement range.

True straightness data

Minimise the effects of air turbulence and vibration by capturing a higher density of straightness data in a continuous sweep of the axis.

More data than ever

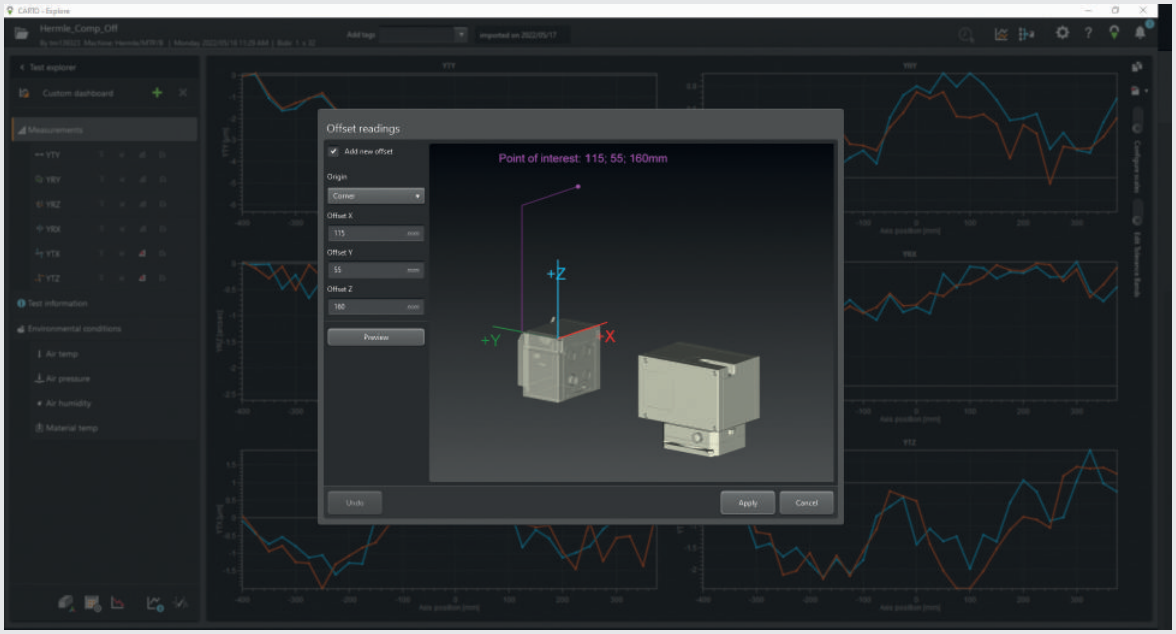
At every target CARTO stores laser position, environmental data from the connected compensator and time stamps the data. This allows greater in-depth error diagnosis when analysing data.

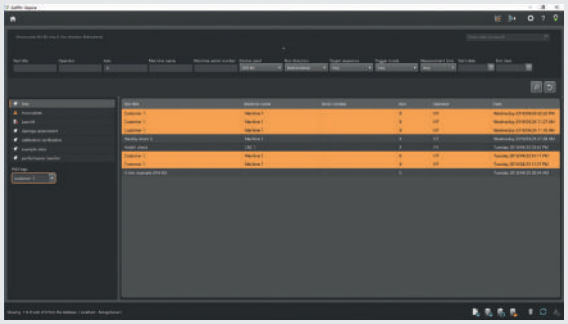




Explore

Data – analysed







Reporting

Analyse data to international standards to meet your requirements. Create PDF reports using our customisable combined report function, or simply copy and paste data sections as required.

Error visualisation

The 3D error visualisation feature allows interpretation of errors and the relationship between the 6 degrees of freedom.

Measure the point of interest

Measurement with the hardware at the exact point of interest is often not possible. Recalculate captured data to give the true errors at the source.

Compare anything

Compare historical data, different measurement types, positional data against environment.

Back-up and sharing data

Export single or multiple tests at the click of a button. Alternatively, back-up the entire database to a single '.carto' file.

Data organisation

Tagging allows efficient organisation of test data to suit your requirements. Easily search and filter data within the database.

Compensate

Errors – corrected

Compensate provides solutions to improve positioning performance of your motion system using error correction files. The standard format is Renishaw files (LEC.REN and LEC2.REN) with raw error data. These files are backward compatible with previous Renishaw software used for ML10 and XL-80 laser systems.



Volumetric compensation

Benefits include:

Compensation graphics

Visually demonstrate an expected improvement in positioning performance after compensation.

