SP80 and SP80H installation and integration guide

Document part number: H-1000-5212-06-A

General information

ORIGINAL LANGUAGE VERSION

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Care of equipment

Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

Changes to Renishaw products

Renishaw reserves the right to improve, change or modify its hardware or software without incurring any obligations to make changes to Renishaw equipment previously sold.

Company registration details

Renishaw plc. Registered in England and Wales. Company no: 1106260. Registered office: New Mills, Wotton-under-Edge, Gloucestershire, GL12 8JR, UK.

Packaging

To aid end user recycling and disposal the materials used in the different components of the packaging are stated here:

Packaging component	Material	94/62/EC code	94/62/EC number
Packing foam	Low density polyethylene	LDPE	04
Outer box	Corrugated fibreboard	PAP	20
Bag	High density polyethylene	HDPE	02

Patents

Features of Renishaw's SP80 system and associated products are the subjects of one or more of the following patents and patent applications:

CN100460814	EP1495282	US7055258
	EP1792139	US7526873
		USRE40578

Product compliance

EU declaration of conformity

Contact Renishaw plc or visit www.renishaw.com/EUCMM for the full EU declaration.

UK declaration of conformity

Contact Renishaw plc or visit www.renishaw.com/UKCMM for the full UK declaration.

EMC conformity

This equipment must be installed and used in accordance with this installation guide. This product is intended for industrial use only and should not be used in a residential area or connected to a low voltage power supply network which supplies buildings used for residential purposes.

FCC (USA only)

Information to user (47 CFR 15.105)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Information to user (47 CFR 15.21)

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

Equipment label (47 CFR 15.19)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

ICES-001 (Canada only)

This ISM device complies with Canadian ICES-001(A) / NMB-001(A).

Cet appareil ISM est conforme à la norme ICES-001(A) / NMB-001(A) du Canada.

REACH regulation

Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at:

www.renishaw.com/REACH

China RoHS

Contact Renishaw plc or visit www.renishaw.com/ChinaRoHSCMM for the full China RoHS tabulation.

System requirements

Electrical requirements

UCC S3 controller

Please refer to the UCC T3 PLUS and UCC S3 installation guide (Renishaw part number H-1000-2118) for safety instructions and documentation relevant to the use of the UCC S3 controller and its subsystems.

UCC PI 80 controller

Please refer to the UCC PI 80 installation guide (Renishaw part number H-1000-7608) for safety instructions and documentation relevant to the use of the UCC PI 80 controller and its subsystems.

CC6 counter card

Please refer to the CC6 Installation and programmer's guide (Renishaw part number H-1000-6008) for safety instructions and documentation relevant to the use of the CC6 counter card.

NOTE: The SP80 and SP80H can be powered by either a connection to a Renishaw UCC S3 controller and UCC PI 80 interface, or an IU80 and CC6 counter card via a PC or an OEM specifically designed system.

Environmental requirements

IU80 interpolator unit

The IU80 complies with (or exceeds) with the following environmental conditions stated in BS EN 61010-1:1993:

Indoor use	IP30
Altitude	Up to 2000 m
Operating temperature	+15 °C to +30 °C
Storage temperature	-10 °C to +70 °C
Relative humidity	80% maximum (non-condensing) for temperatures up to +31 °C Linear decrease to 50% at +40 °C
Transient overvoltages	Installation category II
Pollution degree	2

Safety

There is no overtravel protection in the +Z axis other than an end stop. The control system must therefore be able to stop the motion of the machine in the +Z axis of the probe before the endstop is reached. If this is not the case, safety glasses must be worn when operating or observing the operation of the SP80 and SP80H system to avoid injury in the case of stylus breakage.

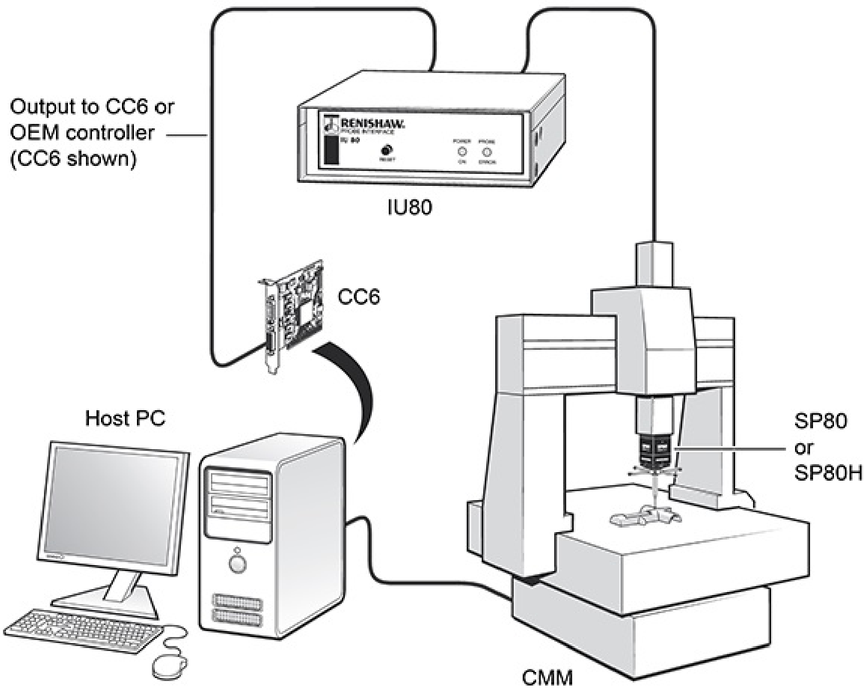
Machine operators must be trained in the use and application of the SP80 and SP80H in the context of the machine it is fitted to before being allowed to operate that machine.

CAUTION: Permanent magnets are used in some components of the SP80 and SP80H system. It is important to keep them away from items which may be affected by magnetic fields, e.g. data storage systems, pacemakers and watches etc.

System interconnection and electrical integration

SP80 can be integrated in the following ways:

- Direct integration with Renishaw's UCC S3 controller (this requires the use of a UCC PI 80 interface)
- Using Renishaw's CC6 PCI counter card together with Renishaw's IU80 interpolator unit
- OEM designed counter card used with Renishaw's IU80 interpolator unit
- OEM designed counter card and interpolator unit



Probe connector pin-outs

The electrical connections to and from the SP80 and SP80H are through the 15-way HDD connector at the top of the probe body.

SP80 and SP80H probe connector pin-outs

Pin	Function	Pin	Function
1	Vref (see note below)	9	PROBE PRESENT
2	0 V	10	GREEN LED OFF
3	N/C	11	RED LED ON
4	Cos Z	12	Sin Z
5	Cos Y	13	Sin Y
6	Cos X	14	Sin X
7	+9 V to +18 V	15	Reserved for Renishaw use
8	N/C	Shell	Screen

NOTE: Vref is nominally 2.5 V and is the zero crossing reference for the Sin and Cos output signals. This reference voltage, and all other signal inputs must be monitored downstream of the probe using a high impedance buffered input.

The effective impedance of any input signal to ground should be >100 KΩ. Failure to comply with this requirement may result in an apparent fault, or reduction in amplitude of the Sin and Cos outputs. Contact Renishaw for advice if uncertain.

The recommended cable specification for the SP80 probe is the same as the current motorised head cable (PH10) which is:

- Mating connectors must be metal bodied
- The overall cable screen is continuous and connected to the system ground on the user's equipment through the bodies of the connectors
- The maximum overall single core resistance between the SP80 and the IU80 interpolator must be <2.5 Ω.

The maximum cable length between the SP80 / SP80H and the interface equipment is 30 m.

Connecting the IU80 interpolator unit

The IU80 is connected to the SP80 by the machine cable and the short adaptor cable. The output of the IU80 is then transferred either to the Renishaw CC6 PCI counter card, or to an OEM controller via a Renishaw supplied unterminated cable.

See sections System interconnection and electrical integration, Connecting SP80 / SP80H to IU80 and CC6 and Connecting SP80 / SP80H to IU80 and OEM counter card for further detail.

IU80 features and LEDs

Signal interpolation

The IU80 divides the 4 micron periodic signals produced by the SP80 by a factor of 200. This gives a system resolution of 20 nm for each probe axis.

Error signal generation

The IU80 monitors the signals received from the SP80 probe to ensure that each axis readhead is functional. In the event of probe cable damage or unreliable probe signals, an error signal is latched and provides an output via pin 4 of the 26-way connector. A red LED on the IU80 front panel also indicates the same error conditions however, the different errors can be distinguished by an operator looking at the different LED states as detailed in the IU80 LED summary section below. The latch can be reset by either pressing the button on the front panel or applying logic '1' to pin 3 of the 26-way connector.

Probe present signal

The IU80 will detect if an SP80 probe is connected.

If a probe is present, error signals will be enabled and pin 8 of the 26-way plug will be logic '0'.

If a probe is not present, error signals will be disabled and pin 8 of the 26-way ouput connector will be logic '1'.

IU80 front panel

The front panel of the IU80 has two LED indicators and a reset button.

The green 'POWER ON' LED is illuminated when power is applied to the IU80.

The red 'PROBE ERROR' LED is illuminated if an error has been detected.

The reset button, when pressed, will clear the error condition.

IU80 LED summary

PROBE ERROR LED status	Indication
Permanently off	No error
Permanently on	Probe signal integrity compromised
Flashing	Cable break detected

In the event of an error signal all measurement should be stopped and the probe recalibrated.

