

MODULE 07A

FOR B1 & B2 CERTIFICATION

MAINTENANCE PRACTICES

Aviation Maintenance Technician Certification Series



72413 U.S. Hwy 40
Tabernash, CO 80478-0270 USA

www.actechbooks.com

+1 970 726-5111

WELCOME

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

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We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2016 01	Module Creation and Release
002	2016 08	Module Revisions and Format Updates
003	2018 11	Corrected figure errors in Sub-Module 03, pages 3.67-3.74.

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TOOLS

The aviation maintenance technician spends a major portion of each day using a wide variety of hand tools to accomplish maintenance tasks. This chapter contains an overview of some of the hand tools the aircraft maintenance professional can expect to use. A technician encounters many special tools as their experience widens; large transport category aircraft have different maintenance tasks from those of a light airplane, and special hand tools are often required when working on complex aircraft.

This chapter outlines the basic knowledge required in using the most common hand tools and measuring instruments used in aircraft repair work. This information, however, cannot replace sound judgment on the part of the individual, nor additional training as the need arises. There are many times when ingenuity and resourcefulness can supplement the basic rules. Sound knowledge is required of these basic rules and of the situations in which they apply. The use of tools may vary, but good practices for safety, care, and storage of tools remain the same.

LAYOUT AND MEASURING TOOLS

Due to wise and experienced advice suggesting that you "measure twice before cutting once," we have placed this tool section first in this sub-module.

Layout and measuring devices are precision tools. They are carefully machined, accurately marked and, in many cases, are made up of delicate parts. When using these tools, be careful not to drop, bend, or scratch them.

The finished product will be no more accurate than the measurements or the layout; therefore, it is very important to understand how to read, use, and care for these tools.

RULES

Rules (also called rulers or line gauges) are made of steel and are either rigid or flexible. The flexible steel rule will bend, but it should not be bent intentionally as it may be broken rather easily. In aircraft work, the unit of measure most commonly used is the inch. The inch may be divided into smaller parts by means of either common or decimal fraction divisions.

The fractional divisions for an inch are found by dividing the inch into equal parts: halves ($\frac{1}{2}$), quarters ($\frac{1}{4}$), eighths ($\frac{1}{8}$), sixteenths ($\frac{1}{16}$), thirty-seconds ($\frac{1}{32}$), and sixty-fourths ($\frac{1}{64}$).

The fractions of an inch may be expressed in decimals, called decimal equivalents of an inch; for example, $\frac{1}{8}$ inch is expressed as 0.125 (one hundred twenty-five thousandths of an inch).

Rules are manufactured in two basic styles — those divided or marked in common fractions and those divided or marked in decimals or divisions of one one-hundredth of an inch. A rule may be used either as a measuring tool or as a straightedge. The imperial rule is a bit harder to read than a metric rule. (*Figure 3-1*)

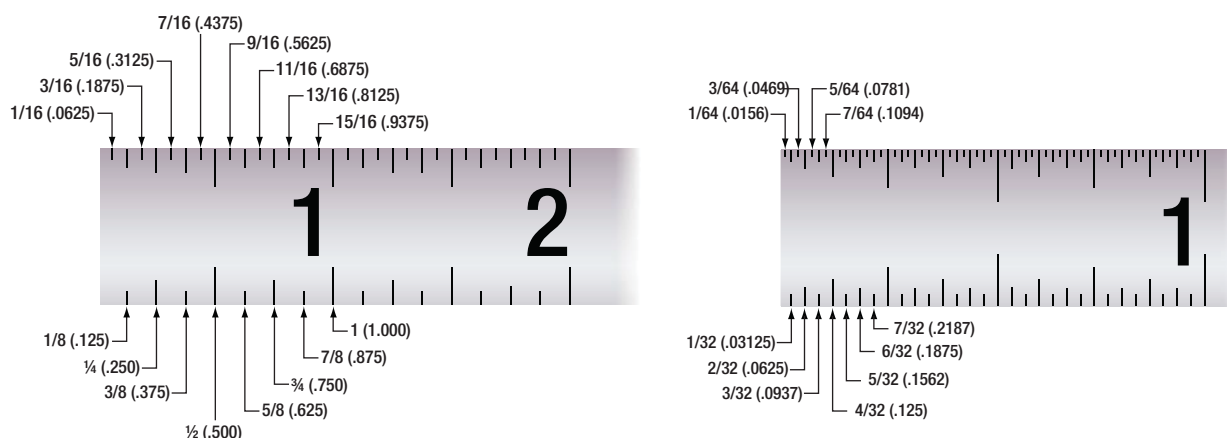


Figure 3-1. Rules.

