

## CHAPTER 2

# MEASURING TOOLS AND TECHNIQUES

When performing maintenance and repair tasks on catapults and arresting gear equipment, you must take accurate measurements during inspection, to determine the amount of wear or service life remaining on a particular item or to make sure replacement parts used to repair equipment meet established specifications. The accuracy of these measurements, often affecting the performance and failure rates of the concerned equipment, depends on the measuring tool you use and your ability to use it correctly.

### COMMON MEASURING TOOLS

**LEARNING OBJECTIVES:** Identify the different types of measuring tools. Describe the uses of different types of measuring tools. Describe the proper care of measuring tools.

You will use many different types of measuring tools in the daily performance of your duties. Where exact measurements are required, use a micrometer caliper (mike). If you use the micrometer caliper properly, it will allow you to measure within one ten-thousandth (0.0001) of an inch accuracy. On the other hand, where accuracy is not extremely critical, a common straightedge rule or tape rule will suffice for most measurements.

### RULES AND TAPES

Figure 2-1 illustrates some of the commonly used straightedge and tape rules. Of all measuring tools, the

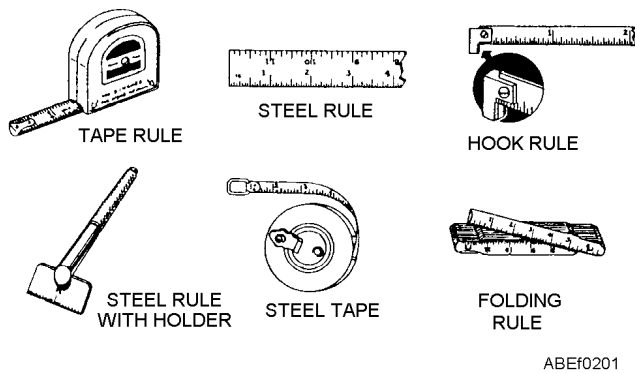


Figure 2-1.—Some common types of rules.

simplest and most common is the steel or wooden straightedge rule. This rule is usually 6 or 12 inches long, although other lengths are available. Steel rules may be flexible or nonflexible, but the thinner the rule is, the easier it is to measure accurately with it, because the division marks are closer to the work to be measured.

Generally, a rule has four sets of graduated division marks, one on each edge of each side of the rule. The longest lines represent the inch marks. On one edge, each inch is divided into 8 equal spaces, so each space represents 1/8 inch. The other edge of this side is divided into sixteenths. The 1/4-inch and 1/2-inch marks are commonly made longer than the smaller division marks to facilitate counting, but the graduations are not normally numbered individually, as they are sufficiently far apart to be counted without difficulty. The opposite side of the rule is similarly divided into 32 and 64 spaces per inch, and it is common practice to number every fourth division for easier reading.

There are many variations of the common rule. Sometimes the graduations are on one side only, sometimes a set of graduations is added across one end for measuring in narrow spaces, and sometimes only the first inch is divided into 64ths, with the remaining inches divided into 32nds and 16ths.

Steel tapes are made from 6 to about 300 feet in length. The shorter lengths are frequently made with a curved cross section so that they are flexible enough to roll up, but remain rigid when extended. Long, flat tapes require support over their full length when measuring, or the natural sag will cause an error in reading.

### MEASURING PROCEDURES

To take a measurement with a common rule, hold the rule with its edge on the surface of the object being measured. This will eliminate parallax and other errors that might result because of the thickness of the rule. Read the measurement at the graduation that coincides with the distance to be measured, and state it as being so

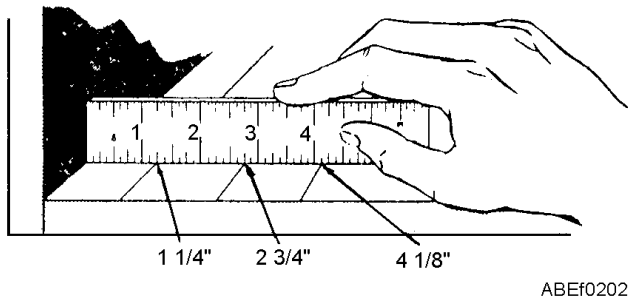


Figure 2-2.—Measuring with and reading a common rule.

many inches and fractions of an inch. (See fig. 2-2.) Always reduce fractions to their lowest terms, for example, 6/8 inch would be called 3/4 inch. A hook or eye at the end of a tape or rule is normally part of the first measured inch.

### Bolts and Screws

The length of bolts and screws is best measured by holding them up against a rigid rule or tape. Hold both the rule and the bolt or screw to be measured up to your eye level, so that your line of sight will not be in error in reading the measurement. As shown in figure 2-3, the bolts or screws with countersink-type heads are measured from the top of the head to the opposite end, while those with other types of heads are measured from the bottom of the head.

### Outside Pipe Diameters

To measure the outside diameter of a pipe, you should use some kind of rigid rule. A wooden rule or a steel rule is satisfactory for this purpose. As shown in figure 2-4, line up the end of the rule with one side of the pipe, using your thumb as a stop. Then, with the one end held in place with your thumb, swing the rule through an arc and take the maximum reading at the

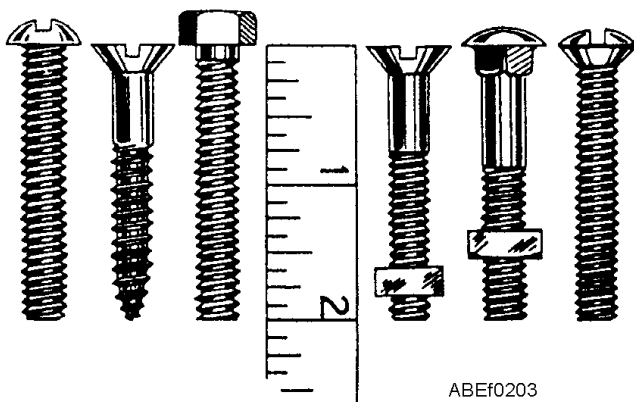


Figure 2-3.—Measuring the length of a bolt or screw.

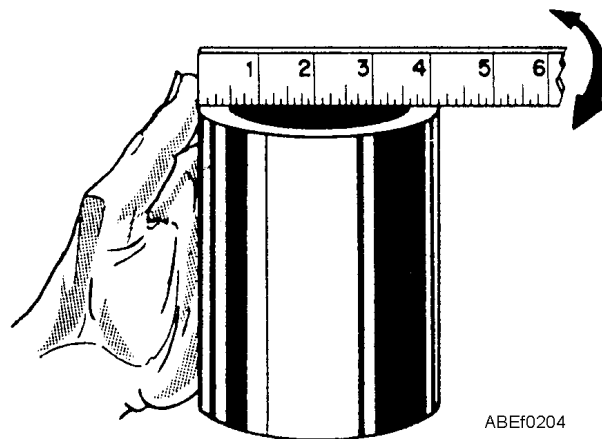


Figure 2-4.—Measuring the outside diameter of a pipe.

other side of the pipe. For most purposes, the measurement obtained by using this method is satisfactory. It is necessary that you know how to take this measurement, as the outside diameter of pipe is sometimes the only dimension given on pipe specifications.

