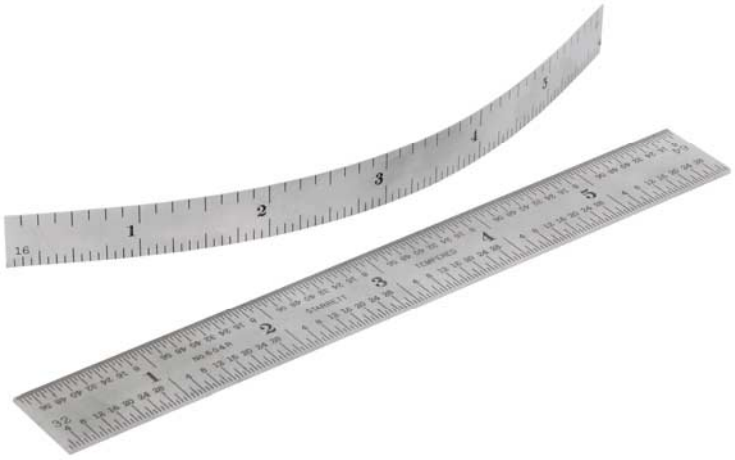
Using a Steel Rule

The steel rule is a basic measuring tool. When used correctly, a good steel rule is a surprisingly accurate measuring device.

What is a steel rule?

Some people confuse rules and scales. A scale is a measuring device used by architects and engineers that assists them in making drawings to a scale other than full size. A rule is used to measure actual sizes. (But don't ask about shrink rules, which are used to make casting patterns and include an allowance for shrinkage of the casting during cooling.)

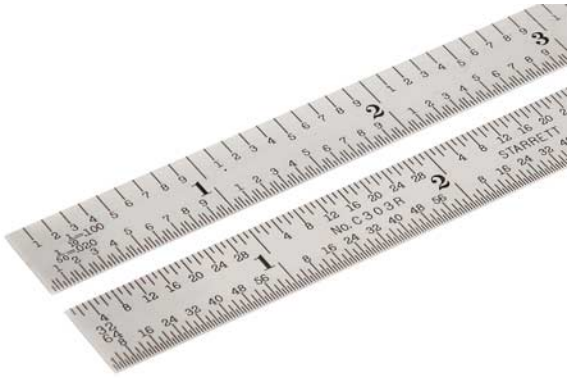
Steel rules come in many sizes and formats. Basic 6" and 12" steel rules come in flexible and rigid forms. Flexible rules are usually ½" wide and 1/64" thick. Starrett calls flexible rules "semi-flexible." Rigid rules are usually ¾" wide and 3/64" thick. Starrett calls rigid rules "spring-tempered."



While most steel rules are 12" long or shorter, they are available up to 144" (12 feet) long.

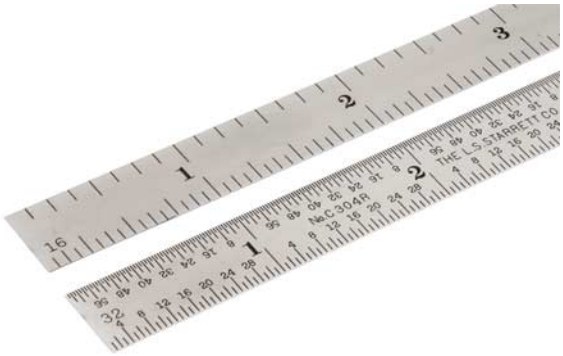
Graduations

There are many options for graduations. Some of the more common are shown in the following photos.



