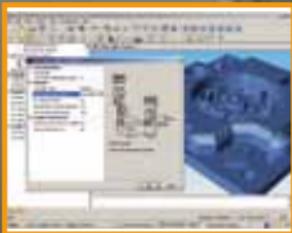


Pocket guide to probing solutions for
CNC machine tools

RENISHAW
apply innovation™



Process control Solutions

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

Probes for CNC machine tools

Solutions ...

Pocket guide contents

This pocket guide provides a complete overview of Renishaw's products for CNC machine tools and helps you to understand the benefits that probing can bring to your business.



Renishaw profile	1
Why probe?	3
The Productive Process Pyramid™	5
Process foundation	
Process setting	
In-process control	
Post-process monitoring	
Product/Application guide	11
Technology centre	13
Spindle and turret probes for process foundation, process setting, in-process control and post-process monitoring	15
Tool setting and broken tool detection for process setting and in-process control	19
PC-based software for process setting as well as in-process control and post-process monitoring	23
Productivity+™ suite	
Renishaw OMV - On-Machine Verification	
Supporting Macro probing software solutions	27
Machine tool diagnostics for process foundation	29
AXISET™ Check-Up	
QC20-W telescopic ballbar	
Styli and accessories	33
Process control solutions tailored for you	34
Custom product design service	35
Service and support	36

Renishaw profile

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.

Metrology

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 five-axis measurement systems.

For machine tool users, contact and laser probes for CNC machine tools allow automated tool setting, workpiece set-up, in-cycle gauging and verification of part and process.

To check a machine's positioning performance, the Renishaw QC20-W ballbar performs tests to recognised international standards.

In motion control Renishaw's laser encoders, optical linear and angle encoders, and magnetic encoders are used for incremental and absolute encoding applications in industries as diverse as electronics, motorsports, semi-conductors and food manufacturing.

To analyse the static and dynamic performance of position-critical motion systems, Renishaw's laser interferometer and environmental compensation system offers a linear measurement accuracy of 0.5 ppm, readings of up to 50 kHz and a linear measurement speed of up to 4 m/s, with a linear resolution of 1 nm.



Healthcare

Renishaw's Raman spectroscopy products exploit the Raman effect to identify and characterise the chemistry and structure of materials. A diverse range of analytical applications include pharmaceutical, forensic science, nanotechnology, biomedical and semiconductors.

In the world of dentistry, Renishaw is the world's leading supplier of in-lab dental CAD/CAM scanning systems, supported by powerful CAD design software, and a unique dental milling system.

Recent developments include medical devices for neurosurgical applications including Deep Brain Stimulation.



Renishaw manufacturing

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.

The Renishaw advanced milling turning and inspection centre (RAMTIC) is a vertical machining centre equipped with Renishaw probing technologies, custom fixtures, indexing trunnions and tooling loading systems. RAMTIC machines are also loaded with an artefact: a known 'golden part' which is regularly calibrated and used as a reference part for machine checks, to eliminate sources of variation.

Through using process control solutions in its own busy production environment, Renishaw understands the true potential of probing and as such is able to explain, from a position of experience, the value that it brings to a manufacturing organisation.

Why probe?

Time is money. Time spent manually setting workpiece positions and inspecting finished product is better invested in machining. Renishaw probing systems eliminate costly machine down-time and the scrapping of components associated with manual setting and inspection.

Increase throughput from your existing assets

If your machines are overloaded then you may be facing a sizeable capital investment to make up the shortfall.

Either that, or a large sub-contract bill.

Or worse still, you might find yourself turning away profitable work.



But what if you could extract more throughput from the machinery you already have?

- 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 rather than working on new processes.



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

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

Reduce rework, concessions and scrap

Scrapping parts is always painful - it's 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?

- improved conformance and consistency
- lower unit costs
- 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?

