

TECHNICAL PAPER

SP80 & SP80H

Ultra-high accuracy
quill mounted scanning probe
with long stylus reach ...



SP80 product overview

Renishaw's SP80 and SP80H quill mounted probes provide **class-leading scanning performance**, as well as the **most flexible use of styli for maximum productivity**.

The SP80 and SP80H (SP80H is the SP80's horizontal mounting option) are passive scanning probes that use digital scale and readhead technology to produce transducer resolution of 0.02 μm , giving the probe exceptional scanning performance even with long styli. The SP80 probe can carry styli up to 800 mm long and 500 g mass, including star configurations which do not require counterbalancing; whereas the SP80H mounts to a horizontal quill and can carry styli up to 500 mm long and 300 g mass, including star configurations.

Rapidly interchangeable stylus holders (SH80) permit deployment of optimised stylus arrangements for each part feature, and their repeatable kinematic mounting to the probe body eliminates the need for re-qualification.

The SP80 probe also has a kinematic mount that provides repeatable connection to the CMM via a mounting plate attached to the CMM's quill, allowing easy removal of the probe. A system of adaptor plates enables SP80 to be easily interchanged with the PH10MQ indexing motorised head – thus bringing multi-sensor capability to the CMM.

SP80 and SP80H are particularly suited to automotive and power train applications where form-measurement of parts having transition fits is necessary. In such cases the features to be measured are often deep, and SP80 probes provide the long reach whilst maintaining the required high accuracy.



Key elements to the ultra-high accuracy performance of both SP80 and SP80H are the compact 'box spring' motion system and the incorporation of Renishaw's 'isolated optical metrology' transducer design, which will be explained in more detail in the 'key innovations' section.

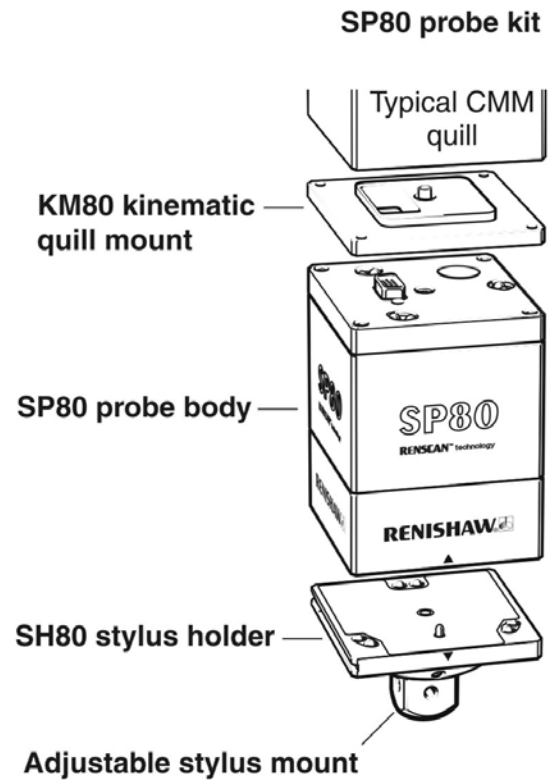
High productivity is of prime importance in today's competitive environment. The SP80 system includes a flexible change rack arrangement with stylus change ports (SCP80) mounted to the Renishaw modular rack system (MRS) – thus enabling automated measurement cycles and high throughput.

Low cost of ownership was a high priority when designing SP80 and SP80H and has resulted in two products with built-in crash protection. In the event of an XY axis collision, the detachable stylus holders simply fall away whilst in a Z-axis collision, an integral bumpstop design protects the probe's mechanism.



