

High speed, high precision non-contact tool setting and broken tool detection



Broken tool detection

High speed tool breakage detection



Tool length and diameter

Measure tool length and diameter at normal spindle cutting speeds



Reduce tool setting times

Reduce set times by up to 90% and improve your process control

Your setting time could be productive time...

Why probe?

Renishaw probing systems eliminate costly machine down-time and the scrapping of components associated with manual setting and inspection.

Your machining centres represent a large capital investment – fast metal removal and the ability to produce intricate parts are just some of the machine's many assets, but your machines are only profitable when they are cutting good parts.

Do you have unprofitable down-time?

Why are most of your machines **idle** for hours?

Simple. Many companies are still setting tools and parts **manually**, and inspecting parts **remote** from the machine – both result in an expensive piece of equipment lying idle.

REDUCE your down-time and scrap – IMPROVE repeatability and accuracy

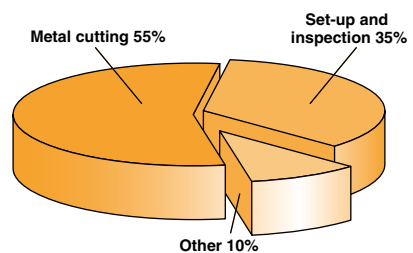
Probes for tool checking and measurement have been one of the metal cutting industries best investments for many years. These systems lead to reduced set-up time and reduced scrap caused by setting errors and undetected broken tools.

Probing software automatically compensates for tool length and diameter, workpiece position and dimensional errors.

Renishaw probing systems are used by companies worldwide to increase productivity and improve part quality. They can be specified as standard equipment from most leading manufacturers. Ease of fitting allows probes to be retrofitted to machines already installed.

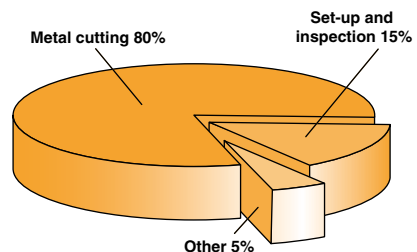
Powerful software packages are available from Renishaw using easily programmable macros for tool setting, workpiece set-up and measurement. These probing cycles, viewed as industry-standard, are simply incorporated into part programs and automatically called with standard machine codes.

How much time do you spend manually setting your CNC machining centre?



Typical available production time without probing systems

Cut setting time by up to 90% with probing AND cut more metal



Typical available production time with probing systems



NC4 compact system

Setting tools saves time and reduces errors

NO trial cuts

- Set a suite of tools in minutes - no manual 'cut and measure' required*
- Probing is more repeatable than manual measurement
- Tools set while rotating, eliminating errors caused by run-out and insert height variation

NO off-line pre-setters

- Set tools in situ at normal cutting speeds for greater accuracy

NO manual offset updates

- Probing software updates tool offsets automatically
- Avoid human error and reduce tool and part damage



TRS1 single-sided tool recognition system

Common features of non-contact systems:

Although the non-contact systems available from Renishaw have their own individual features described in the pages to follow, they all achieve common results:

Reduce tool setting times

- Rapidly measure the working length and diameter of a tool
- Measure tool length and diameter at normal spindle cutting speeds. Radial run out of the spindle, tool holder and tool is included in the measurement
- Measure tools as small as 0.03 mm diameter*
- Measure tools anywhere along the laser beam

Reduce scrap

- Your set-up becomes highly repeatable. Scrap caused by inconsistent setting is reduced as a result

Reduce operating costs

- Operator to machine ratio is reduced

Improve process control

- Monitor and compensate for thermal movement of the machine
- Reduce scrap and rework due to setting errors
- Measure tools without contact – avoid possible wear and damage on delicate tools

* Dependent on separation and mounting
Features above are dependant on system chosen.
See specification table for further details.

Detect broken or incorrect tools

- Perform tool verification and broken tool detection, allowing corrective action eg. call operator or change for 'sister' tooling
- Check for tool breakage with the rapid broken tool detection cycle ('M' code required for this feature)
- Check each facet of a multi-faceted tool for damage ('M' code required for this feature)

Easy to install

- Simple pneumatic system – no solenoid valves to wire up
- System alignment easily achieved with a hand held voltmeter or set-up tool
- 'M' code not required for basic functionality
- Adjuster packs available for quicker/easier installation
- No moving parts – minimal maintenance

Improve safety

- Fully automatic operation so that all machine guarding remains closed during setting or inspection



NC4 compact application

Fit non-contact laser tool setting systems to your machine tools...