SP80 LED control

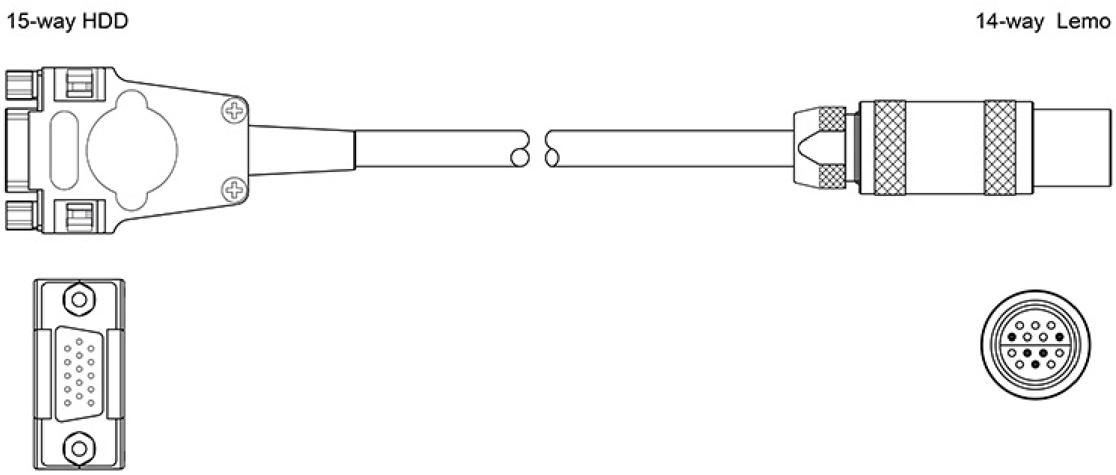
The SP80 probe has a tri-colour LED which can be controlled by the user to act as a visual aid for measurement applications. The LED can be set to red, green or orange depending on the following inputs to pins 9 and 10 of the 26-way 'D' plug.

(Logic '1' = +3 V to +5 V Logic '0' = <0.8 V)

GREEN_LED_OFF (pin 9)	RED_LED_ON (pin 10)	LED colour
0	0	Green
0	1	Orange
1	0	Off
1	1	Red

Connecting SP80 / SP80H using the KM80 or KM6080

The standard SP80 / SP80H probe kit is supplied with a 250 mm long PL157 cable . This connects to the 15-way, high-density D-type connector on top of the SP80, through a slot in the KM80 (or KM6080), and is terminated in a Lemo connector which mates to the CMM machine cable.



Cable pin-outs (SP80 / SP80H > KM80 > KM6080 > M/C cable > IU80)

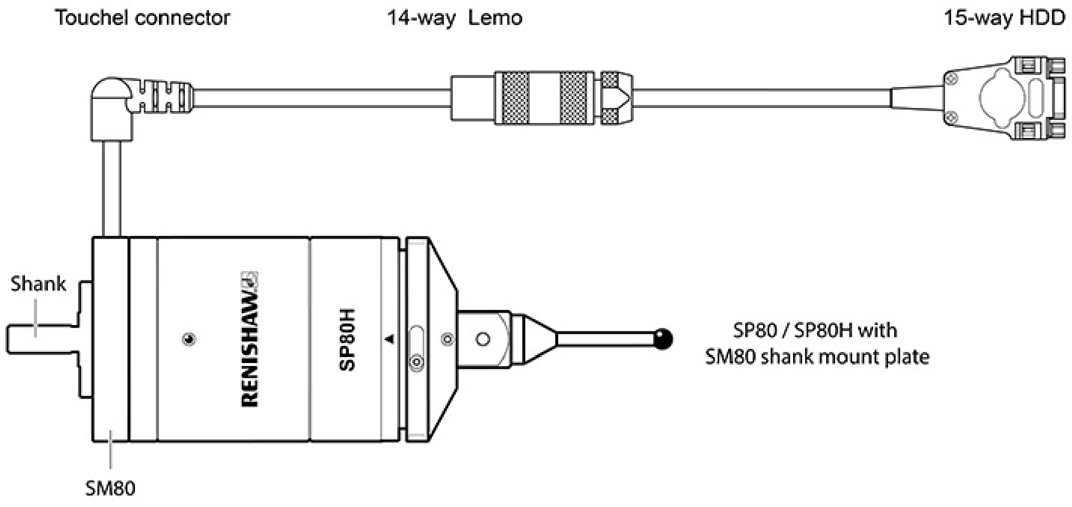
Signal / connector	15-way HDD connector[a]	14-way Lemo connector[a,b]	15-way male D connector[b]
Vref	1	13	8
0 V	2	4	4
	3	Not connected	
Cos Z	4	12	3
Cos Y	5	2	1
Cos X	6	8	11
+9 V to +18 V	7	10	15
	8	Not connected	
PROBE PRESENT	9	14	5
GREEN LED OFF	10	3	6
RED LED ON	11	5	10
Sin Z	12	9	7
Sin Y	13	1	14
Sin X	14	6	12
	15	Not connected	
Screen	Shell	Shell and 11	Shell

[a] PL157 probe cable

[b] Machine cable

Connecting SP80 / SP80H using the SM80

The SM80 converts the output connector on the SP80 / SP80H to a Touchel connector on the rear face of the SM80. The Touchel connector is then designed to be connected directly to a standard PH10 system wiring scheme.



Cable pin-outs (SP80 / SP80H > SM80 > probe head cable > M/C cable > IU80)

Signal / connector	14-way Touchel socket[a]	14-way Lemo connector[a,b]	15-way male D connector[b]
Vref	J	13	8
0 V	M	4	4
		Not connected	
Cos Z	G	12	3
Cos Y	D	2	1
Cos X	F	8	11
+9 V to +18 V	B	10	15
		Not connected	
PROBE PRESENT	K	14	5
GREEN LED OFF	C	3	6
RED LED ON	H	5	10
Sin Z	A	9	7
Sin Y	E	1	14
Sin X	L	6	12
		Not connected	
Screen	N/O	Shell and 11	Shell

