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PRODUCT BULLETIN – PBC1319

Product:	SP25M	Status:	Open
Title:	SP25M – New SH25#A stylus holders and stylus carrying capability update.	Date:	19/03/09

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Summary: This bulletin supersedes PBC790 and PBC790-2

Since the launch of SP25M the probe has been further developed as part of Renishaw's ongoing continuous improvement programme.

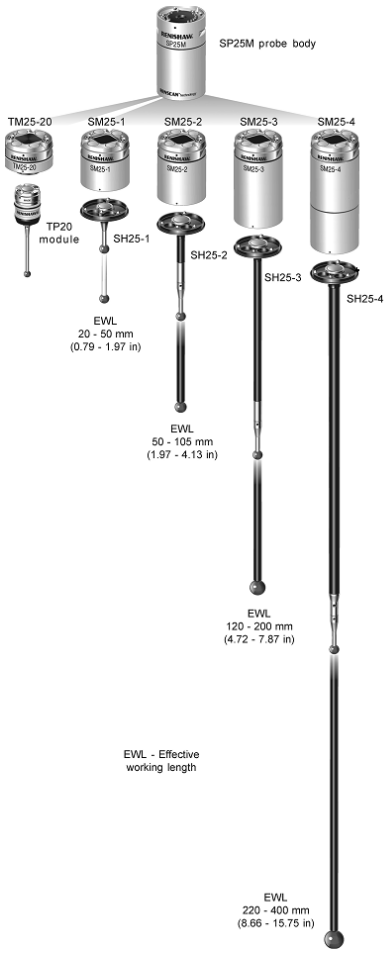
This bulletin introduces the SH25-#A range of stylus holder – specifically designed to meet the challenges posed by cranked or non-straight stylus arrangements.

It also sets out the revised stylus carrying capability of the SP25M compact scanning probe and provides examples of typical test results from trials conducted by Renishaw.

SP25M gives exceptional scanning performance over its entire stylus length range. This has been achieved by use of a dedicated set of scanning modules (SM25-1/2/3/4), each optimised to carry a specific stylus length range whilst maintaining a low contact force band and maximised sensor performance.

The patented innovative design approach has enabled SP25M to successfully counter the loss of scanning system performance traditionally encountered as stylus length increases. It is very important to adhere to the stylus carrying recommendations given within this bulletin.

For all configurations the use of Renishaw's range of M3 styli and accessories is recommended.



Using straight styli

Referring to the illustration shown on page 1, it can be seen that straight styli are mounted directly to the relevant stylus holder (SH25-#) via the M3 thread. Note that the SH25-2/3/4 and the SH25-2A/3A/4A stylus holders have fixed extension stems and therefore only require styli of relatively short length to achieve a longer effective stylus reach.

The four scanning modules (SM25-1/2/3/4) are designed to achieve maximum performance when using straight styli. The stylus carrying capability and typical test results are shown in the following tables. Please refer to the Renishaw stylus catalogue for stylus mass.

Table 1: SP25M – straight stylus carrying capability

Module/Stylus Holder	SM25-1 / SH25-1	SM25-2 / SH25-2	SM25-3 / SH25-3	SM25-4/SH25-4
Effective stylus reach (by using these stylus lengths)	20 mm – 50 mm (20 mm – 50 mm)	50 mm – 105 mm (20 mm – 75 mm)	120 mm – 200 mm (20 mm – 100 mm)	220 mm – 400 mm (20 mm -200 mm)
Maximum permissible stylus length vs (mass)	20 mm (7 g) * 30 mm (10 g) 40 mm (13 g) 50 mm (14 g) *	20 mm (3 g) * 40 mm (8 g) 50 mm (10 g) 75 mm (11 g) *	20 mm (9 g) * 50 mm (10 g) 75 mm (15 g) 100 mm (15 g) *	20 mm (7 g) * 100 mm (8 g) 150 mm (9 g) 200 mm (9 g) *
Max operating stylus tip deflection for above in any orientation	0.5 mm	0.5 mm	0.5 mm	0.5mm

* Representative test results for these configurations is shown in the tables below

The new SH25-#A stylus holders have a different centre of gravity and are slightly heavier. As a result the stylus carrying capability differs slightly from the original standard SH25 stylus holders as shown in the table below.

Table 2: SP25M – SH25-#A– straight stylus carrying capability

Module/Stylus Holder	SM25-2 / SH25-2A	SM25-3 / SH25-3A	SM25-4/SH25-4A
Effective stylus reach (by using these stylus lengths)	50 mm – 105 mm (20 mm – 75 mm)	120 mm – 200 mm (20 mm – 100 mm)	220 mm – 400 mm (20 mm -200 mm)
Maximum permissible stylus length vs (mass)	20 mm (2.5 g) 40 mm (7.5 g) 50 mm (9.5 g) 75 mm (10.5 g)	20 mm (8 g) 50 mm (9 g) 75 mm (10 g) 100 mm (10 g)	20 mm (7.5 g) 100 mm (8.5 g) 150 mm (9 g) 200 mm (9 g)
Max operating stylus tip deflection for above in any orientation	0.5 mm	0.5 mm	0.5mm

Using straight styli - continued

For all of the data that details straight stylus carrying capability the standard range of stylus holders has been used. Wherever possible use a straight stylus with a motorised indexing head rather than a cranked configuration to achieve the best metrology.