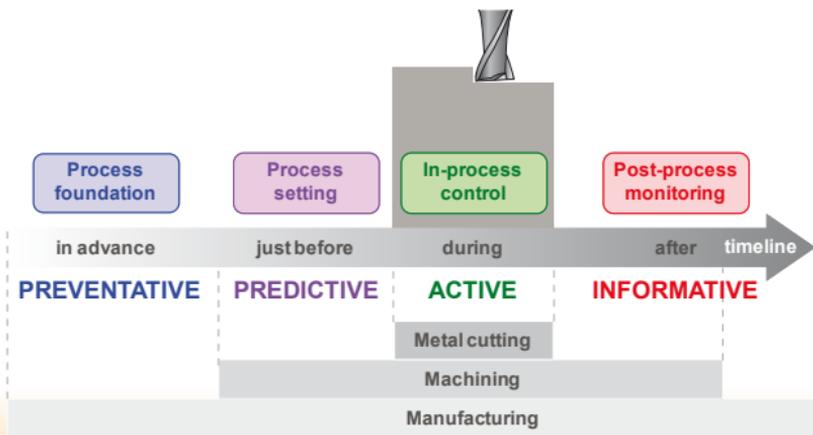
- offer your customers state-of-the-art capabilities
- take on more complex work
- meet customer demands for traceability



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. Placed on a timeline, 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.

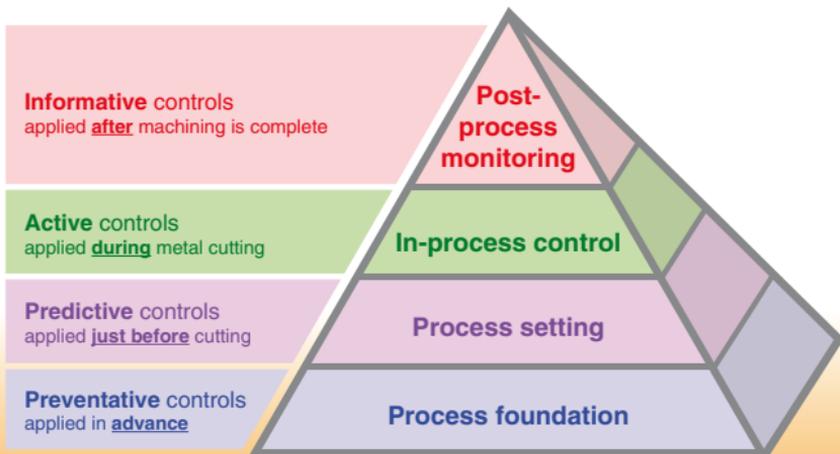
Just before metal cutting, Renishaw's **process setting** solutions establish the location and size of machining system elements.

During metal cutting, Renishaw's **in-process** solutions enable machines to respond to inherent variation and actual conditions 'on the day'.

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™.

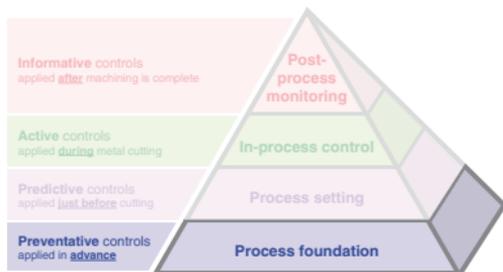
The Productive Process Pyramid™ shows how layers of control can be used to systematically *remove variation from the machining process*, helping to maximise productive metal cutting.



The Productive Process Pyramid™

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.

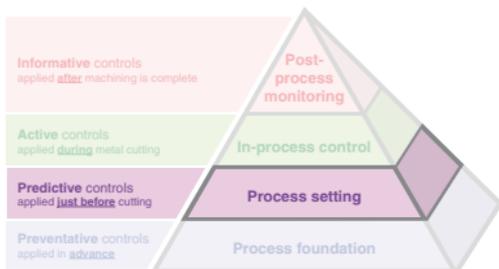
Controls in the process foundation layer include:

- **Design for manufacture** is an approach to product and process design based on a thorough understanding of current capability and a drive towards best practice rather than 'reinvention of the wheel'.
- 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 those external sources of non-conformance that cannot be eliminated in advance, but which are inherent to the operating environment.
- **Process design** requires a systematic approach to sequencing the manufacturing process to give the best opportunity for process stability and automation. This includes integrating process feedback into the process at critical stages.
- **Machine condition optimisation** is an essential element of the process foundation, as 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 that the process will be successful.

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.



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.



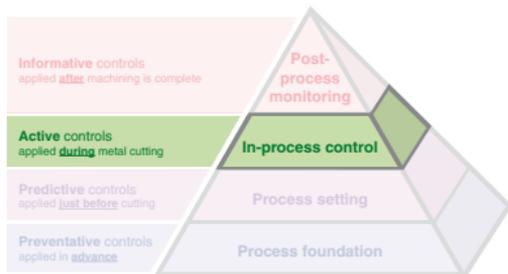
Tool setting establishes ...

