Vernier caliper

http://en.wikipedia.org/wiki/Caliper

Main article: Vernier scale

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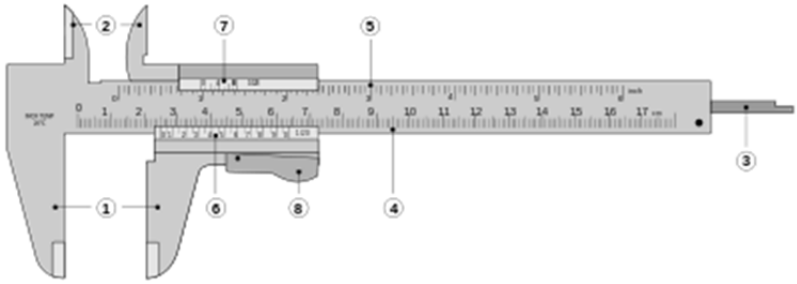


Parts of a vernier caliper:

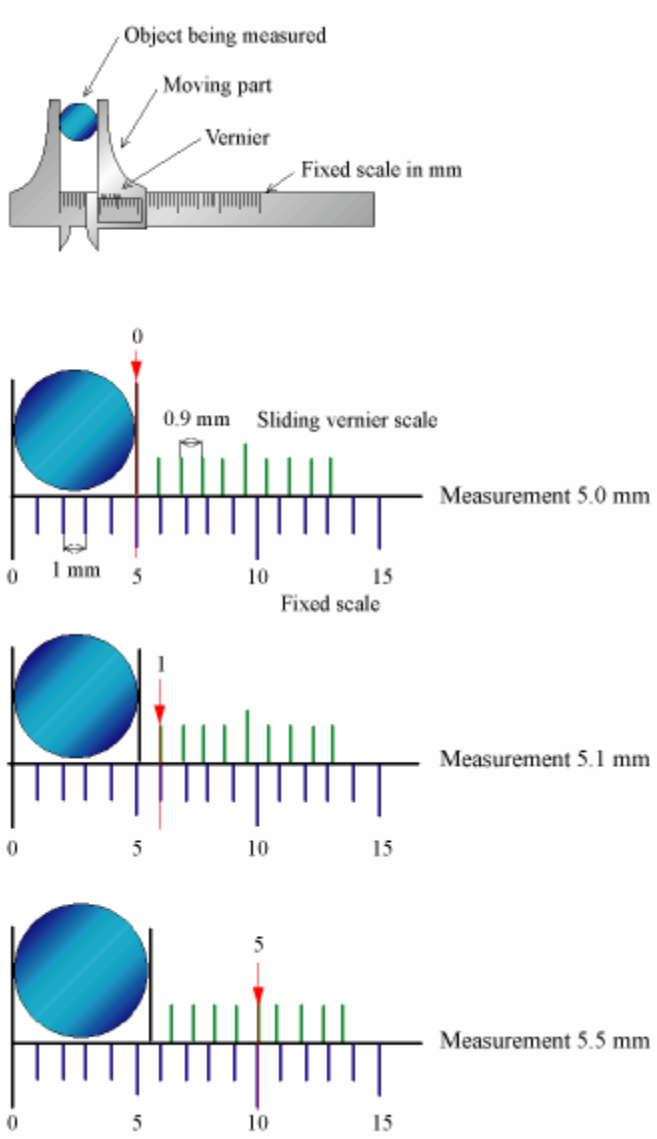
1. **Outside jaws**: used to measure external diameter or width of an object
2. **Inside jaws**: used to measure internal diameter of an object
3. **Depth probe**: used to measure depths of an object or a hole
4. **Main scale**: scale marked every mm
5. **Main scale**: scale marked in inches and fractions
6. **Vernier scale** gives interpolated measurements to 0.1 mm or better
7. **Vernier scale** gives interpolated measurements in fractions of an inch
8. **Retainer**: used to block movable part to allow the easy transferring of a measurement

The vernier, dial, and digital calipers give a direct reading of the distance measured with high accuracy and precision. They are functionally identical, with different ways of reading the result. These calipers comprise a calibrated scale with a fixed jaw, and another jaw, with a pointer, that slides along the scale. The distance between the jaws is then read in different ways for the three types.

The simplest method is to read the position of the pointer directly on the scale. When the pointer is between two markings, the user can mentally interpolate to improve the precision of the reading. This would be a simple calibrated caliper; but the addition of a vernier scale allows more accurate interpolation, and is the universal practice; this is the **vernier caliper**.

