Sears

CRAFTSMAN®

PRECISION TOOLS

CRAFTSMAN® means the finest in precision tools. The accuracy in most Craftsman precision tools meets or exceeds all requirements outlined by Federal specifications.

The materials in Craftsman tools are of the best grades of tool steel with hardening qualities to exceed a 62° Rockwell "C" scale. Forgings are of an above American Standard quality. Workmanship in the Craftsman precision tool is by the skilled craftsman who has spent years at his job, placing his own special talent into each operation he performs.

Inspection standards begin at the raw material stage and continue on through the complete operation of manufacturing the parts.

Continuous roving inspectors check parts as they come off the machines. Parts inspectors check parts before the parts are placed into a parts stockroom. Parts are inspected again at the time of assembly for flaws and workmanship. Lastly, Craftsman precision tools are submitted to a temperature control final inspection room where they are left to cool to 68.7 degrees Fahrenheit for a minimum of 12 hours prior to final inspection. Each and every Craftsman tool goes through a series of inspection steps before the final inspector will put his own personal name on the inspection certificate, denoting an approval or acceptance of the tool before passing it on for packaging.

NOTE: Many Craftsman precision tools have their own certificate that is serial numbered and signed by the final inspector.

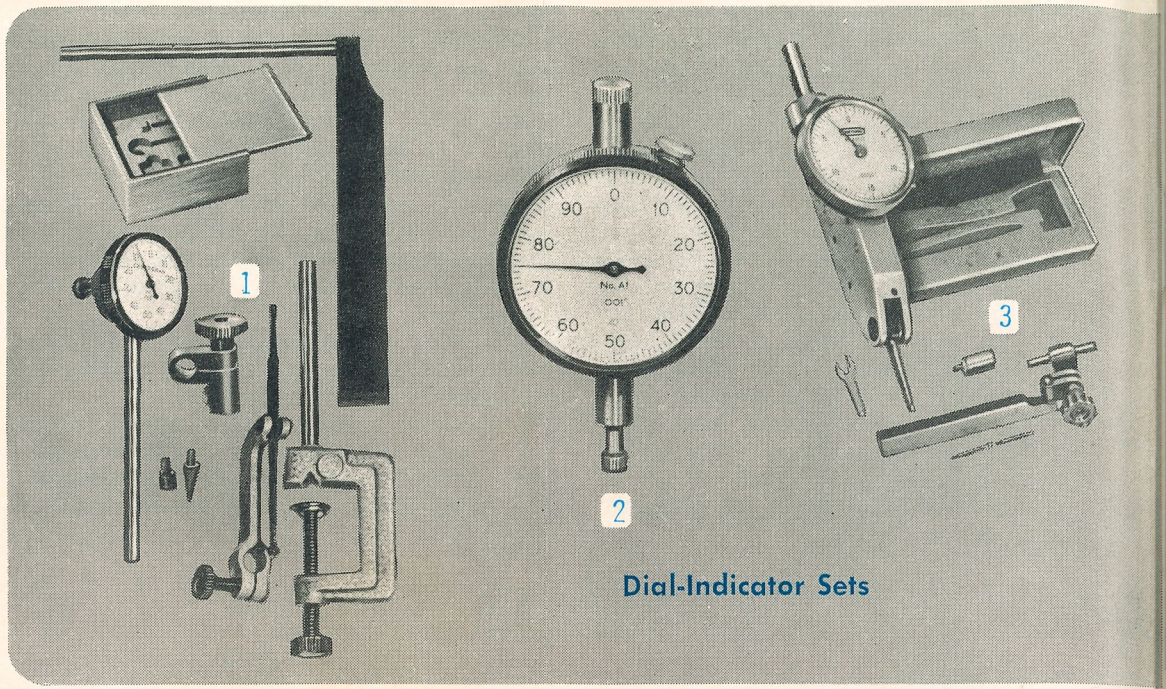
Satisfaction is guaranteed or money back. This is more important than ever because we know quality is built into every Craftsman tool. It will do the job better and last longer.

GUARANTEE

During the first year, we will repair your Craftsman Precision Instrument, free of charge, if defective in material or workmanship. This guarantee service is available by simply returning the instrument to any Sears store throughout the United States.

Sears Roebuck and Co.

You get superb professional quality



CRAFTSMAN® Dial-Indicator Sets for quick reading of precise measurements

1 Check variations from set standards

Graduated 0 to 50 to 0 in .001 inch. Bezel rotates for changing position of zero. "+" and "−" signs on either side of zero. Range .200 in. (2 rev.). Dial diam. 1 11/16 in.

Dial gauge (back plunger type), universal clamp, tool post holder, "G" clamp, lever attachment, 3 contact points. Wood case. Meets Fed. Specs. Mil-I-18422D for accuracy. From England. **No. 3868**

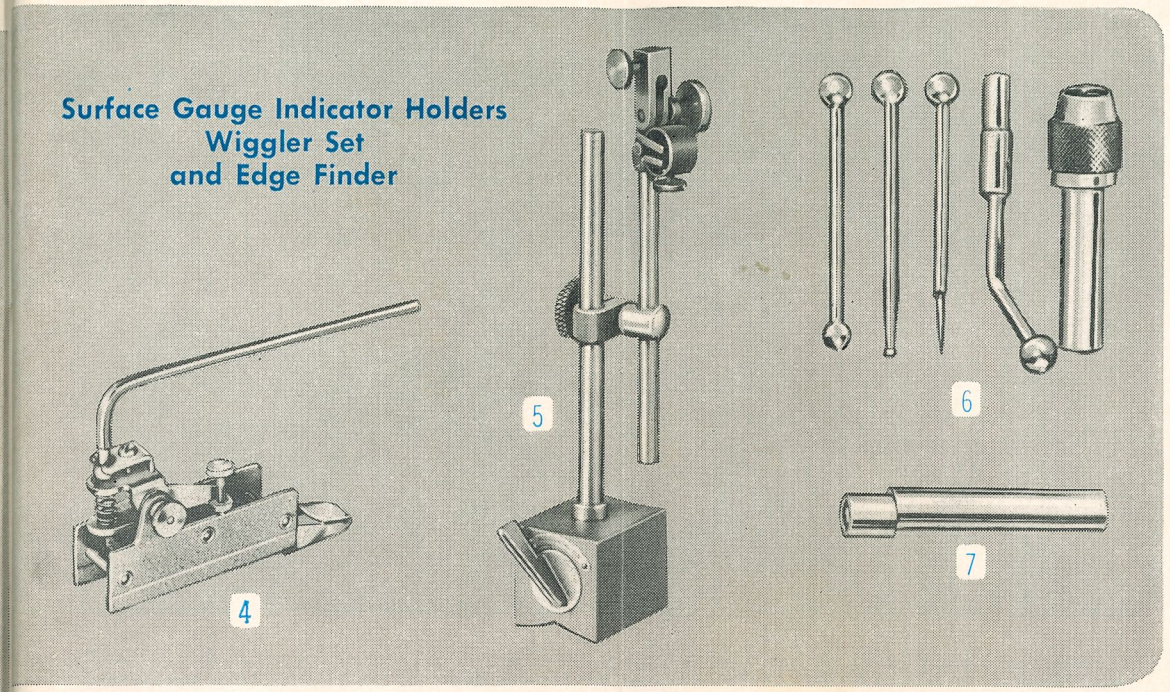
2 Compare dimensions, gauge deviations

Reads 0 to 100 in graduations of .001 in. Full one inch range. Enclosed case protects against dust and oil. Hard brass bearings for long life. Detachable steel point. Dial diam. 2¼ in. Adjustable bezel. England. **No. 38683**

3 Use for checking detailed measurements

Pictest indicator gives .0005 in. reading. 3 contact points, 2 stems (⅜ and 5/32 in.), wrench, universal holder bar, ¼x½ in., and clamp. Automatic reversal with dovetail slots. Meets Fed. Specs. Mil-I-18422D for accuracy. Japan. **No. 40755**

in CRAFTSMAN® Precision Tools . . . .



4 Magnetic Indicator Holder

50-pound pull magnets. Ball and socket action. Is CRAFTSMAN. **No. 3872**

5 On-off Magnetic Base Indicator Holder

Use with any dial indicator: center-lug back, universal-type or plunger back. Fine adjustment allows setting to within .0001 inch. Holding power of 100 lbs. Permanent magnet control for "on", "off". Magnetic base measures 1⅞x1⅞x2¼ inches high. From Japan. Is CRAFTSMAN. **No. 38908**

6 CRAFTSMAN 4-Piece Wiggler Set

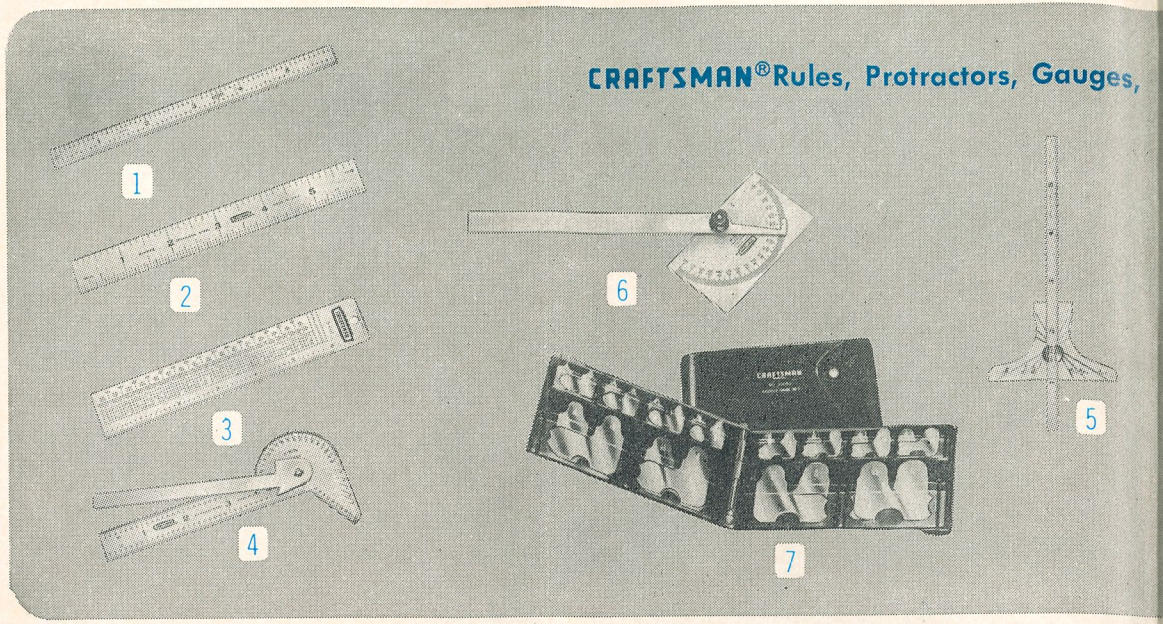
Four attachments adapt the tool for many uses (needle point, ball point, disc point, offset point). Use to insure alignment in boring, milling, drilling operations. All points are readily interchangeable in wiggler shank. Attachments clamp into shank by means of ball swivel joint . . . lets you adjust wiggler to an angular position or true concentricity.