### Inside Pipe Diameters

To measure the inside diameter of a pipe with a rule, as shown in figure 2-5, hold the rule so that one corner of the rule just rests on the inside of one side of the pipe. Then, with one end thus held in place, swing the rule through an arc and read the diameter across the maximum inside distance. This method is satisfactory for an approximate inside measurement.

### Pipe Circumferences

To measure the circumference of a pipe, you must use a flexible-type rule that will conform to the shape of the pipe. A fabric or steel flexible tape rule is adaptable to this job. When measuring the pipe, make sure the tape is wrapped squarely around the axis of the pipe to ensure that the measurement will not be more than the

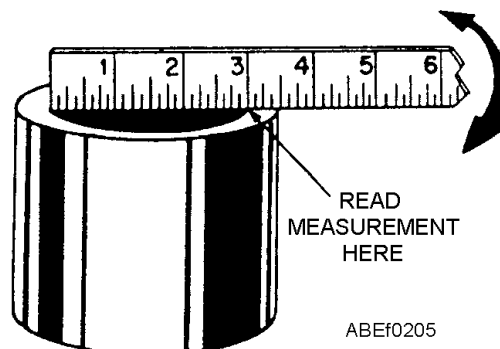


Figure 2-5.—Measuring the inside diameter of a pipe.

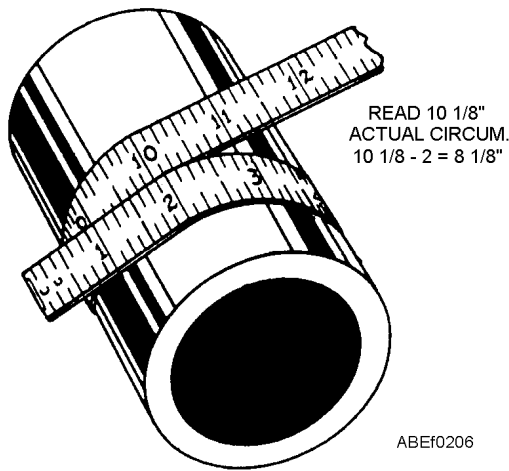


Figure 2-6.—Measuring the circumference of a pipe with a tape rule.

actual circumference of the pipe. This is extremely important when you are measuring a large diameter pipe.

Hold the rule or tape as shown in figure 2-6. Take the reading, using the 2-inch graduation, for example, as the reference point. In this case the correct reading is found by subtracting 2 inches from the actual reading. In this way the first 2 inches of the tape, serving as a handle, will enable you to hold the tape securely.

### Inside Dimensions

For an inside measurement such as the inside of a box, a folding rule that incorporates a 6- or 7-inch sliding extension is one of the best measuring tools. To take the inside measurement, first unfold the folding rule to the approximate dimension. Then, extend the end of the rule and read the length that it extends, adding the length of the extension to the length on the

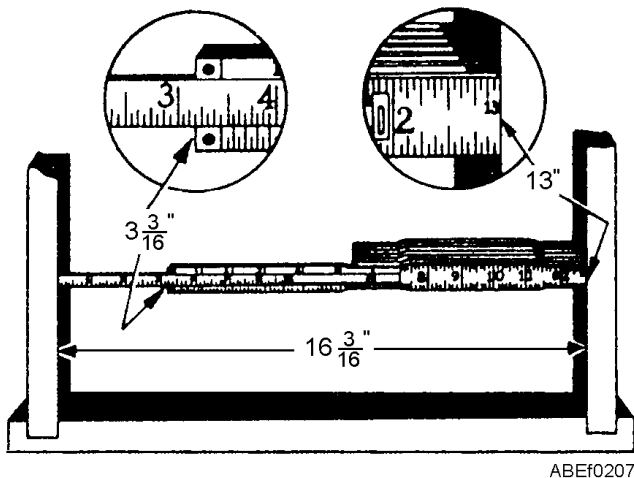


Figure 2-7.—Using a folding rule to measure an inside dimension.

main body of the rule. See figure 2-7. In this illustration the length of the main body of the rule is 13 inches, and the extension is pulled out  $3 \frac{3}{16}$  inches; the total inside dimension being measured is  $16 \frac{3}{16}$  inches.

Notice in the circled inset in figure 2-8 that the hook at the end of the particular rule shown is attached to the rule so that it is free to move slightly. When an outside dimension is taken by hooking the end of the rule over an edge, the hook will move to locate the end of the rule even with the surface from which the measurement is being taken. By being free to move, the hook will retract toward the end of the rule when an inside dimension is taken. To measure an inside dimension using a tape rule, extend the rule between the surfaces as shown, take a reading at the point on the scale where the rule enters the case, and add 2 inches. The 2 inches are the length of the case. The total is the inside dimension being taken.

### Outside Dimensions

To measure an outside dimension using a tape rule, hook the rule over the edge of the stock. Pull the tape out until it projects far enough from the case to permit measuring the required distance. The hook at the end of the rule is designed so that it will locate the end of the rule at the surface from which the measurement is being taken. When taking a measurement of length, hold the tape parallel to the lengthwise edge. For measuring widths, the tape should be at right angles to the lengthwise edge. Read the dimension of the rule exactly at the edge of the piece being measured.

It may not always be possible to hook the end of the tape over the edge of stock being measured. In this case it may be necessary to butt the end of the tape against another surface or to hold the rule at a starting point from which a measurement is to be taken.

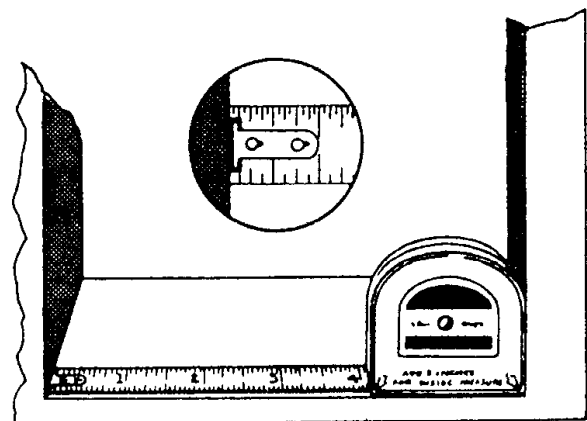


Figure 2-8.—Measuring an inside dimension with a tape rule.

## Distance Measurements

Steel or fiberglass tapes are generally used for making long measurements. Secure the hook end of the tape. Hold the tape reel in the hand and allow it to unwind while walking in the direction in which the measurement is to be taken. Stretch the tape with sufficient tension to overcome sagging. At the same time make sure the tape is parallel to an edge or the surface being measured. Read the graduation on the tape by noting which line on the tape coincides with the measurement being taken.

