Installation and user's guide
H-2000-5124-10-A

RENISHAW
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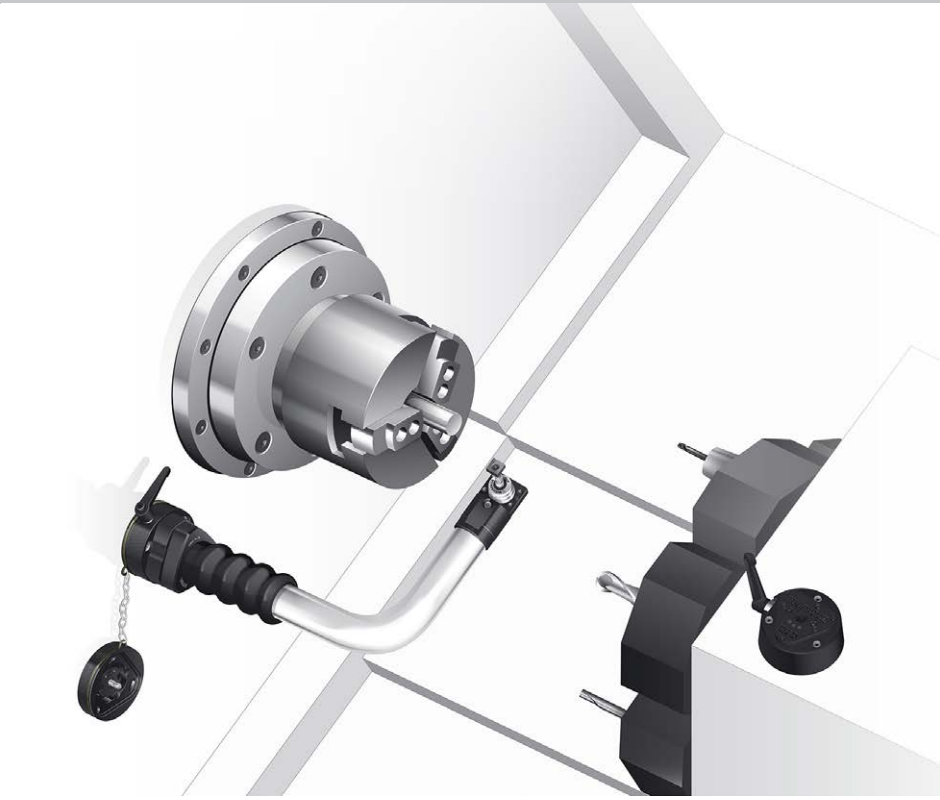
HPRA high-precision removable arm



English

Renishaw part no: H-2000-5124-10-A

Issued: 09.2018

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Contents

Contents

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Warranty

Equipment requiring attention under warranty must be returned to your equipment supplier.

Unless otherwise specifically agreed in writing between you and Renishaw, if you purchased the equipment from a Renishaw company, the warranty provisions contained in Renishaw's CONDITIONS OF SALE apply. You should consult these conditions in order to find out the details of your warranty but, in summary, the main exclusions from the warranty are if the equipment has been:

- neglected, mishandled or inappropriately used; or
- modified or altered in any way except with the prior written agreement of Renishaw.

If you purchased the equipment from any other supplier, you should contact them to find out what repairs are covered by their warranty.

Changes to equipment

Renishaw reserves the right to change equipment specifications without notice.

CNC machines

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

Patents

Features of the Renishaw HPRA and other related products, are subject of one or more of the following patents and/or patent applications:

EP 0967455
JP 4444509
US 6275053

EU declaration of conformity

CE

Renishaw plc declares under its sole responsibility that the HPRA high-precision removable arm is in conformity with all relevant Union legislation.

The full text of the EU declaration of conformity is available at: **www.renishaw.com/mtpdoc**.

FCC Information to user (USA only)

47 CFR Section 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, and

2. This device must accept any interference received, including interference that may cause undesired operation.

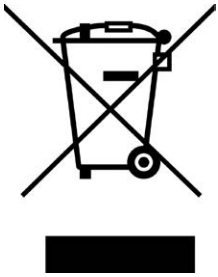
47 CFR Section 15.21

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.

47 CFR Section 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.

WEEE directive



The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic equipment (WEEE) to enable reuse or recycling. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local waste disposal service or Renishaw distributor.

Safety

Information to the user

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

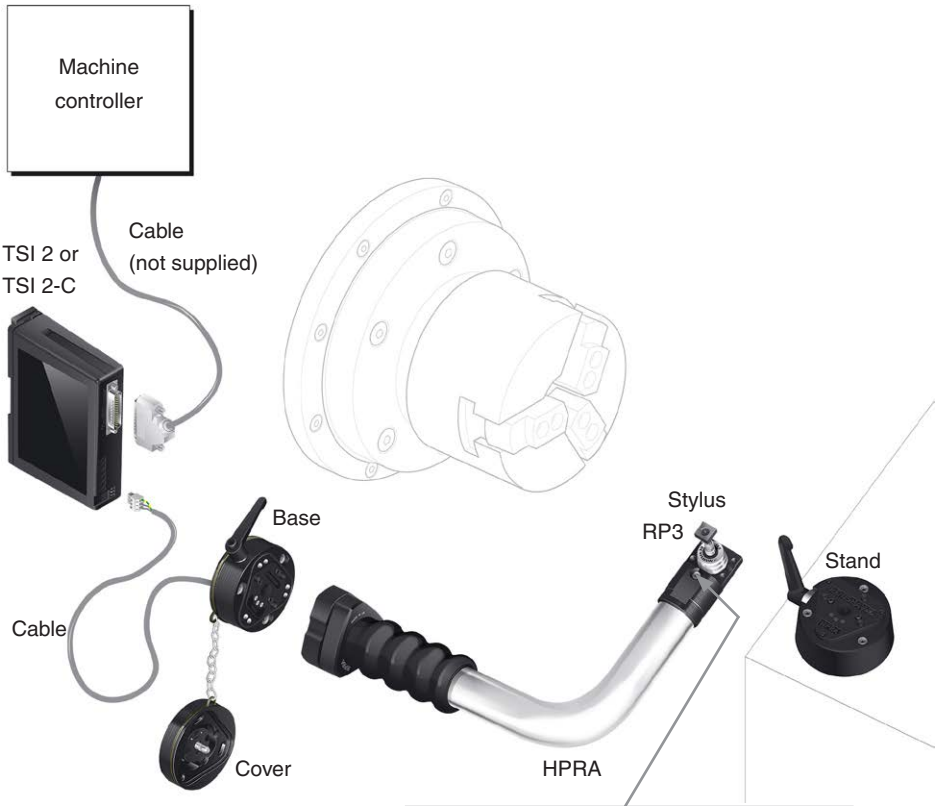
Refer to the machine supplier's operating instructions.

The HPRA system must be installed by a competent person, observing relevant safety precautions. Before starting work, ensure that the machine tool is in a safe condition with the power switched OFF and the power supply to the TSI 2 or TSI 2-C disconnected.

Information to the machine supplier

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 documentation, 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.



Probe status LED	
Green	Arm ready for use and probe seated
Red	Triggered

NOTE: For part numbers, please refer to “Parts list” on page 42.

Variant		Standard rear exit	Standard side exit
Principal application		Tool measuring on 2-axis and 3-axis CNC lathes.	
Transmission type		Hard-wired transmission	
Weight		≈ 3.1kg (109 oz)	
Probe		RP3 (see notes 1 and 2)	
Compatible interfaces		TSI 2 or TSI 2-C	
Cable (to interface)	**Specification**	Ø4 mm (0.16 in), 2-core screened cable, each core 7 × 0.2 mm	
	Length	3 m (9.8 ft), 5.5 m (18 ft), 10 m (32.8 ft), 12 m (39.4 ft)	3 m (9.8 ft)
Sense directions		±X, ±Y, (probe), ±X, ±Z, (machine)	
Typical positional repeatability (see note 3)		5 µm (197 µin) 2σ X/Z (arms for machines with 6 in to 15 in chucks) 8 µm (315 µin) 2σ X/Z (arms for machines with 18 in to 24 in chucks)	
Stylus trigger force (see notes 4 and 5) XY low force XY high force +Z direction		 1.5 N, 153 gf (5.4 ozf) 3.5 N, 357 gf (12.59 ozf) 12 N, 1224 gf (43.16 ozf)	
Sealing		IPX8, BS EN 60529:1992+A2:2013 (IEC 60529:1989+A1:1999+A2:2013)	
Mounting		M6 bolts (3 off)	
Operating temperature		+5 °C to +55 °C (+41 °F to +131 °F)	
Storage temperature		–25 °C to +70 °C (–13 °F to +158 °F)	

Note 1 Where the RP3 is to be used in the probe's Z-axis (the lathe Y-axis), a five-faced stylus is available to order from Renishaw Styli and Fixturing Products.

Note 2 Performance specification is tested at a standard test velocity of 480 mm/min (18.9 in/min) with a 35 mm stylus. Significantly higher velocity is possible depending on application requirements.

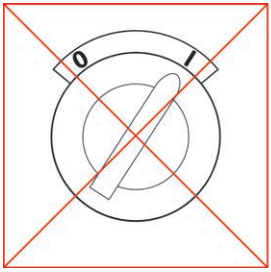
Note 3 Test conditions:

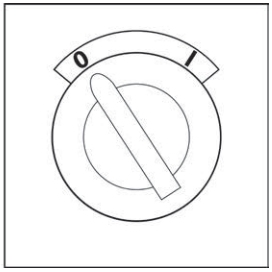
Stylus length:	22 mm (0.87 in)
Stylus velocity:	36 mm/min (1.42 in/min)
Stylus force:	factory settings

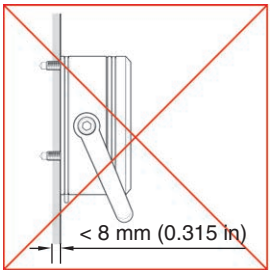
Note 4 Trigger force, which is critical in some applications, is the force exerted on the component by the stylus when the probe triggers. The maximum force applied will occur after the trigger point i.e. overtravel. The force value depends on related variables including measuring speed and machine deceleration.

