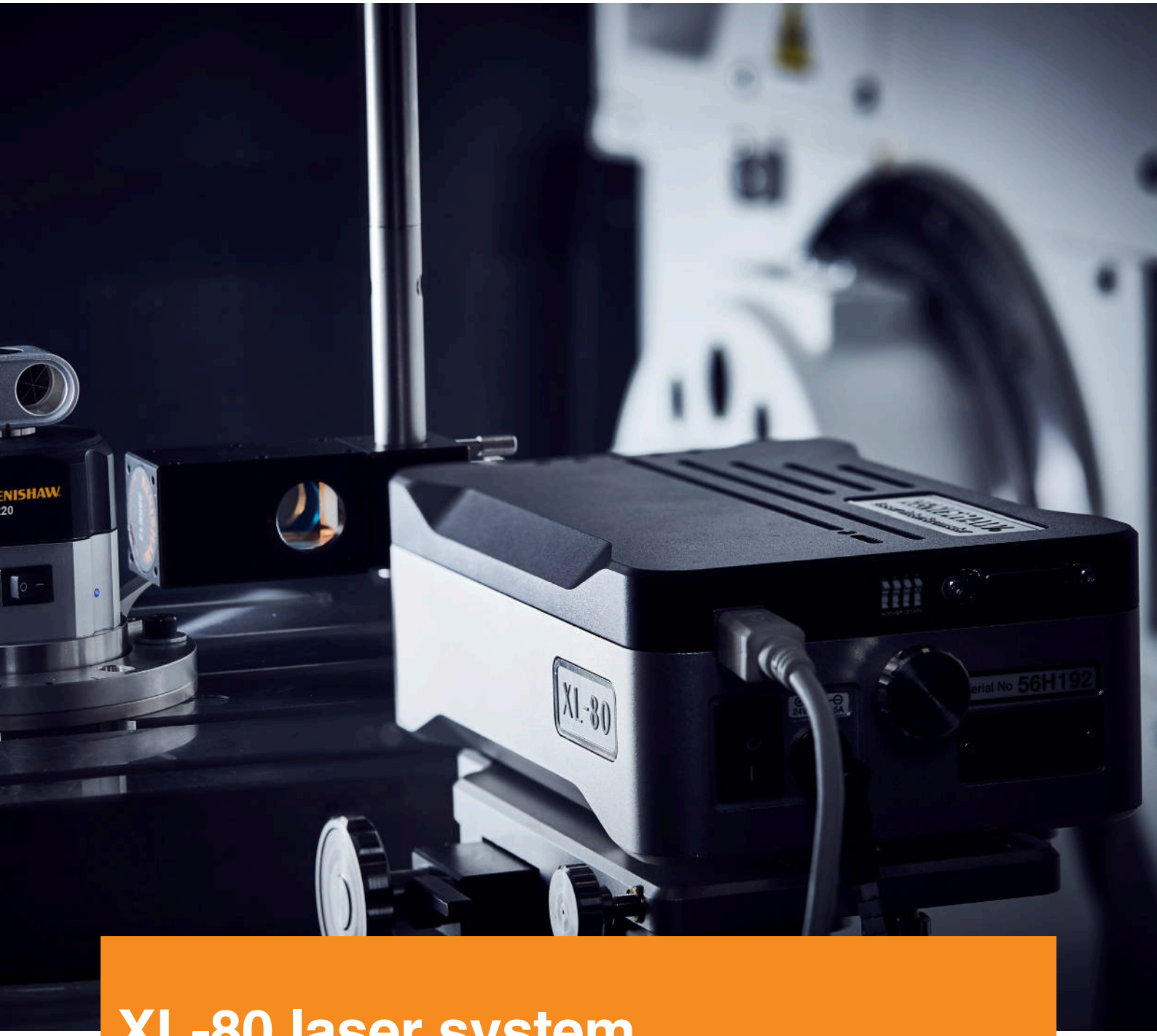
RENISHAW
apply innovation™

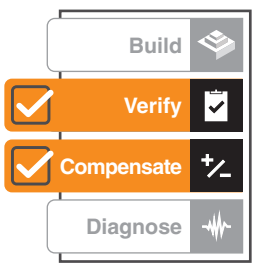


XL-80 laser system

Why you need an XL-80 laser system

Laser interferometry, the globally recognised approach for machine calibration, offers the ultimate in accuracy.

The XL-80 laser system provides versatile, traceable measurement for machine tools, co-ordinate measuring machines (CMMs), motion systems and scientific applications.



www.renishaw.com/xl80

#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 set-up of machines is the foundation of process control, providing the best performance and stable environment for the machining process. Quantifying process capability reduces costs and improves efficiency.

Laser interferometry provides the most accurate and repeatable method of calibration, offering solutions for a wide range of applications.





Machine verification

The XL-80 laser system is primarily used for the verification of motion systems. Measuring machine performance allows users to be confident in their machining or identify issues before they are seen in manufactured parts.

The XL-80 laser is able to directly measure geometric errors in a machine independently, unlike laser tracker systems. This gives confidence in the measurements and makes it possible to isolate specific errors. Machine accuracy can be improved by:

- making targeted alterations to the machine's assembly
- using the data to apply error compensation

Repeat measurement runs can verify the improvement made to the capability of the machine.