Adjustable chuck tension. Tool steel construction. Over-all length, 4⅛ inches. Plastic case included. **No. 4004**

7 CRAFTSMAN ½-inch Single Edge Finder

Hardened steel working surfaces . . centerless ground. Use for positioning tool to locate working edge. **No. 38819**

CRAFTSMAN® Rules, Protractors, Gauges,



1 Chrome-plated Stainless Steel Rules

Catalog Number	Size Inches	Graduations front	Graduations back	Type
No. 40996	6x15/32	1/10, 1/100	1/32, 1/64	Flex.
No. 40136	6x3/4	1/8, 1/16	1/32, 1/64	Rigid

2 Stainless Steel Rules

Catalog Number	Size Inches	Graduations front	Graduations back	Type
No. 4030*	6x1/2	1/16, 1/32	Dec. equiv.	Flex.
No. 4006*	6x3/4	1/32, 1/64	Dec. equiv.	Flex.

*NOT CRAFTSMAN

3 6-inch Reference Table Rule

Graduated in 32nds and 64ths of an inch. With decimal equivalents, tap and drill data. Stainless steel. **No. 4011**

4 Combination Rule

Square, bevel, protactor, circle finder, divider and drill gauge all in one. In 32nds and 64ths in. Stainless steel. **No. 4026**

5 Depth Gauge

Hardened steel head graduated right and left to 30°, 45° and 60° for use as angle gauge. 2¼-in. head shaped to fit your hand. With 6x7/32 inch rule, marked in 32nds and 64ths of an inch. Slide locks at any depth. Held in place by spring tension of steel when not locked. **No. 40442**

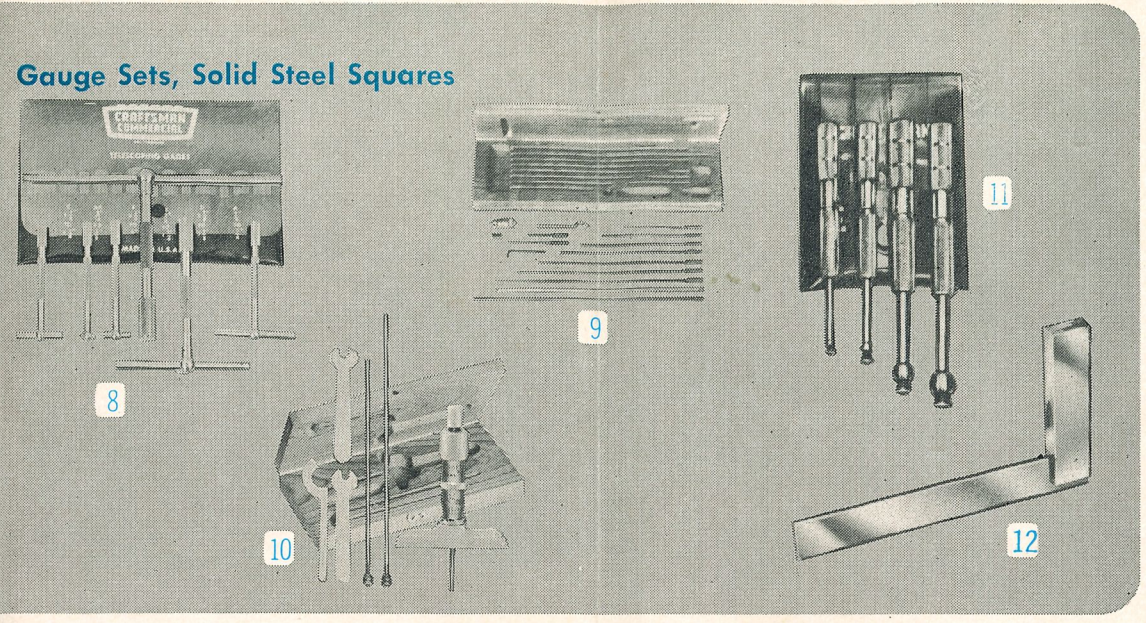
6 Stainless Steel Protractor

Rectangular head. Scale double graduated 0° to 180°. Adjustable spring tension holds setting. **No. 4029**

7 25-piece Radius or Fillet Gauge Set

For measuring inside and outside corner radii as well as concave, convex shapes. Stainless steel blades with corresponding external and internal forms. Includes: 16 gauges (1/32 to 17/64 inch by 64ths), 8 gauges (9/32 to ½ inch by 32nds), 4-inch gauge holder and case. Gauges meet Federal Specifications GGG-G-17b Type VII for accuracy. **No. 40952**

Gauge Sets, Solid Steel Squares



8 CRAFTSMAN 6-piece Gauge Set

For gauging inside slots and holes accurately. Plunger telescopes, locks with knurled screw. Head ends heat-treated for toughness. 5/16 to ½, ½ to ¾, ¾ to 1¼, 1¼ to 2⅛, 2⅛ to 3½, 3½ to 6 in. Meets Fed. Spec. GGG-G-17b for accuracy. **No. 4027**

As above, but with 4 gauges in set. 5/16 to ½, ½ to ¾, ¾ to 1¼, 1¼ to 2⅛ in. **No. 40203**

9 CRAFTSMAN Inside Micrometer Set

.001 in. (1½ to 8½ in.). Meet Fed. Spec. GGG-C-105b for accuracy. Wood case. **No. 3864**

10 CRAFTSMAN Micrometer Depth Gauge Set

Read in .001 inch. Chrome-plated. With lock. Meet Federal Specification GGG-C-105b for accuracy. In wood cases.

Catalog No.	Range	Base
No. 3863	0–3 in.	2½ in.

11 CRAFTSMAN 4-piece Small-hole Gauge Set

Measures up to ½ inch. Oil hardened tool steel. ⅛ to 2/10, 2/10 to 3/10, 3/10 to 4/10, 4/10 to ½ inch. Meets Fed. Spec. GGG-G-17b, Type III, Class 1 for accuracy. Plastic pouch. **No. 4056**

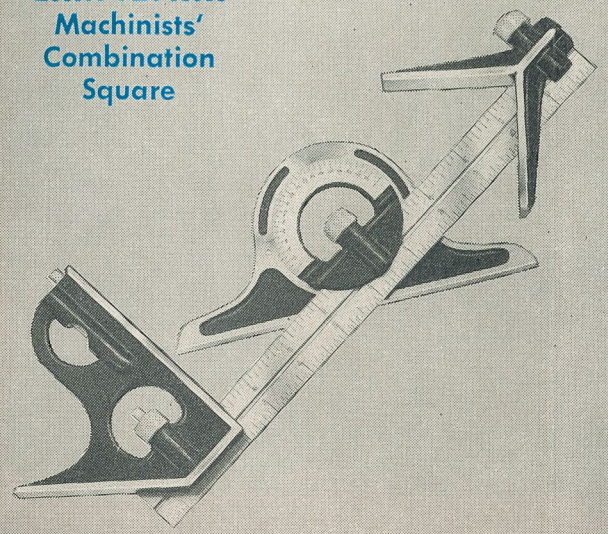
12 CRAFTSMAN Accurate Solid Steel Squares

True right angles inside and outside. Ground and hardened steel blades. Beam and blade pinned solidly. From England.

Catalog No.	Blade	Beam
No. 40401	2 3/16 in.	1¾ in.
No. 40402	3 1/16 in.	2¼ in.
No. 40403	4 in.	3 in.
No. 40404	6 in.	3¾ in.

All CRAFTSMAN® Micrometers meet Federal Specifications for Accuracy . . . made to tolerances of less than .0001 inch

CRAFTSMAN® Machinists' Combination Square



* Blade machine divided for accuracy
* Heads precision ground for close fit
* Use as ruler or straight-edge

Check 90° and 45° angles. Use as depth gauge, height gauge. Hardened, ground steel blade; clear, readable graduations in 8ths, 16ths, 32nds, 64ths of an inch. Cast-iron square head; center head, non-reversible bevel protractor graduated 180° left, right. Level vial in square head. 12-inch blade. Meets Federal Specification GGG-S-656b for precision. **No. 38694**

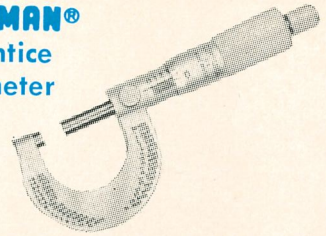
As No. 38694 above, but graduated in 32nds, 64ths, 50ths and 100ths of an inch. **No. 38695**

As 38694 above, but without protractor. **No. 38693**

As No. 38694, but without protractor or center head. **No. 3869**—6-inch blade. **No. 38691**—12- inch blade.

Note: 6 and 12-inch parts not interchangeable.

CRAFTSMAN® Apprentice Micrometer

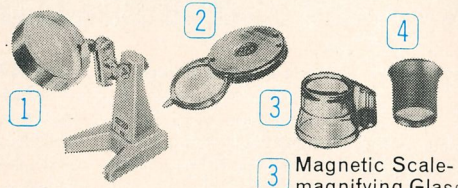


Good, low-cost micrometer for beginning machinists as well as hobbyists and students. Well suited for small measurements where maximum accuracy is not essential.

Accurate to within plus or minus .0015 per inch. Clear, easy-to-read graduations of .001 inch. Measures from 0 up to one full inch.

Handy table of decimal equivalents printed on zinc die-cast frame. Spindle and anvil made of alloy steel. Adjustable anvil compensates for wear. With friction and lock screw. Plastic case also included. Not CRAFTSMAN. **No. 40701**

CRAFTSMAN® Magnifiers



1 2-in. Desk Magnifier

1.7- power; ground lens. Adjusts. **No. 40871**

2 Pocket Magnifiers

Ground glass. With case. 8-power double lens. **No. 40813**

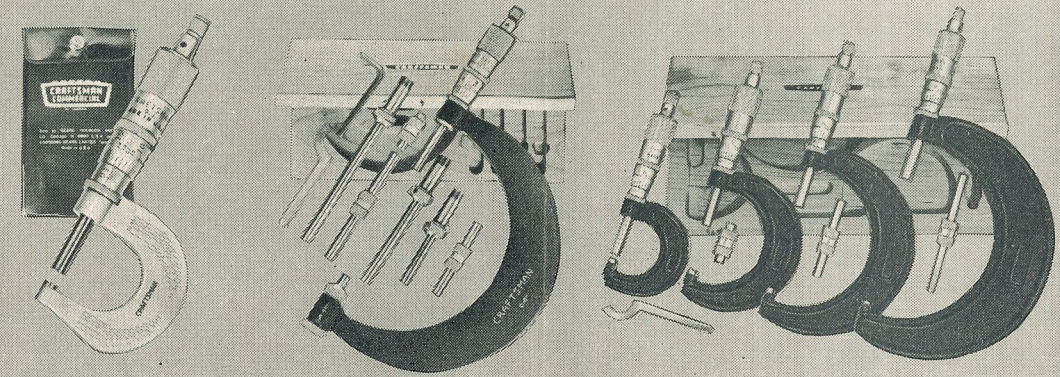
3 Magnetic Scale-magnifying Glass

With 5-power ground glass lens. Magnetic base. **No. 40872**

4 Eye Loupe Magnifying Glass

Black plastic body with ground and polished 4-power lens. Meets Federal Specification GGG-M-95a for precision. **No. 40879**

CRAFTSMAN® Precision Micrometers



Graduated .0001 in.

Small graduations give you maximum accuracy in measuring thicknesses, diameters. Decimal equivalents etched on frame for handy reference. Frame and head of forged steel. Spindle and anvil of alloy tool steel.

Extra-long thimble lines let you read measurements quickly. Threads ground and precision polished. Anvil and spindle carbide tipped. With plastic case. **No. 38662** 0 to 1 inch. **No. 38665** 1 to 2 inches with checking standard.