- 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.



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.

In-cycle 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.



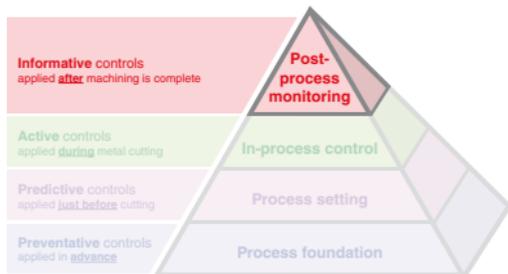
Broken tool detection recognises ...

- 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 on 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 record of component conformance.
- Historical tracking of critical feature dimensions for machine condition monitoring and scheduled maintenance purposes.



Product/Application guide

This guide will help you **identify which probes** are most suited to your application

Type of machine	Machine Size	Probes for process setting, in-process control and post-process monitoring	Tool setting solutions	
			Broken tool detection and tool setting	Broken tool detection
Vertical CNC machining centres 	Compact	OMP40-2/OMP400/RMP40	OTS/TS27R/NC4	TRS2
	Small	OMP40-2/OMP400/RMP40	OTS/TS27R/NC4	TRS2
	Medium	OMP60/RMP60/RMP600	OTS/TS27R/NC4	TRS2
	Large	RMP60/RMP600	TS27R/NC4	TRS2
Horizontal CNC machining centres 	Compact	OMP40-2/OMP400/RMP40	OTS/TS27R/NC4	TRS2
	Small	OMP40-2/OMP400/RMP40	OTS/TS27R/NC4	TRS2
	Medium	OMP60/RMP60/RMP600	OTS/TS27R/NC4	TRS2
	Large	RMP60/RMP600	OTS/TS27R/NC4	TRS2
Gantry CNC machining centre 	All	RMP60/RMP600	TS27R/NC4	TRS2
Manual machines 	All	Job contact probe (JCP)	N/A	N/A

Type of machine	Machine Size	Probes for process setting, in-process control and post-process monitoring	Tool setting solutions	
			Broken tool detection and tool setting	Broken tool detection
CNC lathes 	Small	OLP40/RLP40	HPXX Arms*	
	Medium	OLP40/RLP40	HPXX Arms*	
	Large	OLP40/RLP40	HPXX Arms*	
CNC Mill/Turn centre 	Small	OMP40-2/OMP400 RMP40	HPXX Arms* /NC4	TRS2
	Medium	OMP60/RMP60/ RMP600	HPXX Arms* /NC4	TRS2
	Large	RMP60/RMP600	HPXX Arms* /NC4	TRS2
CNC grinders 	Small	MP250/LP2 HPGA	NC4	N/A
	Medium	MP250/LP2 HPGA	NC4	N/A
	Large	MP250/LP2 HPGA	NC4	N/A
PCB drilling and routing machines 	N/A	N/A	NCPCB	NCPCB

* HPXX refers to all arms listed on pages 21 and 22.

Technology centre

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.



Industry leading transmission systems

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.



Industry specific solutions

Ultra compact probe products are a breakthrough for the growing number of small to medium sized machining centres which previously have been unable to benefit from probing systems.

For these applications Renishaw has developed the **OMP40-2** and **OMP400** ultra compact probes and the **OMI2-C**, a cigar-sized receiver with modulated optical transmission, compact enough to fit into the machine tool spindle head. Both products are ideal for compact machining centres where space is limited.



Industry leading performance

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

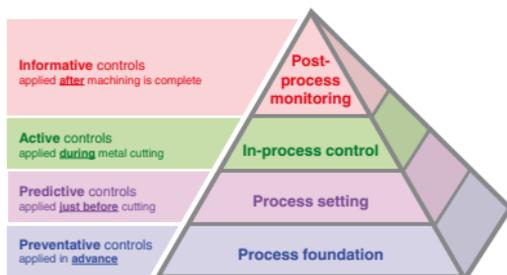
MicroHole™ and **PassiveSeal™** are used on Renishaw's NC4 non-contact system providing unique environmental protection from the harsh machining environment. This ensures IPX8 protection 100% of the time.



