TFT Tools Inc

Operation Instruction

Universal Bevel Protractor

A protractor is a device for measuring the angle between two intersecting lines. The angle is measured in degrees, and a circle is defined as having 360 degrees of identical size. The earliest known protractors were designed in the 17th century by sailors needing to plot courses on nautical charts.

A basic protractor consists of a half-circular piece of material with degree markings notched onto the outside edge of the arc, or curved section. The straight edge is placed along one of the lines to be measured, and the number of degrees is determined by where the second line crosses the arc.

Because it is a half-circle, the basic protractor only measures angles up to 180 degrees. This is adequate in normal use, as the relationship between two lines can always be expressed as an angle of 180 degrees or less. If the original placement of the protractor produces an angle greater than 180 degrees, simply flipping it over will provide a reading of less than 180 degrees.

This is due to the symmetrical nature of the circle; starting from one line, the angle to a second intersecting line can be measured by moving either clockwise or counter clockwise. One direction will measure an angle greater than 180 degrees, and the other will measure an angle less than 180 degrees. They cannot both measure more than 180, as they must add up to 360, the number of degrees in a full circle.

An alternate type of protractor is made from two straight edges attached to each other at one end, with a graduated arc between them. The arc is attached to one arm, and the other arm slides freely over it. An arm is placed along one line, and the other arm is swung outwards until it is parallel to the other line. The degrees are then read off the arc. Astronomers often use a third type of protractor, one formed from a fully circular piece of material. This allows them to directly measure all angles between 0 and 360.

Protractors are generally used for measuring existing lines, but they can also be constructed to help draw them. By attaching a swiveling arm to the straight edge of the semicircular disk described above, lines with arbitrary angles can be drawn. Such devices are most commonly used in drafting of technical drawings such as architectural plans.

The universal bevel protractor picks up where the blade protractor leaves off. The universal bevel protractor (Figure 7) is designed for precision measuring and layout of angles.

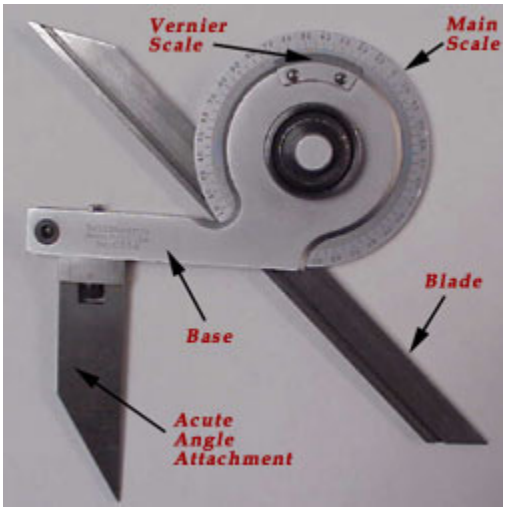
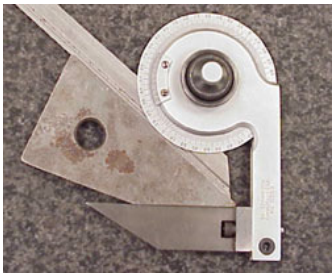


Figure 7. The universal bevel protractor is capable of measuring to within 5 minutes or 1/12 of a degree.

The universal bevel protractor is capable of measuring obtuse angles as well as acute angles when accompanied with the correct attachments. Look at Figure 8 below to give you an idea as to the uses of the universal bevel protractor.


Measuring Acute Angles


Measuring Obtuse Angles

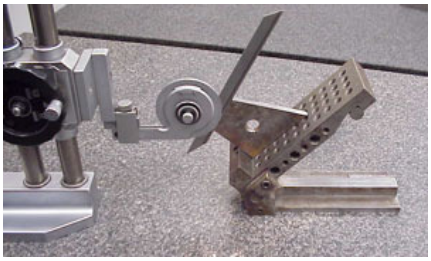

Using a protractor with a vernier height gage.

Figure 8. Measuring applications for the universal bevel protractor.

The main component of the bevel protractor is the main scale . The main scale is graduated into four 90-degree components. The main scale is numbered to read from 0 to 90 degrees and then back from 90 degrees to 0 (Figure 9).

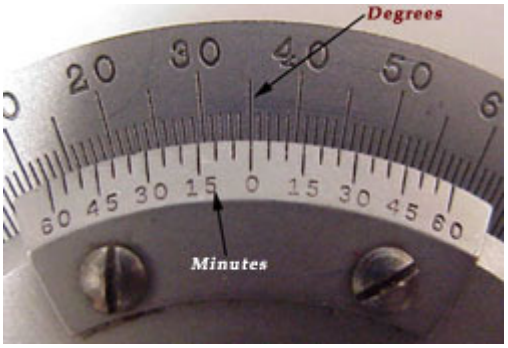


Figure 9. Degrees can be read directly off of the main scale, while the minutes are read on the vernier scale.