Mandrel Micrometer

Large frame gives you wider range of measurement than with regular micrometer . . 0 to 4 inches. Four interchangeable mandrels let one tool do work of 4 fixed-anvil micrometers.

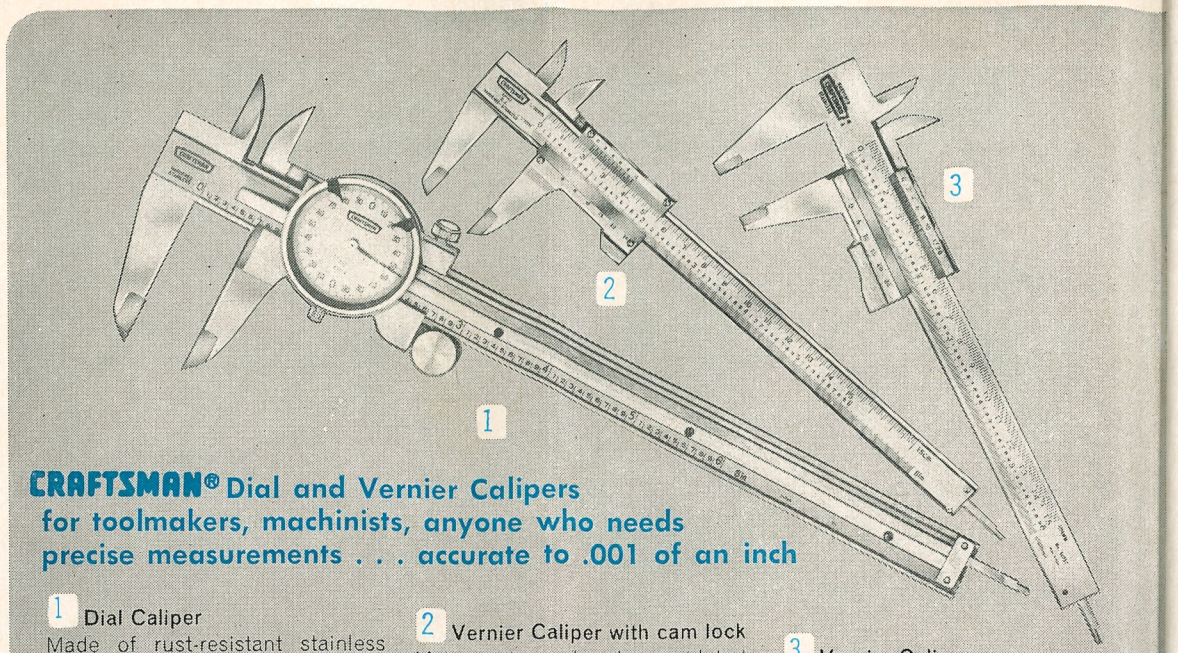
Sturdy tubular steel frame . . 50% lighter than regular solid frame. Satin chrome-plated head. Ratchet cap and lock ring. With 1, 2 and 3-inch checking standards, wrench for changing standards. Graduated at .001 inch. Includes wood case. **No. 38608** (catalog only)

Micrometer Set

Thread ground from steel spindle. Spindle and anvil precision polished. Ratchet stop, spindle lock. Graduated in .001 inch. Measure 0 to 4 inches. Set of 4 with 3 standards, finished wood case. **No. 3860** (catalog only)

Individual Micrometers. Standards incl. with all except 0-1 in. size Without carbide tips.

Catalog Number	Range, inches	Graduations
No. 38601	0-1	.001 inch
No. 38602	1-2	.001 inch
No. 38603	2-3	.001 inch
No. 38604	3-4	.001 inch



CRAFTSMAN® Dial and Vernier Calipers for toolmakers, machinists, anyone who needs precise measurements . . . accurate to .001 of an inch

1 Dial Caliper

Made of rust-resistant stainless steel. With dull chrome-plated scales. English scale on beam. Adjustable bezel. Measuring range 0 to 6 inches. Scales read inside or outside. Balanced design for easy handling. With velvet-lined storage case. Guaranteed one full year . . see guarantee on page 96. Made in Japan. **No. 40172**

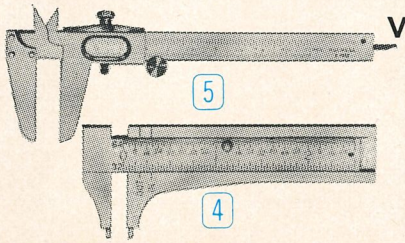
2 Vernier Caliper with cam lock

Main vernier scales chrome-plated. Top in 1/20th mm, bottom in 1/1000ths inch. Stainless steel. Recessed beam. 6 in. long. 5 5/16-in. capacity. Adjustable plates. 1-year guarantee, page 96. Japan. **No. 40182**

Like (2) but without adj. plates. **No. 40181**

3 Vernier Caliper

Stainless steel with polished finish. Automatic thumb lock. Precision ground measuring faces. Graduated on top at 1/20 mm, on bottom at 1/1000 inch. Range 5.3 inches. 8¼ inches long. Converts readings between metric and inches. Guaranteed 1 year. **No. 40257**



Vernier and Slide Calipers

4 CRAFTSMAN Pocket Slide Caliper

Polished steel. Inside measurements to 2⅜ inches, outside to 2¼ inches. (Reads both "in" and "out"). 3-inch scale. Graduated in 32nds and 64ths inch. Spring stop. **No. 4028**

5 COMPANION Vernier Caliper

Accurate to .01 of an inch. Reads both inside and outside. Can also be used as depth gauge. Graduated in 16ths and 32nds of an inch. Big 5-inch capacity. Readings in 1/128ths inch. With roller adjustment. (Not CRAFTSMAN.) **No. 4022**

CRAFTSMAN® Calipers, Dividers and Trammel

(6 thru 8) Flat-leg Dividers and Calipers. Steel with hardened points. Quick-adjusting. Meet same Specs. as below.

	Item	Catalog No.	Size
6	Dividers	No. 38574	4 in.
		No. 38576	6 in.
7	Outside Calipers	No. 38594	4 in.
		No. 38596	6 in.
8	Inside Calipers	No. 38584	4 in.
		No. 38586	6 in.

9 Round-leg Calipers and Dividers

Tapered spool and stiff spring eliminate wobble. Polished steel. Measure 6 inches long. Hermaphrodite and Inside Calipers meet Federal Specifications GGG-C-95 for accuracy. Dividers meet Federal Specifications GGG-D-351e, Type A, Class 2. **No. 38536**—Hermaphrodite (shown) **No. 38526**—Inside (not shown) **No. 38516**—Outside (not shown) **No. 38506**—Dividers (not shown)

10 Adjustable Trammel

Steel . . black wrinkle finish. 3-in. points adjust. Meets Fed. Specs. GGG-T-661b, Type II, Class B for accuracy. **No. 4061**

CRAFTSMAN® Scribers, Punches

11 Scriber with reversible tungsten-carbide tip

Aluminum body. Permanent magnet. **No. 4078**

12 Pocket Scriber with replaceable nickel-plated steel point

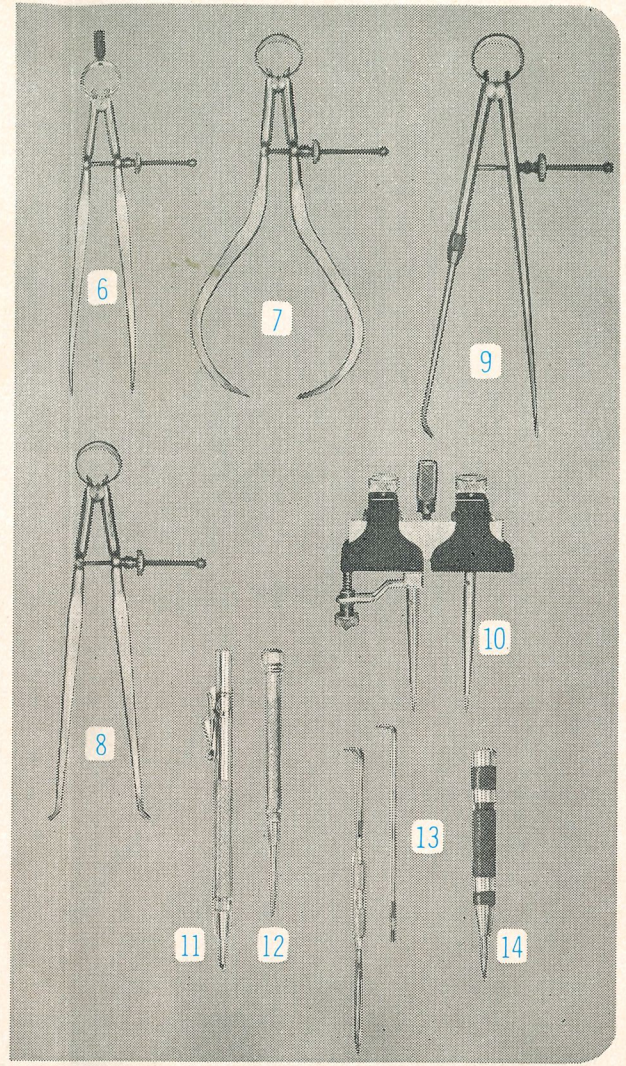
Knurled steel body. Meets Federal Specs. GGG-S-131d. Type I, Class 2. **No. 4051**—¼-inch diameter. **No. 40513**—⅜-inch diameter.

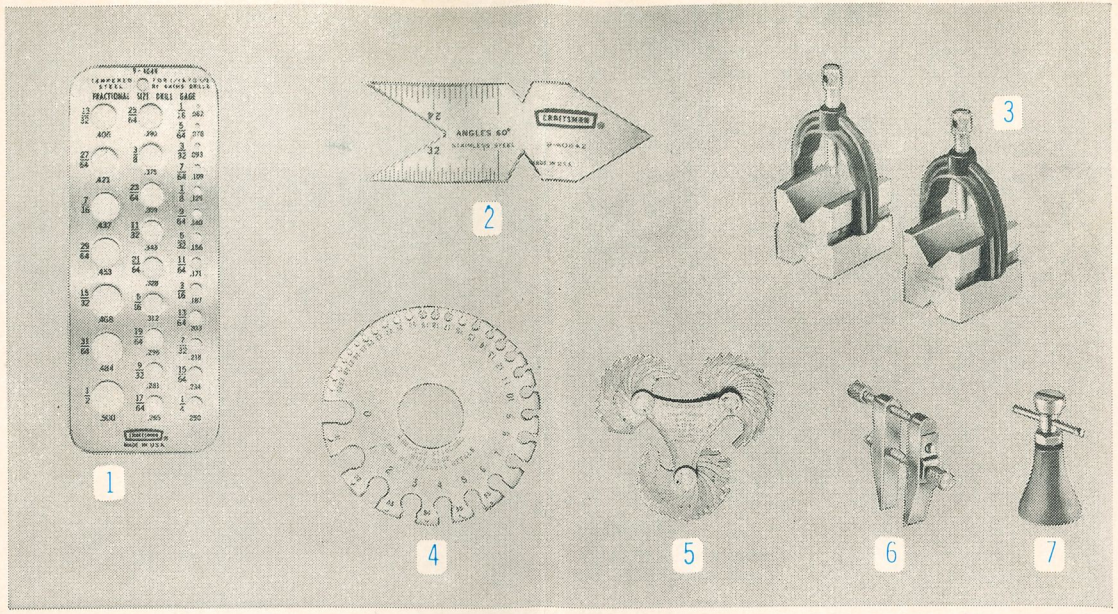
13 Double Scriber . . 1 straight, 2 bent steel points

Interchangeable. 12 in. long. Meets Fed. Specs. GGG-S-131d, Type II, Class 2. **No. 4014**

14 Automatic Center Punch

Alloy-steel point. Adjust for light, heavy impressions. Meets Fed. Specs. GGG-P-831e, Type II, Class B, Style 2. **No. 40541**—½-in. diam. 5 in. long.





