RENISHAW
apply innovation™

Pocket guide to probing solutions for CNC machine tools

Process control solutions







Improve part quality and accuracy and increase the efficiency of your CNC machining centre

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apply innovation™

CNC machine tool probing solutions …

Renishaw's range of process control solutions provides a systematic approach to eliminating variation at all stages of your machining process, backed by innovative technology, proven methods and expert support. This pocket guide provides an overview of Renishaw's solutions for CNC machine tools and the benefits that these can bring to your manufacturing business.

Probing is an established best practice for maximising the efficiency, quality, capability and accuracy of machine tools. As such, the integration of Renishaw probing hardware and software is widely adopted within machining processes.

This booklet explains the basics of probing, from its many benefits; through process control; to product specifications and selection.



Further information can be found via the links provided throughout, or by contacting your local Renishaw office.

www.renishaw.com/contact



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Renishaw profile

Why choose Renishaw?

We offer a comprehensive suite of metrology, advanced manufacturing and process control solutions to enable manufacturers to maximise their productivity and achieve the capabilities they need.

A world leader in engineering technologies, Renishaw applies its core skills in measurement and precision machining to sectors as diverse as dimensional metrology, spectroscopy, machine calibration, motion control, dentistry and surgical robotics.



Solutions for industrial metrology and manufacturing

Our sensors for co-ordinate measuring machines (CMMs) are an industry standard, from basic touch-trigger probes through to automated stylus and probe changers, motorised indexing probe heads, and revolutionary 5-axis measurement systems.

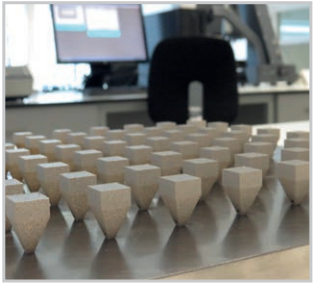
For machine tool users, contact and laser probes for CNC machine tools allow automated tool setting, workpiece set-up, on-machine gauging and verification of parts and processes. They enable reduced setting and inspection times and eliminate, or control, sources of process variation – key requirements for the efficient production of good parts.

Additional supporting technologies for manufacturers include systems to verify and calibrate machine positioning performance, and control and improve manufacturing processes, as well as position encoders and additive manufacturing systems for metal 3D printing.

Manufacturing at Renishaw

Precision high-quality manufacturing, closely coupled to its design operations, is a core element of Renishaw's business strategy. For over 20 years, the company has embraced the principles of design for manufacture, coupled with a relentless focus on eliminating or controlling sources of process variation in its machining operations. The results are predictable, automated, productive processes and faster new product introductions.





The company invests in the latest CNC machine tools, and has many machines of various types, including 4- and 5-axis machining centres, multi-turret mill-turning centres, plus sliding-head and conventional lathes.

By using process control solutions in its own busy production environment, Renishaw understands the true potential of probing. Based on experience, it is able to explain the value that probing brings to a manufacturing organisation.

Why Probe?

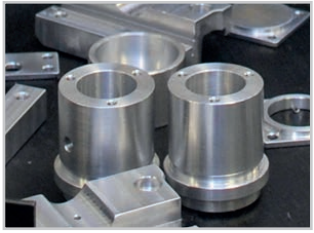
Time is money, and time spent manually setting workpiece positions and inspecting finished products will impact on your manufacturing performance and profitability. Renishaw probing systems eliminate this costly machine down-time and associated scrapping of components.

Increase throughput from your existing assets

If your machines are overloaded, you could face a sizeable capital investment to make up the shortfall, a large sub-contract bill, or worse still, turn away profitable work.

But what if you could extract more throughput from your existing machinery? You could:

- defer capital expenditure
- reduce your sub-contract and overtime bills
- pursue additional business



Increase automation and reduce human intervention

Are you reliant on skilled operators to keep your machines running, leading to high labour costs and a substantial overtime bill? Or perhaps your engineers are tied up with shop support?

What impact would lower direct labour and shop support costs have on your competitiveness? You could:

- automate manual setting and measurement processes
- reduce direct labour costs
- redeploy staff into proactive engineering roles

Reduce rework, concessions and scrap

Scrapping parts is a waste of time, effort and materials. Similarly, rework and concessions lead to late deliveries, fire-fighting and overtime.

If you could largely eliminate such quality costs, how would this help your responsiveness and profitability? You could:

- improve conformance and consistency
- lower unit costs
- have shorter lead times

Enhance your capability and take on more work

Customers are demanding ever more complex work whilst regulations are driving greater traceability throughout the manufacturing process. Are your capabilities keeping pace with the needs of your market?



Do you need a cost-effective way to boost the capability of your machining and inspection processes? You could:

- offer your customers state-of-the-art capabilities
- take on more complex work
- meet customer demands for traceability

Reduce your total cost of ownership

Buying and maintaining manufacturing equipment presents an up-front and ongoing cost to your business. Are you tied to inflexible, out-dated metrology equipment with high running costs?

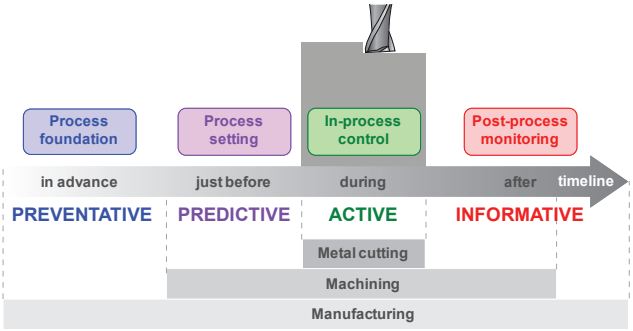
What impact would reduced total cost of ownership have on your bottom line? You could:

- buy fewer, more productive machines
- eliminate expensive, inflexible custom gauges
- reduce calibration and maintenance costs

The Productive Process Pyramid™

Building on its own experiences developing robust manufacturing processes, Renishaw has developed a simple framework to explain how metrology solutions can deliver successful processes through the application of process control.

