

## Sales Bulletin

**Date:** December 8, 2006

**Number:** 260

**To:** CMM OEM's, OES's, Distributors, CMM Engineers and Regional Sales Managers

**Title:** SP25M stylus carrying capability

This bulletin sets out the 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.

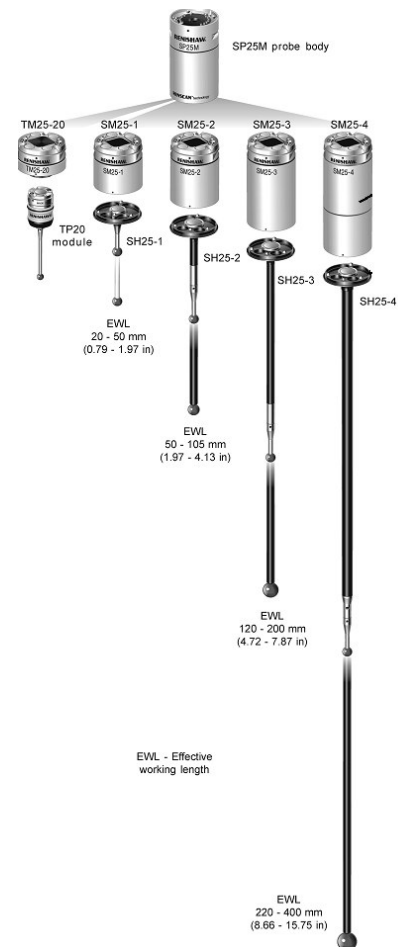
The patented innovative design approach has enabled SP25M to successfully counter the loss of scanning system performance traditionally encountered as stylus length increases. It is therefore very important to adhere to the stylus carrying recommendations given below.

The use of Renishaw's range of M3 styli and accessories is recommended. The range includes several longer styli, with Renishaw Carbon Fibre (Renishaw GF) stems for exceptional performance, as well as kits specifically suited to each of the scanning modules.

### 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 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, is shown in the tables below. Please refer to the Renishaw stylus catalogue for stylus mass.



<b>SP25M - straight stylus carrying capability</b>				
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				

<b>SP25M - straight stylus performance summary - ISO 10360 Pt4 test</b>								
Scan Module	Effective stylus reach	Actual M3 stylus used: Length / Tip Ø / Stem Mat'l	ISO T <sub>ij</sub> data		ISO Diff data		Stylus tip deflection	Time taken
			Raw	Filtered	Raw	Filtered		
SM25-1	21 mm	21mm / Ø3 mm / SS	2.2 µm	1.2 µm	1.3 µm	0.9 µm	0.2 mm	0' 54"
SM25-1	50 mm	50 mm / Ø5 mm / CER	2.6 µm	1.3 µm	1.3 µm	0.7 µm	0.3 mm	0' 57"
SM25-2	105 mm	75 mm / Ø6 mm / GF	2.5 µm	1.8 µm	1.9 µm	1.4 µm	0.3 mm	0' 58"
SM25-3	200 mm	100 mm / Ø6 mm / GF	3.7 µm	2.3 µm	2.9 µm	2.3 µm	0.2 mm	0' 58"
SM25-4	221 mm	21mm / Ø5 mm / SS	2.8µm	1.7 µm	1.5 µm	0.9 µm	0.2 mm	1' 14"
SM25-4	400 mm	200mm / Ø8 mm / GF	6.4 µm	3.5 µm	3.7 µm	0.9 µm	0.2 mm	1' 17"