Specialist laser triggering

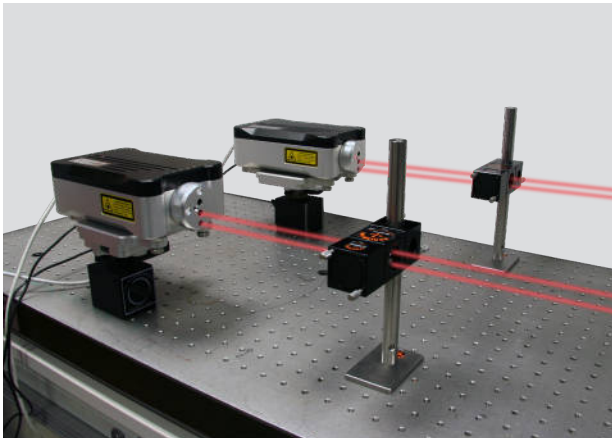
Some applications require the laser to capture data at custom times or synchronised locations. This can be achieved with the CARTO software suite's Capture application using the keypress, position or remote (TPin) triggering option.

Dynamic analysis

Knowledge of a system's dynamic characteristics – acceleration, velocity, vibration, settle time, resonance and damping – is critical in many applications. These characteristics will influence operational capabilities such as positional accuracy, repeatability, surface finish and wear.

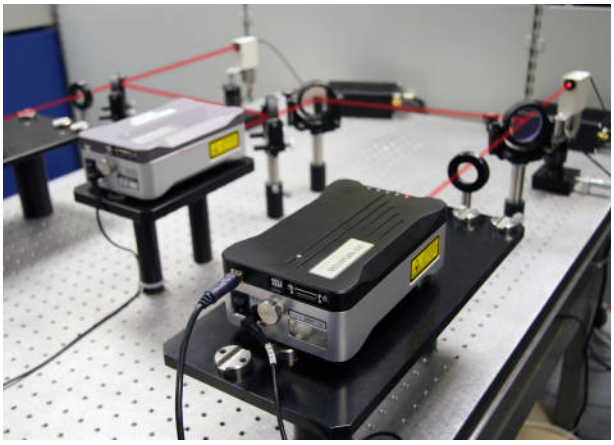
The XL-80 laser measurement system is capable of capturing dynamic data up to 50 kHz.





Dual axis

In some installations, one axis of a machine is controlled by two drives and two feedback systems (for example, spar mills, lathes and large gantry type CMMs). In this instance, two laser set-ups coupled with dual axis software provide the capability to automatically capture data of parallel axes simultaneously.



Laboratory applications

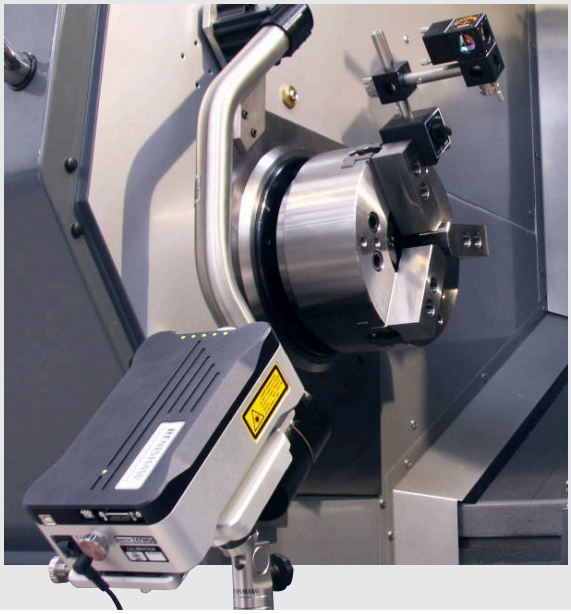
The XL-80 laser has become the system of choice for a variety of laboratory applications since its introduction, including in many of the world's prestigious calibration houses. Its ultra-stable laser frequency, published error budgets, and unbroken path of traceability from the CIPM Mutual Recognition Arrangement (CIPM MRA) make it easy to understand why it so suited as a reference system. A variety of connections and triggering options make the unit flexible and easy to design into a custom rig.