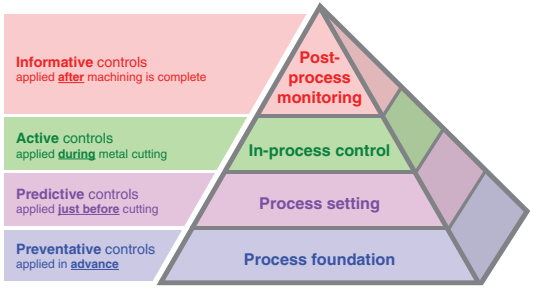
Renishaw's solutions improve machining performance and increase manufacturing capability. Renishaw's process control solutions can be applied in advance of, just before, during and after metal cutting.



- In advance of metal cutting, Renishaw's **process foundation** solutions maximise the stability of the process, environment and machine.
- Just before metal cutting, Renishaw's **process setting** solutions establish the location and size of machining system elements.
- During metal cutting, Renishaw's **in-process control** solutions enable machines to respond to inherent variation and actual conditions.
- After metal cutting, Renishaw's **post-process monitoring** solutions log process routes and verify the process and part.

Renishaw uses process controls identified by the manufacturing timeline to build its Productive Process Pyramid.

The Productive Process Pyramid shows how layers of control can be used systematically to remove variation from the machining process.



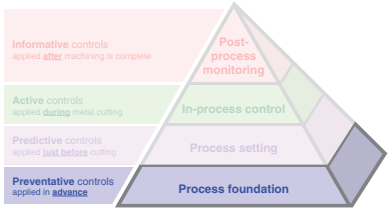
The Productive Process Pyramid™

Productive Process Patterns™

Productive Process Patterns™ from Renishaw provide guidance on best practice and the implementation of a wide range of probing solutions.



For further information, please see **www.renishaw.com/processpatterns**

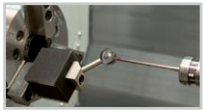


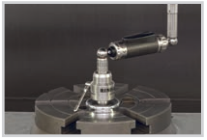
Process foundation

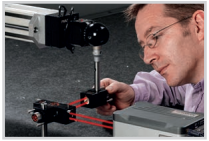
PREVENTATIVE
solutions

Controls in the base layer of the Pyramid are targeted at maximising the stability of the environment in which the process is to be performed. These preventative controls stop special causes of variation having an impact on the machining process.

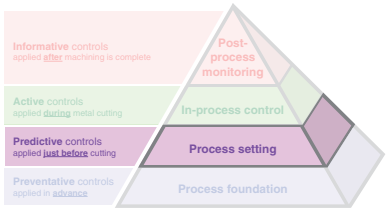
Controls in the process foundation layer include:







- **Design for manufacture –** approaches to product and process design based on a thorough understanding of current capability and a drive towards best practice.
- **Control of process inputs –** involves the use of FMEA and similar techniques to understand and control all the upstream factors that can affect machining process outcomes.
- **Environmental stability –** addresses external sources of non-conformance that cannot be eliminated in advance.
- **Process design –** a systematic approach to sequencing the manufacturing process to enhance process stability and automation. This includes integrating process feedback into the process at critical stages.
- **Machine condition optimisation –** an inaccurate machine cannot make consistently accurate parts. A rigorous process of performance assessment, calibration and (where required) refurbishment can bring the machine's performance in line with the process requirements.



Process setting

PREDICTIVE
solutions

Process-setting controls are on-machine activities, required just before metal cutting, which predict whether the process will be successful.

Tool setting establishes:



- length from the spindle gauge-line to establish a height offset, and to check that length is within the specified tolerance.
- diameter when spinning to establish a tool size offset.

Part setting establishes:

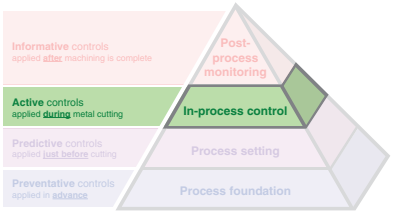


- component identification to select the correct NC program.
- position of a datum feature to establish a work co-ordinate system (WCS).
- billet/component size to determine stock condition and roughing cut sequence.
- orientation of a component (relative to machine axes) to establish the co-ordinate rotation.

Machine setting establishes:



- alignment of a rotary axis, indexer or fixturing elements required to position and hold components.
- position of an indexer's centre of rotation and/or reference points on fixture elements.



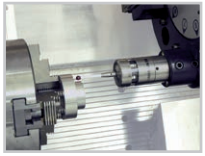
In-process control

ACTIVE
solutions

Controls in this Pyramid layer include actions embedded within the metal cutting process that automatically respond to material conditions, inherent process variations and unplanned events, giving the best chance of a successful process.

On-machine gauging allows:

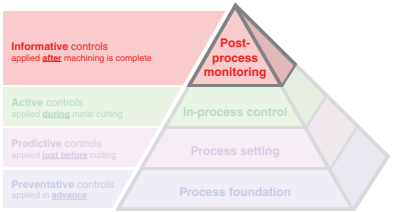
- metal cutting to adapt to variations in the machining process such as part distortion, tool deflection and thermal effects.
- updating of co-ordinate systems, parameters, offsets and logical program flow depending on actual material conditions.



Broken tool detection recognises:

- presence of a tool.
- tool position – to ensure pull-out has not occurred.
- broken and/or chipped tool edges.





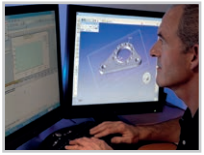
Post-process monitoring

INFORMATIVE
solutions

The top layer of the Pyramid involves monitoring and reporting activities that provide information about the outcome of completed processes which can then be used to influence subsequent activities.