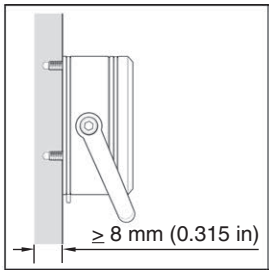
Note 5 These are the factory settings, manual adjustment is not possible.

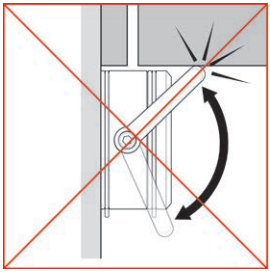
Installing the HPRA

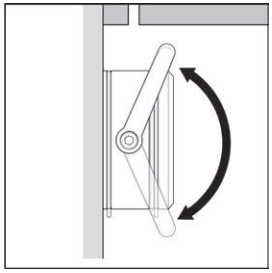


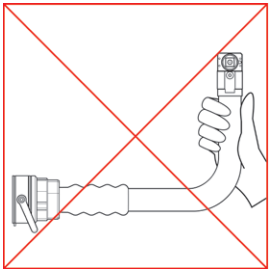


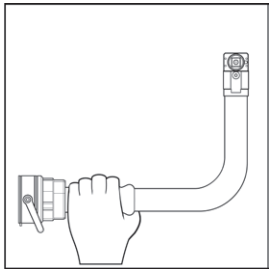




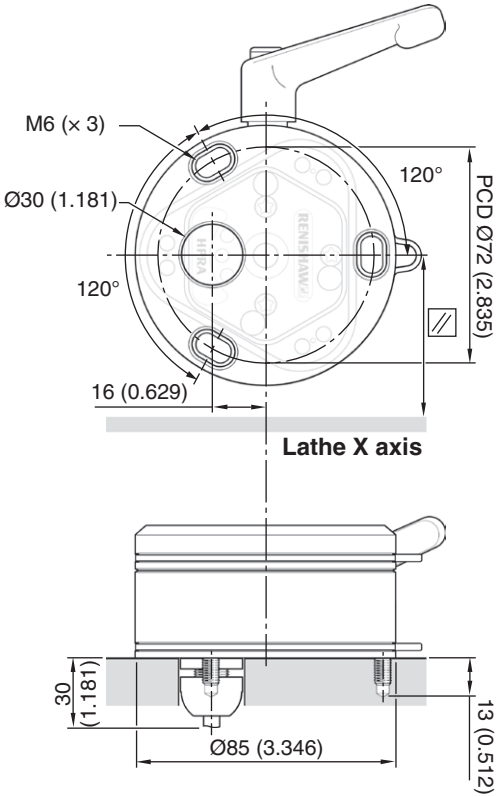






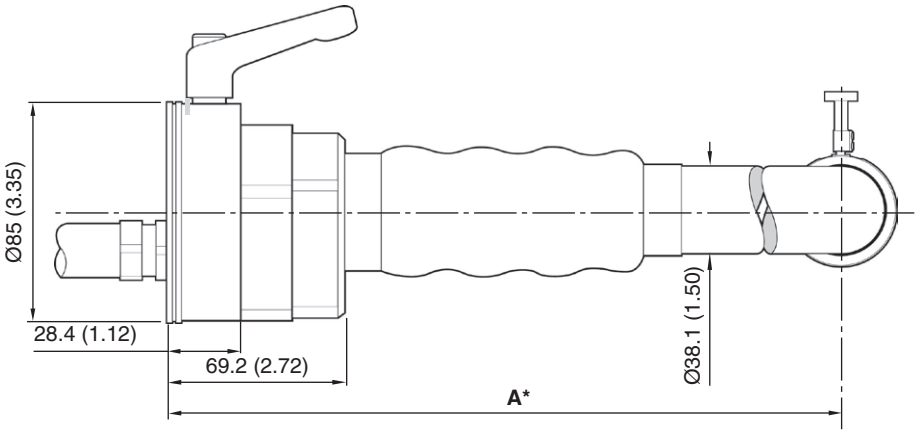


Mounting details



Cover removal

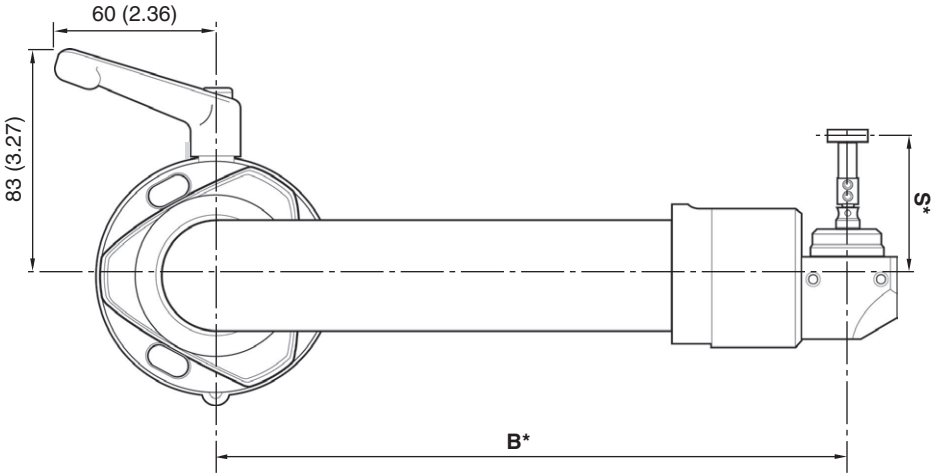
Side view



Dimensions given in mm (in)

* A variety of standard length, rear and side exit arms are available. See the table on page 13 for further information.

Front view



Dimensions given in mm (in)

* A variety of standard length, rear and side exit arms are available. See the table on page 13 for further information.

Dimensions table

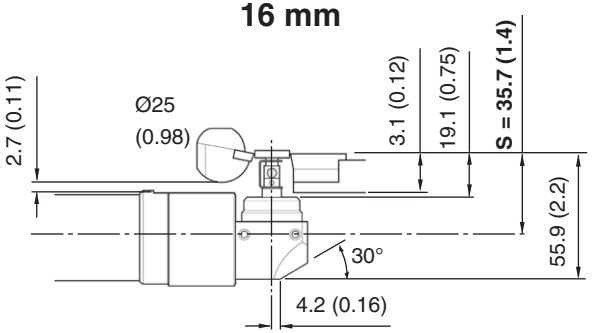
Chuck size	Tooling size	Arm size		S*
		A	B	
6 in	16 mm 20 mm 25 mm 32 mm	250 (9.84)	211 (8.31)	36 (1.42) 41 (1.61) 51 (2.01) 56 (2.20)
8 in	16 mm 20 mm 25 mm 32 mm	280 (11.02)	241 (9.49)	36 (1.42) 41 (1.61) 51 (2.01) 56 (2.20)
10 in	16 mm 20 mm 25 mm 32 mm 40 mm	325 (12.80)	290 (11.42)	36 (1.42) 41 (1.61) 51 (2.01) 56 (2.20) 61 (2.40)
12 in	16 mm 20 mm 25 mm 32 mm 40 mm 50 mm	355 (13.98)	290 (11.42)	36 (1.42) 41 (1.61) 51 (2.01) 56 (2.20) 61 (2.40) 71 (2.80)
15 in	20 mm 25 mm 32 mm 40 mm 50 mm	455 (17.91)	335 (13.19)	41 (1.61) 51 (2.01) 56 (2.20) 61 (2.40) 71 (2.80)
18 in	25 mm 32 mm 40 mm 50 mm	510 (20.08)	375 (14.76)	51 (2.01) 56 (2.20) 61 (2.40) 71 (2.80)
24 in	25 mm 32 mm 40 mm 50 mm	580 (22.83)	450 (17.72)	51 (2.01) 56 (2.20) 61 (2.40) 71 (2.80)

Dimensions given in mm (in)

* Stylus height, S, is adjustable by ±1.5 mm.

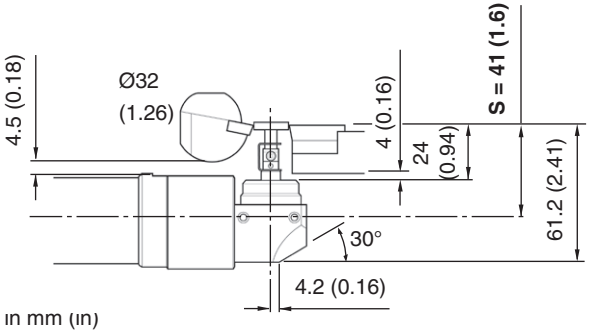
Stylus dimensions by tool size

16 mm



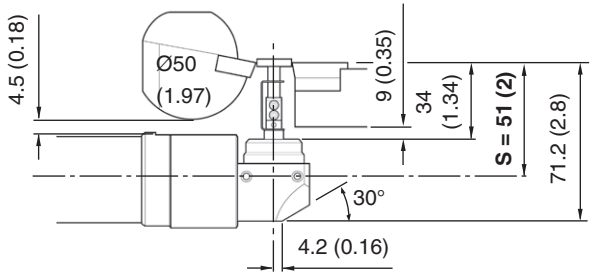
Dimensions given in mm (in)

20 mm



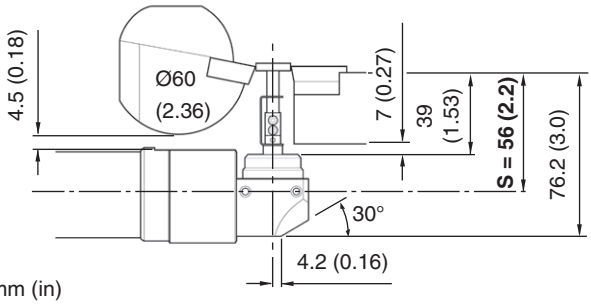
Dimensions given in mm (in)