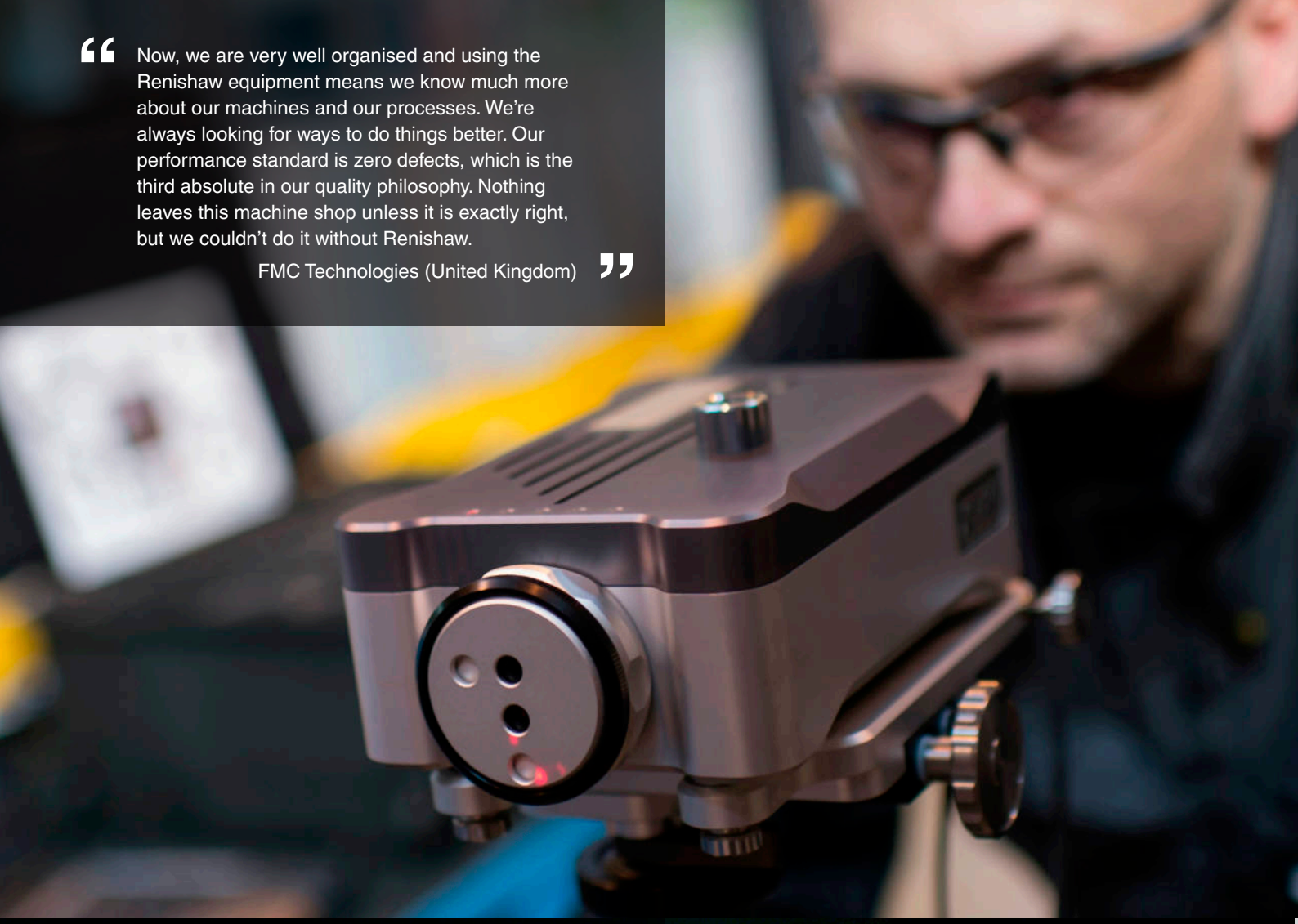
Previous applications have included fixed installation calibration rigs, step gauge measurement and laser frequency calibration rigs.

Special applications

Renishaw design and manufacture solutions based on our knowledge and experience in product applications worldwide.

Please contact your local Renishaw sales office if you have an unusual or specific application, as standard products can often be adapted to provide a custom solution.





> Now, we are very well organised and using the Renishaw equipment means we know much more about our machines and our processes. We're always looking for ways to do things better. Our performance standard is zero defects, which is the third absolute in our quality philosophy. Nothing leaves this machine shop unless it is exactly right, but we couldn't do it without Renishaw.
>
> FMC Technologies (United Kingdom)



> We have found many benefits using Renishaw's XL-80 laser. It is easy to operate, has fast set-up and user-friendly software with an intuitive interface. Compared to the laser brand we used in the past, our efficiency has been enhanced by 30%.
>
> Beijing U-Precision Tech Co., Ltd, (China)

System overview

XL-80 laser

Accurate – an extremely stable laser frequency that is traceable to national and international standards.

The XL-80 laser has an integrated USB port. The laser features an auxiliary analogue signal output as standard, with quadrature output as a factory option. The Aux I/O socket accepts a trigger signal input for remote triggering.

The XL-80 quadrature laser is subject to export control regulations. Note: XL-80 lasers with quadrature output should not be used in a feedback system.

For laser feedback systems, visit **www.renishaw.com/laserencoders**

Tripod and stage

Flexible – a lightweight adjustable tripod for stable positioning of the laser, with a stage for fine setup adjustment.

The tripod stage allows for precise angular rotation and translation of the XL-80 laser. It is designed to be left attached to the laser unit for easy storage and quick set-up. A 'quick fit/release' mechanism enables rapid and secure fixing to the tripod.

For applications where tripod mounting is not convenient, for example, mounting directly on a machine tool table, the stage can be mounted to a magnetic base using an optional adapter.



