

UniqueTek “Tips” File #6: “Using Calipers for Handloading”

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Preface

This document is adapted from the article “Using Calipers” by Chris Wood and Carl Seichert, as posted on littlemachineshop.com. It has been edited and expanded upon, with permission from the authors, to provide additional information about the different types of calipers available, plus techniques and examples specific to handloading.

I would like to give special thanks to Chris Wood for being gracious enough to not only give me permission to use his original work, but for also providing an electronic copy that I could more easily edit. All of the excellent mechanical drawings of digital calipers used in the various examples are also part of this original work and this document would be incomplete without them. Again, many thanks to the authors.

— Lee Love

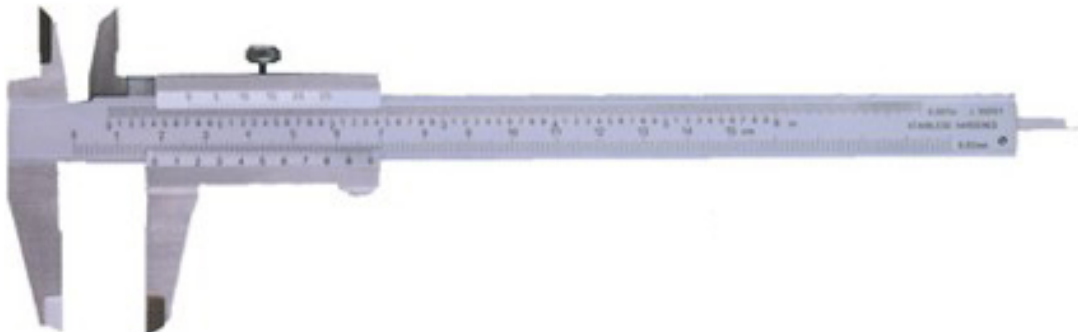
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Calipers are a “must have” tool for every reloading bench. A caliper is a simple measuring device for measuring thickness, diameter and distance between surfaces. It has two jaws, one fixed, the other sliding and a graduated scale. Calipers are very versatile for measuring almost all kinds dimensions of a part. In handloading, the “part” is typically a bullet, cartridge case or a loaded round. Although this article focuses on handloading, calipers are useful for almost limitless applications requiring precise measurements.

A caliper can be used for measuring external dimensions like length, width, and thickness and outside diameters of round objects. It can be used for measuring internal diameters of holes, length and width of cavities using the internal jaws. And, with the help of the depth measuring blade, we can also measure the depth of blind pockets.

Types of Calipers

Vernier Calipers: Vernier Calipers are the oldest and most basic type. They are also the most difficult to read as you have to read the vernier scale, and that takes a bit of practice. To make things more confusing, there are vernier scales with 10 divisions, 24 divisions and 50 divisions, and each type takes a bit of practice to get used to. Very few reloading benches have this type now days, so I will not go into details on how to read a vernier. If you are interested, there are many resources on the Internet.

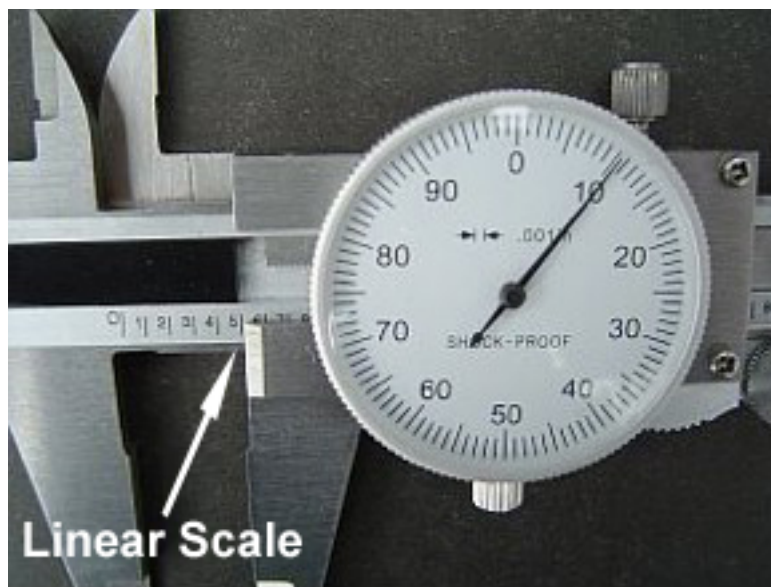


Dial Calipers: Dial Calipers have a dial instead of a vernier scale and are easier to read than a vernier. Never open or close the jaws of a dial caliper rapidly as this can damage the gears in the dial and cause it to jump. This is also a good reason to always close the jaws completely between measurements to be certain that they return to zero. If they don't, it is a good idea to retake that last measurement!