25 mm



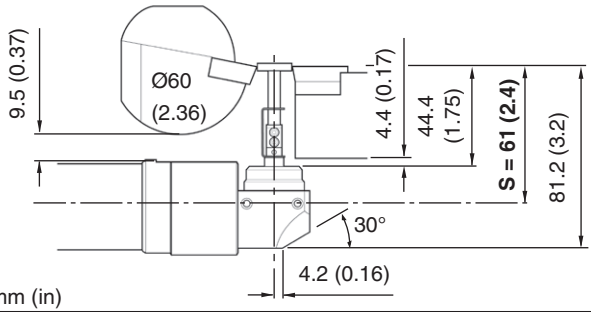
Dimensions given in mm (in)

32 mm



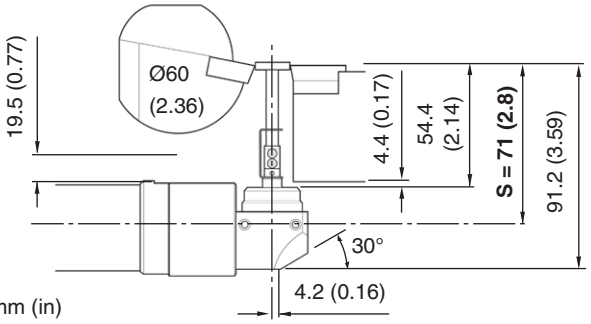
Dimensions given in mm (in)

40 mm



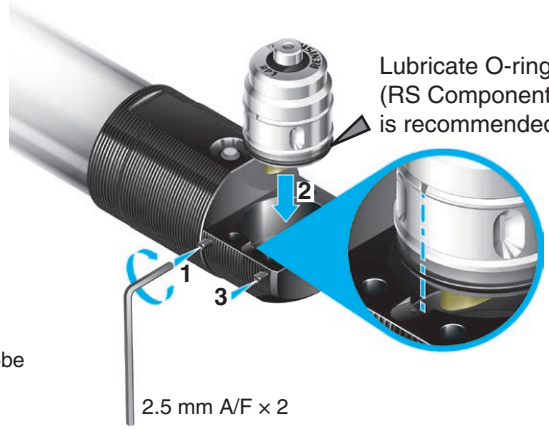
Dimensions given in mm (in)

50 mm



Dimensions given in mm (in)

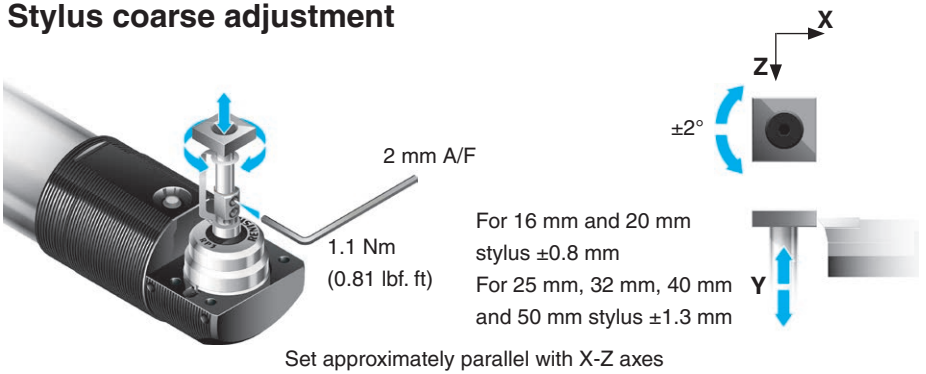
Fitting the probe to the arm



1. Loosen
2. Insert probe
3. Tighten

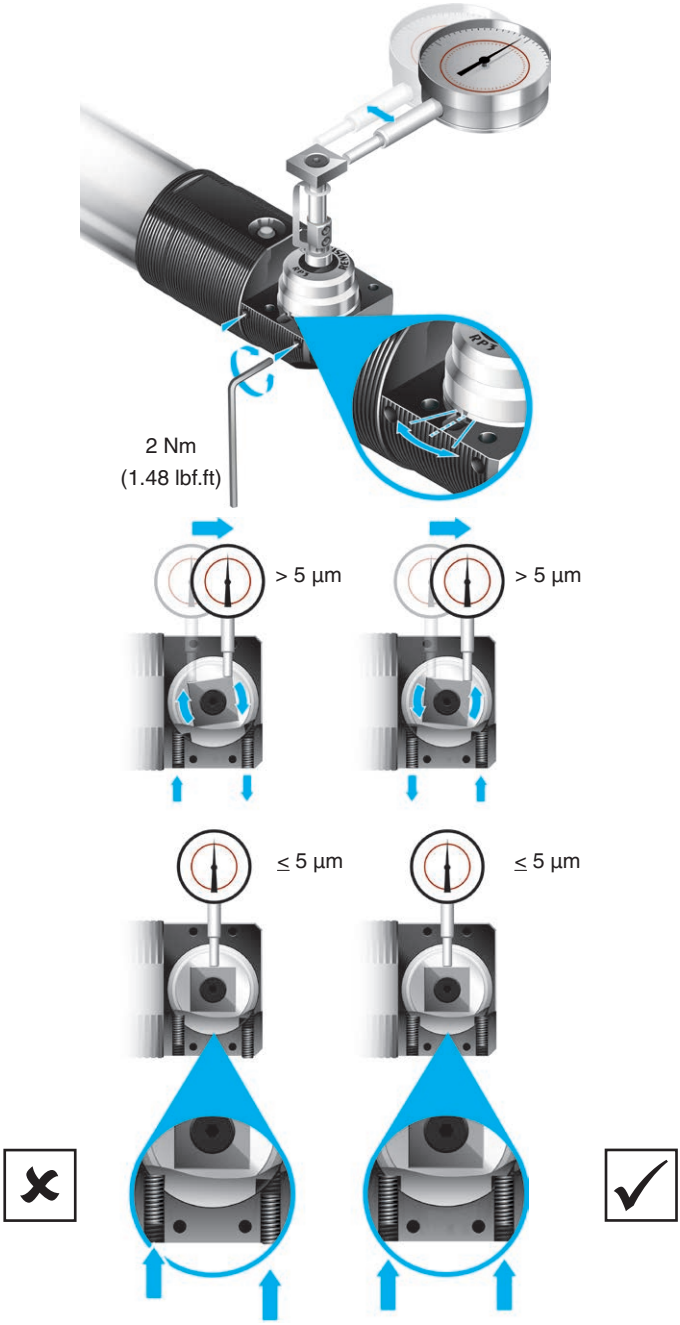
Stylus fitting

Stylus coarse adjustment



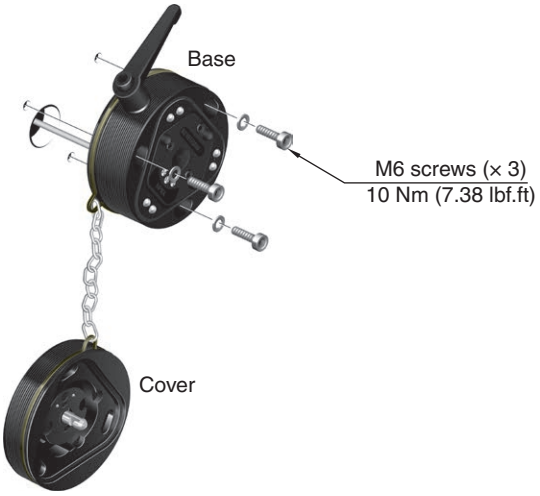
Set approximately parallel with X-Z axes

Stylus fine adjustment

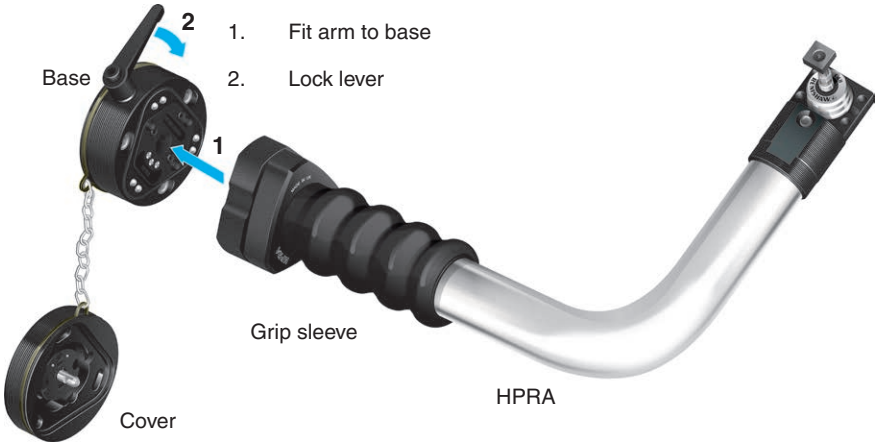


Mounting the base

Step 1 – mounting the base to the machine

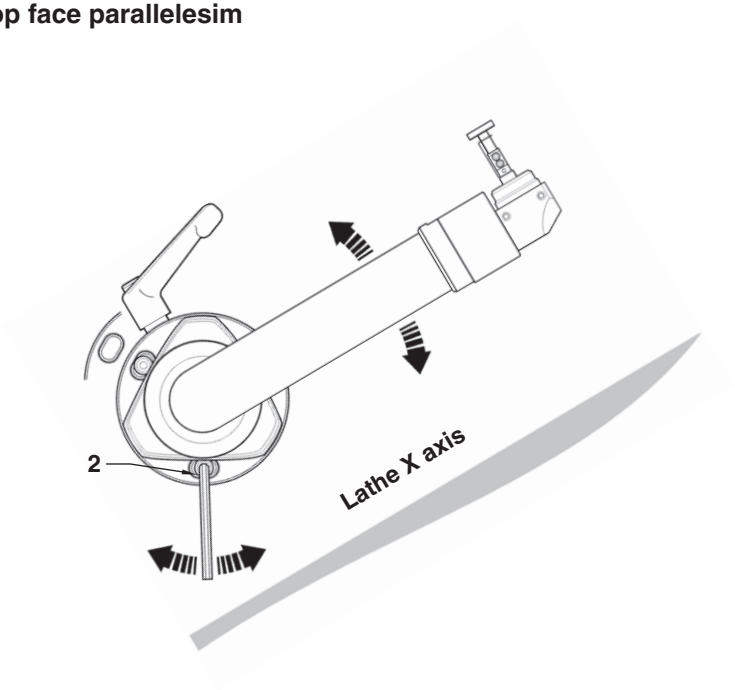


Step 2 – mounting the HPRA to the base



CAUTION: Only handle the HPRA by the grip sleeve.

