WHAT YOU SHOULD KNOW ABOUT PIN GAUGE SETS

Long before coordinate measuring machines (CMMs) became popular and affordable for more people, inspecting hole positions was a tedious job. The workpiece would be set up on a surface plate and hole locations checked in one coordinate, it was then positioned 90° to the original location and the process repeated.

The major problem with this work was determining the centre of each hole. While a series of measurements to determine hole size and then location along with some math would do the job, it took a lot of time.

A European company solved this problem by producing sets of pins of different sizes with tapered entry spanning the size steps between them. These pins were very accurately made but costly. An American company picked up on the idea to produce sets of pins using standard reversible style gauge blanks that kept costs low. Now all the user had to do was keep trying pins in a set until there was a good fit in the hole. Measurement of hole centre distances became a simple matter of indicating over the pins and adjusting the result for the pin diameters.

These pins were never intended to become go/nogo plug gauges even though they could be used in such a manner. One reason for this is their tolerances of +.0002" or -.0002". The standard for these pins allow them to be out of round by half that amount i.e.; .0001” or .0025mm. The pins are produced by a centerless grinding process so roundness variations will be odd-lobed, meaning they cannot be detected using a normal micrometer or other diametrical measuring device. With that potential condition, they will rapidly wear out of their diameter tolerance in a production gauging application.

Another problem encountered in using these pins for go/nogo gauging is related to the standard which allows them to be undersize for up to 1/4" or 6mm in from each end of the pin. This means they are not suitable for checking the diameter of a blind hole.

Despite these limitations, many companies use the pins as go/nogo gauges due to their very low cost. But they are cheaper because - unlike regular gauges - they are rarely inspected on a 100% basis.

CONTROLLING THE SETS:

Having a large quantity of pins on hand for various applications is a real time saver. But keeping track of individual pins can be a headache when you have more than one set of the same sizes. If they get mixed up, you can bet a quality auditor will discover this and call related calibration reports into question.

A simple way to avoid this problem is to colour code the pins with a dab of paint on each end. A green pin in a box full of red pins will stand out and will avoid having people wasting a lot of time checking markings or labels to find the pin that doesn't belong in that set.

CALIBRATION:

If you use pin gauges of this type to qualify a product feature, they must be calibrated to comply with any known quality standard. Often, the cost of calibrating them is nearly the same as the cost to buy them which upsets those facing the situation for the first time.

The reason for this cost is the fact that calibration requires that each pin must be measured. When they were made, a percentage of each size batch was checked on the shop floor to keep costs down. That sort of cost cutting is not permitted when calibration is involved.

To do the job properly, several measurements for size should be taken and two or more reported so you know the state of each pin. Blanket certificates without data are next to useless. If the lab doing the work is claiming to work to ISO 17025, they are required to retain the actual readings, so why not report them?

REDUCING CALIBRATION COSTS:

Pin sets may have several hundred different sizes but not all of them will be used very often. One way to reduce calibration costs in a safe way is to calibrate only those that have been used since the set was last calibrated.

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REDDUCING CALIBRATION COSTS (continued)

An easy way to monitor usage is to mark the pins so you can tell at a glance which ones have been used and thus need calibration. Put a dab of nail polish on the outside diameter at each end of the pin. When a pin is needed, nail polish remover will quickly remove the coating so the pin can be used. Those pins with the polish still in place will not have been used and don't have to be calibrated every time the set is due.

While we can supply the ZZ tolerance pin sets and replacements for them, we recommend Deltronic gauge sets due to their superior Class X quality and accuracy. Since they are available in size increments down to .0001" you can get the most reliable fit possible and since they are 100% inspected, they can be used to qualify hole sizes as well. Many customers buy a Deltronic 25-gauge set every month or so eventually covering a size range suited to their needs.

Figure 1 - Deltronic 25 Gauge Tenth Set - Centre gauge is your specified nominal size. The 12 gauges on the left range downward in .0001" steps and the 12 gauges on the right range upwards in .0001" steps. Sets are also available in metric sizes and in other step configurations. Our customer service will be pleased to provide any information that you require.

CALIBRATION ACCEPTANCE CRITERIA

Regular calibration of your gauges and measuring instruments is a basic requirement of every quality system. A key part of such programmes is determining acceptance criteria for each item. Simply put, at what point do you say that a given item should be rejected?