Reading dial calipers is a two-step process:

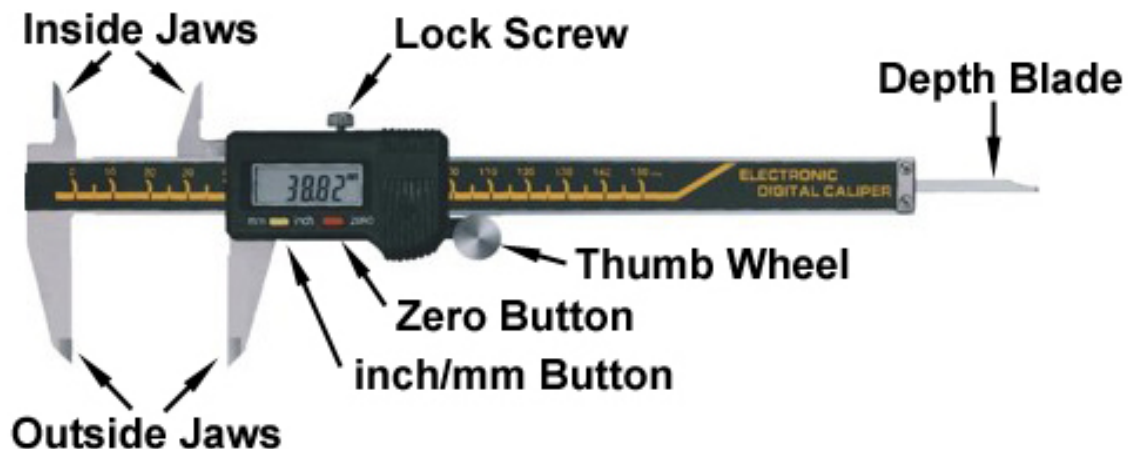
1. Read the divisions on the linear scale. In this example (see photo below), the measurement is just past the 0.5" mark.
– Measurement is $>0.5"$
2. Read the dial. Each line around the perimeter of the dial is $0.001"$. In this example, the dial reads 10 or $0.010"$.
– Add $0.010"$ to $0.5"$ and the final measurement = $0.510"$.



Note: Due to parallax in the photograph, the needle appears to be just past the 10 mark. It is important to always read the dial with your eye straight if front.

Electronic Digital Calipers: Electronic Digital Calipers have become very affordable in recent years and are now the most common type for the reloading bench. They have several added features and capabilities compared to Dial or Vernier Calipers.

- They are very easy and fast to read.
- They can be switched between English and Metric units with the push of a button.
- They can be zeroed at any setting, making it easy to take compound measurements or to sort parts by a size specification (more on those types of measurements later).



Reading an Electronic Digital Calipers is simple. The electronics does all the work and the results are shown on the LCD display. Just read it! In the photo above, the measurement is 38.82mm. If you wanted the measurement in inches, you would just press the mm/inch button and the display would then show the equivalent measurement in inches (it would be 1.528").

Sizes of Calipers

Calipers come in many measurement ranges and with variations in jaw lengths. For reloading purposes, buy a caliper with a range of 0-6" (0-150mm). These will typically come with an Outside Jaw Depth of about 1-1/2" and an Inside Jaw Depth of about 5/8". Calipers of the 0-6" size are the most popular because they are easy to hold and can measure virtually any rifle cartridge including the .50 BMG.

Materials of Construction

Calipers come in a variety of materials including stainless steel, carbon steel, plastic and even carbon fiber. Avoid plastic, polymer and carbon fiber calipers at all costs! You are purchasing a precision measurement tool that will last a lifetime (or longer) if treated with care. Stainless steel jaws will withstand abrasion better than plastics and will not tarnish from the sweat on your hands.

Care and Feeding

Calipers are a precision measurement tool and should be treated with care.

1. **Never drop them!** Even a short drop to a hard table surface can cause damage. I usually keep a gun cleaning pad on the workbench ... just in case I get fumble fingered. An old neoprene mouse pad works well too although may be a bit small. There is also what is called a “counter mat.” A counter mat is essentially a large mouse pad. They are used in gun shops to protect the countertop and the gun from scratches when a customer is handling a gun. Gunsmiths also use them as a padded work surface. Counter pads usually have advertising printed on them for a firearms manufacturer or the gun shop, so you can often get them for free at trade shows or special events if you go and talk to the guys in the vendor booth.
2. **Keep them stored in their case.** Most calipers come with a rigid plastic storage case with a soft foam lining. If a storage case isn’t included, reconsider your purchase!
3. **Keep them clean.** Particles of metal or other abrasive particles will cause rough operation and wear. Open the calipers to their maximum setting and blow out any residue from the rack gear. A can of compressed air (e.g. Dust-Off or other brand of “canned air”) is handy for this and many other jobs around the reloading bench. If absolutely necessary, use a lint-free cloth (an eyeglass cleaning microfiber cloth works great) with a sparing amount of rubbing alcohol to wipe off any residues. Be very careful not to get any alcohol into the dial or electronics module.
4. **Do not lubricate.** Oil or grease will just attract dust and grit. Electronic Digital Calipers may not function at all if there is any oil (or any other liquid) on them. They usually display an error message if this is the case.
5. **Do not use too much force when taking a measurement.** You can apply enough force to actually bend the jaws out of alignment.
6. **Inspect the jaws periodically.** Clean them, and look for any scratches, nicks or dings. Then close the jaws fully, hold them up to a strong light source and look for light leaking through where the jaws meet. You should not be able to see any light leaking through. If there is, it means there is a problem.
7. **Never try to disassemble them!** And never try to repair a caliper yourself. Either send them back to the manufacturer for reconditioning (usually very expensive) or replace them.
8. **Check Calibration Periodically.** I just added a new page regarding calibration at the end of this document.