## CARE OF RULES AND TAPES

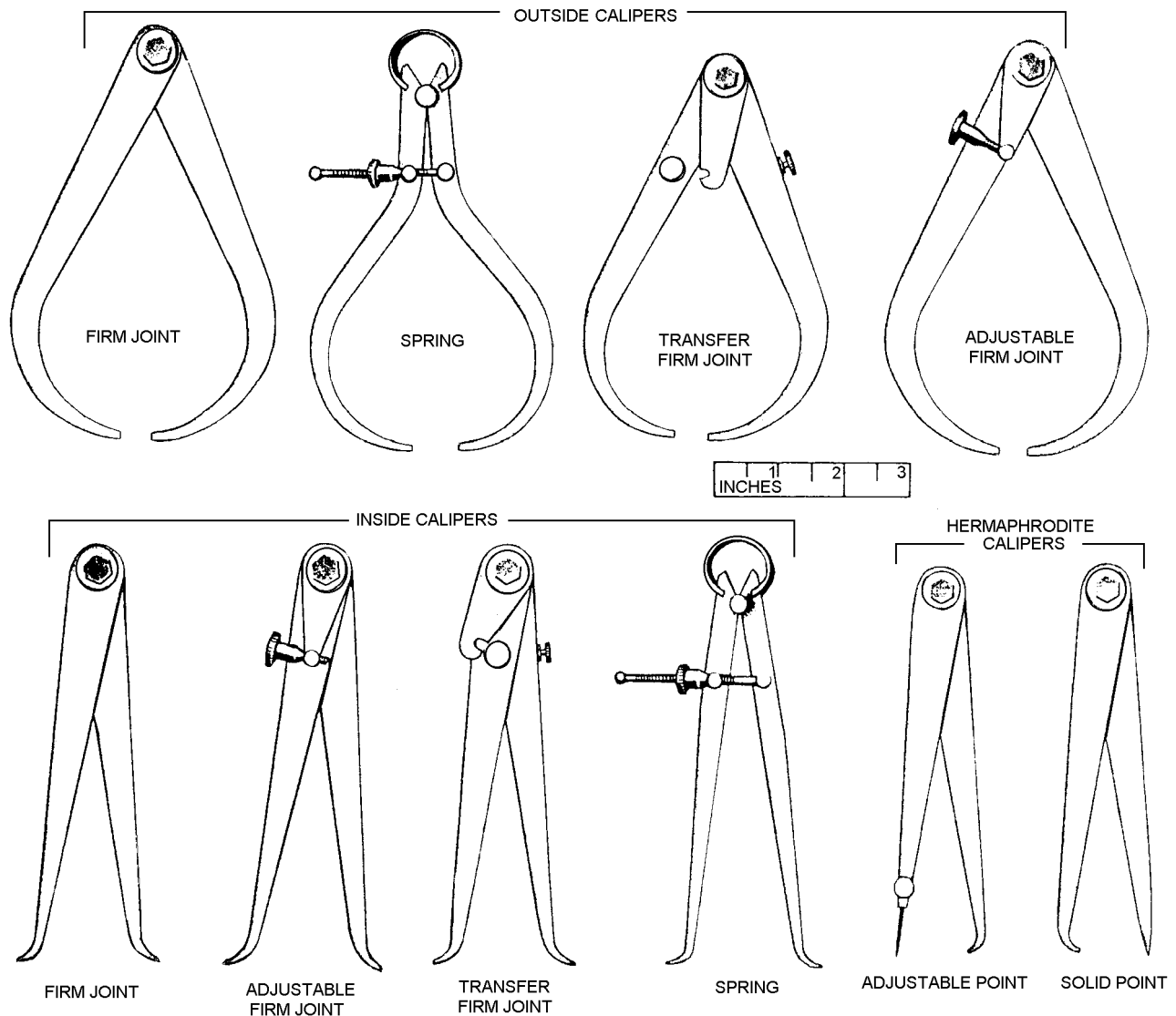
Handle rules and tapes carefully and keep metal ones lightly oiled to prevent rust. Never allow the edges of measuring devices to become nicked by striking

them with hard objects. They should preferably be kept in a wooden box when not in use.

To avoid kinking tapes, pull them straight out from their cases—do not bend them backward. With the windup type, always turn the crank clockwise—turning it backward will kink or break the tape. With the spring-wind type, guide the tape by hand. If it is allowed to snap back, it may be kinked, twisted, or otherwise damaged. Do not use the hook as a stop. Slow down as you reach the end.

## SIMPLE CALIPERS

Simple calipers are used in conjunction with a scale or rule to determine the thickness or the diameter of a surface, or the distance between surfaces. The calipers you will most commonly use are shown in figure 2-9.



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Figure 2-9.—Simple calipers—noncalibrated.

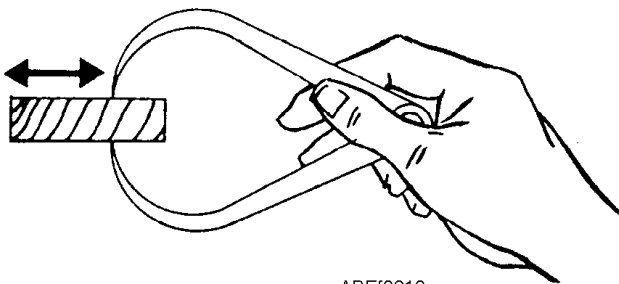
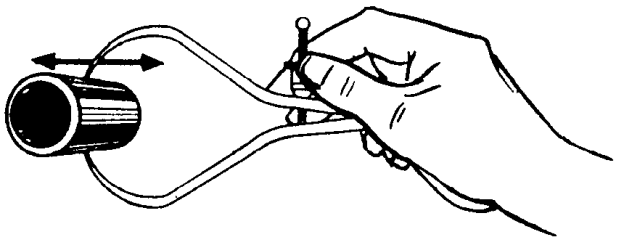
Outside calipers for measuring outside diameters are bow-legged; those used for inside diameters have straight legs with the feet turned outward. Calipers are adjusted by pulling or pushing the legs to open or close them. Fine adjustment is made by tapping one leg lightly on a hard surface to close them, or by turning them upside down and tapping on the joint end to open them.

Spring-joint calipers have the legs joined by a strong spring hinge and linked together by a screw and adjusting nut. For measuring chamfered cavities (grooves) or for use over flanges, transfer calipers are available. They are equipped with a small auxiliary leaf attached to one of the legs by a screw (fig. 2-9). The measurement is made as with ordinary calipers; then the leaf is locked to the leg. The legs may then be opened or closed as needed to clear the obstruction, then brought back and locked to the leaf again, thus restoring them to the original setting.

A different type of caliper is the hermaphrodite, sometimes called odd-leg caliper. This caliper has one straight leg ending in a sharp point, sometimes removable, and one bow leg. The hermaphrodite caliper is used chiefly for locating the center of a shaft, or for locating a shoulder.

## USING CALIPERS

A caliper is usually used in one of two ways. Either the caliper is set to the dimension of the work and the dimension transferred to a scale, or the caliper is set on a scale and the work machined until it checks with the



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Figure 2-10.—Using an outside caliper.

dimension set up on the caliper. To adjust a caliper to a scale dimension, hold one leg of the caliper firmly against one end of the scale and adjust the other leg to the desired dimension. To adjust a caliper to the work, open the legs wider than the work and then bring them down to the work.

