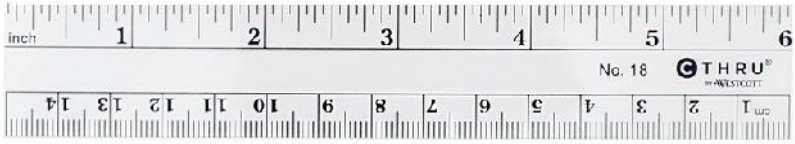
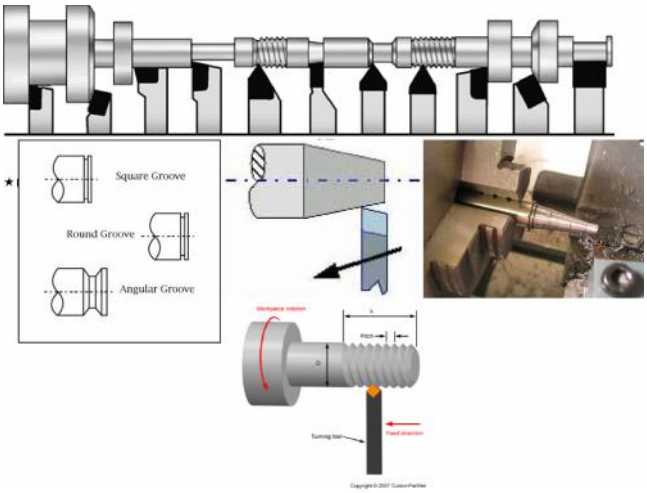


Turning

Turning is a form of machining, a material removal process workpieces/parts by cutting away unwanted material.

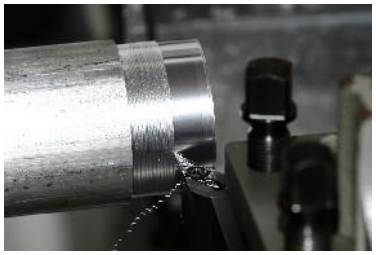
Turning is used to produce rotational, typically axi-symmetric, parts that have many features, such as holes, **grooves, threads, tapers**, various diameter steps.



Turning with Lathe

The turning process requires a turning machine or lathe, workpiece, fixture, and cutting tool.

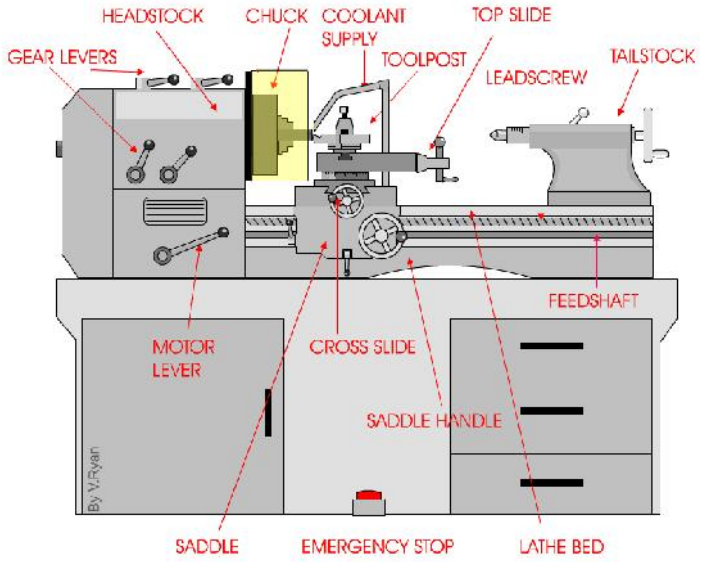
The workpiece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and allowed to rotate at **high speeds.**



The cutter is typically a single-point cutting tool that is also secured in the machine.

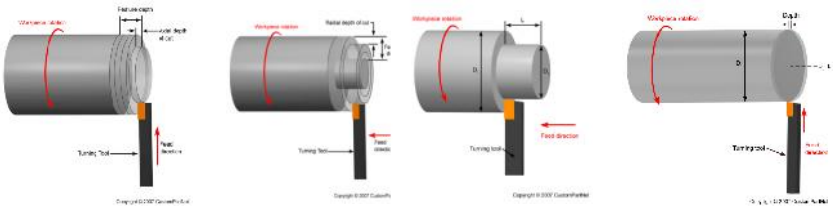
The cutting tool feeds into the rotating workpiece and cuts away material in the form of small chips to create the desired shape.