Table 3: SP25M – straight stylus performance summary - ISO 10360 Pt2 test

Scan Module	Effective stylus reach	Actual M3 stylus used: Length / Tip ∅ / Stem Material	Radius Error	RMS	SPAN
SM25-1	21 mm	21mm / ∅4 mm / SS	–0.09 μm	0.15 μm	0.6 μm
SM25-1	50 mm	50 mm / ∅5 mm / CER	-0.09 μm	0.11 μm	0.4 μm
SM25-2	51 mm	21mm / ∅4 mm / SS	-0.4 μm	0.15 μm	0.6 μm
SM25-2	105 mm	75 mm / ∅6 mm / GF	-0.26 μm	0.13 μm	0.5 μm
SM25-3	121 mm	21mm / ∅4 mm / SS	-0.44 μm	0.14 μm	0.5 μm
SM25-3	200 mm	100 mm / ∅6 mm / GF	-0.19 μm	0.24 μm	0.9 μm
SM25-4	221 mm	21mm / ∅5 mm / SS	0.1 μm	0.34 μm	1.3 μm
SM25-4	400 mm	200mm / ∅8 mm / GF	0.4 μm	0.42 μm	1.8 μm

Table 4: SP25M - straight stylus performance summary - ISO 10360 Pt4 test

Scan Module	Effective stylus reach	Actual M3 stylus used: Length / Tip ∅ / Stem Material	ISO Tij data		ISO Diff data		Stylus tip deflection	Time taken
			Raw	Filtered	Raw	Filtered		
SM25-1	21 mm	21mm / ∅4 mm / SS	1.4 μm	0.9 μm	0.8 μm	0.5 μm	0.2 mm	1’ 07”
SM25-1	50 mm	50 mm / ∅5 mm / CER	1.5 μm	0.7 μm	0.8 μm	0.4 μm	0.2 mm	1’ 08”
SM25-2	51 mm	21mm / ∅4 mm / SS	1.5 μm	0.9 μm	0.8 μm	0.5 μm	0.2 mm	1’ 07”
SM25-2	105 mm	75 mm / ∅6 mm / GF	1.6 μm	0.9 μm	0.9 μm	0.5 μm	0.2 mm	1’ 14”
SM25-3	121 mm	21mm / ∅4 mm / SS	1.9 μm	1.1 μm	1.0 μm	0.6 μm	0.2 mm	1’ 07”
SM25-3	200 mm	100 mm / ∅6 mm / GF	3.2 μm	1.6 μm	2.1 μm	1.0 μm	0.2 mm	1’ 16”
SM25-4	221 mm	21mm / ∅5 mm / SS	2.8 μm	1.7 μm	1.5 μm	0.9 μm	0.2 mm	1’ 14”
SM25-4	400 mm	200mm / ∅8 mm / GF	6.4 μm	3.5 μm	3.7 μm	0.9 μm	0.2 mm	1’ 17”

Table 5: SP25M - straight stylus performance summary - <u>Bi-directional</u> ring gauge scan test

Scan Module	Effective stylus reach	Actual M3 stylus used: Length / Tip ∅ / Stem Material	RMS data		SPAN data		Stylus tip deflection	Raw data pts
			Raw	Filtered	Raw	Filtered		
SM25-1	21 mm	21mm / ∅4 mm / SS	0.23 μm	0.19 μm	1.5 μm	0.9 μm	0.35 mm	2857
SM25-1	50 mm	50 mm / ∅5 mm / CER	0.24 μm	0.17 μm	1.5 μm	0.9 μm	0.2 mm	2794
SM25-2	51 mm	21mm / ∅4 mm / SS	0.24 μm	0.21 μm	1.6 μm	1.2 μm	0.2 mm	2858
SM25-2	105 mm	75 mm / ∅6 mm / GF	0.24 μm	0.18 μm	2.0 μm	1.1 μm	0.2 mm	2609
SM25-3	121 mm	21mm / ∅4 mm / SS	0.38 μm	0.2 μm	2.2 μm	1.3 μm	0.2 mm	2857
SM25-3	200 mm	100 mm / ∅6 mm / GF	0.38 μm	0.27 μm	4.1 μm	1.7 μm	0.2 mm	2484
SM25-4	221 mm	21 mm / ∅5 mm / SS	0.40 μm	0.30 μm	3.0 μm	1.7 μm	0.2 mm	2462
SM25-4	400 mm	200 mm / ∅8 mm / GF	0.80 μm	0.50 μm	5.7 μm	2.7 μm	0.2 mm	2388

SS – Stainless Steel CER – Ceramic GF – Carbon Fibre

Using cranked (non straight) styli

Whilst the SP25M can carry cranked (non straight) styli configurations when using SM25-1/2/3/4 scanning modules and the original standard stylus holders (SH25-1/2/3/4) but for optimum metrology and where larger offsets are required Renishaw recommends the new SH25-2A/3A/4A range of stylus holders.

For SH25-1/2/2A it is mandatory that a 20mm or longer (M3) extension be used between the stylus holder and the crank centre to give the correct 'crank down' distance from the stylus holder to the crank centre. When using SH25-3/4/3A/4A the crank centre may be mounted directly to the stylus holder or an (M3) extension may be used between the stylus holder and the crank centre. For all modules SM25-1/2/3/4, if desired, a straight 'down' stylus can be added to the crank centre to continue the projection 'down' from the stylus holder (providing always that the maximum overall stylus length and mass, as applicable to the relevant module, is not exceeded). (See fig 1)

For 3D scanning with SM25-1/2 the maximum 'crank out' distance is 28 mm and is measured from the cranked (non straight) stylus tip to the centre of crank centre. For 3D scanning with SM25-3/4 the maximum 'crank out' distance is 58mm. (See fig 1)

Multiple crank styli may be used, providing the recommended overall mass of the crank centre together with its cranked styli is not exceeded (See Table 6).

Please refer to Renishaw's stylus catalogue for full details of crank and star stylus configurations that are available. It is recommended that a 'one piece' star stylus be used wherever possible to help minimise mass. However, greater flexibility is possible by configuring a crank centre together with one or more cranked styli.

Note

No SH25-#A is required for the use of cranked styli with an SM25-1 as there is no carbon fibre stem.

For all of the data that details cranked stylus carrying capability the -#A range of stylus holders has been used with the exception of SM25-1.