Renishaw probes provide rapid, automatic and consistent results

Repeatable*

Trigger point repeatability of:

NC2: N/A

NC3: $\pm 0.15 \mu\text{m}$ (2σ)

NC4:

Specified: $\pm 1 \mu\text{m}$ at 1 m

Typical: $\pm 0.1 \mu\text{m}$ (2σ)

Rugged

High resistance to shock and vibration. Sealed to IPX8, resistant to coolant and swarf.

Reliable

MicroHole™ technology ensures proven reliability even in coolant soaked environments.

Easy-to-use

Industry-standard software and minimal probe maintenance.

* Dependent on separation and mounting

MicroHole™ technology

The MicroHole™ system functions by having a constant flow of air through an angled hole in the front of the unit. The flow of air travels up to 250 m/s and prevents any swarf or coolant from entering the unit. The hole is angled so that the turbulence in the air does not disturb the path of the laser beam.

- **No moving parts means no wear or sticking, leading to greater reliability and reduced maintenance**
- **Only 1 'M-code' needed for single broken edge detection**
- **Constant protection even during measurement**
- **Very low maintenance (air filter needs to be replaced annually)**

PassiveSeal™ technology

The PassiveSeal™ system provided additional protection from contamination in the event of an air supply failure. New uniquely integrated protection system, maintaining IPX8 rating 100% of the time - even when the air supply is off.

Drip rejection feature

Renishaws 'drip rejection' feature enables the non-contact system to filter out unwanted false triggers caused by coolant drips. When combined with a non-contact interface unit, the system is able to distinguish between tools and coolant drips, resulting in a robust and reliable system.

Tool recognition technology

The unique tool recognition technology can distinguish between the tool, coolant and swarf, giving fast reliable results under real machining conditions. This recognition system takes a fraction of a second, ensuring that individual tools can be rapidly checked at the beginning or end of a machining cycle.

Features above are dependant on system chosen. See specification table opposite for further details.



NC3 high speed non-contact laser system



NC4 compact laser system application







NC4 high speed non-contact laser device available as fixed or separate systems



...and reduce set times by up to 90%

Which non-contact system is right for my application?

The table below is designed to help identify which non-contact system is the most suitable for your application:

| | NC2 | NC3 | NC4 | | TRS1 |
|--|---|---|--|--|---|
| |  |  |  | |  |
| Function | Tool breakage detection only | Tool setting and tool breakage detection | Tool setting and tool breakage detection | | Tool breakage detection only |
| Laser classification | 670 nm, visible red, Class 2 <1 mW | 670 nm, visible red, Class 2 <1 mW | 670 nm, visible red, Class 2 <1 mW | | 670 nm, visible red, Class 2 <1 mW |
| Fixed system length (operating gap) mm (in) | 135 (80) | 135 (80) | Modular** F300 (225 mm) | Compact** F95 (225 mm); F115 (55 mm); F230 (170 mm) | 0.3 m to 2 m |
| Fixed system dimensions (mm) | 69 (H) x 26 (W) x 135 (L) | 69 (H) x 26 (W) x 135 (L) | 102 (H) x 40 (W) x 300 (L) | 77 (H) x 30 (W) x see above (L) | 72 (H) x 38 (W) x 73 (L) |
| Separate system operating gap (m) | N/A | N/A | From 0.3 m to 5.0 m | | N/A |
| Tx / Rx dimensions | N/A | N/A | Ø30 mm x 35 mm high | | N/A |
| Repeatability of trigger points (2σ) | Not applicable | ± 0.15 µm | Typical: ± 0.1 µm* Specified: ± 1 µm at 1 m | | N/A |
| Min. tool detection | 0.15 mm | 0.1 mm | 0.03 mm* | | 0.5 mm |
| Min. tool measurement | N/A | 0.2 mm | 0.03 mm* | | N/A |
| Pneumatic supply | 1 off 3 mm OD plastic pipe | 1 off 3 mm OD plastic pipe | 1 off 3 mm OD plastic pipe | | Ø 4 mm air pipe |
| Environmental protection | IPX8 air on | IPX8 air on | IPX8 air on or off | | IPX8 air on |
| MicroHole™ | Yes | Yes | Yes | | No |
| PassiveSeal™ | No | No | Yes | | No |
| Tool recognition | No | No | No | | Yes |
| Interface* | N/A | NCi-4 | NCi-4 | | N/A |
| Supply voltage (current) | 10 V to 30 V (35 mA) | 12 V (120 mA) to 24 V (70 mA) | 12 V (120 mA) to 24 V (70 mA) | | 11V Vdc to 30 Vdc (45 mA) |
| Outputs | Voltage free solid state relay (SSR) | 2 voltage free solid state relays (SSR) plus auxiliary relay | Voltage free solid state relay (SSR) plus auxiliary relay | | Voltage free solid state relay (SSR) |
| M-code requirements | Broken tool - 1 | L & D tool setting - 0 High speed broken tool detection - 1. Latch - 1 | L & D tool setting - 0 High speed broken tool detection - 1 Latch - 1 | | No |
| Standard Renishaw software | Yes | Yes | Yes | | Yes |