## CAUTION

Never place a caliper on work that is revolving in a machine.

## Measuring the Diameter of Round Stock or the Thickness of Flat Stock

To measure the diameter of round stock or the thickness of flat stock, adjust the outside caliper so that you feel a slight drag as you pass it over the stock. (See fig. 2-10.) After the proper "feel" has been attained, measure the setting of the caliper with a rule. In reading the measurement, sight over the leg of the caliper after making sure the caliper is set squarely with the face of the rule.

## Measuring the Distance Between Two Surfaces

To measure the distance between two surfaces with an inside caliper, first set the caliper to the approximate distance being measured. Hold the caliper with one leg in contact with one of the surfaces being measured. (See fig. 2-11.) Then, as you increase the setting of the caliper, move the other leg from left to right. Feel for the slight drag indicating the proper setting of the caliper. Then, remove the caliper and measure the setting with a rule.

## Measuring Hard-to-Reach Dimensions

To measure an almost inaccessible outside dimension, such as the thickness of the bottom of a cup, use an outside transfer firm-joint caliper as shown in

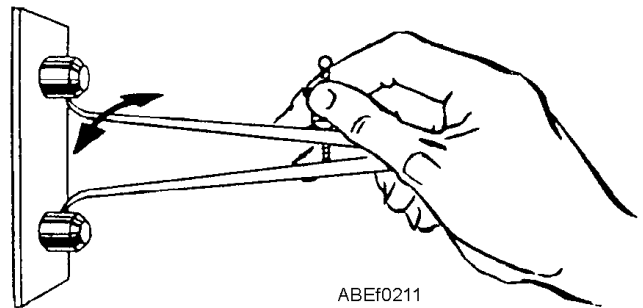


Figure 2-11.—Measuring the distance between two surfaces with an inside caliper.

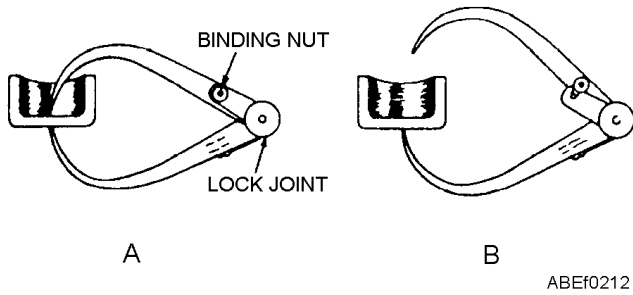


Figure 2-12.—Measuring the thickness of the bottom of a cup.

figure 2-12. When the proper "feel" is obtained, tighten the lock joint. Then, loosen the binding nut and open the caliper enough to remove it from the cup. Close the caliper again and tighten the binding nut to seat in the slot at the end of the auxiliary arm. The caliper is now at the original setting, representing the thickness of the bottom of the cup. The caliper setting can now be measured with a rule.

To measure a hard-to-reach inside dimension, such as the internal groove shown in figure 2-13, use an inside transfer firm-joint caliper. Use the procedure for measuring a hard-to-reach outside dimension.

### Measuring Hole Diameters

To measure the diameter of a hole with an inside caliper, hold the caliper with one leg in contact with one side of the hole (fig. 2-14) and, as you increase the setting, move the other leg from left to right, and in and out of the hole. When you have found the point of largest diameter, remove the caliper and measure the caliper setting with a rule.

### Setting a Combination Firm-Joint Caliper

To set a combination firm-joint caliper with a rule, when the legs are in position for outside measurements, grasp the caliper with both hands as shown in view A of figure 2-15, and adjust both legs to the approximate setting. After you adjust both legs, the shape of the tool

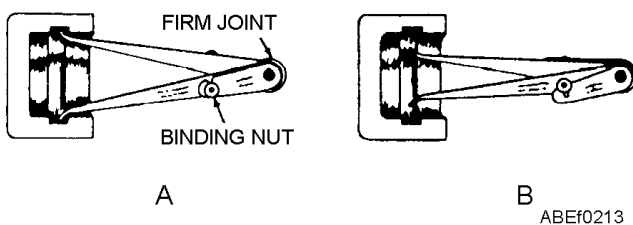


Figure 2-13.—Measuring a hard-to-reach inside dimension with an inside caliper.

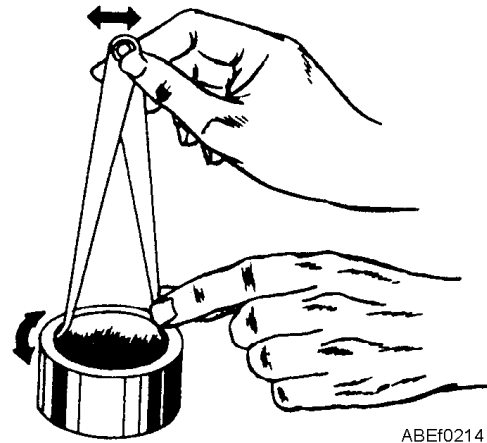


Figure 2-14.—Measuring an inside diameter with an inside caliper.

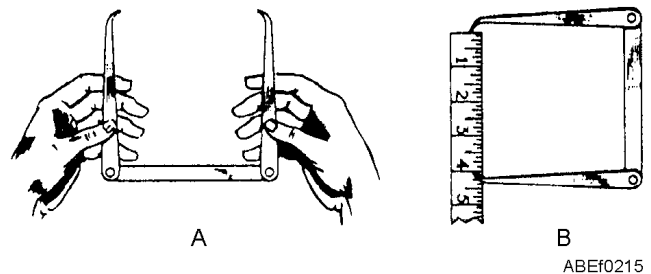


Figure 2-15.—Setting a combination firm-joint caliper.

will be approximately symmetrical. Thus, it will maintain its balance and be easier to handle.

Check this approximate setting as shown in figure 2-15, view B. Sight squarely across the leg at the graduations on the rule to get the exact setting required.

If it is necessary to decrease or increase the setting, tap one leg of the caliper as shown in figure 2-16. The arrow indicates the change in setting that will take place.

When the caliper is set for inside measurements, the same directions for adjusting the setting apply.

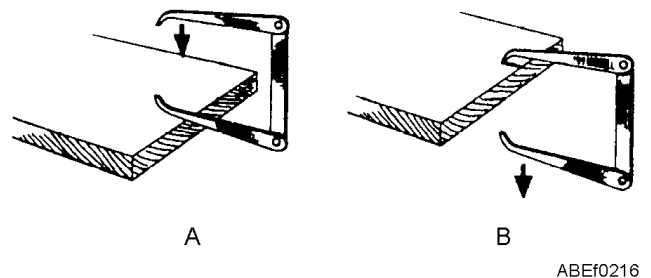


Figure 2-16.—Decreasing and increasing the setting of a firm-joint caliper.