Key features and benefits

Laser frequency accuracy

±0.05 ppm over three years is achieved by thermal control of the laser tube's length to within nanometres

Accurate

Maintains full measurement accuracy from 0 °C to 40 °C

Traceable measurement

Interferometric measurements directly benefit from the traceability of the laser wavelength. Renishaw calibrations are traceable to signatories of the CIPM MRA, which provides consistent measurement standards around the world

Convenient to align

Lightweight optics and a comprehensive range of quick fixturing solutions. Optics give non-overlapping output and return laser beams to simplify alignment

Easy to set up

Signal strength LEDs and laser alignment features make it simple to set up and quick to use

Thermal stability

The laser heat source is separate from the measurement optics. Anodised aluminium optics acclimatise 10 times quicker than steel optics, whilst being light and durable

XC-80 compensator and sensors

Reliable – environmental compensator allows XL-80 laser measurement accuracy over the full environmental range.

The greatest uncertainty in laser measurements arises from variations in environmental conditions (air temperature, air pressure, and humidity), altering the laser wavelength. The XL-80 laser uses an XC-80 environmental compensation unit and very accurate sensors to automatically compensate measurements for environmental effects.



To compensate for a machine's thermal expansion, up to three material temperature sensors may be connected to the XC-80 compensator. The 'intelligent sensors' process the readings at source. Magnetic attachments and 5 m connectable sensor cables maximise usability.

XL-80 system case

Portable – wheeled system cases offer robust protection.

The tough waterproof system cases feature custom designed foam inserts to minimise shock.

A choice of cases complement different system configurations and feature pockets for storing fixturing or accessories.



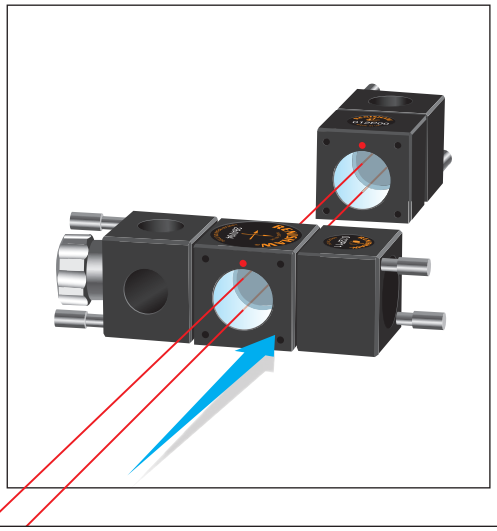
XL-80 measurement types

Linear measurement

This is the most common form of measurement performed with a laser.

When performing linear measurement the XL-80 laser measures the change in relative distance between a reference and measurement optical path. Either optic can be moving, providing one remains stationary. The XL-80 laser system provides accuracy performance of ±0.5 ppm with a resolution of 1 nanometre.

A long range linear kit is available for 40 m to 80 m applications.



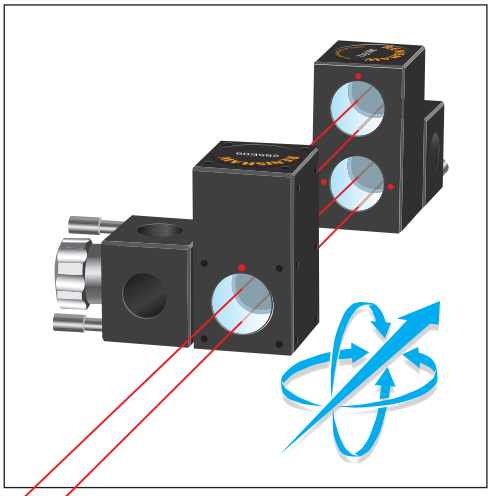
Angular measurement

Angular errors are among the largest contributors to positioning errors in machine tools and CMMs.

Angular measurements are made by monitoring the change in optical path generated between a fixed angular interferometer and the movement of the angular reflector.

The angular set-up can measure maximum angular deflections of up to ±10° with a resolution of 0.01 arc secs.

Angular optics are available with steel housings for greater thermal stability. A combination optics kit is available for single set up of both linear and angular optics.

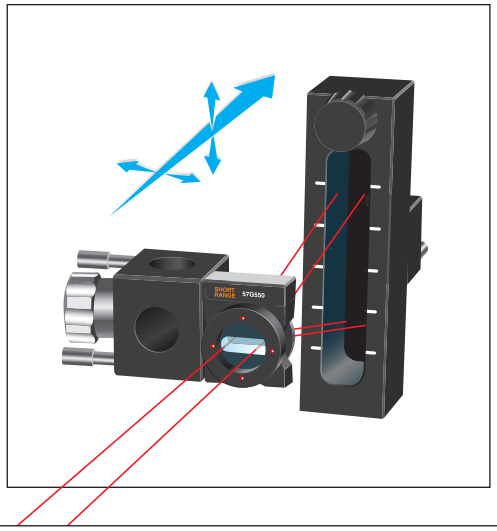


Straightness measurement

This identifies bending or overall misalignment in the guideways of a machine.

This measurement quantifies linear deviation perpendicular to the axis of travel by observing change in the optical path generated by the lateral displacement of the straightness reflector or Wollaston prism. Straightness errors are usually the result of wear in the guideways, a machine collision or poor machine foundations.

A combination of two straightness measurements make it possible to assess the parallelism of independent axes. Straightness kits are available for short axes (0.1 m to 4 m) and long axes (1 m to 30 m).



