MEASUREMENT

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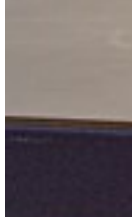
How to Choose the Correct Measuring Tool for Any Application

There are many options to choose from when deciding on a dimensional measurement tool. Consider these application-based factors when selecting a measurement solution.

#basics #qualitygagingtips



GEORGE SCHUETZ
Director of Precision Gages, *Mahr Inc.*

Fixed plug gages such as air gaging provide the highest performance results. Photo Credit: Mahr Inc.

When determining the dimensional length of a part, there are probably hundreds of tools available, starting with a simple vernier caliper up to a high-end coordinate measuring machine (CMM). These tools — and everything in between — can produce a result but it may not be the best result in terms of ease of use, cost and practicality for the dimension being checked.

Much depends on the accessibility and tolerance of the dimension, how many parts need to be checked and by whom. Oftentimes, in the real world — where the part is being produced — a good, better or best guide can be helpful. There is never a logical decision tree for making these choices, but by understanding some principles and asking the right questions, good results can be obtained faster.

When versatility is required and tolerances are not too tight, one can achieve good results by measuring a part with hand tools such as calipers and micrometers. These hand tools are referred to as measuring instruments because they have the standard or reference scale integral to the instrument. With a mechanical micrometer, the standard is the screw thread in the thimble, while with digital micrometers or calipers, it is the electronic scale or encoder within the tool.

With these tools, the part is measured against the internal standard. These measuring instruments offer a lot of versatility since they have a very long measuring range, but on the other hand, they will be slower to use and require more operator skill to obtain the best result. For basic measuring tasks, nothing beats the versatility of a caliper or micrometer. But once we start to get into a higher production environment with tighter tolerances, there is a better way.

An adjustable gaging instrument is the first step towards getting better results that are faster, easier to use and more precise. Instead of being universal with an internal scale, this gage class is more dedicated to the task. Snap gages of outer diameters (ODs) or bench inner diameters (ID)/OD gages fall into this group. They are dedicated to the specific task and use an external standard from which the part is compared. Thus, they are often referred to as comparative gages. These typically have a large adjustable range but a very short comparative range, and tend to have much higher resolution for the result.

	Ease of use	Versatility	Performance	Lowest Uncertainty
Calipers/Mics	√	√√√√	√	√
Snap/ID/OD Gages	√√√	√√√	√√√	√√√
Fixed Dimension Gages	√√√√	√	√√√√	√√√√

Comparison of measuring tool characteristics. Photo Credit: Mahr Inc.

With these gages, the instrument is adjusted and set to size using a master ring or disc. The gage is then locked into place for the dimension and sample parts are compared — smaller or larger — to the master setting. Since this dedicated gage is now set for one dimension, it becomes very fast and easy to use for the operator. The part can go into the gage only one

way; often, the part can be placed in the gage and released by the user, producing a result free of any operator error. And depending on the readout device and construction of the comparative gage, high-precision results are obtained.

However, for the best results in a production environment, a comparative gage with the benefits above is made, but dedicated to the specific size being checked. This gage class would include air gaging for IDs or ODs or a fixed-size, mechanical-plug gage. Because these gages are dedicated to the specific dimensional check, they are by far the fastest and easiest to use. Since they are still comparative gages, an external master of the nominal size is required to set the reference the parts are compared to.

The part can be measured only one way, it goes onto the gage quickly, and there is absolutely no operator influence. Therefore, the comparative gaging results tend to be the best in terms of repeatability, precision and overall certainty of measurement because they eliminate most of the user-influenced and gage-design errors.

There are many factors to consider when choosing the correct measuring or gaging solution that best meet the application; however, once these factors are known, along with the performance characteristics of the gaging options, the best choice for the task can be made.

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The Right Gage for Measuring Small Bores

Small bore holes present a unique set of challenges for precision measurement, but small mechanical bore gages can be used for tight tolerances in this application.