Using cranked (non-straight) styli – Stylus carrying capability

Table 6: SP25M – cranked (non-straight) stylus carrying capability

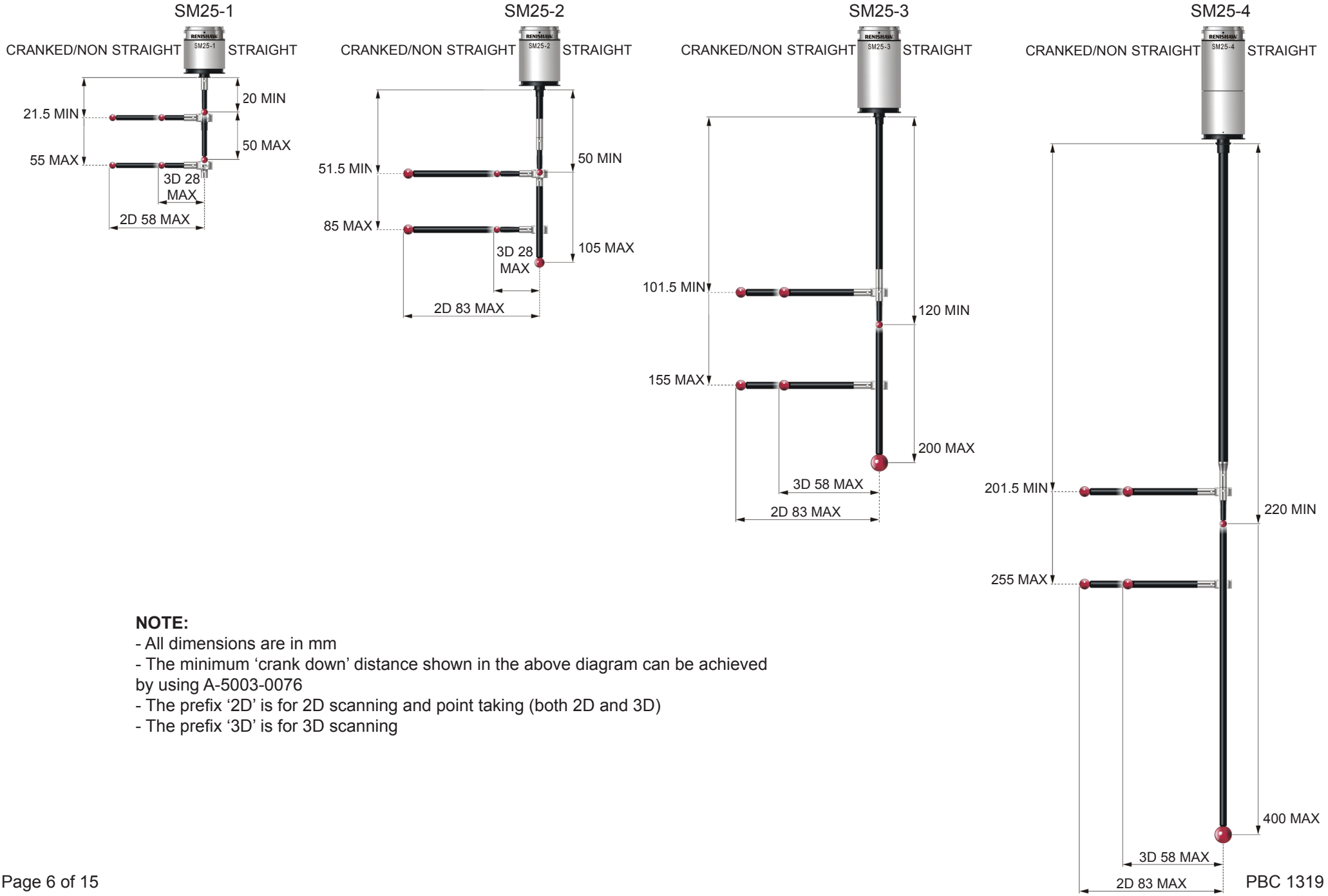
Module / Stylus Holder	'Crank down' distance using a extension * between the stylus holder and the crank centre.	3D Scanning Maximum 'crank out' distance when measured to tip of crank (star) stylus	2D Scanning and Point Taking Maximum 'crank out' distance when measured to tip of crank (star) stylus	Maximum 'down' stylus (same as 'effective stylus reach' – see straight styli above)	Maximum permissible mass of crank (star) centre plus all styli	Max operating stylus tip deflection for above in any orientation
SM25-1 / SH25-1	25 mm **	28 mm **	58 mm **	50 mm	9 g ***	0.4 mm
SM25-1 / SH25-1	55 mm **	28 mm **	58 mm **	50 mm	9 g ****	0.4 mm
SM25-2 / SH25-2	55 mm	28 mm	83 mm	105 mm	6 g ***	0.4 mm
SM25-2 / SH25-2	85 mm	28 mm	83 mm	105 mm	7 g ****	0.4 mm
SM25-2 / SH25-2A	55 mm **	28 mm **	83 mm **	105 mm	6 g ***	0.4 mm
SM25-2 / SH25-2A	85 mm **	28 mm **	83 mm **	105 mm	7 g ****	0.4 mm
SM25-3 / SH25-3	105 mm	58 mm	83 mm	200 mm	13 g	0.4 mm
SM25-3 / SH25-3	125 mm	58 mm	83 mm	200 mm	12 g ***	0.4 mm
SM25-3 / SH25-3	155 mm	58 mm	83 mm	200 mm	11 g ****	0.4 mm
SM25-3 / SH25-3A	105 mm	58 mm	83 mm	200 mm	12 g	0.4 mm
SM25-3 / SH25-3A	125 mm	58 mm	83 mm	200 mm	11 g ***	0.4 mm
SM25-3 / SH25-3A	155 mm **	58 mm	83 mm **	200 mm	10 g ****	0.4 mm
SM25-4 / SH25-4	205 mm	58 mm	83 mm	400 mm	11 g	0.4 mm
SM25-4 / SH25-4	225 mm	58 mm	83 mm	400 mm	10 g ***	0.4 mm
SM25-4 / SH25-4	255 mm	58 mm	83 mm	400 mm	8g ****	0.4 mm
SM25-4 / SH25-4A	205 mm	58 mm	83 mm	400 mm	11 g	0.4 mm
SM25-4 / SH25-4A	225 mm **	58 mm	83 mm **	400 mm	10 g ***	0.4 mm
SM25-4 / SH25-4A	255 mm	58 mm	83 mm	400 mm	8g ****	0.4 mm