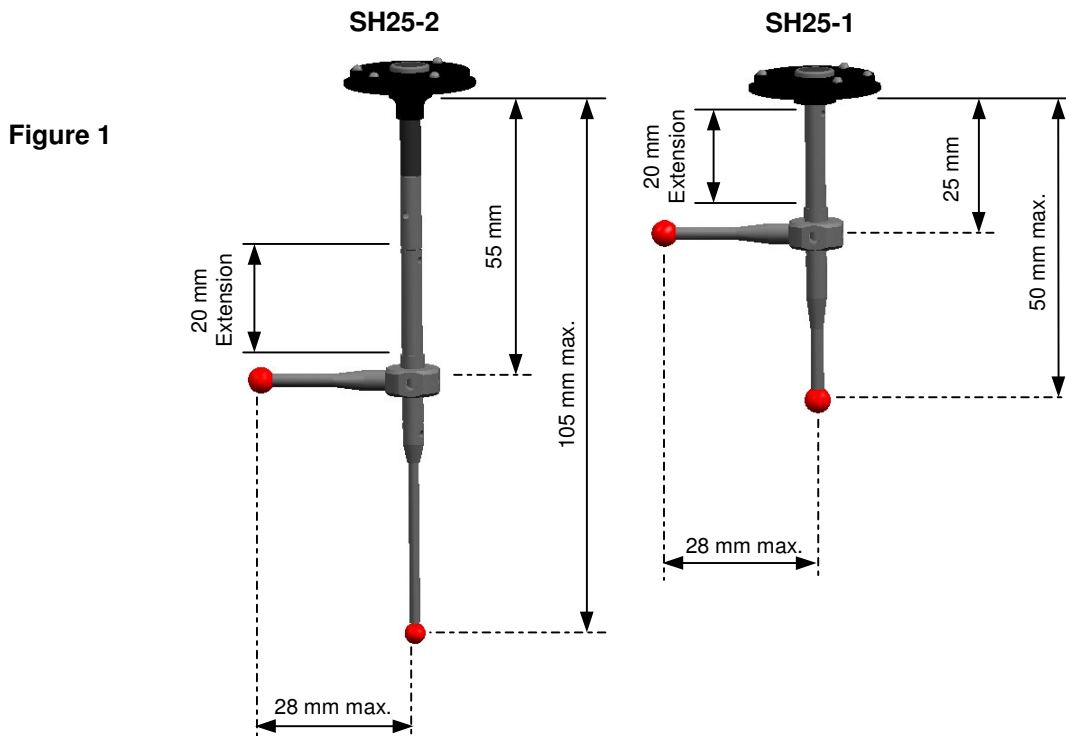
<b>SP25M - straight stylus performance summary - Bi-directional ring gauge scan test</b>								
Scan Module	Effective stylus reach	Actual M3 stylus used: Length / Tip Ø / Stem Mat'l	RMS data		SPAN data		Stylus tip deflection	Raw data pts
			Raw	Filtered	Raw	Filtered		
SM25-1	21 mm	21mm / Ø3 mm / SS	0.24 µm	0.19 µm	1.7 µm	1.0 µm	0.2 mm	954
SM25-1	50 mm	50 mm / Ø5 mm / CER	0.36 µm	0.29 µm	2.0 µm	1.4 µm	0.2 mm	924
SM25-2	105 mm	75 mm / Ø6 mm / GF	0.41 µm	0.34 µm	2.7 µm	1.6 µm	0.3 mm	906
SM25-3	200 mm	100 mm / Ø6 mm / GF	0.43 µm	0.30 µm	3.0 µm	2.0 µm	0.2 mm	904
SM25-4	221 mm	21 mm / Ø5 mm / SS	0.40 µm	0.30 µm	3.0 µm	1.7 µm	0.2 mm	2462
SM25-4	400 mm	200 mm / Ø8 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 (star) styli

The SP25M can carry cranked (star) styli configurations when using SM25-1 and SM25-2 scanning modules only.

It is mandatory that a 20mm long (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. Then, 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, as applicable to the relevant module, is not exceeded).



The maximum 'crank out' distance is 28 mm and is measured from the cranked (star) stylus tip to the centre of crank centre. Figure 1 illustrates the maximum crank styli dimensions described above.

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 below).

Please refer to Renishaw's stylus catalogue for full details of crank and star stylus configurations that are possible. 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.

## Using cranked (star) styli - continued

<b>SP25M – cranked (star) stylus carrying capability</b>				
Module / Stylus Holder	SM25-1 / SH25-1	SM25-2 / SH25-2	SM25-3 / SH25-3	SM25-4 / SH25-4
Mandatory 'crank down' distance by using a 20 mm long extension * between the stylus holder and the crank (disc) centre.	25 mm **	55 mm **	<b>NOT RECOMMENDED</b>	<b>NOT RECOMMENDED</b>
Maximum 'crank out' distance when measured to tip of crank (star) stylus	28 mm **	28 mm **		
Maximum 'down' stylus (same as 'effective stylus reach' - see straight styli above)	50 mm	105 mm		
Maximum permissible mass of crank (star) centre plus all styli	9 g ***	6 g ***		
Max operating stylus tip deflection for above in any orientation	0.4 mm	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 mandatory 20 mm extension				

Please note - test results for cranked styli (shown below) were performed at both A0 and A90 orientations of the probe head, to simulate 'worst case' applications. A single 21 mm long stylus (part number A-5000-7606) was used which was mounted to an M3 star centre (part number A-5000-7610).