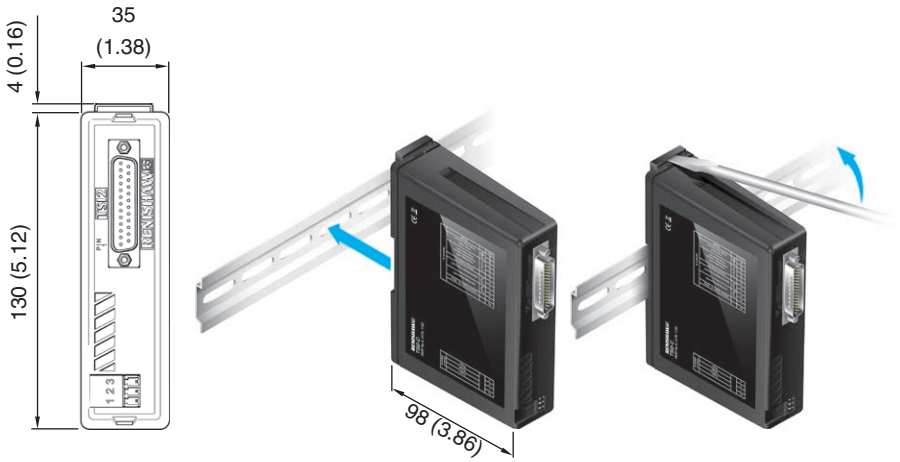
Step 3 – top face parallelesim



1. Rotate arm on bottom mounting screw **2** to set stylus alignment.
2. Tighten all screws **2** to 10 Nm (7.38 lbf.ft).
3. Check that stylus alignment has not moved after tightening.
4. If required, fit dowel base in position. Drill through base into mounting using pilot holes as a guide. Fit roll pins supplied in base fixing kit. Apply corrosion inhibitor to pins after fitting.

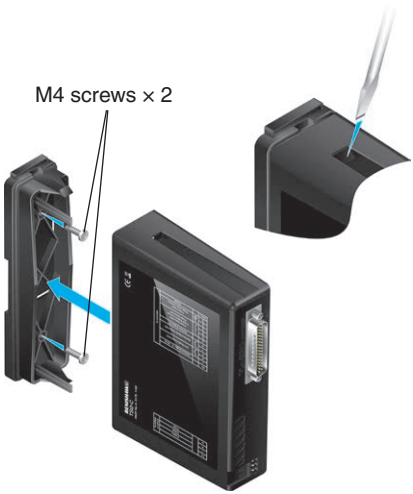
Installing the TSI 2 and TSI 2-C interface installation

The TSI 2 or TSI 2-C interface unit should be installed in the CNC control cabinet. Where possible, site the unit away from potential sources of interference such as transformers and motor controllers.

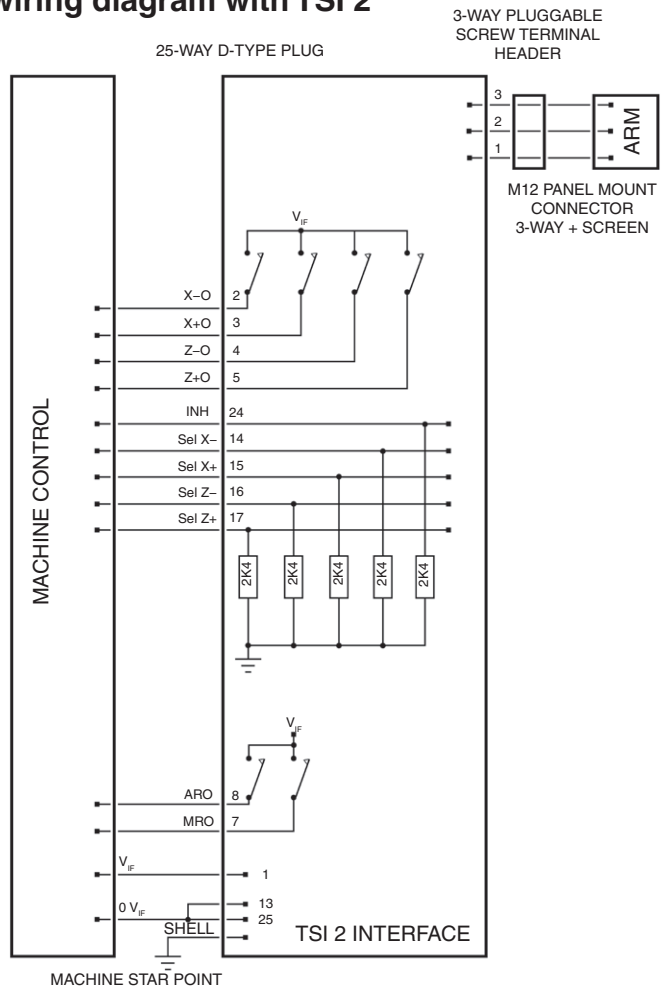


Dimensions given in mm (in)

Alternative mounting



HPRA wiring diagram with TSI 2



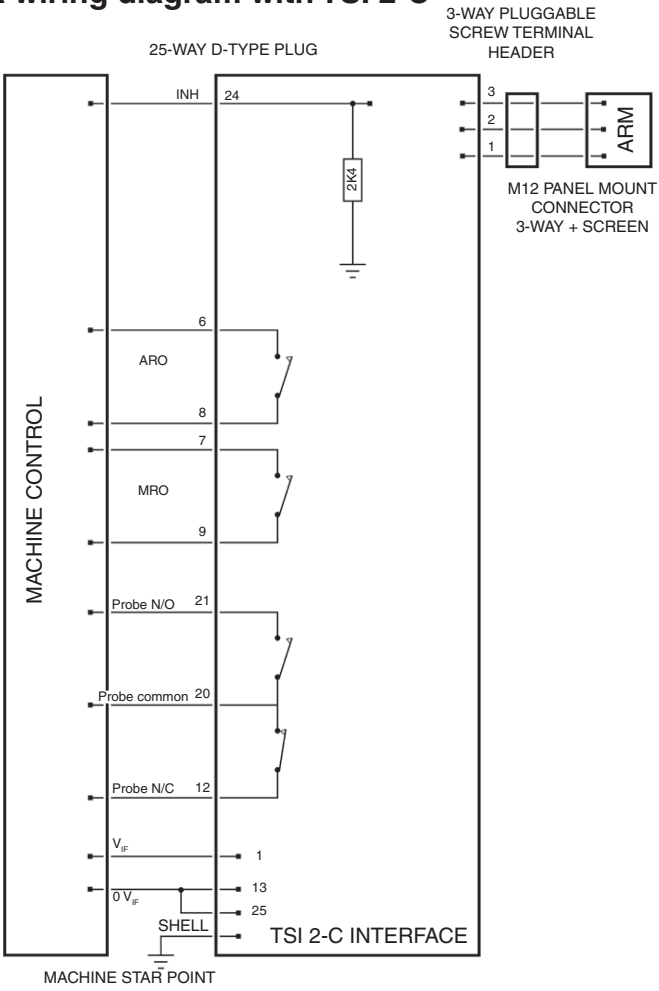
V_{IF} = 24 Vdc (18 Vdc to 30 Vdc).

This supplies the power to the system electronics which include the probe circuit.

I_{MAX} = 100 mA (not including output load currents).

Circuit protection: power supply protected against limited overcurrent and reverse connection.

HPRA wiring diagram with TSI 2-C



V_{IF} = 24 Vdc (18 Vdc to 30 Vdc).

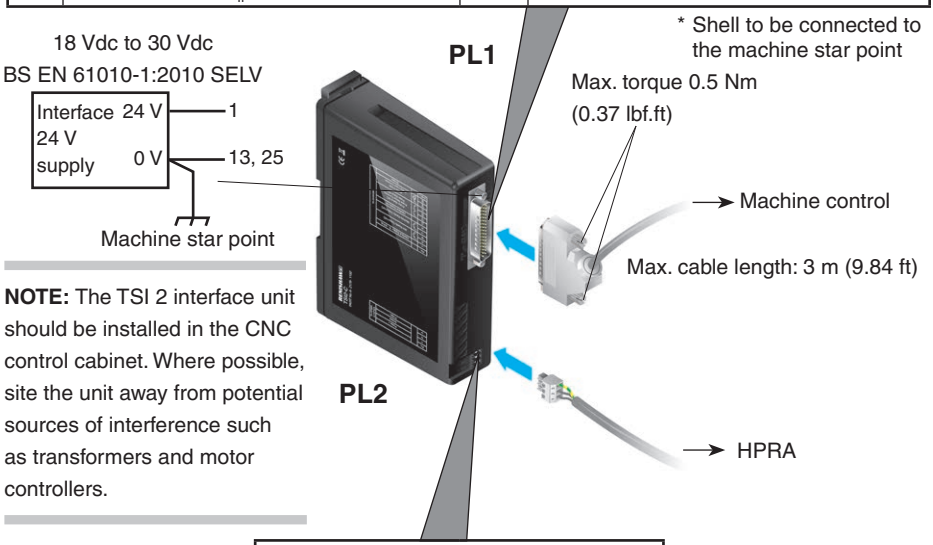
This supplies the power to the system electronics which include the probe circuit.