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

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

Spindle and turret probes



Probe	LP2	MP250
Dimensions	Ø 25 mm x 40.8 mm	Ø 25 mm x 40.7 mm
Machine type	Lathe and Grinding	Lathe and Grinding
Transmission type	OMP40M/RMP40M or Hard wired	Hard wired
Performance accuracy	Standard (kinematic)	High (strain gauge)
Repeatability	1.0 µm	0.25 µm
3D Pre-travel variation	N/A	1.0 µm
Maximum recommended stylus length	100 mm	100 mm
Switch ON method	N/A	N/A
Battery type	N/A	N/A



OMP40-2

Ø 40 mm x 50 mm

Compact and small

Infra-red (optical)

Standard (kinematic)

1.0 µm

N/A

100 mm

Optical 'M' code,
auto start

1/2 AA

OLP40

Ø 40 mm x 58.3 mm

Lathe

Infra-red (optical)

Standard (kinematic)

1.0 µm

N/A

100 mm

Optical 'M' code,
auto start

1/2 AA

RLP40

Ø 40 mm x 58.3 mm

Lathe

Radio (FHSS)

Standard (kinematic)

1.0 µm

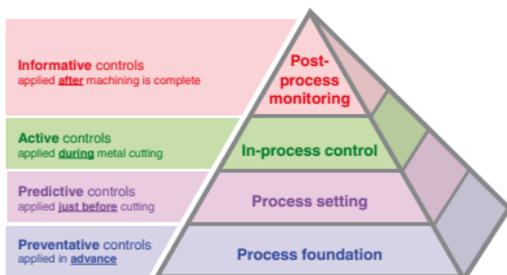
N/A

100 mm

Radio 'M' code, spin

1/2 AA

Spindle and turret probes



Probe	RMP40	OMP400
Dimensions	Ø 40 mm x 50 mm	Ø 40 mm x 50 mm
Machine type	Compact - Large	Compact - Small
Transmission type	Radio (FHSS)	Infra-red (optical)
Performance accuracy	Standard (Kinematic)	High (Strain gauge)
Repeatability	1.0 µm	0.25 µm
3D Pre-travel variation	N/A	1.0 µm
Maximum recommended styli length	100 mm	200 mm
Switch ON method	Radio 'M' code, spin	Optical 'M' code, auto start
Battery type	1/2 AA	1/2 AA



OMP60

Ø 63 mm x 76 mm

Medium - Large

Infra-red (optical)

Standard (Kinematic)

1.0 µm

N/A

150 mm

Optical 'M' code, spin or shank switch

AA

RMP60

Ø 63 mm x 76 mm

Medium - Large

Radio (FHSS)

Standard (Kinematic)

1.0 µm

N/A

150 mm

Radio 'M' code, spin or shank switch

AA

RMP600

Ø 63 mm x 76 mm

Medium - Large

Radio (FHSS)

High (Strain gauge)

0.25 µm

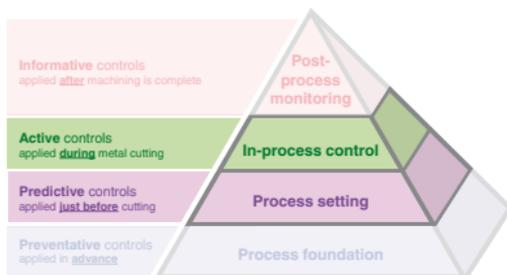
1.0 µm

200 mm

Radio 'M' code, spin or shank switch

AA

Tool setting and broken tool detection



Probe	NC4	TS27R
Machine type	Small - Large	Small - Large
Function	Tool setting and tool breakage detection	Tool setting and tool breakage detection
Minimum tool detection	Ø0.03 mm	Ø1 mm
Repeatability	1 µm	1 µm
Stylus trigger force	N/A	1.3 N to 2.4 N / 130 gf to 240 gf depending on sense direction
Laser classification	Class 2 <1 mW 670nm	N/A



