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Speed

Accuracy

Flexibility

REVO® high performance 5-axis measurement system

The REVO system's range of tactile scanning, touch-trigger, surface finish, ultrasonic and vision measurement probes provides the choice of an optimum tool to measure multiple features, all on a single CMM platform.

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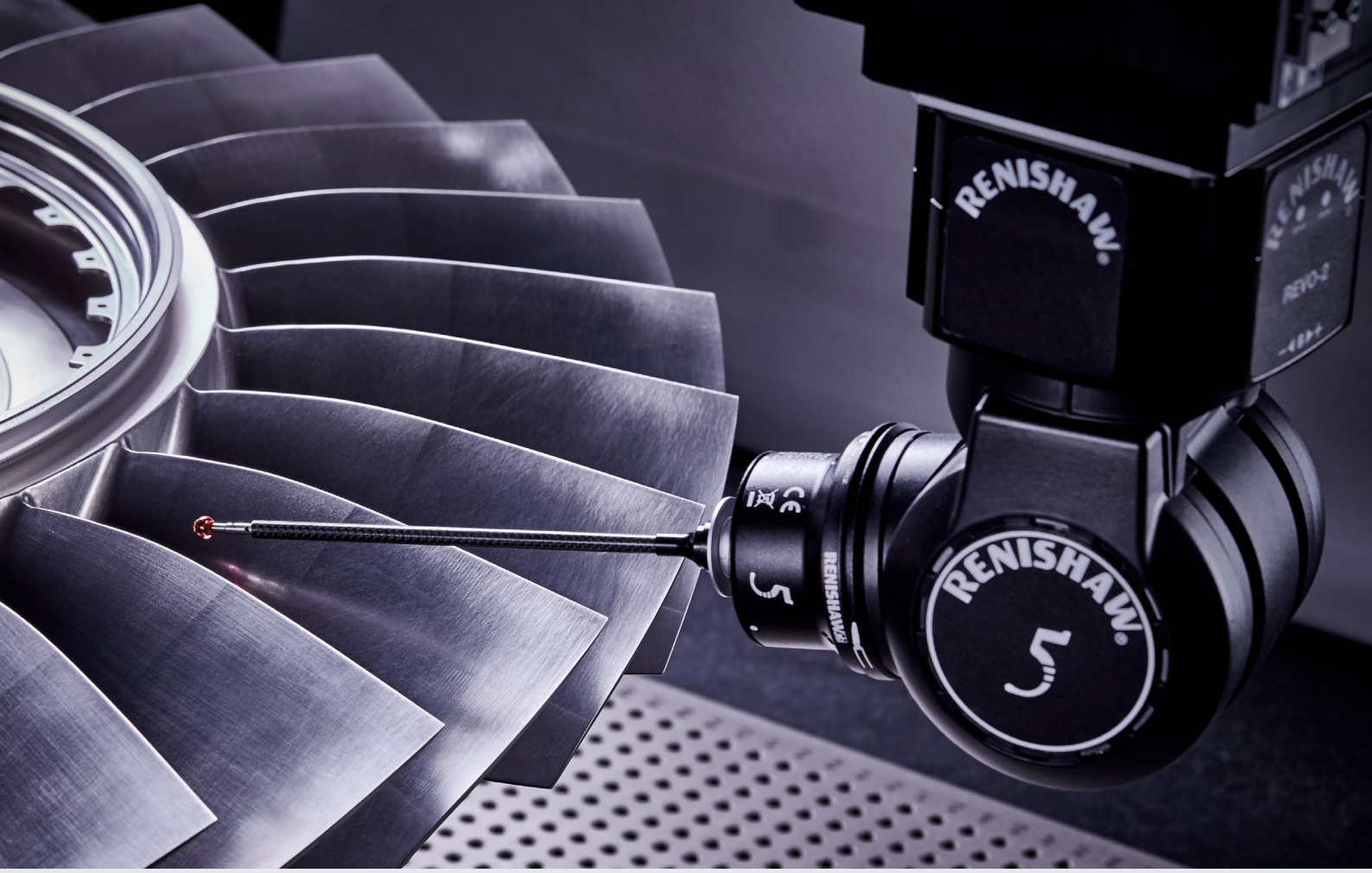


5-axis measurement technology

For more than 40 years, Renishaw has delivered innovations that have been milestones in industrial metrology, from the original touch-trigger probe and motorised indexing head to repeatable stylus changing and modular scanning systems. Renishaw's 5-axis measurement technology represents the biggest step-change in measurement capability that has ever been introduced.