SP80 and SP80H probe body

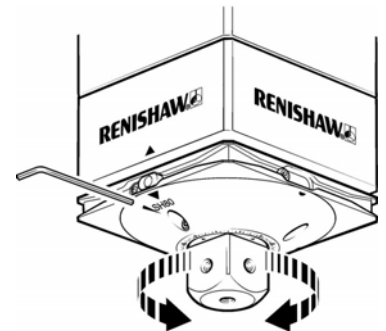
The SP80 probe body houses the motion system and 'isolated optical metrology' transducer system. The compact 'box spring' motion system comprises an arrangement of three sets of parallel springs, one for each body axis, set in a cube - hence the body shape. The motion of the stylus is coupled to a 'moving cube' holding graduated reflective scales – again one for each axis. The readheads are mounted on the wall of the probe and the light projected from them is reflected from the moving scales. This 'isolated optical' method of motion detection does not require any form of moving wire connection.



SP80 has long stylus carrying capability up to 800 mm long and 500 g mass (unbalanced)

SH80 stylus holder

The detachable stylus holder is located on the probe body using a repeatable kinematic joint and magnets. It provides automatic stylus changing capability (via SCP80s mounted to MRS) and has an M5 stylus mount attachment. For additional flexibility, this may be rotated by adjusting a grub screw, and does not need to be removed from the probe body to make the adjustment.



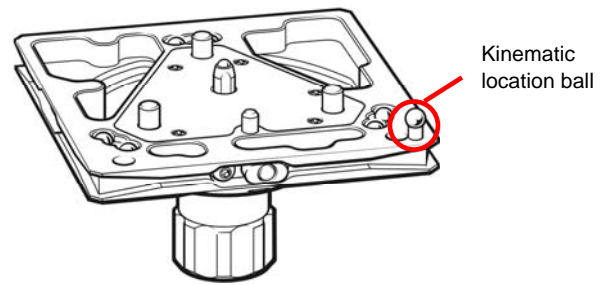
SH80K

SP80 and SP80H do not use absolute encoders, therefore the encoders position is not remembered when you power off the probe and it would be necessary to re-home it when the probe is powered back on.

Fitting the new SH80K stylus holder, which has a kinematic location ball, before the power is switched off allows you to power off the SP80 or SP80H probes and turn them back on without need to re-home the probe.

The kinematic location ball locates into a kinematic location screw that is fitted to the probe and therefore holds the probe mechanism in a fixed position. The readheads remain in a fixed position and the probe does not need to be re-homed on power up.

The SH80K can be fitted to the probe either manually (less accurate) or automatically using an SCP80/SCP80V. SH80K is supplied as standard with new SP80 or SP80H probe kits from October 2007.



SH80K can be used with any SP80 probe providing you fit the kinematic location screw to the probe body. This screw is fitted as standard to all probes sold since October 2007. If you have an earlier probe it will be necessary to fit the screw following the instructions provided with the SH80K.

SCP80 and SCP80V change ports

The SCP80 change port has an innovative **pivoting mechanism** that smoothly detaches the SH80 from the probe body during an automated change cycle and **reduces the pull-off force required to <20N**.



SCP80 has mechanism to pivot the SH80 during change cycle creating gentle detachment from probe body

The SCP80V is a new rack port designed for use with SP80H to allow automatic changing of the SCP80 stylus holders.

Like the standard SCP80, the SCP80V is designed to be mounted to an extrusion based rack. However, we do not offer a rack mounting solution such as the MRS for SCP80V as the vertical mounting extrusion is incorporated into the machine design and will therefore be supplied by the OEM.

We recommend the use of the SCP80V when **auto changing with a stylus configuration that requires a long stylus pointing through the back of a horizontally mounted port** (SCP80), when you will find that due to the position of the centre of gravity the rack might not function correctly. Due to the higher spring force the SCP80V can also be mounted to the standard MRS rail along side the SCP80 and overcome this when used for changing stylus holders that are using styli that will point through the back of the port.

SP80 quill connection options

There are several options for mounting SP80 and SP80H on the CMM quill. All provide a fixed probe arrangement but also offer a rapid and repeatable probe removal and replacement. The standard method is using a mounting plate suited to 80 mm square CMM quills (called the KM80). Alternatively, mounting plates (KM6080 quill adaptor plates) to suit 60 mm square quills and shank type mounting are available.