“ZERO” Before Measurement

Before you take a measurement – (make that before you take every measurement) – close the caliper and make sure the reading is 0.000. If the reading is not 0.000, do this:

1. Open the jaws about an inch. Then use the thumb of your free hand to wipe off the mating surfaces of the jaws. Use an alcohol wipe if needed.
2. Close the caliper again. On an electronic digital caliper, if the reading is not 0.000, press the “zero” button so that it does read 0.000. To zero a dial caliper, release the locking screw then rotate the bezel so that the needle points to 0.000, then tighten the locking screw.

If you are taking repeated measurements for a long period of time, you may note that the zero needs to be adjusted frequently. This is because the calipers are absorbing heat from your hand and the metal is expanding ... all the more reason to recheck zero frequently.

Four Basic Measurement Types

Calipers can take four basic types of measurements:

1. Outside
2. Inside
3. Depth
4. Step

Any caliper, whether a vernier, dial or digital, can take these measurements.

Note: There are also calipers built for special purposes that may be capable of only one or two types of measurements. But the calipers you will find for sale by the gun accessory supply companies will be capable of all four of these measurement types.

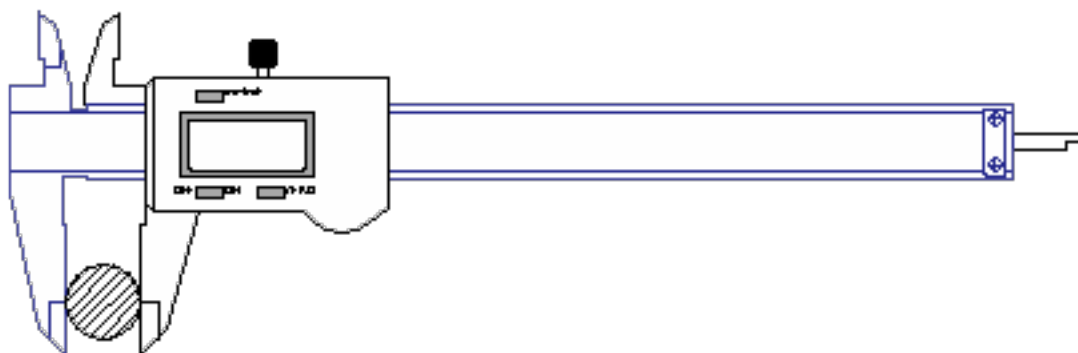
Outside Measurement

Outside measurements are the most basic and frequently used measurement type you can do with a caliper. You will use outside measurement for:

- Case Dimensions (length, diameter, rim thickness, extractor groove depth, wall thickness, etc.)
- Bullet Length and Diameter
- COL (Cartridge Overall Length) aka OAL
- Cartridge Neck Diameter
- Crimp

To take an outside measurement:

1. Close the jaws and zero the calipers.
2. Open the jaws and place the jaws around the part to be measured.
3. Slide the jaws closed until they contact the part.
4. Read the measurement.



Sounds easy, and it is, but if you don't do it correctly the measurement will not be accurate. If the calipers are not straight (that is, perpendicular to the part being measured) the measurement will not be accurate. Likewise, if there is dirt on the jaws or the part, the measurement will not be accurate.

When taking a measurement, close the jaws only lightly, with pressure that is consistent from one measurement to the next. You'll soon see that it's possible to fudge the results by just pressing a little harder. You don't want to do this. If you're new to calipers, it may be a good idea to practice for a while (on a gauge block if you have one) to make sure you can get repeatable measurements. Many calipers have a knurled thumbwheel that makes moving the jaw easier. The thumbwheel makes for smooth movement of the jaws, but it also makes it easier to apply too much force and potentially damage the calipers or the part being measured.

Measure with the flat area of the jaws whenever possible. You will notice that the tips of the jaws are beveled so you can also measure down into narrow slots (e.g., case extractor groove, bullet cannelure or cast bullet grease groove). But if the groove is too narrow and/or deep, the sides of the jaws may come to rest on the top of the groove, yielding an inaccurate measurement. You must be certain that the narrowed edge of the jaws is making contact at

the bottom of the groove.