What is 5-axis measurement?

Based on advanced head, sensor and control technology, Renishaw's 5-axis measurement technology delivers unprecedented measuring speed and flexibility, whilst avoiding the speed versus accuracy compromises inherent in conventional techniques. It boosts measurement throughput, minimises lead times and gives manufacturers a more comprehensive appreciation of the quality of their products.

Unlike systems based around indexing heads or fixed probes, 5-axis motion enables the stylus to follow a continuous path around complex components without having to leave the surface to index the head. Controller algorithms that synchronise CMM and head motion produce an optimal tip path and minimise CMM dynamic errors.

Increased throughput with 5-axis measurement

The ultimate scanning speed of a CMM is limited by machine dynamics, typically to between 80 and 150 mm/sec. However, long before this limit has been reached, measurement accuracy decreases – often limiting the effective maximum measuring speed to between 10 and 20 mm/sec.

Non-linear motion on a Cartesian CMM induces accelerations and decelerations that twist and deflect the machine structure, and these dynamic deflections result in measurement errors that increase with measurement speed and acceleration.

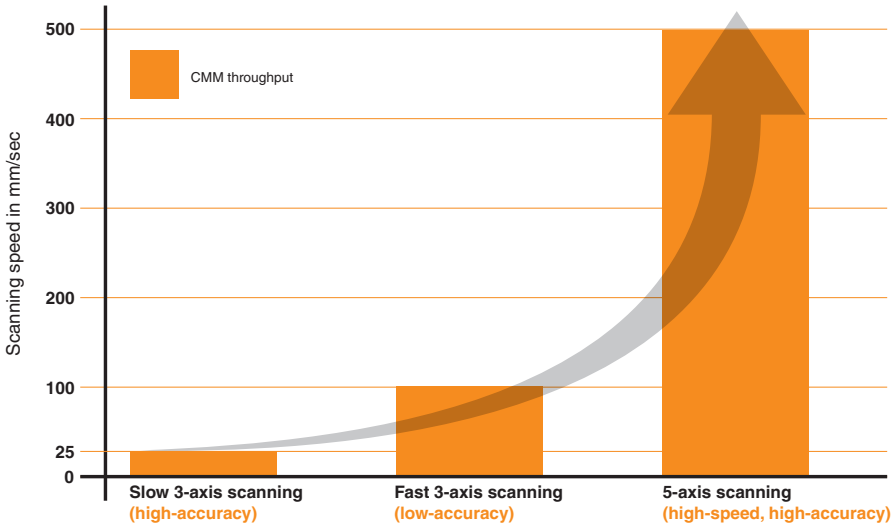
Renishaw's 5-axis measurement avoids those dynamic deflections by minimising machine accelerations whilst moving the stylus very rapidly over the component surface.

Reduce measurement cycle times without compromising accuracy

- Eliminate bottlenecks
- Rapid process feedback
- High-speed head and sensor calibration
- Less time spent indexing and more time spent measuring
- Avoid changing stylus clusters

Advantages of Renishaw's 5-axis measurement

Renishaw's 5-axis measurement breaks through the dynamic performance barrier by minimising the accelerations and hence the inertial loads on the machine structure. The REVO head does most of the measurement work, enabling exceptional throughput without compromising accuracy.



Renishaw's unique 5-axis measuring techniques

The 5-axis motion and infinite positioning capability of the REVO head enable blended scanning, seamlessly combining two different scanning techniques. Bores can be measured using touch points, circular scans or helical scans, whilst data on contoured surfaces and edges can be captured with a sweeping motion of the head.

5-axis scanning

- Simultaneous motion control of 5 axes
- Data gathered 'on the fly' whilst the head is moving
- Dynamic 2-axis head provides most of the stylus motion
- Unique tip-sensing probe technology
- Scanning with 5 axes of simultaneous motion allows unparalleled measurement flexibility

REVO® 5-axis multi-sensor scanning system

Every process and feature in a REVO system has been designed to enable users to achieve previously unobtainable levels of inspection throughput:

- 5-axis complex form scanning; REVO's ability to gather very large quantities of accurate inspection data at ultrahigh scanning speeds is invaluable
- Very high-speed gathering of touch points using the servo head's infinitely variable 2-axis motion
- Innovative, patented tip-sensing probe technology allowing the sensing to be very close to the surface measured, yielding better accuracy, even with long styli
- Novel calibration; Renishaw's 5-axis measurement tip-sensing probe (RSP2) requires only a single tip calibration to be accurate at all angles of rotation, typically saving several hours in the set-up routine
- Infinite positioning and 5-axis synchronised motion, which facilitates access to features with far fewer stylus configurations than a fixed scanning head
- Multi-sensor capability for optimum probe selection, with all data being in the same co-ordinate reference frame

The REVO system consists of the following elements:

- REVO-2 measuring head
- Multi-sensor options providing tactile scanning, non-contact vision, surface finish and ultrasonic measurement
- 5-axis measurement fully integrated control loop achieved using Renishaw's UCC S5 controller and SPA servo power amplifier
- A REVO system change rack designed to allow automatic probe and stylus holder changing

REVO-2 dynamic measuring head

The REVO-2 measuring head features spherical air bearing technology in each of its 2 axes, driven by brushless motors linked to high-resolution encoders to provide fast, high-accuracy positioning.

- Infinite positioning and 5-axis motion reduce non-productive transitions between features and allows access to difficult features
- Rapid calibration with all positions inferred means more time measuring
- Maximum reach up to 800 mm from centre of head rotation
- Multi-sensor probe and stylus changing capability

Measure faster
- Up to 50 times faster surface speed than 3-axis scanning

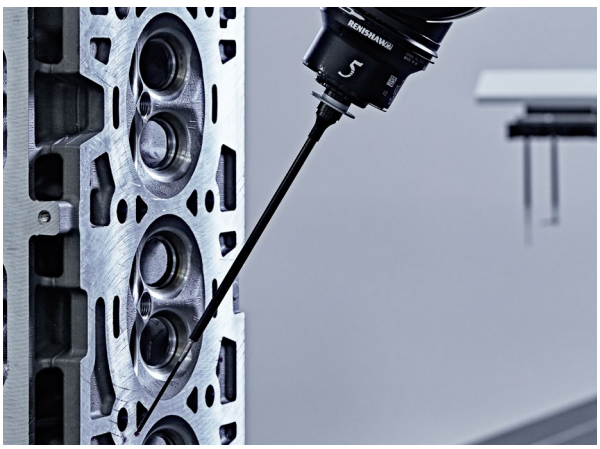
Measure more points
- 4000 points per second acquisition rate

Measure more accurately
- With the REVO tip-sensing RSP2

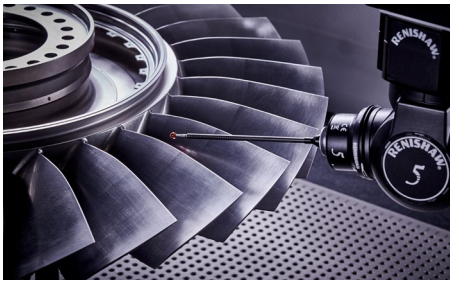
Measure more features
- Infinite positioning for unparalleled flexibility

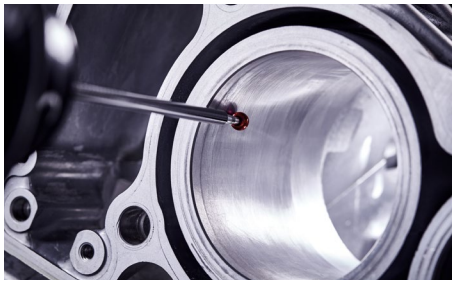
Measure without compromise
- 100% inspection for optimal part verification and process control

Measure surface finish
- Integral motorised C-axis rotation for optimised feature access
- Automated, operator-independent CMM surface finish measurement



REVO® system probes





RSP2

RSP2 is a dedicated lightweight tip-sensing probe for use on REVO systems, capable of 2D-scanning (X, Y) and 3D-touch-trigger measurement.

The RSP2 has a universal body to which a number of different length stylus holders, with a maximum reach of 500 mm, can be fitted. The RSP2 works by using an enclosed laser that is directed onto a reflector at the stylus tip. As the stylus touches the part and bends, the reflector is displaced. The altered return path of the laser is then sensed and the exact tip position of the stylus is known because the reflector and stylus ball are close together. Stylus wear is minimised by the low scanning forces that are used.

RSP3

RSP3 provides the REVO system with 3D-scanning (X, Y, Z) and crank stylus capabilities.