I_{MAX} = 100 mA (not including output load currents).

Circuit protection: power supply protected against limited overcurrent and reverse connection.

TSI 2 interface connections

1	18 Vdc to 30 Vdc (V_{IF})	14	Select X– input (Sel X–)
2	X– output (X–O)	15	Select X+ input (Sel X+)
3	X+ output (X+O)	16	Select Z– input (Sel Z–)
4	Z– output (Z–O)	17	Select Z+ input (Sel Z+)
5	Z+ output (Z+O)	24	Inhibit input (INH)
6	Arm ready output (ARO)	25	0 V_{IF} (GND)
7	Machine ready output (MRO)	Shell*	Screen (SCR)
13	0 V_{IF} (GND)	-	-



NOTE: The TSI 2 interface unit should be installed in the CNC control cabinet. Where possible, site the unit away from potential sources of interference such as transformers and motor controllers.

		Rear exit version or side exit version	
		Standard	**Trigger delay**
1	Probe + (P+)	Blue	Green
2	Screen (SCR)	Grey/Black	Grey/Black
3	Probe – (P–)	Green	Blue

V_{IF} = 18 Vdc to 30 Vdc
Imax = 80 mA All outputs o/c

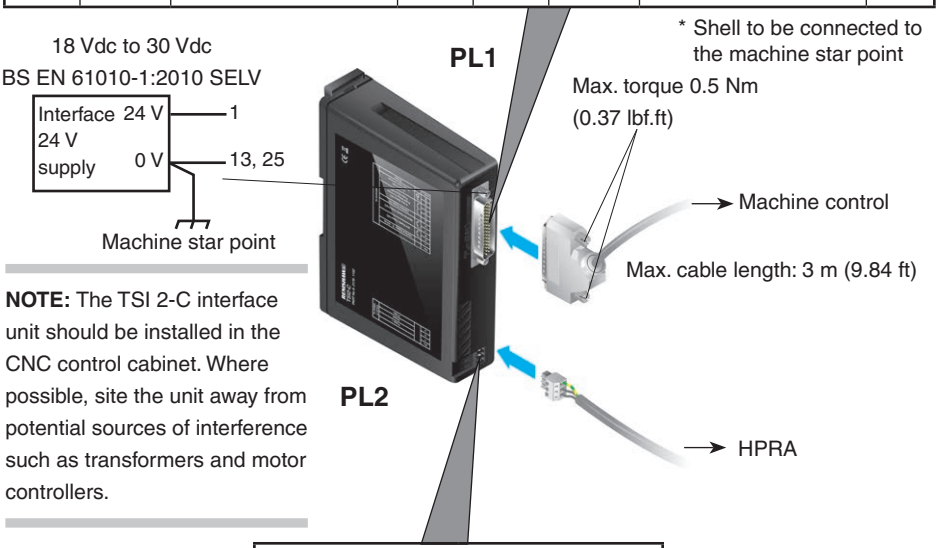
Input power supply protection is provided by self-resetting fuses. Reverse polarity protection is provided.

Cable screen must be terminated at the machine star point via the most direct route from the free end of the cable.

Mount interface and route cables away from known sources of EMI.

TSI 2-C interface connections

1		18 Vdc to 30 Vdc	To controller	21		Probe status (N/O)	To controller
6		ARO (N/O) (arm ready output)		20		Probe common	
8				12		Probe status (N/C)	
7		MRO (N/O) (machine ready output)		24		Probe inhibit (15 Vdc to 30 Vdc)	
9				25			
13		0 V_{IF} (GND)		Shell		Screen*	



NOTE: The TSI 2-C interface unit should be installed in the CNC control cabinet. Where possible, site the unit away from potential sources of interference such as transformers and motor controllers.

		Rear exit version or side exit version	
		Standard	**Trigger delay**
1	Probe + (P+)	Blue	Green
2	Screen (SCR)	Grey/Black	Grey/Black
3	Probe – (P–)	Green	Blue

V_{IF} = 18 Vdc to 30 Vdc
Imax = 80 mA All outputs o/c

Input power supply protection is provided by self-resetting fuses. Reverse polarity protection is provided.

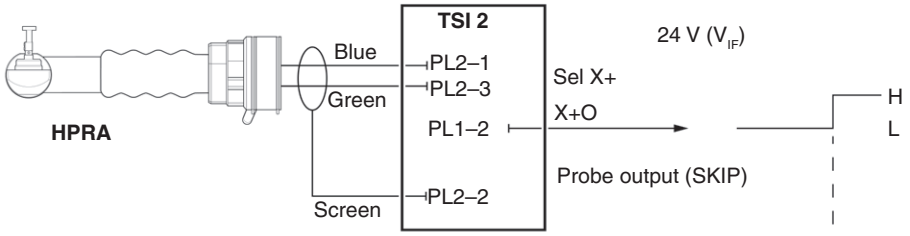
Cable screen must be terminated at the machine star point via the most direct route from the free end of the cable.

Mount interface and route cables away from known sources of EMI.

HPRA with a TSI 2 interface

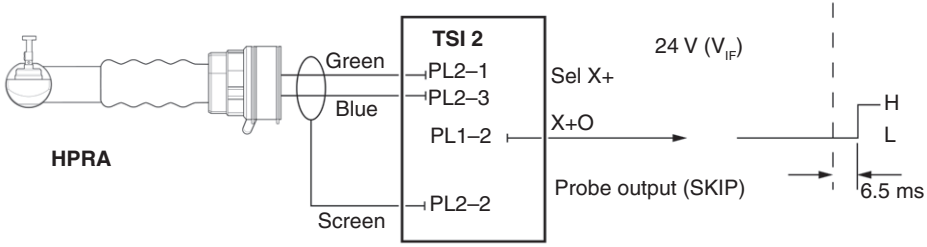
RP3 probe with standard connection

Blue/Green (side exit) wire configuration for DELAY OFF



RP3 probe with trigger delay circuit

Blue/Green (side exit) wire configuration for DELAY ON

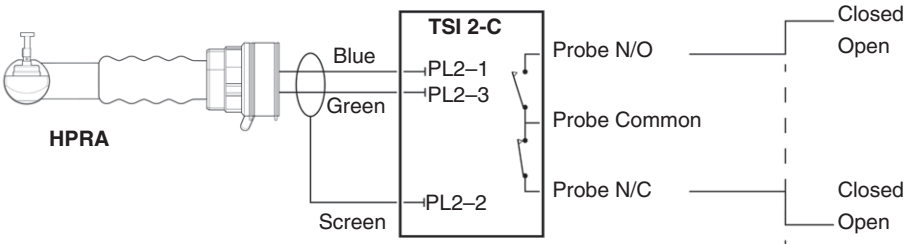


HPRA with a TSI 2-C interface

RP3 probe with standard connection

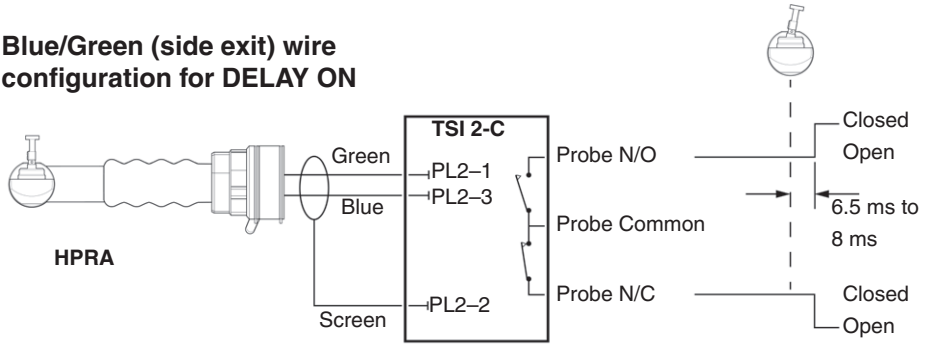
Blue/Green (side exit) wire configuration for DELAY OFF

Example below shows normally closed probe status output delay.

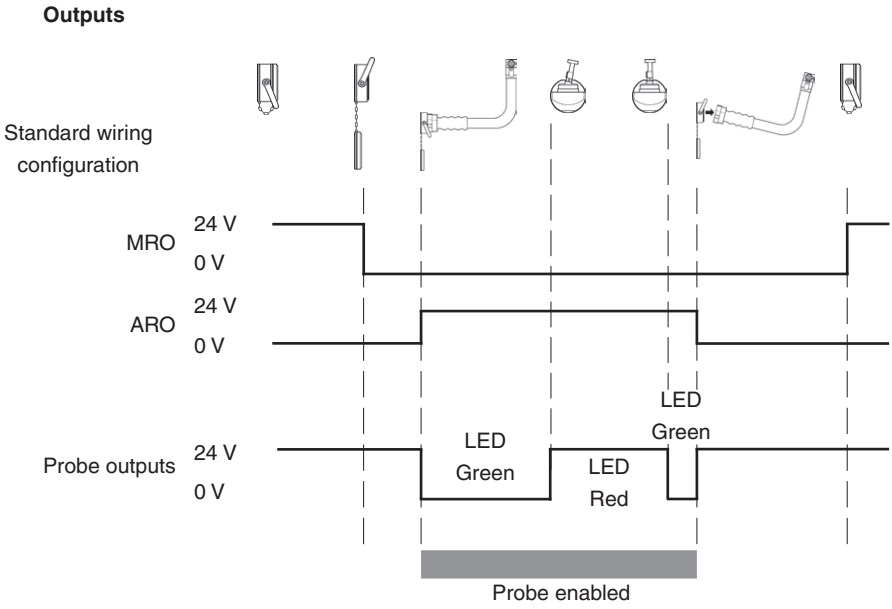


RP3 probe with trigger delay circuit

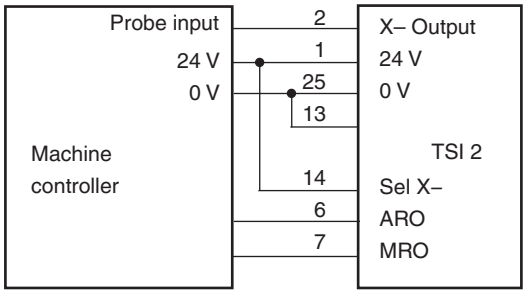
Blue/Green (side exit) wire configuration for DELAY ON