Round objects are rarely perfectly round. You should rotate the object and take multiple measurements to find out. The general practice is to use the maximum measurement as the diameter. Or, your goal may be to sort parts (e.g. bullets) by how out of round they are. In this case you would take repeated measurements to find both the maximum and minimum diameter.

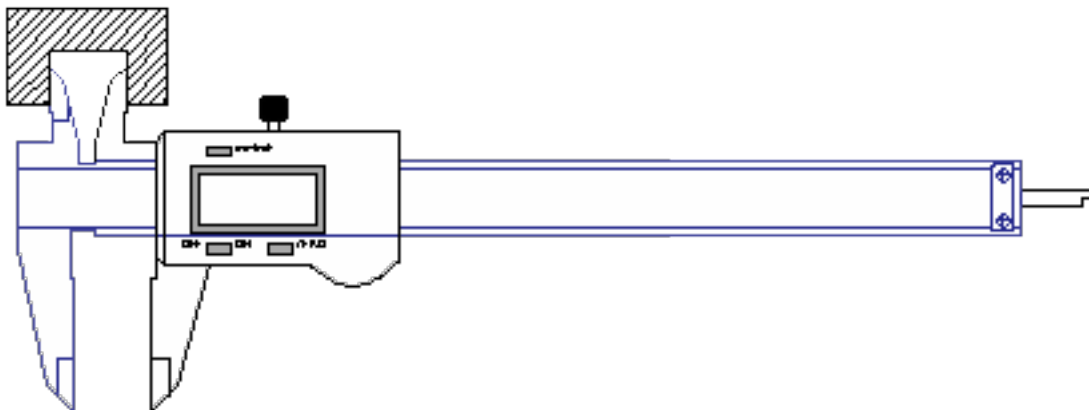
Inside Measurement

The smaller jaws on the top of the caliper are used for inside measurements. You will notice that the sharp edges face away from each other. Inside measurements are used for:

- Case mouth diameter
- Primer pocket diameter

To take an inside measurement:

1. Close the jaws and check zero.
2. Place the inside-measuring jaws into the space to be measured and slide the jaws apart until the jaws contact the part. Use the same amount of pressure that you learned to use for outside measurements.
3. Read the measurement.



4.

It's a little harder to keep things aligned correctly when you are taking an inside measurement. Be sure that the calipers are not cocked, or you will not get an accurate measurement. In reloading, inside measurements will frequently be done on round objects (e.g. cartridge case mouths, primer pocket diameter) and, as stated earlier, they are rarely perfectly round. Plan on taking several measurements with the case rotated a bit each time.

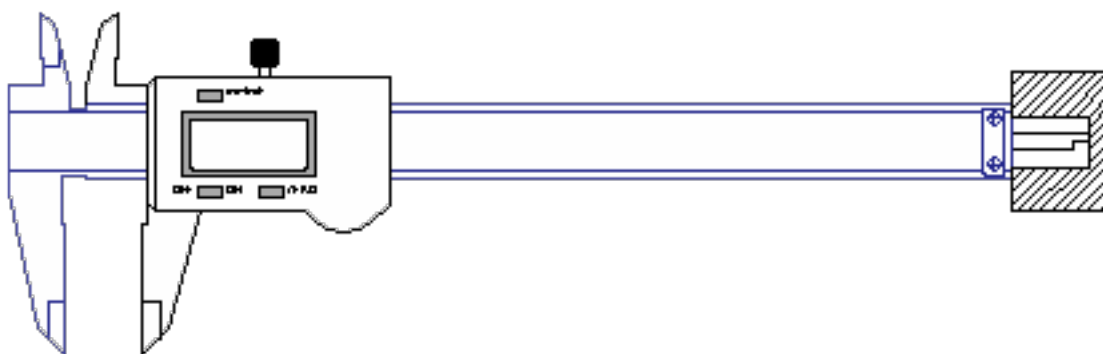
Depth measurement

As you open the caliper the depth blade extends out of the far end. This blade is for taking depth measurements. It is also easily bent if dropped, especially if fully extended. Depth Measurement is used for:

- Primer Seating Depth
- Primer Pocket Depth
- Case Internal Length
- Case Web Thickness (I'll explain in detail later)

To take a depth measurement:

1. Close the caliper jaws and check zero.
2. Press the machined end of the caliper against top of the hole you want to measure.
3. Open the caliper until the depth blade contacts the bottom of the hole.
4. Read the measurement.



It can be tricky keeping the caliper straight over the hole, especially with larger diameter holes where only one side of the caliper beam is resting on the mouth of the hole.