* Performance figures based on F95 compact fixed system

** Other separations available upon request

Non-contact systems from Renishaw. The options...



TRS1 single sided device

TRS1 tool recognition

The TRS1 is the new, single-sided tool recognition system from Renishaw. Conventional non-contact broken tool detection systems depend on the laser beam being blocked (tool OK) or not blocked (tool broken).

The TRS1 is different. It offers benefits beyond other tool breakage systems, as it does not merely look for a change in light levels. The new tool recognition technology distinguishes between the tool and coolant or swarf, whilst it is also fast and reliable under real machining conditions.

FEATURES:

- Cost effective, fast and reliable tool breakage detection device
- Detection of tools as small as $\text{Ø}0.5 \text{ mm}^*$ with the tool typically spending about 1 second in the laser beam.
- Single sided unit resulting in a simple and quick to install
- Ability to detect tools at a distance of 0.3 m to 2 m range.



NC2 and NC3 systems

NC2 tool breakage detection device

The NC2 is an ultra-compact laser system offering broken tool detection. The NC2 system offers a compact, cost-effective tool breakage detection solution to users of VMCs and HMCs.

FEATURES:

- Cost effective
- Detection of tools as small as $\text{Ø}0.15 \text{ mm}$
- Short cycle times
- Ultra-compact overall length of just 135 mm with a laser beam length of 85 mm

* Dependent on separation and mounting

NC3 non-contact tool setting and tool breakage detection

The NC3 is an ultra-compact laser system for high-speed, high performance, non-contact tool measurement and broken tool detection.

FEATURES:

- Impressive repeatability of $\pm 0.15 \mu\text{m}$ (2σ)
- Drip rejection feature selectable via switch
- High speed broken tool detection cycle
- Measure tools of $\text{Ø}0.2 \text{ mm}$ or larger.
Detect broken tools as small as $\text{Ø}0.1 \text{ mm}$

The NCi-4 interface has enabled a brand new high speed tool breakage detection cycle to be used.

NC4 compact high-speed tool setting and breakage detection

The NC4 is a flexible laser system with ultra-compact laser tool setting transmitter and receiver units that can be mounted on separate brackets, or as a single fixed system. The F95, F115 and F230 additions to the series, set new performance standards in small packages

FEATURES:

- Ideal for machines previously unsuitable for large non-contact systems.
- New PassiveSeal™ failsafe device, preventing contamination.
- Specified repeatability $\pm 0.1 \mu\text{m}$ (2σ) at 1 m separation. Typical repeatability of $\pm 0.1 \mu\text{m}$ (2σ)
- Measure and detects tools of $\text{Ø}0.03 \text{ mm}$ or larger



NC4 separate system



NC4 compact range



Renishaw software – comprehensive and easy to use...

Renishaw has developed software packages for a range of CNC controls, comprising simple commands (often just single lines) written into the CNC program.