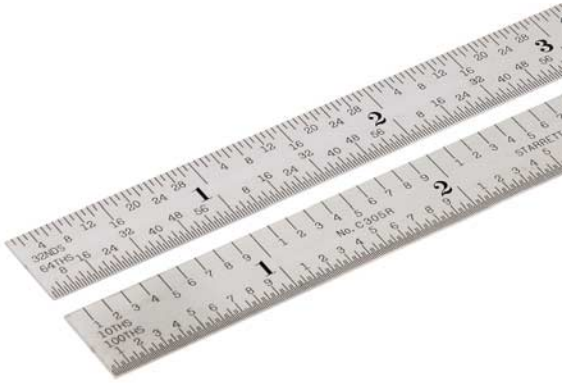
3R

32nds, 64ths, 10ths, 50ths



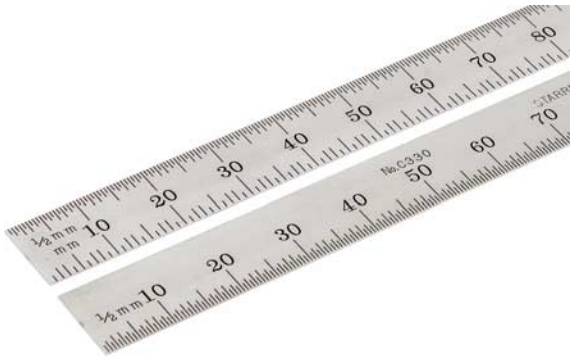
4R

8ths, 16ths, 32nds, 64ths



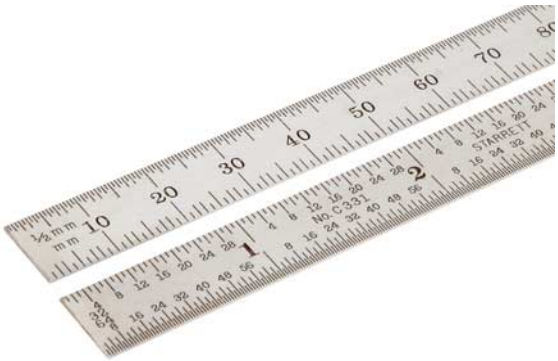
5R

32nds, 64ths, 10ths, 100ths



30 (Metric)

mm & 0.5mm both sides



31 (Inch/Metric)

0.5mm & 32nds, mm & 64ths

What makes a good steel rule?

Conventional wisdom is that the best steel rules are machine divided. This means the graduations are cut on a machine that uses gearing to ensure the graduation lines are evenly spaced and the correct distance apart.

Most steel rules are now made by a photoengraving process called photo etching. A photosensitive resist is exposed through a precision master negative to create a pattern of masked and clean areas. An etching solution forms the graduations and other markings on the rule.

Good steel rules have uniform graduation line widths. Variation in line width makes accurate measurement difficult.

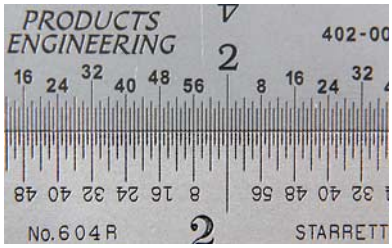
So let's take a look at the conventional wisdom. Are machine divided rules better than photo etched rules? When this marketing claim was first made, it was probably true. But now it is most certainly not true.

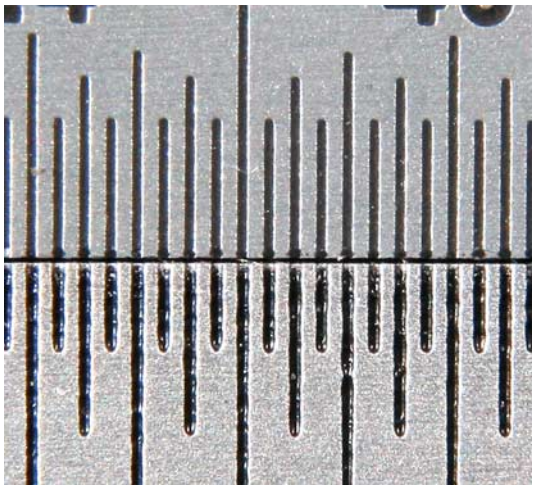
The process of machine dividing rules was developed about 125 years ago. It probably produced a major improvement in the accuracy of rules. But anything that relies on gears and mechanics must involve some measure of error, simply because the machine cannot be perfectly made.

Photoengraving, on the other hand, relies on a precision master to transfer the design to the rule. With a perfect master, each rule made from that master should also be virtually perfect. So the question becomes how well can a master be made? And the answer is very well indeed. The basic process for making steel rules is the same process by which computer processors and other integrated circuits are made with extreme precision. Current technology can create a master negative that is orders of magnitude better than required to make a steel rule.

The two major manufacturers of steel rules in the United States are the L. S. Starrett Company (Starrett) and Products Engineering Corporation (PEC). PEC makes steel rules for many of the other brands that are available in the United States. Starrett rules are machine divided, whereas PEC rules are precision etched. The following photos show the two companies' rules next to each other. The left photo shows the two rules at about full size. The right shows a

section of each at a higher magnification. Which rule do you think is easier to read?





The material that a steel rule is made of is also important to the quality. Good steel rules are made from high-carbon spring steel that is hardened and tempered to Rc 47-52. They are chrome plated, usually with a satin finish, for corrosion resistance and readability.

You might have noticed the difference in color between the Starrett and PEC steel rules in the previous photos. PEC steel rules use a unique plating process to achieve a brighter, satin chrome finish that enhances the contrast between the black graduation lines and the surface of the rule. This also enhances their readability.

While you can find many inexpensive steel rules made of stainless steel, it is not a great material from which to make steel rules. The stainless steel used to make steel rules cannot be hardened to the level of spring steel and thus it tends to yield when bent, keeping the curve, and not snapping back to straight.