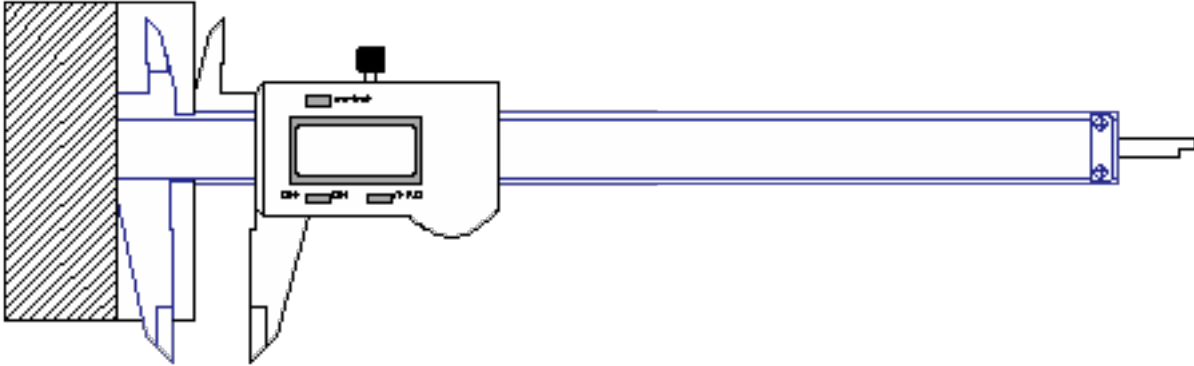
Another technique that I like to use is to set the calipers to slightly more than the depth of the hole. Insert the depth blade into the hole until it just touches bottom, then gently press down until the end of the caliper touches the opening of the hole. Since the depth blade makes contact first it will press the blade up until the caliper beam meets the top of the hole. Read the measurement. This technique frees you to concentrate of holding everything squarely aligned.

Step Measurement

Step measurement is the hidden use of a caliper. Many instructions skip this entirely, but it is still good to know about.

To take a depth measurement:

1. Zero the caliper, and then open the caliper slightly.
2. Place the sliding jaw on the upper step of the work piece, then open the caliper until the fixed jaw contacts the lower step.
3. Read the measurement.



Let's say you want to measure the rim thickness of a .44 Magnum case. The chamfer around the base of the rim makes it difficult to position the calipers jaws to get an accurate measurement. Step measurement can be used to solve this problem.

1. Close the jaws and zero the calipers.
2. Measure the case overall length using the outside measurement jaws.
3. Use step measurement to measure the case length from the mouth to the front face of the rim. Place the sliding jaw against the case mouth, then open the caliper until the fixed jaw contacts the rim.
4. Subtract the two measurements to get the rim thickness.

Compound Measurements

Because you can zero an electronic digital caliper at any point, you can use it to do some of the arithmetic required for compound measurements.

Measuring Case Rim Thickness

The Step Measurement section gave an example for measuring rim thickness. A digital caliper could have been employed to do the subtraction.

1. Close the jaws and zero the calipers.
2. Measure the case overall length using the outside measurement jaws.
3. Press the zero button to zero the display.
4. Use step measurement to measure the case length from the mouth to the front face of the rim. The display will show the rim thickness. *

* In this case, the display will show a negative number. If you find that disconcerting, you can perform the step measurement first and the case overall length second and the result will be a positive number. Either way it is done, it will be the same number.

Sorting Cartridge Cases by Trim Length

If you want to sort cartridge cases for length and separate the cases that are too long and need trimming, from those that are too short.

1. Close the jaws and zero the calipers.
2. Open the jaws and set the calipers to read the desired case length, and then press the zero button.
3. Start measuring cases. Any that measure greater than 0.000 are too long and are separated into a pile to be trimmed. Those that measure a negative number are too short and are separated into a pile to be discarded.

Note: Don't forget to close the jaws and recheck the zero periodically!

This same technique also works for sorting bullets by diameter or length.

*Measuring Cartridge Case Head Thickness**

To measure the cartridge case head thickness, use this procedure.

1. Close the jaws and zero the calipers.
2. Open the jaws and insert the depth measurement blade into the case mouth and measure the inside case length.
3. Press the "zero" button to zero the display.
4. Using the outside measurement jaws, measure the case overall length. The display will show the head thickness.