* For example, use part number M-5000-3592 (20 mm long x M3 stainless steel extension)

** Representative test results for these configurations is shown in the tables below

*** This excludes the mass of the 20 mm extension **** This excludes the mass of the 50 mm extension

Fig 1. Stylus carrying combinations



NOTE:
- All dimensions are in mm
- The minimum 'crank down' distance shown in the above diagram can be achieved by using A-5003-0076
- The prefix '2D' is for 2D scanning and point taking (both 2D and 3D)
- The prefix '3D' is for 3D scanning

Fig 2. ISO 10360-2 Span (µm)

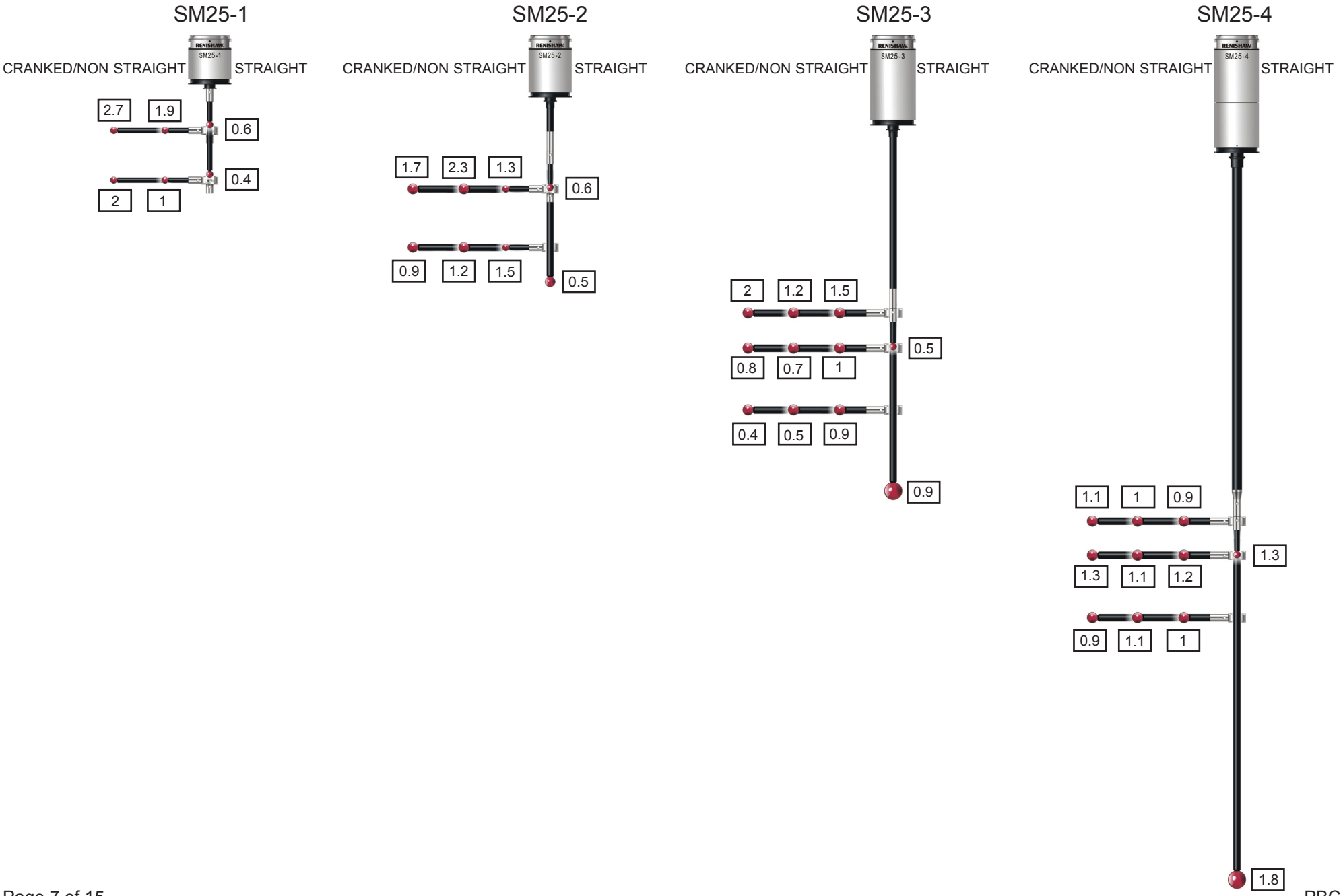


Fig 3. ISO 10360-4 Filtered Tij (60 UPR µm)