Typical cycles include:

- Rotating length setting (taps, drills, face mills, large cutters etc.)
- Rotating diameter setting (slot drills, boring bars etc.)
- Cutting edge checking – check each facet of a multi-faceted tool for damage
- Cutting radius and linear profile checking
- High speed broken tool detection
- Thermal compensation
- Calibration using a flat-bottom cylinder-type master tool
- Optical beam alignment for setting up the system
- Wide range of CNC controllers supported

Tool length/diameter setting

The tool is automatically positioned over the laser. The following example program is then executed:

Typical example (Fanuc):

G65 P9862 (tool length setting)

G65 P9862 B3. D31. (tool length and diameter setting)

High speed broken tool detection

This cycle is used for high speed broken tool detection of tools that are solid on-centre e.g. drills, taps etc. The end of the tool is positioned in the laser beam and by detecting whether the beam is broken, the condition of the tool is determined very quickly.

Typical example (Fanuc):

G65 P9866 H-0.5

Broken tool detection

Plunge check

When running the following cycle after machining, the tool is automatically positioned over the laser beam. It is then plunged into the beam to check its overall length. With the following example, both long and short tool conditions can be checked to a tolerance of 0.5 mm.

Typical example (Fanuc):

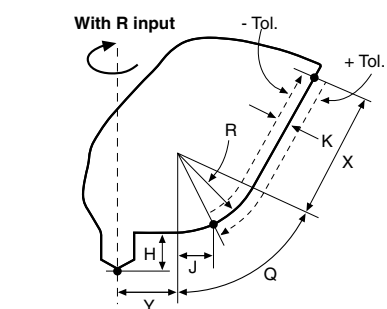
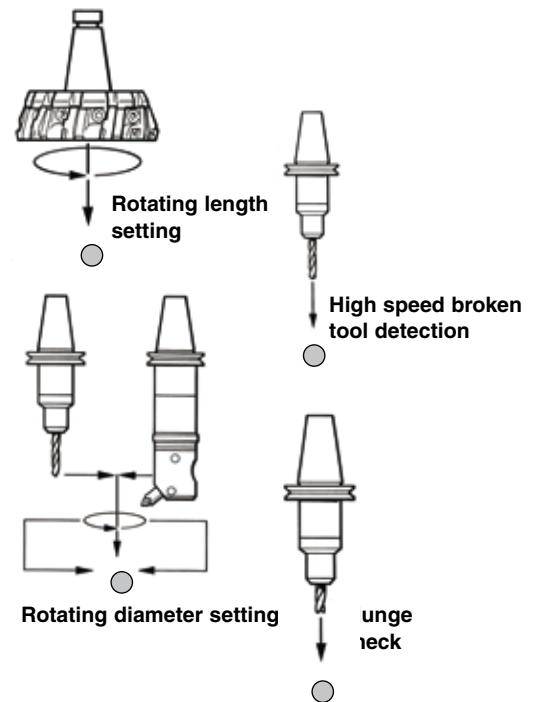
G65 P9863 H-0.5

Cutter radius and linear profile checking

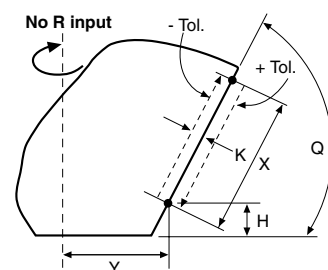
This cycle is used to check the profile of ballnose cutters, cutters with corner radii, and cutters with linear profiles. The profile is checked to find out if it is within a specified form tolerance.

Typical example (Fanuc):

G65 P9865 B3. H0 J0.5 Q90. R5. X10



Checking a profile with a corner radius



Checking a linear profile

Renishaw applies innovation to provide solutions to your problems

Renishaw is an established world leader in metrology, providing high performance, cost-effective solutions for measurement and increased productivity. A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Renishaw designs, develops and manufactures products which conform to ISO 9001 standards.

Renishaw provides innovative solutions using the following products:

- **Probe systems for inspection on CMMs (co-ordinate measuring machines).**
- **Systems for job set-up, tool setting and inspection on machine tools.**
- **Scanning and digitising systems.**
- **Laser and automated ballbar systems for performance measurement and calibration of machines.**
- **Encoder systems for high accuracy position feedback.**
- **Spectroscopy systems for non-destructive material analysis in laboratory and process environments.**
- **Styli for inspection and tool setting probes.**
- **Customised solutions for your applications.**

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