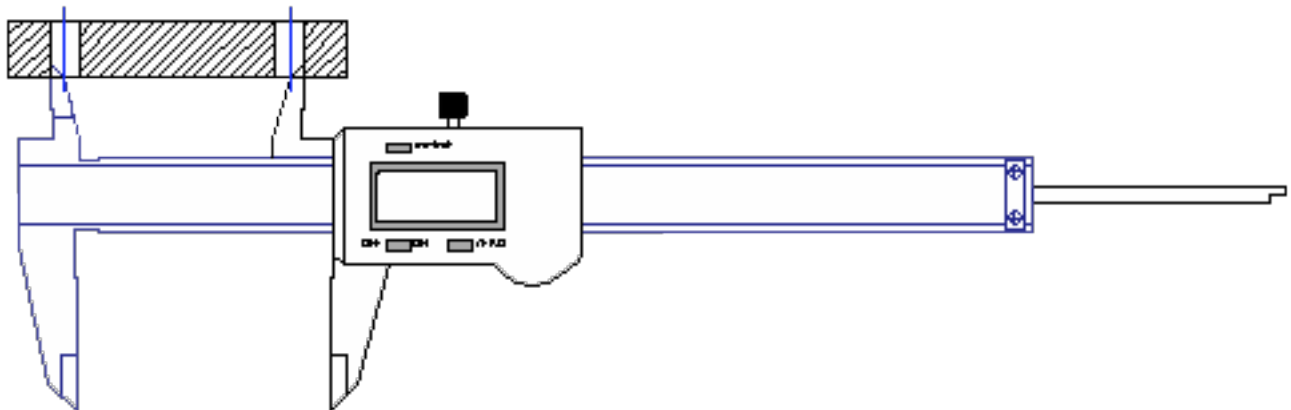
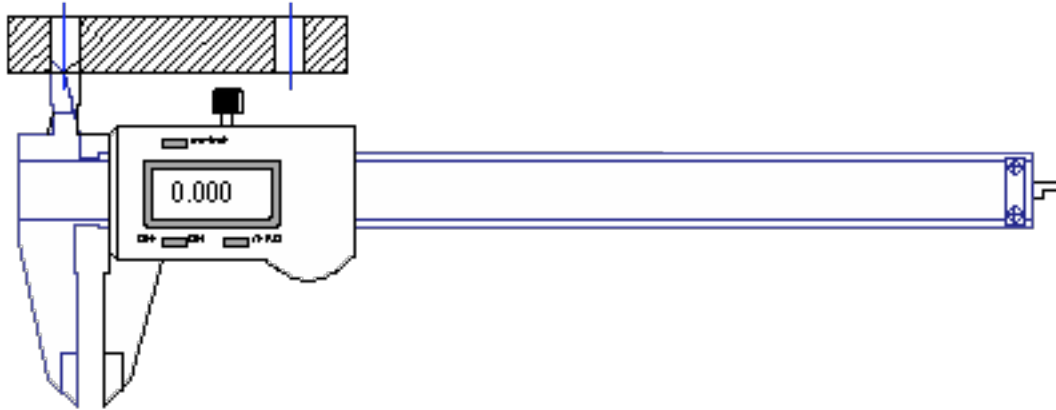
* Measuring the case head thickness is often enough to let you cull out cases with excessively thick or thin webs. If you want to measure the web thickness, you need to measure the primer pocket depth and then subtract it from the case head thickness.

There are many other compound measurements that can be accomplished using electronic digital calipers. You can find all sorts of examples on the Internet. Here are just a few more general examples, not necessarily specific to reloading, but handy to know anyway.

Center Distance

Use this procedure to measure the center distance between two holes of equal diameter.

1. Use the inside jaws to measure the diameter of one of the holes. Before you remove the caliper from the hole, press the button to zero the caliper while it is set to the diameter of the hole.
2. Still using the inside jaws, measure the distance between the far surfaces of the two holes. The caliper reading is the distance between centers of the two holes. Note: Be sure to use the same (inside) jaws for both measurements. And remember that this works only if the holes are the same size.



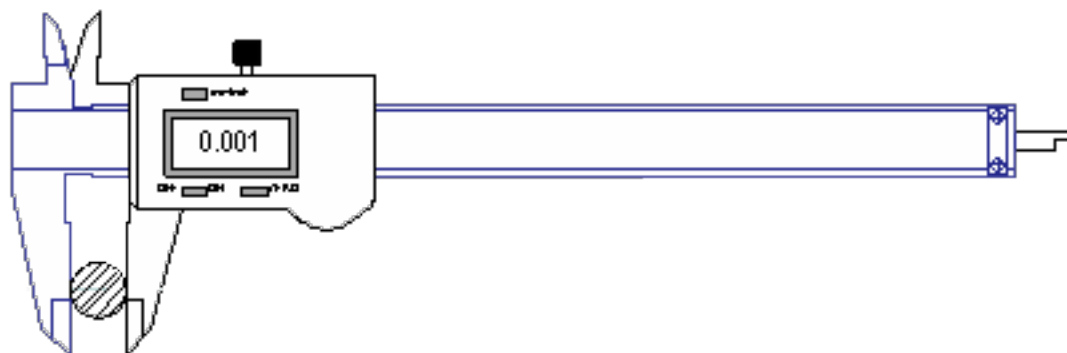
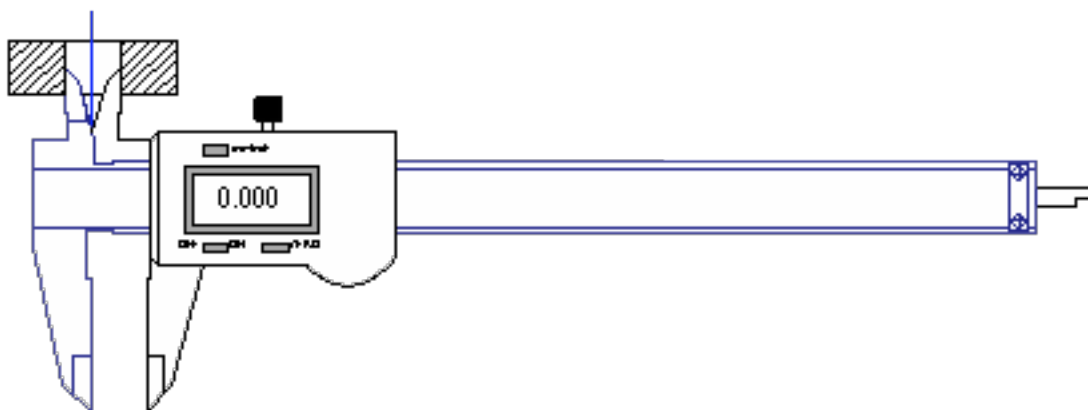
Note: This same technique also works for measuring the distance between the centers of two bolts or studs. You just use the outside jaws instead of the inside jaws. Again, the bolts must be the same size.

