

# MP250 machine tool probe system



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# Before you begin

## Disclaimer

WHILE CONSIDERABLE EFFORT WAS MADE TO VERIFY THE ACCURACY OF THIS DOCUMENT AT PUBLICATION, ALL WARRANTIES, CONDITIONS, REPRESENTATIONS AND LIABILITY, HOWSOEVER ARISING, ARE EXCLUDED TO THE EXTENT PERMITTED BY LAW.

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## Trade marks

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Other brand, product or company names are trade marks of their respective owners.

## Warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

## CNC machines

CNC machine tools must always be operated by fully trained personnel in accordance with the manufacturer's instructions.

## Care of the probe

Keep system components clean and treat the probe as a precision tool.

## Patents

Features of the MP250 probe and other similar Renishaw products, are the subject of one or more of the following patents and/or patent applications:

CN 101142461  
CN 101171493  
CN 111133272  
EP 1866602  
EP 1880163  
EP 2154471  
EP 3688405  
IN 305341  
IN 364693  
JP 2020-535419  
JP 5283501  
JP 5308811  
JP 5611297  
US 2020-0191564  
US 7603789  
US 7792654  
US 8140287  
WO 2019/063991

## Intended use

The MP250 is a hardwired probe that enables automated workpiece inspection and part set-up on CNC grinding and other types of machines.

## Safety

### Information to the user

In all applications involving the use of machine tools or CMMs, eye protection is recommended.

### Information to the machine supplier/ installer

It is the machine supplier's responsibility to ensure that the user is made aware of any hazards involved in operation, including those mentioned in Renishaw product literature, and to ensure that adequate guards and safety interlocks are provided.

Under certain circumstances, the probe signal may falsely indicate a probe seated condition. Do not rely on probe signals to halt the movement of the machine.

### Information to the equipment installer

All Renishaw equipment is designed to comply with the relevant UK, EU and FCC regulatory requirements. It is the responsibility of the equipment installer to ensure that the following guidelines are adhered to, in order for the product to function in accordance with these regulations:

- any interface **MUST** be installed in a position away from any potential sources of electrical noise, i.e. power transformers, servo drives etc.;
- all 0 V/ground connections should be connected to the machine "star point" (the "star point" is a single point return for all equipment ground and screen cables). This is very important and failure to adhere to this can cause a potential difference between grounds;
- all screens must be connected as outlined in the user instructions;
- cables must not be routed alongside high current sources, i.e. motor power supply cables etc., or be near high-speed data lines;
- cable lengths should always be kept to a minimum.

### Equipment operation

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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# MP250 basics

## Introduction

Renishaw's second generation MP250 ultra compact probe for tool and cutter grinding machine sets new standards for reliability and robustness,

Easily identified by the C marking on the probe body (see figure below), the second generation MP250 continues to successfully combine minaturisation of the popular LP2 with high accuracy of the RENGAGE™ technology, to provide users with a simple upgrade to solid-state strain gauge technology and all the associated benefits this brings:

- excellent 3D performance to allow probing of contoured surfaces;
- improved repeatability in all probing directions;
- low pre-travel variation to provide high accuracy, even when used with long styli;
- a proven improvement in life;
- compact and robust design; ideal for grinding machine applications;
- resistance to shock and false triggering through the use of digital filtering.



The second generation MP250 is compatible for application with both HSI and HSI-C interfaces. Full functional capability of second generation MP250 is realised when it is used in conjunction with the HSI-C interface. Application with HSI-C enables the user to select a suitable level of immunity to false triggers, caused by machine vibrations or accelerations.

In addition to providing high accuracy measurement on your grinding machine, the MP250 also offers:

- A reduced need to calibrate:

Whilst pre-travel variation is not regarded as a form of measurement error, since it can be easily compensated for by calibrating the probe, on complex parts it may be necessary to probe in many different directions. Calibrating the probe in each direction can be extremely time consuming.

The MP250 has almost no pre-travel variation (typically  $\pm 0.25 \mu\text{m}$  ( $10.00 \mu\text{in}$ ) in the X, Y plane and  $\pm 1.00 \mu\text{m}$  ( $40.00 \mu\text{in}$ ) 3D). This allows the machine to be programmed to drive the stylus onto any part at any angle such that it touches the component normal to the surface. It is NOT NECESSARY to re-calibrate the probe in each direction it is to be used. Once calibrated, the probe can be used in ANY direction. However, if the probe is re-orientated between measuring points, some form of calibration should be considered at each orientation due to the effect of gravity on the stylus.

For further information about calibration, refer to page 3.6 “Calibrating the MP250”.

## Re-orientation of the probe

If an MP250 is fitted with a long or ‘heavy’ stylus, and its orientation is changed from horizontal to vertical or vice-versa (i.e., such as on a 5-axis machine with a swivelling head), it is possible for the probe to trigger and remain triggered requiring a probe reset. It is also possible, if the MP250 is fitted with a long or ‘heavy’ stylus, mounted horizontally and then rotated about its own axis, for the probe to trigger and remain triggered. It is recommended that the probe inhibit function is used to turn off power to the MP250 during every re-orientation move. Once the re-orientation move is complete, the probe inhibit function should be removed so that power to the probe is restored. The probe will then take a minimum of 0.4 seconds before it is ready to measure and must remain stationary during this period. In order to reset correctly, the probe stylus must be in free air and not in contact with the workpiece, or anything else, when the inhibit function is removed.

For further details of the probe inhibit function, see the *HSI hard-wired system interface* installation guide (Renishaw part no. H-5500-8554) or the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501).

## Switch-on delay

To ensure that the probe activates correctly, it is important to make sure that it is stationary when it is switched on. If the probe is not stationary during the start sequence, then there is a possibility that the probe could be initialised in the incorrect position and produce a permanently triggered output.