[a] PL5, PL6, PL12 or PL13 probe head cables

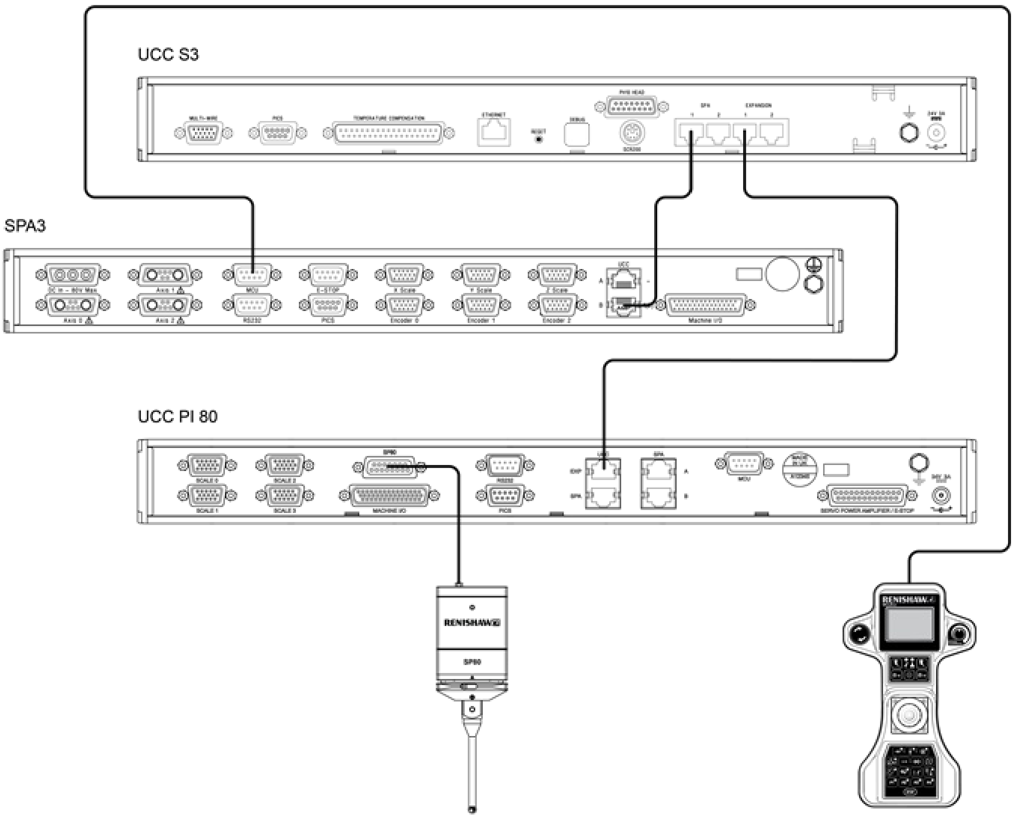
[b] Machine cable

Connecting SP80 / SP80H using UCC PI 80

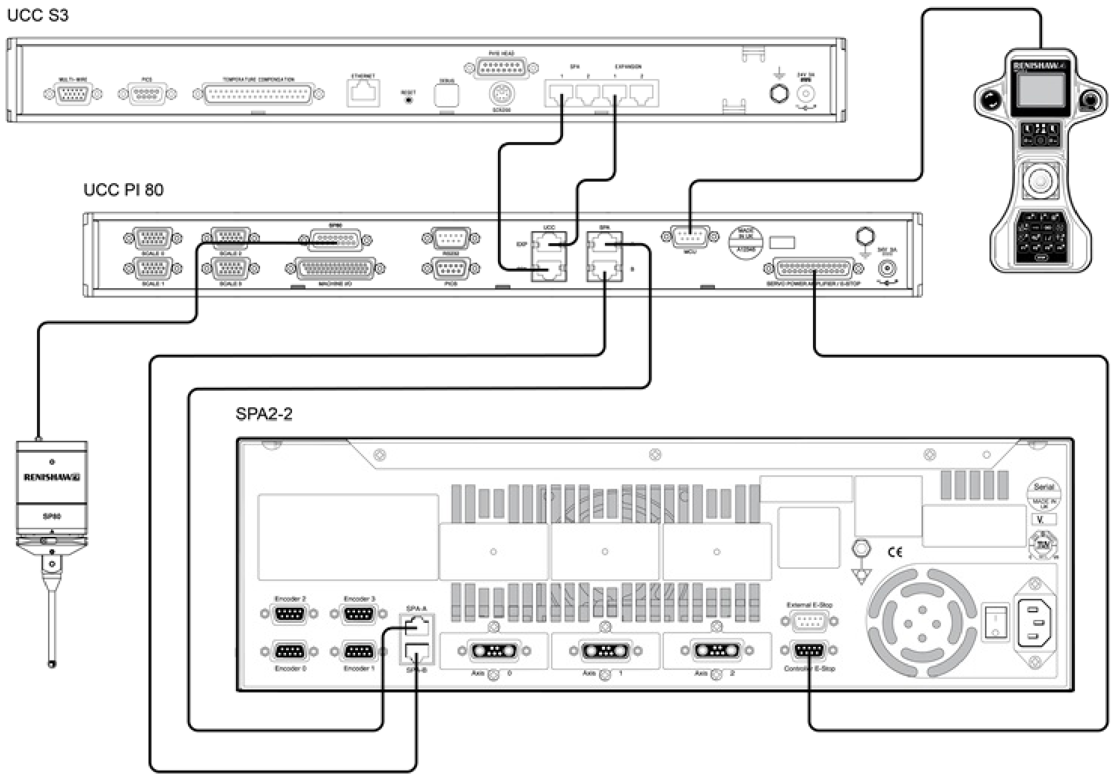
The UCC PI 80 has different configuration layouts to provide an interface to CMM systems with three, four or five machine axes, whether brushed or brushless motors.

NOTE: The UCC S3 needs to be version V.2 or newer - see label on rear panel (first shipped February 2015).

3-axis CMM with brushed motors

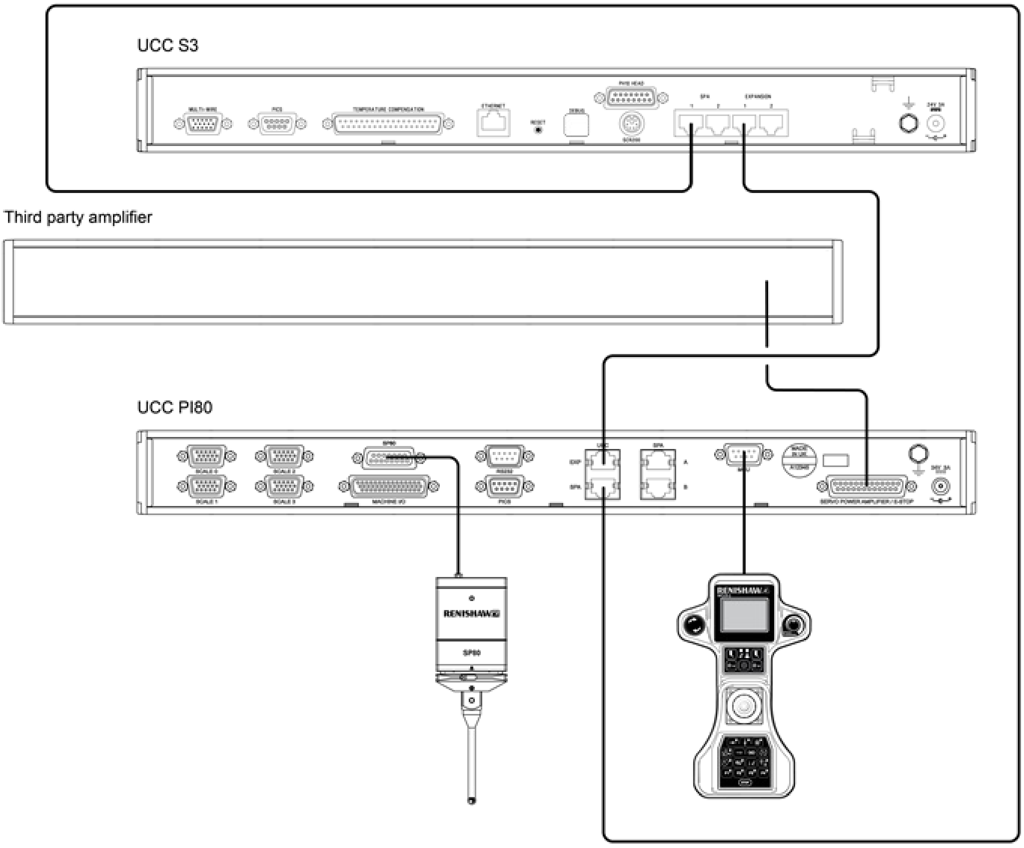


3- or 4-axis CMM with brushless motors

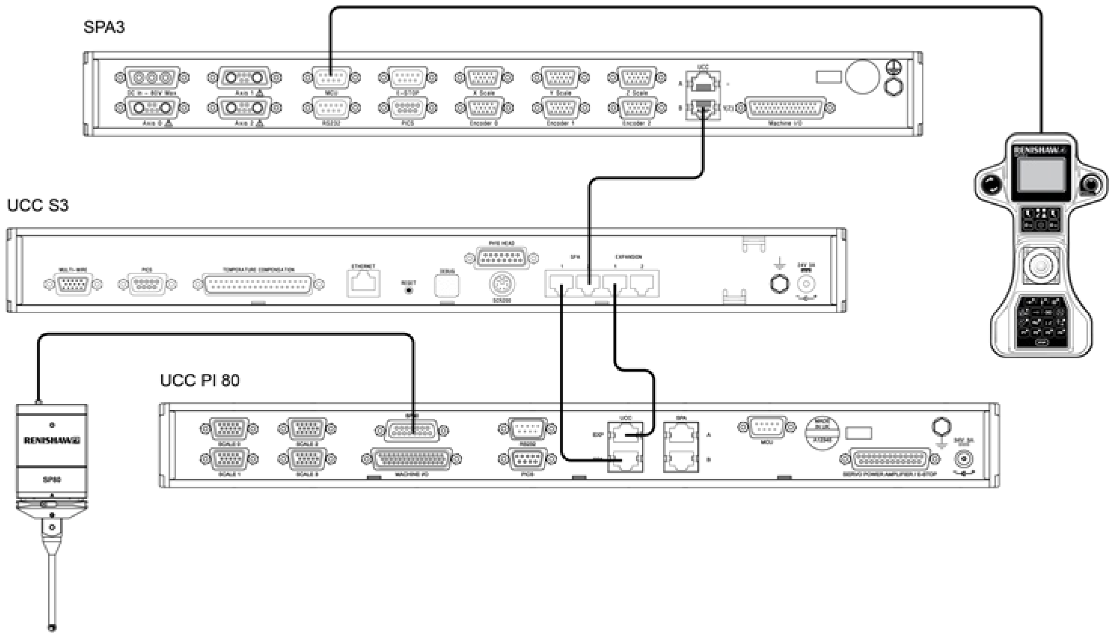


NOTE: See UCC BI installation guide (Renishaw part number H-1000-7602) for configuration instructions.

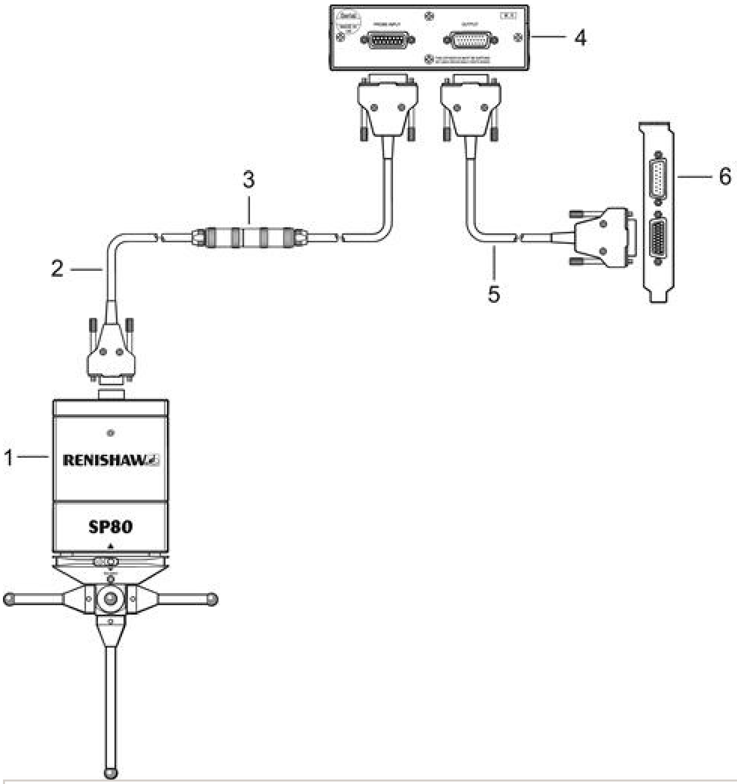
3- or 4-axis large CMM with motors requiring an analogue servo power amplifier



3-axis CMM with DC motors



Connecting SP80 / SP80H to IU80 and CC6



Key	Description
1	SP80 / SP80H probe (shown for mounting on the CMM via KM80)
2	PL157 - SP80 to Lemo adaptor cable
3	PLM6 / 7 / 8 / 9 - standard machine cable
4	IU80 interpolator box
5	PL158 - IU80 output cable to CC6
6	CC6 PCI counter card

The IU80 conditions the SP80 / SP80H signal into an RS422 differential quadrature scale signal. This unit is required when a UCC S3 and UCC PI 80 is not used for the integration of the probe. The IU80 has a 15-way D input connector to accept the standard PH10 machine cable, and a 26-way D output connector, incorporating all axis outputs from the probe.

NOTE: This cable must not exceed 1 m in length.