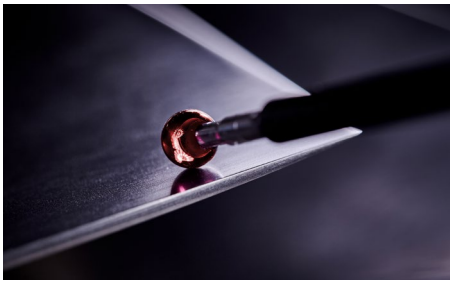
The RSP3 is used for 3-axis scanning with a fixed REVO-2 head angle during measurement. The range of probes allows different lengths of stylus to be used whilst maintaining optimum metrology performance.

The probe's pivoting motion system has two diaphragm springs, one of the RSP3 springs allows movement in all directions whilst the other (pivot) spring is stiff in (probe) X and Y, but allows movement in Z.

The RSP3 probe and module elements are built as one. A family of RSP3 probes is available to allow a range of stylus lengths to be used.

RSH range for RSP2

RSH3 range for RSP3



RSP3-6

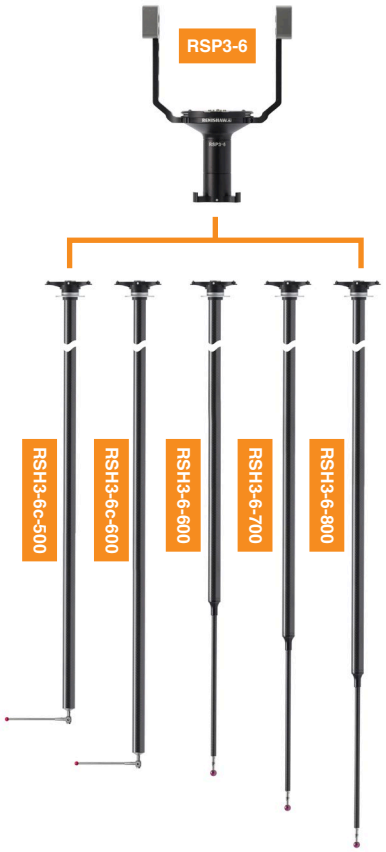
RSP3-6 provides enhanced capability for accessing deep bores and inspecting features within large parts.

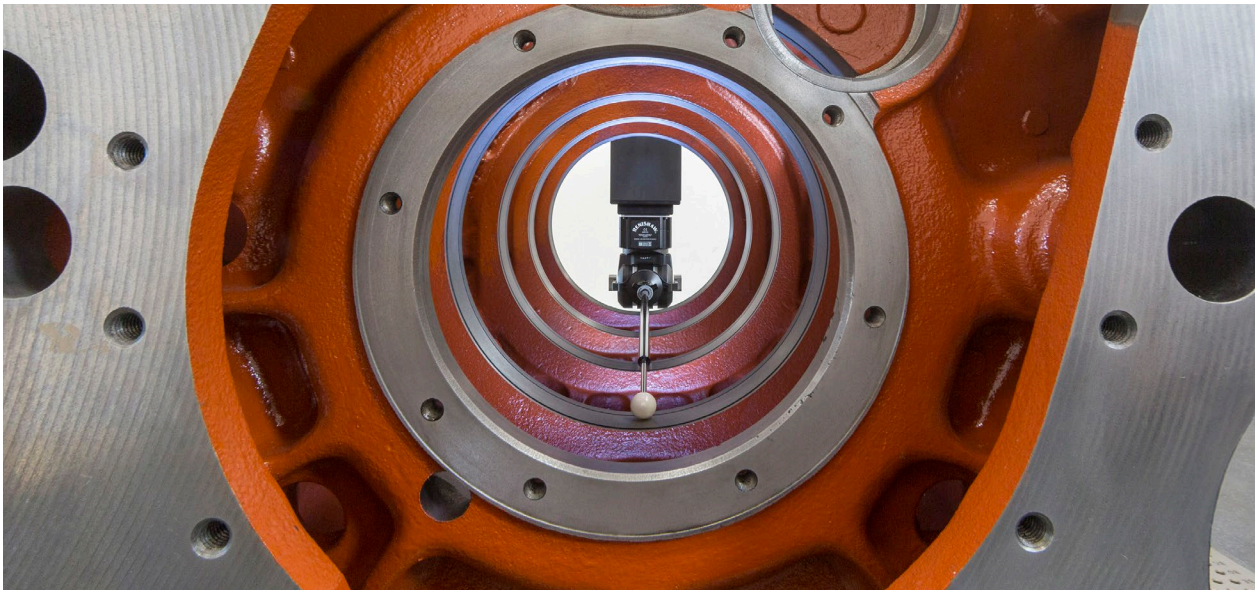
The probe can carry a range of stylus holders for applications requiring straight and cranked extensions and can be used for both touch-trigger and 2D scanning measurement.