CRAFTSMAN® Gauges . . . Clamp Sets . . . Jack Screw

1 Drill Gauge
Made of polished steel. Measures 29 fractional sizes, 1/16 to ½ inch. **No. 4049**

Drill and Wire Gauge
Sizes 1 to 60. Index for taps. Not shown. **No. 4047**

2 Lathe-Center Gauge
U.S. Standard 60°. Made of stainless steel. With graduations at 14th, 20th, 24th and 32nd inch. **No. 40642**

3 4-piece V-block and Clamp Set
Hardened tool steel V-blocks, precision ground for both square and parallel accuracy . . measure 1⅝x 1¼x1¼ in. Clamps hold up to 1-inch round or irregular work material. Set includes 2 V-blocks and 2 clamps. **No. 4083**

4 Circular Gauge
For measuring wire, sheet and plate sizes 0 to 36. American Standard for non-ferrous metals. **No. 4023**

5 V-thread Gauge
Pitches 4 to 84. England. **No. 4031** 51 leaf set.

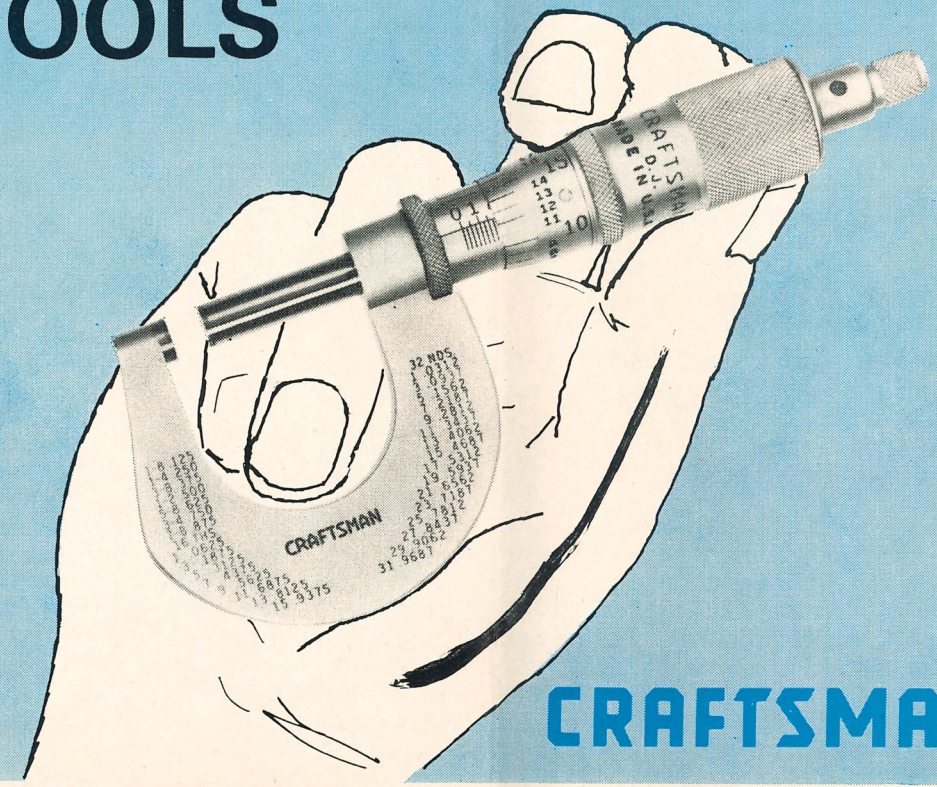
6 Toolmaker's Clamp with parallel steel jaws
Not CRAFTSMAN. Case-hardened jaws. Spring clip. Jaw length 2⅛ inches. Capacity 0 to 1 inch. **No. 4481**

As above but 4 inches long
Capacity 0 to 2 inches. **No. 4486**

7 Jack Screw
CRAFTSMAN. Maximum height 4 inches. Adjusts 1 inch. Lifts 1000 lbs. **No. 4088**

Sears Has a Credit Plan to Suit Your Needs—ask for details

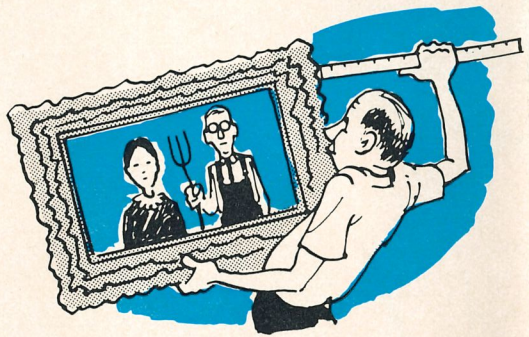
USING PRECISION MEASURING TOOLS



CRAFTSMAN®

Shortcut to Becoming an Expert

Precision measuring is no more than a fine degree of accuracy in measuring an object. We have all had experience in measuring something. You could say you caught a sunfish as large as your hand and everyone would have a pretty good idea of its approximate size. Maybe you have hung a picture on the wall. You might use a yard stick to find out how far up from the floor, how far from a wall or doorway will the picture look the best and where to place a hanger to hold it.

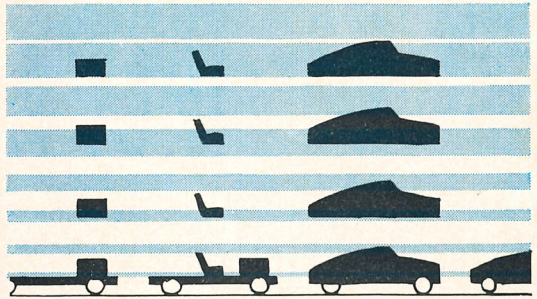


If you want to drill four ¼″ holes exactly three inches apart, you would want an accurate ruler to find the centers of where the holes were to go, and you have to make sure you had a ¼″ drill.

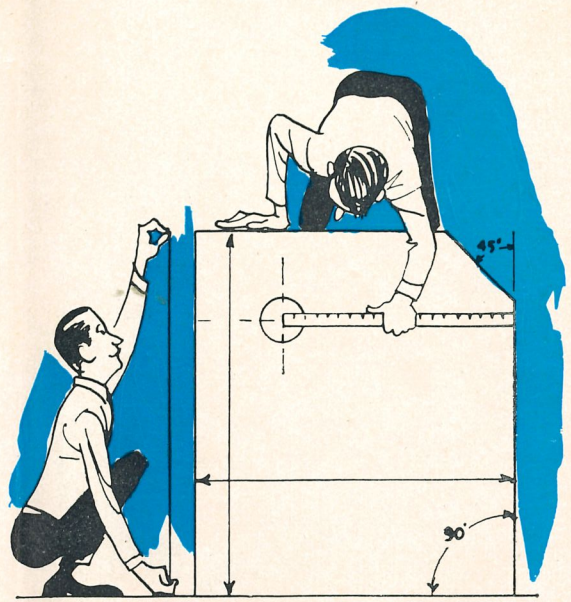
So you see the more precisely you want to do something, the more precise your measurements must be. Therefore, the more accurate your measuring tool must be.

To understand why precision tools are necessary, we have only to look around. For wherever there are metal products, there is a need for precision measuring devices. Modern production today demands the interchange of parts with perfectly matched fits. In addition, quality and high speed production have been proven essential in the manufacturing of automobiles, appliances, tools, and medical instruments. Space and missile programs also make use of precision measuring tools.

Because of the accuracy precision measurement brings, high speed manufacturing equipment can be produced. Parts of a product can be made in other locations and shipped to an assembly point and the product is put together there. This allows a manufacturer to take advantage of cost factors and highest efficiency to produce a good product at the lowest possible price.

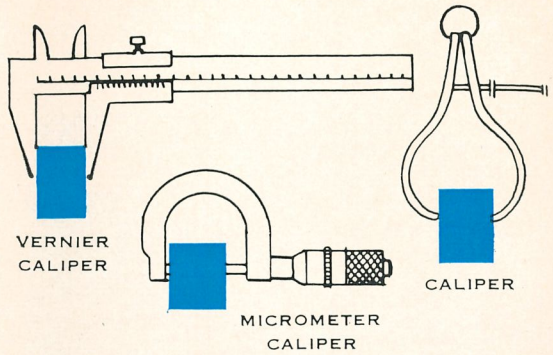


Metrology is the science of precision measurement. Measurement is the language of science. It is the language we use to communicate in exact, precise dimension. The purpose of measurement is for knowledge to be stored as a reference point to be used again, either to make or compare something else larger, smaller, or the same size.

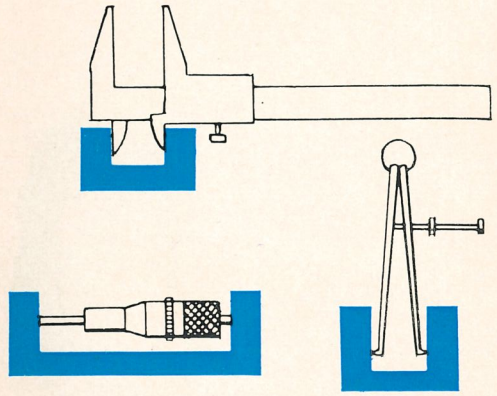


The more measurements we have of an object, the more we know about its size. Each characteristic (holes, slots, indentations, angles, or bevels) must be measured not only as to each size, but to its relation with the other measurements. (If we are to drill a hole in an object, we would want to know how large a hole is, how far from each edge of the object is the center, and how deep do we drill it.) The accuracy in accomplishing this depends on the preciseness of the measuring tools and the skill of the machinist using them. If these measurements are properly recorded along with the properties of the material the object is made from, another machinist in some other location could produce an exact duplicate from these specifications.

The only difference between generally measuring the size of an item and measuring it precisely is within the application of a highly precision tool. The first measurement we are usually interested in is the outside dimensions of an object, the length, width, and depth. This can be accomplished with a ruler in many cases. The problem with the ruler will be that reading it depends on an eye judgment and you can't always lay the ruler flat against the object.



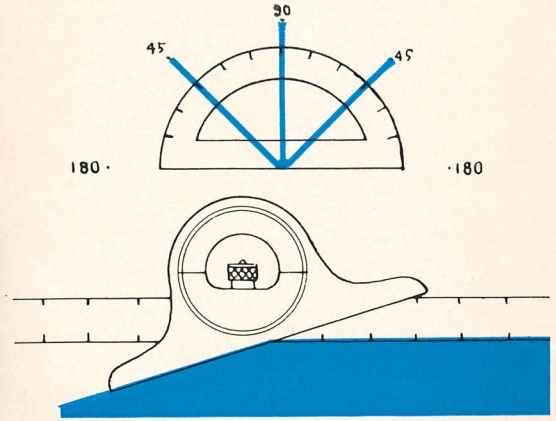
We need a tool that can actually touch the surfaces to get an accurate measurement. This tool is called a caliper. A basic caliper for an outside dimension would look like an ice tong with a set screw to hold them open at any set distance. By placing the points on the outside surface of an object and tightening the set screw, you can hold this width and transfer it to another point. By incorporating



a calibrated scale of measurement, such as on the vernier caliper, you can take a reading of the width and record it for future use.

