Manufacturing Processes

Introduction to Manufacturing Processes

- **Definition of Manufacturing**
- The word manufacturing is derived from Latin:
  - ***manus = hand, factus = made***
- Manufacturing is the economic term for making goods and services available to satisfy human wants.
- ***Manufacturing implies creating value to a raw material by applying useful mental and physical labour.***
- Whether from nature or industry materials cannot be used in their raw forms for any useful purpose.
- The materials are then shaped and formed into different useful components through different manufacturing processes to fulfil the needs of day-to-day work.
- ***Manufacturing converts the raw materials to finished products to be used for some purpose.***

Manufacturing Processes

- Manufacturing processes is a very fundamental subject since it is of interest not only to mechanical engineers but also to engineers from other discipline of engineering.
- There are various manufacturing processes by which a product can be made.
- Each process however has its own limitation and restriction and due to this reason a particular process is adopted to certain specific applications.
- Thus while a product can be manufactured by two or more processes, the real problem is to select the most economical out of them.
- A detailed understanding of various manufacturing processes is thus very essential for every engineer. This helps in designing the proper product required for him.
- He would be able to assess the feasibility of manufacturing from his designs.
- He may find that there are more than one process is available for manufacturing a particular product and he can make a proper choice of the process which would require lowest manufacturing cost.

CLASSIFICATION OF MANUFACTURING PROCESSES

- Manufacturing processes can be grouped as:
- Q Casting, foundry or moulding processes.
- Q Forming or metal working processes. Q Machining (metal removal) processes. Q Joining and assembly
- Q Surface treatments (finishing).
- Q Heat treating

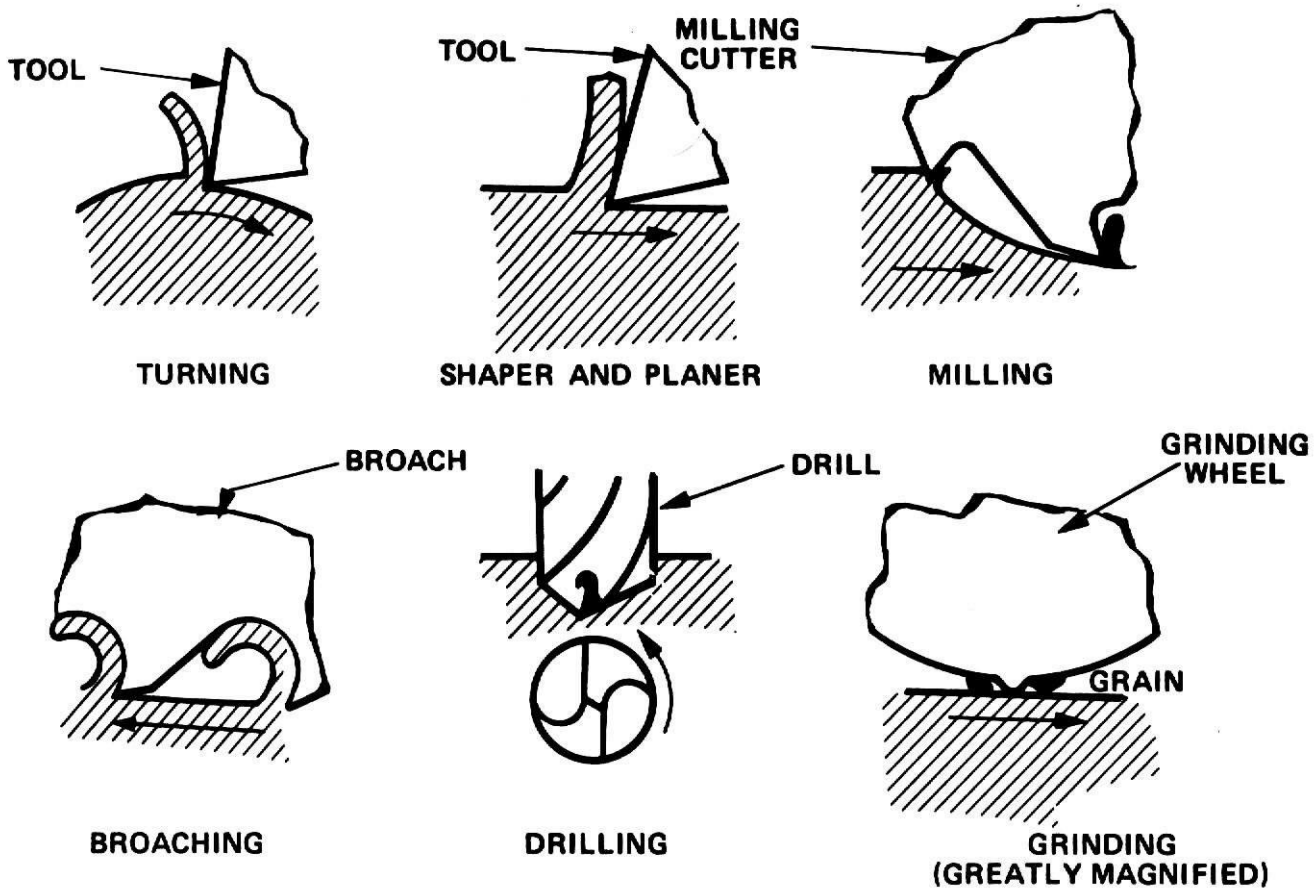
•These groups are not mutually exclusive. For example, some finishing processes involve a small amount of metal removal or metal forming. A laser can be used for joining/metal removal/heat treating.