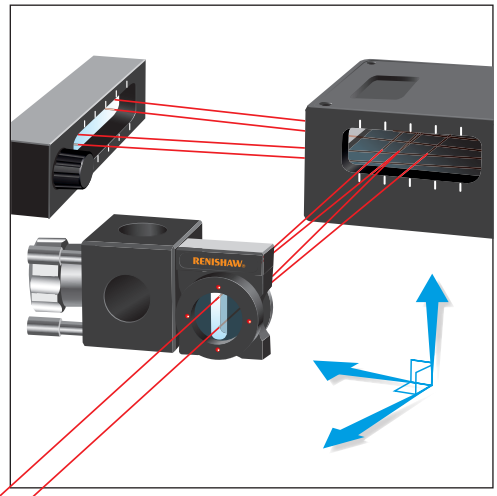
Squareness measurement

This measurement determines the perpendicularity of two nominally orthogonal linear axes.

Squareness errors could be the result of movement in machine foundations, misalignment of home position sensors (on gantry machines) or poor build control. They will directly impact the geometry of parts produced by this machine.

The squareness between two axes can be calculated using a calibrated optical square and combining two straightness measurements.

To complete a squareness measurement involving the vertical axis, additional optical accessories will be required.

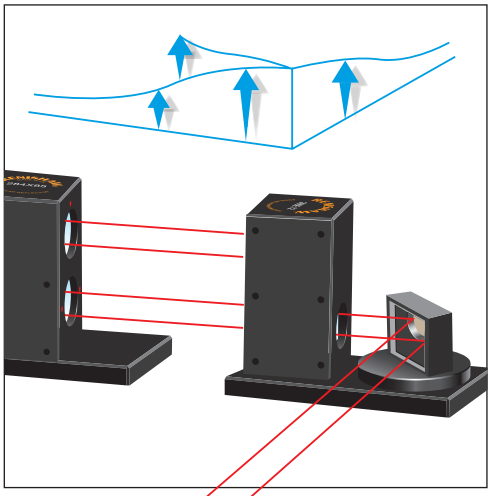


Flatness measurement

This measurement analyses the surface form for CMMs and other nominally flat surfaces.

This enables a 3D picture to be built up and documents the deviations from a perfectly flat surface. If these errors are significant to the application, then remedial work such as lapping, may be required.

The flatness kit contains two mirrors and three sizes of base, providing flexibility for a range of applications.



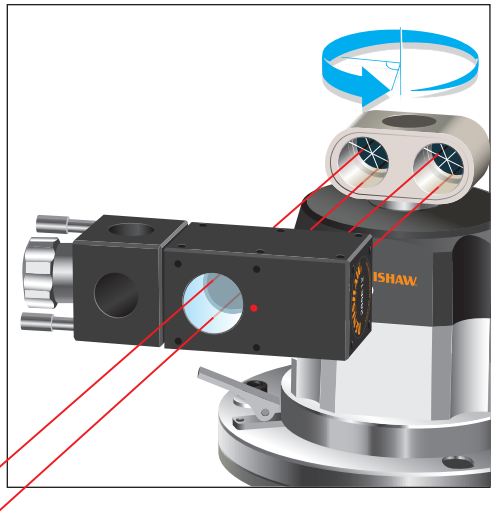
Rotary axis measurement

Rotary axis measurement assesses the indexing performance of a machine's rotary axes.

The rotary set-up measures rotary axis positioning accuracy by comparing the movement displayed on a machine's controller with that measured by the hardware.

The XR20 rotary axis calibrator works in conjunction with the XL-80 and XM-60 laser systems to measure positioning errors to an accuracy to ±1 arc second.

For more information visit **www.renishaw.com/xr20**



Accessories



1 Optics mounting kit

The optics mounting kit is used to mount the measurement optics to the machine under test in a variety of set-ups.

2 Magnetic base

The magnetic base is used for mounting the optics or the XL-80 laser (when used in combination with the XL magnetic base adaptor). The base features an on/off switch for quick mounting and a female M8 fixing thread. The supplied kit contains 2 bases.

3 Large retroreflector

The large retroreflector is used for straightness and squareness measurements involving the vertical axis of the machine.

4 Straightness base

The straightness base is designed to mount the straightness reflector and adjustable turning mirror (or laser beam steerer with fixed turning mirror) for some vertical axis measurements. This base can also be used for the mounting of linear and angular optics.

5 Vertical turning mirror

The adjustable turning mirror is used for directing the beam during straightness and squareness measurements involving the vertical axis of the machine.

6 Swivel mirror

This mirror can be used as an alignment aid for ANSI B5.54 and ISO 230-6 diagonal measurements. It is useful when measuring slant-bed lathes. Clamping screws allow the mirror to be easily attached to measurement optics.

7 Straightness shutter

This shutter allows measurements where the return beam is in the same horizontal plane as the output beam. When used with straightness optics it allows for straightness measurements in the vertical plane.

8 XL magnetic base adaptor

This adaptor allows the tripod stage to be mounted to a magnetic base, or any other fixturing which accepts an M8 thread.

9 Fixed turning mirror

The fixed turning mirror reflects the laser beam through 90°. Like the swivel mirror, it can be attached to the measurement optics to aid optical set-up and is used primarily when there is restricted access to the axis of measurement.



10 Pan and tilt adaptor kit

The pan and tilt adaptor kit is designed to allow flexible mounting of laser calibration equipment at angles between 0° to 90° with an infinite pan rotation.

