Part- I

Material Removal Process

Material Removal Process

Machining:

- **Machining (Material Removal Process) of materials is basically adopted to get higher surface finish, close tolerance and complex geometric shapes, which otherwise difficult to obtain by other processes.**

Machining is probably the most expensive process

Because:

1-Amount of material is removed from the raw material in the form of chips in order to achieve the require shape.

2-A lot of energy is expended in this process.

Machine Tool

- A machine tool is one which while holding the cutting tools is able to remove the metal from a workpiece in order to generate the requisite part of the given size, configuration and finish

- Machine tools are mother machines, since without them no component can finished.
- Machine tools have been in existence for a long time and the success of the industrial revolution can be mainly attributed to them.
- Manufacturing Technology has major technological changes through various developments in microelectronics.
- The availability of computers and microprocessors has completely changed the machine tool scenario by bringing in the flexibility which was not possible through conventional mechanisms.
- The development of numerical control in 1952 brought about a kind of flexibility to the metal cutting operation.

Manufac-turing process	*Typical application*	*Size range, kg*	*Tolerance Surface Finish*	*Typical production volume*	*Relative tooling cost*	*Disadvantages of usage*
Turning	All materials	Unlimited	± 0.050 mm 2.0 µm	Very high	Medium	Relatively slow Material wastage
Milling	All materials	Unlimited	±0.050 mm 2.0 µm	High	Medium	Relatively slow Material wastage
Grinding	All materials	Unlimited	±0.025 mm 0.4 µm	High	Medium	Expensive finishing operation
Electric discharge machining	Electrically conductive materials		± 0.003 mm 0.1 µm	Low	Low	Dielectric fluid must be filtered

Types of Machine Tool

- **Casting and metal working are the primary manufacturing processes where the metal is first given an intermediate shape which is usually brought to its final form through metal cutting process.**
- **Assembling of various parts into workable equipment often requires the mating of the complementary surfaces in terms of form, dimension and surface finish.**

There are a large variety of material removal processes available such as:

1) Turning machines (lathes)
2) Drilling machines
3) Boring machines
4) Milling Machines
5) Grinding Machines
6) Shaping and Planning Machines
7) Gear Cutting Machines
8) Unconventional Machining Machines

- **Besides these varieties of machine tools, we have a number of specialized variations depending upon the requirement.**

They are:

a) Automats

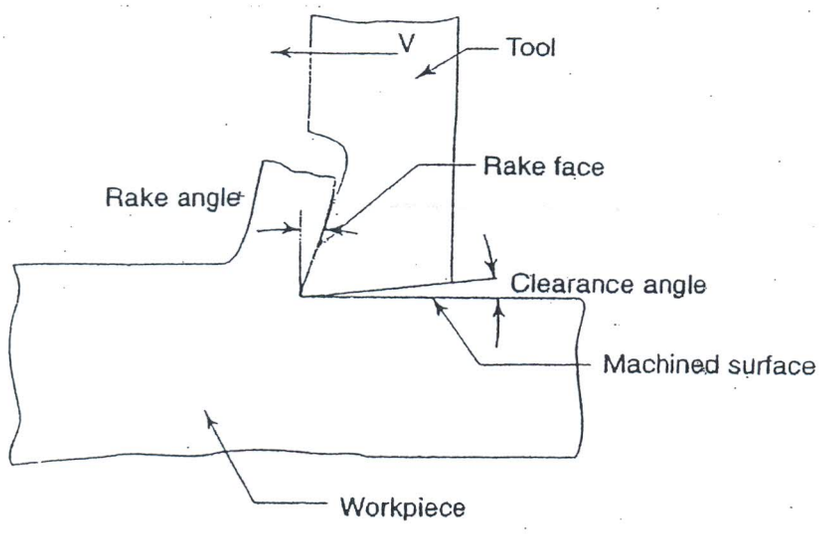
b) Copy turning machines

c) Copy milling machines

Metal Cutting

- **The importance of the machining processes can be emphasized by:**
- **In USA more than $ 100 billion are spent annually on machining**
- **15% of the all metal produced in USA was converted into chips**

- Typical cutting tool in simplified form is shown in figure.