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### NOTES:

The probing program on the machine will need to take account of the switch-on delay.

The stylus must not be deflected when the probe is switched on, otherwise the system will not initialise correctly and may appear permanently triggered.

During the initialisation period just after switch on, the probe status output is triggered for safety reasons.

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## Immunity to false triggers

Probes subjected to high levels of vibration or shock loads may output signals without having contacted any surface.

When the MP250 is used with the HSI-C interface, the probe can be configured to operate with three different levels of immunity to false triggers. MP250 operating configurations are selectable via a switch on the HSI-C interface:

- Level 1 provides a low latency configuration for measuring in the machine acceleration zone with small approach distances.
- Level 2 provides a default configuration for general usage.
- Level 3 provides a high false trigger immunity configuration for either manoeuvring to the measure position at high speed or when measuring with 'heavy' styli at high speed.

For more information about selecting MP250 operating configurations, see the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501).

When the MP250 is used with the HSI interface a constant 8 ms delay is added to provide resistance to vibration or shock loads.

## Measurement cycles

The probe must be powered off after a measurement cycle. The probe inhibit function may be used to turn off power to the MP250 after a measurement cycle is completed.

Before starting a measurement cycle, the probe inhibit function should be removed so that power to the probe will be turned on. The probe will then take a minimum of 0.4 seconds before it is ready to measure and must remain stationary during this period.

During a measurement cycle, measured points must be taken when the probe triggers (probe status goes from seated to triggered) and not when it reseats (probe status goes from triggered to seated). The performance of the probe when it reseats is not specified.

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**NOTE:** It may be advantageous to switch to level 3 to enable high speed probe position moves between measurement points. For more information about high speed probe position moves, see the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501).

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## Trigger speed

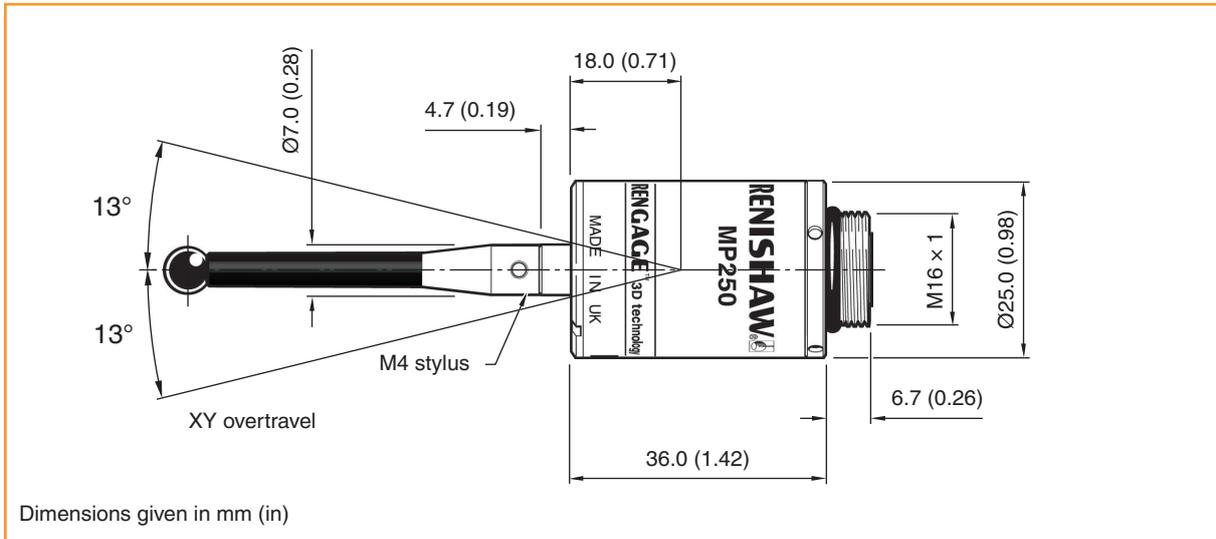
The probe should not be used at speeds below 3 mm/min.

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**NOTE:** Take care when using the machine handwheel to ensure the probing speed is greater than 3 mm/min.

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## MP250 dimensions



Stylus overtravel limits		
Stylus length	$\pm X / \pm Y$	Z
50.0 (1.97)	15.0 (0.59)	6.5 (0.26)
100.0 (3.94)	26.0 (1.02)	6.5 (0.26)