Comparing a Hole to a Shaft

Need to make a shaft or pin to fit an existing hole? Or are you boring a cylinder to fit a piston? You can use your electronic caliper to read the size difference directly.

1. Use the inside jaws to measure the diameter of the hole. Before you remove the caliper from the hole, press the button to zero the caliper while it is set to the diameter of the hole.
2. Use the outside jaws to measure the shaft. A positive reading (no minus sign displayed) shows that the shaft is larger than the hole. A negative reading (the minus sign appears to the left of the digits) shows that the shaft is smaller than the hole and will fit.

The caliper shows you how much material you need to remove, from either the shaft or the hole, to make them fit.

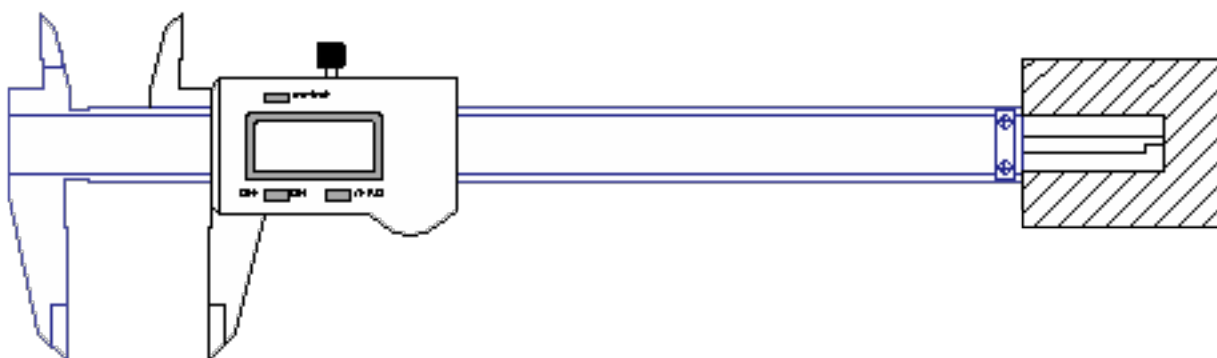
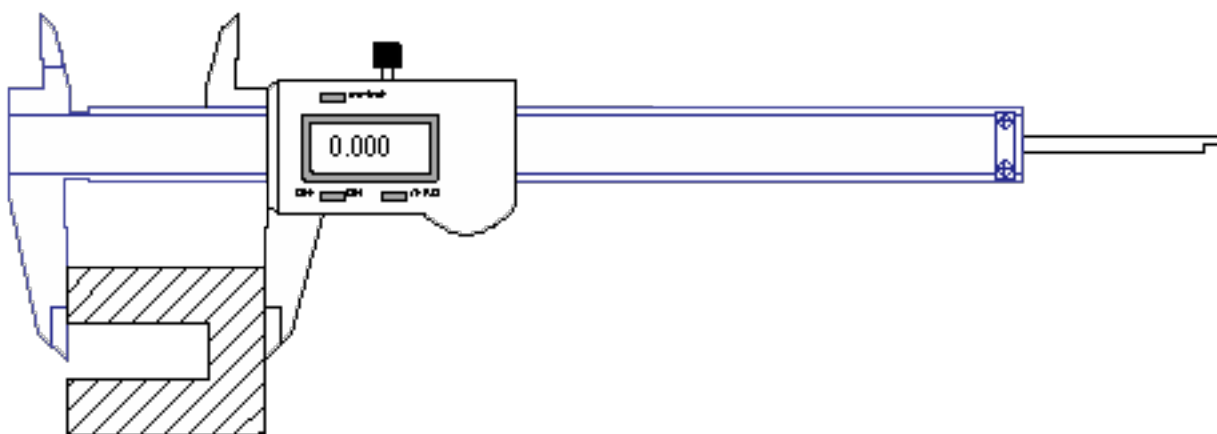


Remaining Thickness

This is the same technique as was previously described for measuring the head thickness of a cartridge case. But it is so handy I wanted to include this description and the nifty drawings.