Process logging records:

- events that happen during the machining process such as manual or automated changes to process parameters, offsets or co-ordinate systems.
- interventions to the process which may have influenced the outcome.



On-machine verification enables:

- inspection of critical features in the same environmental conditions as the metal-cutting process.
- confidence in the stability of the machining process.

Post-process reporting allows:

- documented records of component conformance.
- historical tracking of critical feature dimensions for machine condition monitoring and scheduled maintenance purposes.



For further information, please see **www.renishaw.com/processcontrol**

Product application guide

Identify which machine tool probes are suited to your application

Machine types		Vertical CNC machining centres 			Horizontal CNC machining centres 			Gantry CNC machining centres 	CNC lathes 			CNC multi-tasking machines 			CNC grinders 
Products		S*	M*	L*	S*	M*	L*	All	S§	M§	L§	S‡	M‡	L‡	All
Standard accuracy probes repeatability 1.00 µm (40 µin) 2σ	OMP40-2	●	●		●	●						●			
	OLP40								●	●		●			
	OMP60		●	●		●	●					●	●		
	RMP40	●	●		●	●						●	●		
	RLP40								●	●	●	●	●		
	RMP60		●	●		●	●	●					●	●	
	LP2	●	●	●	●	●	●		●	●	●	●	●	●	●
High accuracy probes repeatability 0.25 µm (10 µin) 2σ	OMP400	●	●		●	●						●			
	OMP600		●	●		●	●					●	●		
	RMP600		●	●		●	●	●				●	●	●	
	MP250														●
Contact tool setters and broken tool detection	OTS	●	●		●	●									
	RTS		●	●		●	●	●							
	TS27R	●	●	●	●	●	●	●							
	LTS	●	●	●	●	●	●	●							
Non-contact tool setters and broken tool detection	NC4	●	●	●	●	●	●	●				●	●	●	●
Non-contact broken tool detection	TRS2	●	●	●	●	●	●	●				●	●	●	
Contact tool setting arms	HPRA								●	●	●	●	●	●	
	HPPA								●	●	●	●	●	●	
	HPMA								●	●	●	●	●	●	
	HPGA								●	●	●	●	●	●	●

*Table sizes	S (Small)	M (Medium)	L (Large)
	<700 mm × 600 mm	<1200 mm × 600 mm	>1200 mm × 600 mm

	S (Small)	M (Medium)	L (Large)
§	Chuck size 6 in to 8 in or smaller	Chuck size 10 in to 15 in	Chuck size 18 in to 24 in
‡	Working range <1500 mm	Working range <3500 mm	Working range >3500 mm

Industry-leading technology and performance

Breakthrough solutions are at the heart of Renishaw's business strategy, which is captured by the phrase '**apply innovation'.** The innovative product design is a result of unparalleled investment into R&D, allowing Renishaw to offer you **market leading solutions** to help your business.





Modulated optical transmission is used for all new generation 'OMP' probes, providing the highest level of resistance to light interference.

Frequency hopping spread spectrum (FHSS) is a unique transmission system that does not use a dedicated radio channel. Instead, the probe and receiver 'hop' together through a sequence of frequencies, enabling multiple probe systems and other industrial equipment to coexist, with negligible chance of interference.

RMI-Q multiple probing is a combined transmitter, receiver and interface unit that enables individual radio turn-on and operation of up to four separate Renishaw radio probes. This permits numerous combinations of radio probes and/or radio tool setters to be used on the same machine tool. Unlike the optical transmission systems, line-of-sight between the probe and receiver is not necessary.

RENGAGE™ strain gauge technology brings unrivalled 3D measurement performance and repeatability and is used in the OMP400, OMP600, RMP600 and MP250 probes.

MicroHole™ and **PassiveSeal™ technologies** are used in Renishaw's NC4 non-contact system providing unique environmental protection from the harsh machining environment. This ensures IPX8 protection 100% of the time.

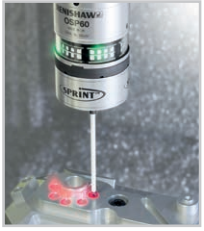
ToolWise™ technology is used in Renishaw's TRS2 non-contact broken tool detection system and can distinguish between the tool and coolant or swarf.

SwarfStop™ technology is an additional metal sealing device on the HPGA, positioned between the hub and base, acting as a physical barrier for environmental protection.

SupaTouch technology automatically optimises on-machine measurement cycles to minimise cycle time and maximise productivity.

SPRINT™ on-machine scanning technology enables measurement strategies that allow fast and accurate form and profile data capture from both prismatic and complex 3D components.





Standard accuracy machine tool probes

"Previously it could take 1.5 hours to set a job that took 4.5 hours of machining; that was totally unacceptable. Now we can do the same set-up in 10 minutes, immediately freeing up 1 hour 20 minutes to cut more metal, which we make money on."

Sewtec Automation (United Kingdom)







Probe	OMP40-2	OLP40	OMP60
Dimensions	Ø40 mm × 50 mm (1.57 in × 1.97 in)	Ø40 mm × 58.3 mm (1.57 in × 2.30 in)	Ø63 mm × 76 mm (2.48 in × 2.99 in)
Machine type	Small to medium	Lathe	Medium to large
Transmission type	Infrared (optical)	Infrared (optical)	Infrared (optical)
Performance accuracy	Standard (kinematic)	Standard (kinematic)	Standard (kinematic)
Repeatability	1.00 µm (40 µin)	1.00 µm (40 µin)	1.00 µm (40 µin)
3D lobing in X Y Z	N/A	N/A	N/A
Maximum recommended stylus length	100 mm (3.94 in)	100 mm (3.94 in)	100 mm (3.94 in)
Switch ON method	Optical M-code; auto start	Optical M-code; auto start	Optical M-code; auto start; spin or shank switch
Battery type	1/2 AA	1/2 AA	AA

Standard accuracy machine tool probes

"Through Renishaw we discovered machine tool probe measurement solutions that could deliver in-process measurement control and real-time data feedback … This was a massive help in terms of increasing production efficiency and precision."