Lathe



Turning Operations

Typically the workpiece is rotated on a spindle and the tool (cutter) is fed into it radially, axially or both ways simultaneously to give the required surface.
As materials are though and hard, there occurs high contact force between the tool and workpiece. Therefore, a feature is typically machined in several passes as the tool moves to the specified axial/radial depth of cut for each pass.

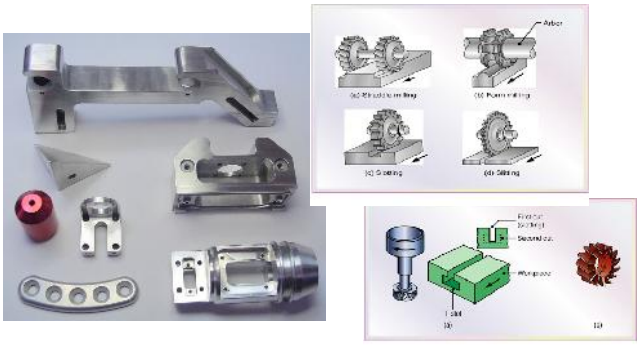


The term **turning,** in the general sense, refers to the generation of any cylindrical surface with a single point tool.
The generation of surfaces oriented primarily perpendicular to the workpiece axis are **called facing**. In facing a radial feed is dominant.

Parts manufactured via Turning

Milling

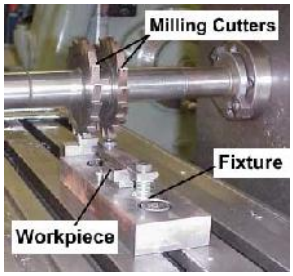
Milling is a process of producing **flat and complex shapes** with the use of multi-tooth cutting tool by progressively removing a predetermined amount of material from the workpiece.

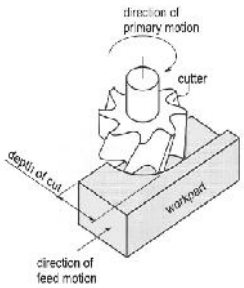


Miling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three dimensional surface contours

Milling

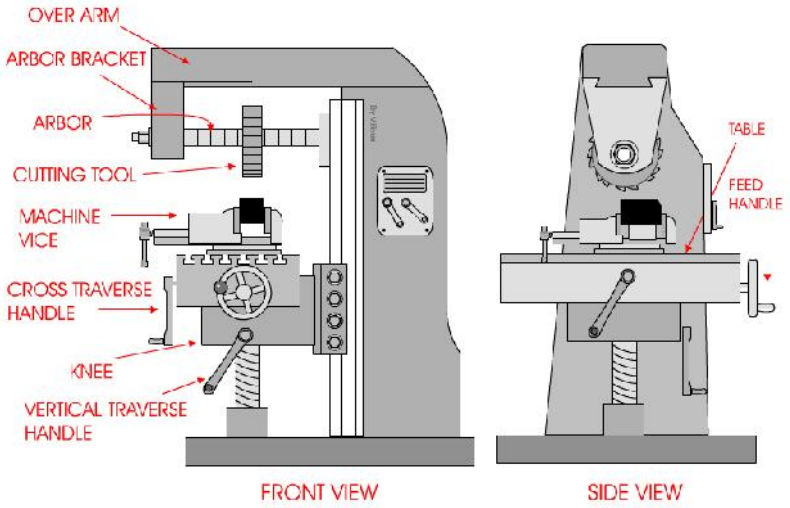
The milling process requires a milling machine, workpiece, fixture, and cutter. The workpiece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to a platform inside the milling machine.