RSP3-6 key benefits:

- Reach - Available with straight extensions up to 800 mm from REVO-2's A-axis centre of rotation, and cranked extensions up to 600 mm
- Accuracy - Scanning accuracy; typically better than 10 µm form error (filtered) and 5 µm diameter error. Touch-trigger accuracy; typically better than 3 µm form and diameter error
- Part of the REVO 5-axis multi-sensor system - Long extensions combined with 5-axis movements for better part access and multi-sensor changing for increased flexibility

RSH3-6 range for RSP3-6





SFP2 surface finish probe

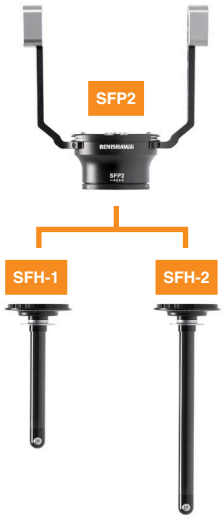
Surface finish measurement has traditionally required the use of hand-held sensors or moving the part onto a dedicated measuring machine.

The SFP2 probe makes surface finish inspection an integral part of your CMM measurement, enabling automatic switching from dimensional to surface finish measurement.

The SFP2 probe offers numerous benefits

- SFP2 benefits from the REVO system's infinite positioning and 5-axis movement, and features an integral motorised C-axis
- CMM programs can include automated and operator-independent surface finish measurement. All results, including surface finish data, are recorded and stored in a single location for easy retrieval
- Integrated surface finish and dimensional inspection can remove the need for dedicated surface measurement equipment, reducing factory footprint and eliminating the risks and overhead of unnecessary part handling

SFH range for SFP2



SFM surface finish modules

The SFP2 module variants offer a range of tip arrangements which, combined with the knuckle joint between module and holder, provide access to the most difficult to reach features.

Each SFM module is its own miniature measuring device, incorporating Renishaw's proprietary encoder system to transduce the motion of the stylus tip. Specialised modules have been designed to meet the unique demands of specific part features such as valve guide ways, curved blade surfaces and spool bore short lands.

The SFM-A series are designed for general purpose, SFM-B for scanning close to obstructive faces, SFM-C for automotive engine valve guide ways, SFM-D for rotors, blisks and blades (especially fillet radii), SFM-E for automatic transmission valve bodies, valve seats, and minimum feature access, SFM-G for inspection of small groove feature, and SFM-H for scanning with large cut-off values.

SFM range

RVP vision probe

RVP provides high performance 5-axis measurement for non contact applications.

5-axis motion between part features and real time image processing dramatically increase data collection rates for small features and delicate or flexible parts that cannot be measured using tactile probes.

The RVP system comprises a vision probe body, vision modules, rack ports and a calibration artefact. The image capture and processing components of the system are held inside the vision probe body and include an industry standard, robust, CMOS sensor for reliable image capture.

The vision modules allow a range of features with different sizes and shapes to be inspected. All vision modules contain integral LED lighting to achieve a sharp contrast between holes and part material. Background feature enhancement is also available using backlighting combined with bespoke part fixturing.

VM range for RVP

Enhanced access for non-contact vision measurement

The angle change mirror (ACM) is an accessory designed to enhance access for the RVP non-contact vision system. Using a precision, first-surface mirror, ACM rotates the field of view through 90° allowing vision inspection of bore surfaces and other features previously inaccessible to RVP.

ACM is ideal for automotive applications where engine cylinder bore surfaces and electric-motor stator features can be difficult to access.

Stator electrical connectors and insulation paper can be easily inspected using RVP, while ACM provides access to these components inside the stator bore.

Honing marks inside engine cylinder bores can also be easily accessed and inspected.

ACM mounts magnetically to a kinematic ring on VM11-2 vision module allowing orientation at multiple positions to maximise part accessibility. 24 positions are available at 15° intervals around the VM11-2 axis. The orientation can be altered, or the ACM changed, automatically using the VMCP REVO port.