OTS

Small - Medium

Tool setting and tool
breakage detection

Ø1 mm

1 µm

1.3 N to 2.4 N /
130 gf to 240 gf
depending on sense direction

N/A

TRS2

Small - Large

Tool breakage detection

Ø0.05 mm

N/A

N/A

Class 2 <1 mW 670nm

RP3

Small - Large Lathes

Tool setting using
Renishaw Arms

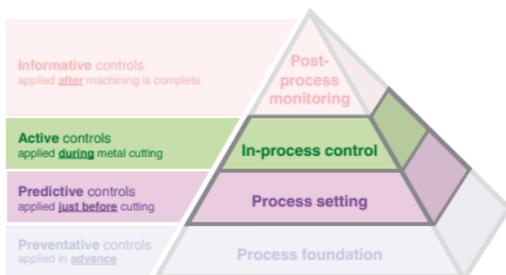
Ø1 mm

1 µm

1.5 N to 3.5 N

N/A

Tool setting and broken tool detection



Arm probe systems for TURNING and GRINDING CENTRES



Arm	HPRA
Function	Removable arm with highly repeatable mounting
Probe	RP3
Key features	<ul style="list-style-type: none"> • Available in a wide range of sizes to suit most requirements • Bi-colour LED for continuous feedback on system status • Uses minimal machine space when stored - the arm is removed from the machine for storage • Retrofittable to existing machines



HPPA

Manually operated pull-down arm with highly repeatable operation

RP3

- Available in a range of standard configurations - customised sizes can be specified
- Long-life rotary device durability
- Low thermal growth steel arm
- Bi-colour LED for continuous feedback on system status
- Uses minimal machine space when stored



HPMA

Fully automatic arm with highly repeatable positioning

RP3

- Rapid actuation
- Full program control of tool setting and broken tool detection
- Available in a range of standard configurations - customised sizes can be specified
- Bi-colour LED for continuous feedback on system status



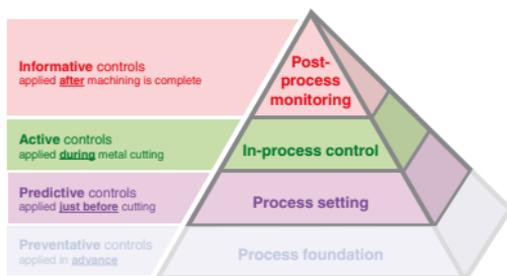
HPGA

Fully automatic arm with highly repeatable positioning

MP250 or LP2

- 3-axis repeatability
- Strain gauge compatibility
- Rapid actuation
- Full program control of tool setting and broken tool detection
- Available in a range of standard configurations - customised sizes can be specified

PC-based software



Productivity+™ applications suite

Productivity+™ is a system which makes it easier to apply the Productive Process Pyramid to machining cycles. It provides a complete set of Windows® software and on-machine macros which let you easily add measurements, updates and logical decisions to existing and new cutting programs.

- Easily add process setting, in-process control, and post process monitoring tasks to NC programs; in just a couple of clicks you can automate job set-up and cutter offset updates.
- Tasks are embedded in the NC program and on-machine macros. This means they are performed every time the program is run, without the need for operator involvement or an external PC.
- Drag-and drop programming of logical decisions which are also embedded in the NC code, allowing tasks such as go / no-go checks or automatic re-machining.

Productivity+™ also generates full reports from the machine, giving a detailed level of process reporting which records the in-cycle updates which were made, as well as reporting on the geometric measurements from part inspection.



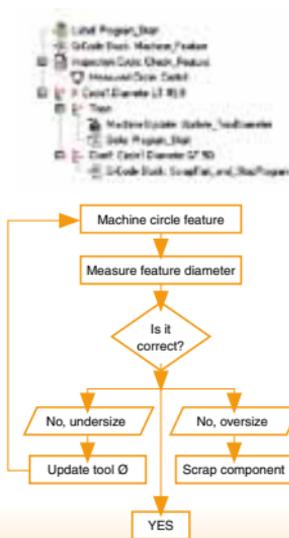
Productivity+™ Active Editor Pro

Allows the addition of process control tasks into existing cutting code. Solid model programming and full toolpath visualisation make it easy to quickly create process control cycles. A final postprocessing step merges the cutting and process control code, resulting in a single set of programs for the machine tool.



Productivity+™ GibbsCAM® plug-in

Integrates fully with the GibbsCAM package to allow the creation of process control tasks at the same time as programming the cutting tasks on the machine. For users of GibbsCAM this solution gives complete flexibility of measurement within a familiar environment.