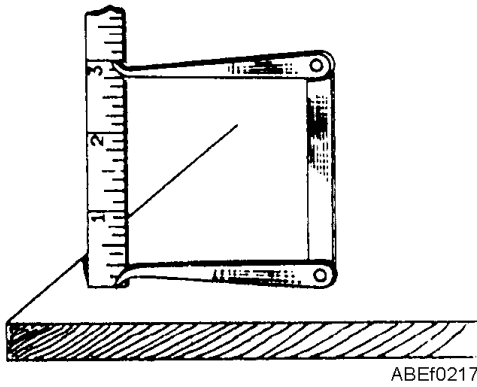


Figure 2-17.—Setting a combination firm-joint caliper for inside measurements.

Figure 2-17 shows how the end of the rule and one leg of the caliper are rested on the bench top so that they are exactly even with each other when the reading is taken.

### Setting Outside and Inside Spring Calipers

To set a particular reading on an outside spring caliper, first open the caliper to the approximate setting. Then, as shown in figure 2-18, place one leg over the end of the rule, steadying it with the index finger. Make the final setting by sighting over the other leg of the caliper squarely with the face of the rule at the reading, and turning the knurled adjusting nut until the desired setting is obtained.

To set an inside spring caliper to a particular reading, place both caliper and rule on a flat surface as shown in figure 2-19. The rule must be held squarely or normal (90° in both directions) to the surface to ensure accuracy. Adjust the knurled adjusting nut, reading the setting on the rule with line-of-sight normal to the face of the rule at the reading.

### Transferring Measurements from One Caliper to Another

To transfer a measurement from one spring caliper to another, hold the calipers as shown in figure 2-20.

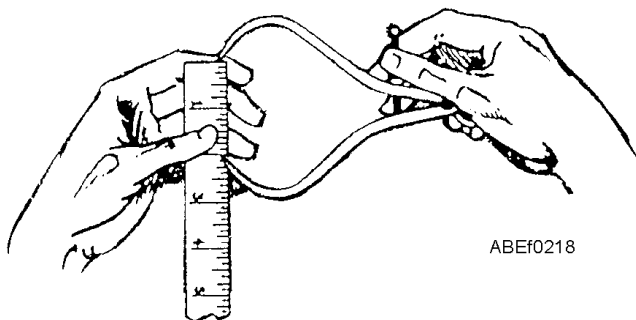


Figure 2-18.—Setting an outside spring caliper.

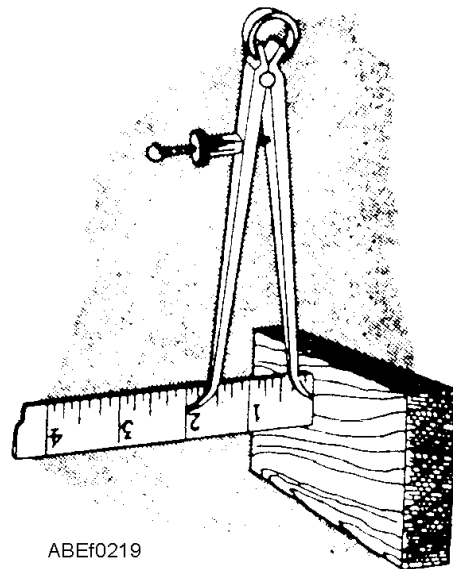


Figure 2-19.—Setting an inside spring caliper.

Note that one of the man's fingers is extended to steady the point of contact of the two lower caliper legs. In this figure the inside caliper is being adjusted to the size of the outside caliper. As careful measurements with calipers depend on one's sense of touch, which is spoken of as "feel," calipers are best held lightly. When you notice a slight drag, the caliper is at the proper setting.

### CARE OF CALIPERS

Keep calipers clean and lightly oiled, but do not over oil the joint of firm-joint calipers or you may have difficulty in keeping them tight. Do not throw them around or use them for screwdrivers or pry bars. Even a slight force may spring the legs of a caliper so that other measurements made with it are never accurate. Remember that calipers are measuring instruments and must be used only for the purpose for which they are intended.

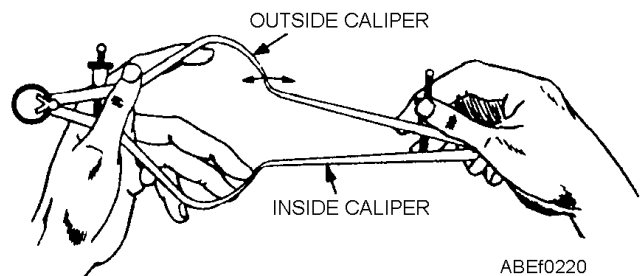


Figure 2-20.—Transferring a measurement from an outside to an inside caliper.

## REVIEW QUESTIONS

- Q1. Identify the different types of measuring tools.
- Q2. Describe the uses of different types of measuring tools.
- Q3. Describe the proper care of measuring tools.

## PRECISION MEASURING EQUIPMENT

**LEARNING OBJECTIVES:** Identify the different types of precision measuring tools. Describe the uses of different types of precision measuring tools. Describe the proper care of measuring tools. Maintain inventory and accountability of precision equipment.

In much wider use by ABEs than even common calipers are the various types of micrometer calipers. As was stated earlier, you can use micrometer calipers to take accurate measurements to the nearest one ten-thousandth of an inch. However, in most applications a measurement to the nearest one-thousandth of an inch is considered acceptable accuracy. These measurements are expressed or written as a decimal (0.0001, 0.001, 0.01), so you must know how to read and write decimals.

## TYPES OF MICROMETER CALIPERS

There are three types of micrometer calipers, commonly called micrometers or simply mikes, used throughout the Navy: the outside micrometer, including

the screw thread micrometer; the inside micrometer; and the depth micrometer. (See fig. 2-21.) The outside micrometer is used for measuring outside dimensions, such as the outside diameter of a piece of round stock or the thickness of a piece of flat stock. The screw thread micrometer is used to determine the pitch diameter of screws. The inside micrometer is used to measure the inside diameter of a cylinder or hole. The depth micrometer is used for measuring the depth of a hole or recess.

## Outside Micrometer

The nomenclature of an outside micrometer is illustrated in figure 2-22.

The sleeve and thimble scales of a micrometer (fig. 2-23) have been enlarged and laid out for demonstration. To understand these scales, you need to know that the threaded section on the spindle, which revolves, has 40 threads per inch. Therefore, every time the thimble completes a revolution, the spindle advances or recedes 1/40 inch, or 0.025 inch.

Note the horizontal line on the sleeve is divided into 40 equal parts per inch. Every fourth graduation is numbered 1, 2, 3, 4, and so on, representing 0.100 inch, 0.200 inch, and so on. When you turn the thimble so its edge is over the first sleeve line past the 0 on the thimble scale, the spindle has opened 0.025 inch. If you turn the spindle to the second mark, it has moved 0.025 inch plus 0.025 inch, or 0.050 inch.