COMBINATION SETS

The combination set, as its name implies, is a tool that has several uses. It can be used for the same purposes as an ordinary tri-square, but it differs from the tri-square in that the head slides along the blade and can be clamped at any desired place. Combined with the square or stock head are a level and scriber. The head slides in a central groove on the blade or scale, which can be used separately as a rule. (*Figure 3-2*)

The spirit level in the stock head makes it convenient to square a piece of material with a surface and at the same time tell whether one or the other is plumb or level. The head can be used alone as a simple level.

The combination of square head and blade can also be used as a marking gauge to scribe lines at a 45° angle, as a depth gauge, or as a height gauge. A convenient scriber is held frictionally in the head by a small brass bushing. The protractor head can be used to check angles and also may be set at any desired angle to draw lines.

SCRIBER

The scriber is designed to serve the aviation mechanic in the same way a pencil or pen serves a writer. In general, it is used to scribe or mark lines on metal surfaces. The scriber is made of tool steel, 4 to 12 inches long, and has two needle pointed ends. One end is bent at a 90° angle for reaching and marking through holes. (*Figure 3-3*)

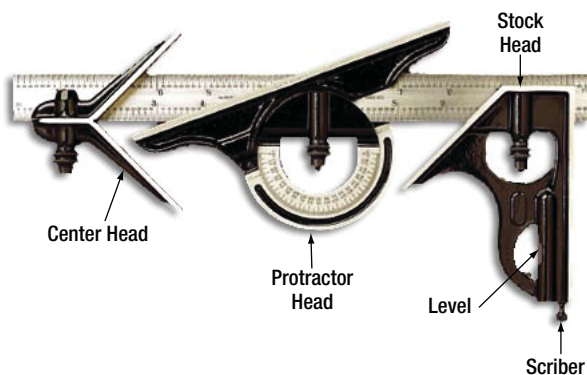


Figure 3-2. Combination set.



Figure 3-3. Scriber.

Before using a scriber, always inspect the points for sharpness. Be sure the straightedge is flat on the metal and in position for scribing. Tilt the scriber slightly in the direction toward which it will be moved, holding it like a pencil. Keep the scriber's point close to the guiding edge of the straightedge. The scribed line should be heavy enough to be visible, but no deeper than necessary to serve its purpose.

DIVIDERS AND PENCIL COMPASSES

Dividers and pencil compasses have two legs joined at the top by a pivot. They are used to scribe circles and arcs and for transferring measurements from the rule to the work. Pencil compasses have one leg tapered to a needle point; the other leg has a pencil or pencil lead inserted. Dividers have both legs tapered to needle points.

When using pencil compasses or dividers, the following procedures are suggested:

1. Inspect the points to make sure they are sharp.
2. To set the dividers or compasses, hold them with the point of one leg in the graduations on the rule. Turn the adjustment nut with the thumb and forefinger; adjust the dividers or compasses until the point of the other leg rests on the graduation of the rule that gives the required measurement.
3. To draw an arc or circle with either the pencil compasses or dividers, hold the thumb attachment on the top with the thumb and forefinger. With pressure exerted on both legs, swing the compass in a clockwise direction and draw the desired arc or circle.
4. The tendency for the legs to slip is avoided by inclining the compasses or dividers in the direction in which they are being rotated. In working on metals, the dividers are used only to scribe arcs or circles that will later be removed by cutting. All other arcs or circles are drawn with pencil compasses to avoid scratching the material.
5. On paper layouts, the pencil compasses are used for describing arcs and circles. Dividers should be used to transfer critical measurements because they are more accurate than a pencil compass.