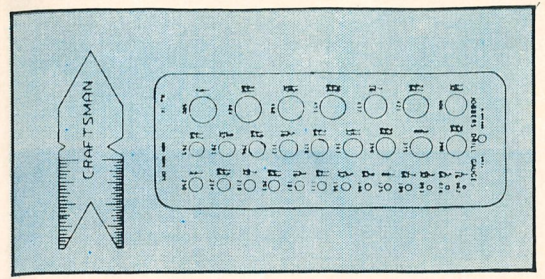
A more sophisticated instrument is the micrometer caliper with an accuracy to .001 of an inch. By reversing the idea of an outside caliper, we come up with an inside caliper for getting measurements of grooves, holes, cutouts, etc. If we place a crossbar on an inside micrometer (caliper) we have a depth gage.

Angles and degrees of a circle must be measured with a protractor, and by attaching a moveable ruler with a set screw to hold it in a given position, various angles can be measured and recorded.



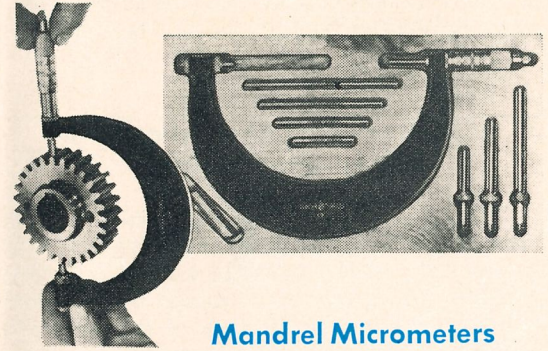
PROTRACTORS

Rigid established measurements of angles, holes, curves, and standard sizes, etc., are referred to as gages.



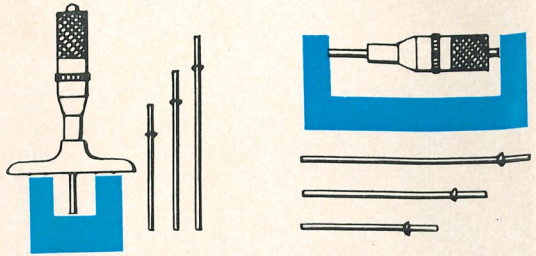
These are the basics for the precision tools in measuring and checking of measurements. There are many variations of these ideas, either in size or combination.

By looking through the specification handbook at specified tools, you should be able to establish a familiarity with these variations.



Mandrel Micrometers

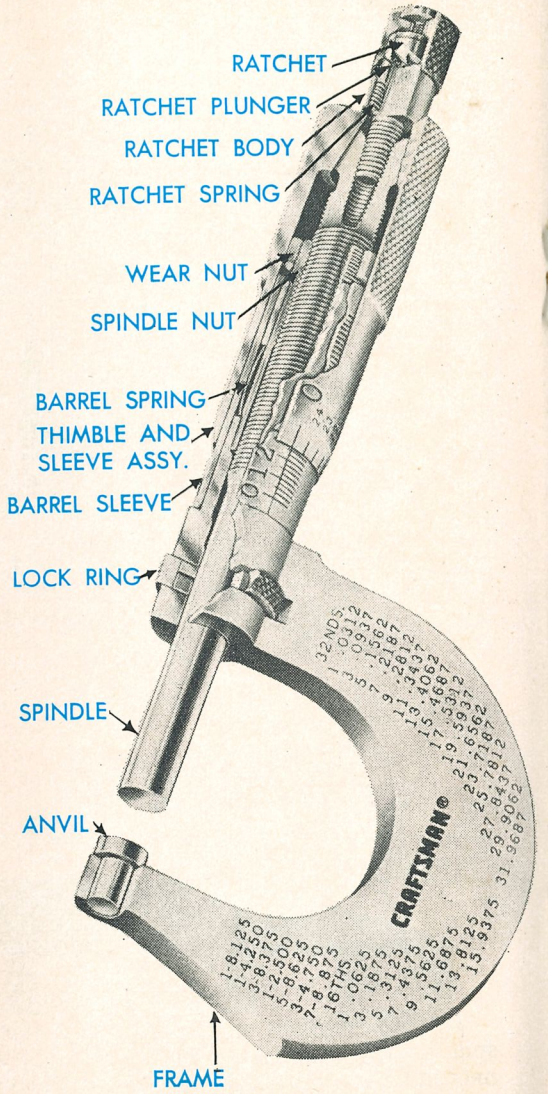
It has a steel tubular frame with a range of 0 to 4 inches and 4 interchangeable mandrels, and 3 checking standards. Especially useful where wide range of measurement is desired with low tool investment. For shops where continued use of same measurement is not required.



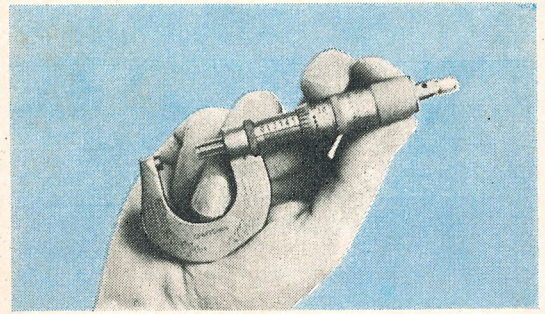
Small size inside micrometers and depth gauge adaptations have limited movement of ½″. With the use of mandrels their range can be readily increased, by the interchange of a mandrel that approximates the distance to within the ½″ travel of the micrometer head. Then by adding the length of the mandrel to the micrometer reading you will get an accurate measurement.

Micrometer Construction and Operating Principle

The principle of the Micrometer Caliper consists of a highly accurate ground screw or spindle which is rotated in a fixed nut, thus opening or closing the distance between two measuring faces on the ends of the anvil and spindle. A piece of work is measured by placing it between the anvil and spindle faces and rotating the spindle by means of the thimble until anvil and spindle both contact the work. The desired work dimension is then found from the micrometer reading indicated by the graduations on the sleeve and thimble as described on the following pages.

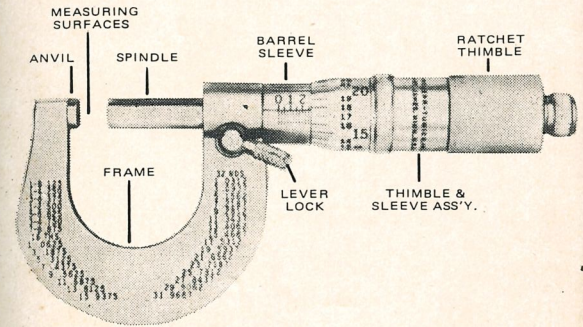


How to Hold a Micrometer



Note the above picture. The last two fingers are used to hold the frame against the palm. This leaves the thumb and first two fingers free to rotate the barrel.

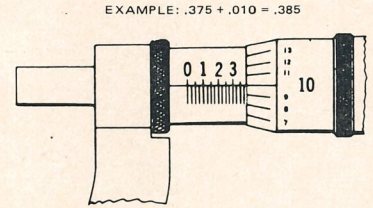
How to Read a Micrometer Caliper Graduated in Thousandths of an Inch



Since the pitch of the screw thread on the spindle is 1/40″ or 40 threads per inch in micrometers graduated to measure in inches, one complete revolution of the thimble advances the spindle face toward or away from the anvil face precisely 1/40″ or .025 inches.

The longitudinal line on the barrel sleeve is divided into 40 equal parts by vertical lines that correspond to the number of threads on the spindle. Therefore, each vertical line designates 1/40 or .025 inches and every fourth line which is longer than the others designates hundreds of thousandths. For example: the line marked "1" represents .100″, the line marked "2" represents .200″, and the line marked "3" represents .300″, etc.

The beveled edge of the thimble is divided into 25 equal parts with each line representing .001″ and every line numbered consecutively. Rotating the thimble from one of these lines to the next moves the spindle longitudinally .001 inches; rotating two divisions represents .002″, etc. Twenty-five divisions indicate a complete revolution, .025 or 1/40 of an inch.



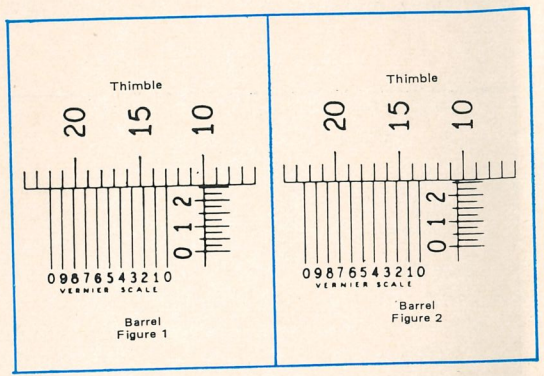
Your reading is taken by FIRST—read the barrel including the last visible line—then add the amount shown on the thimble. EXAMPLE— .375 + .010 equals .385.

To read the micrometer in thousandths, multiply the number of vertical divisions visible on the barrel sleeve by .025″, and to this add the number of thousandths indicated by the line on the thimble which coincides with the longitudinal line on the barrel sleeve.

Example: Refer to illustration page 17.

How to Read a Micrometer Caliper Graduated in Ten-Thousandths of an Inch

Micrometers graduated in ten-thousandths of an inch are used like micrometers graduated in thousandths as described on the preceding page, except that an additional reading in ten-thousandths which is obtained from a vernier is added to the thousandths reading.



The Vernier consists of ten divisions on the barrel sleeve, shown in figures 1 and 2, which occupy the same space as nine divisions on the thimble. Therefore, the difference between the width of one of the ten spaces on the Vernier and one of the nine spaces on the thimble is one-tenth of a division on the thimble, or one-tenth of one thousandth, which is one ten-thousandth. To read a ten-thousandths micrometer, first obtain the thousandths reading, then see which of the lines on the Vernier coincide with a line on the thimble. If it is line marked "1" add one ten-thousandth, if it is line marked "2" add two ten-thousandths, if it is line marked "5" add five ten-thousandths as in figure 2.

Example: Refer to figure 1 opposite.

The "2" line on barrel sleeve is visible, representing	.200″
There are two additional lines visible each representing .025″ 2 × .025″ ..... =	.050″
Line "10" on the thimble coincides with the longitudinal line on the sleeve, representing	.010″
The "0" lines on the Vernier coincide with lines on the thimble, representing	.0000″
The Micrometer reading is	.2600″

Example: Refer to figure 2 opposite.

The "2" line on sleeve is visible, representing	.200″
There are two additional lines visible, each representing .025″ 2 × .025″ ..... =	.050″
The longitudinal line on the barrel sleeve lies between the "10" and "11" on the thimble indicating ten-thousandths of an inch are also to be added as read from the Vernier	.010″
The "5" line on the Vernier coincides with a line on the thimble, representing . . . 5 × .0001″ . . . =	.0005″
The Micrometer Reading is	.2605″

How to Read a Micrometer Graduated in Hundredths of a Millimeter

Since the pitch of the spindle screw in metric micrometers is 0.5 millimeters, one complete revolution of the thimble advances the spindle toward or away from the anvil exactly 0.5 millimeters.

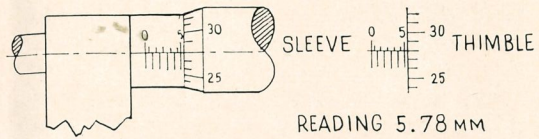
The longitudinal line on the sleeve is graduated in millimeters from 0 to 25mm and each millimeter is subdivided in 0.5mm. Therefore it requires two revolutions of the thimble to advance the spindle a distance equal to 1 millimeter.