Benefits of Active Editor Pro include:

- Full integration of tool setting, probe qualification, job set-up, component inspection, machine updates and logic
- Multi-axis machine tool support
- Construct virtual features from previously measured feature geometry
- Embed frequently used cycles within custom macros
- Point-and-click programming directly from imported solid models
- On-screen simulation with collision detection
- Graphical user interface and simple, icon driven operation
- Program multiple machine tool controllers from the same Productivity+™ program

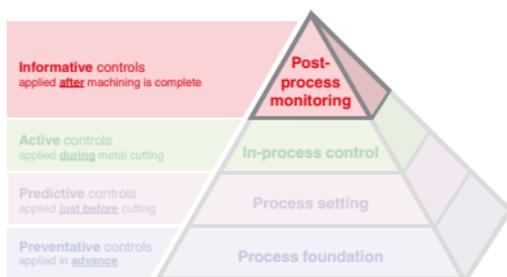
Both applications allow simulation of probe cycles for program prove out. When programming is complete, each application can produce a single G-code output file containing all required cutting and measurement information. Simply load to the machine tool control and run as normal.

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Portions of this software are owned by Tech Soft America LLC.

PC-based software



Renishaw OMV - On Machine Verification

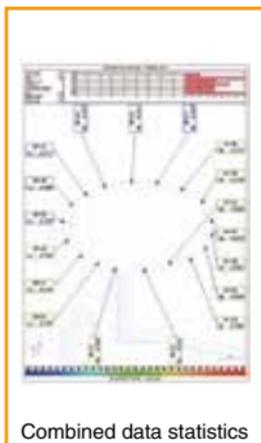


Renishaw OMV

Powerful PC based 3D verification software

- Verify part conformance before removing from the machine
- Geometric feature or free-form surface inspection options
- Create probing routines directly from a CAD model
- Live feedback during probing for instant Go/No-Go decision regarding part conformance
- Configurable reporting in tabular and graphical formats
- Support for 3- and 5-axis machine tools
- On-screen program simulation with collision error log





Automatically check complex machined parts against the corresponding CAD model before removing the job from the machine tool. Simple to generate probing routines for inspecting geometric features and **free-form surfaces**.



Supporting macro probing software solutions

Probing packages available

		Fanuc 0-18A 21/30-32M	Fanuc 0-21 30-32T	Mazak	Mitsubishi Meldas	Yasnac	Fadal	Okuma OSP/U	Haas	Hurco WinMax	Siemens 800 series	Siemens 802 81 OD/840D/ 82BD
Machining centres	EasyProbe	●			●	●			●			●
	Inspection	●		●	●	●	●		●		●	
	Inspection Plus	●		●	●	●		●	●	●		●
	Tool setting (contact)	●		●	●	●	●	●	●	●	●	●
	Tool setting (non-contact)	●		●	●	●	●	●	●	●		●
	GibbsCAM Plug-in	●		●	●	●		●	●			●
	Active Editor Pro	●		●	●	●		●	●			●
	Renishaw OMV	●		●	●	●		●	●			●
Turning centres	Inspection		●	●	●	●		●	●		●	●
	Tool setting		●	●	●				●		●	●
	3-axis tool setting		●									
Mill turns	Inspection plus			●								
	Tool setting (non-contact)			●								

EasyProbe

Minimal programming skill required

- Software for machining centres
- Simple and fast job set-up and measuring routines
- For operators with minimal programming skill

Inspection

For use by an operator or part programmer

- Software for machining centres and turning centres
- Basic inspection / job setup software
- Set work offsets
- Update tool offsets
- Print inspection results *
- Suitable for use by an operator or part programmer
- Additional packages available to enhance and extend the capabilities of the standard inspection software.

Seica	GE2000	Toshiba Tosnuc	Acramatic AZ100	Heidenhain	Num	Traub	Hitachi Seicos	Makino	Mori Seiki MAPP5	Andron	Fidia	Brother	Huroc	Nakamura	Doosan (Fanuc)
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Inspection Plus

For an extended range of program cycles

- Software for machining centres
- A totally integrated package
- Vector and angle measure options
- Print options *
- Extended range of cycles
- SPC cycle
- 1-touch or 2-touch probing
- Tool offset compensation by percentage of error
- Output data stored in an accessible variable stack