As with other vernier measuring devices, the vernier scale of the bevel protractor allows the tool to divide each degree into smaller increments. The vernier scale is divided into 24 spaces, 12 spaces on either side of the zero (see Figure 9).

Each space on the vernier scale is, therefore, one-twelfth of a degree. One-twelfth of a degree is equal to 5 minutes. To read the protractor, note where the zero on the vernier scale lines up with the degrees on the dial in Figure 10. The degrees are read directly from the main scale. The zero on the vernier scale is just pass the 85 degree mark. Now, *reading in the same direction (counter-clockwise)*, count, by five, from zero on the vernier scale to the lines that match up on the dial (Figure 10).

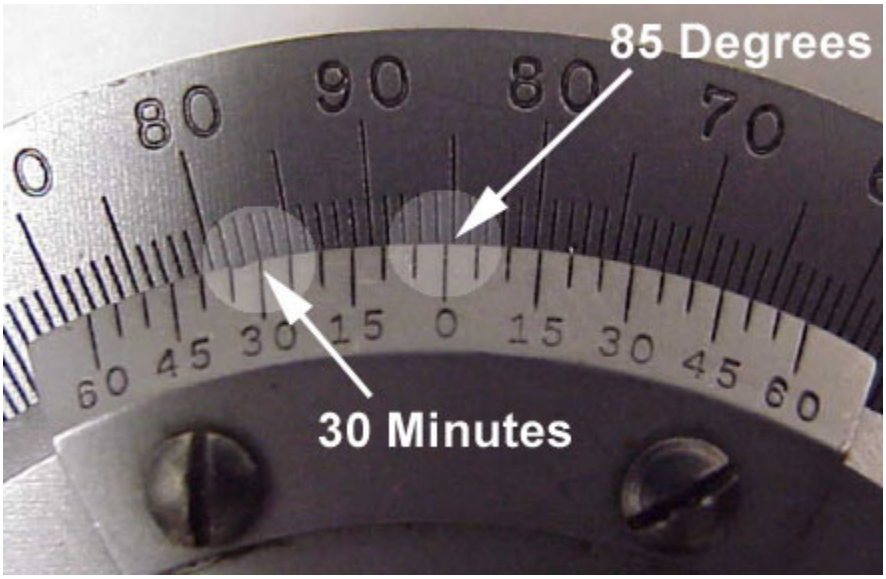


Figure 10. Always read the vernier in the same direction that you read the dial.

Add this number of minutes to the number of whole degrees. The total number of degrees and minutes in Figure 10 would equal 85 degrees and 30 minutes. Look at the measurements in Figure 11 to get you more accustomed to vernier bevel protractor reading.

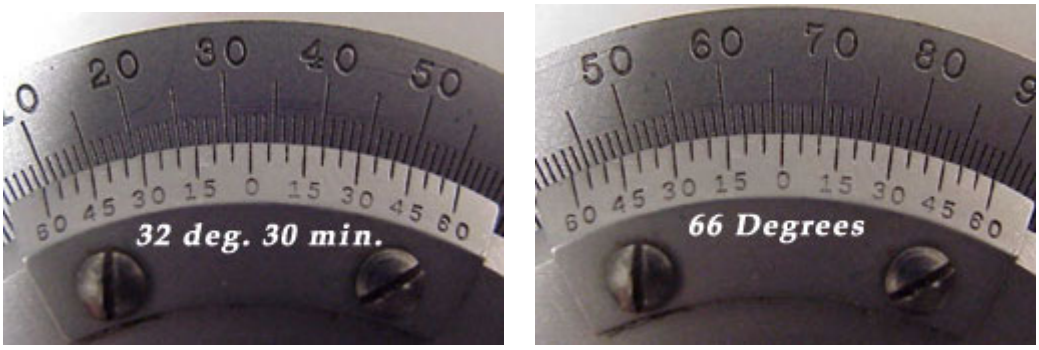


Figure 11. Vernier bevel protractor readings.

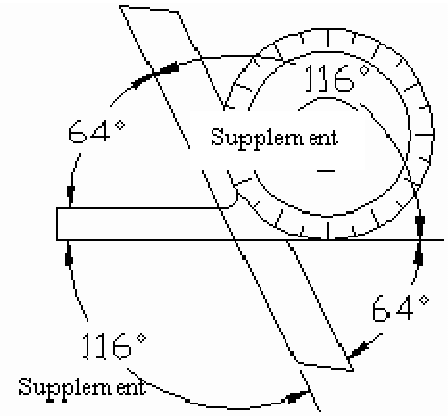


Figure 12. When reading from 90 degrees, make sure to note the positions where the angle and the supplement are formed.

Any angle can be measured with the vernier bevel protractor, but you have to be careful to note which part of a full circle you are measuring. For every position of the bevel protractor, four angles are formed (Figure 12). Two of the angles can be read directly on the main scale and the vernier scale while the other two are supplemental angles. Keep track of the obtuse and acute angles and try to read from zero whenever possible. There is no general rule for use, just keep in mind that you are adding to 90 degrees to make up the angle being measured.