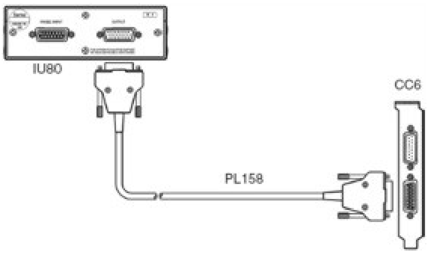
The IU80 connects to the CC6 counter card using the PL158 cable. The connections are detailed below. If making your own cable it should be no greater than 1 m in length.

NOTE: The IU80 RESET function (pin 3 below) is only available with IU80s manufactured to version 3 and above.

Cable pinouts (IU80 > CC6)

IU80 output 26-way HDD	Signal	CC6 input pin 26-way HDD
1	X DigA	1
2		
3	RESET	9
4	ERROR	4
5	Not used	5
6	Z DigB	6
7		
8	Probe Present	2
9	Green_LED_OFF	7
10	Red_LED_ON	8
11	X DigA	11
12	X DigB	12
13	X DigB	13
14	Y DigA	14
15	Y DigA	15
16	Y DigB	16
17	Y DigB	17
18	0 V	25
19	Not used	19
20	Z DigA	20
21	Z DigA	21
22	Z DigB	22
23	+12 V @ 250 mA max	24
24	+5 V @ 1 A max	23
25		
26	Not used	26
Shell	Screen	Shell

For further information concerning the CC6 system please ask your local Renishaw contact.



PL158 - IU80 to CC6 cable

Probe and IU80 power supply

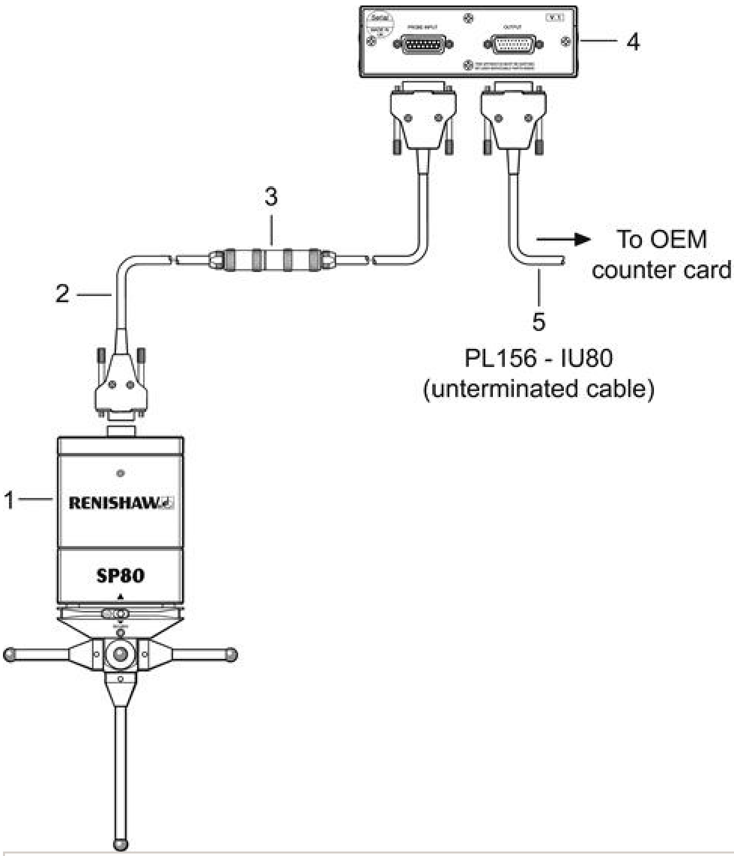
The IU80 must be provided with two power supplies.

+9 V to +18 V @ 300 mA max to supply the SP80 probe and

+4.75 V to 5.25 V @ 1 A max to supply the IU80.

Power must originate from either the OEM's controller or from a Renishaw CC6 counter card.

Connecting SP80 / SP80H to IU80 and OEM counter card



Key	Description
1	SP80 / SP80H probe (shown for mounting to CMM via KM80)
2	PL157 - SP80 to Lemo adaptor cable
3	PLM6 / 7 / 8 / 9 - standard machine cable
4	IU80 interpolator box
5	PL156 - IU80 output cable to OEM counter card (supplied unterminated)

The output of the IU80 can be connected directly to the CMM controller using an unterminated PL156 cable.

NOTE: The IU80 RESET function (pin 3 below) is only available with IU80s manufactured to version 3 and above.

IU80 output 26-way HDD	Signal	Electrical characteristics	Colour
1	X DigA	EIA-422A	Red
2			N/C
3	RESET	TTL	White / blue
4	ERROR	TTL	Blue
5			N/C
6	Z DigB	EIA-422A	
7			N/C
8	Probe Present	TTL	Yellow / blue
9	Green_LED_OFF	TTL	Yellow
10	Red_LED_ON	TTL	White
11	X DigA	EIA-422A	Black
12	X DigB	EIA-422A	Brown
13	X DigB	EIA-422A	Violet
14	Y DigA	EIA-422A	Orange
15	Y DigA	EIA-422A	Pink
16	Y DigB	EIA-422A	Turquoise
17	Y DigB	EIA-422A	Grey
18	0 V		N/C
19			N/C
20	Z DigA	EIA-422A	Red / blue
21	Z DigA	EIA-422A	Green / red
22	Z DigB	EIA-422A	Yellow / red
23	+9 V to +18 V	300 mA max	White / red
24	+5 V	1 A max	Red / black
25	0 V		Red / brown
26	N/C		N/C
Shell	Screen		Screen

Probe and IU80 power supply

The IU80 must be provided with two power supplies.

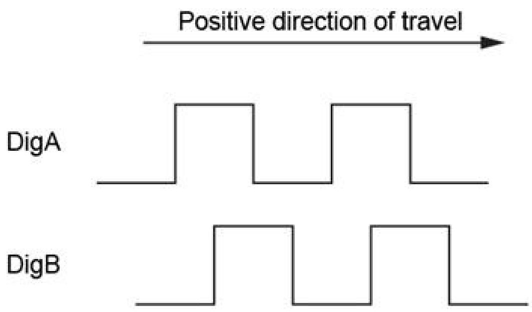
+9 V to +18 V @ 300 mA max to supply the SP80 probe and

+4.75 V to 5.25 V @ 1 A max to supply the IU80.

Power must originate from either the OEM's controller or from a Renishaw CC6 counter card.

IU80 output signal format

The signals produced by IU80 are in EIA-422-A differential square wave format and in quadrature for each probe axis. The sign definition for the signals is a positive count when DigA leads DigB.

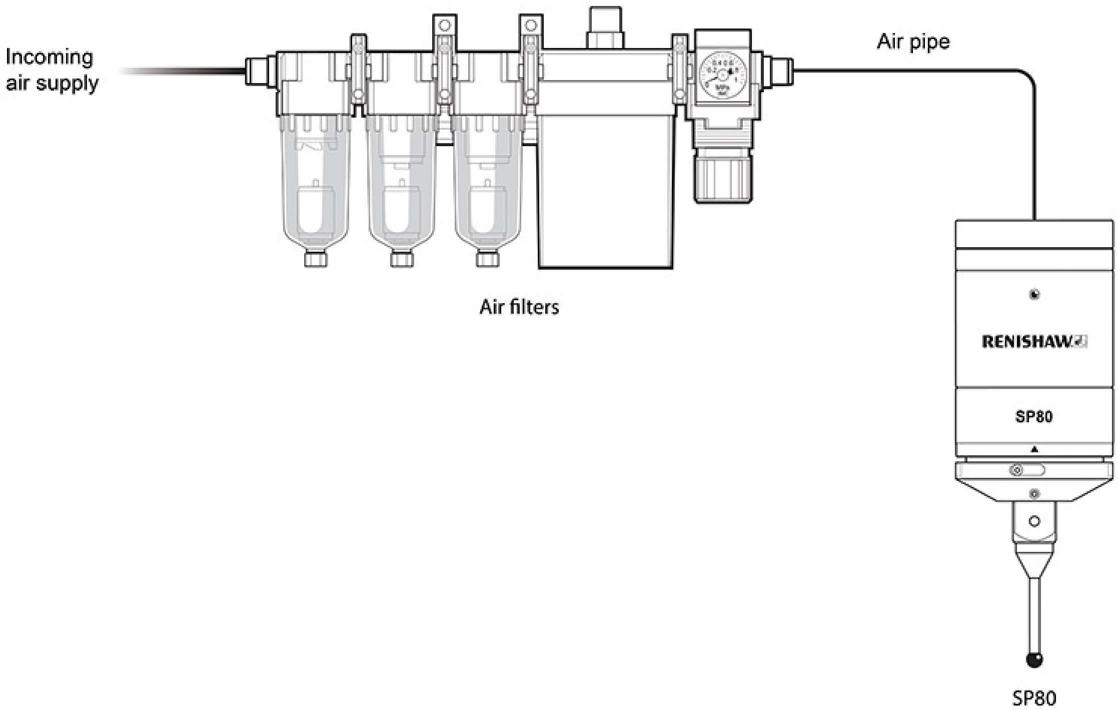


The IU80 provides a minimum edge separation of 90 ns between any of the edges of a pair of quadrature signals.

Air supply

SP80 and SP80H units built after September 2010 have the ability to fit the air purge option. From this date all new probes have been supplied with a suitable push fit connector as part of the standard probe kit.

The SP80 and SP80H probes are supplied with a blanked off air purge hole. If the probe is to be operated in an environment where oil mist or other heavy vapours are present it is essential that an air supply is used to maintain positive purging of any contamination from the interior of the probe.



The air purge system requires an air filter. This can be purchased directly from Renishaw (Renishaw part number A-3060-0070) or a suitable alternative can be used.

Air filter maintenance

WARNING: It is vital that the air filters used for SP80 and SP80H air purge meet the specification detailed below and that the filter unit is maintained to the manufacturer's specification.