Vernier, dial, and digital calipers can measure internal dimensions (using the uppermost jaws in the picture at right), external dimensions using the pictured lower jaws, and in many cases depth by the use of a probe that is attached to the movable head and slides along the centre of the body. This probe is slender and can get into deep grooves that may prove difficult for other measuring tools.

The vernier scales may include metric measurements on the lower part of the scale and inch measurements on the upper, or vice versa, in countries that use inches. Vernier calipers commonly used in industry provide a precision to 0.01 mm (10 micrometres), or one thousandth of an inch. They are available in sizes that can measure up to 1,829 mm (72 in).[8]



The vernier scale is constructed so that it is spaced at a constant fraction of the fixed main scale. So for a decimal measuring device each mark on the vernier is spaced nine tenths of those on the main scale. If you put the two scales together with zero points aligned, the first mark on the vernier scale is one tenth short of the first main scale mark, the second two tenths short, and so on up to the ninth mark—which is misaligned by nine tenths. Only when a full ten marks are counted is there alignment, because the tenth mark is ten tenths—a whole main scale unit short, and therefore aligns with the ninth mark on the main scale.

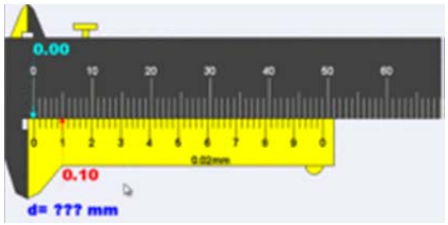
Now if you move the vernier by a small amount, say, one tenth of its fixed main scale, the only pair of marks that come into alignment are the first pair, since these were the only ones originally misaligned by one tenth. If we move it two tenths, the second pair aligns, since these are the only ones originally misaligned by that amount. If we move it five tenths, the fifth pair aligns—and so on. For any movement, only one pair of marks aligns and that pair shows the value between the marks on the fixed scale.

Vernier acuity

Vernier scales work because the human eye can detect that two line segments are aligned. Vernier acuity is the ability by a person to detect the proper alignment of two line segments.[6] In most people, Vernier acuity is particularly high, enabling accurate differentiation between aligned and misaligned marks on a vernier scale.

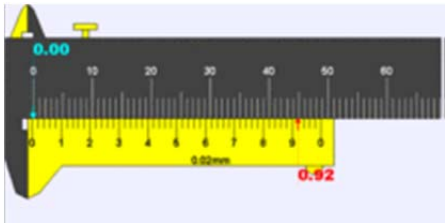
Zero error

The method to use a vernier scale or caliper with zero error is to use the formula: 'actual reading = main scale + vernier scale - (zero error)'. Zero error may arise due to knocks that cause the calibration at the 0.00 mm when the jaws are perfectly closed or just touching each other.



when the jaws are closed and if the reading is 0.10mm, the zero error is referred to as +0.10mm.The method to use a vernier scale or caliper with zero error is to use the formula 'actual reading = main scale + vernier scale - (zero error)' thus the actual reading is 19.00 + 0.54 - (0.10) = 19.44 mm

Positive zero error refers to the fact that when the jaws of the vernier caliper are just closed, the reading is a positive reading away from the actual reading of 0.00mm. If the reading is 0.10mm, the zero error is referred to as +0.10mm.



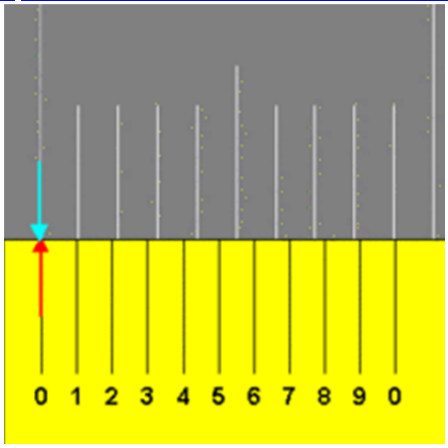
when the jaws are closed and if the reading is -0.08mm, the zero error is referred to as -0.08mm..The method to use a vernier scale or caliper with zero error is to use the formula 'actual reading = main scale + vernier scale - (zero error)' thus the actual reading is 19.00 + 0.36 - (-0.08) = 19.44 mm

Negative zero error refers to the fact that when the jaws of the vernier caliper are just closed, the reading is a negative reading away from the actual reading of 0.00mm. If the reading is 0.08mm, the zero error is referred to as -0.08mm.