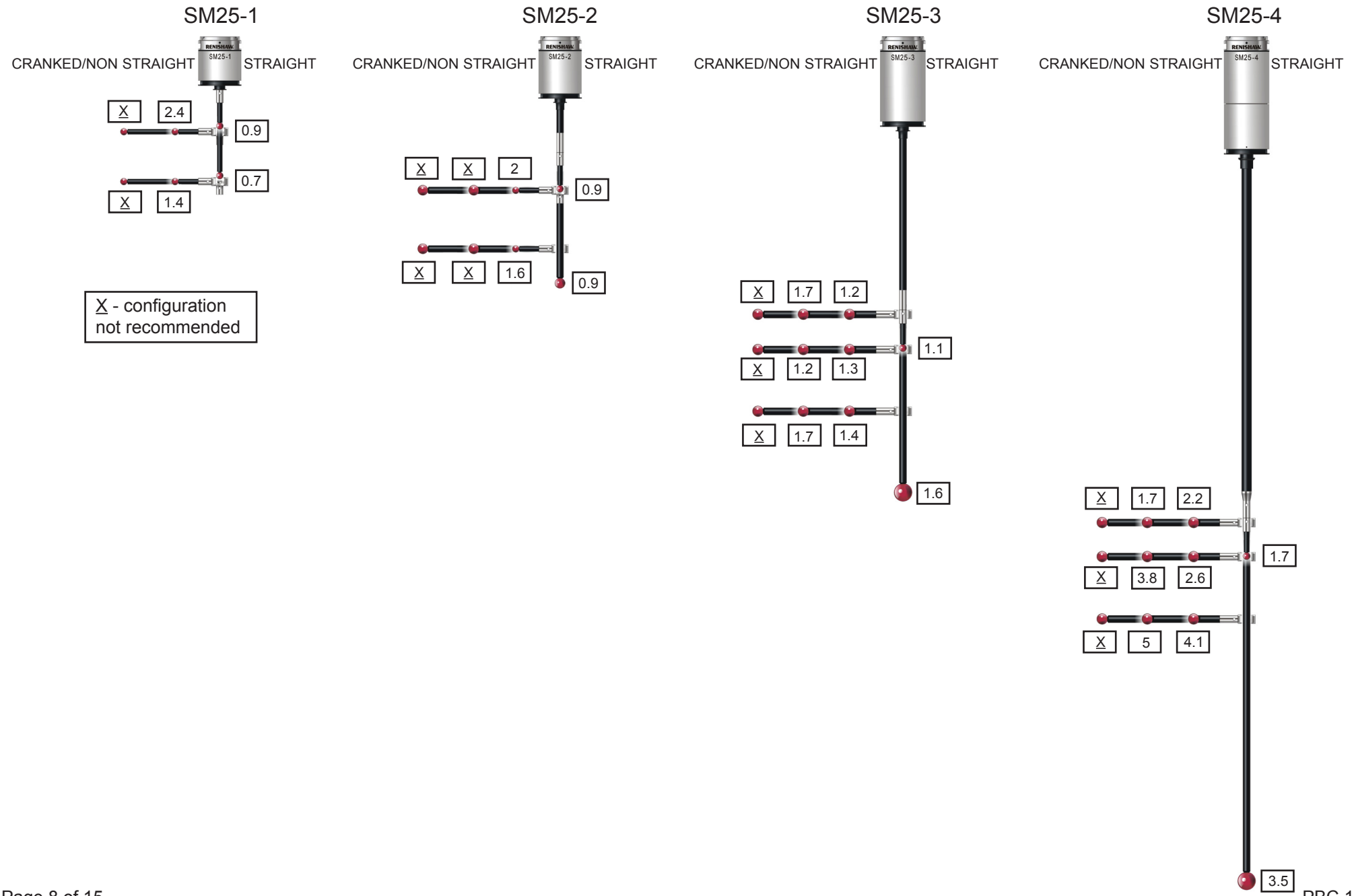
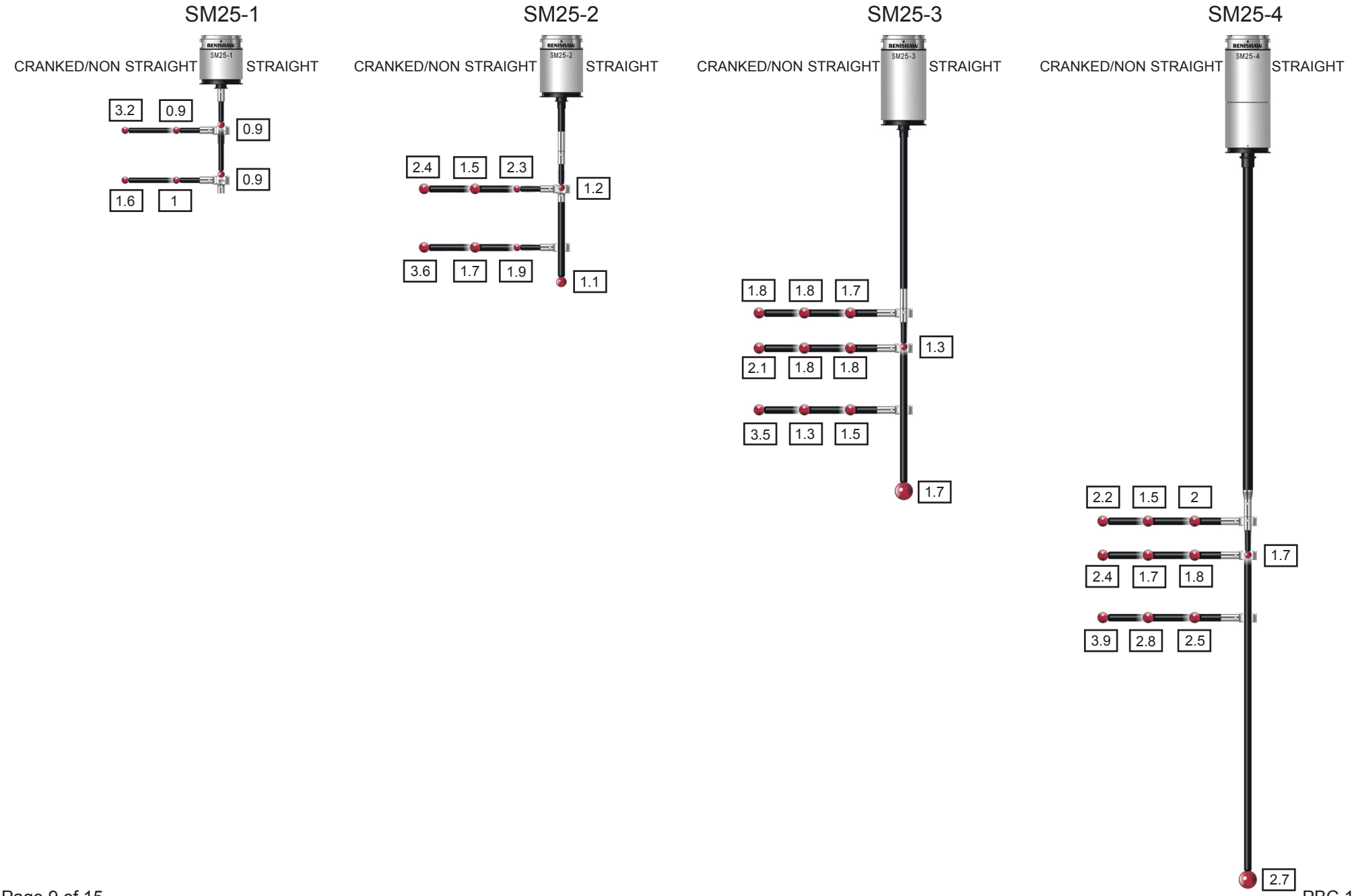