To maintain the air quality:

1. Ensure the air provided to the filtration system meets the specification given.

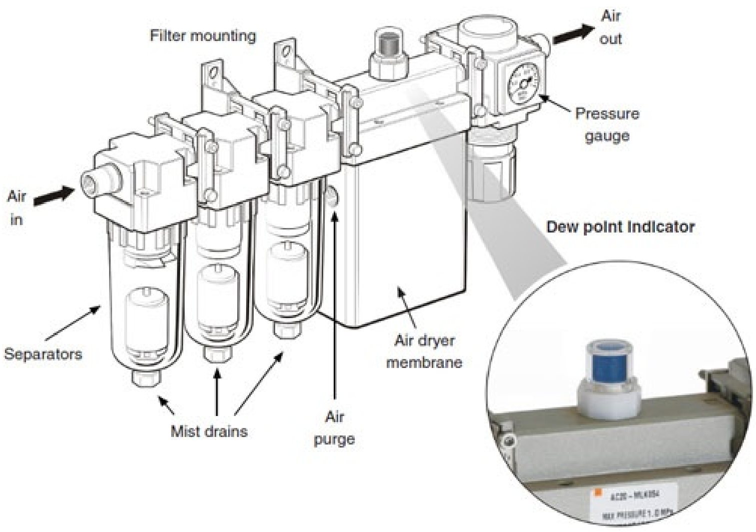
Incoming air supply specification:

Air pressure	1 to 2 bar*
Air consumption	15 to 25 litres per minute

BS ISO 8537-1:2010 [4:4:4]	
Particle size	15 µm
Dirt concentration	8 mg / m^3
Dew point	+3 °C
Oil	5 mg / m^3

***NOTE:** The exact values are dependent on the inherent characteristics of the air pipe between the air filters and the SP80 / SP80H. Higher flow rates should be avoided as this could impair metrology.
Please ask the installer for the specification.
It is important that the air supply to the probe is maintained to ensure that the positive purging is effective.

2. Regularly monitor the dew point indicator (see image below) and follow the instructions given in the table.



For more information please visit the air filtration manufacturer's website http://www.smcpneumatics.com and search for IDG5 filters. (Please refer to the section 'Air filter service kits' for details on air filter service kit part numbers).

Dew point indications and maintenance instructions

Grain colour	Causes	Solutions
Blue / green	Normal operation.	No action required.
Pink / yellow	Water and oil flow into membrane air dryer.	1) Check and replace filters if necessary. 2) Check condition of inlet air for excess oil or water.

NOTE: The grains may be pink / yellow on delivery and can take up to 1½ hours to turn blue / green when air is connected.

NOTE: When dew point indicator absorbs vapourised oil content or other gaseous components in the compressed air, it may turn a colour other than blue / green or pink / yellow.

Air filter service kits

The Renishaw filter service kit (M-3060-0933) contains:

SMC part number	Description	Quantity
AF20P-060S	5 µm filter element for use with AF20 unit	1
AFM20P-060AS	0.3 µm filter element for use with AFM20 unit	1
AFD20P-060AS	0.01 µm filter element for use with AFD20 unit	1

We recommend that the above filter kit is replaced every two years.

The Renishaw membrane dryer service kit (M-3060-0943) contains:

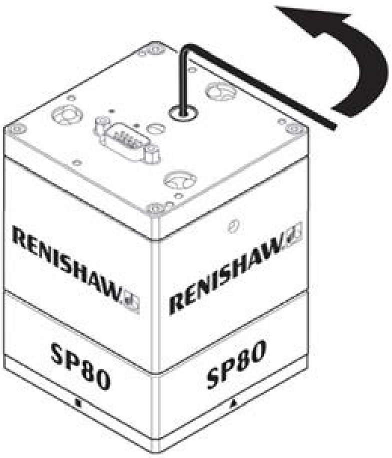
SMC part number	Description	Quantity
IDG-EL5	Membrane module kit for use with IDG5 unit	1
IDG-DP01	Dew point indicator kit for use with IDG5 unit	1

We recommend that the above filter kit is replaced every four years.

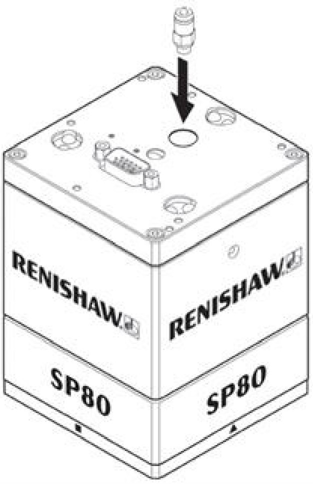
Installing SP80 / SP80H air purge option

Install the air purge connector by following the steps detailed below:

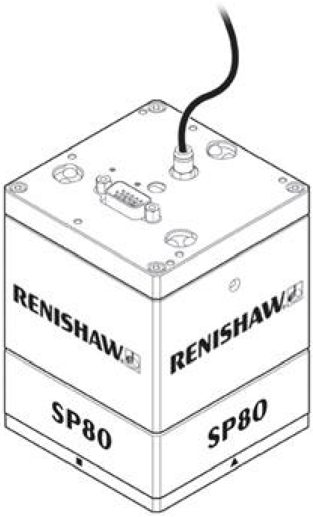
1. Remove screw as indicated.



2. Screw the supplied air fitting (P-MA01-0043) into the hole.



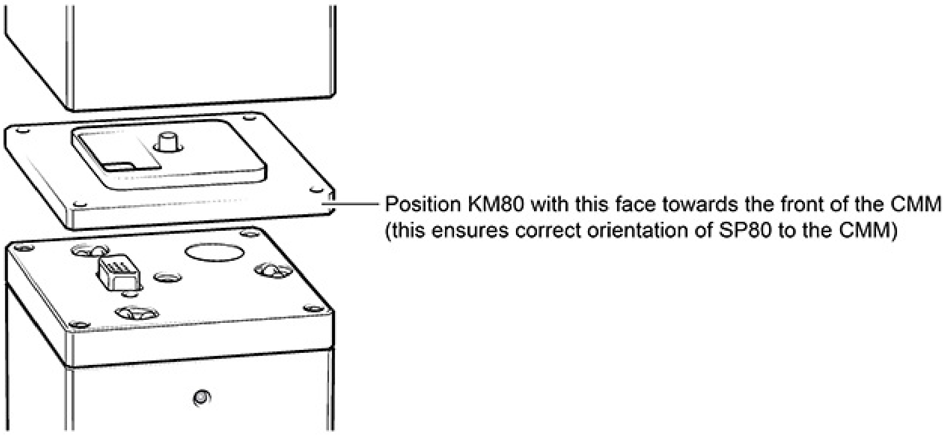
3. Fit the air pipe to the air fitting.



Attaching the KM80 quill adaptor plate

Mounting the SP80 and SP80H on the CMM via the KM80 is the recommended method due to its inherent stiffness, as well as the reduced overall Z length when compared to the alternative mounting options (KM6080 or SM80). The KM80 has the same mechanical footprint as the PH10MQ (80 mm × 80 mm), and is attached to the CMM quill using 4 × M3 or M4 screws in the corners of the plate. Orientate the KM80 to the CMM axis as shown below, such that the front of the SP80 probe (as indicated by the LED) faces forward.

Orientation and attachment of the KM80 to the quill:



Alternative quill adaptor plates

Attaching the KM6080 quill adaptor plate

The KM6080 (60 mm × 60 mm) is attached to the quill using four screws. It is important to orientate the KM6080 on the quill such that the probe is aligned facing forwards (with the LED facing towards the front of the CMM).

Attaching the SM80 quill adaptor plate

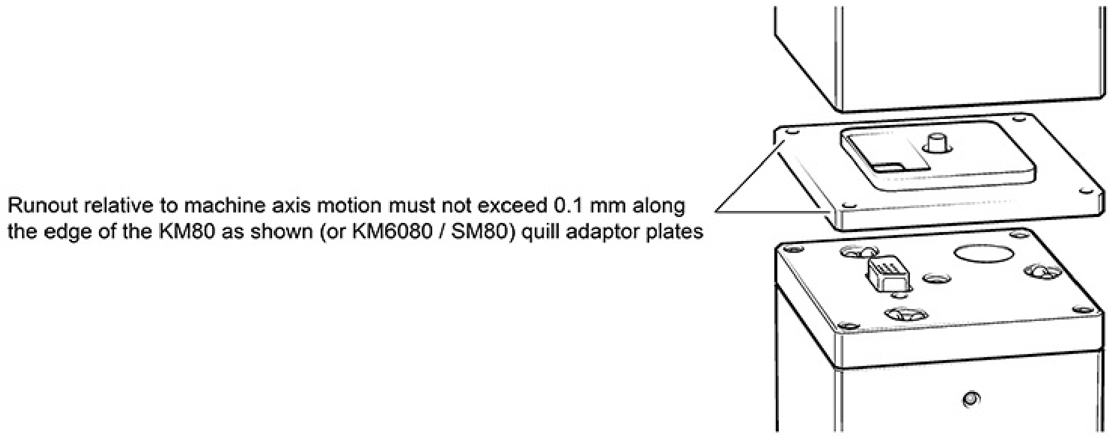
Screw the shank firmly to the SM80 and offer it up to the quill. Slot the shank into the fixing mechanism of the CMM and tighten. Care should be taken to ensure that the SM80 is held as securely as possible. To ensure that the probe will be aligned facing forwards (with the LED facing towards the front of the CMM), position the SM80 in the quill such that the touchel connector is facing towards the rear of the quill (facing towards the rear of the CMM).

NOTE: Poor shank mounting can impair measuring accuracy and therefore this mounting method should be avoided wherever possible.

Aligning the KM80, KM6080 or SM80 for use with the SCP80(V)

To ensure satisfactory operation with both SCP80 and SCP80V during the change cycle, the KM80, KM6080 quill adaptor plate or SM80 shank mount must be aligned to the CMM axes within the limits shown.

