

Measuring with the right twist

ZEISS Articulating Stylus



Whitepaper



Seeing beyond

Measuring with the right twist

The probe changing magazines of some coordinate measuring machines look like a bizarre cactus: dozens of probes of different lengths stick out like spikes in different directions, waiting to be used. This is sometimes necessary when complex components are inspected, maximum accuracy is required and a simple probe configuration is not sufficient. This means that a correspondingly large number of stylus changes are necessary, which in turn results in high time and financial costs.

The remedy is a so-called articulating stylus. The articulating stylus replaces several configurations with fixed styli, since its stylus can be swiveled in one plane, motor-driven and software-controlled. For example, it can be tilted upward at an angle to move into an opening that points downward at an angle. This saves money because far fewer probes are needed, and it reduces the time required for initial assembly and determination of exact alignment, as well as for changing probes on the fly, especially for hard-to-reach workpieces.

This white paper explains the advantages of a swivel probe and the applications for which it is particularly suitable. A cylinder head is used as an example to show how considerable the time savings are.

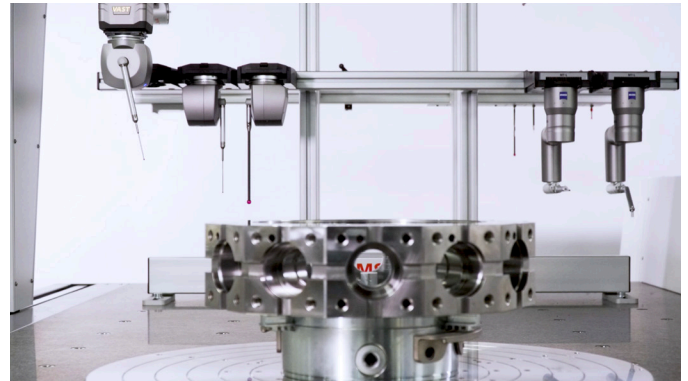


The articulating stylus replaces several configurations with fixed styli, as its stylus can swivel in one plane, motor-driven and software-controlled.

Five probes instead of 15

This example will illustrate the advantages of an articulating stylus. A German automotive manufacturer previously tested a cylinder head with 75 inspection features to be measured using fixed styli. The measurement is performed on two sides. Side A previously required seven fixed stylus configurations, while side B required eight, all of which were set up with different styli in all possible angular positions. With an Articulating Stylus, these numbers shrink to two configurations for Side A and three for Side B. The fact that there is not only one configuration in each case is due to the fact that fixed styli may still be used for highly accurate individual inspection features. The swivel