SuperAlloy Industrial Company Ltd (Taiwan)









Probe	RLP40	RMP40	RMP60	LP2
Dimensions	Ø40 mm × 58.3 mm (1.57 in × 2.30 in)	Ø40 mm × 50 mm (1.57 in × 1.97 in)	Ø63 mm × 76 mm (2.48 in × 2.99 in)	Ø24.8 mm × 33.2 mm (0.98 in × 1.31 in)
Machine type	Lathe	Small to medium	Medium to large	Small to large
Transmission type	Radio (FHSS)	Radio (FHSS)	Radio (FHSS)	O/RMP40M O/RMP60M hard-wired
Performance accuracy	Standard (kinematic)	Standard (kinematic)	Standard (kinematic)	Standard (kinematic)
Repeatability	1.00 µm (40 µin)	1.00 µm (40 µin)	1.00 µm (40 µin)	1.00 µm (40 µin)
3D lobing in X Y Z	N/A	N/A	N/A	N/A
Maximum recommended stylus length	100 mm (3.94 in)	100 mm (3.94 in)	100 mm (3.94 in)	100 mm (3.94 in)
Switch ON method	Radio M-code; spin	Radio M-code; spin	Radio M-code; spin or shank switch	N/A
Battery type	1/2 AA	1/2 AA	AA	N/A

High accuracy machine tool probes

"We are very happy with the accuracy of RMP600 and, in particular, the consequent reduction in scrap parts further down the production line. These are large expensive components and we use the probe to identify and avoid errors."

Tods Composite Solutions (United Kingdom)









Probe	OMP400	OMP600	RMP600	MP250
Dimensions	Ø40 mm × 50 mm (1.57 in × 1.97 in)	Ø63 mm × 76 mm (2.48 in × 2.99 in)	Ø63 mm × 76 mm (2.48 in × 2.99 in)	Ø25 mm × 36 mm (0.98 in × 1.42 in)
Machine type	Small to medium	Medium to large	Medium to large	Grinder
Transmission type	Infrared (optical)	Infrared (optical)	Radio (FHSS)	Hard-wired
Performance accuracy	High (strain gauge)	High (strain gauge)	High (strain gauge)	High (strain gauge)
Repeatability	0.25 µm (10 µin)	0.25 µm (10 µin)	0.25 µm (10 µin)	0.25 µm (10 µin)
3D lobing in X Y Z	±1.00 µm (40 µin)	±1.00 µm (40 µin)	±1.00 µm (40 µin)	±1.00 µm (40 µin)
Maximum recommended stylus length	200 mm (7.88 in)	200 mm (7.88 in)	200 mm (7.88 in)	100 mm (3.94 in)
Switch ON method	Optical M-code; auto start	Optical M-code; auto start; spin or shank switch	Radio M-code; spin or shank switch	N/A
Battery type	1/2 AA	AA	AA	N/A

On-machine scanning system

SPRINT™ on-machine contact scanning system

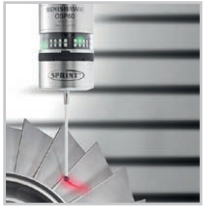
"The increased performance requirements of modern high-value components call for ever more demanding tolerances, and the SPRINT system is a valuable enabling technology to increase confidence in the manufacturing process."

Nuclear AMRC
(United Kingdom)



Probe	OSP60
Dimensions	Ø62 mm × 100.6 mm (2.44 in × 3.96 in)
Transmission type	High-speed optical
Scan range	±0.3 mm (0.012 in)
Scan resolution	0.1 µm (4 µin)
Speed	15 m/min (49 ft/min)
Data points	1000 points/sec
Stylus range	75 mm to 150 mm (2.95 in to 5.9 in)
Battery type	3 × CR123 lithium

High-speed, high-accuracy scanning system for fast on-machine part set-up, in-process control and machine health check applications.



- Revolutionary high-speed measurement
- Exceptional accuracy for full 3D definition
- Unique capability and applications

The SPRINT system captures 3D points across the part surface and analyses data in real time, enabling game-changing opportunities for automated in-process control and verification of machine capability.

Working with key organisations, Renishaw has developed a range of industry-focused applications, maximising system potential and allowing scanning to be easily adopted as the next generation of on-machine probing.

Prismatic and discrete point measurement are also possible, allowing users to perform job set-up and process control activities more rapidly and accurately than is achievable with traditional probing solutions.

The OSP60 probe is programmed through the Productivity+™ suite of software, or using CAM or G-code.

For more information, please see **www.renishaw.com/sprint**

Tool setting and broken tool detection

Contact systems

"Since we started using Renishaw probes and software there has been a reduction of 66% in set-up time and we have stopped talking about component rejections and manual errors."

Associated Tools (India)









Probe	OTS	RTS	TS27R	Primo LTS
Machine type	Small to medium	Medium to large	Small to large	Small to large
Function	Tool setting and tool breakage detection	Tool setting and tool breakage detection	Tool setting and tool breakage detection	Tool setting and tool breakage detection
Minimum tool detection	Ø1.0 mm (0.0394 in)	Ø1.0 mm (0.0394 in)	Ø1.0 mm (0.0394 in)	Ø0.1 mm (0.0039 in)
Repeatability	1.00 µm (40 µin)	1.00 µm (40 µin)	1.00 µm (40 µin)	0.75 µm (30 µin)
Stylus trigger force	1.30 N to 2.40 N / 133 gf to 245 gf depending on sense direction	1.30 N to 2.40 N / 133 gf to 245 gf depending on sense direction	1.30 N to 2.40 N / 133 gf to 245 gf depending on sense direction	3 N / 306 gf Z direction
Laser classification	N/A	N/A	N/A	N/A

Tool setting and broken tool detection

Contact systems

"If it wasn't for the Renishaw system, the machine could, for example, operate with a broken cutting tip, with disastrous results. Furthermore, since tools are checked for breakage automatically, one operator can easily manage both machines."