Both the long edges and the ends of steel rules should be ground for straightness and accuracy. Ends that are ground square, and in proper relationship to the graduations allow accurate measurements from the ends of the steel rule.

A properly made steel rule will have virtually no error in the graduations. Any error in the rule is between the first graduation and the end of the rule. The standards for this error are actually quite lenient. The first graduation can have an error between +0.004" and –0.002" and still meet the standards. Most steel rules will handily meet this standard.

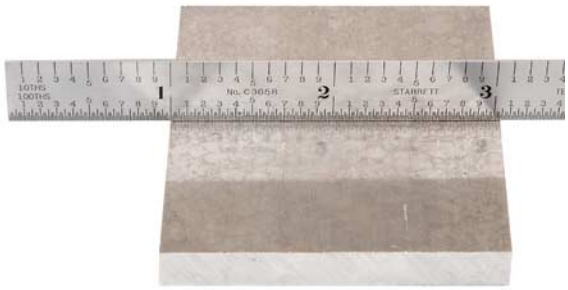
Care of steel rules

Steel rules are precision measuring instruments. Don't use your steel rule as a scraper, screwdriver or pry bar. Don't drop it or bang it around. Keep your steel rule very lightly oiled.

Inspect your steel rule periodically. Be sure that it is not bent or dented. Check that the corners are square and sharp. Be sure there are no burrs anywhere on the steel rule. If you find any of these problems, replace your steel rule.

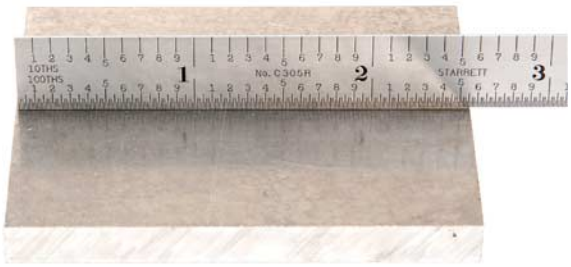
Measuring

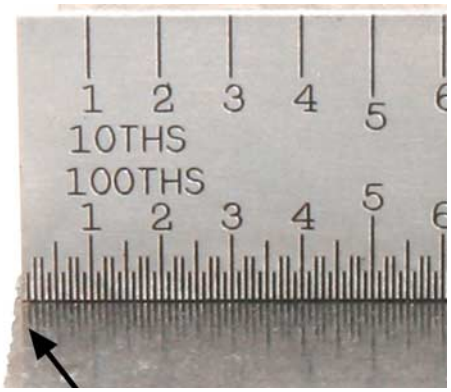
Here is the correct way to measure a part with a steel rule. Notice that we are measuring from the 1" graduation on the left. (Be sure to subtract 1" from the measurement you read.) It is more accurate to measure between two graduation lines than from the end of the rule.



It is okay to measure from the end of the rule when there is a hard stop that you can press the rule against. The accuracy of this measurement depends on the quality of the grinding of the end of the rule.

But trying to align the end of the rule with the edge of a part is simply not an accurate way to measure.





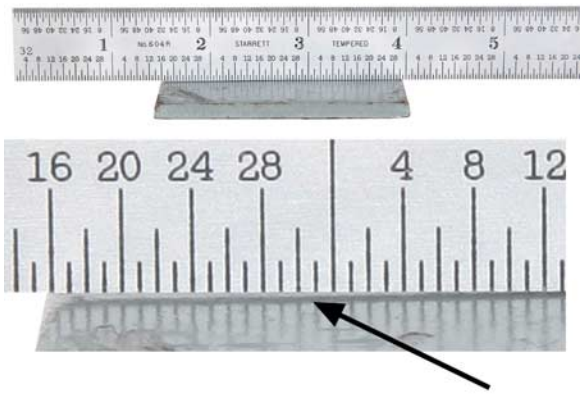
Be sure the graduations on the rule are adjacent to the part being measured. When the rule is laid flat on the part, you cannot get an accurate measurement because of parallax.

Good technique Poor technique

Be sure the steel rule is straight across the dimension you want to measure. If the steel rule is at an angle, the measurement cannot be accurate.

Good technique Poor technique

Another use for a rigid steel rule is to check the flatness of a part. Because the edges are ground, you can make a visual check of the flatness of a part by standing the steel rule on edge across the part. Try it in several places and look for light under the rule. With a good steel rule you should be able to see 0.0005" of deviation from flat.



How accurate is a steel rule?

In general, a measuring device is considered accurate to the smallest graduation. So a steel rule that is graduated to 1/64" is accurate to about 0.015". But with careful visual interpolation, you actually measure to about 0.005" with a good steel rule. That's about the width of one of the graduation lines.