Aligning the KM80 with the CMM axes:

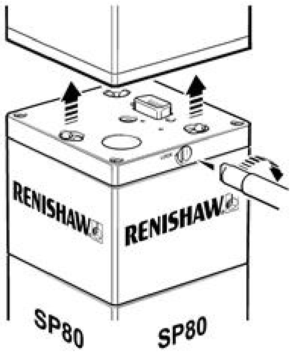


Mounting the SP80 / SP80H body to the quill adaptor plate

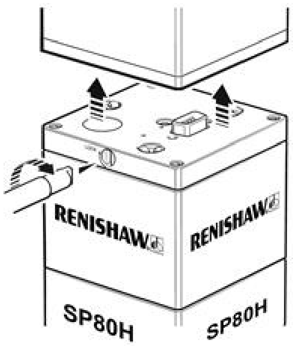
The SP80 and SP80H probe bodies have the female half of the kinematic joint incorporated in its top plate. The male half of the kinematic joint is incorporated in the KM80, the KM6080 and the SM80. To attach the probe to the quill adaptor plate proceed as follows:

1. Align the probe such that the 15-way connector on the top face is aligned with either the KM80 / KM6080 aperture or the mating connector in SM80, whichever is applicable.
2. If using the KM80 / KM6080, make the necessary connection with the probe cable within the quill. If using the SM80, ensure that the connector halves mate correctly during the next step.
3. Carefully locate the two halves of the kinematic joint together. Insert the S10 key into the autojoint key slot (at rear of probe) and turn the key clockwise until it locks tight.

Reverse the above procedure to remove the probe from the CMM taking care to prevent the probe from falling.



Attaching the SP80 to the quill adaptor plate (KM80 shown)



Attaching the SP80H to the quill adaptor plate (KM80 shown)

Mounting / removing the SH80 / SH80K on the SP80 / SP80H body

The SH80 incorporates the male half of a magnetic kinematic joint that connects to the female half of the joint on the bottom of both the SP80 and SP80H probe body. The SH80 carries M5 styli, and has a 5-way centre design that can be rotationally adjusted for infinite angle position of the stylus.

Fitting SH80 / SH80K

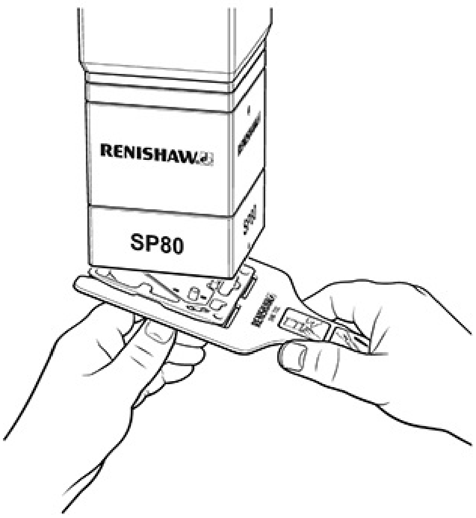
Fit the SH80 / SH80K into the SH80 removal tool and slowly offer up to the SP80 / SP80H, whilst aligning the triangular alignment marks indicating the front of the probe, and allow the magnetic attraction to make the kinematic joint – the damping mechanism located in the SH80 will ensure a gentle connection. The SH80 tool should also be used to remove the SH80 and SH80K.

Ultimately we recommend that where possible stylus changing is performed automatically to give the best system performance.

Removing the SH80 / SH80K

When removing the SH80 / SH80K manually it is recommended to use the SP80 removal tool, which is supplied as standard with every probe kit.

Slide the removal tool into the grooves on the SH80 / SH80K. Then use the SH80 removal tool to act as a lever.



NOTE: When removing the SH80 manually take care not to twist the unit as this can damage the alignment and damper pins.

Mounting styli on the SH80 and styli orientation

Mounting styli on the SH80

It is recommended that the SH80 is removed from the probe body when attaching styli.

M5 stylus arrangements are directly screwed into the 5-way cube on the SH80. Where required, use step down adaptors to smaller thread styli, or select cubes and knuckles to create the required cluster. However wherever possible, M5 styli should be used to ensure the stiffness of construction.

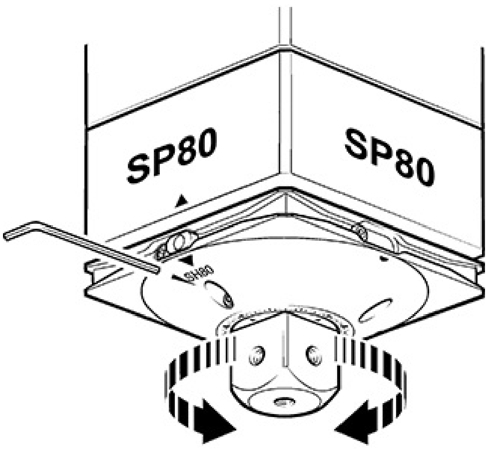
NOTE: Always hold SH80 with your spare hand as the SH80 tool does not retain the SH80.

Styli orientation

The stylus cluster can be rotationally adjusted to its required position by adjustment of the 5-way cube as follows:

1. Releasing the rotational clamping screw using the 2 mm across flats hexagonal key.
2. Rotating the stylus cluster to the required position.
3. Tighten the rotational clamping screw to torque of 1.0 Nm.

Rotational stylus adjustment:



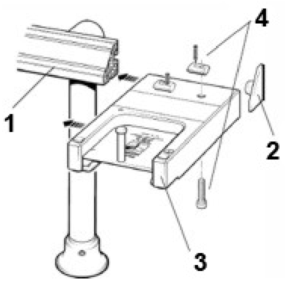
Fitting the SCP80 / SCP80V to the MRS / MRS2 rack system

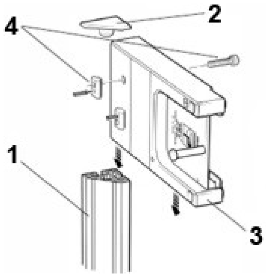
Fitting SCP80 to the MRS rail

The SCP80 change ports can be fixed to an MRS or MRS2 rack system. It is recommended that they are attached to the MRS / MRS2 rail using the following procedure, where it is assumed that the MRS / MRS2 rack system is correctly installed.

Installation procedure

1. Loosely assemble the T-nuts and bolts [4] to the mounting holes in the SCP80 [3] *.
2. Offer up the SCP80 [3] to the MRS rail [1] and align the T-bolts with the slot on the underside of the rail.
3. Slide the SCP80 onto the rail to the desired position, ensuring that sufficient operating clearance exists to carry out all SH80 docking routines.
4. Using the hexagonal key supplied, hand-tighten the T-nuts and bolts.
5. Align the SCP80 to the CMM axes, as described in 'Alignment of the SCP80(V) to the CMM axes', before finally tightening it to the MRS rail.
6. Fit end caps to the MRS rail.





Key	Description
1	MRS / OEM rail
2	End cap
3	SCP80 / SCP80V
4	T-nuts and bolts *

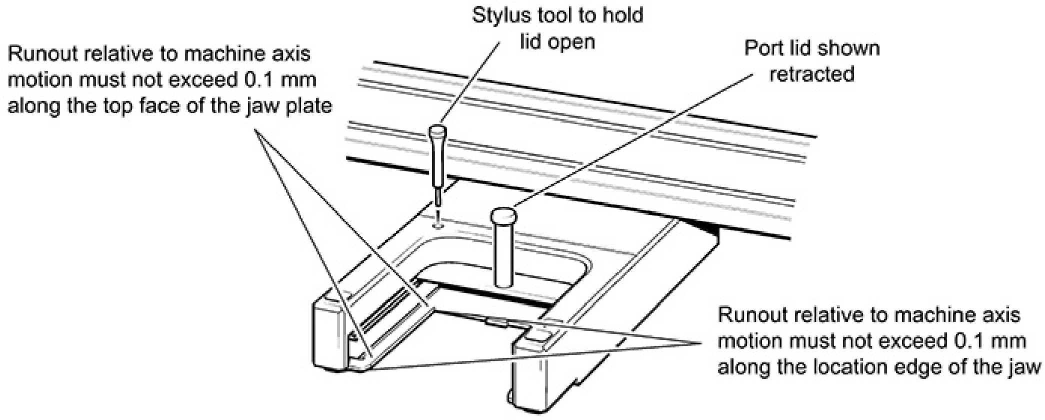
NOTE: SCP80V will fit to MRS using the same method. The rail for SCP80V is supplied by the OEM and may look different to that illustrated.

* **NOTE:** T-nuts must be used with the MRS system. However T-nuts and D-nuts are compatible with the MRS2 system.

Alignment of the SCP80(V) to the CMM axes

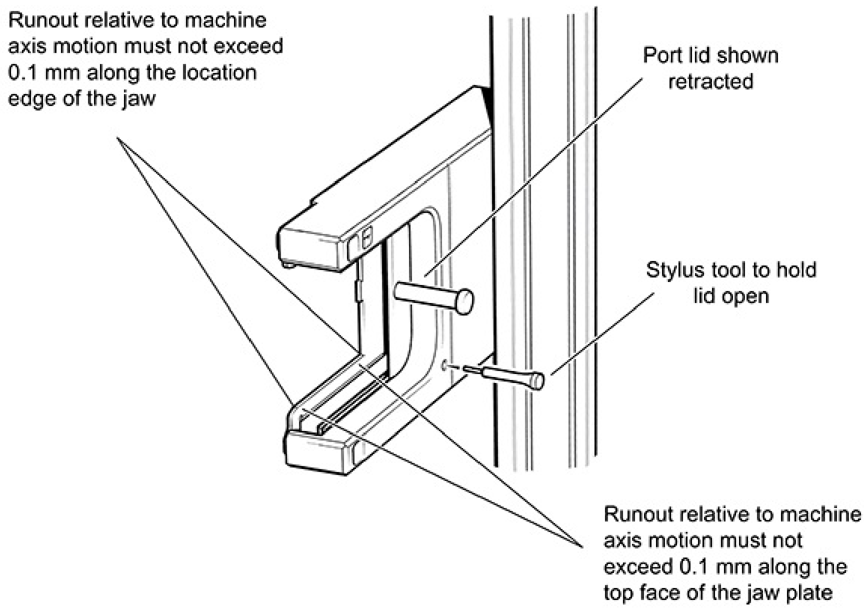
Alignment of the SCP80 to the CMM axes

The alignment of the SCP80 to the CMM axes should be checked to be within the limits shown below.