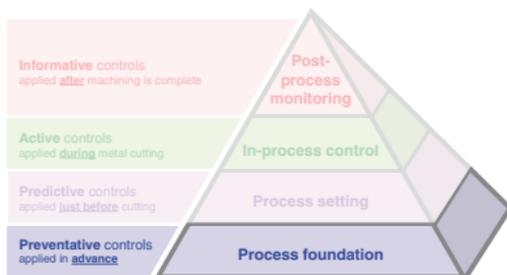
Tool setting

For contact and non-contact probes

- Rotating tool setting software for machining centres - for TS27R probe
- Non-contact tool setting software is preferred for applications using delicate tools, and other applications where the probe must not obstruct the machine's working envelope

* where this control option is available

Machine tool diagnostics



AXISET™ Check-Up



Rapid and accurate health checks for multi-axis machines

- Measure and report multi-axis machine performance in a matter of minutes
- Capability to detect and report errors in rotary axis centre of rotation (pivot points) that are critical in 5-axis interpolation
- Fully automated probing tests provide accurate and consistent results, avoiding introduced errors associated with manual tests
- User defined test angles allow machines to be tested at critical orientations
- Tolerance functions increase confidence before critical features are machined
- History and comparison functions allow performance to be tracked over time, allowing trends to be monitored and maintenance scheduled
- Graphical reports combined with tolerance checking quickly identify changes in performance due to collisions or setting errors
- All graphical plots are available in printed reports for record keeping and distribution

There has been strong growth in the market for multi-axis machines, but until now, no easy and reliable process for analysing the performance of their rotary axes and identifying problems caused by incorrect machine set-up, collisions or wear.

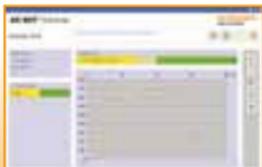
Compatible with common formats of 5-axis and multi-tasking machines, AxSet Check-Up provides machine users with a fast and accurate health check of rotary axis pivot points. Alignment and positioning performance checks are carried out rapidly to benchmark and monitor complex machines over time.

With its probing macro software and a dedicated calibration artefact, it provides graphical representations of multi-axis machine performance. It makes PASS or FAIL decisions based on defined tolerances, and allows performance to be tracked over time, using history and comparison functions. All of which helps to identify poor machine alignments and geometry due to machine set-up, collisions or wear.

Performance analysis is reported graphically via Microsoft® Excel®, compared against user defined tolerances and stored for historical comparison. All results can be printed in a standardised report via Microsoft® Word®.



Circular plot

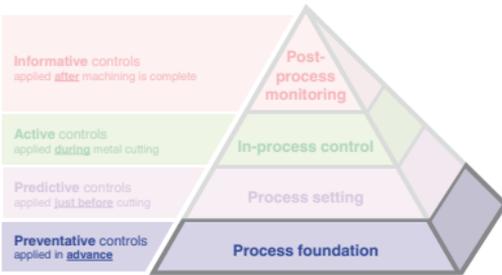


Angular plot



History plot

Machine tool diagnostics



QC20-W telescopic ballbar



The QC20-W ballbar system offers a fast and effective method for checking the accuracy of CNC machines. It provides comprehensive diagnosis which allows you to

- Improve machine performance
- Reduce down time after crashes
- Plan maintenance and reduce scheduled down time
- Comply with QA and QC system requirements
- Improve job allocation by understanding individual machines capabilities

In short take control of your machining operations. If you own CNC machine tools you need the assurance of running regular ballbar checks.

A simple test

A simple circular path is programmed for the machine tool. The ballbar very accurately measures the radius of the arc and compares it to the programmed path. It's a quick test that usually takes less than 10 minutes, even including the set up. Renishaw's unique software not only gives you an overall measure of machine accuracy (circularity or circular deviation) but a detailed diagnosis of up to 19 error terms (e.g. backlash, scale error, squareness etc) that can be used to target maintenance and repairs. Supplied as a portable kit, just add a PC and you're ready to start testing within minutes.

QC20-W: a major Improvement

Renishaw's QC10 ballbar was the acknowledged market leader. Now the QC20-W brings the advantages of wireless operation, enabling simpler testing and enhanced 'closed door' operation, improved software functionality and a unique 220° 'partial arc' test. This allows 3 plane testing from a single set up but also allows testing where axis travel is limited (e.g. Z axis on machining centres or X axis on lathes) using the standard fixturing supplied.