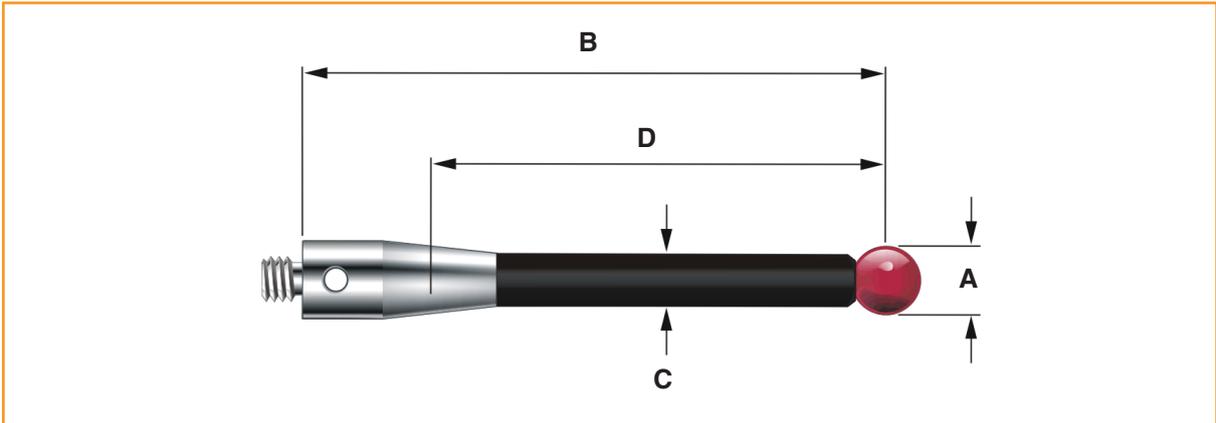
## MP250 probe specification

<b>Principal application</b>	Workpiece inspection and job set-up on CNC grinders.	
<b>Transmission type</b>	Hard-wired transmission	
<b>Compatible interfaces</b>	HSI and HSI-C	
<b>Recommended styli</b>	High modulus carbon fibre, lengths 50.0 mm (1.97 in) or 100.0 mm (3.94 in).	
<b>Weight</b>	64 g (2.26 oz)	
<b>Sense directions</b>	±X, ±Y, +Z	
<b>Unidirectional repeatability</b>	0.25 µm (10.00 µin) 2σ – 35 mm stylus length (see note 1)	
<b>X, Y (2D) form measurement deviation</b>	±0.25 µm (10.00 µin) – 35 mm stylus length (see note 1)	
<b>X, Y, Z (3D) form measurement deviation</b>	±1.00 µm (40.00 µin) – 35 mm stylus length (see note 1)	
<b>Stylus trigger force</b>		
XY plane (typical minimum)	0.08 N, 8.0 gf (0.29 ozf) (see notes 2 and 5)	
+Z direction (typical minimum)	2.25 N, 229.0 gf (8.09 ozf) (see note 2 and 5)	
<b>Stylus overtravel force</b>		
XY plane (typical minimum)	0.70 N, 71.3 gf (2.52 ozf) (see notes 3 and 5)	
+Z plane (typical minimum)	5.0 N, 510 gf (18.0 ozf) (see notes 4 and 5)	
<b>Minimum probing speed</b>	3 mm/min (0.12 in/min)	
<b>Environment</b>	IP rating	IPX8, BS EN 60529:1992+A2:2013
	Storage temperature	–25 °C to +70 °C (–13 °F to +158 °F)
	Operating temperature	+5 °C to +55 °C (+41 °F to +131 °F)

- Note 1 Performance specification is for a test velocity of 240 mm/min (9.45 in/min) using a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.
- Note 2 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers.  
The maximum force applied will occur after the trigger point i.e. overtravel. The force value depends on related variables including measuring speed and machine deceleration. RENGAGE equipped probes offer ultra low trigger forces.
- Note 3 Stylus overtravel force in XY plane occurs 50.0 µm (1968.50 µin) after the trigger point and rises by 0.12 N/mm, 12 gf/mm (0.02 ozf/in) until the machine tool stops (in the high force direction).
- Note 4 Stylus overtravel force in + Z direction occurs 1.0 µm (39.37 µin) after the trigger point and rises by 0.6 N/mm, 61 gf/mm (0.08 ozf/in) until the machine tool stops.
- Note 5 These are the factory settings, applicable when used with the HSI-C interface, level 2 default configuration for general usage, using a 50 mm stylus.

### Recommended styli

High modulus carbon fibre styli are designed to minimise pre-travel and improve accuracy, as the stem material is extremely stiff. This inherent stiffness makes the following styli most suitable for strain gauge applications.



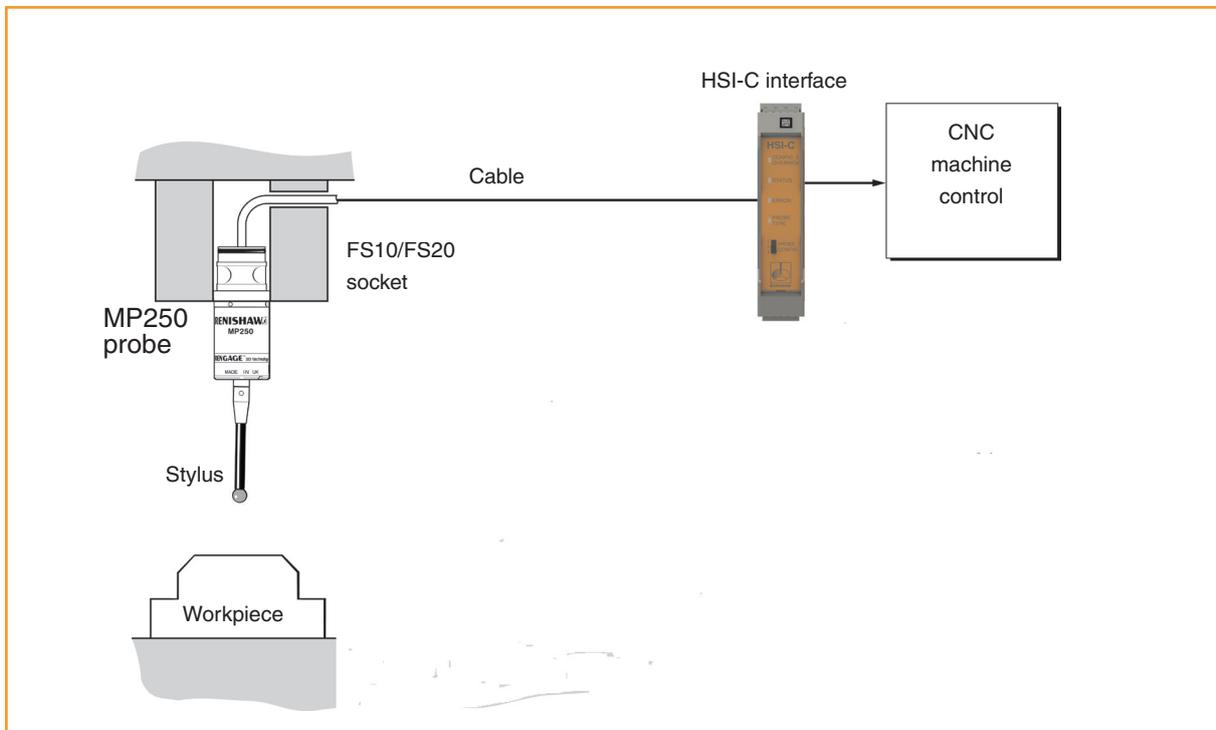
Part number		A-5003-7306 Carbon fibre	A-5003-6510 Carbon fibre
<b>A</b>	Ball diameter mm (inch)	6.0 (0.24)	6.0 (0.24)
<b>B</b>	Length mm (inch)	50.0 (1.97)	100.0 (3.94)
<b>C</b>	Stem diameter mm (inch)	4.5 (0.18)	4.5 (0.18)
<b>D</b>	EWL mm (inch)	38.5 (1.52)	88.5 (3.48)
	Mass g (oz)	4.1 (0.14)	6.2 (0.22)