#qualitygagingtips #basics

GEORGE SCHUETZ
Director of Precision Gages, *Mahr Inc.*

Over the years, this column has examined using air gaging and back pressure to measure small bores (under 1 mm/0.040 inch). Air gaging can be an acceptable way of measuring small bores, but it does not provide any form information; it only provides the flow area as related to the diameter. However, because these holes are so small, there may not be another economical solution.

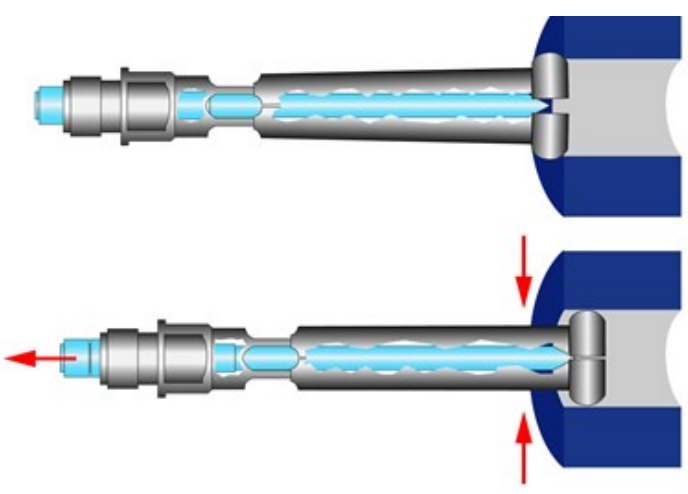

Photo Credit: Mahr Inc.

Increase the size, though, and there is a whole family of bore gages available for measuring holes that range from 1 mm to 20 mm; in other words, a whole family of bore gages for these small bores. These precision mechanical bore gages use comparison to determine the size and shape deviations of bores. Unlike fixed plug gages that employ a ground cylinder and sensitive contact to compare a bore to a master, these small, comparative gages basically take the mechanical transfer out of the plug and use it as a standalone probe to measure small bores. Since there is no centralizing plug, the small-

bore probe is rocked through the bore being measured to capture the smallest value related to the diameter of the bore — very much in the same manner as the tried-and-true adjustable bore gage.

The big difference — or perhaps the small difference — is that this type of probe bore gage can measure bores a lot smaller than the normal, adjustable bore gage. The adjustable bore gage is just as its name implies: adjustable to cover a large range of parts, but with a very limited measuring range. For example, a small-bore probe with a nominal size of 1 mm will measure a bore from 0.95 to 1.15 mm; a nominal 10 mm probe can measure 9.4 to 10.6 mm; and a nominal 20 mm probe can measure 19.4 to 20.6 mm bores. Though limited in range, these bore probes have repeatability better than 1 µm and will be accurate to 1% of the measuring range.

So, what is really happening with these small-bore probes? As noted, they operate very similarly to fixed plug gages. There are two sensitive contacts held with flexures. As the contacts change with bore diameter, they transfer the size via a tapered pin to the indicating device. The indicators can be a dial, digital indicator or comparator, or even a linear variable differential transformer (LVDT) probe and amplifier.

Left-right rocking of gage in bore. Photo Credit: Mahr Inc.

As with any comparative gage, these small probe gages require a setting master. The user of these bore probes will place the master on the bore probe and rock the bore plug in a side-to-side manner, observing the indicator readout and watching for the reversal point, or the smallest value. The user will then set this point to zero or the nominal size. Once set, the gage is taken to the bore to be measured and the same rocking process is used to find the diameter. With today's digital indicators, this process can be easier since many digital indicators have dynamic memories that can latch upon the minimum value, eliminating the need for the user to remember the reversal point.

These probes can be used in special stands that will orient the small-bore probe to the part and lower it into the bore. When used in this manner, the bore does not have to be rocked, as the probe is square to the bore because it is self-centralizing and will therefore provide the actual diameter deviation.

Like fixed plug gaging, the probes are available in through- and blind-hole configurations and with chromed contacts for normal wear conditions, or a diamond-like coating for extreme wear applications.

Small probe gages are often the only means of precisely measuring bores from 1 to 5 mm. In the hands of an experienced user, they can provide the results needed for tight tolerance bore measuring applications.