11 Long range linear optics kit

Over long distances a laser beam diverges. Outgoing and incoming laser beams may interfere with one another. The long range linear kit includes a periscope to separate the beams and a large retroreflector to maintain separation. The target provided makes alignment easier and allows for measurements of between 40 m and 80 m.

12 Small linear optics kit

The small linear optics kit allows an XL-80 laser system to be used in applications where a small and light measurement retroreflector is desirable. The small retroreflector weighs just 10% of the standard linear retroreflector. This minimises the retroreflector's effect on a machine's dynamic performance and provides greater flexibility in its mounting options. The use of these optics limits range to 4 m.

13 LS350 laser beam steerer

This unique optic provides fine angular adjustment of the laser beam in both horizontal and vertical planes, making laser alignment a simple one step process. The beam steerer speeds up linear, angular and straightness measurements, whether in-line or at 90°.

14 Quarter wave plate

The quarter wave plate converts laser light from linear to circularly polarised light. It allows the retroreflector optic to be replaced with a plane mirror for linear measurements. Two common applications where the use of a plane mirror would be beneficial are high resolution systems or where the measurement face moves perpendicularly to the laser beam, for example, on an XY stage. This application requires a highly reflective surface.

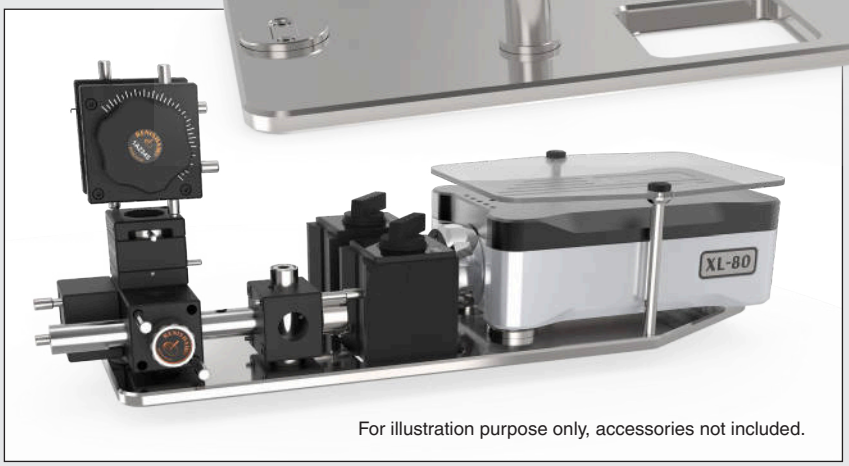
Specialist options

Linear diagonal measurement kit

The linear diagonal measurement kit provides a convenient way to mount and set up a XL-80 laser and measurement optics to a machine tool for checking machine positioning performance along its diagonals, in accordance with B5.54 and ISO 230-6 standards.

The purpose-built fixturing magnetically attaches to a machine tool bed and provides the user with all the optical adjustments needed to meet the challenges of a diagonal set-up. Locating the laser and accessories* on a single plate allows easy transfer to another location for further testing.

*Accessories sold separately.



For illustration purpose only, accessories not included.

TB20 universal kit

The TB20 quadrature trigger box can be used to remotely trigger the XL-80 laser. It monitors the position feedback signals between a machine's encoders and its controller, and feeds trigger signals to the XL-80 laser. This allows synchronisation of scale position or movement to the XL-80 data capture.

The TB20 universal kit is primarily used in applications such as leadscrew or encoder system calibration.



CARTO software suite

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



The intuitive CARTO user interface allows users to begin capturing and analysing data quickly, without the need for training.

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



Automatic test method generation

On completion of a test, test methods are saved automatically, creating a database which can be easily searched for conducting repeat tests.

More data than ever

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

Part program generation

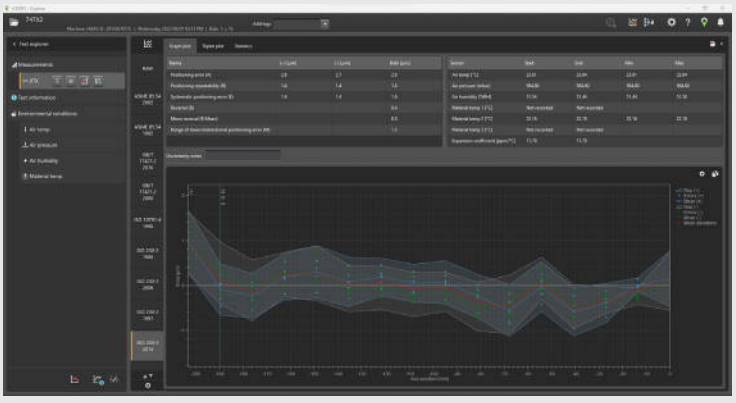
Generate machine tool part programs based on your defined test methods.

Data stitch

Data stitch enables measurement of long axes in several short sections. This allows the use of higher performance short range straightness optics over longer axis measurements.

Explore

Data – analysed



Reporting

Analyse data to international standards to meet your requirements. Create PDF reports using our customisable combined report function.