EWL = effective working length

# System installation

## Installing the MP250

### Typical MP250 installation with a HSI-C



**NOTE:** MP250 connects to the probe connector (Block 4) on the HSI-C interface.

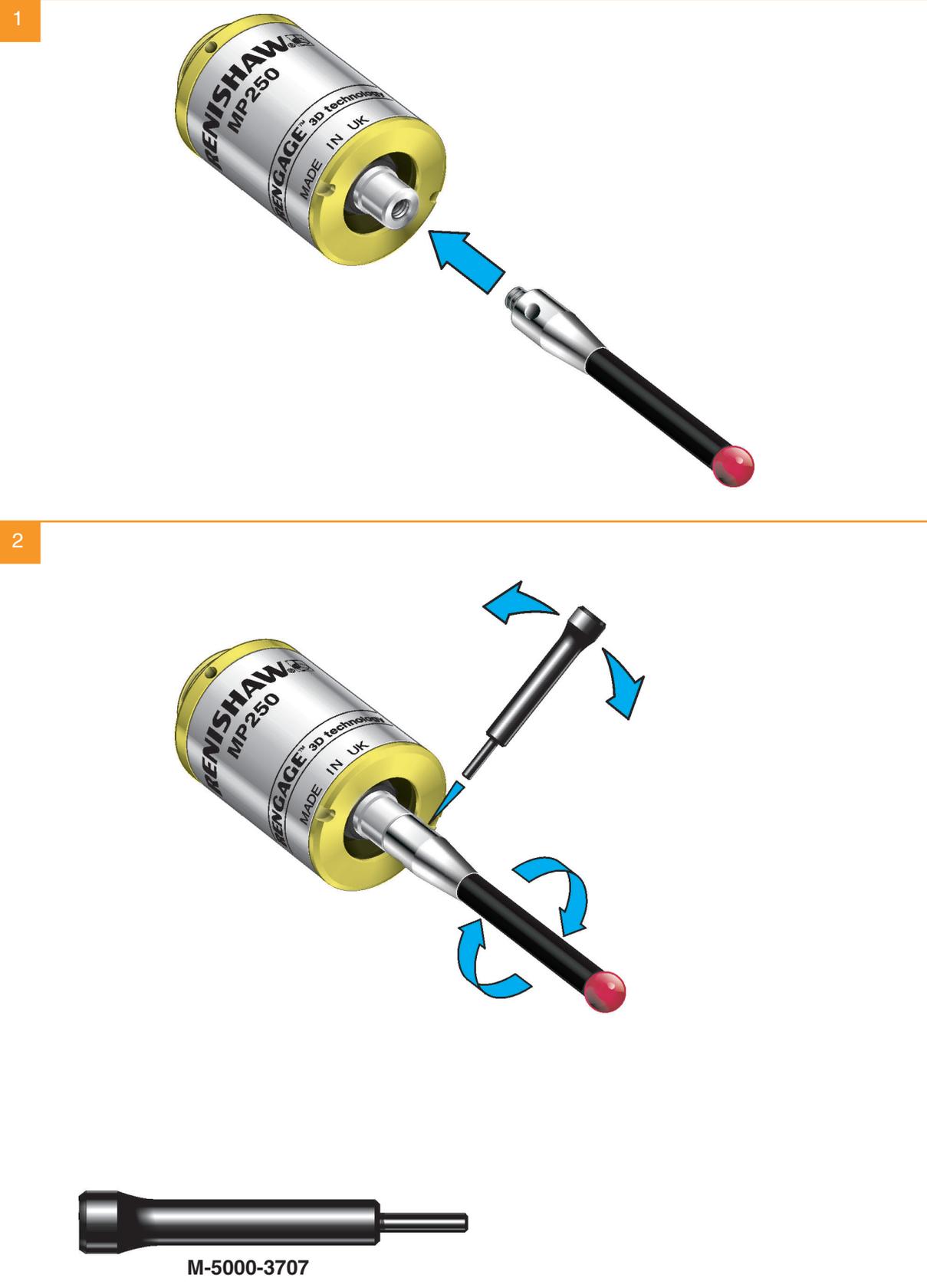
**NOTE:** The screen connection between the probe socket and the HSI-C interface must be connected. See the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501 for connection details. Failure to do so will cause poor performance.