<b>SP25M – cranked (star) stylus performance summary - ISO 10360 Pt2 test</b>					
Scan Module (position)	Crank Configuration	Actual M3 stylus used: Length / Tip Ø / Stem Mat'l	Radius Error	RMS	SPAN
SM25-1 (A0)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	-0.3 µm	0.26 µm	1.4 µm
SM25-1 (A90)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	-0.7 µm	0.29 µm	1.3 µm
SM25-2 (A0)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	0.1 µm	0.39 µm	1.5 µm
SM25-2 (A90)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	-0.3 µm	0.65 µm	3.4 µm

## Using cranked (star) styli - continued

SP25M – cranked (star) stylus performance summary - ISO 10360 Pt4 test								
Scan Module (position)	Crank Configuration	Actual M3 stylus used: Length / Tip Ø / Stem Mat'l	ISO T <sub>ij</sub> data		ISO Diff data		Stylus tip deflection	Time taken
			Raw	Filtered	Raw	Filtered		
SM25-1 (A0)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	2.2 µm	1.3 µm	1.2 µm	0.8 µm	0.25 mm	1' 03"
SM25-1 (A90)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	2.5 µm	2 µm	1.5 µm	1.3 µm	0.25 mm	1' 03"
SM25-2 (A0)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	2.2 µm	1.5 µm	1.1 µm	0.8 µm	0.25 mm	1' 03"
SM25-2 (A90)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	3.7 µm	3.1 µm	2.4 µm	2.1 µm	0.25 mm	1' 03"

SP25M – cranked (star) stylus performance summary - Bi-directional ring gauge scan test								
Scan Module (position)	Crank Configuration	Actual M3 stylus used: Length / Tip Ø / Stem Mat'l	RMS data		SPAN data		Stylus tip deflection	Raw data pts
			Raw	Filtered	Raw	Filtered		
SM25-1 (A0)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	0.4 µm	0.3 µm	2.7 µm	1.7 µm	0.25 mm	1550
SM25-1 (A90)	25 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	0.3 µm	0.2 µm	2.3 µm	1.2 µm	0.25 mm	1553
SM25-2 (A0)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	0.4 µm	0.4 µm	2.7 µm	1.9 µm	0.25 mm	1582
SM25-2 (A90)	55 mm 'down'	21mm / Ø4 mm / SS (mounted to crank centre)	0.6 µm	0.5 µm	3.7 µm	2.4 µm	0.25 mm	1580

## Using Disc Styli

The SP25M can carry disc styli using the full range of modules SM25-1/2/3/4. It is mandatory that a 20mm long (M3) extension be used between the stylus holder and the disc stylus. The disc stylus carrying capability is shown in the table below.

<b>SP25M - disc stylus carrying capability</b>				
Module / Stylus Holder	SM25-1 / SH25-1	SM25-2 / SH25-2	SM25-3 / SH25-3	SM25-4/SM25-4
Effective stylus reach (by using a 20 mm long extension * between the stylus holder and the disc)	20 mm	50 mm	120 mm **	220mm
Maximum permissible disc stylus mass	9 g ***	6 g ***	12 g ***	10 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 mandatory 20 mm extension				

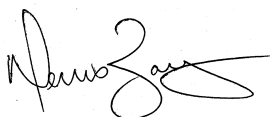
<b>SP25M - disc stylus performance summary - Bi-directional ring gauge scan test</b>								
Scan Module	Effective stylus reach *	Actual disc stylus used: Diameter / Mat'l	RMS data		SPAN data		Stylus tip deflection	Data pts
			Raw	Filtered	Raw	Filtered		
SM25-3 (A0)	120 mm	Ø35 mm / SS	0.5 µm	0.3 µm	3.7 µm	2.3 µm	0.25 mm	885
SM25-3 (A90)	120 mm	Ø35 mm / SS	0.4 µm	0.3 µm	2.6 µm	1.8 µm	0.25 mm	896
* Including the 20 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-5003-5288) is available that can be used with SM25-1/2.

<b>COMMON CRITERIA FOR TEST RESULTS GIVEN ABOVE</b>	
TEST SITE	RENISHAW UK
STYLI USED	RENISHAW'S M3 STYLUS RANGE
CMM specification	$U^3 = 0.48 \mu\text{m} + L / 1000$
CMM controller	Renishaw's UCC1
Probe calibration	Renishaw's 3 <sup>rd</sup> order polynomial calibration method
Data filter used	Harmonic simple cut off order = 60 UPR (undulation per revolution)
Artefacts used	Ø25 mm (nom) Calibration Sphere (for the ISO 10360 Pt2/Pt4 tests) Ø50 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

If you have any questions, please contact Renishaw's CMM Department at: 847-286-9953.

Sincerely,



Denis Zayia  
CMM Business Manager  
Renishaw Inc