Alignment of the SCP80V to the CMM axes

The alignment of the SCP80V to the CMM axes should be checked to be within the limits shown below.



Establishing SCP80(V) port datums

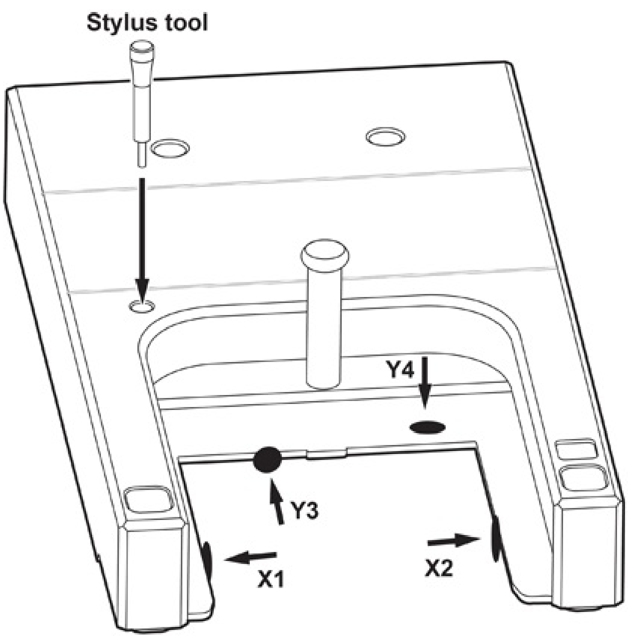
The following section describes the recommended procedure for datuming each installed SCP80(V) port. Before commencing the following should have been completed:

- The SCP80(V) ports should have previously been fitted to the MRS rail (or extrusion) and aligned to the CMM axes
- The SP80 / SP80H probe should have been correctly installed, aligned and fitted with a suitable M5 stylus
- The probe and stylus should have been calibrated and made ready to take single point measurements

NOTE: The examples given here assume that the MRS / SCP80 rack system is aligned to the X-axis of the CMM, being along the rear of the working area.

Procedure for establishing the port datum for SCP80 and SCP80V

Both rack port types use the same procedure just in different orientations. The following routine should be completed using manual CMM control.



1. Open the port lid to the extreme of travel and place a stylus tightening tool or similar object into the retaining hole to keep it in place.
2. Take 4 points on the jaw plate as follows:

- Take points 1 and 2 across the central jaw and record X1 and X2 values
- Take point 3 at the rear edge and record the Y3 value
- Take point 4 on the top face of the jaw plate (take care not to hit the post on the rack lid) and record the Z4 value

3. Create the X and Y port datums as follows:

- X origin = (X1 + X2)/2
- Y origin = Y3 – 41.5 mm + (stylus tip diameter/2)*
- Store the datums then assign them, and the port, an identification number

4. Create the Z port datum using one of the following methods:
The Z origin must be created in a way that enables satisfactory changing of the SH80 in the SCP80 over the entire stylus range (mass) that the SP80 can carry. This range is from 33 g to 500 g with the effect that 'droop' increases with mass.

METHOD 1 (preferred)

This method will ensure the SH80 enters the docking slot of SCP80 such that the docking features are centrally aligned in the Z axis.

- Using the port calibration stylus supplied with the probe kit, the probe should be nulled. A temporary Z port datum should be calculated as follows:
  Temporary Z origin = Z4 – (stylus length + (stylus tip diam/2)* + 38 mm)
- Then for all other stylus configurations, with differing mass, the Z port datum should be calculated as follows:
  Z origin = Z4 – (stylus length + (stylus tip diam/2)* + 38 mm – ZOFFSET)
  (Where ZOFFSET is the value of any Z axis droop observed with heavier styli mass).
- Store the datum then assign it, and the port, an identification number.

METHOD 2 (non-preferred)

This method is simpler to use and merely uses a constant ZOFFSET value which will allow any stylus configuration within the SP80 carrying range of 33 g to 500 g to be docked.
However, the user will notice the following characteristics during docking when using this method: with lighter styli the SH80 will be seen to pull downward, and with heavier styli the SH80 will be seen to pull upward.

- Using the port calibration stylus supplied with the probe kit, the Z port datum should be calculated as follows:

Z origin = Z4 – (stylus length + (stylus tip diam/2)* + 37 mm)

- Store the datum and assign it, and the port, an identification number

* Assuming no tip compensation when measuring.

Put down and pick up routines for SH80

The recommended pick up and put down routines are detailed below and consist of driving sequentially through four positions. These apply to both SP80 and SP80H.

NOTE: The speed of motion during the change cycle should be restricted to 20 mm/s maximum.

Put down routine for SH80 / SCP80 or SCP80V

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=0
Inhibit the probe			
Reduce CMM speed to 20 mm/sec max			
Move to the port datum position	PX=0	PY=0	PZ=0
Detach the SH80	PX=0	PY=0	PZ=30
Pause for the port to reset - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=30
Restore normal CMM drive speed			

Pick up routine for SH80 / SCP80 or SCP80V

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=30
Reduce CMM speed to 20 mm/sec max			
Move into the port pick up position	PX=0	PY=0	PZ=30
Attach the SH80	PX=0	PY=0	PZ=0
Pause for the SH80 to clasp - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=0
Restore normal CMM drive speed			
Activate the probe			

Put down and pick up routine for SH80K with SP80

Put down routine for SH80K and SP80

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=3
Inhibit the probe			
Reduce CMM speed to 20 mm/sec max			
Move to the port datum position	PX=0	PY=0	PZ=3
Detach the SH80K	PX=0	PY=0	PZ=30
Pause for the port to reset - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=30
Restore normal CMM drive speed			

Pick up routine for SH80K and SP80

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=30
Reduce CMM speed to 20 mm/sec max			
Move into the port pick up position	PX=0	PY=0	PZ=30
Attach the SH80K	PX=0	PY=0	PZ=3
Pause for the SH80K to clasp - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=3
Restore normal CMM drive speed			
Activate the probe			

Put down and pick up routine for SH80K with SP80H

Put down routine for SH80K and SP80H

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=2.5
Inhibit the probe			
Reduce CMM speed to 20 mm/sec max			
Move to the port datum position	PX=0	PY=0	PZ=2.5
Detach the SH80K	PX=0	PY=0	PZ=30
Pause for the port to reset - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=30
Restore normal CMM drive speed			

Pick up routine for SH80K and SP80H

Move description	Offsets orientated to the probe axes PX	Offsets orientated to the probe axes PY	Offsets orientated to the probe axes PZ
Move to the clearance position	PX=0	PY=100	PZ=30
Reduce CMM speed to 20 mm/sec max			
Move into the port pick up position	PX=0	PY=0	PZ=30
Attach the SH80K	PX=0	PY=0	PZ=2.5
Pause for the SH80K to clasp - 3 sec min			
Exit port to the clearance position	PX=0	PY=100	PZ=2.5
Restore normal CMM drive speed			
Activate the probe			

Modes of operation

Qualification (calibration of the probe)

The SP80 and SP80H probes require qualification (calibration) before it is able to give accurate positional data.
After the probe and stylus combination is calibrated it can be used in a variety of ways. Principally these will be as either a single point measurement probe or a profile measurement-scanning probe. Please refer to the modes below.

Scanning mode

SP80 and SP80H can be used as a continuous deflection contact scanning probe for profile measurement or for surface digitising purposes. In this case the CMM controller must respond to the deflections of the probe in real time to maintain surface contact.

Single point measurement mode

The following are methods that can be used for taking single point measurements using a calibrated SP80 or SP80H. OEMs are advised to evaluate each of these to determine the best solution for their own system.

Static averaging method

SP80 and SP80H can be used to take single points to give increased accuracy whilst reducing the effects of machine vibration by performing static averaging.

The probe stylus should be made to contact the workpiece and deflect the stylus to the recommended amount (50 µm). The CMM should be halted and kept nominally stationary.

Whilst the machine is stationary, surface position readings should be taken which are then averaged to give one single surface point. The longer the system is kept stationary, the more readings can be gathered to give a more accurate result and to average out the effect of machine vibration.

Extrapolate to zero method

Data is acquired whilst in contact and moving normal to the surface, either on the way in or whilst backing off. This is extrapolated to zero probe displacement position. It has the advantage that the measurement takes place at zero force, minimising the deflection on probe, stylus and CMM, and additionally is less sensitive to probe calibration.

Threshold methods

There are two types of threshold method as described below. Type 1 takes data whilst driving the probe onto the part to a pre-set deflection threshold, whilst type 2 takes data whilst backing off to the pre-set deflection threshold.

Type 1

A target deflection threshold should be set. The probe is driven onto the part until this target deflection threshold is seen, at which time the controller simultaneously stores all CMM axes together with the probe deflections - this is the data point.

Type 2

A target deflection should be set. Additionally, an upper target deflection should be set which will enable a back off move to the target deflection to be executed at a constant velocity. The probe is driven onto the part until the upper target deflection is seen, at which time the motion should halt and a back off move should commence. When the target deflection is seen, the controller simultaneously stores all CMM axes together with the probe deflections - this is the data point.

Maximising performance

Calibration

The probe and stylus must be calibrated correctly. Renishaw has extensive experience of scanning and offers support and advice on calibration algorithms and control software suited to SP80. Please contact Renishaw for further information.

