

Styli recommendations for on-machine scanning probes

Introduction

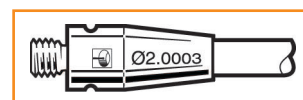
Standard Renishaw styli are well suited for touch-trigger applications. During scanning, where measurements require higher probe deflections, the likelihood of the stylus stem contacting the component increases. To address this, Renishaw has developed a range of narrow-stem styli with precisely controlled squareness tolerances which reduce the risk of the stylus fouling against a vertical face when scanning. We recommend the use of narrow-stem styli for all on-machine scanning applications.

Styli for probes with SPRINT™ technology

Probes incorporating SPRINT™ technology deliver optimal performance when used with ceramic styli.

SPRINT-specific styli are available in two ranges: the SPRINT standard range, suitable for most applications, and the SPRINT calibrated range, designed for the most demanding applications.

The ball on each SPRINT calibrated stylus is measured and UKAS certified. The exact ball diameter is engraved onto the stylus holder, allowing this value to be applied during probe calibration as an absolute reference.



Both ranges feature design enhancements that deliver improved metrology performance in machine tool-based scanning applications.

Styli for probes with RENGAGE™ technology

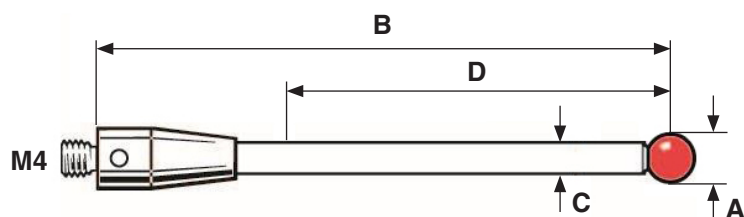
Probes incorporating RENGAGE™ technology deliver optimal performance when used with carbon fibre styli. These styli are suitable for 3D touch trigger measurement and 2D (XY) scanning applications.

Surface finish stylus

Capability of the RMP400S includes surface finish verification. Using specially designed disc styli roughness measurement to Ra 0.5 µm is possible.

Optionally, surface finish styli can be fitted with a short M2 stylus. This provides a single stylus solution for applications combining touch-trigger, scanning, and surface finish verification.

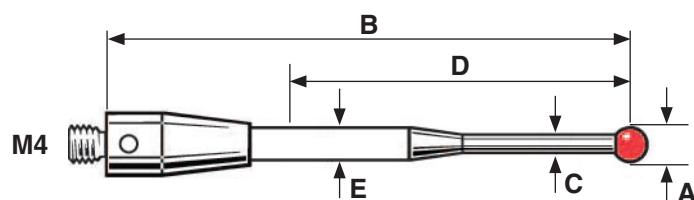
Recommended SPRINT styli (ceramic stems): 6 mm ball diameter



Part number	Ball material	A: ball diameter mm (in)	B: length mm (in)	C: stem diameter mm (in)	D: ESWL ¹ mm (in)	Mass g (oz)
Standard range						
A-5004-4472	Ruby	6.0 (0.24)	100.0 (3.94)	3.8 (0.15)	62.9 (2.48)	6.5 (0.23)
A-5004-4474	Ruby	6.0 (0.24)	150.0 (5.91)	3.8 (0.15)	71.5 (2.81)	8.0 (0.28)
A-5004-6470	Silicon nitride	6.0 (0.24)	100.0 (3.94)	3.8 (0.15)	62.9 (2.48)	6.5 (0.23)
A-5004-6471	Silicon nitride	6.0 (0.24)	150.0 (5.91)	3.8 (0.15)	71.5 (2.81)	8.0 (0.28)
Calibrated range						
A-5465-8576	Ruby	6.0 (0.24)	100.0 (3.94)	3.8 (0.15)	62.9 (2.48)	6.5 (0.23)
A-5465-8577	Ruby	6.0 (0.24)	150.0 (5.91)	3.8 (0.15)	71.5 (2.81)	8.0 (0.28)
A-5465-5008	Silicon nitride	6.0 (0.24)	100.0 (3.94)	3.8 (0.15)	62.9 (2.48)	6.5 (0.23)
A-5465-5009	Silicon nitride	6.0 (0.24)	150.0 (5.91)	3.8 (0.15)	71.5 (2.81)	8.0 (0.28)

¹ ESWL = Effective Scanning Working Length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection.