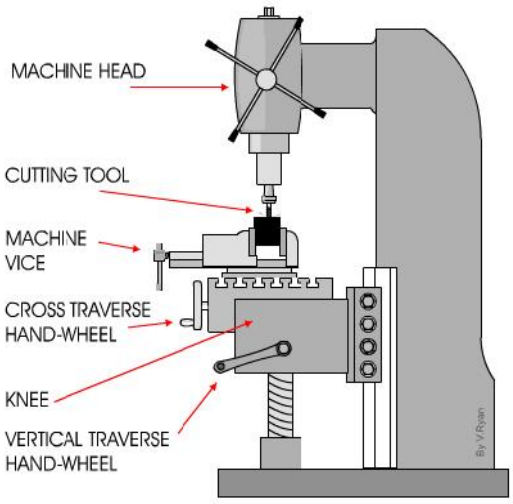


The cutter is **a cutting tool** with sharp teeth that is also secured in the milling machine and rotates at **high speeds**. By feeding the workpiece into the rotating cutter, material is cut away from this workpiece in the form of small chips to create the desired shape.

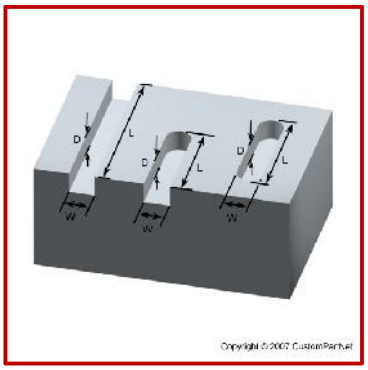
Horizontal Milling Machines

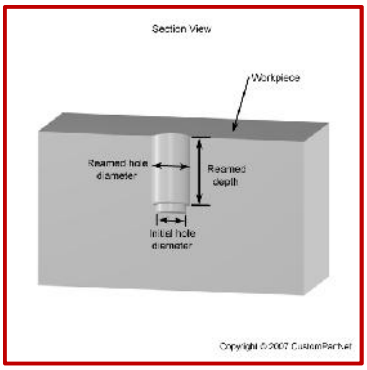


Vertical Milling Machines



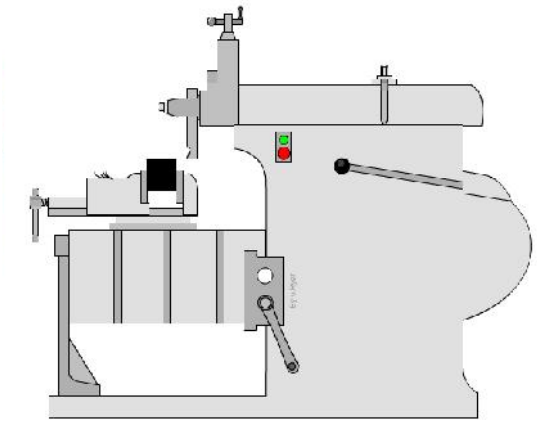
Parts manufactured via Milling



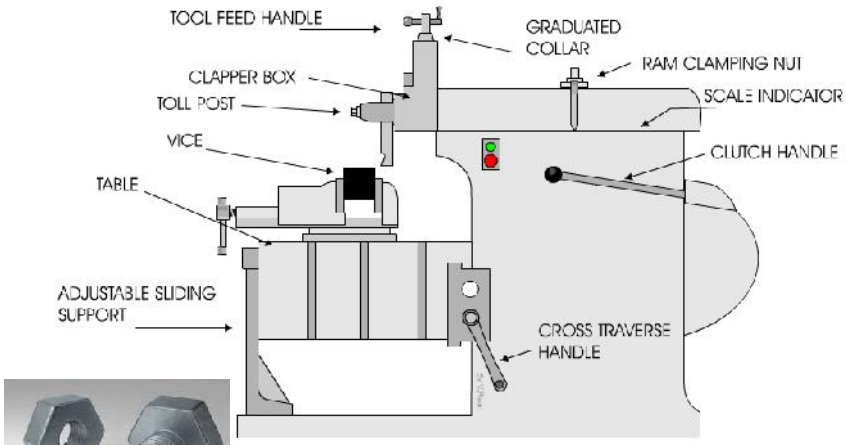


Shapping Machine

A shaping machine is used to machine surfaces. It can cut curves, angles and many other shapes. It is a popular machine in a workshop because its movement is very simple although it can produce a variety of work.