A proven track record

The telescopic ballbar has established itself over nearly 20 years as THE single most flexible, practical and powerful tool for the analysis of CNC machine tools; recognised in major international standards such as ASME B5-54 and ISO 230.4. It is used regularly by thousands of companies worldwide who find it to be a cost-effective solution to improving their business. Whether it's a one man service operator, end user or the largest of machine tool OEMs, the result is the same, proven performance.

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 we recommend that you:

Keep styli short

The more that a stylus bends or deflects, the lower the accuracy. Probing with the minimum stylus length for your application is the best option.

Minimise joints

Every time you join styli and extensions, you introduce potential bending and deflection points.

Try, wherever possible, to keep to the minimum number of pieces for your application.

Keep the ball as large as possible

There are two reasons for this, firstly, it maximises your ball/stem clearance thereby reducing the chances for false triggers caused by 'shanking out' on the stylus stem; secondly, the larger ball reduces the effect of the surface finish of the component being inspected.

Renishaw has used its expertise in probe and stylus design to develop a comprehensive range of CMM and machine tool styli to offer the greatest possible precision.

The genuine Renishaw stylus range comprises several types:

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 standard products, Renishaw's Styli and Custom Products Division offers a unique service by providing customers with a total solution for their probing needs for CMM, machine tool or scanning applications.



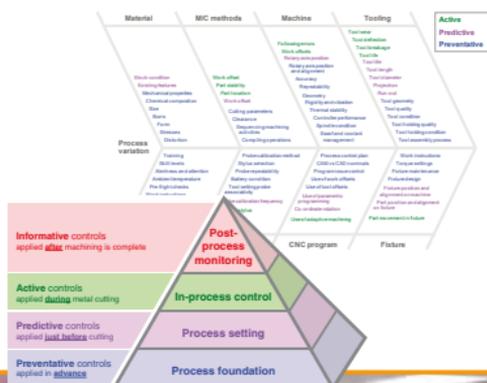
Process control solutions tailored for you

Renishaw recognises that its customers sometimes need support to design and implement process solutions. Using the Productive Process Pyramid™ as a framework within which to work, Renishaw's experienced engineers can assist you to improve your manufacturing processes.

Renishaw offers more than just innovative product solutions.

With a range of services tailored to your needs, Renishaw can help you understand the potential variables in your manufacturing facilities so that you can control and transform your manufacturing process.

- Process control training
- Process control consultancy
- Turn-key solutions
 - Process design
 - Process implementation
 - Process stabilisation
 - Process maintenance



Custom product design service

Total product service

- Design and manufacturing solutions based on Renishaw's knowledge and experience in product applications worldwide.
- Easy integration of Renishaw's probing products onto your machine.
- Best application of standard and custom products on customers' machines.
- Cost and delivery times minimised as standard parts are used where possible.

A team approach

Renishaw's custom design service team encompasses design, engineering, production and marketing specialists, to ensure a comprehensive and efficient service.

Many years of experience in satisfying specific customer requirements exist within the group, which is backed by Renishaw's worldwide experience in probing related technology and applications.

The group works with Renishaw's customer support service, our distributors and ultimately our customer to ensure the most effective solution is found.

Access to Renishaw's custom design service

If your specialised needs cannot be met from the standard range of products, we will be pleased to make recommendations to your regular Renishaw supplier.

To help identify your particular needs, your supplier will assist you in completing a questionnaire. He will need full details of the specific application for which the system will be used, together with any environmental constraints. The make and model of the host machine tool must be specified, as should the required total accuracy of the probing system.

The required timescale is also important. The initial quantity and forecast of future requirements will naturally affect the final price quotation.



Service and support

Renishaw recognises the value of good support and offers many different options which are available through our international offices. We aim to keep you operational, with a rapid response to your needs.

Upgrades

One alternative with worn out, damaged or obsolete product is to upgrade to a more modern equivalent. Where this is possible, the option will always be offered to you when contacting us.

Repairs

There are several levels of repair, 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 damage is beyond economical repair, or immediate despatch is required, we have stocks of service exchange items (RBEs). These items have also passed the stringent 'as new' final tests, and have been subject to a complete refurbishment with the replacement of all parts subject to wear regardless of their condition.

A fully refurbished RBE item is very competitively priced, reflecting our commitment to existing users.

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