CALIPERS

Calipers are used for measuring diameters and distances or for comparing distances and sizes. The three common types of calipers are inside, outside, and hermaphrodite calipers. (*Figure 3-4*)

Outside calipers are used for measuring outside dimensions — for example, the diameter of a piece of round stock. Inside calipers have outward curved legs for measuring inside diameters, such as diameters of holes, the distance between two surfaces, the width of slots, and other similar jobs. A hermaphrodite caliper is generally used as a marking gauge in layout work. It should not be used for precision measurement.

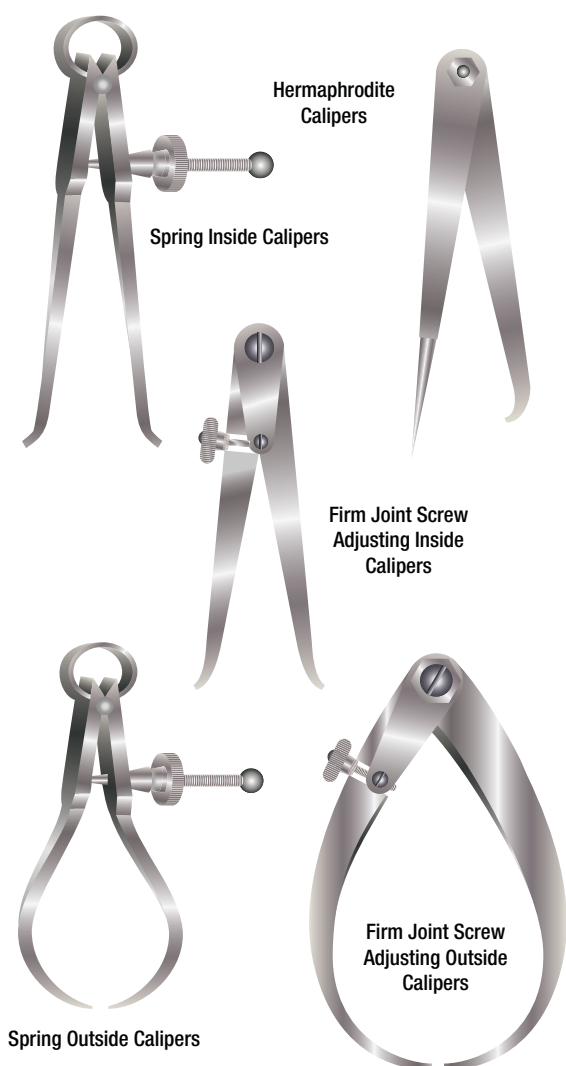


Figure 3-4. Calipers.

MICROMETER CALIPERS

There are four types of micrometer calipers, each designed for a specific use: outside micrometer, inside micrometer, depth micrometer, and thread micrometer. Micrometers are available in a variety of sizes, either 0 to ½ inch, 0 to 1 inch, 1 to 2 inch, 2 to 3 inch, 3 to 4 inch, 4 to 5 inch, or 5 to 6 inch sizes. In addition to the micrometer inscribed with the measurement markings, micrometers equipped with electronic digital liquid crystal display (LCD) readouts are also in common use.

The AMT will use the outside micrometer more often than any other type. It may be used to measure the outside dimensions of shafts, thickness of sheet metal stock, the diameter of drills, and for many other applications. (*Figure 3-5*)

The smallest measurement which can be made with the use of the steel rule is one sixty-fourth of an inch in common fractions, and one one-hundredth of an inch in decimal fractions.

To measure more closely than this (in thousandths and ten-thousandths of an inch), a micrometer is used. If a dimension given in a common fraction is to be measured with the micrometer, the fraction must be converted to its decimal equivalent.

All four types of micrometers are read in the same way. The method of reading an outside micrometer is discussed later in this chapter.



Figure 3-5. Outside micrometers.