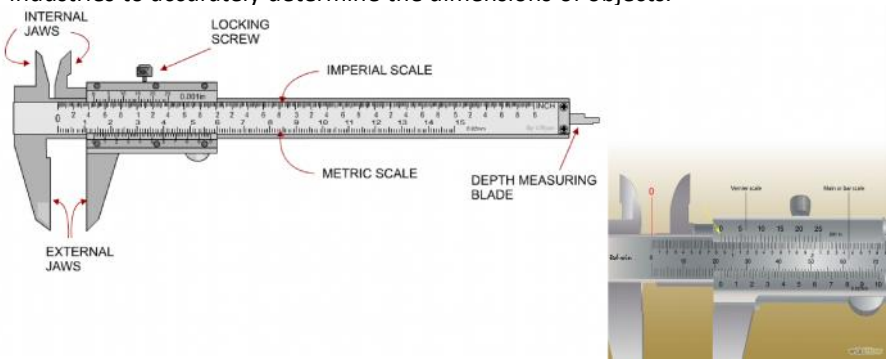


Shapping Machine



Vernier Calipper

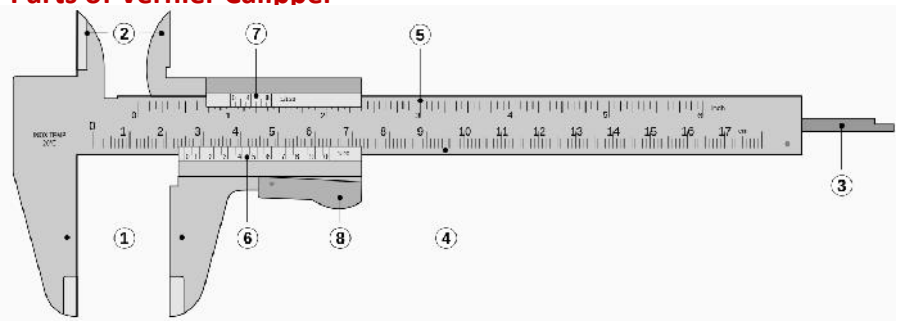
A **vernier caliper** (or vernier) is a common tool used in laboratories and industries to accurately determine the dimensions of objects.



The Vernier caliper has two jaws; one is fixed and the other is sliding (figure 2). The caliper has also two scales: the first is the bar (or main scale) and the second is the Vernier scale (moving with sliding jaws).

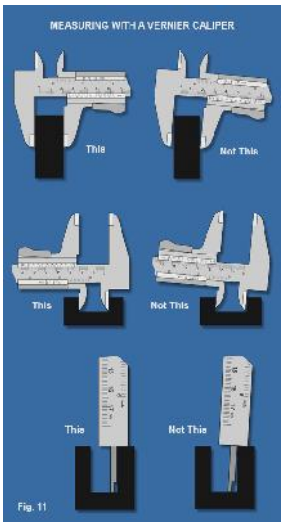
The use of Vernier scale increases the resolution of the calipers to tenths or hundredths of a millimeter.

Parts of Vernier Calipper

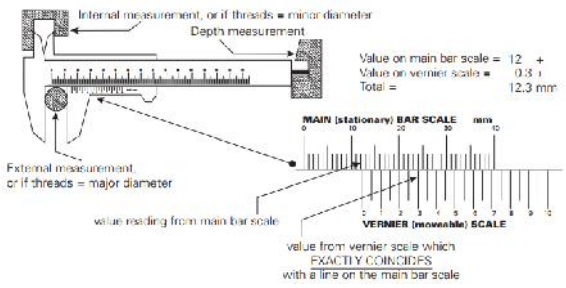


1.Outside large jaws: used to measure external diameter or width of an object
2.Inside small jaws: used to measure internal diameter of an object
3.Depth probe: used to measure depths of an object or a hole
4.Main scale: scale marked every mm
5.Main scale: scale marked in inches and fractions
6.Vernier 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

Measuring with Vernier Calipper



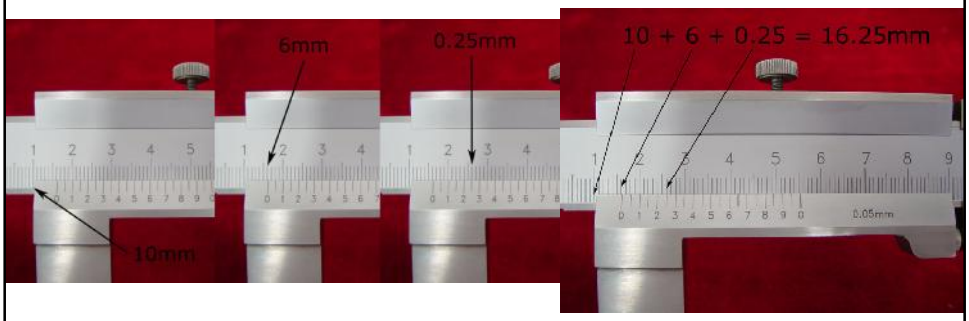
- the length of an object (with external Jaws),
- the outer diameter of a round or cylindrical object (with external Jaws),
- the inner diameter of a pipe (with internal Jaws),
- the depth of a hole. (with depth measuring blade).