# Preparing the MP250 for use

## Fitting the stylus

System  
installation

3.2



## Fitting the MP250 into a probe socket

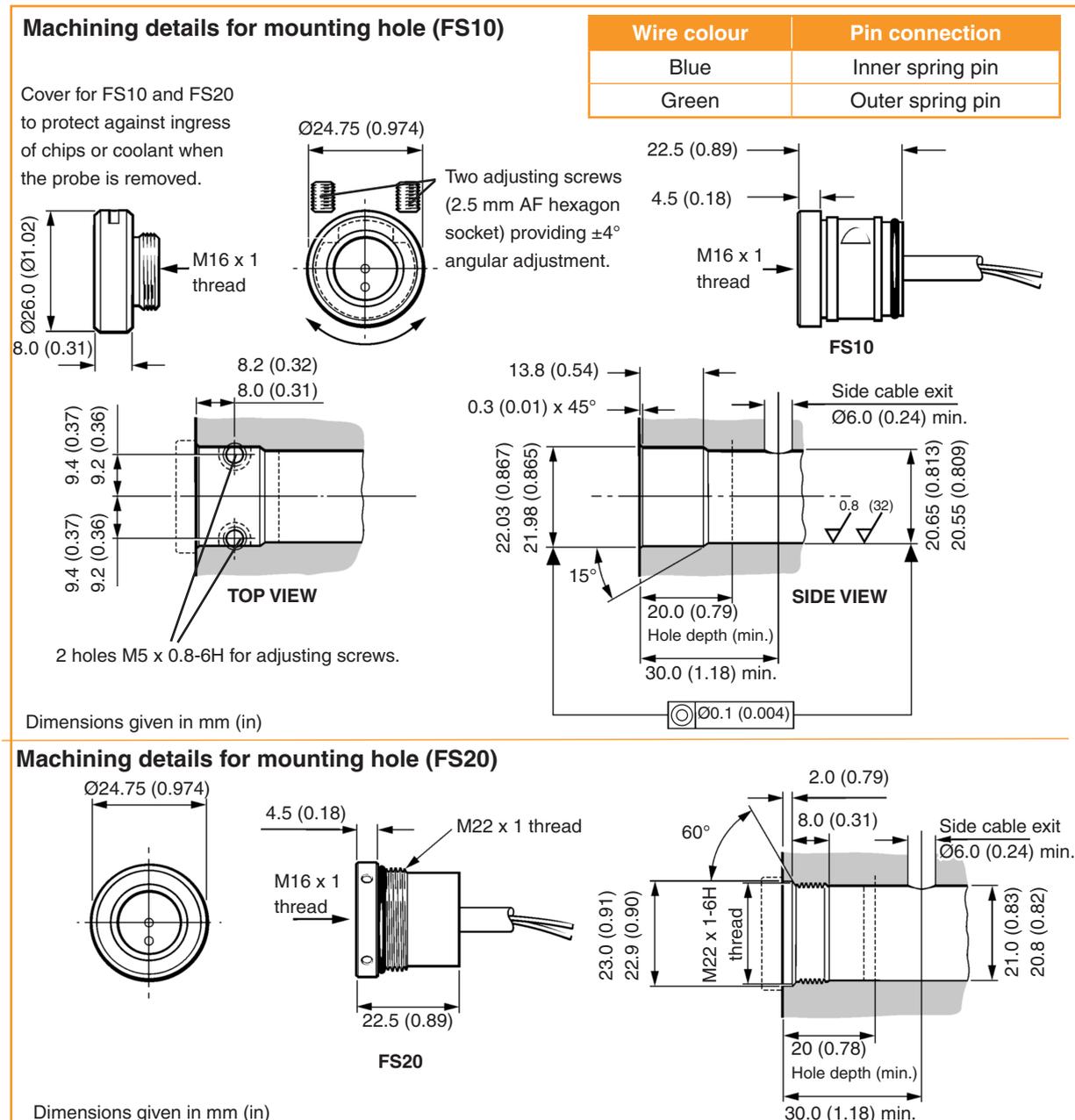
### Mounting the probe socket to your machine

#### NOTES:

The MP250 probe is not electrically compatible with the FS1i or FS2i probe sockets with integral interface.

The MP250 probe must not be connected to the cable previously installed for LP2 application. The MP250 must be used with either a FS10 or FS20 probe sockets which have screened cables.

1. Referring to the machining drawings below, prepare the machine to allow installation of the probe socket.
2. Mount the probe socket to the machine.



3. Using the C-spanner (Renishaw part no. A-2063-7587) supplied, tighten the probe socket to between 10.0 Nm and 12.0 Nm (7.38 lbf.ft and 8.85 lbf.ft).