Ducati Motor (Italy)



Probe	RP3
Machine type	Small to large lathes
Function	Tool setting using Renishaw arms
Minimum tool detection	Ø1.0 mm (0.0394 in)
Repeatability	1.00 µm (40 µin)
Stylus trigger force	1.50 N to 3.50 N / 153 gf to 357 gf in XY plane
Laser classification	N/A

Non-contact systems





NC4	TRS2
Small to large	Small to large
Tool setting and tool breakage detection	Tool breakage detection
Ø0.03 mm (0.0012 in)	Ø0.2 mm (0.008 in)
±0.10 µm (4 µin)	N/A
N/A	N/A
Class 2 <1 mW 670nm	Class 2 <1 mW 650nm

Tool setting and broken tool detection

Arms for CNC lathes, multi-tasking machines and grinders

"We were generating too much scrap using optical presetters to measure our KM units. Also, following this form of measurement, a bank of data of some 150 characters had to be typed into the CNC control by the operator. Today, the repeatability is guaranteed, operator error is minimised, and scrap rates eliminated."

Geo. W. King Ltd.
(United Kingdom)









Arm	HPRA	HPPA	HPMA	HPGA
Application	Lathes and multi-tasking	Lathes and multi-tasking	Lathes and multi-tasking	Lathes and multi-tasking grinder
Function	Tool setting	Tool setting	Tool setting and broken tool detection	Workpiece inspection
Repeatability	5.00 µm (197 µin) 2σ X/Z (6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (18 in to 24 in chucks)	5.00 µm (197 µin) 2σ X/Z (6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (18 in to 24 in chucks)	5.00 µm (197 µin) 2σ X/Z (6 in to 15 in chucks) 8.00 µm (315 µin) 2σ X/Z (18 in to 24 in chucks)	3.00 µm (118 µin) 2σ X/Y/Z
Probe	RP3 (1.00 µm (40 µin) 2σ repeatability)	RP3 (1.00 µm (40 µin) 2σ repeatability)	RP3 (1.00 µm (40 µin) 2σ repeatability)	MP250 (0.25 µm (10 µin) 2σ repeatability) LP2 (1.00 µm (40 µin) 2σ repeatability)
Operation	Removable	Manual	Automatic	Automatic
Chuck sizes	Standard 6 in to 24 in solutions	Standard 6 in to 24 in solutions	Standard 6 in to 24 in solutions	Range to suit most machines

Software for machine tool applications

Renishaw provides a selection of software solutions designed to complement our range of measurement and process control hardware.

On-machine programming packages, which are installed and resident on the CNC machine tool control, are best suited to 'on the fly' shop floor programming. Programming is typically performed at the machine using traditional G-code or one of our growing range of graphical user interfaces (GUIs).

	Programming			Functionality			
	G-code	Set and Inspect/GUI	GoProbe	Part setting	Inspection	Tool setting	Reporting
Inspection Plus	●	●	●	●	●		●
Contact tool setting	●	●	●			●	
Non-contact tool settting	●	●				●	

For more information, including software functionality and controller suppport, please see Data sheet *Probe software for machine tools: programs and features* (Renishaw part no. H-2000-2298) at **www.renishaw.com/machinetoolsoftware**

Off-machine (PC-based) programming packages enable a wide variety of tasks to be performed using post processors configured for individual machine tools. Probe routines can be programmed alongside CAM programs or on a standalone PC, providing flexibility and control when integrating probing into the various stages of a production process.

	Part setting	Inspection	Data analysis	Reporting	Advanced reporting
Productivity+™	●	●		●	
PowerINSPECT OMV Pro	●	●		●	●
Renishaw CNC Reporter			●		●

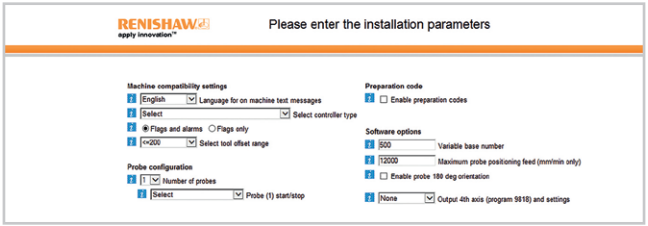
On-machine programming

Inspection Plus

Inspection Plus is an integrated macro software package for part setting and inspection which supports a comprehensive range of cycles from basic part set-up through to more complex vector and angular measurement.

Incorporating new SupaTouch optimisation technology, Inspection Plus calibrates a machine tool, controller and Renishaw probe as a complete system. SupaTouch intelligently selects one-touch or two-touch measurement 'on the fly' to ensure optimum positioning and measurement feedrates in every application.

Experienced users can create and execute cycles using traditional G-code techniques. Renishaw's range of user-friendly interfaces – including GoProbe and Set and Inspect – supports new and less experienced users.



Key features and benefits:

- Automated updates of tool and work offsets
- Choice of automated or manual (jog) modes
- Full system optimisation using SupaTouch technology
- Integrated configuration wizard

For further information, please see **www.renishaw.com/inspectionplus**

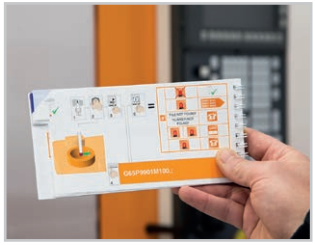
On-machine programming

GoProbe

GoProbe is a unique combination of user-friendly probing cycles, self-study training materials (training part, pocket guide, quick-reference tool and e-learning course), and an intuitive smartphone app that enables users to get up and running with their Renishaw machine tool probing system in minutes.