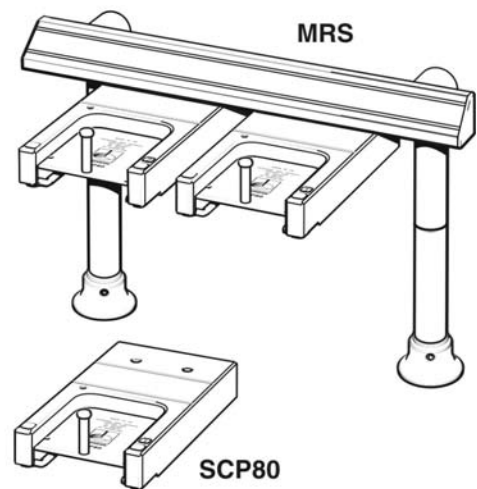
Interchange of SP80 and SP80H with other probe systems on a single CMM

Where the flexibility of multi-sensor CMM functionality is required, there are additional adaptor plates that make possible to interchange an SP80 fixed scanning probe and a PH10MQ motorised indexing probe head (able to carry any contact / non-contact probe with a Renishaw 'autojoint' mounting).

Automation using the SCP80 stylus change ports

The full productivity potential of the SP80 system can be realised when the measurement routine is automated using the highly cost effective SCP80 ports. These mount directly to Renishaw's modular rack system (MRS) thus providing flexible multi-port solutions. The system allows easy future expansion.

Two SCP80s mounted on an MRS



Interfacing SP80 with the CMM controller

SP80 and SP80H are fully compatible with Renishaw's universal CMM controller (UCC) which gives the user the benefit of sophisticated in-built scanning cycles to simplify measurement routines. Alternatively, where the CMM is fitted with an OEM's controller, a Renishaw interpolator unit (IU80) and counter card (CC6) is available to handle the probe's outputs and make integration easy.

Optimised probe performance

Renishaw has developed, and provides, an advanced calibration method, together with software, to maximise probe performance.

SP80 and SP80H key innovations

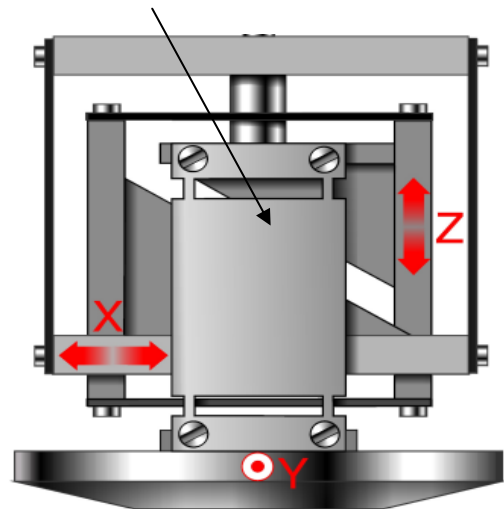
Without doubt, SP80 sets class leading standards of flexibility, performance and low costs of ownership. Incorporating Renishaw's innovative '**isolated optical metrology transducer design**' allows SP80 probes to achieve **remarkable accuracy with long styli** – a critical factor for the market sectors these probes predominately serve.

The probes themselves are **extremely compact**, thereby freeing up valuable CMM working volume. Renishaw's approach to scanning technology design features the simple and space efficient, 'box spring' motion system arrangement. This design is also **extremely robust**.

