The latest digital calipers provide numerous electronic features that make the device easier to use, yet add little in the way of cost. *Source: Mahr Federal Inc.*

Caliper Basics

The versatility of the caliper, along with its range and ease of use, makes it well suited for a multitude of measuring applications. BY GEORGE SCHUETZ

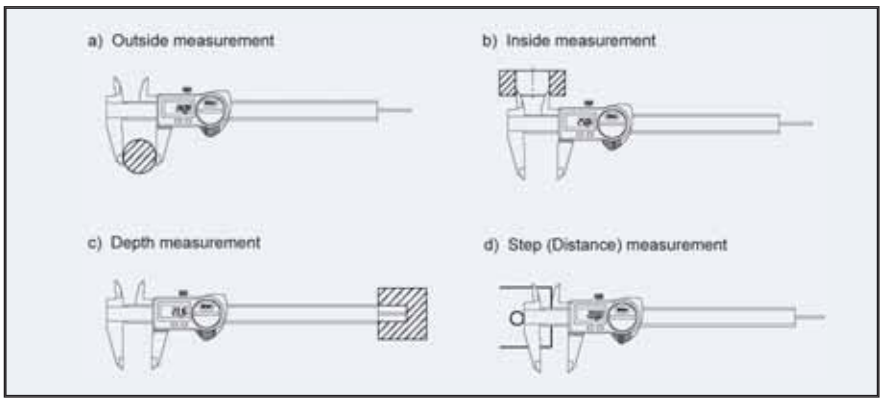
Calipers are extremely versatile tools for making a wide range of distance measurements, including both outside diameters (OD) and inside diameters (ID). While micrometers are more accurate, they have a limited measurement range, typically several inches. Calipers can span from 2 inches to 4 feet, depending on the length of the scale. External measurements are made by closing the jaws over the piece to be measured, while internal measurements are made by opening up the inside diameter contacts. Depth and other measurements can be made with a depth rod built into the instrument's beam.

There are three basic types of caliper that may be found today in a machinist's tool chest:

- **Vernier.** The vernier caliper is the original design and still the most rugged. Graduated much like a micrometer, it requires the alignment of an etched scale on the vernier plate with an equally spaced scale running the length of the tool's handle. Skillful alignment of the tool and interpretation of the reading is necessary to achieve the measurement tool's stated accuracy.
- **Dial.** A dial caliper is a second-generation caliper. Similar in construction to the vernier caliper, this style replaces the vernier scale with a dial indicator. The indicator is fixed to the moveable jaw and engaged with a toothed rack on the body of the unit. The dial, which is typically balanced, meaning it can move in either plus or minus directions from zero, may be graduated in either inch or metric units.

  The dial caliper is a dual-purpose tool and can make either direct or comparative measurements. To make a comparison, first measure the reference dimension and set the dial indicator to zero. Then measure the dimension to be compared. The indicator will show how much the compared dimension varies from the original (plus or minus).

  Another useful feature of the dial caliper are jaws that slide past each other to allow contact points or depth rod extensions to fit into narrow openings for small ID measurements.
- **Digital.** In the past 25 years the digital caliper has made its way onto the shop floor. The latest designs provide numerous electronic features that make the device easier to use, yet add little in the way of cost. These include: easy switching between inch and metric units on the readout, tolerance indications, digital output to electronic data collection systems, zero setting anywhere along the caliper's range and retention of the zero setting even when the caliper is turned off. With no moving parts in the readout, the digital caliper is durable, and newer units are even waterproof.



Figures a and b illustrate basic OD and ID measurements. Figures c and d illustrate more complex depth and step measurements. *Source: Mahr Federal Inc.*

MEASUREMENT INFLUENCES

The biggest problem with calipers is that measurements are subject to variation from one operator to another. Two types of influences contribute to this variation: "feel" or inconsistent gaging force, and subjective, or psychological, factors.

Because the caliper is a contact instrument, sufficient torque must be

applied to the anvils to make good positive contact between the part and the instrument. The only torque calibration in the human hand is the operator's "feel." What feels like solid contact to one operator may not feel correct to another; therefore, the readings may be different.