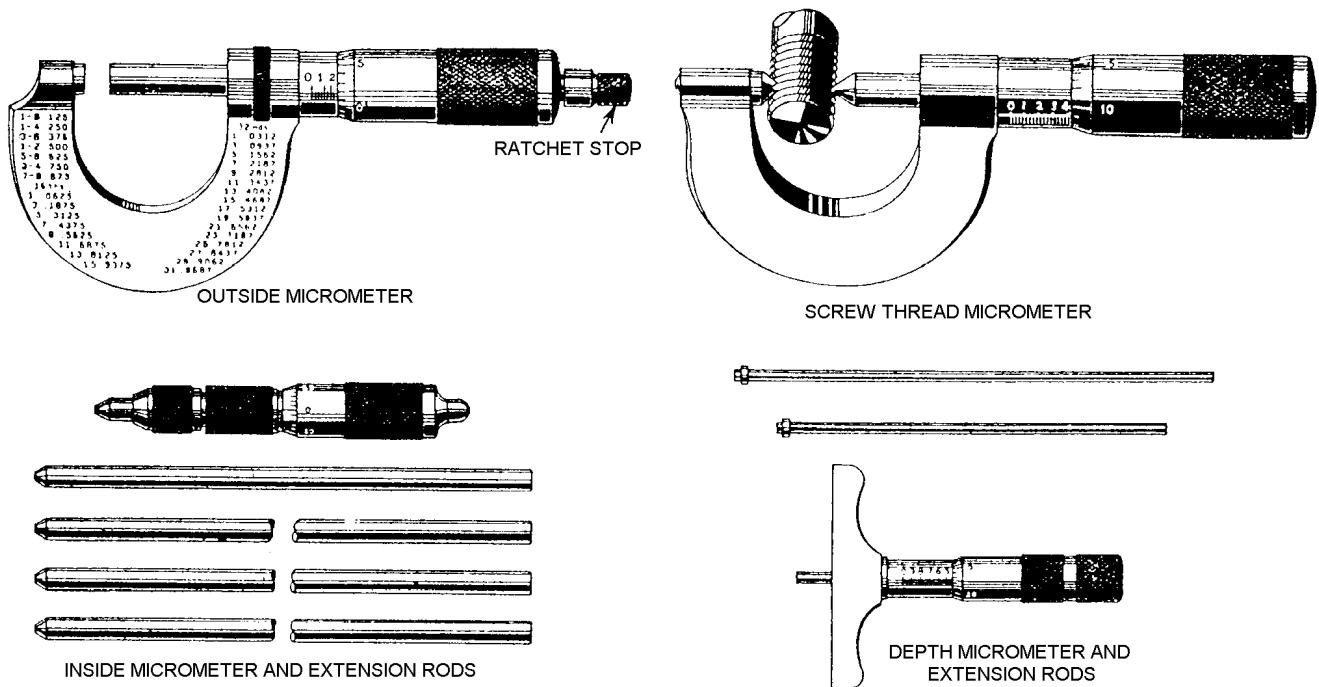


Figure 2-21.—Common types of micrometers.



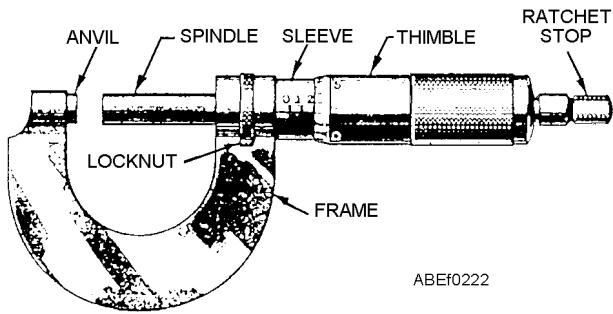


Figure 2-22.—Nomenclature of an outside micrometer caliper.

When the beveled edge of the thimble stops between graduated lines on the sleeve scale, you must use the thimble scale to complete your reading. The thimble scale is divided into 25 equal parts; each part or mark represents 1/25th of a turn. And, 1/25th of 0.025 inch equals 0.001 inch. Note that in figure 2-23 every fifth line on the thimble scale is marked 5, 10, 15, and so on. The thimble scale permits you to take very accurate readings to the thousandths of an inch.

The enlarged scale in figure 2-24 can help you understand how to take a complete micrometer reading to the nearest thousandth of an inch.

The thimble is turned far enough to expose the 7 on the sleeve scale but not far enough to expose the first mark after the 7. Therefore, the measurement must be between 0.700 inch and 0.725 inch. Exactly how far between 0.700 inch and 0.725 inch must be read on the thimble scale.

As you can see, the thimble has been turned through 12 spaces of its scale, and the 12th graduation

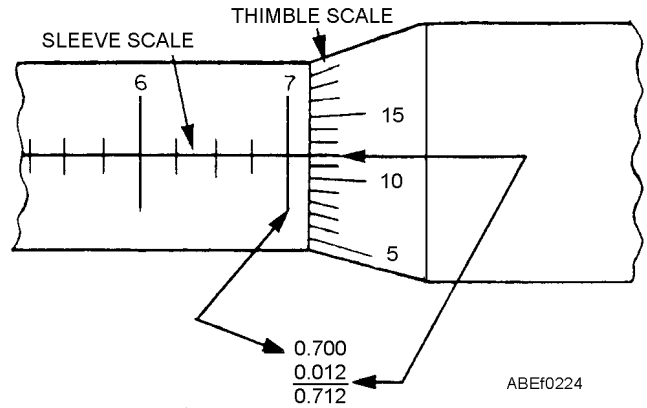


Figure 2-24.—Enlarged micrometer scale.

is lined up with the reference line on the sleeve. When the value on the sleeve scale is added to the value on the thimble scale that is lined up with the reference line on the sleeve scale, the space between the anvil and spindle must be 0.712 inch (seven hundred and twelve thousandths of an inch).

**MICROMETER-READING EXERCISE.—**

Occasionally you attain a reading in which the horizontal reference line of the sleeve scale falls between two graduations on the thimble scale, as shown in figure 2-25. Note the horizontal reference line is closer to the 15 mark than to the 14 mark. To read this measurement to **THREE** decimal places, simply round off to the 15 mark, as shown in example A of figure 2-25. To read this measurement to **FOUR** decimal places, estimate the number of tenths of the distance between thimble scale graduations the horizontal reference line has fallen. Each tenth of this distance equals one ten-thousandth (0.0001) of an inch. Add the ten-thousandths to the reading as shown in example B of figure 2-25.

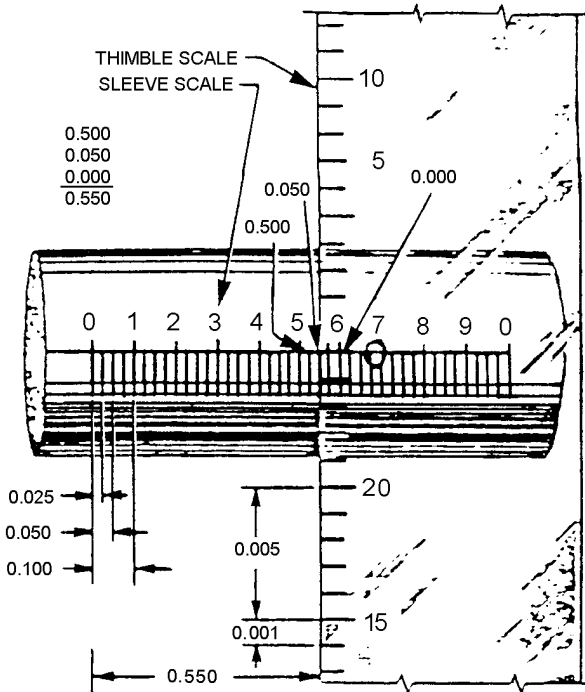


Figure 2-23.—Sleeve and thimble scales of a micrometer.