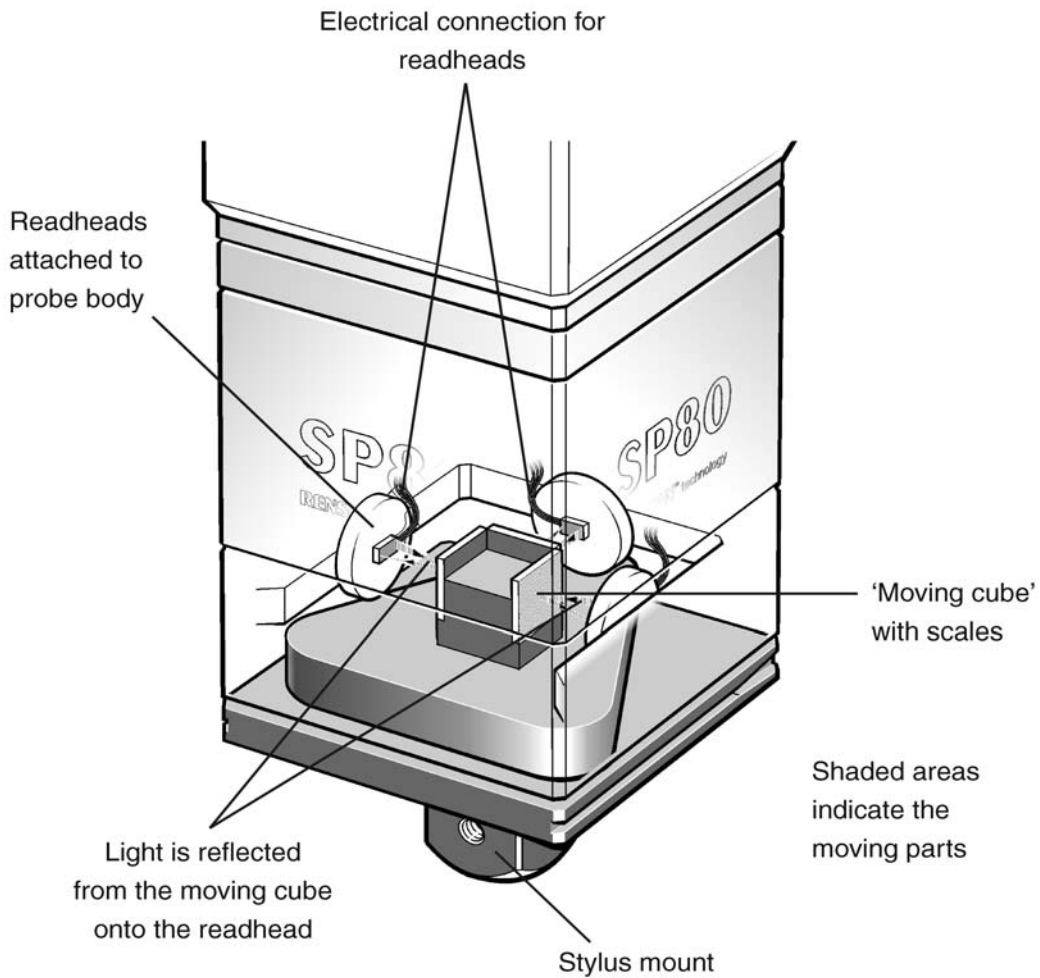
Coupled with the **low probe mass** and **low spring rate of ~1.8 N/mm**, an improved dynamic response is achieved over traditional scanning probe designs. The result is that **SP80 probes allow faster scanning measurements to be taken**.

Using an isolated optical metrology transducer system, **SP80 probes directly measure the deflection of the whole mechanism**, thus providing outstandingly accurate position sensing. **The transducer design can detect sources of variable error such as thermal and dynamic effects**. In contrast, probes with displacement sensors mounted on stacked axes suffer from latency under changing inertial loads, and cannot detect thermal growth in their mechanisms.