Custom compensation configuration

Create custom configuration files to suit user requirements, minimising potential configuration errors and reducing downtime of the compensation process.

Optional add-ons

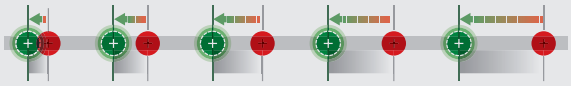
Semi-automatic error correction is available in native machine tool language. Compensate optimises cutting performance, reducing scrap and saving costs.

Error compensation output

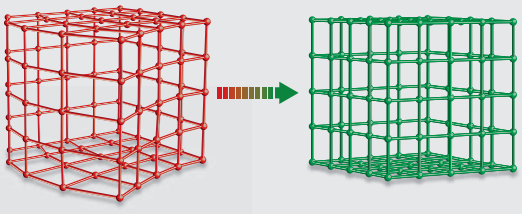
The machine-dedicated user interface reduces user input, with no manual editing of compensation tables, reducing machine downtime.

Optional add-ons are available for:

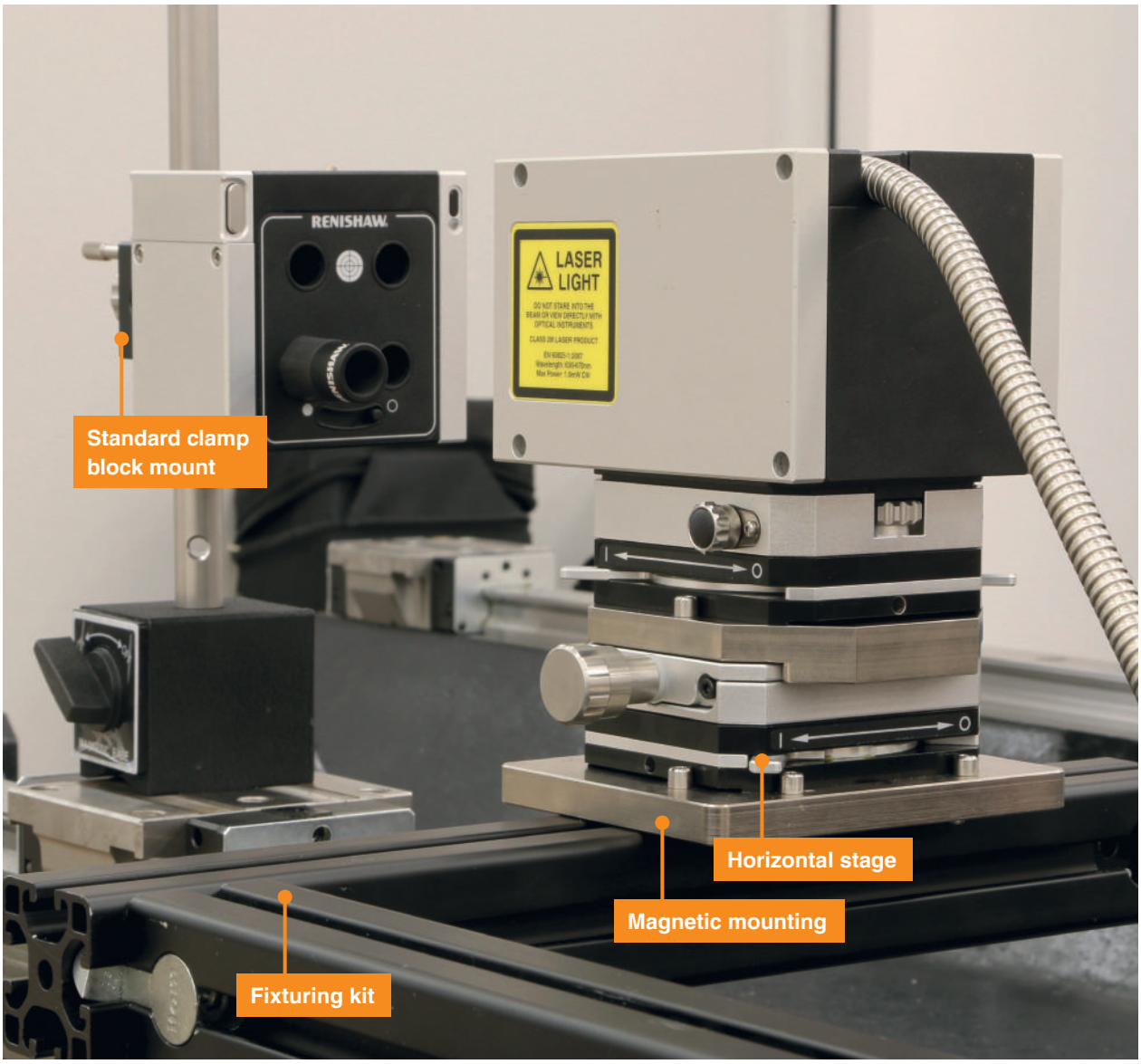
Pitch compensation - provides easy updates of linear, straightness and rotary compensation tables for controls with supported options (single degree of freedom).