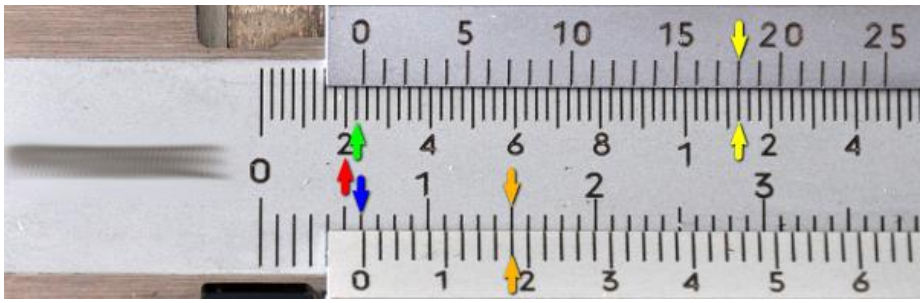
Measuring with Vernier Calipper

Making measurement with a caliper is a two step procedure:

1. Read the number on the left of the "0" of the Vernier(sliding) scale. It is the coarse measurement in millimeters.
2. Find the first exact coincidence of the ticks on the Vernier and fixed scale. Count the number of ticks from "0" to coincident tick and multiply it with the resolution of the Vernier Scale. The resolution value is generally written on the Vernier scale (on right hand side of the scale ticks)

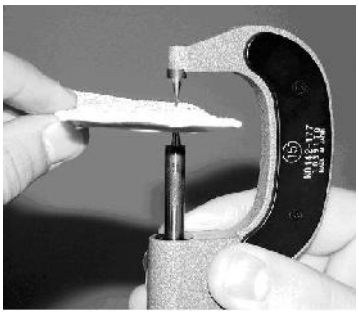


Video

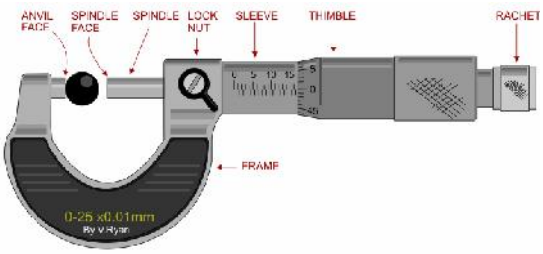


Micrometer

A **micrometer** is a special tool that is designed for more precise dimensional measurements.
They are generally made to have the precision of hundredth of a millimeter.
The standard micrometers can be used measure thickness and outer diameters of the objects.




Parts of a Micrometer

Ratchet : Part that moves the finely threaded screw. when the pressure on the object being measured is sufficient, a click sound is heard.
Frame : Horseshoe-shaped part that supports the anvil and a moving device.
Anvil : Cylindrical part that is attached to the frame of the micrometer to support the object to be measured; the object is placed between the anvil and the spindle.
Thimble: Moving cylindrical part that is activated by ratched driven screw and carries a higher resolution scale.
Spindle : Cylindrical end of the finely threaded screw.
Lock nut: Ring-shaped part that locks the finely threaded screw in its final position to preserve the measurement obtained.

Measuring with Micrometer

Making measurement with a micrometer is a three step procedure:

1. Read the number on the left of the thimble (moving part) of micrometer. It is the coarse measurement in millimeters. Normally, the sleeve, where scale is marked, has a resolution of 0.5mm.
2. Follow the main (horizontal) line, on which the coarse scale is marked, till the front end of the thimble where the cylindrical scale is marked. Read the number on the thimble across the main line on thimble. The number will be between 0 to 50.
3. The result (fine reading) is multiplied by 10 to convert it to micrometer. The fine reading is added to coarse reading to find the measured distance.