Compare anything

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

Data manipulation

Analyse data how you want using a built-in comprehensive range of data manipulation tools. Alternatively, data can be exported to comma separated value (CSV) format to be analysed outside of the CARTO software suite.

Data organisation

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

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.

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 laser measurement software used for ML10 and XL-80 products.

Benefits include:

Compensation graphics

Visually demonstrate an expected improvement in positioning performance after compensation.

Custom compensation configuration

Create custom configuration files to suit your 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 allows you to minimise scrap and save costs.

Output in machine tool file format

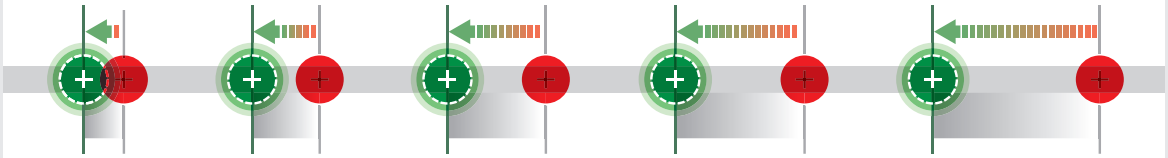
Compensate output files are formatted in native machine tool language, ready for transfer to supported controllers.

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).



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

Performance specifications

All values stated are subject to environmental conditions.

Linear

Specification	Metric
Linear measurement range*	0 m – 80 m
Measurement accuracy (with XC-80 compensator)	±0.5 ppm (±0.5 µm per metre)
Resolution	0.001 µm

* 0 m – 40 m standard. Performance specifications for linear (above) and other measurement modes are quoted to 95% confidence level (k = 2), and are valid across the full environmental operating range.

Angular

Specification	Metric
Axial range	0 m – 15 m
Angular measurement range	±175 mm/m
Angular accuracy **Angular accuracy (calibrated)**	±0.002A ±0.5 ±0.1M µ rad ±0.0002A ±0.5 ±0.1M µ rad*
Resolution	0.1 µm/m

* for 20° C ±5° C
A = displayed angular reading M = measurement distance in metres

Straightness

Specification		Metric
Axial range	**(short range)** **(long range)**	0.1 m – 4.0 m* 1 m – 30 m
Straightness measurement range		±2.5 mm
Accuracy	**(short range)** **(long range)**	±0.005A ±0.5 ±0.15 M^2 µm ±0.025A ±5 ±0.015 M^2 µm
Resolution	**(short range)** **(long range)**	0.01 µm 0.1 µm

A = displayed straightness reading M = measurement distance in metres
* Longer ranges are achievable with data stitch

Rotary

Specification	Metric
Angular target range	up to 25 revolutions
Measurement accuracy	±5 µm/m
Max axis rotation speed	<5˚ axis rotation – unlimited >5˚ axis rotation – 10 rpm
Bluetooth range	Typically 5 – 10 metres
Orientation	Any

Flatness

Specification	Metric
Axial range	0 m – 15 m
Flatness measurement range	±1.5 mm
Accuracy	±0.002A ±0.02 M2 µm
Resolution	0.01 µm
Foot spacing	50 mm, 100 mm and 150 mm

A = displayed flatness reading M = length of the diagonal in metres

Squareness

Specification		Metric
Range		±3/M mm/m
Accuracy	(short range) (long range)	±0.005A ±2.5 ±0.8 M µ rad ±0.025A ±2.5 ±0.08 M µ rad
Resolution		0.01 µm/m

A = displayed squareness reading M = measurement distance in metres of the longest axis

Product specifications

System performance

Maximum travel velocity	4 m/s*
Dynamic capture rate	10 Hz – 50 kHz**
Preheat time	<6 minutes
Specified accuracy range	0 °C – 40 °C

* 1.6 m/s (80 nm quadrature); 0.2 m/s (10 nm quadrature)
** 20 MHz in quadrature mode

Environmental sensors

	Range	Accuracy
Material temperature	0 °C – 55 °C	±0.1 °C
Air temperature	0 °C – 40 °C	±0.2 °C
Air pressure	650 mbar – 1150 mbar	±1 mbar
Relative humidity (%)	0% – 95% non-condensing	±6% RH

XL-80 laser

Laser frequency accuracy	±0.05 ppm
Dimensions (weight)	214 mm x 120 mm x 70 mm (1.85 kg)
Power supply	External, 90 V AC – 264 V AC, auto sensing
Laser output	
Interface	Integral USB comms
TPin (trigger signal)	Yes
Quadrature signal output	Yes (factory option)
Analogue voltage output	Yes
Signal strength LEDs	Yes

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

System cases

	Case 1 (base system)	Case 2 (full system)
Case dimensions (L x H x D)	560 mm x 351 mm x 229 mm	560 mm x 455 mm x 265 mm
System weight*	12 kg – 17 kg	16 kg – 25 kg

*System in case weight depends upon options specified
System weights indicated are for:
Case 1: Linear XL-80 and XC-80 system
Case 2: Linear, angular and straightness XL-80 and XC-80 system