Simply jog the probe to the start position, use the training tools – or the GoProbe app – to create the required single-line command, enter that command in MDI mode and press cycle start.





Key features and benefits:

- Embedded into latest Inspection Plus and contact tool setting software
- No probing experience required
- Comprehensive self-study training materials
- Smartphone app to generate single-line commands
- Compatible with all Renishaw inspection probes

For further information, please see **www.renishaw.com/goprobe**

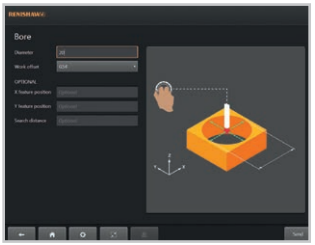
In-process control
Process setting

Set and Inspect

Set and Inspect is a simple, on-machine probing app for use on a Microsoft® Windows®-based control – or on a Windows®-based tablet connected to the control via Ethernet.

An intuitive interface guides the user through the process of creating a probing cycle, automatically generates the required machine code for the probing cycle and loads it to the control, eliminating data entry errors while reducing programming times.





Key features and benefits:

- User-friendly interface for use with Inspection Plus and tool setting software
- No probing experience or machine code knowledge required
- Embedded help text and images
- Immediately view results data
- Compatible with a range of 3-axis and 5-axis machines

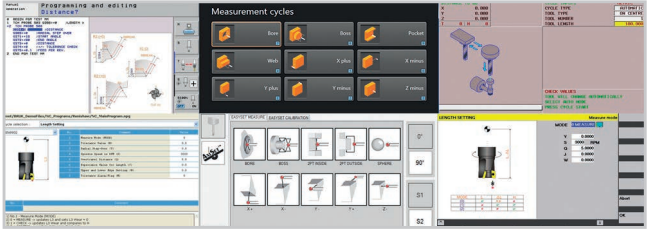
For further information, please see **www.renishaw.com/setandinspect**

On-machine programming

Graphical user interfaces (GUIs)

In addition to Set and Inspect, Renishaw offers a further range of user-friendly GUIs to guide users through the process of part setting, inspection and tool setting.

Each GUI provides an intuitive, user-friendly environment designed to assist users in generating a probing cycle, eliminating the difficulty associated with traditional machine tool programming, and allowing cycles to be produced and selected with minimal user input.



Key features and benefits:

- User-friendly interface
- Supports probe calibration, part setting, contact tool setting and inspection cycles
- AxiSet™ Check-Up pivot point compensation and non-contact tool setting (package dependent)

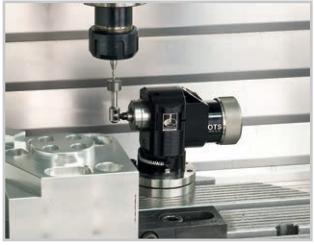
For further information, please see **www.renishaw.com/gui**

In-process control
Process setting

Tool setting

Tool setting software allows users to set length and diameter offsets for single point and multiple point tools, perform in-cycle broken tool detection and manual or automatic positioning.

Tool setting software is available for all Renishaw contact and non-contact tool setting hardware technologies.





Key features and benefits:

- Significant time savings
- Automated tool length and diameter setting
- Reduced scrap
- Eliminate manual setting errors
- In-cycle tool breakage detection

For further information, please see **www.renishaw.com/toolsettingsoftware**

Off-machine (PC-based) programming

Productivity+™ software

Productivity+™ provides users with a simple-to-use environment for incorporating in-cycle probe routines into machining cycles, with no requirement for G-code programming experience.

Calculation of measurement results, logic decisions and machine tool updates are all performed on the CNC itself, eliminating the need for external communications.

Productivity+ can assist in three core areas of a machining process:

- Predictive **process-setting** tasks – such as job set-up, part and tool identification
- Active **in-process control** tasks – such as tool condition monitoring, tool dimension updates and re-machining based on measurement results
- Informative **post-process** reporting tasks – providing users with information about a completed process and helping to influence decisions for subsequent operations and processes

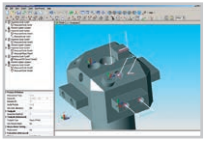
Key features and benefits:

- Automatic, real time, adaptation of cutting programs
- Program using component solid models (or manually where no model exists)
- Probe cycle visualisation, including crash detection
- Multi-axis support for a wide range of machine tool controls

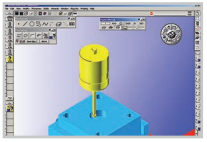
> *We looked at the whole production cycle time and in some cases were able to reduce it by up to 50%. Productivity+ software […] made this possible. Productivity+ makes it much easier to prove out the process before going on the machine.*
>
> **Alp Aviation (Turkey)**

Productivity+ software is available in four application versions:

Active Editor Pro: allows process control tasks to be integrated into existing cutting code. Solid model programming and toolpath visualisation make it easy to create probe cycles. Post processing merges the cutting and process control code, resulting in a single machine program.



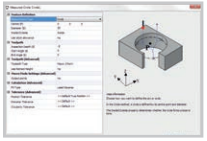
GibbsCAM® plug-in: integrates fully with the GibbsCAM package to allow the creation of process control tasks while programming cutting tasks. For GibbsCAM users this solution gives complete measurement flexibility within a familiar environment.



CNC plug-in: with an online editor allowing measurement programs to be updated on the machine, this software controls the OSP60 SPRINT™ probe and enables significantly enhanced data processing. Optionally, programs can be created offline using Productivity+™ Active Editor Pro.



Productivity+ API: Productivity+ functionality can also be embedded into CAM packages. Contact your CAM vendor to see if the API is supported.