Parallel acting springs form the 'box spring' motion system



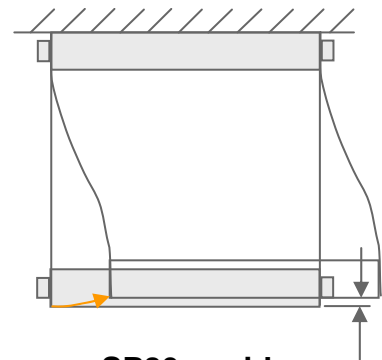
Simple and compact box spring mechanism



Isolated optical metrology

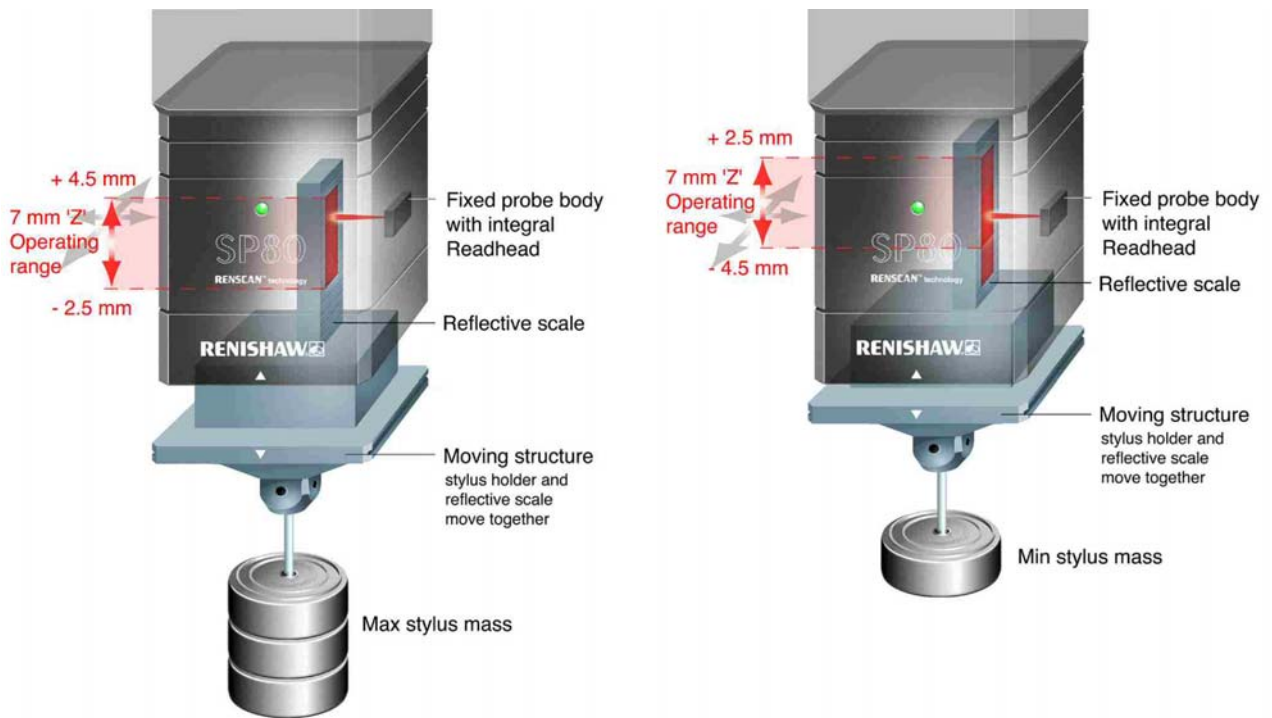
Direct measurement of the stylus motion relative to the static probe body removes the need for moving wire connections which may impede motion

Isolated optical metrology can be explained as a feature of the transducer system. The high-resolution digital readheads for each axis are fixed to the probe body and measure the deflection in each direction of scales mounted integrally to the motion system (see above diagram). Any **inter-axis error** caused by the arc motion of each pair of parallel-acting springs is **directly measured by the SP80 sensor system**. The squareness and straightness of the SP80's axes are, therefore, not derived from the mechanism, but optically from the scale cube.