HPRA and TSI 2 wiring configuration



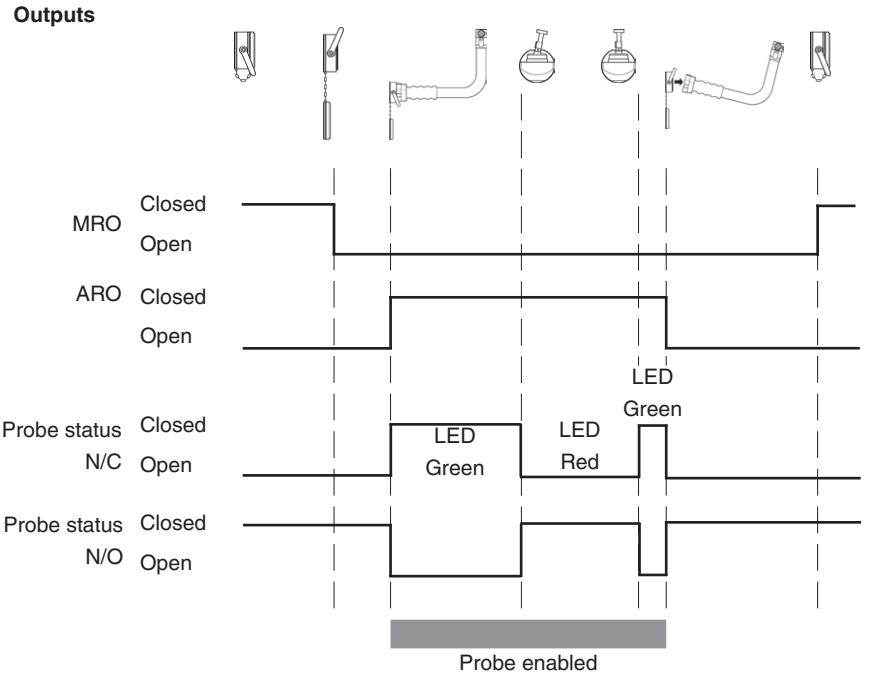
NOTE: These wiring diagrams assume the standard one-wire Renishaw probe output can be used. Where the four-wire option is required (i.e. Fanuc automatic length management input XAE, ZAE), the user must provide FOUR inputs from the control to indicate which axis is moving in order to obtain a probe trigger (Sel X–, Sel X+, Sel Z–, Sel Z+). This signal will instruct the TSI 2 to send the probe trigger output out through one of four possible channels (X–, X+, Z–, Z+).

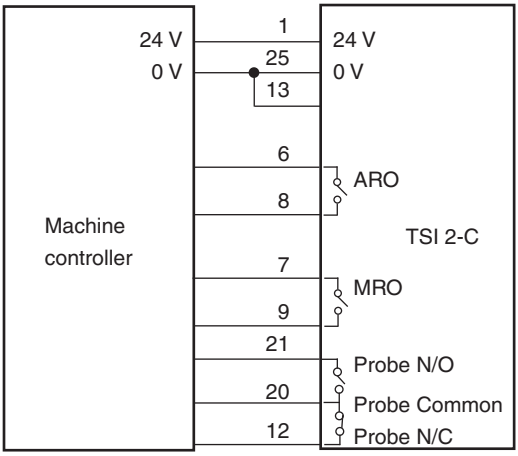


ARO (PL1-6) **MRO (PL1-7)**

Open Collector Transistor (OCT) ACTIVE HIGH outputs V_{IF} – 2.4 V@ max. source 20 mA

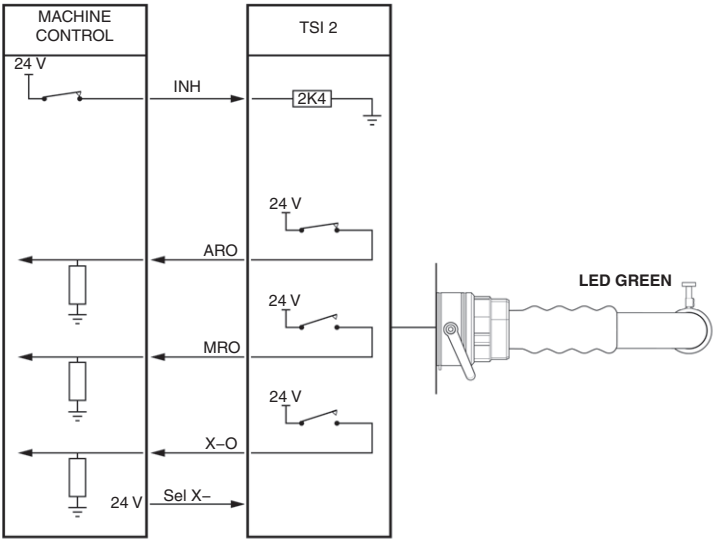
HPRA and TSI 2-C wiring configuration

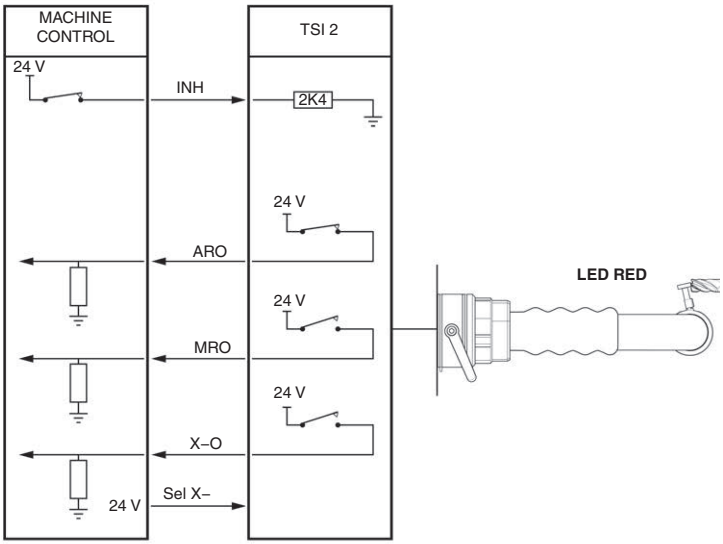




Probe inhibits with TSI 2

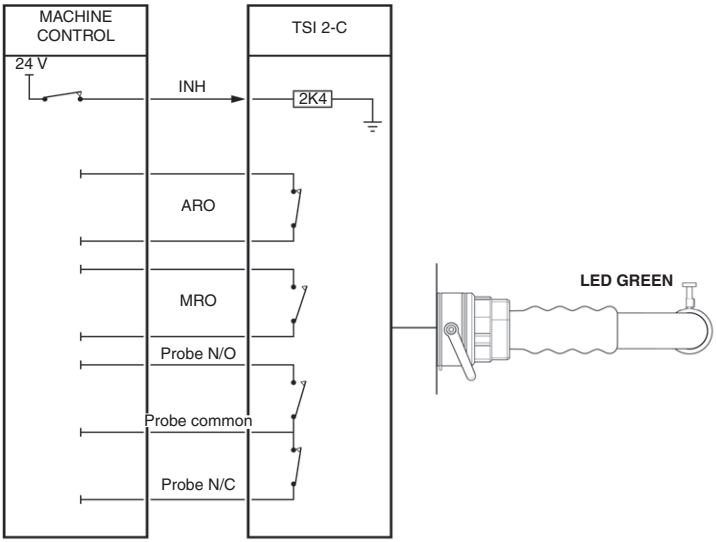
Shown as “ACTIVE HIGH” configuration.

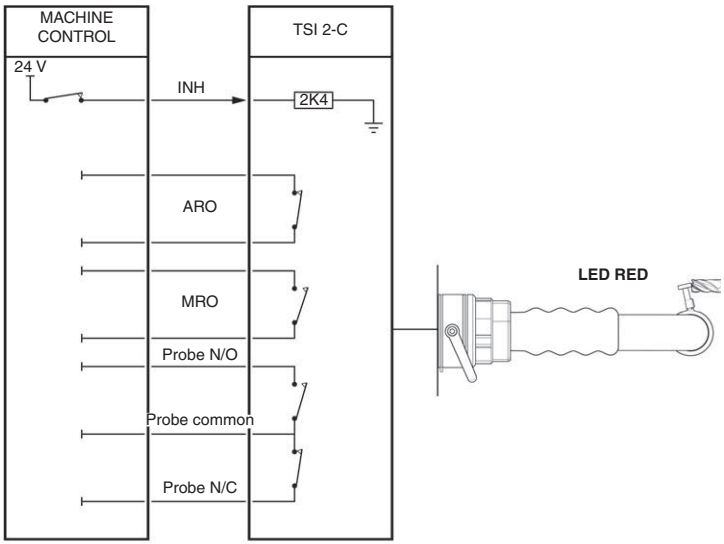




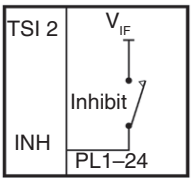
Probe inhibits with TSI 2-C

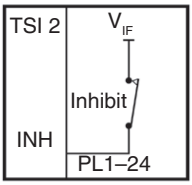
Shown as “ACTIVE HIGH” configuration.