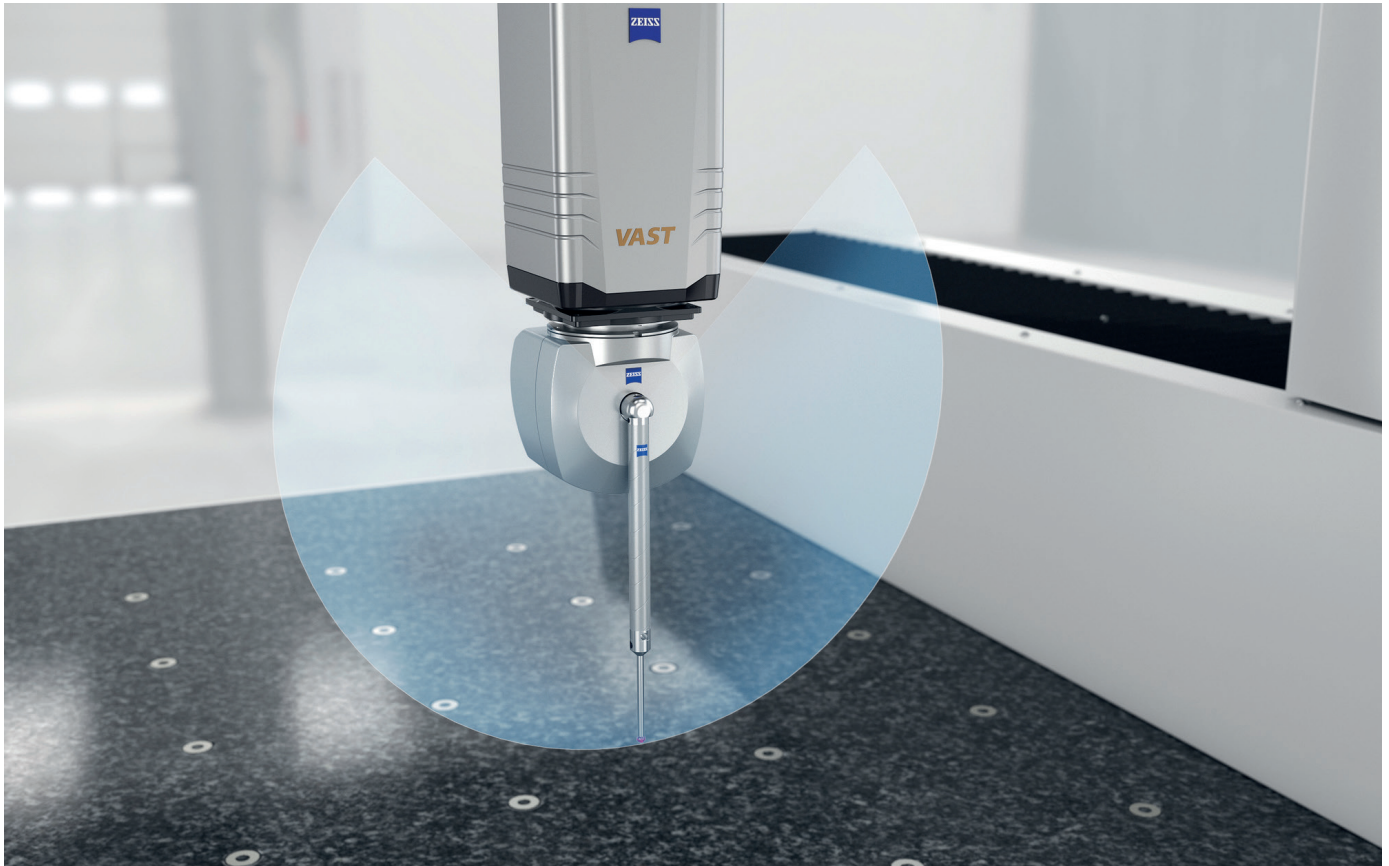
stylus operates in one plane, and for another plane, another articulating stylus must be inserted that is rotated 90° about the z-axis. If more flexibility is required with an additional axis, it can be used in combination with a rotary table. The Articulating Stylus therefore does not completely replace complex stylus configurations, but it does reduce their number and thus the



In the combined use with a rotary table, maximum flexibility is provided. For instance, as in the calculated example, the number of probes required can be reduced from 15 to 5.

time required for stylus changes considerably. In the example of the cylinder head, the time saved is 26% for side A and 15% for side B. The time required to completely measure the cylinder head is reduced by 23%, which is a significant saving in the time- and cost-sensitive automotive industry, which typically has to wrestle for every percentage point of increased efficiency. In other applications, where 20 to 30 probes work on one coordinate measuring machine, the time savings can be even greater. Especially when there are large components to be measured and the sensor has to travel several useless meters back and forth to change probes. This effect is particularly visible on machines with a long Y-axis - not forgetting that a large number of probes requires a correspondingly large probe changing magazine. This takes up space and, like the probes, must be checked regularly and replaced when worn, which adds to the acquisition costs. Since the probe is used more often, a diamond or diamond-coated probe can be useful on the ZAS. This combines flexibility with durability and saves money compared to several individual diamond styli.

Faster even when calibrating



The Articulating Stylus saves money because far fewer styli are needed. It also reduces the time required for initial assembly and for changing styli during operation, especially for workpieces that are difficult to access.

The time savings calculated above only refer to the probe changes during operation. The time for calibration must also be considered. How often this has to be done depends on the requirements for the accuracy of the measurement. In some operations, calibration is required several times a day, but where precision is not so critical, once a week is sufficient. Although calibrating a stylus configuration only takes a few minutes, it adds up for complex configurations with several stylus changes. With the ZEISS Articulating Stylus, calibration takes about 15 minutes. If the swiveling stylus replaces five fixed stylus combinations, a large time saving is already achieved. During the calibration process, eight defined angular positions are addressed by a motor, after which all angular positions from $+135^\circ$ to -135° are steplessly calibrated. Of course, the calibration is performed automatically, controlled by software, here in the example of ZEISS CALYPSO. Anyone who has enjoyed CALYPSO training will also have mastered the ZEISS Articulating Stylus - no special training is required.