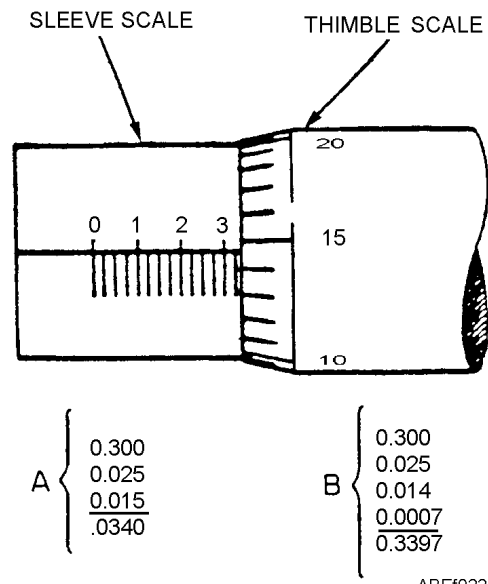


Figure 2-25.—Reading sleeve and thimble scales of a micrometer.

**READING THE VERNIER SCALE ON A MICROMETER.**—Many times you are required to work to exceptionally precise dimensions. Under these conditions it is better to use a micrometer that is accurate to ten-thousandths of an inch. This degree of accuracy is obtained by the addition of a vernier scale.

The vernier scale of a micrometer (fig. 2-26) furnishes the fine readings between the lines on the thimble rather than requiring you to estimate the reading. The 10 spaces on the vernier are equivalent to 9 spaces on the thimble. Therefore, each unit on the vernier scale is equal to 0.0009 inch, and the difference between the sizes of the units on each scale is 0.0001 inch.

When a line on the thimble scale does not coincide with the horizontal reference line on the sleeve, you can determine the additional spaces beyond the readable thimble mark by finding which vernier mark matches up with a line on the thimble scale. Add this number, as that many ten-thousandths of an inch, to the original reading. In figure 2-27 see how the second line on the vernier scale matches up with a line on the thimble scale.

This means that the 0.011 mark on the thimble scale has been advanced an additional 0.0002 beyond the horizontal sleeve line. When you add this to the other readings, the reading is  $0.200 + 0.075 + 0.011 + 0.0002$ , or 0.2862, as shown.

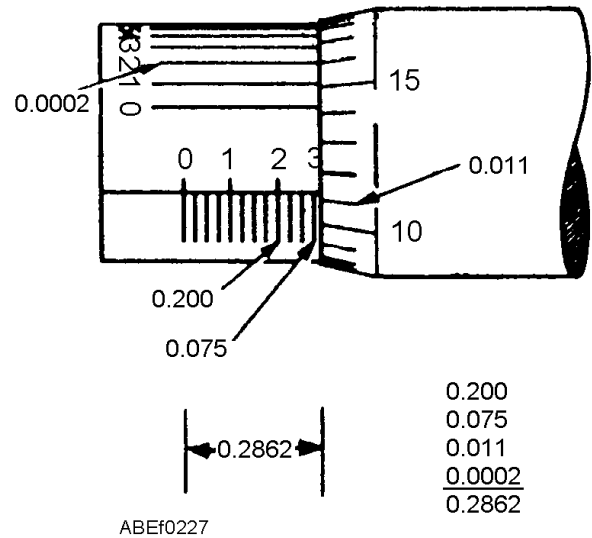


Figure 2-27.—Reading a vernier scale micrometer.

### Inside Micrometer

The inside micrometer, as the name implies, is used for measuring inside dimensions, such as pump casing wearing rings, cylinder, bearing, and bushing wear. Inside micrometers usually come in a set that includes a micrometer head, various length spindles (or extension rods) that are interchangeable, and a spacing collar that is 0.500 inch in length. The spindles (or extension rods) usually graduate in 1-inch increments of range; for example, 1 to 2 inches, 2 to 3 inches (fig. 2-28).

The 0.500 spacing piece is used between the spindle and the micrometer head so the range of the micrometer can be extended. A knurled extension handle is usually furnished for obtaining measurements in hard-to-reach locations.

**Reading the inside micrometer.** To read the inside micrometer, read the micrometer head exactly as you would an outside micrometer, then add the micrometer reading to the rod length (including spacing collar, when installed) to obtain the total measurement.

### Depth Micrometer

The depth micrometer is used to measure the precise depths of holes, grooves, and recesses by using interchangeable rods to accommodate different depth measurements (fig. 2-21). When using a depth micrometer, you must make sure the base of the micrometer has a flat, smooth surface to rest on and that it is held firmly in place to ensure an accurate measurement (fig. 2-29).