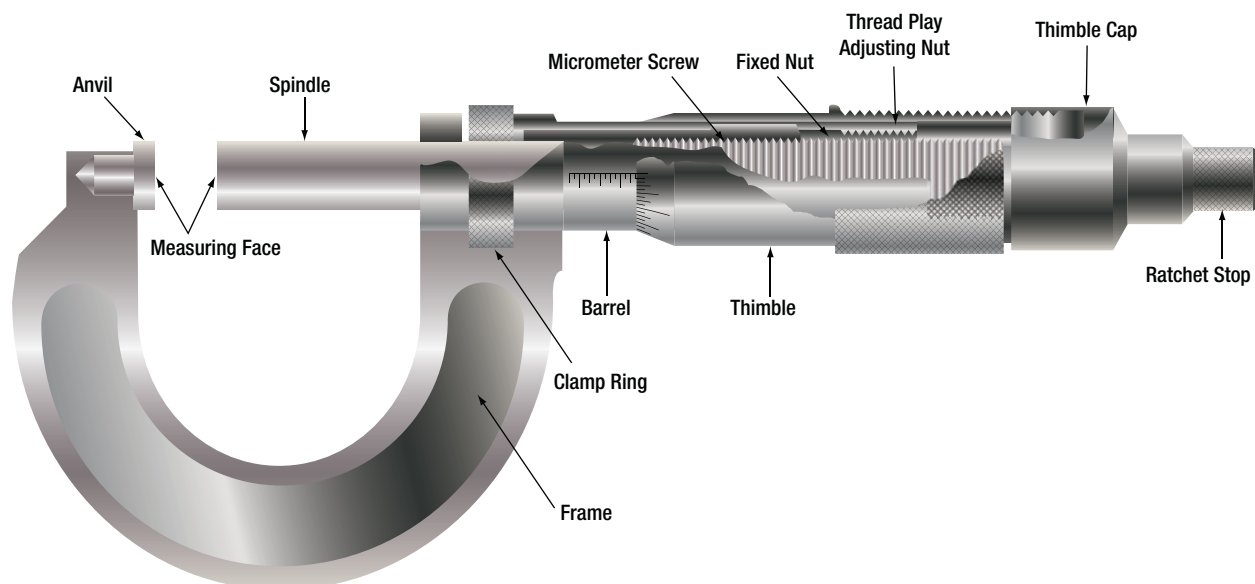


Figure 3-6. Outside micrometer parts.

Micrometer Parts

The fixed parts of a micrometer are the frame, barrel, and anvil. The movable parts of a micrometer are the thimble and spindle. The thimble rotates the spindle which moves in the threaded portion inside the barrel. Turning the thimble provides an opening between the anvil and the end of the spindle where the work is measured. The size of the work is indicated by the graduations on the barrel and thimble. (*Figure 3-6*)

Reading A Micrometer

The lines on the barrel marked 1, 2, 3, 4, and so forth, indicate measurements of tenths, or 0.100 inch, 0.200 inch, 0.300 inch, 0.400 inch, respectively. (*Figure 3-7*)

Each of the sections between the tenths divisions (between 1, 2, 3, 4, and so forth) is divided into four

parts of 0.025 inch each. One complete revolution of the thimble (from zero on the thimble around to the same zero) moves it one of these divisions (0.025 inch) along the barrel.

The bevel edge of the thimble is divided into 25 equal parts. Each of these parts represents one twenty-fifth of the distance the thimble travels along the barrel in moving from one of the 0.025 inch divisions to another. Thus, each division on the thimble represents one one-thousandth (0.001) of an inch.

These divisions are marked for convenience at every five spaces by 0, 5, 10, 15, and 20. When 25 of these graduations have passed the horizontal line on the barrel, the spindle (having made one revolution) has moved 0.025 inch.

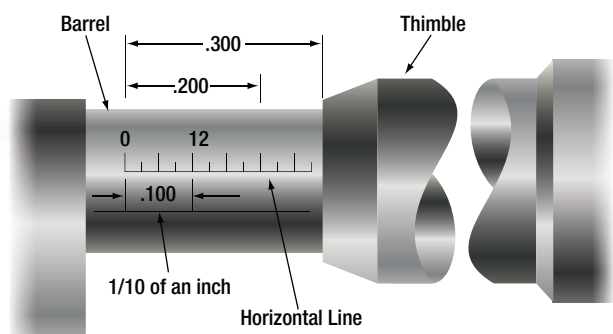


Figure 3-7. Micrometer measurements.