Where gauges are concerned, many companies opt to use the tolerance to which the gauge was made. This can be very wasteful and expensive. Those tolerances are for the gauge maker, not the user, and only apply to a new gauge. A gauge on bottom limit could be out of tolerance after very little use using this type of criteria when it might still be more than suitable for your work.

Your acceptance criteria should be based on the tolerances of the work the gauges will be used to check. Typically, ten percent of the work tolerance is allocated for the gauges, half for the go gauge, and half for the nogo gauge.

Acceptance criteria arrived at on this basis can significantly reduce your gauge costs because you can often find situations where the go gauge can stand considerable wear before it will have to be replaced.

If you need assistance in establishing acceptance criteria for your gauges, talk to one of our technical representatives who will help you work up some numbers.

Editor's Note:

We have decided to periodically offer our readers bonus reprints of previously published articles written by our President. The following page is the first of these offerings. If you have the time, we would appreciate your feedback to help us decide what to provide in future issues.

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Hill Cox has written many articles on all areas of dimensional metrology. This includes a monthly column “Other Dimensions” for the U.S. publication, Quality Magazine (www.qualitymag.com). Quality is a monthly business publication serving the quality assurance and process improvement needs of more than 64,000 manufacturing professionals. Quality has given us permission to share some of these articles with Metrology Insider’s Notes readers. We will include them from time to time and hope that you enjoy them.

THE ANCIENTS CAN TEACH TODAY'S ENGINEER ABOUT MEASUREMENT.

The Egyptian pyramids have long been spoken of as examples of human ingenuity and skill. This ancient era brought into being one of the first length standards, the cubit. Flatness of the massive stones used to build the great pyramid was said to be within 0.05 inch or better. And to this day, no one has successfully demonstrated how these huge building blocks were handled. Builders then knew about measurement and construction techniques we may never understand.

However, the Egyptians were not alone in their engineering and measurement skills. The ancient peoples who built stone circles and related constructions need to be recognized for their impressive feats. Several experts on these still-standing monuments maintain the circle builders were ahead of the Egyptians.

The most notable remnant from this era, now thought to be constructed in approximately 3100 B.C., is Stonehenge in England. It was made from massive stones that were hauled great distances. As with the pyramids of Egypt, modern scientists and engineers have not determined how the people of that time moved and positioned the huge stones, however there are many theories.

People with religious or other leanings, and new-age philosophers, all claim different reasons for building Stonehenge and the structures that predate it. I'll leave the "why" to someone else and instead focus on the "what" these structures offer in terms of measurement and the accuracies involved.

Like the pyramids, Stonehenge shows great knowledge of astronomy and geometry, as well as length measurement. Experts indicate that hundreds of the stone circles take advantage of the same standards of length in their construction, ranging from 300 feet to several miles in diameter.

Alex Thom, professor emeritus of engineering at Oxford University in England, began a personal study of stone circles that lasted from the late 1940s to the mid-1960s. He hauled his surveying and other equipment to more than 100 sites in England and made some amazing, yet little known, discoveries.

Thom determined that the architects of the stone circles used a standard unit of length that was 2.72 feet long. A statistical study of more than 100 circles showed a deviation of only 0.003 feet, and their standard of length was within 0.1%. That's not bad for builders who didn't even have a tape measure. Their abilities in angular measurement were within a few minutes of a degree.

While measuring and mapping the alignment of various sights, Thom discovered an equilateral triangle that was exact in its measurement and angels; the sides were exactly 6 miles long. This is not something one easily accomplishes by using only some sticks and string.

Often referred to as sacred sites, and now treated as such by many, a large number of circles are in exact alignment from Cornwall to East Anglia—a considerable distance even by today's standards. I'm not sure that modern global positioning systems could get these circles more accurately aligned.

Astronomy played a major role in simple tools of that period and have them still intact thousands of years later.

If you think you can match the ancient engineers in their pyramid or circle endeavors, go for it. Unfortunately, it is unlikely that I, or anyone currently reading this column, will be around to see if your project is still standing for the test period. But do not despair, I’ll take your word for it when we meet in the next world.

--Hill Cox is president of The American Measuring Tool Manufacturers Association (AMTMA) and is chair of its technical committee. He is also president of Frank J. Cox Sales Ltd. (Brampton, Ontario, Canada.) He may be reached at CoxH@bmp.com.