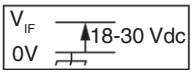


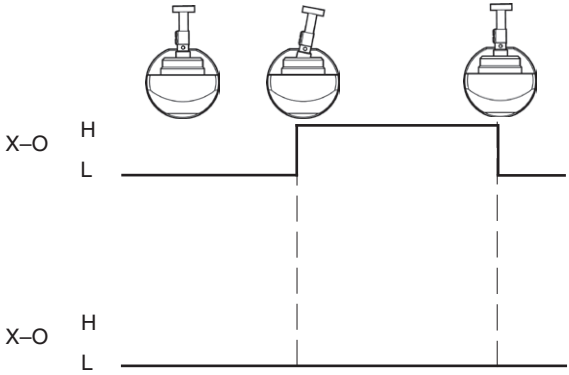


TSI 2 interface inputs





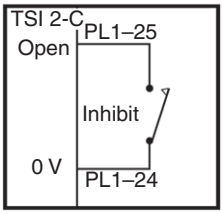


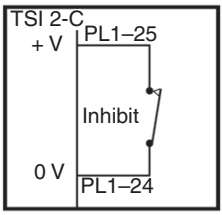


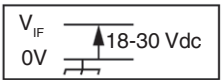
NOTE: Probe status LED will still function when inhibit is active.

TSI 2-C interface inputs

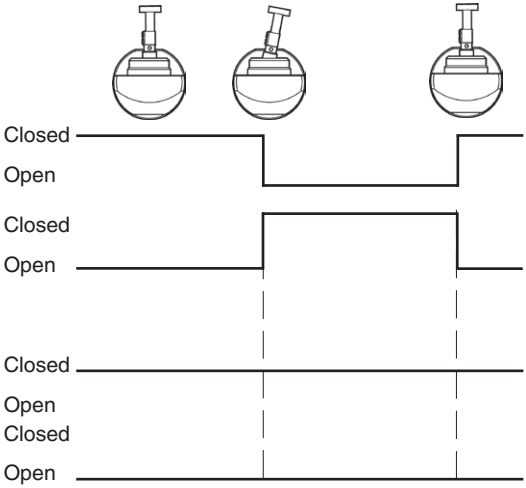
The inhibit input is not polarity conscious. Apply a voltage of 15 Vdc to 30 Vdc across PL1-24 and PL1-25 to activate. The inhibit input presents a load of 12.5 mA max.
Probe inhibit disables the probe outputs.





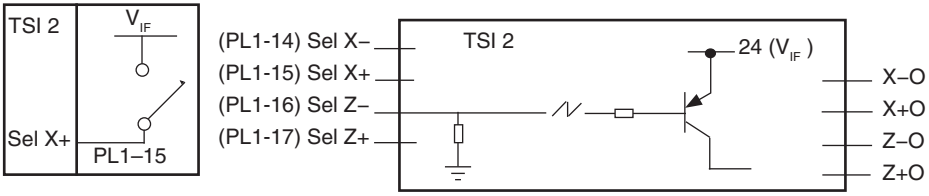


Probe status N/C
Probe status N/O
Probe status N/C
Probe status N/O



NOTE: Probe status LED will still function when inhibit is active.

Probe select inputs (for arms used with TSI 2 only, not applicable for arms used with TSI 2-C)



Sel X– → X–O
Sel X+ → X+O

Sel Z– → Z–O
Sel Z+ → Z+O

Input specification with TSI 2

INH
Sel X–
Sel Z–
Sel Z+
Sel X+

} Internally pulled down (2K4) ACTIVE HIGH inputs

Output specification with TSI 2

(PL1-2) X–O
(PL1-3) X+O
(PL1-4) Z–O
(PL1-5) Z+O

} OCT ACTIVE HIGH outputs V_{IF} – 3.8 V @ max. source 120 mA
V_{IF} – 2.4 V @ 20 mA

Input specification with TSI 2-C

INH Internally pulled down (2K4) ACTIVE HIGH inputs

Output specification with TSI 2-C

ARO and MRO are solid-state relay (SSR) contacts.

Probe signal outputs

Active closed.

Active open.

Please refer to “TSI 2-C interface connections” on page 24.

Base removal

CAUTIONS:

Base seal washer (**7**) must be fitted to ensure sealing integrity.

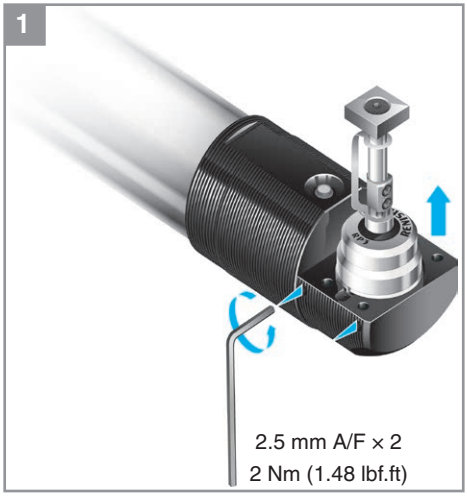
Base removal must be performed in the following sequence to avoid cable/connector damage.

1. Remove the three M6 screws (**1**).
2. Remove the base (**2**).
3. Ensuring that the the base fitting (**6**) doesn't rotate, unscrew and remove the cable gland nut (**3**), the compression seal (**4**) and the skid washer (**5**).
4. Unscrew and remove the base fitting (**6**) and the washer (**7**).

RP3 probe removal

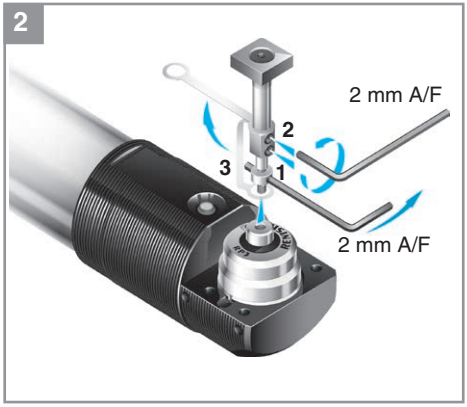
CAUTION: Ensure the area around the probe is dry and free of swarf and coolant before removing the probe.

1. Remove the M5 grub screws prior to cleaning to allow any coolant to escape.
2. Clean the probe and the area around the probe using clean dry air (Dust Remover clean air spray [RS Components no. 846-698] is recommended).
3. Remove the probe.



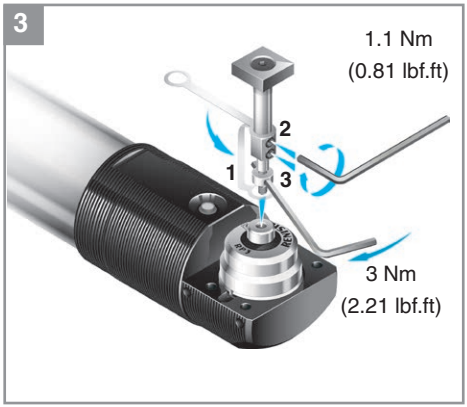
Stylus and break stem removal

1. Using a 2 mm hexagonal key fitted through the hole in the break stem (**1**), unscrew the stylus from the probe.
2. Using a 2 mm hexagonal key, unscrew the two M3 grub screws (**2**) that hold the break stem to the stylus.
3. Free the end of the captive link from the threaded end of the break stem (**3**) and remove the break stem.



Break stem and stylus fitting

1. Fit the free end of the captive link over the threaded end of the break stem (**1**).
2. Fit the break stem inside the stylus and secure it by tightening the two M3 grub screws (**2**).
3. Using a 2 mm hexagonal key fitted through the hole in the break stem (**3**), fit the stylus to the probe.



RP3 probe maintenance

RP3 probe care

The probe mechanism is protected from coolant and debris by a diaphragm. This provides adequate protection under normal working conditions.

Periodically clean the probe and check the diaphragm for signs of damage.

CAUTION: Do not remove the diaphragm. If the diaphragm is damaged, return the probe to your supplier for repair.

Cleaning and diaphragm inspection

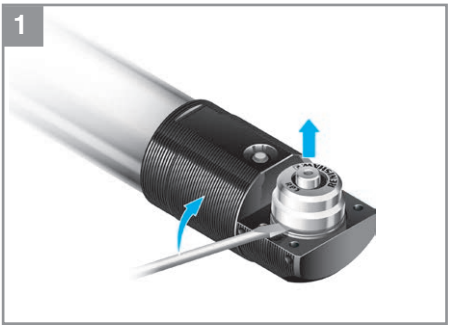
1. Leaving the probe in the arm, use a screwdriver to release and remove the front cover.
2. Clean the probe mechanism with low pressure clean coolant.

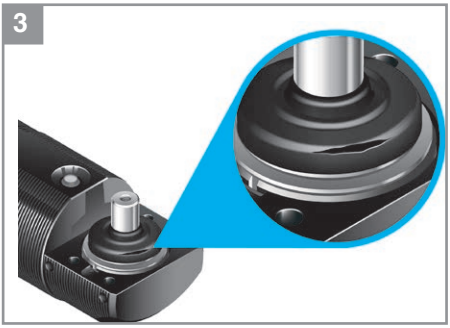
CAUTION: Do not use high pressure water jets to clean the probe mechanism.

3. Inspect the diaphragm for damage. If it is damaged, return the probe to your supplier. DO NOT REMOVE THE INNER DIAPHRAGM AS THIS WILL INVALIDATE YOUR WARRANTY.

Fitting the cover

4. Fit the front cover by pressing it back into place with your hand.





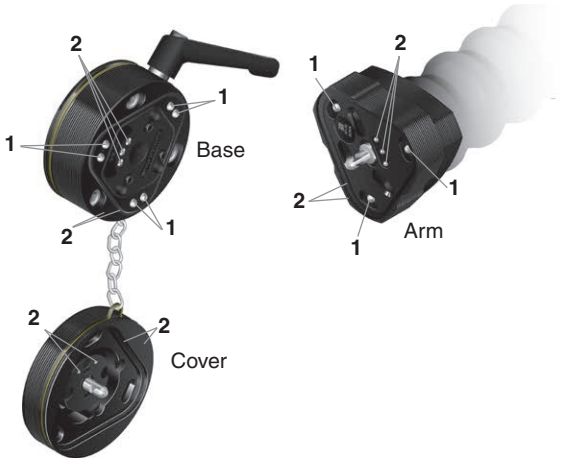
HPRA maintenance

Base inspection and cleaning

CAUTION: DO NOT use polish or solvent when cleaning the base or arm contacts.