The beveled edge of the thimble is graduated in 50 divisions, every fifth line being numbered from 0 to 50. Since a complete revolution of the thimble advances the spindle 0.5mm, each graduation on the thimble is equal to 1/50 of 0.5mm or 0.01mm, two graduations equal 0.02mm, etc.

To read a metric micrometer, add the total reading in millimeters visible on the sleeve to the reading in hundredths of a millimeter indicated by the graduation on the thimble which coincides with the longitudinal line on the sleeve.

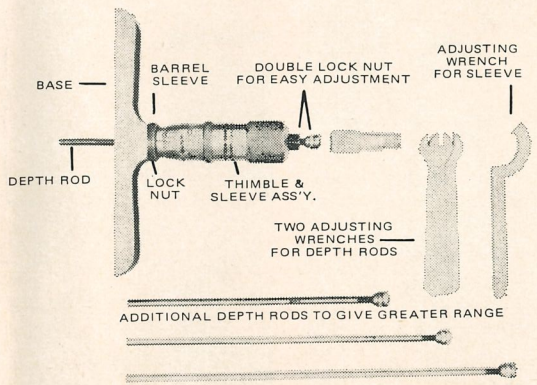
Example: Refer to illustration below.

The "5"mm graduation is visible, representing	5 mm
There is one additional 0.5mm line visible, representing	0.5 mm
Line "28" on the thimble coincides with the longitudinal line on the sleeve, each line representing 0.1mm ..... 28 × 0.1 =	0.28mm
The micrometer reading is	5.78mm



How to Read and Use a Depth Micrometer

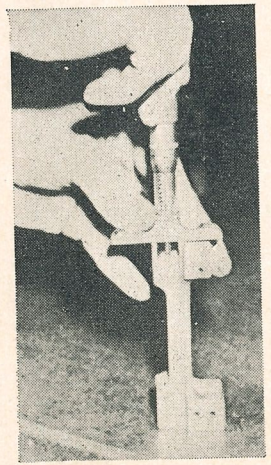
A Depth Micrometer, as the name implies, was designed to measure the depth of holes,



slots, recesses, keyways, etc.

The tool consists of a hardened, ground and lapped base combined with a micrometer head. Measuring rods with individual length adjustment are inserted through a hole in the micrometer head and brought to a positive seat by a knurled nut. The head is precision ground and has a one-inch movement. The rods are furnished to measure in increments of one inch. Each rod protrudes through the base and moves as the thimble is rotated.

The reading is taken exactly the same as with an outside micrometer except that sleeve graduations run in the opposite direction. In obtaining a reading using a rod other than the 0-1″, it is necessary to consider the additional rod length. For example, if the 1-2″ rod is being used, one inch must be added to the reading on the sleeve and thimble. When using the 2-3″ rod, two inches must be added to the reading, and so on.



Before using the depth Micrometer, be sure that base, end of rod, and work are wiped clean, and that rod is properly seated in micrometer head. Hold base firmly against work as shown above, and turn thimble until rod contacts bottom of slot or recess. Tighten lock nut and remove tool from work to read measurement.

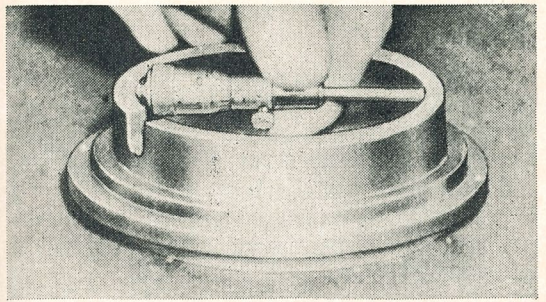
Adjustment to compensate for wear is provided by an adjusting nut at the end of each rod. Should it become necessary to make an adjustment of a rod, back off the adjusting nut one-half turn before turning to new position.

How to Read and Use an Inside Micrometer

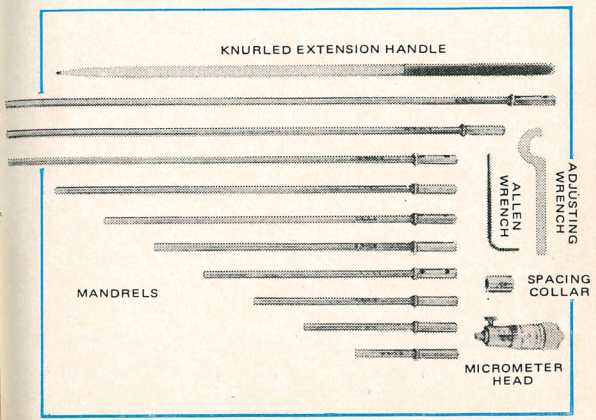
AN INSIDE MICROMETER is used for measuring inside diameters of cylinders, rings, for setting calipers, comparing gages and measuring between parallel surfaces. The measurement is taken over the ends or contacts and read off the micrometer head in thousandths of an inch. By use of the interchangeable mandrel, internal dimensions for 1½ to 12½ in. are readily taken.

Before assembling selected mandrel to micrometer head, be sure to wipe dirt from both mandrel shoulder and head. Hold assembled tool across diameter of work as shown below with one end contacting work. Screw micrometer head thimble until other end lightly contacts work. Be sure to rock contact points slightly in different directions to "feel" true diameter of work. Set mic. head to this true diameter, then take reading exactly as with an outside micrometer (page 17). Add micrometer reading to mandrel length to obtain total measurement.

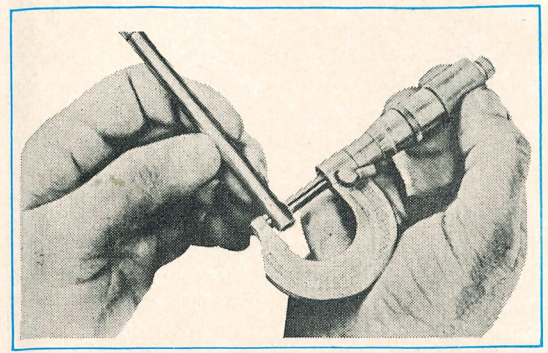
Contact points, on both micrometer head and mandrels are hardened and ground with radius which permits accurate measurements in cylindrical as well as straight recesses.



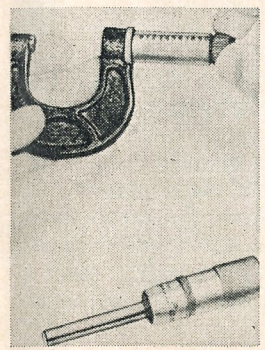
A knurled extension handle is available for obtaining inside measurements in hard-to-reach locations.

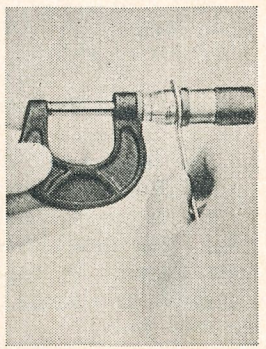


How to Use, Adjust and Care for Micrometers



For most measurements the micrometer is held as shown. The work is placed against the anvil with the left hand while the spindle is turned down on work with thumb and index finger of right hand. Caution: Do not force measurement — light contact pressure assures correct reading. After some practice, you will develop a measuring "feel" that will give your readings automatic accuracy.





Do not remove work from micrometer before taking reading. If reading cannot be seen without removing micrometer, lock the spindle at the final setting with the lock nut and slide micrometer off work by the frame.

Adjusting a Micrometer can be done in two easy steps. To eliminate play in spindle, back off the thimble, and tighten the knurled wear nut just enough to eliminate play. See illustration bottom page 21.

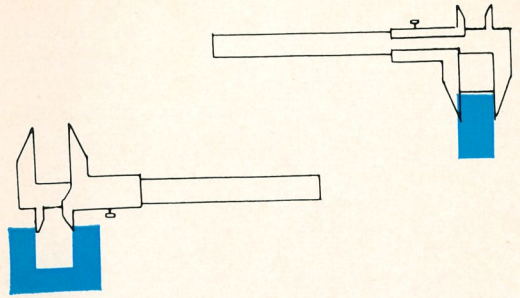
To adjust zero reading, clean all dirt or grit from measuring faces, bring them together, and insert spanner wrench (furnished with micrometer) in the small hole of the sleeve as shown at right above. Then turn the thimble sleeve until its zero line corresponds with zero line on barrel sleeve.

Caring for your micrometer requires little effort, pays off in long, accurate life. Be sure to check your micrometer periodically for accuracy, making adjustments shown above as required. An occasional drop of Precision Instrument Oil on spindle and spindle threads also assures free running performance.

Always wipe off your micrometer before putting away — never use air hose as this is apt to force dirt and grit into spindle threads. Proper storage cases are provided with Craftsman tools.

Vernier Caliper

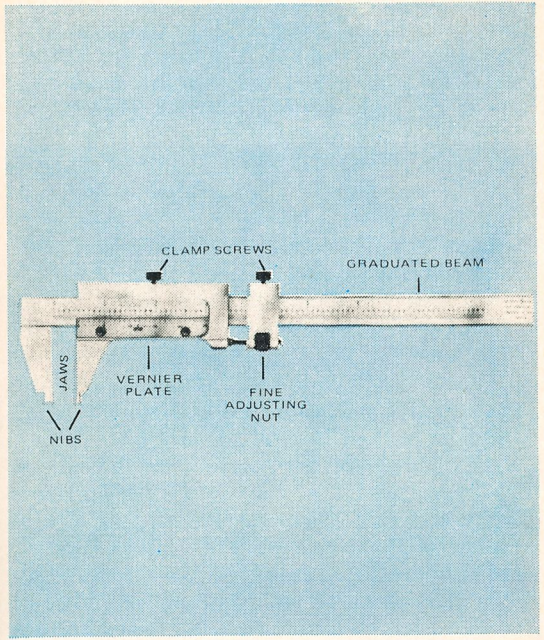
The vernier caliper is actually a slide caliper with a vernier scale of measurement. The term vernier is taken from the man's name that broke measurements down into finer and finer degrees. So when we add a finer scale of measure to a larger measure, we call this a vernier scale.



The slide caliper is designed for inside and outside measurements. This is the same as the micrometer but has certain restrictions and advantages over the other. This style caliper is designed to take quick, accurate measurements and is a versatile tool. It is not as accurate as the micrometer, but often used in conjunction with one.

Vernier Caliper Construction and Operating Principle

A Vernier Caliper consists basically of a stationary part and a movable part. The stationary part is the hardened graduated beam with fixed measuring jaw, hardened ground and lapped in one piece from the finest tool steel. The movable part is the Vernier slide assembly combining the movable jaw and Vernier plate along with clamp screws and adjusting nut. The Vernier slide moves as a unit along the graduated beam to bring both jaws in contact with work, and readings are taken in thousandths of an inch by the position of the Vernier plate zero line in relation to the beam graduations.



The inside reading is the thickness of the nibs when closed, which is the smallest measurement you can take with the caliper. Since the width of both nibs must be included in all inside measurements, you can see that all Vernier Calipers automatically compensate for this on the "inside" Vernier plate, making all inside measurements direct.

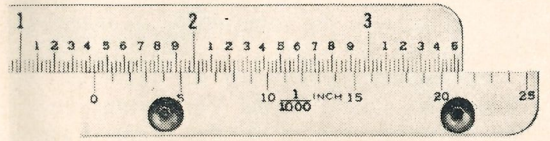
Like any precision measuring tool, a Vernier Caliper must not be forced. Move Vernier slide by hand until jaws contact work. Tighten clamp screw located over fine adjusting nut and turn fine adjusting nut until jaws engage work firmly but not too tightly. Then tighten clamp screw over Vernier plate and carefully remove caliper to get reading.