Fig 4. Bi-Directional Ring Gauge Filtered Span (60 UPR µm)



Using cranked (non-straight) styli – SH25-# Metrology compared to SH25-#A

SH25-2A / 3A / 4A have distinct metrology advantages over SH25-2 / 3 / 4 for any stylus arrangement where the stylus holder is subjected to torsional load, for example cranked, knuckle joint and "dog-legged" styli arrangements.

The standard SH25 stylus holders still have advantages over the SH25-#A range particularly for straight styli arrangements where the metrology differences between the two designs are negligible.

For example using straight styli, the smaller diameter of the carbon fibre allows small diameter deep holes to be scanned without the stylus holder "shanking out" on the side of the hole.

The following three tables compare typical metrology performance with the standard SH25-# compared to the SH25-#A range of stylus holders for both straight and cranked stylus configurations.

Table 7: Metrology comparison SH25-2 against SH25-2A - Bi-directional ring gauge scan test

	Straight stylus performance Effective stylus reach 51 mm.			**Cranked stylus performance** Crank down distance 55 mm. Crank out distance 83 mm.		
Stylus Holder	SPAN data		Stylus tip deflection	SPAN data		Stylus tip deflection
	Raw	Filtered		Raw	Filtered	
SH25-2	1.6 μm	1.2 μm	0.2 mm	14.9 μm	5.9 μm	0.35 mm
SH25-2A	1.5 μm	1.1 μm	0.2 mm	4.1 μm	2.4 μm	0.35 mm

Table 8: Metrology comparison SH25-3 against SH25-3A - Bi-directional ring gauge scan test

	Straight stylus performance Effective stylus reach 121 mm.			**Cranked stylus performance** Crank down distance 125 mm. Crank out distance 83 mm.		
Stylus Holder	SPAN data		Stylus tip deflection	SPAN data		Stylus tip deflection
	Raw	Filtered		Raw	Filtered	
SH25-3	2.2 μm	1.3 μm	0.2 mm	11.8 μm	8.2 μm	0.35 mm
SH25-3A	2.5 μm	1.7 μm	0.2 mm	3.5 μm	2.1 μm	0.35 mm

Table 9: Metrology comparison SH25-4 against SH25-4A - Bi-directional ring gauge scan test

	Straight stylus performance Effective stylus reach 221 mm.			**Cranked stylus performance** Crank down distance 225 mm. Crank out distance 83 mm.		
Stylus Holder	SPAN data		Stylus tip deflection	SPAN data		Stylus tip deflection
	Raw	Filtered		Raw	Filtered	
SH25-4	3.0 μm	1.7 μm	0.2 mm	15.7 μm	5 μm	0.35 mm
SH25-4A	3.5 μm	2.4 μm	0.5 mm	5.1 μm	2.4 μm	0.35 mm

Using cranked (non-straight) styli with SH25-#A holders - continued

Table 10: SP25M – cranked (non-straight) stylus performance summary - ISO 10360 Pt2 test					
Scan Module	Crank Configuration	Actual M3 stylus used: Length / Tip ∅ / Stem Material (mounted to crank centre)	Radius Error	RMS	SPAN
SM25-1	25 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.1 µm	0.48 µm	1.9 µm
SM25-1	25 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	–0.04 µm	0.56 µm	2.7 µm
SM25-1	55 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.15 µm	0.21 µm	1 µm
SM25-1	55 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.03 µm	0.34 µm	2 µm
SM25-2	55 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.54 µm	0.38 µm	1.3 µm
SM25-2	55 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.19 µm	0.61 µm	2.3 µm
SM25-2	55 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0.07 µm	0.53 µm	1.7 µm
SM25-2	85 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.35 µm	0.34 µm	1.5 µm
SM25-2	85 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.05 µm	0.23 µm	1.2 µm
SM25-2	85 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0.09 µm	0.25 µm	0.9 µm
SM25-3	105 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.3 µm	0.41 µm	1.5 µm
SM25-3	105 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	-0.23 µm	0.31 µm	1.2 µm
SM25-3	105 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0.66 µm	0.56 µm	2 µm
SM25-3	125 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.14 µm	0.28 µm	1 µm
SM25-3	125 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.12 µm	0.16 µm	0.7 µm
SM25-3	125 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0 µm	0.22 µm	0.8 µm
SM25-3	155 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.28 µm	0.25 µm	0.9 µm
SM25-3	155 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.06 µm	0.15 µm	0.5 µm
SM25-3	155 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0.04 µm	0.1 µm	0.4 µm
SM25-4	205 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.01 µm	0.24 µm	0.9 µm
SM25-4	205 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.19 µm	0.21 µm	1 µm
SM25-4	205 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	-0.11 µm	0.28 µm	1.1 µm
SM25-4	225 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	0.01 µm	0.21 µm	1.2 µm
SM25-4	225 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.18 µm	0.29 µm	1.1 µm
SM25-4	225 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	0.05 µm	0.3 µm	1.3 µm
SM25-4	255 mm ‘down’ 28 mm ‘out’	21mm / ∅4 mm / SS	-0.07 µm	0.25 µm	1 µm
SM25-4	255 mm ‘down’ 57.5 mm ‘out’	50mm / ∅5 mm / CER	0.1 µm	0.34 µm	1.1 µm
SM25-4	255 mm ‘down’ 83 mm ‘out’	75mm / ∅6 mm / GF	-0.1 µm	0.21 µm	0.9 µm