Volumetric compensation - provides easy updates of compensation tables for linear, angular, straightness, roll and squareness (21 degrees of freedom).



For the latest list of supported controls, see here: **www.renishaw.com/carto-add-ons**



Fixturing kit

The fixturing kit simplifies and extends the options for mounting the XM-60 into the working volume of a machine tool. Applications that previously were too complex to measure can now easily be catered for. The kit contains a series of extrusions that can be easily assembled.

This supports users in:

- measuring the full axis of travel for:
  - linear extension from the bed of the machine
  - vertically mounting beside the machine bed
- mounting the XM-60 onto a chuck for lathe or machining centre applications
- mounting the receiver extended from the spindle

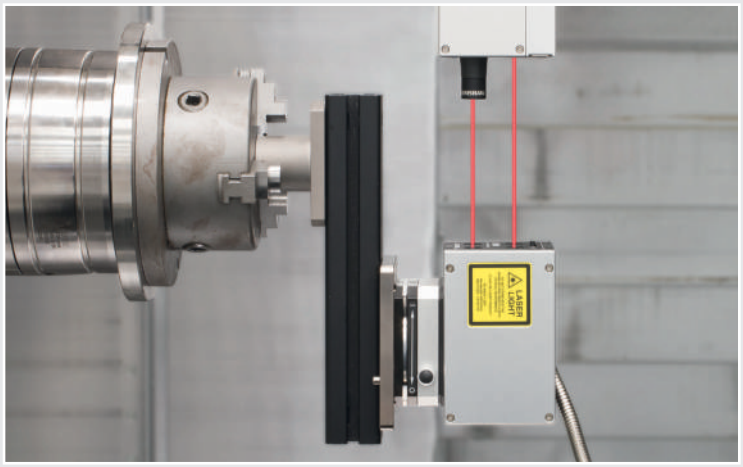


Versatile fixturing

The XM-60 multi-axis calibrator has a range of versatile fixturing suitable for different machine configurations.

Magnetic mounting

The integral switchable magnetic base on the XM-60 launch unit allows quick attachment to the machine. An internal protection device ensures the magnet is only activated when correctly installed on the machine, preventing damage.



90 degree bracket

The 90 degree bracket enables users to switch the orientation of the XM-60 with ease. Guide pins assist the location of the XM-60 until the magnetic base is activated, making accurate positioning simple. The 90 degree bracket can also be used to mount the unit off the edge of the machine bed.



Standard clamp block mount

The XM-60 receiver uses a clamp block and pillar method for simple attachment to the machine. The standard kit contains four pillars and two clamp blocks which gives even more flexibility in mounting options.

Custom fixture interface

For specialist fixture applications the clamp block can be easily removed for the user to attach custom fixturing to the back of the receiver, using the tapped holes directly.

Horizontal stage

This optional accessory enables precise alignment in applications without an axis perpendicular to the travel, such as stages and printers. Precision translation of the XM-60 launch unit is easily achieved without disturbing yaw alignment.



> **By using the XM-60, the KES team can collect a range of measurements, including linear, pitch, horizontal and vertical, in the same time it takes to collect a single measurement using conventional techniques.**
>
> KES Machine (USA)

XM-60 system specification

XM-60 multi-axis calibrator

Dimensions (weight)	**Laser** (L) 320 mm x (H) 122 mm x (W) 193 mm (weight 3.7 kg) **Launch** 125.5 mm x 124.1 mm x 86 mm (weight 1.9 kg) **Receiver** 161.2 mm x 82 mm x 82 mm (weight 0.6 kg) Complete XM-60 system in the case excluding optional XC-80 compensator is 23 kg
Power supply	24 V DC 2.5 A 60 W
System measurement capability	Linear, straightness, angular (pitch/yaw), roll
Laser output	
Interface	Integral USB comms, no separate interface