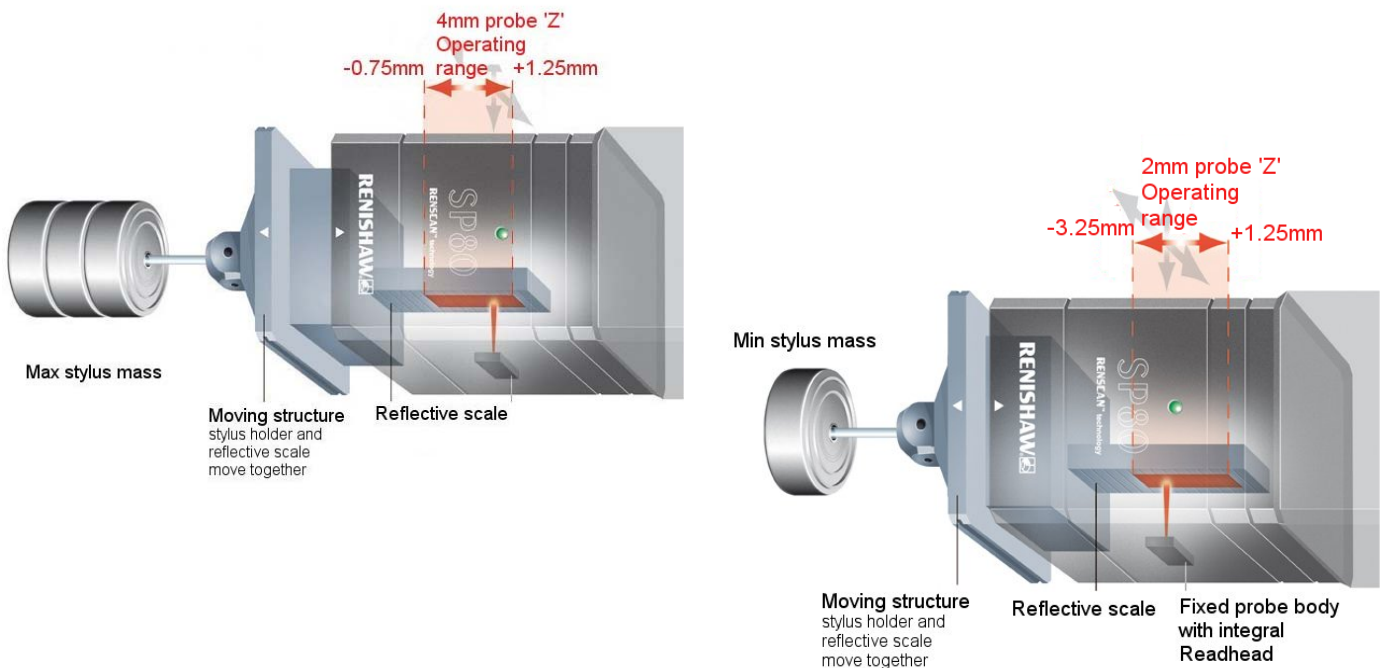


SP80 avoids inter-axis errors

An important feature of the readhead arrangement is the ability to maintain an **operating range of ± 2.5 mm deflection in all axes for SP80, even when using the heaviest stylus mass (500 g)**. For example, for the Z axis this is achieved by having 7 mm of usable range on the scale, thereby using a different part of the scale as the motion system naturally droops under increasing stylus mass (see diagram below).