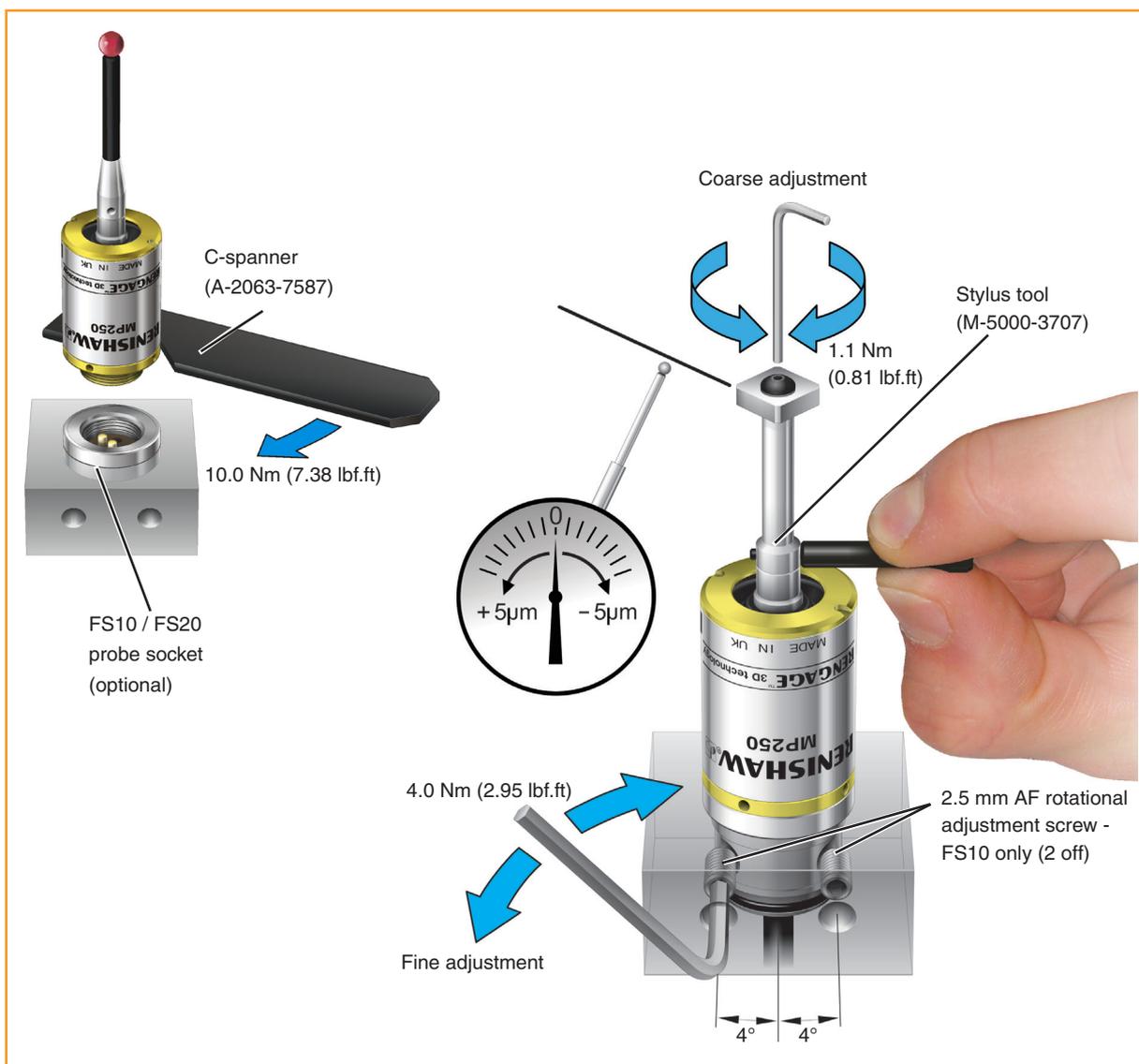
4. Route the cable of the probe socket to the HSI-C or HSI interface.
5. Referring to either the *HSI hard-wired system interface* installation guide (Renishaw part no. H-5500-8554) or the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501), connect the probe socket cable to the HSI or HSI-C interface.

### Mounting the MP250 probe to the probe socket

1. Ensure that the HSI or HSI-C is not powered, or the inhibit input is activated.
2. Screw the MP250 into the probe socket.
3. Using the C-spanner (Renishaw part no. A-2063-7587) supplied, tighten the MP250 to 10.0 Nm (7.38 lbf.ft).

### Aligning the probe's stylus to the machine's axes

1. Fit a square tip stylus to the probe.
2. The square tip of the stylus must align exactly with the machine's X and Y axes. Coarse adjustment is obtained by visually aligning the stylus tip with the machine axes. Fine adjustment is provided via two rotational adjustment screws acting on the optional FS10 socket ( $\pm 4^\circ$ ).