XC-80 environmental compensator

Dimensions (weight)	135 mm x 58 mm x 52 mm (490 g)
Power supply	Powered via USB from PC
Internal sensors	Air pressure Relative humidity
Remote sensors	1 air temperature, 1 – 3 material temperature
Interface	Integral USB comms, no separate interface
Environmental sensors	Material temperature: 0 °C – 55 °C Air temperature: 0 °C – 40 °C

Please contact your local Renishaw office for further details at **www.renishaw.com/contact**

Performance specifications

XM-60 multi-axis calibrator

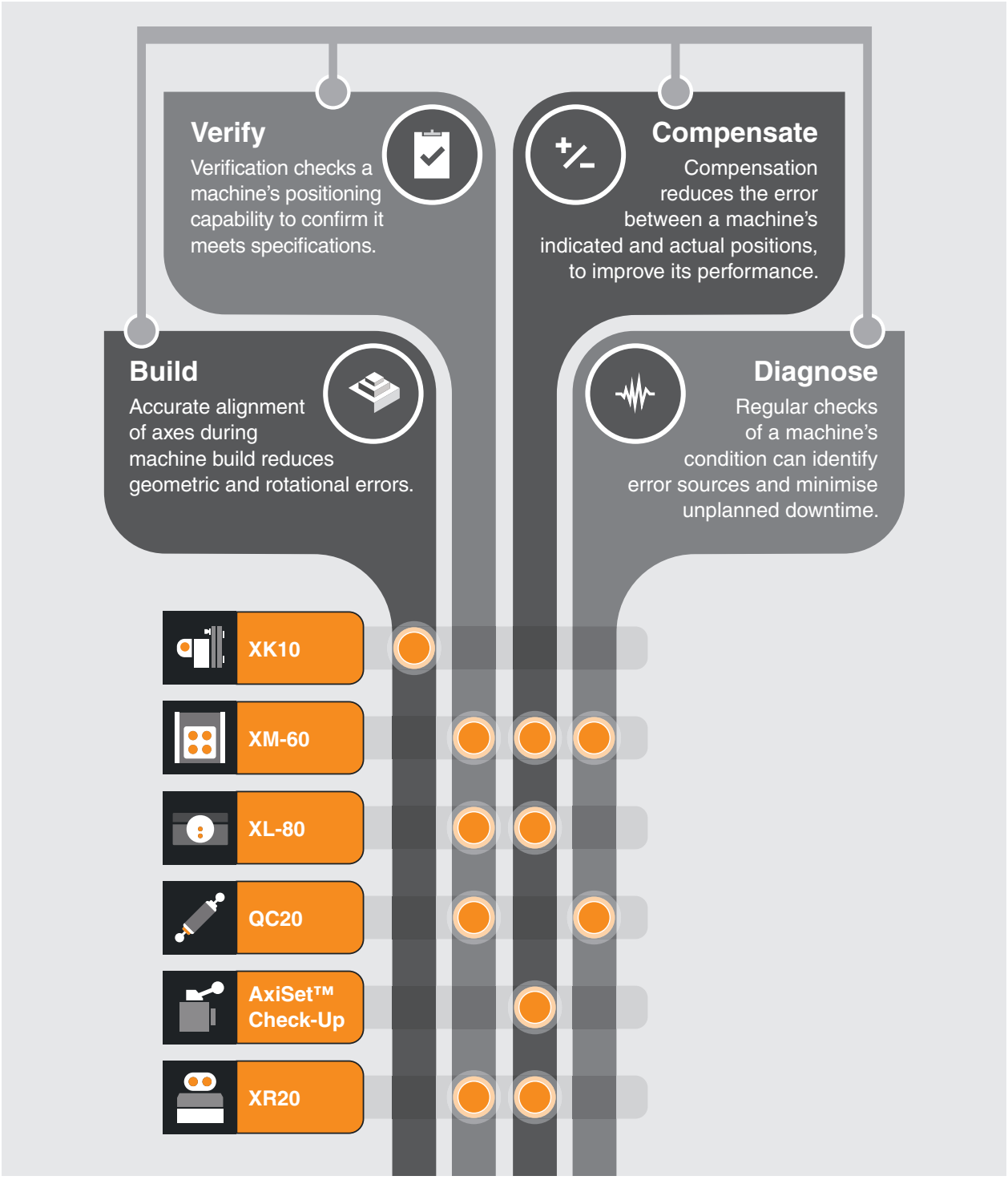
Measurement type	Axial range	Measurement range	Accuracy	Resolution
Linear	0 m to 8 m	0 m to 8 m	±0.5 ppm (with environmental compensation)	1 nm
Angular (pitch/yaw)	0 m to 8 m	±500 µrad	±0.004A ±(0.5 µrad +0.11M µrad)	0.03 µrad
Straightness*	0 m to 6 m	±50 µm ±250 µm	±0.01A ±1 µm ±0.01A ±1.5 µm	0.25 µm
Roll*	0 m to 4 m 4 m to 6 m	±500 µrad	0 to 4 m: ±0.01A ±6.3 µrad 4 to 6 m: ±0.01A ±10.0 µrad	0.12 µrad

Note: Accuracy values are reported to a statistical confidence of 95% (k=2). They do not include the errors associated with the normalisation of the readings to a material temperature of 20°C.