The micrometer is read by first noting the last visible figure on the horizontal line of the barrel representing tenths of an inch. Add to this the length of barrel between the thimble and the previously noted number. (This is found by multiplying the number of graduations by 0.025 inch.) Add to this the number of divisions on the bevel edge of the thimble that coincides with the line of the graduation. The total of the three figures equals the measurement. *Figure 3-8* shows several sample readings.

Vernier Scale

Some micrometers are equipped with a vernier scale that makes it possible to directly read the fraction of a division that is indicated on the thimble scale. Typical examples of the vernier scale as it applies to the micrometer are shown in **Figure 3-9**.

All three scales on a micrometer are not fully visible without turning the micrometer, but the examples shown in **Figure 3-8** are drawn as though the barrel and thimble of the micrometer were laid out flat so that all three scales can be seen at the same time. The barrel scale is the lower horizontal scale, the thimble scale is vertical on the right, and the long horizontal lines (0 through 9 and 0) make up the vernier scale.

In reading a micrometer, an excellent way to remember the relative scale values is to remember that the 0.025 inch barrel scale graduations are established by the lead screw (40 threads per inch). Next, the thimble graduations divide the 0.025 inch into 25 parts, each equal to 0.001 inch. Then, the vernier graduations divide the 0.001 inch into 10 equal parts, each equal to 0.0001 inch. Remembering the values of the various scale graduations, the barrel scale reading is noted. The thimble scale reading is added to it; then the vernier scale reading is added to get the final reading. The vernier scale line to be read is always the one aligned exactly with any thimble graduation.

In the first example in **Figure 3-9**, the barrel reads 0.275 inch and the thimble reads more than 0.019 inch. The number 1 graduation on the thimble is aligned exactly with the number 4 graduation on the vernier scale. Thus, the final reading is 0.2944 inch. In the second example in **Figure 3-9**, the barrel reads 0.275 inch, and the thimble reads more than 0.019 inch and less than 0.020 inch. On the vernier scale, the number 7 graduation coincides with a line on the thimble. This means that the thimble reading would be 0.0197 inch. Adding this to the barrel reading of 0.275 inch gives a total measurement of 0.2947 inch.

The third and fourth examples in **Figure 3-9** are additional readings that would require use of the vernier scale for accurate readings to ten-thousandths of an inch.