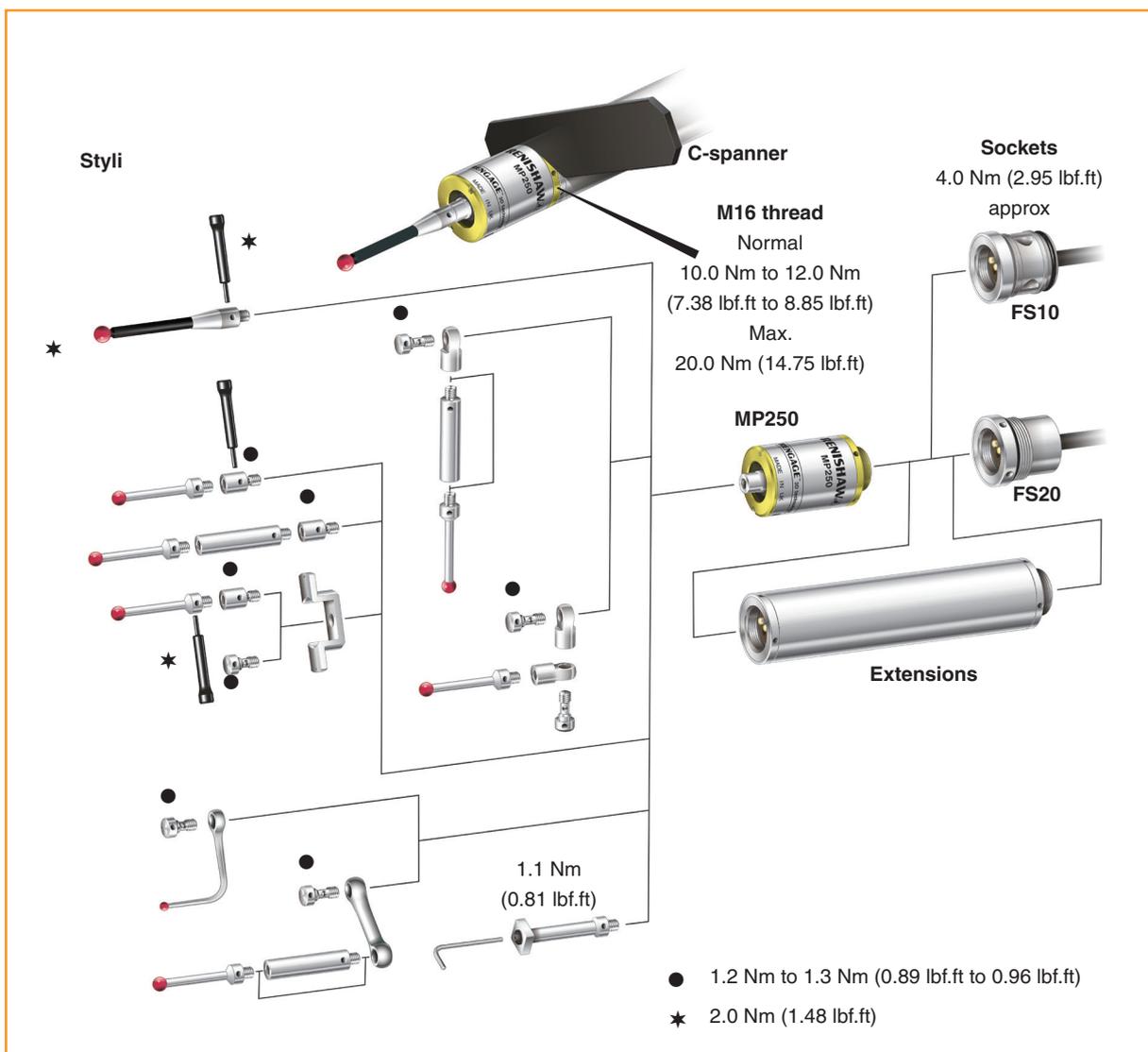
## Stylus configurations

The modular stylus range can be configured to suit the application requirements. Fit a weak link to protect the probe from damage in the event of excessive overtravel.

Styli are fully described in the *Styli and accessories* technical specification (Renishaw part no. H-1000-3200).

## Screw torque values

**CAUTION:** To prevent damage occurring to the MP250 probe and associated components, the screw torque values given below must be used when assembling component parts together.



## Calibrating the MP250

### Why calibrate a probe?

A spindle probe is just one component of the measurement system which communicates with the machine tool. Each part of the system can introduce a constant difference between the position that the stylus touches and the position that is reported to the machine. If the probe is not calibrated, this difference will appear as an inaccuracy in the measurement. Calibration of the probe allows the probing software to compensate for this difference.

During normal use, the difference between the touch position and the reported position does not change, but it is important that the probe is calibrated in the following circumstances:

- when a probe system is to be used for the first time;
- when the MP250 operating configuration is changed;
- when a new stylus is fitted to the probe;
- when it is suspected that the stylus has become distorted or that the probe has been crashed;
- at regular intervals to compensate for mechanical changes of your machine tool;
- if repeatability of relocation of the probe shank is poor. In this case, the probe may need to be recalibrated each time it is selected.

Three different operations are to be used when calibrating a probe. They are:

- calibrating either in a bored hole or on a turned diameter of known position;
- calibrating either in a ring gauge or on a datum sphere;
- calibrating the probe length.

### Calibrating in a bored hole or on a turned diameter

Calibrating a probe, either in a bored hole or on a turned diameter of known size, automatically stores values for the offset of the stylus ball to the spindle centre line. The stored values are then used automatically in the measuring cycles. Measured values are compensated by these values so that they are relative to the true spindle centre line.

### Calibrating in a ring gauge or on a datum sphere

Calibrating a probe either in a ring gauge or on a datum sphere with a known diameter automatically stores one or more values for the radius of the stylus ball. The stored values are then used automatically by the measuring cycles to give the true size of the feature. The values are also used to give true positions of single surface features.

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**NOTE:** The stored radius values are based on the true electronic trigger points. These values are different from the physical sizes.

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### Calibrating the probe length

Calibrating a probe on a known reference surface determines the length of the probe, based on the electronic trigger point. The stored value for length is different from the physical length of the probe assembly. Additionally, the operation can automatically compensate for machine and fixture height errors by adjusting the probe length value that is stored.

## Calibration feedrate and rotary axes

It is very important that the probe calibration is carried out at the same speed as the measurement speed, as this automatically compensates for the fixed time difference between the stylus touching the part and the machine control reading the scale position.

If a rotary axis on the machine rotates the workpiece into the stylus then different diameter workpieces will touch the stylus at different linear speeds. The measurement speed is therefore likely to be different from the calibration speed and compensation will have to be carried out to account for the different speeds.

## Calibration of each MP250 operating configuration

Specific calibration data is required for each of the MP250 probe configuration levels; 1, 2 and 3, selectable via the HSI-C interface.

When a probing cycle switches between configuration levels for specific measuring moves, then it will be necessary to refer to the relevant calibration data applicable to the configuration level used for the specific measuring move.

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**NOTE:** Application of the config. 3 override function for fast positional moves does not require level 3 calibrated data.

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## HSI or HSI-C interface

For information about the *HSI hard-wired system interface* installation guide (Renishaw part no. H-5500-8554) or the *HSI-C hard-wired system interface - configurable* installation guide (Renishaw part no. H-6527-8501).

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# Maintenance

## Maintenance

You may undertake the maintenance routines described in these instructions.

Further dismantling and repair of Renishaw equipment is a highly specialised operation, which must be carried out at authorised Renishaw Service Centres.

Equipment requiring repair, overhaul or attention under warranty should be returned to your supplier.

The MP250 probe is designed to operate in the grinding machine environment. Do not allow metal chippings to collect around the probe body or dirt and liquids to enter the sealed working parts. Ensure all mating surfaces are kept clean.

Periodically check the probe's O-ring, cables and connectors to ensure that they are free of damage and secure.

It is recommended that, once a month, the probe's front cover is removed and any residue removed with a low pressure jet of coolant. Never use sharp objects or degreasing agents on the probe.

## Diaphragm replacement

### MP250 diaphragms

The probe mechanism is protected from coolant and debris by two diaphragms. These provide adequate protection under normal working conditions.

The user should periodically check the outer diaphragm for signs of damage. If this is evident, replace the outer diaphragm. An outer diaphragm replacement kit (Renishaw part no. A-5500-1650) is available from your supplier.

