Technology White Paper

Coordinate measurement technology: An introduction to dealing with microns

Quality is not monitored, it is produced. Suppliers to the automotive sector will tell you a tale or two about this. They not only need to deliver their parts to large car manufacturers 'just in time', the parts must also be near fault-free. Quality control is no longer just for finished products – measurement technologies now actively control the entire manufacturing process. If product quality isn't up to standard, business can be lost.

The importance of precision measurement is now a recognized reality in today's manufacturing world. As technology has improved, so have the tools available to manufacturers – both in their function and in their accuracy.

A broad range of tactile and optical measurement technologies are now available. The most common – and basic – of these tactile, or touch, technologies is a group of devices collectively known as hand tools. This family includes such classics as micrometers and calipers. They are some of the most frequently used hand measuring instruments, but they are not without fault. Because they rely on the user to take the measurement properly and correctly interpret the result, measurements can vary greatly depending on the operator. Furthermore, hand tools also do not easily provide the measurement documentation demanded by today's customers.

Optical, or non-contact, measurement technology has been greatly improved in recent years. Though they often work reliably, offer the advantage of being contact-free, and are increasingly easy to use, many of these devices do not provide the high level of accuracy of tactile methods. Those optical devices that do yield relatively accurate results can only take measurements in two dimensions. When industry and market demands require three dimensional measurements in the micron range, tactile methods continue to be the best option.

Though traditional in their use and common in manufacturing, lower-cost tactile technologies like hand tools are not enough by themselves to ensure long-term manufacturing quality. Traditional hand tools and improving optical methods can be used to support other measurement processes, but to achieve the measurement accuracies demanded today, they often cannot be viewed as stand-alone full solutions.

Complex manufacturing processes

It is not just about accuracy. Parts and components are becoming increasingly more complex as a result of faster, more accurate processing techniques. Measurement technologies need to keep pace with this reality. If users want to safeguard complex manufacturing processes, they must make use of improved coordinate measurement technologies.

In modern manufacturing, a wide variety of products are produced in a single process. This is an additional challenge for measurement engineers as control must be maintained over manufacturing processes at all times. Such control is currently only possible with flexible coordinate measurement technologies.

Design engineers also play an important part as their work is yet another area where companies use coordinate measurement technologies. While designing new or improved parts on their computer, they generally do not worry about how easy or difficult it will be to inspect it later on. Often, such measurement problems can only be handled using a coordinate measuring device. Fabrication methods that take measurement technologies into consideration could help alleviate this problem.

Skeptical quality managers claim that manufacturing methods have become more complicated since the introduction of CAD systems. In reality, their level of freedom has increased which has only made the quality engineer's job more difficult. Coordinate measurement technologies help resolve this dilemma.

Traceability

A decisive advantage of coordinate measurement technologies is their traceability. Conformity to national and international standards is extremely relevant as it is the only way to validate measurement results. It enables users to verify that their parts are in tolerance with a high level of confidence. Companies integrated into the global value-added chains rely heavily on traceability.

Coordinate measuring machine design

Coordinate measurement technology is often deemed as the ultimate authority in the metrology sector – and with good reason. Coordinate measuring machines (CMMs) have experienced an extremely rapid level of development since their introduction in the 1950s.

CMMs collect detailed dimensional data by moving a ball tip sensing device called a probe along the surface of the part being measured. Basically, all CMMs determine the coordinates of a point in space. Linear encoders built into each axis allow them to track their movement relative to the probe with very high precision. High end devices used properly and under ideal conditions can give results that deviate from the true value by as little as 0.1µm.

Some CMMs are manually operated while others are computer controlled for automated inspections. When first introduced, all CMMs required a specialized operator to manually move the probe from point to point to take measurements. These devices were not computerized and still required the operator to record and calculate measurement data and results.

Today's manufacturers increasingly rely on the precision provided by CMMs. This fact is due to the accuracy and traceability they provide to an ever demanding market.

Functionality

The parts to be measured by CMMs are usually digitized point-by-point. Touch probes trigger when contact is made with the surface, automatically recording the resulting position. To ensure the effectiveness of the process, encoders and sensors must be routinely calibrated.

The measurement values are processed using a host computer and the captured points are used to calculate basic geometry. These include deformities, curves, and freeform shapes. The computer is also responsible for controlling the measurement machine itself. Results can be easily graphed – optimizing the reporting process.

Measurement technology as a service

The recommendation, or demand, to use CMMs is often made by a company's engineering or quality department. The measurement technology manufacturer must work with the prospect's engineers in order to ensure the technology provided fulfills the customer's requirements. CMM software must be flexible and adaptable to various needs to ensure that the quality of the parts and part components being manufactured is not compromised.

Often, measurement technology manufacturers offer various solutions for a company's entire product portfolio and the unique problems each presents; giving those looking for improved measurement and manufacturing processes more control of their measurement strategy.

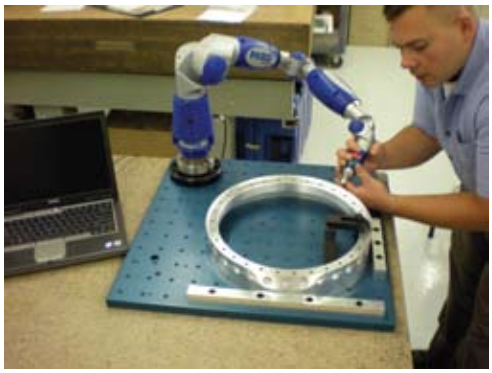
A better solution

Today's CMMs are offered in different performance classes and can be customized to match individual requirements. Regardless of company size, CMMs are an integral part of the quality control process. Large, small, and even medium-sized companies all can have similar applications and even more similar goals: to manufacture the best possible product using the best possible process.

Though CMMs have been improved from their early days in the 1950s, they still operate using the same principles as when they were invented. Accuracy has been improved as well as functionality, but what has become known as traditional, or fixed, CMMs still have their own flaws. The most obvious of those is their need to remain in a fixed position.

To effectively monitor manufacturing processes, dimensions must be checked quickly and accurately right on the production line.

A suitable alternative to fixed CMMs is the portable CMM. They take the accuracy and consistency of traditional machines right to the manufacturing floor where they can be moved around and used at will. This minimizes or eliminates the down time created by having to take parts to a CMM room.



Traditional CMMs still carry relative high price tags and complexity. Portables have not only broken the inspection room barrier, they are far less expensive and relatively easier to use than their traditional cousins. Portable CMMs deliver faster ROIs, improved functionality, and a better user experience.

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