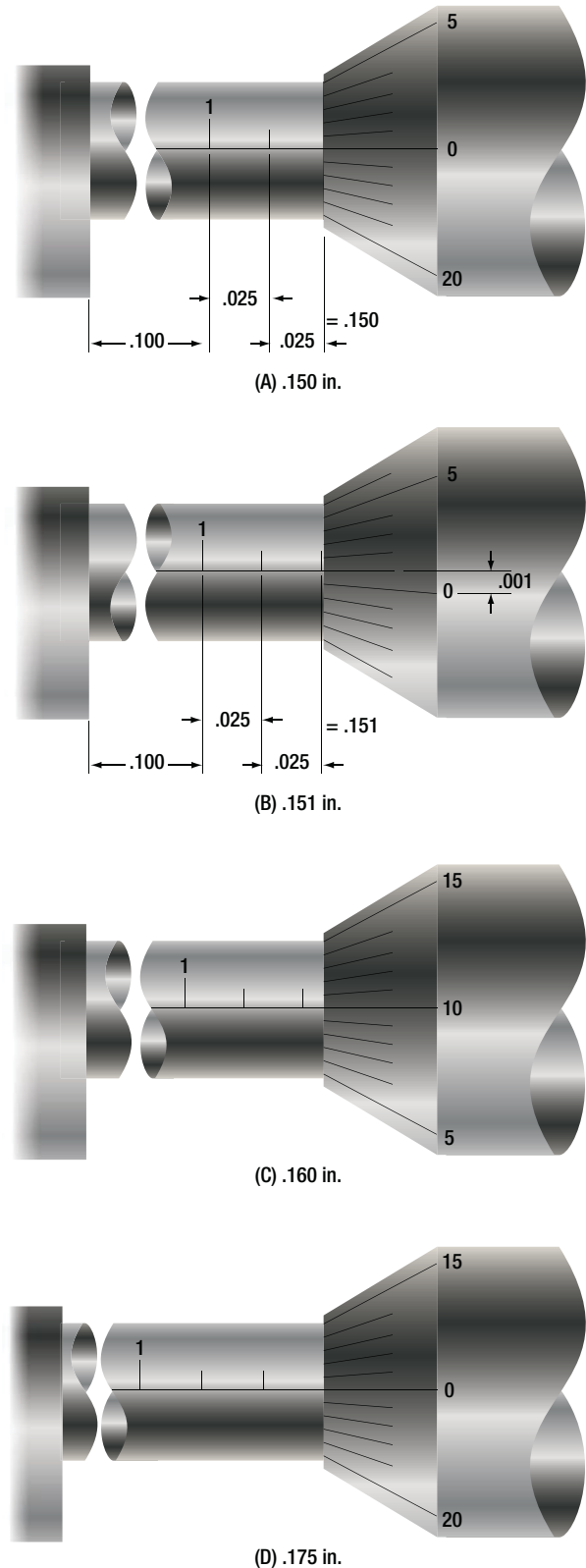


Figure 3-8. Reading a micrometer.

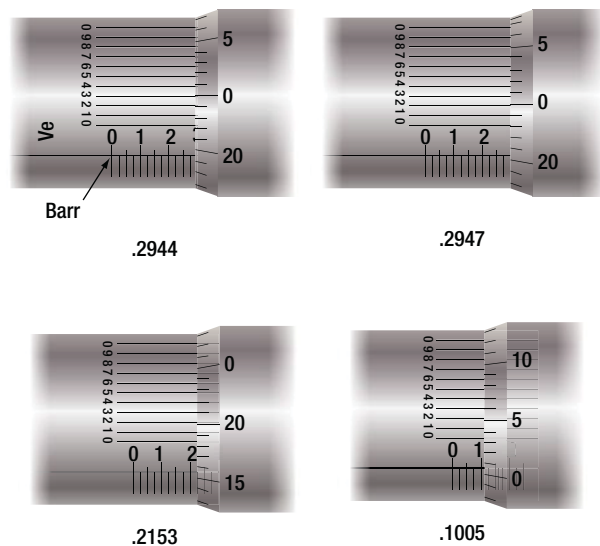


Figure 3-9. Vernier scale readings.

Using A Micrometer

The micrometer must be handled carefully. If it is dropped, its accuracy may be permanently affected. Continually sliding work between the anvil and spindle may wear the surfaces. If the spindle is tightened too much, the frame may be sprung permanently and inaccurate readings will result.

To measure a piece of work with the micrometer, hold the frame of the micrometer in the palm of the hand with the little finger or third finger, whichever is more convenient. This allows the thumb and forefinger to be free to turn the thimble for adjustment.

DIAL INDICATOR

A variation of the micrometer is the dial indicator, which measures variations in a surface by using an accurately machined probe mechanically linked to a circular hand whose movement indicates thousandths of an inch, or is displayed on a liquid crystal display (LCD) screen. (*Figure 3-10*)

A typical example would be using a dial indicator to measure the amount of runout, or bend, in a shaft. If a bend is suspected, the part can be rotated while resting between a pair of machined V-blocks. A dial indicator is then clamped to a machine table stand, and the probe of the indicator is positioned so it lightly contacts the surface. The outer portion of the dial is then rotated until the needle is pointed at zero. The part is then rotated,



Figure 3-10. Dial indicator.

and the amount of bend is displayed on the dial as the needle fluctuates. The total amount of the fluctuation is the runout.

Another common use for the dial indicator is to check for a warp in a rotating component such as a brake disc. In some cases, this can be done with the brake disc installed on the airplane, with the base clamped to a stationary portion of the structure. In either case, it is imperative that the dial indicator be securely fastened so that the movement of the indicator itself induces no errors in measurement.