SS – Stainless Steel CER – Ceramic GF – Carbon Fibre

Table 11: SP25M – cranked (non-straight) stylus performance summary - ISO 10360 Pt4 test								
Scan Module	Crank Configuration	Actual M3 stylus used: Length / Tip ∅ / Stem Material (mounted to crank centre)	ISO Tij data		ISO Diff data		Stylus tip deflection	Time taken
			Raw	Filtered	Raw	Filtered		
SM25-1	25 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	3.1 μm	2.4 μm	1.7 μm	1.2 μm	0.2 mm	1’ 11”
SM25-1	55 mm ‘down’ 28mm ‘out’’	21mm / ∅4 mm / SS	4.8 μm	1.4 μm	2.4 μm	0.8 μm	0.2 mm	1’ 09”
SM25-2	55 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	2.5 μm	2 μm	1.5 μm	1.3 μm	0.2 mm	1’ 09”
SM25-2	85 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	2.8 μm	1.6 μm	1.7 μm	1 μm	0.2 mm	1’ 08”
SM25-3	105 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	1.8 μm	1.2 μm	1.2 μm	0.8 μm	0.2 mm	1’ 12”
SM25-3	105 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	2.3 μm	1.7 μm	1.3 μm	1 μm	0.2 mm	1’ 12”
SM25-3	125 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	2.1 μm	1.3 μm	1.2 μm	0.8 μm	0.2 mm	1’ 12”
SM25-3	125 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	2.2 μm	1.2 μm	1.3 μm	0.7 μm	0.2 mm	1’ 11”
SM25-3	155 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	2.7 μm	1.4 μm	1.9 μm	1.2 μm	0.35 mm	1’ 16”
SM25-3	155 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	2.6 μm	1.7 μm	1.7 μm	1.1 μm	0.35 mm	1’ 16”
SM25-4	205 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	3 μm	2.2 μm	1.7 μm	1.3 μm	0.2 mm	1’ 11”
SM25-4	205 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	2.6 μm	1.7 μm	1.8 μm	1.2 μm	0.2 mm	1’ 17”
SM25-4	225 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	3.2 μm	2.6 μm	2.0 μm	1.9 μm	0.2 mm	1’ 16”
SM25-4	225 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	4.6 μm	3.8 μm	3.5 μm	3.2 μm	0.2 mm	1’ 25”
SM25-4	255 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	5 μm	4.1 μm	3 μm	2.6 μm	0.2 mm	1’ 10”
SM25-4	255 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	8.3 μm	5 μm	4.9 μm	2.7 μm	0.2 mm	1’ 10”

SS – Stainless steel CER – Ceramic GF – Carbon Fibre

Using cranked (non-straight) styli - continued

Table 12: SP25M – cranked (non-straight) stylus performance summary - Bi-directional ring gauge scan test

Scan Module	Crank Configuration	Actual M3 stylus used: Length / Tip ∅ / Stem Material (mounted to crank centre)	RMS data		SPAN data		Stylus tip deflection	Raw data pts
			Raw	Filtered	Raw	Filtered		
SM25-1	25 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.26 μm	0.19 μm	1.9 μm	0.9 μm	0.2 mm	2858
SM25-1	25 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.62 μm	0.56 μm	6 μm	3.2 μm	0.2 mm	2794
SM25-1	55 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.28 μm	0.16 μm	3 μm	1 μm	0.2 mm	2868
SM25-1	55 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.36 μm	0.24 μm	4.9 μm	1.6 μm	0.2 mm	2796
SM25-2	55 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.6 μm	0.56 μm	3.1 μm	2.3 μm	0.2 mm	2858
SM25-2	55 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.33 μm	0.26 μm	2.8 μm	1.5 μm	0.2 mm	2857
SM25-2	55 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.55 μm	0.47 μm	4.1 μm	2.4 μm	0.35 mm	2733
SM25-2	85 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.35 μm	0.24 μm	4.5 μm	1.9 μm	0.2 mm	2858
SM25-2	85 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.45 μm	0.36 μm	3 μm	1.7 μm	0.2 mm	2795
SM25-2	85 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.75 μm	0.6 μm	6.1 μm	3.6 μm	0.2 mm	2734
SM25-3	105 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.4 μm	0.35 μm	2.3 μm	1.7 μm	0.2 mm	2858
SM25-3	105 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.44 μm	0.38 μm	2.7 μm	1.8 μm	0.2 mm	2858
SM25-3	105 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.42 μm	0.36 μm	3 μm	1.8 μm	0.2 mm	2733
SM25-3	125 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.47 μm	0.42 μm	2.7 μm	1.8 μm	0.2 mm	2856
SM25-3	125 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.47 μm	0.35 μm	2.7 μm	1.8 μm	0.2 mm	2856
SM25-3	125 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.55 μm	0.46 μm	3.5 μm	2.1 μm	0.35 mm	2732
SM25-3	155 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.38 μm	0.31 μm	2.6 μm	1.5 μm	0.2 mm	2858
SM25-3	155 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.37 μm	0.27 μm	2.9 μm	1.3 μm	0.2 mm	2858
SM25-3	155 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	1.01 μm	0.69 μm	11.8 μm	3.5 μm	0.2 mm	2734
SM25-4	205 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.45 μm	0.38 μm	2.6 μm	2 μm	0.2 mm	1439
SM25-4	205 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.38 μm	0.26 μm	2.5 μm	1.5 μm	0.2 mm	1440
SM25-4	205 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.51 μm	0.34 μm	4.2 μm	2.2 μm	0.2 mm	1376
SM25-4	225 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.41 μm	0.32 μm	2.7 μm	1.8 μm	0.2 mm	1438
SM25-4	225 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.42 μm	0.3 μm	2.6 μm	1.7 μm	0.2 mm	1438
SM25-4	225 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.65 μm	0.48 μm	5.1 μm	2.4 μm	0.35 mm	2731
SM25-4	255 mm ‘down’ 28mm ‘out’	21mm / ∅4 mm / SS	0.67 μm	0.59 μm	3.6 μm	2.5 μm	0.2 mm	2858
SM25-4	255 mm ‘down’ 57.5mm ‘out’	50mm / ∅5 mm / CER	0.69 μm	0.55 μm	5.9 μm	2.8 μm	0.2 mm	2794
SM25-4	255 mm ‘down’ 83mm ‘out’	75mm / ∅6 mm / GF	0.99 μm	0.75 μm	8.5 μm	3.9 μm	0.2 mm	2730

SS – Stainless steel CER – Ceramic GF – Carbon Fibre

Using Disc Styli

The SP25M can carry disc styli using the full range of modules SM25-1/2/3/4.