Probe deflection

Scanning deflections should be kept small, as the machine settings and application will allow loads on the probe, stylus and CMM quill to be minimised.

The probe must be operated within its calibrated deflection range. For best performance, take measurements at the mid-point of the calibration deflection limits. It is recommended that the probe is calibrated at deflections of 0.2 mm and 0.8 mm, with best measurement data then achieved at 0.5 mm.

Touch / scan speed

Performance will vary with probe speeds:

- Longer heavy stylus combinations will require slower speeds
- Generally, best performance is obtained at speeds less than 10 mm/sec
- Avoid abrupt changes to CMM speed while taking measurements

Cleanliness

Ensure both stylus and workpiece are clean.

CMM maintenance

- Ensure that the CMM has been correctly maintained and has been corrected for geometrical errors such as axis squareness, pitch, roll and yaw etc
- Ensure that the CMM has an error map which is up to date and enabled in the control system
- Check the system accuracy from time to time by running an ISO 10360-4 test or other similar routine
- Regularly check the volumetric measuring performance of the CMM by using Renishaw's MCG machine checking gauge

Stylus selection

Refer to web page SP80 and SP80H stylus selection for detail.

SP80 and SP80H stylus selection

NOTE: For more detailed information about the range of Renishaw styli please refer to the styli and accessories technical specifications booklet (Renishaw part number H-1000-3200).

Of particular interest to SP80 and SP80H users is M5 styli section. This details not only an extensive range of M5 styli that are compatible with the SP80 and SP80H, but also includes a complete range of carbon fibre extension bars of 11 mm or 20 mm diameter, and up to 500 mm long.

Accuracy at the point of contact

As industry has developed its requirement for increasingly diverse and complex manufactured parts, inspection systems have had to work hard to keep up. The use of CMMs with probing systems and in-process inspection on machine tools are two of the solutions offered by Renishaw to help you maximise your productivity and maintain the highest possible standards of quality.

Successful gauging depends very much on the ability of the probe's stylus to access a feature and then maintain accuracy at the point of contact. At Renishaw, we have used our expertise in probe and stylus design to develop a comprehensive range of CMM styli to offer you the greatest possible precision.

These notes explain the critical features of each stylus type, helping you to choose the right design for each inspection need.

What is a stylus?

A stylus is that part of the measuring system which makes contact with the component, causing the probe mechanism to displace. The generated signal enables a measurement to be taken. The feature to be inspected dictates the type and size of stylus used. In all cases, however, maximum rigidity of the stylus and perfect sphericity of the tip are vital.

The performance of your gauging can easily be degraded if you use a stylus with poor ball roundness, poor ball location, bad thread fit or a compromised design that allows excessive bending during measurement. To ensure the integrity of the data you gather, make certain that you specify and use a stylus from the comprehensive range of genuine Renishaw styli.

Best practice when using a stylus

In order to maintain accuracy at the point of contact we recommend that you:

- Keep styli short
- Minimise joints
- Maximise stem diameter and stylus ball size where possible
- Regularly inspect stylus tips for wear or damage

Ball materials available with Renishaw styli

Ruby

The industry standard and the optimum stylus ball material for a vast majority of measurement applications, ruby is one of the hardest known materials. Synthetic ruby is 99% pure aluminium oxide, which is grown into crystals (or 'boules') at 2000 °C using the Verneuil process.

The boules are then cut and gradually machined into a highly spherical form. Ruby balls are exceptionally smooth on the surface, have great compressive strength and a high resistance to mechanical corrosion.
Very few applications exist where ruby is not the best ball material, however there are two such applications where balls manufactured from other materials are recommended.

Silicon nitride

The first is for heavy duty scanning applications on aluminium. Because the materials attract, a phenomenon known as 'adhesive wear' can occur which involves build up of aluminium from the surface onto the ball. A better ball material for such applications is silicon nitride.

Silicon nitride possesses many similar properties to ruby. It is a very hard and wear resistant ceramic which can be machined into very high precision spheres. It can also be polished to an extremely smooth surface finish. Silicon nitride does not have the attraction to aluminium and so does not exhibit the adhesive wear seen with ruby in similar applications. Silicon nitride does, however, show significant abrasive wear characteristics when scanning on steel surfaces so its applications are best confined to aluminium.

Zirconia

The second circumstance where ruby may be problematic is once again in heavy duty scanning applications on cast iron. Interaction between the two materials can result in 'abrasive wear' of the ruby ball surface. For such applications, zirconia balls are recommended.

Zirconia is a particularly tough ceramic material with hardness and wear characteristics approaching those of ruby. Its surface properties, however, make it an ideal material for aggressive scanning applications on cast iron components.

Stem material available with Renishaw styli

Steel

Stems manufactured from non-magnetic stainless steel are used widely for styli with ball/tip diameters of 2 mm or greater and with lengths up to 30 mm. Within this range, one-piece steel stems offer the optimum stiffness to weight ratio, giving adequate ball/stem clearance without compromising stiffness with a joint between the stem and threaded body.

Tungsten carbide

Tungsten carbide stems are best used for maximising stiffness with either small stem diameters, required for ball diameters of 1 mm and below, or over longer lengths up to 50 mm. Beyond this, weight can become a problem or stiffness is lost due to deflection at the stem-to-body joint.

Ceramic

For ball diameters greater than 3 mm, and lengths over 30 mm, ceramic stems offer stiffness comparable to steel, and are significantly lighter in weight than tungsten carbide. Ceramic stemmed styli can also offer additional crash protection to your probe as the stem will shatter in a collision.

Carbon fibre (Renishaw GF)

There are many grades of carbon fibre materials, however Renishaw GF combines optimum stiffness characteristics, both longitudinally and in torsion (important in star constructions) with extremely low weight. Carbon fibre is inert and this, combined with a special resin matrix, provides excellent protection in the most hostile machine tool environments.

Renishaw GF is ideal for maximising stiffness while giving very low mass for styli above 50 mm in length. It is the optimum stem material for high accuracy strain gauge technology probes with excellent vibration damping characteristics and negligible co-efficient of thermal expansion.

SP80 and SP80H maintenance

The SP80 / SP80H probe is a serviceable part. In the event of a problem, please contact your supplier for assistance.

Following the simple maintenance procedures given below will prolong the operational life and continued high performance of the system. The user should determine the frequency of inspection and maintenance actions according to the conditions of use.

CAUTION: Always adhere to the safety instructions given in this guide. Failure to do so could adversely affect the performance of the probe and / or lead to personal injury.

SP80 and SP80H probe bodies and stylus holders (SH80 and SH80K)

The external surfaces of all system components should only be cleaned using a soft, lint free cloth. All parts must always be kept dry.

The kinematic coupling mechanisms, incorporated throughout the system, have a precision ball-on-ball seating, electrical contacts and permanent magnets. The coupling has been tested in a wide variety of environments and is highly tolerant of non-metallic dust, but regular inspection and cleaning is recommended to ensure continued high performance of the probe system.

Renishaw supplies a kit for easy cleaning of the kinematic coupling, which is available from your local Renishaw supplier, part number A-1085-0016.

SCP80(V) stylus changing port

Periodic cleaning of the ports, lids and outer surfaces, using a soft lint free cloth, is recommended to prevent contamination of stored stylus holders.

Styli

Stylus balls, threads and mating faces should be cleaned using a proprietary cleaning cloth or solvent such as isopropyl alcohol. Stylus balls should be regularly inspected for damage or 'pick-up' of component material (a problem sometimes encountered with continuous scanning).

SP80 and SP80H system integration notes

The following sections identify various probe characteristics that customers will need to be aware of during the integration of the SP80 / SP80H system.

Return to zero

The probe has a nominal absolute centre position where the functions of stylus configuration and probe orientation cause it to rest. Because of small amounts of internal friction, when the probe is displaced from this zero point, the stylus will not return to exactly the same point on the scale and the axis deflection readings will show a different value. Typically, after a 1 mm deflection, the probe will return to within 10 µm of its free state original position.

This characteristic of probe performance is called RETURN TO ZERO and is a feature of all analogue probes. It is not a source of error as the scale system continues to monitor position. Rather it is merely a factor which must be taken into account when designing control software for using the probe. It can be given a value which represents the diameter of a sphere around the nominal zero position within which the probe will return to rest after any displacement.

It is important to take this into account as it affects the minimum amount of deflection necessary before the stylus is considered to be in contact with the surface. Because the stylus can return to a value other than the nominal zero, the CMM must recognise the fact that the range of rest positions of the stylus must not cause the machine motion, as the stylus is not necessarily in contact with a surface even though it is “deflected”. The CMM software should have a parameter for this minimum probe deflection and only deflections above this amount should be considered as the stylus being in contact with a surface.

Probe initialisation (home routine)

The SP80 and SP80H utilise digital scale and readhead technology and requires the scale system to be referenced prior to usage following power being supplied to the probe.

The procedure for this is to remove the SH80 stylus holder from the SP80 /SP80H probe body and permit the probe mechanism to return to its zero reference position; when the probe is in this position the scales within the head should be referenced (set to 0). This 'null' position should be recorded.

NOTE: The above 'null' position procedure has to be completed every time power is removed from the probe/system only if the SH80K is NOT fitted.

When each SH80 is attached, complete with stylus cluster, the offset from the 'null' position should be recorded and stored for that particular arrangement. This should be recalled every time the stylus holder is reattached.

The difference in position at rest from the offset can be attributed to the return to zero property of the probe. Note that the accuracy of the 'home' position will be +/- 10 µm. This will lead to a discrepancy between styli calibrated in previous sessions to this one. Hence the OEM should incorporate a more sophisticated homing routine including the location of a known feature.

Probe inertia

Due to the inertia of the SP80 / SP80H motion system high CMM accelerations may cause non-contact probe deflections to exceed thresholds set within the control algorithms; this inertia will vary according to the stylus arrangement.

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