The measurement speed depends, among other things, on

how quickly the sensor moves from one measuring area to the next and probes the workpiece. With the ZEISS Articulating Stylus, the coordinate measuring machine moves the sensor to the required position in three-dimensional space, then the stylus swivels to the correct angle to perform the measurement. The drive to the measuring element and stylus positioning are optimized with ZEISS CALYPSO for time savings. Performance features such as ZEISS VAST navigator technology and fly scanning make it possible to save up to 50% time during the actual measurement by scanning.

Just the right one - For many applications

For the best measurement tolerances, fixed styli will still be used as the preferred choice in the future. However, the ZEISS Articulating Stylus balances precision with speed and simplicity.. It adds just two micrometers to the accuracy of the coordinate measuring machine, which is the lowest value of all articulating styli available on the market and more accurate than styli on a robot arm. This is quite sufficient for many measuring tasks and is rewarded by a higher measuring speed. There are minor restrictions in the configuration of the probes. These may be a maximum of 200 mm long. And if probes are to measure in bores, these must have a diameter of at least 1.5 mm, since the smallest sphere

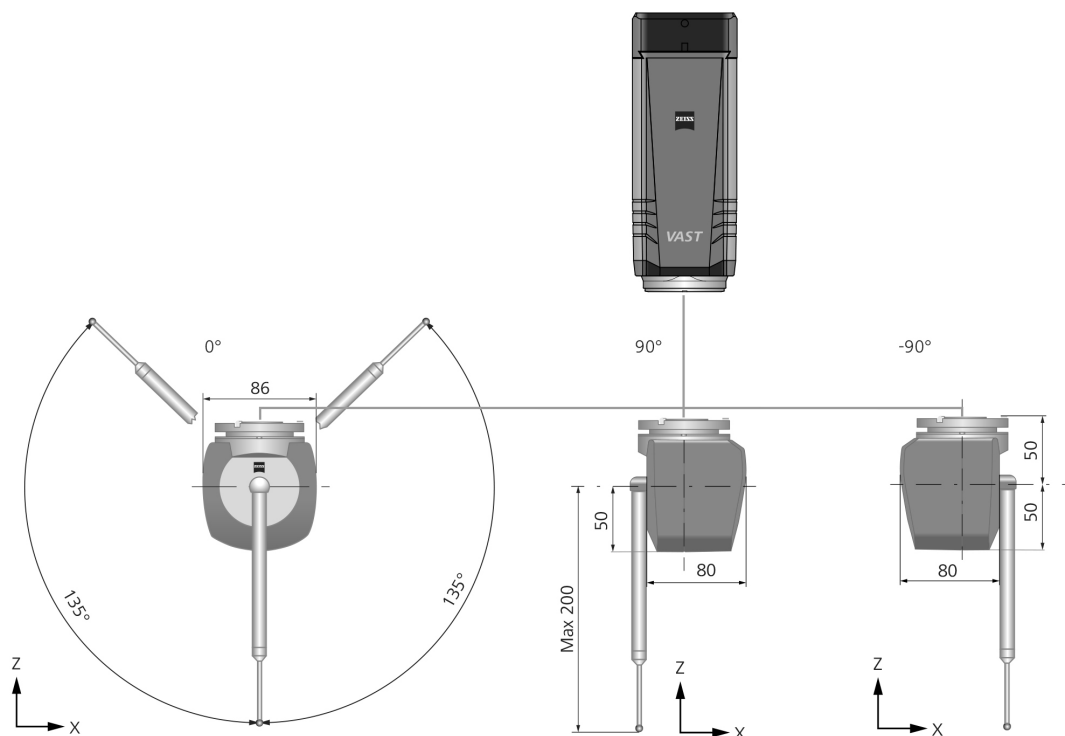
diameter of the probes that can be used is 1 mm. The maximum immersion depth is 150 mm.

ZEISS has been marketing its Articulating Stylus since November 2019. It works on the ZEISS VAST gold sensor, so it masters active scanning measurement on coordinate measuring machines such as ZEISS PRISMO, for example. Around two dozen customers are using it, including well-known companies from the automotive industry, the aerospace sector and the medical industry.



Good to know

Because of the number of axes an Articulating Stylus can handle, there is sometimes confusion among users. If a sensor is capable of 5 axes, this does not mean that it can move around five axes. Three of these axes are always provided by the coordinate measuring machine with its linear traverse paths x, y and z. The swiveling stylus is another axis. And if the user mounts the component on a rotary table, rotation around the z axis is added as a further axis - making a total of five.



The Articulating Stylus adds only two microns to the accuracy of the coordinate measuring machine, the lowest value of any swiveling stylus on the market and more accurate than styli on a robotic arm.

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