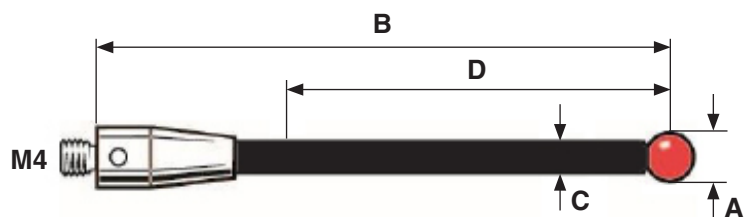
**Recommended SPRINT styli (ceramic and tungsten carbide stems):
2 mm to 4 mm ball diameter**



Part number	Ball material	A: ball diameter mm (in)	B: length mm (in)	C: stem diameter mm (in)	D: ESWL ¹ mm (in)	E: stem diameter mm (in)	Mass g (oz)
Standard range							
A-5004-6463	Ruby	2.0 (0.08)	80.0 (3.15)	1.5 (0.06)	10.7 (0.42)	3.8 (0.15)	5.9 (0.21)
A-5004-6464	Ruby	3.0 (0.12)	100.0 (3.94)	2.0 (0.08)	27.0 (1.06)	3.8 (0.15)	7.4 (0.26)
A-5004-6465	Ruby	4.0 (0.16)	100.0 (3.94)	2.0 (0.08)	42.6 (1.68)	3.8 (0.15)	7.4 (0.26)
A-5004-6467	Silicon nitride	2.0 (0.08)	80.0 (3.15)	1.5 (0.06)	10.7 (0.42)	3.8 (0.15)	5.9 (0.21)
A-5004-6468	Silicon nitride	3.0 (0.12)	100.0 (3.94)	2.0 (0.08)	27.0 (1.06)	3.8 (0.15)	7.4 (0.26)
A-5004-6469	Silicon nitride	4.0 (0.16)	100.0 (3.94)	2.0 (0.08)	42.6 (1.68)	3.8 (0.15)	7.4 (0.26)
Calibrated range							
A-5465-5001	Ruby	2.0 (0.08)	80.0 (3.15)	1.5 (0.06)	10.7 (0.42)	3.8 (0.15)	5.9 (0.21)
A-5465-5002	Ruby	3.0 (0.12)	100.0 (3.94)	2.0 (0.08)	27.0 (1.06)	3.8 (0.15)	7.4 (0.26)
A-5465-5003	Ruby	4.0 (0.16)	100.0 (3.94)	2.0 (0.08)	42.6 (1.68)	3.8 (0.15)	7.4 (0.26)
A-5465-5005	Silicon nitride	2.0 (0.08)	80.0 (3.15)	1.5 (0.06)	10.7 (0.42)	3.8 (0.15)	5.9 (0.21)
A-5465-5006	Silicon nitride	3.0 (0.12)	100.0 (3.94)	2.0 (0.08)	27.0 (1.06)	3.8 (0.15)	7.4 (0.26)
A-5465-5007	Silicon nitride	4.0 (0.16)	100.0 (3.94)	2.0 (0.08)	42.6 (1.68)	3.8 (0.15)	7.4 (0.26)

¹ ESWL = Effective Scanning Working Length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection.