Subjective, or psychological, influences are all in the operator's head. Tell an inspector that the best machinist in the plant made this part and influence enters the picture. Or suppose the boss walks over and asks an inspector to measure a part and adds, "I just made it myself." In these cases, measurements may tend to be better than the part deserves.

There also are more subtle types of influences. For example, studies have shown that if an operator knows what size a selection of parts ought to be before he measures them, readings will tend to be closer to that ideal than if the target dimension is unknown.

USING CALIPERS

The popularity of calipers is both based on their versatility and ease of use. They are used for basic OD and ID measurements, as well as more complex depth and step measurements. Other common caliper measurements include measuring the center distance between two holes, comparing a shaft diameter to a hole ID and gaging remaining thickness when drilling a hole in a workpiece.

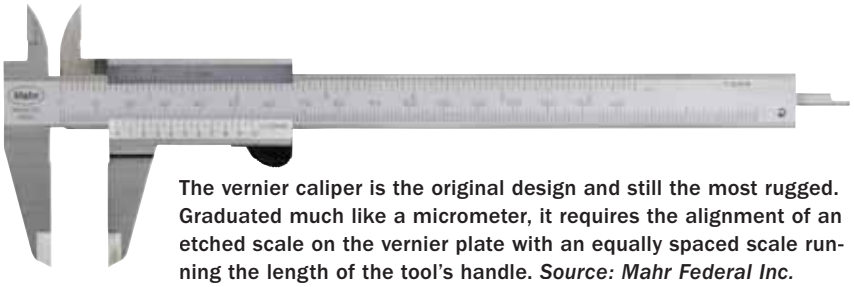
Beyond these basics, however, there are a number of different anvils and contacts available that extend caliper use to many special measurement applications.

Ball contacts are used to measure wall thickness of tubes and other cylindrical components. Calipers are available with one or two ball/radiused contacts, and in some cases the ball contacts can be supplied as attachments for use with standard flat-tipped anvils. The attachments may be quickly and easily applied, but when using this type of attachment, the ball diameters must be taken into account by subtracting them from the caliper reading.

Similarly, other specialized anvil attachments and accessories are available to measure threads, bores and serrations, recesses, recessed IDs and ODs, grooves and distances between grooves. A depth measuring bridge can extend the effective diameter of the beam, allowing depth measurement of wider holes. Some models even offer an attachable device for measuring force.

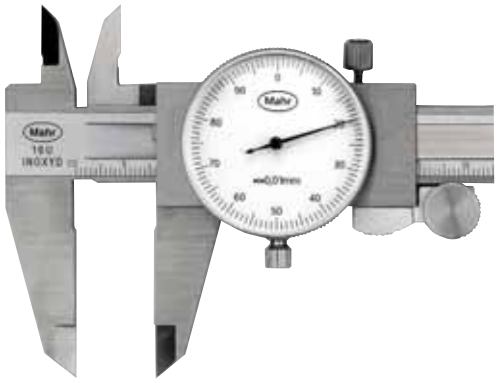
However, because these accessories and attachments extend the measuring range, parallelism errors can creep into the measurement. Thus, it is important to check parallelism of the contacts using a precision ball. A discrepancy of more than a grad on the vernier scale is a sign that the parallelism of the anvil needs to be corrected.

Even the best and most basic hand measuring tool can be made better by adapting it to special application requirements. By choosing the most appropriate accessories for the application, one will achieve faster and more accurate measurement results.



The vernier caliper is the original design and still the most rugged. Graduated much like a micrometer, it requires the alignment of an etched scale on the vernier plate with an equally spaced scale running the length of the tool's handle. *Source: Mahr Federal Inc.*

The water-resistant digital calipers are designed for use in extreme production environments in accordance with the IP67 standard. *Source: Mahr Federal Inc.*



Similar in construction to the vernier caliper, the dial caliper replaces the vernier scale with a dial indicator. The indicator is fixed to the moveable jaw and engaged with a toothed rack on the body of the unit. *Source: Mahr Federal Inc.*

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