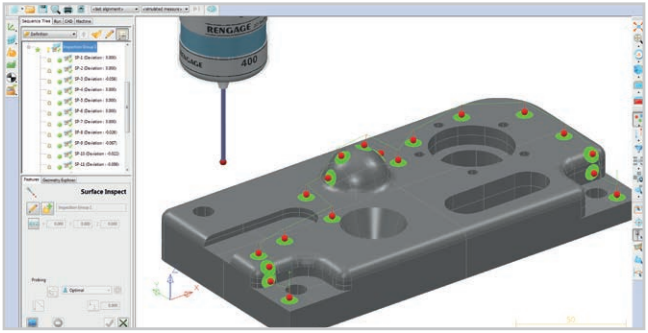


For further information, please see **www.renishaw.com/prodplus**

Off-machine (PC-based) programming

PowerINSPECT OMV Pro

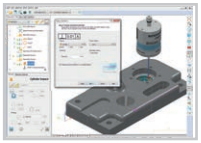
Delcam's PowerINSPECT OMV Pro allows users to perform CMM-style, post-machining inspection and verification tasks on their machine tool, and create comprehensive reports of measurement results and part tolerance.



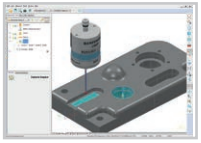
Key features and benefits:

- Program directly from solid models
- Geometric feature and free-form surface inspection
- File import techniques project inspection points onto a solid model
- 'Live' return of measurement results to a PC
- Configurable graphical and text-based reporting
- Multi-axis machine support
- Probe path simulation for collision detection

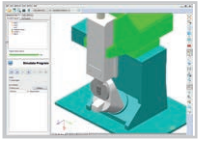
Advanced functionality provided by the application includes:



Geometric dimensioning and tolerancing (GD&T): create elements to determine relationships between features for full comparison of machine measurements against manufacturing drawings before component removal.



Constructed features: create additional measurements and data points using previously measured features. This function is particularly useful when inspecting components with a large number of prismatic features.



Machine simulation: extend program simulation to include a 3D machine model; invaluable when using multi-axis machines and components with complex geometries.

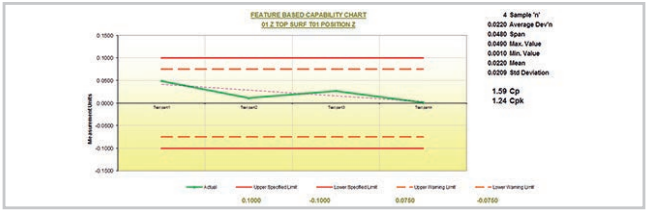
For further information please see, **www.renishaw.com/omv**

Off-machine (PC-based) programming

Renishaw CNC Reporter

Operating within the Microsoft® Excel® environment, Renishaw CNC Reporter provides a simple tool for analysing data and generating inspection reports from results returned by Productivity+™ and Inspection Plus.

Capability charts track results for a single or critical feature across a batch of components to help determine machine wear and thermal effects, and to assist in scheduling preventative maintenance tasks.



[Renishaw CNC Reporter is] … an instant indicator, very easy to see the trend of the process. I can keep dimensions within the control limits and easily keep a record of every measured value.

Martin Aerospace (United Kingdom)

Key features and benefits:

- Results displayed in a clear and easy to understand format
- Archive results and review using the complementary Data Manager tool
- Simple, familiar Excel environment
- Colour-coded reports allow instant Go/No go decisions
- Feature tracking and control plots for process monitoring

For further information, please see **www.renishaw.com/cncreporter**

Machine tool diagnostics

QC20-W telescopic ballbar

The QC20-W wireless ballbar offers fast and effective analysis of CNC machine tools and is recognised in major international standards such as ASME B5-54 and ISO 230.4.

Providing an overall measure of machine tool accuracy, the Renishaw ballbar and software enables accurate comparison of a programmed circular path with its actual measured radius. In addition to circularity or circular deviation, diagnosis of up to 19 error terms including backlash, scale error and squareness can be used to efficiently target maintenance and repair.



Key features and benefits:

- Ensure accurate parts, first time
- Reduce scrap, rework, machine down-time and costs
- Plan maintenance and track machine performance trends
- Comply with QA and QC system requirements
- Determine individual machine capability

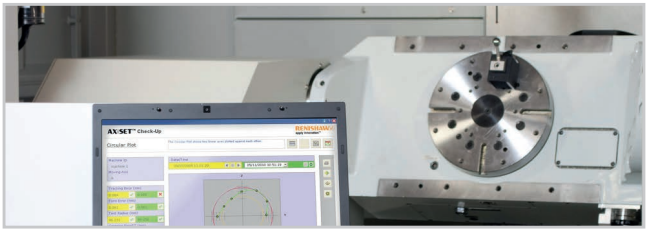
For further information, please see **www.renishaw.com/qc20**

Machine tool diagnostics

AxiSet™ Check-Up

A complete solution for checking the alignment and positioning performance of rotary axes. In just a few minutes, users of multi-axis machining centres and multi-tasking machines can identify and – where possible – automatically correct for poor machine alignments and geometry.

Providing a fast and accurate check of rotary axis pivot points, AxiSet™ Check-Up helps users to maintain a stable machining environment. When used alongside Renishaw's QC20-W ballbar system and laser interferometers, AxiSet Check-Up gives an unparalleled machine diagnosis solution.