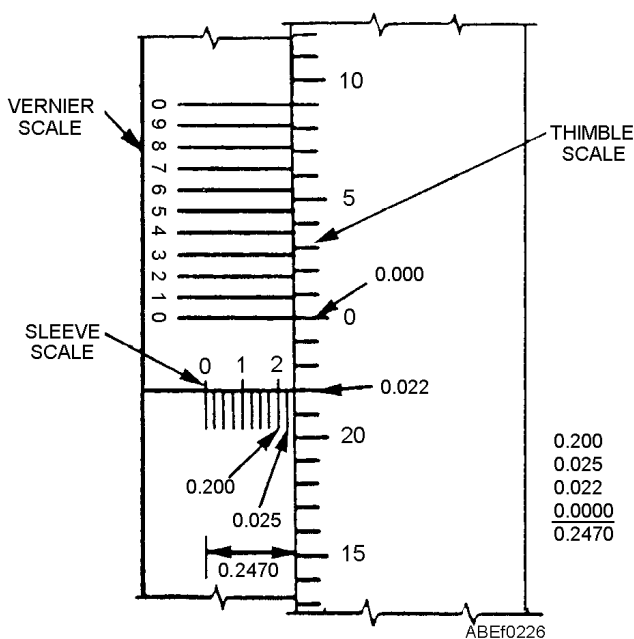
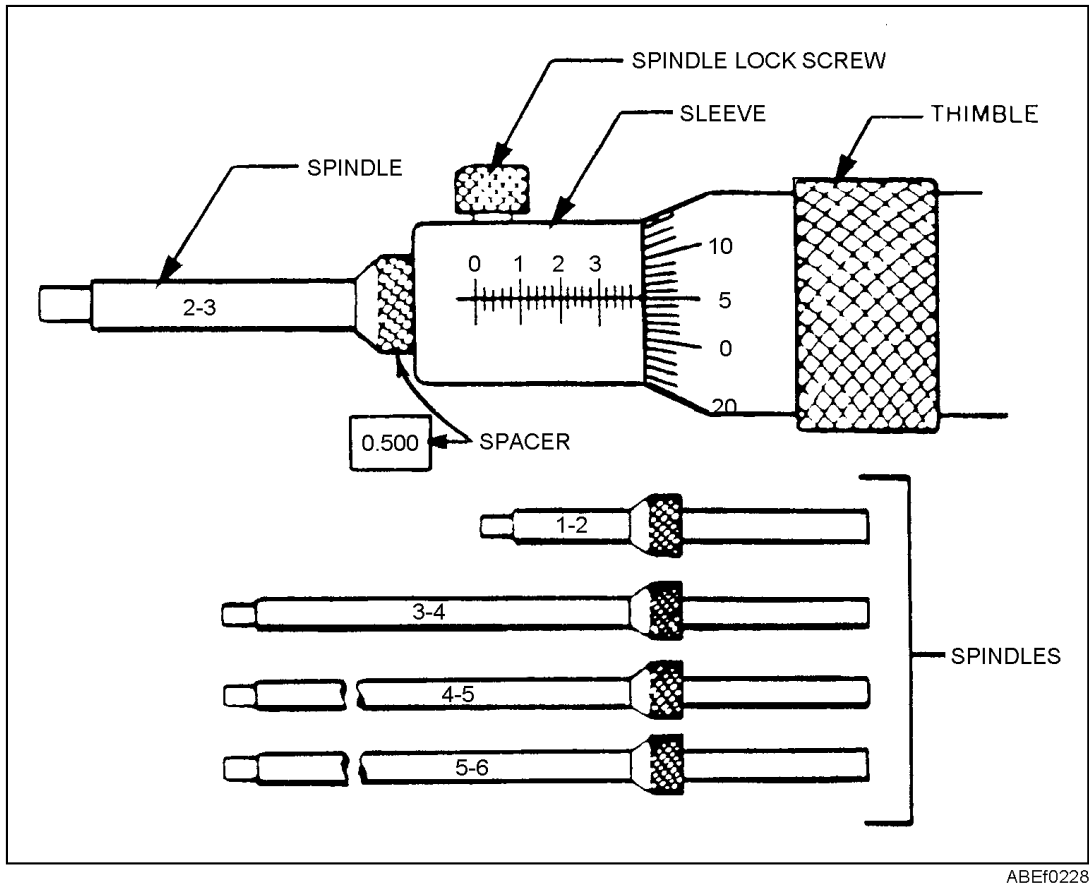


Figure 2-26.—Vernier scale of a micrometer.

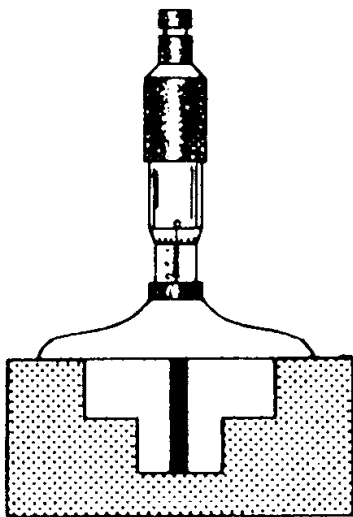


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Figure 2-28.—Inside micrometer set.

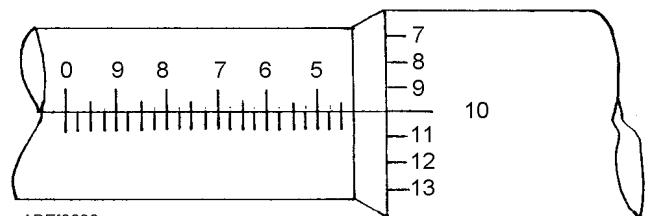
**Reading a depth micrometer.** When reading a depth micrometer, you will notice that the graduations on the sleeve are numbered in the opposite direction of those on an outside or inside micrometer. When you are reading a depth micrometer, the distance to be measured is the value that is covered by the thimble.

See figure 2-30; consider the reading shown. The thimble edge is between the numbers 4 and 5. This shows a value of at least 0.400 inch on the sleeve's major divisions. The thimble also covers the first minor division on the sleeve; this has a value of 0.025 inch. The value shown on the thimble circumference scale is 0.010 inch. Adding these three values together results in a total of 0.435 inch, or the total distance that the end of the extension rod has traveled from the base. This measurement added to the length of the extension rod used gives you the total depth of the hole, recess, or groove that was measured.



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Figure 2-29.—Using a depth micrometer.



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Figure 2-30.—Depth micrometer sleeve and thimble scales.

## SELECTING THE PROPER MICROMETER

The types of micrometers commonly used are made so that the longest movement that the micrometer spindle or rod can make is 1 inch. This movement is called the range; for example, a 2-inch micrometer has a range of from 1 inch to 2 inches, and can only measure work with a thickness or diameter within that range. Therefore, it is necessary to first determine the approximate size, to the nearest inch, of the work to be measured and then select the proper size micrometer. The size of a micrometer indicates the size of the largest work it can measure.

## CARE OF MICROMETERS

Keep micrometers clean and lightly oiled. Make sure they are always stored in a case or box when not in use, to protect them from damage. Never clean any part of a micrometer with emery cloth or other abrasive. The measuring tools that have been described in this chapter are the ones that you, as an ABE, will routinely use while performing your assigned duties. You may, however, occasionally be required to use other less commonly used measuring tools. Some of these are the dial indicator, telescopic (snap) gauge, the vernier caliper, or screw thread gauge. The description of these tools and instructions for their use can be found in the training manual Use and Care of Hand Tools and Measuring Tools, NAVEDTRA 12085.

## INVENTORY AND ACCOUNTABILITY

All measuring tools will be marked in some manner, etched, stenciled, etc., to comply with standard inventory instructions. These standard instructions may be found in Aircraft Launch and Recovery Equipment (ALRE) Tool Control Manual, NAEC-MISC-51-OR732.

Some measuring tools such as tapes and calipers may be part of a specific toolbox inventory. Other precision measuring instruments such as micrometers,

snap gauges and vernier calipers will normally be maintained in the division's central tool room. Regardless of the tool's permanent location, it is always the user's responsibility to maintain, care for and use the tool properly.

Damage, loss, or an improperly working tool should be reported immediately. Loss of a tool becomes especially critical when working on or around the catapult or arresting gear machinery. The tool may be "lost" in the machinery and, if not found, may cause catastrophic damage to the equipment and serious injury to personnel. Always double-check the inventory ensuring every tool is accounted for upon job completion. The proper tools will help you maintain your equipment but only if you maintain your tools properly.

## REVIEW QUESTIONS

- Q4. *Identify the different types of precision measuring tools.*
- Q5. *Describe the uses of different types of precision measuring tools.*
- Q6. *Describe the proper care of precision measuring tools.*
- Q7. *All precision measuring tools will be \_\_\_\_\_ in some manner to comply with the standard inventory instructions found in NAEC-MISC-51OR732.*

## SUMMARY

This chapter has introduced you to some of the most often used measuring tools and the techniques for using them. Selecting the proper tool; using and maintaining the various tools; and inventorying the tools have all been discussed. By thoroughly understanding and comprehending this chapter, you, as an ABE, will be able to perform your daily duties more efficiently and safely.