How to Read a 25-Division Vernier Caliper

Vernier Calipers permit highly accurate measurements in thousandths of an inch and are read as follows. Referring to the illustration below, the beam of the tool is graduated in 40ths or .025 of an inch, every fourth division representing a tenth of an inch, being numbered. The Vernier plate is divided into twenty-five divisions numbered 0, 5, 10, 15, 20, 25. The twenty-five divisions on the Vernier occupy the same space as ninety-nine divisions on the beam.

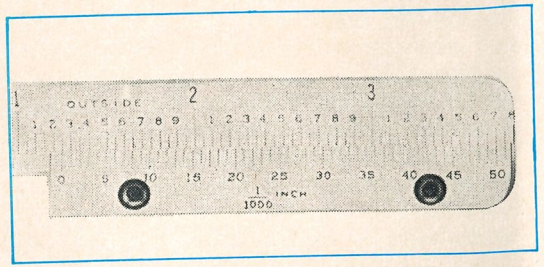
Since one division on the beam equals .025 inch, 99 divisions equal 99 x .025″ of 2.475 inch and 25 divisions on the Vernier also equal 2.475 inch. Therefore, one division on the Vernier equals 1/25 x 2.475″ or .024 inch and the difference between one beam division (.025″) and one Vernier division (.024″) equals .025″ less .024″ or .001 inch. If the tool is set so that the 0 line on the Vernier coincides with a 0 line on the beam, the line to the right of the 0 on the Vernier will differ from the line to the right of the 0 on the beam by .001 inch; the second line by .002 inch and so on. The difference will continue to increase .001 inch for each division until the line 25 on the Vernier corresponds with line 2.500 on the beam.

To read the tool, note how many inches,



tenths (or .100) and fortieths (or .025) the 0 mark on the Vernier is from the 0 mark on the beam; then add the number of thousandths indicated by the line on the Vernier which exactly corresponds with a line on the beam. EXAMPLE: In the illustration on page 23 the Vernier has been moved to the right 1.000 plus .400 plus .025 which equals 1.425 inches as shown on the beam, and the eleventh line on the Vernier coincides with a line on the beam. Therefore, .011 of an inch is to be added to the reading on the beam and the total reading is 1.436 inches.

How to Read a 50-Division Vernier Caliper or Height Gage



The beam of the tool is graduated in twentieths of an inch (.050″). Every second division represents a tenth of an inch and is numbered. On the Vernier plate is a space divided into fifty parts and numbered 0, 5, 10, 15, 20, 25 — 45, 50. The fifty divisions on the Vernier occupy the same space as forty-nine divisions on the beam.

The difference between the width of one of the fifty spaces on the Vernier and one of the forty-nine spaces on the beam is therefore 1/50 of 1/20 or 1/1000 of an inch. If the tool is set so that the 0 line on the Vernier coincides with the 0 line on the beam, the line to the right of the 0 on the Vernier will differ from the line to the right of the 0 on the beam by 1/1000; the second line by 2/1000 and so on. The difference will continue to increase 1/1000 of an inch for each division until the line 50 on the Vernier coincides with the line 49 on the beam.

To read the tool, note how many inches, tenths (or .100) and twentieths (or .050) the 0 mark on the Vernier is from the 0 mark on the beam. Then note the number of divisions on the Vernier from 0 to a line which exactly coincides with a line on the beam.

EXAMPLE: In the previous cut the Vernier has been moved to the right one and four tenths and one twentieth inches (1.250), as shown on the beam and the fourth line on the Vernier coincides with a line on the beam. Four thousands of an inch are therefore to be added to the reading on the beam and the total reading is one and two hundred and fifty-four thousandths inches (1.254).

CAUTION

When using Vernier Calipers, please remove all of the protective grease from the sides of the graduated bar before moving any sliding members. It is important for the bar to be wiped before moving the slide so that all dirt or other particles are removed, thereby preventing possible damage to the graduations and interference with the operation of the tool.

How to Care for Vernier Gages

Like any precision measuring tool, a Vernier Gage requires a reasonable amount of care to insure continued accuracy and ease of operation. Much of this care is everyday routine in good shop housekeeping and the rest a matter of periodic inspection and adjustment.

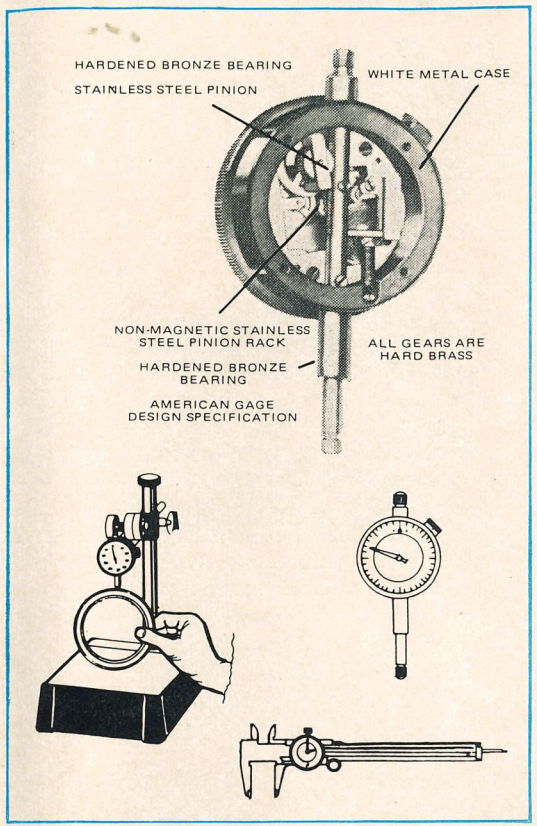
A Vernier Gage should be handled gently, but firmly and never forced in obtaining measurements. Bring the movable contact surface as close to work as possible by hand before using fine adjusting nut. Keep work and gage measuring surfaces free of dirt and grit to prevent inaccuracy and damage to precision lapped surfaces . . . and wipe gage carefully after use to prevent rust and staining and store in case with clamp screws loosened. When Vernier Gage is temporarily set down on the bench, be sure it lies flat and well away from the edge.

Check Vernier Gage periodically for accuracy at the zero line. In the case of the Vernier Caliper, bring the nibs together and check alignment of zero lines on beam and Vernier plate. Vernier Depth Gages are checked by placing base on surface plate and lowering blade until it too contacts the surface plate. Vernier Height 12″ and larger gages are checked against a standard.

Because of precision fitting of slides an occasional drop of Precision Instrument Oil should be used for free-running performance. Never use emery cloth to polish gage contact surfaces, or attempt to adjust gage for wear. Complete repair facilities are maintained at the factory for this purpose with prompt service assured.

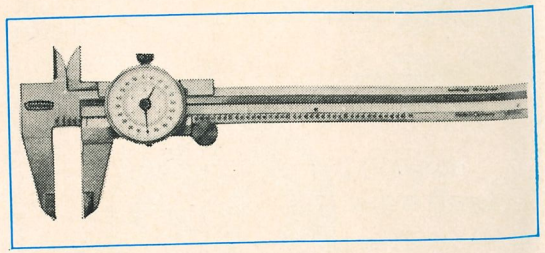
Dial Indicator

Dial indicators are adaptable to a number of different tools, such as the slide caliper, smoothness gages, roundness checking, snap on, etc. Dials are another method of taking a reading of measurement and are especially good when checking for variations.



Dial Calipers

On the lower edge, the main scale of the caliper is graduated into inches, 0″, 1″, 2″, and etc. Each inch is divided into ten parts equal to .100 per division. The Beveled edge of the jaw has a reference line scribed in, to indicate location of the sliding jaw relative to the main scale.



The dial is equipped with an inner and outer dial face. The inner (small) dial face is divided into inches, 0″, 1″, 2″, and etc., which are numbered. Each inch is divided into ten parts equal to .100 per division, which are also numbered. This inner dial is read by the short hand, with one revolution of the hand being equal to 6″.

The outer dial face is numbered 0, 10, 20, and etc. to 0 at the lower side of the dial and 10, 20 and etc. to 0 again at the top of the dial. The outer dial is read by the long hand, with one half of one revolution equal to .100 and a complete revolution equal to .200.

To read the distance the caliper is open, begin by noticing how many inches, and tenths are indicated by the reference line on the sliding jaw.

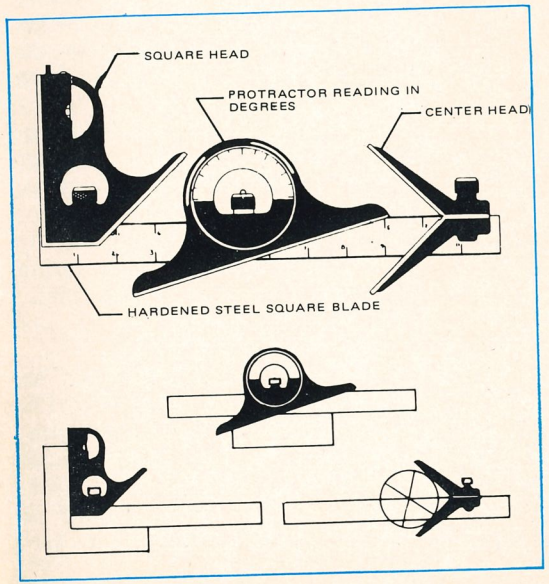
In the illustration, this would be 5 or .500. On the dial we find the small hand agrees we are at .500 with the long hand reading 0 We have a total reading of .500.

If the caliper jaw were opened to bring the large hand to the 20 mark just past the lower 0, we would have a reading of .520.

In like manner, if the jaw were moved one inch further than the illustration, we would have a reading of 1.500 on the main scale and the dial would be the same as shown for a total reading of 1.500.

Note: The dial may be adjusted to zero position by loosening the bezel lock screw and rotating the bezel to zero and again tightening the bezel lock screw.

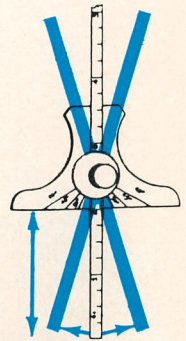
Machinist Combination Squares

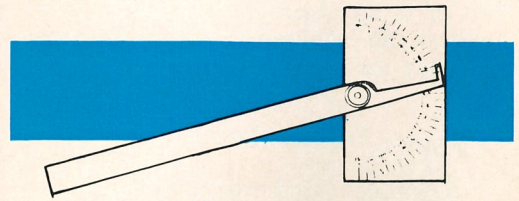


The machinist's combination square is by far the most versatile and most often found precision measuring instrument in a machinist's tool chest. With square head it is a layout tool, height or depth gage, try or miter square, level, etc. With center head and square, find center of shafts, circles. With protractor, find or lay out angles, check work. This tool can be used for checking layout or production, inspecting, setup — practically all factory operations.

Depth-Angle Gage

The depth and angle gage is used to measure depths, to set and transfer angles, to roughly check or inspect hole, slot or shoulder depths. Graduated in 64ths of an inch, it should be used only as a guide where close precision work is concerned.