A = displayed error reading
M = measured distance in metres
*The data stitch functionality in CARTO supports accurate readings for all six degrees of freedom beyond 6 metres.

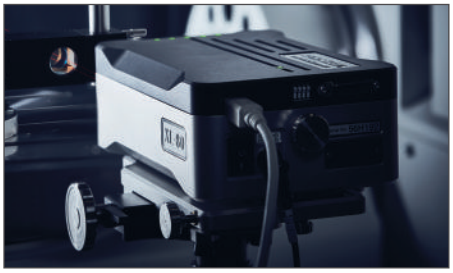
Renishaw's machine measurement solutions

Renishaw offers a range of calibration solutions for improved machine performance, increased machine up-time and preventative maintenance schedules.



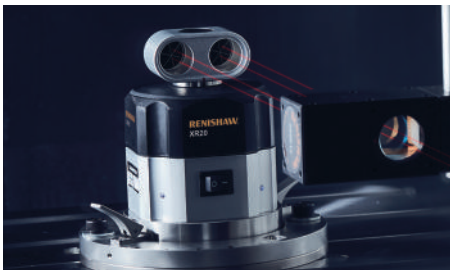
Renishaw's innovation has transformed industrial metrology

Renishaw offers a range of calibration solutions for machine tools, CMMs and other applications:



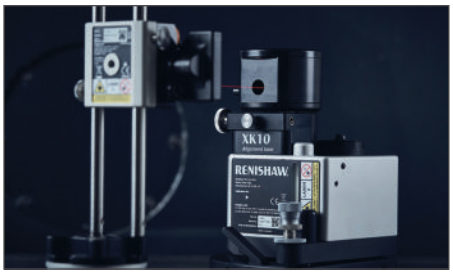
XL-80 laser measurement system

- The ultimate in traceable, versatile motion system analysis
- ±0.5 ppm certified linear measurement accuracy



XR20 rotary axis calibrator

- Measurement accuracy of up to ±1 arc second
- Totally wireless operation for quick and easy set up



XK10 alignment laser system

- Versatile laser alignment and set-up tool for machines and peripherals
- Intuitive software provides a step-by-step approach for each measurement type



QC20 ballbar system

- The most widely used system for machine tool performance verification
- Reduces machine down-time, scrap and inspection costs



AxiSet™ Check-Up for machine tools

- Rapid on-machine measurement of rotary axis performance
- Accurate detection and reporting of errors in rotary axis pivot points

RENISHAW
apply innovation™

Service and quality

Our ongoing commitment to service and quality provides our customers with the complete solution



Training
Renishaw offers an established range of comprehensive operator training courses either on-site or at a Renishaw training centre.

Our experience in metrology allows us to teach not just about our products, but also underlying scientific principles and methods of best practice. This enables our customers to get the most out of their manufacturing processes.

Support
Our products enhance quality and productivity, and we strive for total customer satisfaction through superior customer service and expert knowledge of potential product applications. When you purchase a laser or ballbar system from Renishaw, you are buying into a worldwide support network that understands machine metrology and the service of production equipment.

Renishaw calibrations in the UK are traceable to the National Physical Laboratory, a signatory of the CIPM MRA. Calibration facilities worldwide can provide local laser calibration traceability.

Design and build
Not only does Renishaw have comprehensive in-house design capability, its extensive manufacturing capacity allows it to produce nearly all components and assemblies in-house. This gives us the ability to fully understand and control our design and build process.

The performance of Renishaw lasers has been independently verified by the National Physical Laboratory (UK) and the Physikalisch-Technische Bundesanstalt (Germany).

Certification
Renishaw plc is certified and audited regularly to the latest ISO 9001 quality assurance standard. This ensures all aspects of design, manufacture, sales, after sales support, and recalibration remain at the highest standards.

The certificate is issued by BSI Management Systems, an internationally recognised certification body, accredited by UKAS.

bsi.

www.renishaw.com/xm60

#renishaw

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