The user must not remove the inner diaphragm. If damaged, return the probe to your supplier for repair.

### Outer diaphragm inspection (refer to the figure on page 4.3 )

1. Remove the stylus.
2. Using C-spanner (Renishaw part no. A-2063-7587) supplied, release and remove the front cover from the probe.
3. Inspect the outer diaphragm for damage. If damage is found then it will be necessary to replace the outer diaphragm. Order diaphragm replacement kit (Renishaw part no. A-5500-1650).

### Inner diaphragm inspection

Inspect inner diaphragm for damage. If damaged, return the probe to your supplier. **DO NOT REMOVE INNER DIAPHRAGM AS WARRANTY WILL BE INVALIDATED.**

### Outer diaphragm replacement (refer to the figure on page 4.3)

1. To remove the damaged outer diaphragm, press the stylus holder downwards and release. This action will cause the outer diaphragm to pop out from its location. The outer diaphragm can now be gripped by its outer edge and removed.
2. Screw the diaphragm positioning tool (Renishaw part no. A-5500-1652) supplied into the stylus holder.
3. Ensuring that the new diaphragm is in the correct orientation, carefully push the diaphragm to the end of the diaphragm positioning tool and gently ease into position by hand. Take care not to over stretch the inner sealing ring as this may cause the diaphragm to split.
4. Finally, using insertion tool (Renishaw part no. M-5500-1654) supplied, press the diaphragm down onto the probe until it is seated within the groove on the stylus holder.
5. Apply a smear of general purpose lubrication oil onto the outer rim.
6. Refit front cover.
7. Remove the diaphragm positioning tool. Refit stylus and recalibrate probe.



**NOTE:** Periodically check the probe's rear O-ring, cables and connections for signs of damage and slackness.

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# Fault-finding

Symptom	Cause	Action
<b>Poor probe repeatability and / or accuracy.</b>	Debris on part or stylus.	Clean part and stylus.
	Poor electrical connections.	Check connections.
	Loose probe mounting or loose stylus.	Check all bolts and screwed connections. Tighten as appropriate.
	Excessive machine vibration.	Eliminate vibrations.  Use 'PROBE CONFIG.' level 3, high false trigger immunity configuration (HSI-C only).
	Calibration out of date and / or incorrect offsets.	Review probing software.
	Calibration and probing speeds not the same.	Review probing software.
	Calibration feature has moved.	Correct position.
	Measurement occurs as stylus leaves surface.	Review probing software.
	Measurement occurs within the machine's acceleration and deceleration zone.	Review probing software.  Use 'PROBE CONFIG.' level 1, low latency configuration (HSI-C only).
	Probing speed too high or too slow.	Perform simple repeatability trials at various speeds.
	Temperature variation causes machine and workpiece movement.	Minimise temperature changes.
Machine tool faulty.	Perform health checks on machine tool.	

Symptom	Cause	Action
<b>Probe permanently triggered.</b>	Probe speed below 3 mm/min.	Increase probing speed. Turn probe off then on again.
	Probe orientation has changed – i.e. from horizontal to vertical.	Turn probe off and then on again by use of the inhibit function.
	New stylus has been fitted.	Ensure stylus is seated during switch on.
	Horizontal probe has rotated about its own axis.	Turn probe off, then on again.
	Excessive vibration.	Eliminate vibration. Turn probe off then on again.  Use 'PROBE CONFIG.' level 3, high false trigger immunity configuration (HSI-C only).
	Very fast thermal changes.	Make sure the machine's temperature is stable.
<b>False triggers.</b>	Cable screen broken.	Replace cable.
	Poorly regulated supply voltage.	Correctly regulate voltage supply.
	Excessive machine vibration / machine accelerations.	Eliminate sources of vibration.  Use 'PROBE CONFIG.' level 3, high false trigger immunity configuration (HSI-C only).
<b>Intermittent reseal error.</b>	Inner diaphragm pierced or damaged.	Return probe to supplier for repair.
	Twisted outer diaphragm.	Apply lubrication oil. For more information, see page 4.2, "Maintenance".
<b>Complete probe failure.</b>	Poor electrical connections.	Check connections.
	Loose probe mounting on shank or loose stylus.	Check all bolts and screwed connections. Tighten as appropriate.
	Cable screen broken.	Replace cable.
	Poorly regulated supply voltage.	Correctly regulate voltage supply.

# Parts list

Type	Part number	Description
MP250	A-5500-1600	MP250 probe with tool kit (C-spanner × 2 and stylus tool) and support card.
FS10	A-5500-1710	FS10 adjustable probe socket with 10.0 m (32.81 ft) of screened cable.
FS20	A-5500-1810	FS20 fixed probe socket with 10.0 m (32.81 ft) of screened cable.
HSI-C interface	A-6527-1000	HSI-C probe system interface.
HSI interface	A-5500-1000	HSI probe system interface.
Swarf deflector	M-2063-8003	Swarf deflector Ø 28.0 mm (1.10 in) (protects probe from hot swarf).
Diaphragm replacement	A-5500-1650	Outer diaphragm replacement kit.
C-spanner	A-2063-7587	C-spanner.
Stylus tool	M-5000-3707	Tool for tightening / releasing styli.
<b>Publications.</b> These can be downloaded from our web site at <a href="http://www.renishaw.com">www.renishaw.com</a> .		
HSI	H-5500-8504	Installation guide: for the set up of the HSI.
HSI-C	H-6527-8501	Installation guide: for the set up of the HSI-C.
Styli	H-1000-3200	Technical specification: Styli and accessories or visit our Online store at <a href="http://www.renishaw.com/shop">www.renishaw.com/shop</a> .
Software list	H-2000-2298	Data sheet: Probe software for machine tools – programs and features.

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