SLIDE CALIPERS

Often used to measure the length of an object, the slide caliper provides greater accuracy than the ruler. It can, by virtue of its specially formed jaws, measure both inside and outside dimensions. As the tool's name implies, the slide caliper jaw is slid along a graduated scale, and its jaws then contact the inside or outside of the object to be measured. The measurement is then read on the scale located on the body of the caliper, or on the LCD screen. (*Figure 3-11*)

Some slide calipers also contain a depth gauge for measuring the depth of blind holes.

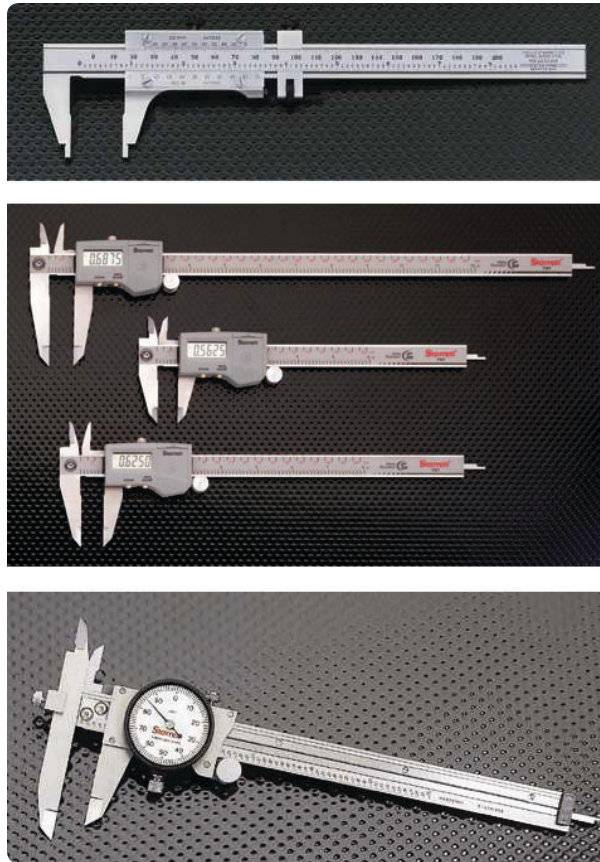


Figure 3-11. Various types of slide calipers.

GENERAL PURPOSE TOOLS

SCREWDRIVERS

The screwdriver can be classified by its shape, type of blade, and blade length. It is made for only one purpose, i.e., for loosening or tightening screws or screw head bolts. **Figure 3-12** shows several different types of screwdrivers. When using the common screwdriver, select the largest screwdriver whose blade will make a good fit in the screw that is to be turned.

A common screwdriver must fill at least 75 percent of the screw slot. If the screwdriver is the wrong size, it cuts and burrs the screw slot, making it worthless. The damage may be so severe that the use of screw extractor may be required. A screwdriver with the wrong size blade may slip and damage adjacent parts of the structure. The common screwdriver is used only where slotted head screws or fasteners are found on aircraft. An example of a fastener that requires the use of a common screwdriver is the cam-lock style fastener that is used to secure the cowling on some aircraft.

The two types of recessed head screws in common use are the Phillips and the Reed & Prince.

Both the Phillips and Reed & Prince recessed heads are optional on several types of screws. As shown in **Figure 3-12**, the Reed & Prince recessed head forms a perfect cross. The screwdriver used with this screw is pointed on the end. Since the Phillips screw has a slightly larger center in the cross, the Phillips screwdriver is blunt on the end. The Phillips screwdriver is not interchangeable with the Reed & Prince. The use of the wrong type screwdriver results in mutilation of the screwdriver and the screw head. When turning a recessed head screw, use only the proper recessed head screwdriver of the correct size. The most common crosspoint screwdrivers are the Number 1 and Number 2 Phillips.

An offset screwdriver may be used when vertical space is limited. Offset screwdrivers are constructed with both ends bent 90° to the shank handle. By using alternate ends, most screws can be seated or loosened even when the swinging space is limited.