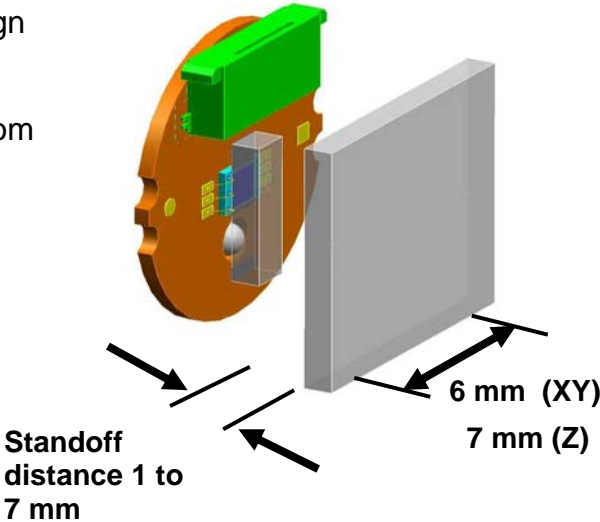


SP80 has full operating range even with the heaviest styli



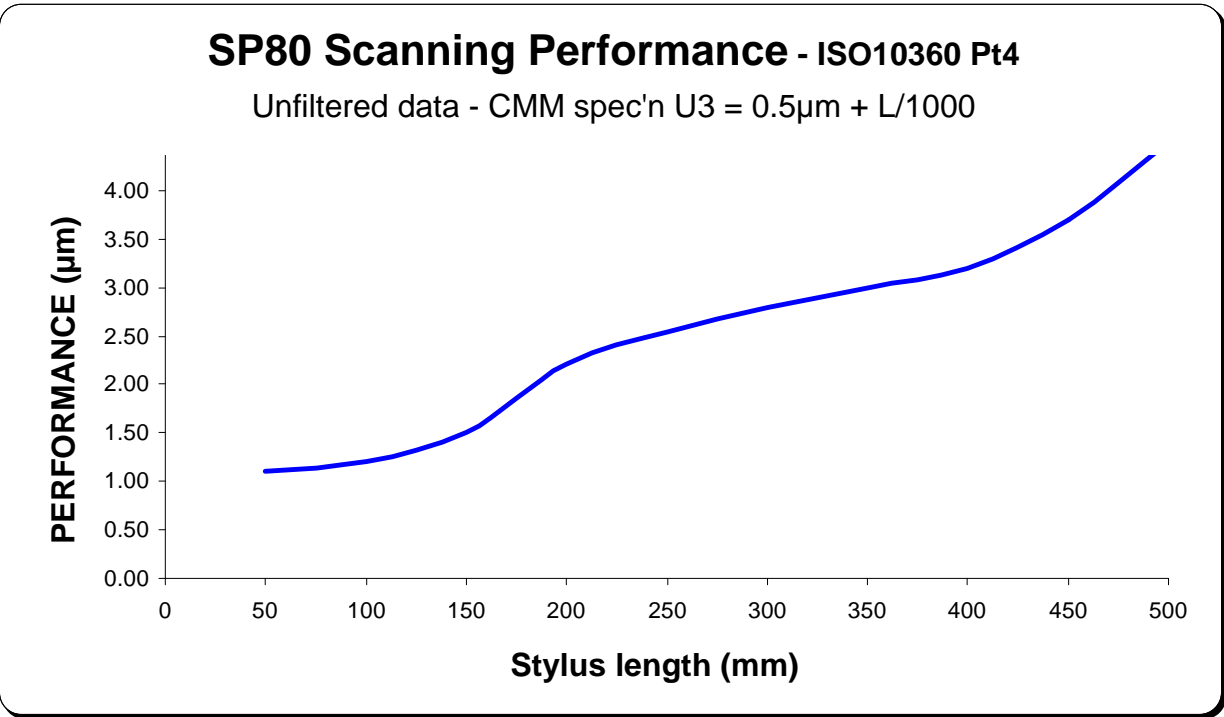
SP80H has full operating range even with the heaviest styli

Another remarkable feature of the readhead design is a capability to work perfectly within a large proximity range of between +1 mm and +7 mm from the scale.



SP80 performance

The plot below illustrates SP80's remarkable high accuracy scanning performance with increasing stylus lengths.



Summary

SP80 and SP80H are set to become the scanning probes of choice for automotive and power train sectors where high accuracy form measurement, with deep reach into components, is required. The system flexibility and affordability is acknowledged as being significant in terms of user benefits.