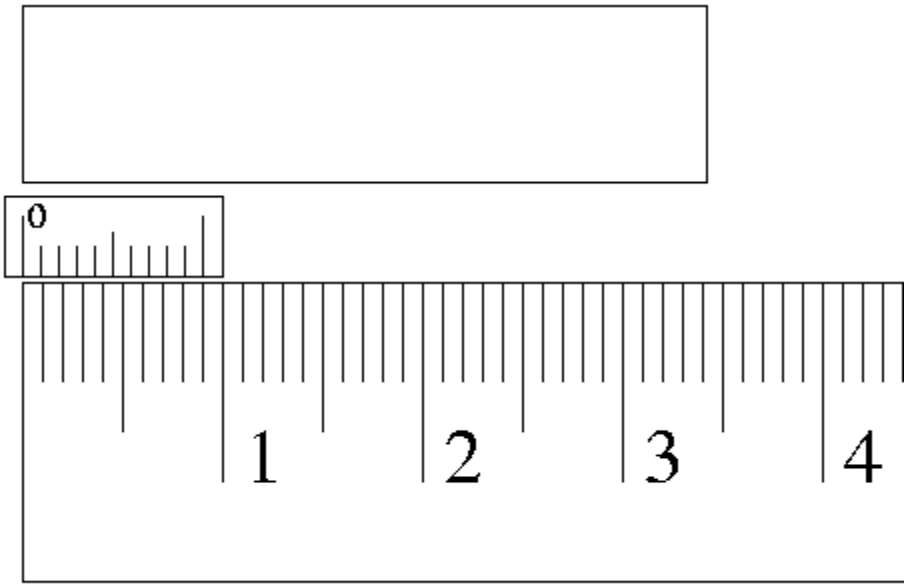
See also

- Micrometer
- Nonius — device invented by Pedro Nunes
- Transversal (instrument making) – technique in use prior to vernier scales.

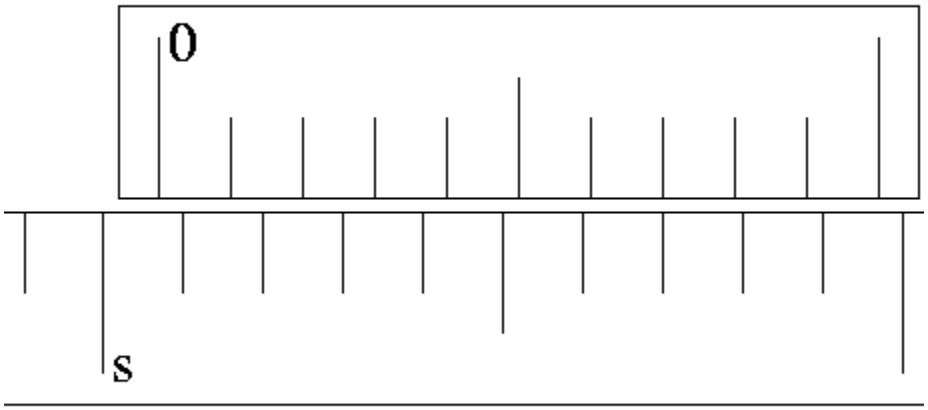
Notes

1. ^ Barrow calls the device a "vernier". See: John Barrow, *Navigatio britannica: or a complete system of navigation* … (London, England: W. and J. Mount and T. Page, 1750), pages 140-142, especially page 142.
2. ^ [a] [b] Daumas, Maurice, *Scientific Instruments of the Seventeenth and Eighteenth Centuries and Their Makers*, Portman Books, London 1989 ISBN 978-0-7134-0727-3
3. ^ 1911 Encyclopaedia Britannica article on Navigation. Accessed April 2008
2. 

3.
4. Vernier scale Direct vernier
5. Direct vernier
6. Direct verniers are the most common. The indicating scale is constructed so that when its zero point is coincident with the start of the data scale, its graduations are at a slightly smaller spacing than those on the data scale and so none but the last graduation coincide with any



http://physicspmb.ukzn.ac.za/OnlineExercises/IntroVernier/intro2.html



http://physicspmb.ukzn.ac.za/OnlineExercises/IntroVernier/vernier7.html