Universal tripod

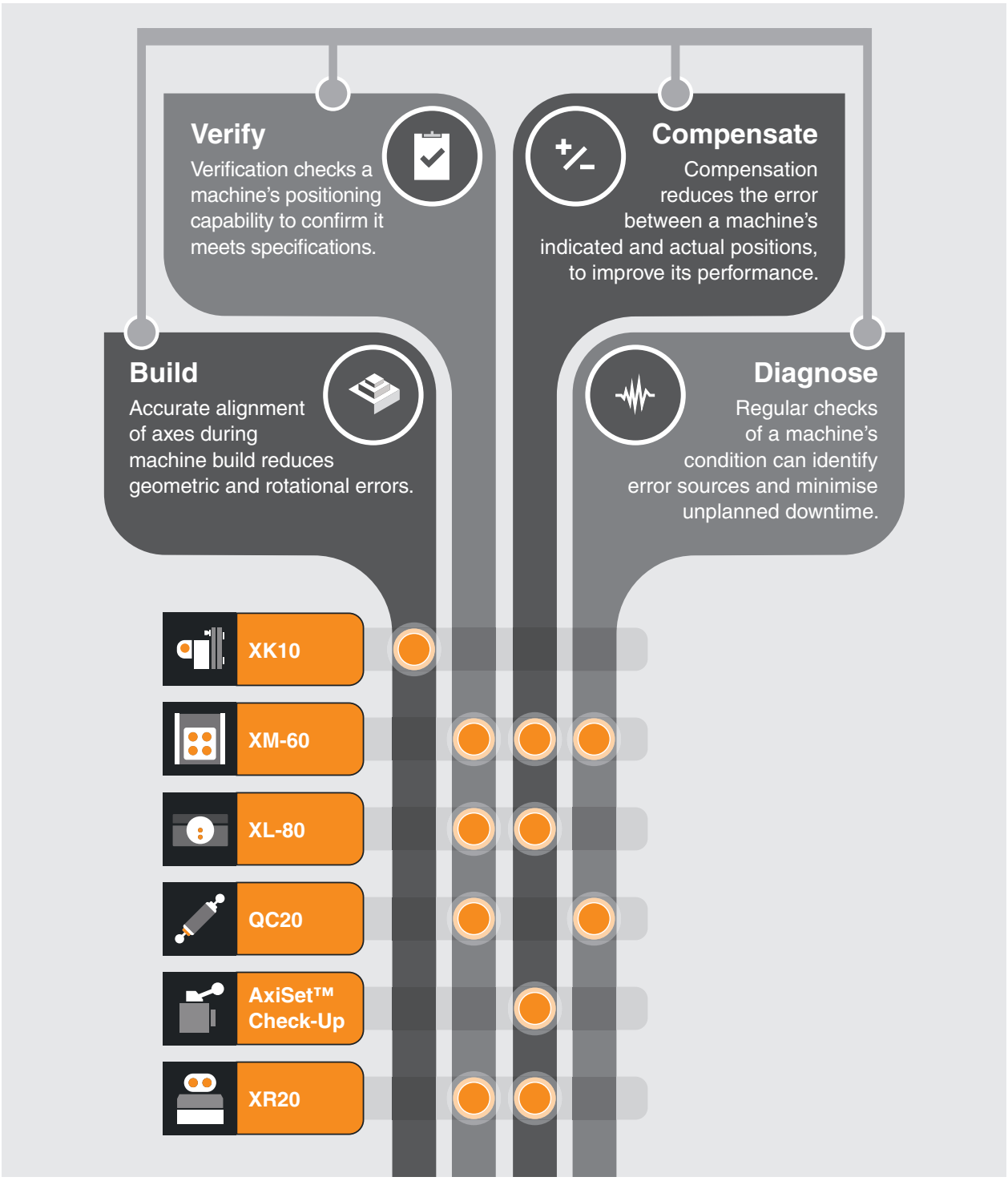
Dimensions folded with boss (weight)	Ø160 mm x 640 mm (3.9 kg)
Working height range (to laser output beam)	Minimum: 540 mm Maximum: 1560 mm (column up)
Case dimensions	170 mm x 170 mm x 670 mm

Certification

Certification	XL-80, XC-80, air and material temperature sensors certificates comply with requirements of ISO 17025
Quality system	ISO 9001, BSI certified

Renishaw's machine measurement solutions

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



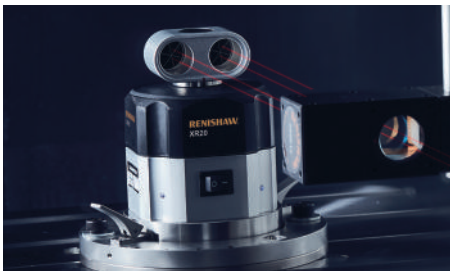
Renishaw's innovation has transformed industrial metrology

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



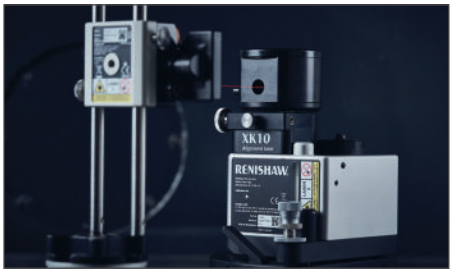
XM-60 multi-axis calibrator system

- Measure six degrees of freedom in any orientation from a single set-up
- Unique technology, optical roll measurement and fibre optic launch



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

- 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

At Renishaw, we 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.

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