RUP1 ultrasonic probe

The RUP1 ultrasonic probe increases the multi-sensor capability of the REVO system, offering ultrasonic thickness inspection.

Unlike many other ultrasonic systems, the RUP1 probe uses an innovative elastomer tip ball to provide excellent coupling between the probe and the material.

System characteristics

The RUP1 probe is fully compatible with the MRS2 change rack using the RCP TC-3 rack change port and is interchangeable with all other probe options available for the REVO system.

The RUP1 probe is fully integrated into MODUS™ metrology software (version 1.12) and UCCsuite software (version 5.8). It includes features such as geometry and material calibration, tip ball size monitoring and compensation, automatic calculation of REVO head positions based on the back-wall angle for non-parallel surfaces, and tip life monitoring.

RUP1 key benefits:

- The RUP1 probe removes the need for skilled operators to interpret oscilloscope screens, and it releases shop floor real estate as immersion tanks and deep bore CMMs are not required.
- The tip ball is user-replaceable and is preserved by a protective cap that can be automatically removed and replaced to maximise tip life.
- The RUP1 probe uses a 20 MHz transducer and provides a thickness measurement range of 1 mm to 20 mm with an accuracy of better than 10 µm using touch points.

5-axis measurement controller technology

Renishaw's UCC controllers provide the powerful platform for 5-axis measurement systems, bringing unprecedented flexibility and productivity to CMM users.

The UCC S5 is designed to meet the exacting demands of 5-axis scanning and the processing of 4,000 data points per second at speeds of up to 500 mm/sec. It also provides smooth, simultaneous motion of the CMM and head axes ensuring minimal dynamic deflection of the CMM structure for optimal metrology performance.

Renishaw's UCC controllers support the I++DME command protocol which is also supported by the majority of CMM metrology software products.

The system operates on a Client (application software) / Server (controller software) basis where the responsibility for metrology performance lies with the server. Renishaw has developed the UCCserver application to manage all aspects of CMM metrology and probe calibration.

There are two hand controllers available for REVO equipped machines, the wired MCU5-2 and the wireless MCU W-2. Each one provides multi-functional control of the machine, REVO head and probe. The W-2 joystick has a working range of 25 m from its base station and a battery life of more than 8 hours.

The REVO-2 probe changer system

The REVO-2 probe changer system allows automatic REVO-2 probe and stylus holder changing, enhancing flexibility through the use of a range of stylus configurations.

RCP TC-2 and -3 are thermally controlled ports specially designed for changing the REVO probes. RCP TC-2 is used for RSP2 and RSP3 probes. RCP TC-3 is used for RSP3-6 and RUP1 probes.

RCP TCs key benefits:

- Maintain the probes at operating temperature when not in use, for optimum metrology.
- Compatible with MRS1 and MRS2.

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A history of innovation

Renishaw is an established world leader in engineering technologies with a strong history of innovation in product development and manufacturing. Our metrology leadership and our reputation for engineering excellence have put us at the forefront of our markets since 1973.

We design, develop, and deliver solutions and leading-edge products that help manufacturers maximise production output, significantly reduce the time taken to produce and inspect components, and keep their machines running reliably.

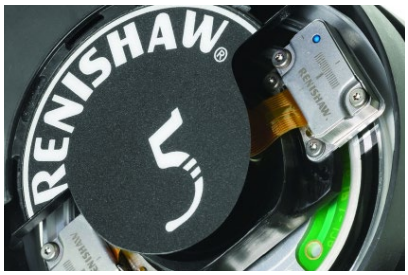
A worldwide network of subsidiary companies and distributors provides exceptional service and support for our customers.

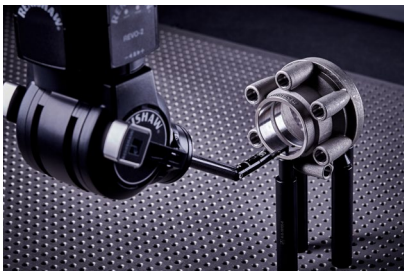
Solutions for CMM users

- Probe systems
- Controllers and interfaces
- Diagnostics and calibration systems
- Position encoders
- Styli
- Metrology fixtures
- Software solutions
- Racks and accessories

Additional smart manufacturing solutions

- Probing and measurement systems for automated machining
- Machine diagnostics and preventative maintenance
- Renishaw Central manufacturing data platform
- 3D scanning on machine tools
- Equator™ shopfloor gauging for process control close to the point of manufacture





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