When you need to drill a hole that does not go through the part, you might want to know how much material remains between the bottom of the hole and the other side of the part. Your electronic caliper can display this distance for you.

1. Use the outside jaws to measure the total thickness of the part. Before you remove the caliper from the part, press the button to zero the caliper while it is set to the thickness of the part.
2. Now use the depth blade to measure the depth of the hole. The caliper reading (shown as a negative number) is the remaining thickness between the bottom of the hole and the other side of the part.



Calibration

Only very expensive calipers (Mitutoyo, Starrett, Fowler, etc.) have a NIST traceable calibration certificate, and will set you back around \$200.00. The digital calipers available from the usual handloading supply sources and costing from \$25.00 to \$85.00, are unlikely to come with a Calibration Certificate. That doesn't mean they aren't good measurement tools. It also doesn't mean you can ignore periodic calibration checks. It is good practice to clean, inspect and calibrate your calipers on a regular basis ... and, of course, after dropping them any significant distance. Dropping calipers is a certain recipe for knocking the jaws out of parallel.

Here is a very good YouTube video demonstrating the calibration of a Digital Calipers.

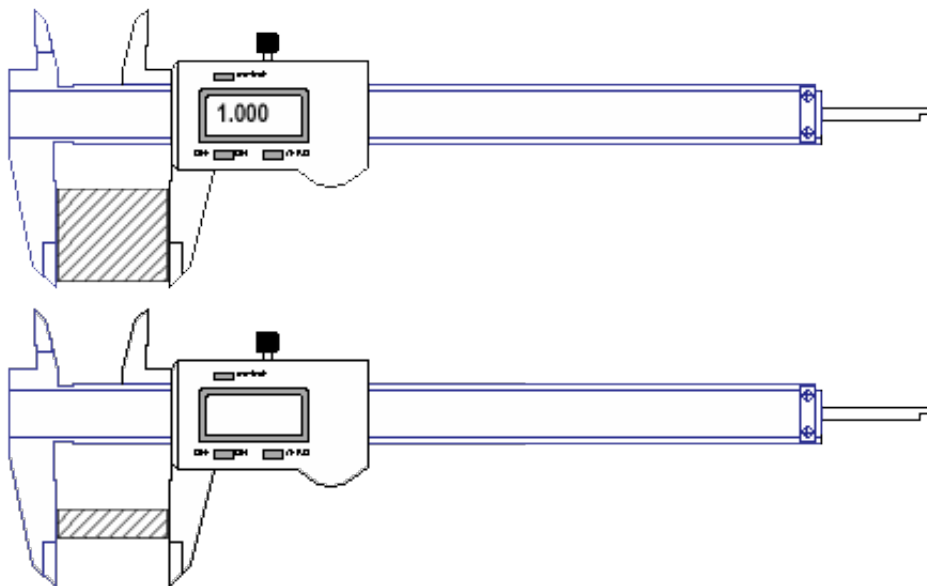
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The calibration method demonstrated in the video comes from the American National Standard on Calipers (ASME B89.1.14). This Standard provides the essential requirements for the specification, verification, and calibration of calipers, including vernier, dial, electronic digital, and specialty calipers.

But you don't need a fancy Calibration Checker like that shown in the video ... or even an entire set of Block Gauges. Just a single 1in Rectangular Gauge Block will provide a quick and effective calibration reference that will suffice for handloading. They are available in Grades K, 00, 0, AS-1 and AS-2. Grade 0 is preferred but Grade AS-1 is acceptable. I found Mitutoyo 1 in Rectangular Gauge Blocks at Grainger for \$45 for Grade 0 and \$39 for Grade AS-1.

Using a Gauge Block

The drawings below show two different ways to use a Gauge Block. The top drawing shows measuring the entire width of the Gauge Block. But the recommended method, shown in the bottom drawing, is to hold the Gauge Block so that you can take multiple measurements down the length of the jaws. This will allow you to check that the jaws are parallel. Measuring at least three locations is recommended.



NOTE: Always handle Gauge Blocks with vinyl or nitrile gloves to prevent contamination with skin oils and sweat. Although the Mitutoyo Gauge Blocks are made from high-carbon, high-chrome steel, and specially heat treated to minimize wear and dimensional change over time, they are still vulnerable to corrosion.

An old school, yet highly effective, test is to fully close the jaws and then hold them up to a bright light. If light is leaking through in spots or at one end, it is a sure sign that the jaws are worn or out of parallel.

Closing Thoughts

I'm certain that you will find many other ways to use calipers at your reloading bench that I didn't mention here. It is this versatility that makes calipers so useful!

References:

Wood, C., and Seichert, C., 2005, Using Calipers, *LittleMachineShop.com*, <https://cdn.shopify.com/s/files/1/0671/3157/2405/files/UsingCalipers.pdf> (as last accessed this site on 30-Oct-2008)