Recommended RENGAGE styli (carbon fibre stems): 6 mm ball diameter



Part number	Ball material	A: ball diameter mm (in)	B: length mm (in)	C: stem diameter mm (in)	D: EWL ¹ mm (in)	ESWL ² mm (in)	Mass g (oz)
Narrow stem							
A-6560-5180	Ruby	6.0 (0.24)	50.0 (1.97)	3.5 (0.14)	33.5 (1.32)	33.5 (1.32)	3.9 (0.14)
A-6560-5181	Ruby	6.0 (0.24)	100.0 (3.94)	3.5 (0.14)	83.5 (3.29)	69.8 (1.66)	4.7 (0.17)
A-6560-5552	Silicon nitride	6.0 (0.24)	50.0 (1.97)	3.5 (0.14)	33.5 (1.32)	33.5 (1.32)	3.9 (0.14)
A-6560-5553	Silicon nitride	6.0 (0.24)	100.0 (3.94)	3.5 (0.14)	83.5 (3.29)	69.8 (1.66)	4.7 (0.17)
Standard stem							
A-5003-7306	Ruby	6.0 (0.24)	50.0 (1.97)	4.5 (0.18)	38.5 (1.52)	33.5 (1.32)	4.1 (0.14)
A-5003-6510	Ruby	6.0 (0.24)	100.0 (3.94)	4.5 (0.18)	88.5 (3.48)	42.2 (1.66)	6.2 (0.22)
A-5003-5730	Silicon nitride	6.0 (0.24)	50.0 (1.97)	4.5 (0.18)	38.5 (1.52)	33.5 (1.32)	4.1 (0.14)
A-5003-5731	Silicon nitride	6.0 (0.24)	100.0 (3.94)	4.5 (0.18)	88.5 (3.48)	42.2 (1.66)	6.2 (0.22)

¹ EWL = Effective working length, measured from the centre of the ball to the point at which the stem will foul against the feature when measuring 'normal' to the part. Applicable for touch-trigger measurement.

² ESWL = Effective scanning working length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection (0.55 mm (0.022 in) for a 50 mm stylus; 1.05 mm (0.041 in) for a 100 mm stylus). Applicable for scanning measurement.

Recommended RENGAGE styli: surface finish



Part number	Disc material	A: disc tip radius µm (µin)	Disc diameter mm (in)	B: length mm (in)	C: stem diameter mm (in)	ESWL mm (in) ¹	Mass g (oz)
A-6970-0015	Tungsten carbide	5 (0.20)	6.2 (0.24)	100 (3.94)	3.5 (0.14)	83 (3.27)	5.8 (0.2)
A-6970-0010	Zirconia	10 (0.40)	6.2 (0.24)	100 (3.94)	3.5 (0.14)	83 (3.27)	5.8 (0.2)

¹ ESWL = Effective scanning working length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection of 0.105 mm (0.004 in).

M2 styli for use with surface finish styli

Optionally, surface finish styli can be fitted with a short M2 stylus. This provides a single stylus solution for applications combining touch-trigger, scanning, and surface finish verification.

With this configuration, ESWL depends on the length of the M2 stylus.

Considerations when selecting the M2 stylus

- Minimise overall stylus mass.
- The ball diameter must be smaller than 6 mm (0.24 in) to provide adequate clearance for surface scanning with the disc.
- Ensure an adequate ESWL for your application.



Part number	Ball material	A: ball diameter mm (in) ¹	B: M2 stylus length mm (in) ²	C: M2 stylus diameter mm (in)	ESWL mm (in) ³	Mass g (oz)
A-5000-7803	Ruby	2.5 (0.10)	10.0 (0.40)	1.0 (0.04)	6.3 (0.25)	0.3 (0.01)
A-5000-4161	Ruby	4.0 (0.16)	20.0 (0.79)	1.5 (0.06)	20 (0.79)	0.6 (0.02)
A-5003-4781	Ruby	5.0 (0.2)	30.0 (1.19)	3.0 (0.12)	30 (1.18)	0.79 (0.03)
A-5003-2286	Ruby	5.0 (0.2)	50.0 (1.97)	3.0 (0.12)	50 (1.97)	1.1 (0.4)
A-5004-1920	Silicon nitride	2.5 (0.10)	10.0 (0.40)	1.0 (0.04)	6.3 (0.25)	0.3 (0.01)
A-5004-0236	Silicon nitride	4.0 (0.16)	20.0 (0.79)	1.5 (0.06)	20 (0.79)	0.6 (0.02)
A-5004-1956	Silicon nitride	5.0 (0.2)	30.0 (1.19)	3.0 (0.12)	30 (1.18)	0.79 (0.03)
A-5004-1971	Silicon nitride	5.0 (0.2)	50.0 (1.97)	3.0 (0.12)	50 (1.97)	1.1 (0.4)

¹ Maximum recommended M2 stylus ball diameter is 5 mm (0.2 in).