For SH25-1/2/2A it is mandatory that a 20mm long (M3) extension be used between the stylus holder and the disc stylus (except where the disc has an effective length close to 20mm, for example A-5000-3615).

The disc stylus carrying capability is shown in the below tables.

Table 13: SP25M – SH25-#–disc stylus carrying capability

Module / Stylus Holder	SM25-1 / SH25-1	SM25-2 / SH25-2	SM25-3 / SH25-3	SM25-4/SM25-4
Effective stylus reach (by using these extensions * between the stylus holder and the disc)	20 mm (20mm)	50 mm (20mm)	100 - 150 mm (0 – 50mm)	200 - 250mm (0 – 50mm)
Maximum permissible disc stylus length vs mass	20mm (9 g ***)	20mm (6 g ***)	0mm (13g) 20mm (12 g ***)** 50mm (11 g ****)	0mm (11g) 20mm (10 g ***) 50mm (8 g ****)
Max operating stylus tip deflection for above in any orientation	0.4 mm	0.4 mm	0.4 mm	0.4mm

* For example, use part number M-5000-3592 (20 mm long x M3 stainless steel extension)

** Representative test results for these configurations is shown in the tables below

*** This excludes the mass of the 20 mm extension

**** This excludes the mass of the 50 mm extension

Table 14: SP25M – SH25-#A– disc stylus carrying capability

Module/Stylus Holder	SM25-2 / SH25-2A	SM25-3 / SH25-3A	SM25-4/SH25-4A
Effective stylus reach (by using these extensions * between the stylus holder and the disc)	50 mm (20mm)	100 - 150 mm (0 – 50mm)	100 - 150 mm (0 – 50mm)
Maximum permissible disc stylus length vs mass	20mm (6 g ***)	0mm (12g) 20mm (11 g ***) 50mm (10 g ****)	0mm (11g) 20mm (10 g ***) 50mm (8 g ****)
Max operating stylus tip deflection for above in any orientation	0.4 mm	0.4 mm	0.4mm

* For example, use part number M-5000-3592 (20 mm long x M3 stainless steel extension)

** Representative test results for these configurations is shown in the tables below

*** This excludes the mass of the 20 mm extension

**** This excludes the mass of the 50 mm extension

Table 15: SP25M - disc stylus performance summary - Bi-directional ring gauge scan test								
Scan Module	Effective stylus reach	Actual disc stylus used: Diameter / Material	RMS data		SPAN data		Stylus tip deflection	Data pts
			Raw	Filtered	Raw	Filtered		
SM25-3 (A0)	100 mm	Ø30 mm / CER	0.52 μm	0.5 μm	2.9 μm	2.4 μm	0.2 mm	1244
SM25-3 (A0)	120 mm *	∅35 mm / SS	0.5 μm	0.3 μm	3.7 μm	2.3 μm	0.25 mm	885
SM25-3 (A90)	120 mm *	∅35 mm / SS	0.4 μm	0.3 μm	2.6 μm	1.8 μm	0.25 mm	896
SM25-3 (A0)	150 mm **	Ø30 mm / CER	0.53 μm	0.48 μm	3.6 μm	2.5 μm	0.2 mm	1244
SM25-4 (A0)	200 mm	Ø30 mm / CER	0.77 μm	0.72 μm	4.5 μm	3.5 μm	0.2 mm	1244
SM25-4 (A0)	250 mm **	Ø30 mm / CER	0.77 μm	0.68 μm	4.2 μm	3.1 μm	0.2 mm	1243
* Including the 20 mm extension ** Including the 50 mm extension								

Renishaw has developed a lightweight 30mm diameter disc stylus (A-5003-7098) that will enable two-dimensional scanning with SM25-1/2 scanning modules. Alternatively a 12mm diameter disc stylus (A-5000-3615) is available that can be used with SM25-1/2.

Using Extensions

The SP25M can be used with the PEM25 (25mm), PEM1 (50mm) and PEM2 (100mm) autojoint to autojoint extension bars to extend the effective probe reach. SP25M cannot be used with PEM3 (200mm).

TABLE 16: COMMON CRITERIA FOR TEST RESULTS GIVEN ABOVE	
TEST SITE	RENISHAW UK
STYLI USED	RENISHAW'S M3 STYLUS RANGE
CMM specification	$U^3 = 0.48\ \mu m + L / 1000$
CMM controller	Renishaw's UCC2
Probe calibration	Renishaw's 3rd order polynomial calibration method
Data filter used	Harmonic simple cut off order = 60 UPR (undulation per revolution)
Artefacts used	∅25 mm (nom) Calibration Sphere (for the ISO 10360 Pt2/Pt4 tests) ∅50 mm (nom) Ring Gauge (for the ring gauge scan tests)
Scanning speed	5 mm/s (for the ISO 10360 Pt4 and ring gauge tests)
Touch speed	5 mm/s (for the ISO 10360 Pt2 tests)
Back off speed	1 mm/s (for the ISO 10360 Pt2 tests)
Bi-directional scans	The effect of probe mis-alignment and contact friction will result in radius changes with scanning direction if a suitable calibration procedure is not used. Mechanical hysteresis within a probe mechanism is best demonstrated by a bi-directional scan. Therefore, Renishaw have decided to take the high integrity approach of quoting ring gauge metrology using bi-directional scan data to demonstrate the performance of the Renishaw probe and calibration method