Key features and benefits:

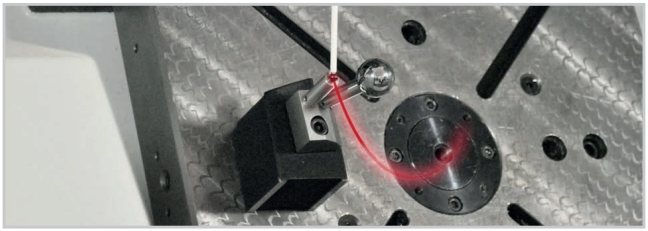
- Determine pivot point and lathe centre-line errors
- Measure and report critical errors quickly
- Reliably check and track machine performance trends
- Automatically update machine pivot points

For further information, please see **www.renishaw.com/axiset**

SPRINT™: Machine Health Check

The SPRINT™ Machine Health Check application is designed for sustainable machining processes on 3-axis and 5-axis table/table milling centres. It can verify machine tool performance in less than one minute using simple tests based on the SPRINT system's exceptionally accurate 3D measurement capability.

Fast enough to be used automatically prior to machining to detect warm-up issues and previously unidentified problems, the application can also be used as part of a regular maintenance regime providing long-term sustainability and performance monitoring.



Key features and benefits:

- Determine machine capability in less than one minute
- Immediate Go/No go decision
- Assists in long term machine condition monitoring
- Minimal operator intervention
- Supplied with unique test artefact
- Linear test for 3-axis machine tools; kinematic text for 5-axis machine tools

For further information, please see **www.renishaw.com/healthcheck**

Off-machine gauging and measurement systems

The Equator™ system



The Equator system is a high-speed comparative gauge for inspection of medium- to high-volume manufactured parts alongside the machine tool.

The highly repeatable gauging technology is based on the traditional comparison of production parts to a reference master part. Re-mastering immediately compensates for any change in the thermal conditions of a shop-floor environment. Equator gauging systems provide speed, repeatability and ease of use for manual or automated applications. They enable in-process and post-process control with options for closed-loop feedback to machine tool controllers and extensive process reporting.

Equator gauging systems are fully programmable and can be used for multiple applications.

For further information, please see **www.renishaw.com/gauging**

CMM probe systems



From the original touch-trigger probe, motorised indexing head, repeatable stylus changing and modular scanning systems, Renishaw sensors for co-ordinate measuring machines (CMMs) are an industry standard. Renishaw's 5-axis CMM technology delivers unprecedented speed and measurement flexibility whilst avoiding the speed versus accuracy compromises inherent in conventional techniques.

For further information, please see **www.renishaw.com/cmm**

Styli and accessories



When precision counts, insist on genuine Renishaw styli.

- Comprehensive standard range available for fast delivery
- Custom design service available to suit exact customer requirements

To maintain accuracy at the point of contact:
Keep styli short
The more that a stylus bends or deflects, the lower the accuracy.

Minimise joints
Joining additional styli and extensions introduces potential bending and deflection points.

Keep the ball as large as possible
Maximises ball/stem clearance, reducing the chances for false triggers caused by 'shanking out' on the stylus stem, and prevents measurement variations caused by the component's surface finish.

At Renishaw we have used our expertise in probe and stylus design to develop a comprehensive range of styli offering the greatest possible precision. The range comprises star, disc and straight styli, short and long, extensions, complete stylus kits and crash protection devices. If you cannot achieve your objectives using our extensive range of products, Renishaw offers a custom design service to provide a total probing solution for scanning and touch trigger applications on machine tools, gauging systems and CMMs.

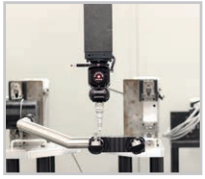
For further information, please see **www.renishaw.com/styli**

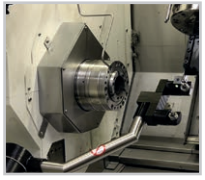
Custom solutions

Established for over 30 years, our Custom Products team has unparalleled experience in providing custom-designed inspection products and accessories ranging from specialist styli to full probing systems.

We offer:

- Engineering and applications advice
- Design services from concept through to one-off or low-volume production
- Realistic timescales
- Clear supporting documentation





In 30 years we have produced a vast range of bespoke system components, interfaces, calibration kits, accessories and specialised probing systems.

Every Renishaw custom product is hand-built to the same high quality as our standard product range and is backed by our unrivalled global sales and support network.

> *"Renishaw's expedited delivery made our customer happy enough to request a quote for two additional arms. I have lost track of how many times the product has materialised seemingly out of thin air to meet our needs."*
>
> **CNC Engineering Inc.**
> **(United States)**

Service, support and training

Renishaw provides a high level of support to all its customers through a network of over 70 service and support offices in 35 countries.

Renishaw's experienced global staff have the commitment and applications expertise necessary to provide comprehensive support; from initial installation, to supplying ongoing applications assistance and a range of service packages to keep your system in operational condition.

Upgrades

Where possible, the option to upgrade worn-out, damaged or obsolete product to a more modern equivalent will always be offered when contacting us.

Repairs

There are several levels of repairs, so if your equipment only has a minor fault, you only pay a minor charge. However, all repaired items have to pass the same stringent final tests as new equipment.

RBE (Repair by exchange)

If immediate despatch is required, we have stocks of service exchange items (RBEs). These items have been subject to the stringent 'as new' final tests and a complete refurbishment with the replacement of all parts subject to wear. *

Training

We offer a comprehensive programme of user maintenance and application courses.

Our experienced engineers recognise individual requirements and can offer flexible dates for courses either at our facilities or at your site. Our goal is to build process and system knowledge, enabling you to run and maintain your systems, and reduce cost of ownership.

*Compliance to Renishaw T&Cs is required.

Further information

For more information on anything covered in this pocket guide, please refer to the *Probing systems for CNC machine tools* document (Renishaw part no. H-2000-3020), or visit **www.renishaw.com/mtp**



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About Renishaw

Renishaw is an established world leader in engineering technologies, with a strong history of innovation in product development and manufacturing. Since its formation in 1973, the company has supplied leading-edge products that increase process productivity, improve product quality and deliver cost-effective automation solutions.

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

For worldwide contact details, visit www.renishaw.com/contact

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