² Maximum recommended M2 stylus length is 50 mm (1.97 in).

³ ESWL = Effective scanning working length, measured from the centre of the ball to the point at which the stem will foul against a vertical face when at the maximum scanning deflection of 1.05 mm (0.041 in). Applicable for scanning applications only.

Notes on stylus selection

Renishaw recommend the use of narrow-stem styli for all scanning applications. Using standard M4 styli restricts the effective scanning working length (ESWL).

What is ESWL?

ESWL is the distance from the stylus ball centre to the point where the probe stem fouls a vertical face when at its maximum scanning deflection. ESWL is crucial when scanning in deep features like engine cylinders.

How is ESWL calculated?

The following factors define the ESWL of a stylus:

- A combination of the manufacturing tolerances of the probe and the stylus.
- The maximum scanning deflection.
- The stylus length, ball and stem diameter.

Stylus ball material

The material being scanned dictates the stylus ball material to be used.

- **Ruby.** Ruby is the optimum stylus ball material for most measurement applications, offering exceptional surface smoothness, great compressive strength, and a high resistance to mechanical corrosion. Renishaw recommend ruby stylus balls for most probing applications with the exception of scanning aluminium (due to adhesive wear; a build up of aluminium from the component surface that accumulates on the ball surface), and scanning cast iron (due to abrasive wear).
- **Silicon nitride.** Silicon nitride is an extremely hard and wear-resistant ceramic. Renishaw recommend silicon nitride stylus balls when scanning aluminium, and titanium alloys with coolant. Avoid using silicon nitride balls when scanning steel surfaces due to abrasive wear.

Stylus ball size

Use the largest stylus ball size consistent with the component features (smaller balls are best for smaller features). This maximises the ball/stem clearance, which reduces the chance of fouling on the stylus stem. Renishaw recommend narrow-stem styli for all scanning applications. If your application requires a stylus outside this range, a standard stylus with a ball diameter of up to 8 mm (0.31 in) is permissible. Alternatively, contact your local Renishaw distributor.

Stylus ball sphericity

Renishaw use Grade 5 stylus balls with a sphericity of 0.13 μm (5 μin).

Stylus stem length

Use stylus lengths of 80 mm to 150 mm (3.15 in to 5.91 in) with SPRINT technology probes.

Use stylus lengths of 50 mm to 100 mm (1.96 in to 3.94 in) with RENGAGE technology probes.

If your application requires a stylus outside this range, contact your local Renishaw distributor.

Stylus stem assembly

Minimise the number of joints/linkages in the stylus stem. Every joint introduces potential bending and deflection points. Narrow-stem styli contain the minimum number of constituent parts.

Stylus stem material

Stylus stems use materials chosen for their optimal stiffness, low mass, and thermal stability. These properties help maximise both rigidity and ESWL.

Renishaw recommend the use of ceramic styli with SPRINT technology probes.

Renishaw recommend the use of carbon fibre styli with RENGAGE technology probes. All RMP400S performance specifications are based on the use of carbon fibre styli.

Stylus stem type

Only use straight stem styli. Do not use star, disc, or cylinder styli for scanning applications.

Custom design service

If your objectives cannot be achieved using our recommended scanning styli, Renishaw can provide a custom solution for your scanning application. Our Styli and Fixturing Products Division has supplied over 5,000 unique custom styli into probing applications worldwide. For advice and further details contact your local Renishaw distributor. Always use genuine Renishaw styli to avoid compromising your probe performance.

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