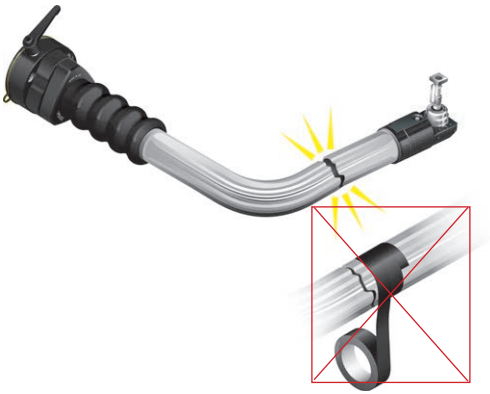
1. Wipe clean and grease base and arm contact points and tungsten carbide balls (**1**).
2. Wipe clean mating faces and seal (**2**).

CAUTION: Ensure the cover is wiped clean and is dry before refitting.



HPRA inspection

Periodically inspect the arm for signs of damage. If it is damaged, contact your supplier. DO NOT ATTEMPT TO FIX IT YOURSELF.



Tool setting

Tool setting definitions

Probe datuming determines the relationship between the machine spindle and the stylus location, as well as the effective size of the tool setting stylus.

Your Renishaw tool setting probe can be datumed by measuring a 'datum tool' of known size and position.

Tool setting establishes the size and position of your cutting tools before you use them to machine a component.

This assists you to produce parts that are 'right first time'.

With a Renishaw tool setting probe you can determine the size and position of your cutting tools quickly and easily.

Tool breakage detection checks the length of tools to see if the tool has chipped or broken since it was last set.

Probe datuming

Why datum the probe?

A Renishaw touch-trigger probe allows you to use your machine tool to determine the size and position of your tools. When the stylus contacts the surface of your tool, the positions of the machine axes should be recorded at that moment.

To determine the location of the surface of the tool, the software must know the size and position of the stylus.

Various probe datuming techniques allow you to determine the relationship between the stylus and the machine spindle.

Whilst the spindle/stylus relationship will not change under normal conditions, there are certain circumstances under which you should redatum the tool setting probe:

- Before using the probe for the first time on a machine.
- Whenever a new stylus is fitted.
- If you have made any adjustment to the probe alignment.
- If you suspect that the stylus has become distorted.

Setting tools

Setting tool lengths

Tools can be set for length in one of two ways:

- Static
- Rotating

Static length setting is suitable for tools whose cutting edges are located on the spindle centre line, for example, drills. Static length setting involves moving the tip of a tool to contact the stylus – see Figure 1.

Rotating length setting (for driven tools) is suitable for tools whose cutting edges are located around their circumference, for example slot drills. As with static length setting, rotating length setting involves moving the tip of a tool to contact the stylus but doing so while rotating, and doing so in the opposite direction to that which is used for cutting.

Rotating length setting ensures that the true high or low point of the tool is detected.

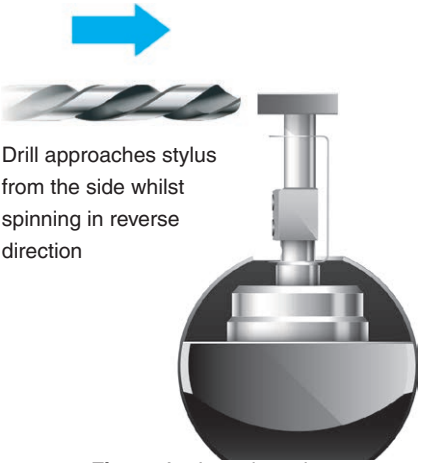


Figure 1 – Length setting

Setting tool diameters

Tools which are used to interpolate features, for example, slot drills, must be set for diameter.

Rotating diameter setting (for driven tools) is suitable for tools that are used to interpolate features, for example, slot drills, and which must be set for diameter. It involves moving the side of a tool to contact the stylus tip and, as with rotating length setting, the tool must be rotating in the opposite direction to that which is used for cutting (to protect the stylus) – see Figure 2.

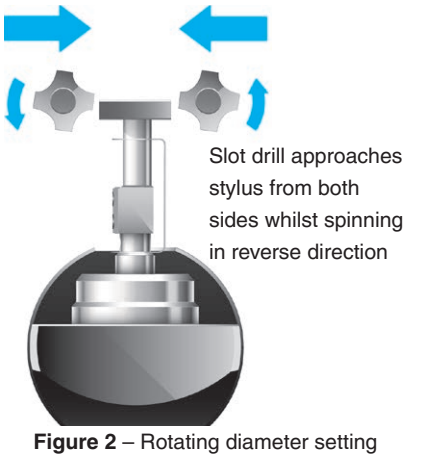


Figure 2 – Rotating diameter setting

Tool breakage detection

Tool breakage detection checks the lengths of your tools to identify tooling failures. By preventing damaged tools from being used for further machining, tool breakage detection forms a vital element of an automated machining process. Your Renishaw tool setting probe can be used to perform in-cycle checks on your tooling. By measuring the length of the tool before and after use you can be sure that damaged tools will not be used on subsequent machining operations. This reduces the risk of scrap, machine damage and broken tooling in subsequent operations, for example, taps.

Your tool breakage detection software should record the most recent tool length for each tool and compare this with the length measured during the tool breakage detection operation. If a significant difference is detected, the operator can be called to change the damaged tool.

Calibrating the tool setting probe

The exact procedure adopted is specific to each machine, control system and software package. However, certain rules are common.

Before setting tools, it is necessary to calibrate the stylus position to establish its trigger points in relation to a datum on the machine. This can be achieved by using a tool of known reference.

You should recalibrate the probe periodically (at least every 6 months), and in special circumstances, for example, if the arm has been subjected to a crash or if the stylus has been replaced.

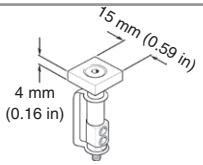
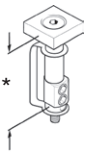
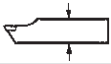
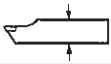
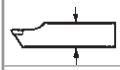
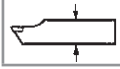
The recommended frequency of normal recalibration is dependent on how frequently the arm is used. This may vary greatly depending on the application of the tool setting arm, for example, a typical jobbing shop may want to set tools twice per day and have eight tools to set. This would therefore result in two arm operations per day. A large volume manufacturer, however, may only wish to check for broken tools, but with a typical cycle time of 5 minutes and 24-hour working days, would operate the arm 288 times per day.

Use the table below to determine how frequently you should recalibrate your probe:

Recommended frequency of arm recalibration	
Arms operations per day	Recalibrate every ...
< 50	6 months
< 100	3 months
> 100	1 month

Symptom	Cause	Action
Poor system repeatability.	Mounting screws not fully tightened.	Tighten screws to specified torque.
	Loose probe.	Verify tightness of probe in arm assembly.
	Loose stylus.	Ensure tip of stylus is tight. Ensure M4 grub screw in stylus stem is tight. Ensure crash protection device is fully tightened into RP3 probe.
	Swarf on tool tip.	Remove swarf.
	Calibration and updating of offsets is not occurring.	Review software.
	Calibration and probing speeds are not the same.	Review software.
	Probing is being performed within the machine's acceleration/deceleration zones.	Review software.
	Arm not mounted as recommended i.e. on sheet metal guards.	Mount on solid base.
	Probing feedrate is too high for the machine controller.	Perform repeatability trials at various feedrates.
	Temperature variation is causing excessive movement of the machine and the HPRA.	Minimise machine and HPRA temperature changes. Increase the frequency of calibration.
	Machine has poor repeatability due to loose encoders, backlash, tight slideways and/or accidental damage.	Perform health check on machine.

Symptom	Cause	Action
Poor system repeatability (continued).	Excess machine vibration.	Eliminate vibration. Change wiring to enable probe trigger delay circuit.
No probe output (probe status LED not lit).	Damaged or dirty probe contacts.	Check condition of probe contacts. If contacts are dirty, clean using compressed air and a clean lint-free cloth.
	Damaged or dirty arm base contacts.	Check condition of arm base contacts. If contacts are dirty, clean using compressed air and a clean lint-free cloth.
	Probe not connected.	Check wiring to machine. Check probe properly located in holder.
	Probe has failed.	Remove probe and check probe for continuity across probe contacts (resistance should be less than 1 KΩ).

Recommended for:	 Stylus assembly	 * Stylus assembly	 Break stem
 16 mm	A-2197-0157	14.2 mm (0.56 in)	M-2197-0156
 20 mm	A-2197-0158	19.5 mm (0.77 in)	M-2197-0156
 25 mm	A-2197-0159	29.5 mm (1.16 in)	M-2197-0150
 32 mm	A-2197-0160	34.5 mm (1.36 in)	M-2197-0150
 40 mm	A-2197-0161	39.5 mm (1.55 in)	M-2197-0150
 50 mm	A-2197-0162	49.5 mm (1.95 in)	M-2197-0150

Item	**Part number**	**Description**
Tool kit	A-2176-0636	Standard HP arm tool kit.
Tool kit	A-2176-0639	Micro HP arm tool kit.
Base fixing	A-2176-0028	HPRA base fixing kit.
Front cover	A-2197-0006	RP3 probe front cover kit.
TSI 2-C	A-2176-1152	TSI 2-C interface unit with DIN rail mounting.
TSI 2	A-2176-0010	TSI 2 interface unit with DIN rail mounting.
RP3 probe	A-2197-0004	RP3 probe assembly.
Rear exit base	A-2176-0443	HPRA rear exit base assembly (3 m cable).
Stand	A-2176-0019	HPRA stand base assembly.
Publications. These can be downloaded from our website at **www.renishaw.com**.		
HPRA	H-2000-5124	Installation and user's guide: HPRA high-precision removable arm.
RP3	H-2000-5187	User guide: RP3 probe.
Software list	H-2000-2298	Data sheet: Probe software for machine tools – programs and features.

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