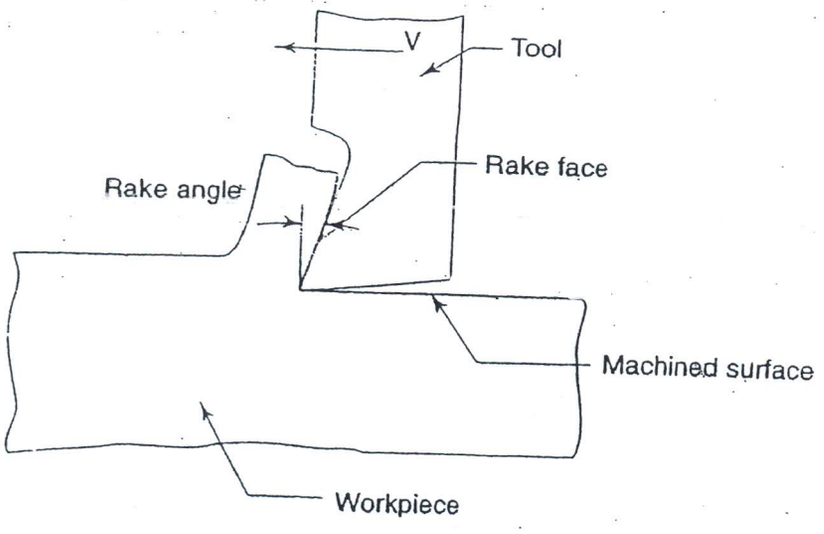
Rake Angle

- It is the angle between the face of the tool (rake face) and the normal to the machining direction
- Higher the rake angle better is the cutting and less cutting forces
- Increasing tile rake angle reduces the metal backup available at the tool face. This reduces the strength of the tool tip.

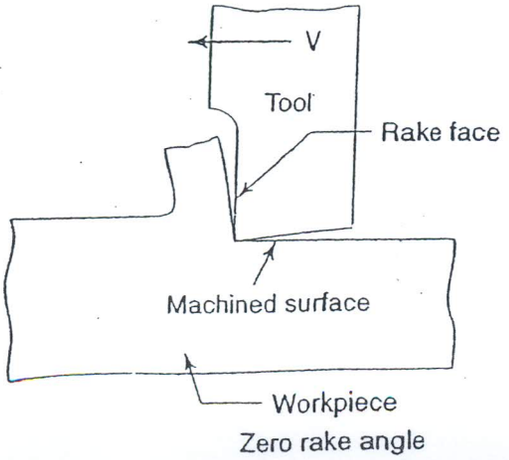
- **There is a maximum limit to rake angle and this is generally of the order of 15 degree for high speed steel tools cutting mild steel.**

- **It is possible to have rake-angles at zero or negative as shown in figure.**

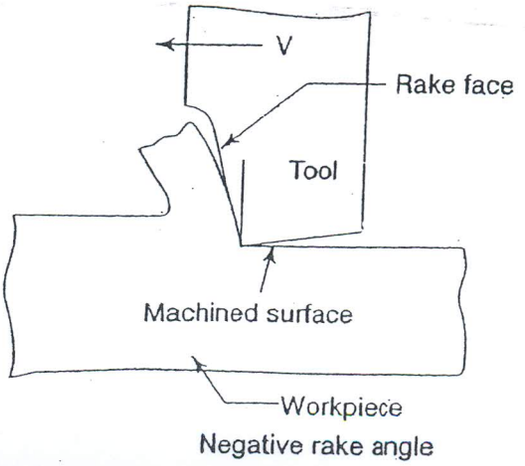
- **These are generally used in the case of highly brittle tool materials such as carbides or diamonds for giving extra strength to the tool tip.**



Positive rake angle



Zero rake angle



Negative rake angle

Clearance Angle

This is the angle between the machined surface and underside of the tool flank face

- **The clearance angle is provided such that the tool will not rub the machined surface**

- **A very large clearance angle reduces the strength of tool tip**

- **The clearance angle of the order 5-6 degree**