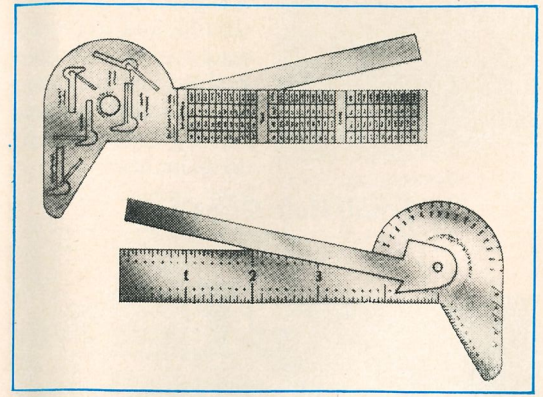
Protractors

Used for accurate reading and transferring of angles, for setting levels, layout work, etc. Adjustable spring tension holds setting, knurled nut locks setting securely when needed. Rectangular head.

Scale double graduated 0° to 180° left and right for quicker reading.

Steel Rules

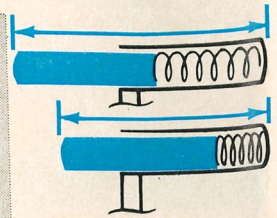
Steel rules are what the name implies, rulers made of steel. They are usually 6″ to 18″ long, ¾″ to 1″ wide and come either flexible or stiff. The scales vary from 1/100″ to 1/16″ and are usually used for checking.



Combination Rules

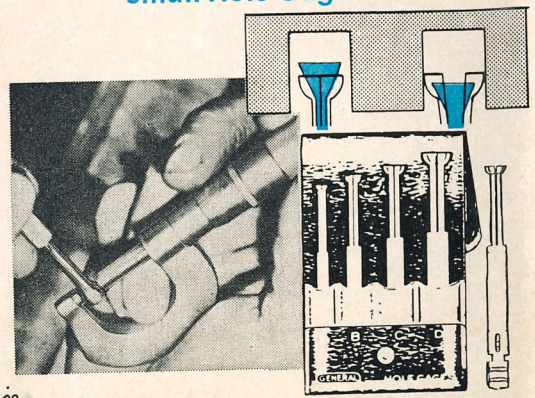
Combination rules are multi-purpose tools, pocket size, that provide, for example: a square, protractor, 4″ scale, checking standard for drill points and a tap and drill table.

Telescoping Gage Sets



One leg telescopes into the other under spring tension and is locked in position by tightening the handle. They can be preset to a certain measure or inserted into a hole, slot or recess and locked, removed and measured with a caliper or micrometer. Usually for measuring from 5/16" to 6 inches.

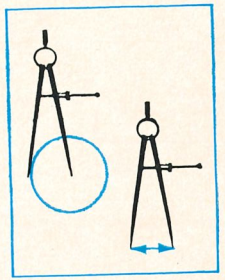
Small Hole Gage Sets



For measuring inside diameters or widths of small shallow holes for slots. Half-Ball construction permits use not accessible with regular gages. Simply insert half-ball into slot or hole, cone shaped wedge, forces the ball to spread until outside edges touch the walls of the hole, lock into position, remove and take micrometer measurement.

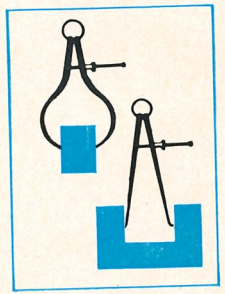
Dividers

Used usually in scribing and layout work for scribing arcs or the transfer of a repeated measurement. An adjustment screw holds a positive setting. Replaceable points compensate for wear.



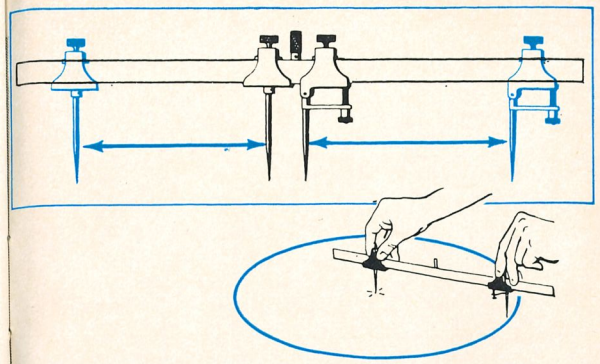
Calipers

This is a simple form of caliper. One for outside measurement, the other for inside. They are used primarily for transferring a measurement from an object or to an object, as they have no calibration for reading the size.



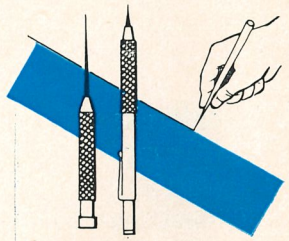
Trammel Points

Trammels are used where dimensions are greater than regular divider or caliper capacity. They are adjusted to position along a hardwood beam, one point having an extra adjustment for fine measurements. Their function is the same as a divider or caliper.



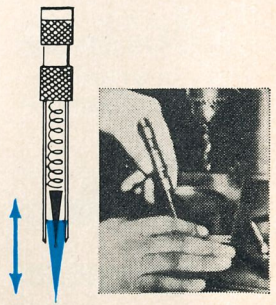
Scribers

For scribing lines or points in layout, scribers have various and replaceable points. Hardened tool steel that will scribe on virtually anything and come with both straight and bent points.



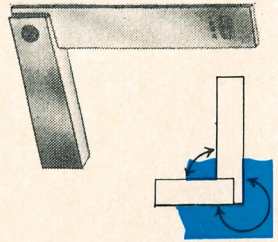
Automatic Center Punch

This is a spring loaded point that can be triggered with the same hand that is holding the tool. Has adjustable force for hard or soft metals. Makes a one hand operation of spotting holes for drilling, etc.



Solid Steel Squares

True right angles, both inside and outside. Steel squares are used to check squareness of parts and set ups.

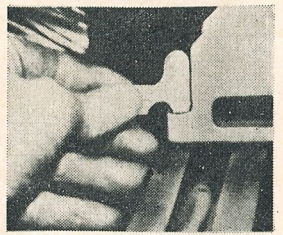


Preset Gages

These are rigid established measurements of angles, holes, curves and standard sizes.

Radius or Fillet Gage

Used to measure the radii of inside or outside corners, convex or concave shapes. Used by machine operators on actual work, also by pattern makers, tool and die sinkers and set up men.

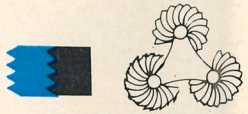


Thickness or Feeler Gage

Used by toolmakers, machinists and mechanics to check clearances. Accurately gages clearance by inserting proper sized leaf into gap.

Screw Pitch or Thread Gage

51 leaf screw-thread gage ranges in pitches from 4 to 84, gages the following threads: American national, U.S. standard.

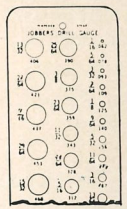


Center Gages

Used to check the lathe centers; angle of thread cutting tools. Has 14th, 20th and 32nd scale for measuring number of threads per inch. American National or U.S. 60° Standard.

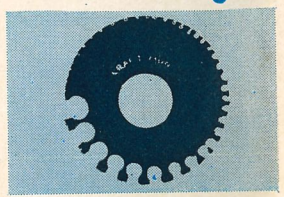
Drill Size Gage

Used to quickly and easily check drill sizes. Made of hardened steel to maintain accuracy and have decimal equivalents of the various drill sizes under each hole.

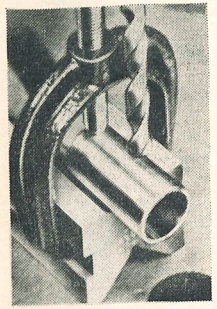


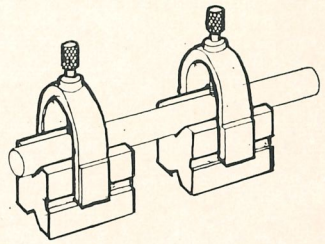
Wire Size Gage

Used to gage wire, sheets, plates, etc. of non-ferrous metals like brass, copper, aluminum, etc. Decimal equivalents of gage nos. stamped on reverse side.



V-Blocks and Clamps

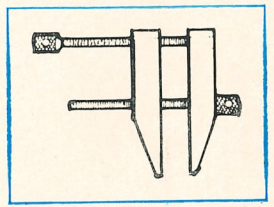




V-blocks firmly hold round or irregular shaped work for drilling, milling, grinding, tapping, etc. V-blocks are hardened tool steel, precision ground in matched pairs.

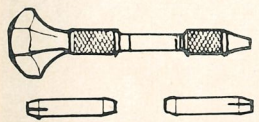
Toolmakers Clamp

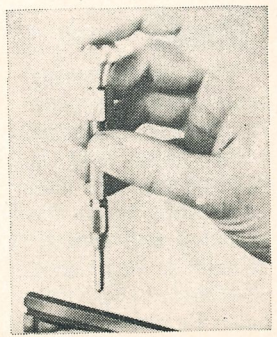
Parallel steel jaws hold work for drilling, tapping, reaming, etc.



Pin Vise

Used to hold small parts or to hold small tools in grinding, polishing, filing, drilling, etc.





Wiggler or Center Finder

All points easily interchangeable; clamp into shank by a ball swivel joint.

Needle Point — Quick, accurate location of working centers to bring work into alignment with machine spindle in many boring, milling, drilling operations.

Ball Point — Locate work by bringing the .250″ diameter ball in contact with the slot, hole, shoulder, etc. — then index machine and work to desired alignment with spindle.

Disc Point — Like the ball point but .100″ diameter for use in smaller slots, channels, shallow holes, etc.

Offset Indicator Point — Used with indicator in layout, checking, machinery, inspection operations.

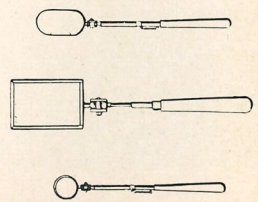
Edge Finder

Hardened steel working surfaces.

Centerless ground, for positioning tool to locate working edge.

Inspection Mirrors

A time saver for machinists, set-up men, toolmakers, service men, mechanics, and homeowners. Makes hard to see or inaccessible areas easy to see, especially for appliance servicemen.



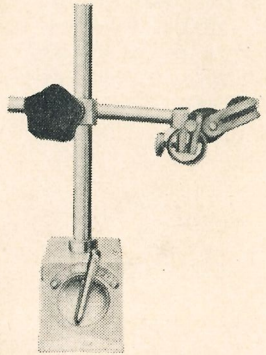
Magnetic Base Holder

(For Dial Indicators)

125 lb. vibration free magnetic pull. On-off magnetic lever for easy one hand mounting. Centered "V" magnet for strongest possible grip on round or flat surfaces.

Two magnetic surfaces bottom and back.

Post mounts two ways — vertically or horizontally.



Postscript

This completes the list of tools discussed in this book.

We have by no means covered all precision hand tools. Space does not permit it. But we have included the more common ones, those most useful to the average machinist or tool and die maker. And much of the information about one type of tool applies equally well to other types.

We wish to repeat here one fundamental requirement which applies to all precision tools. TOOLS NEED CARE. No matter what kind of tool it is, it should be kept in shape. Keep your hands and tools wiped clean while you are using them. Be sure your tools are clean before you put them away. Store them in such a manner that they will not suffer harm while they are not in use. Such procedure will pay dividends whether applied to a complete set of expensive tools or to a dime store screwdriver. The type of information in this book is no substitute for practical experience. The only way to find out about tools is to use them. But we hope this book offers some new details to those familiar with tools, and furnishes a certain background for those unacquainted with them.

And we hope that it has given a new dignity to tools. For hand tools are the beginning of industry, and without them our present civilization and style of life would still be a dream of the distant future.