Machining Process

- Cast, formed and shaped products may need further machining operations to give them the desired final shape, after removal of extra material in the form of chips.C

- Machining processes remove material from a work piece by
  - CUTTING (As in case of machine tools like lathe, shaper etc)
  - ABRASIVE (As in case of a grinding wheel)
  - NON TRADITIONAL (Processes such as EDM, ECM Etc.)

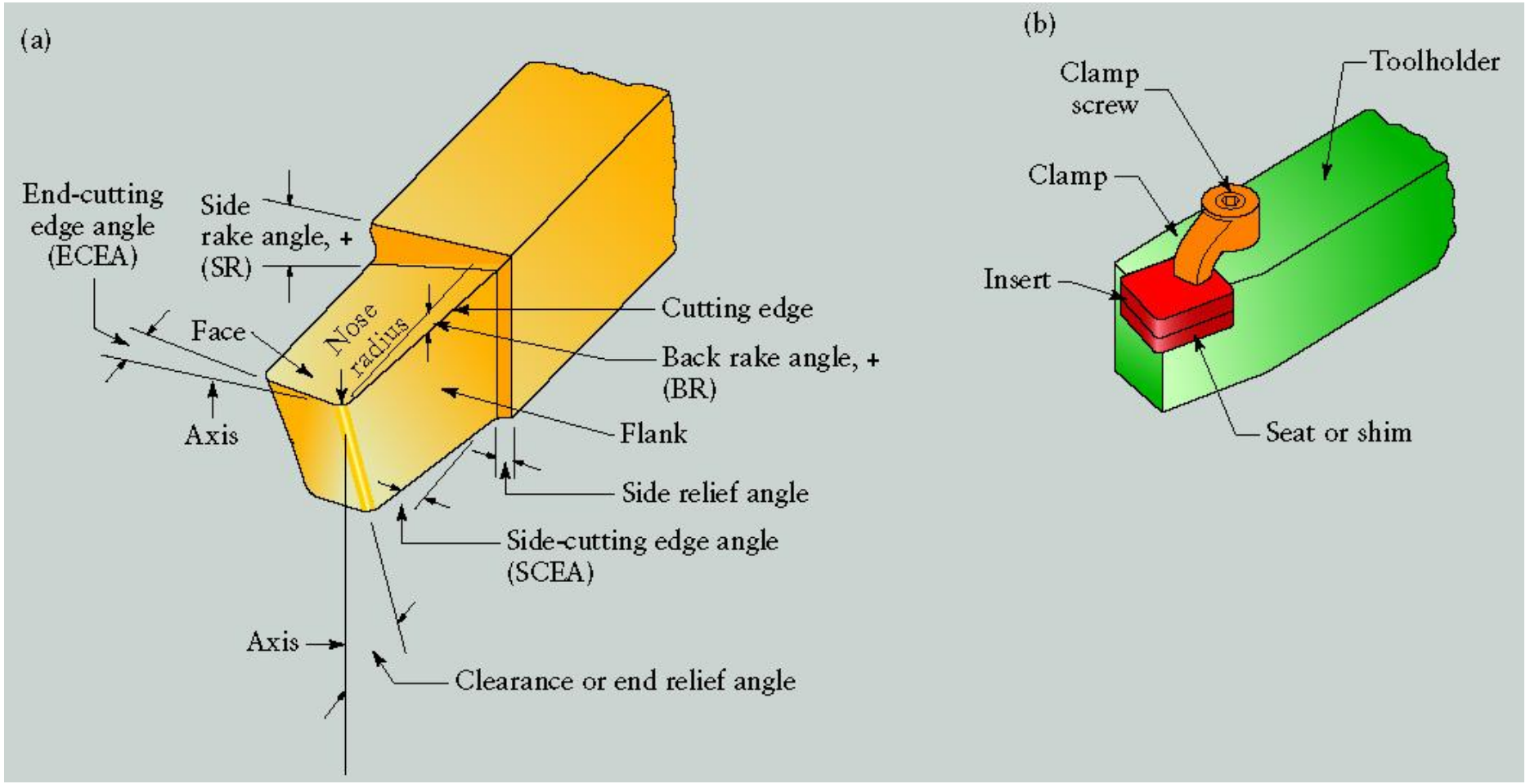
Metal Cutting Processes



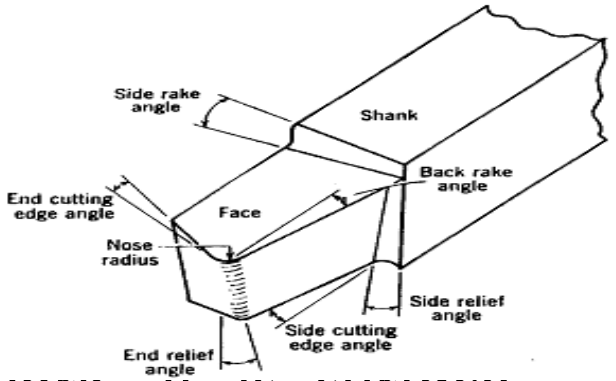
What is a Cutting Tool

- A cutting tool is any tool that is used to remove metal from the work piece by means of shear deformation.
- It is one of most important components in machining process
- It must be made of a material harder than the material which is to be cut, and the tool must be able to withstand the heat generated in the metal cutting process.
- Two basic types
  - Single point
  - Multiple point

Single Point Cutting Tool



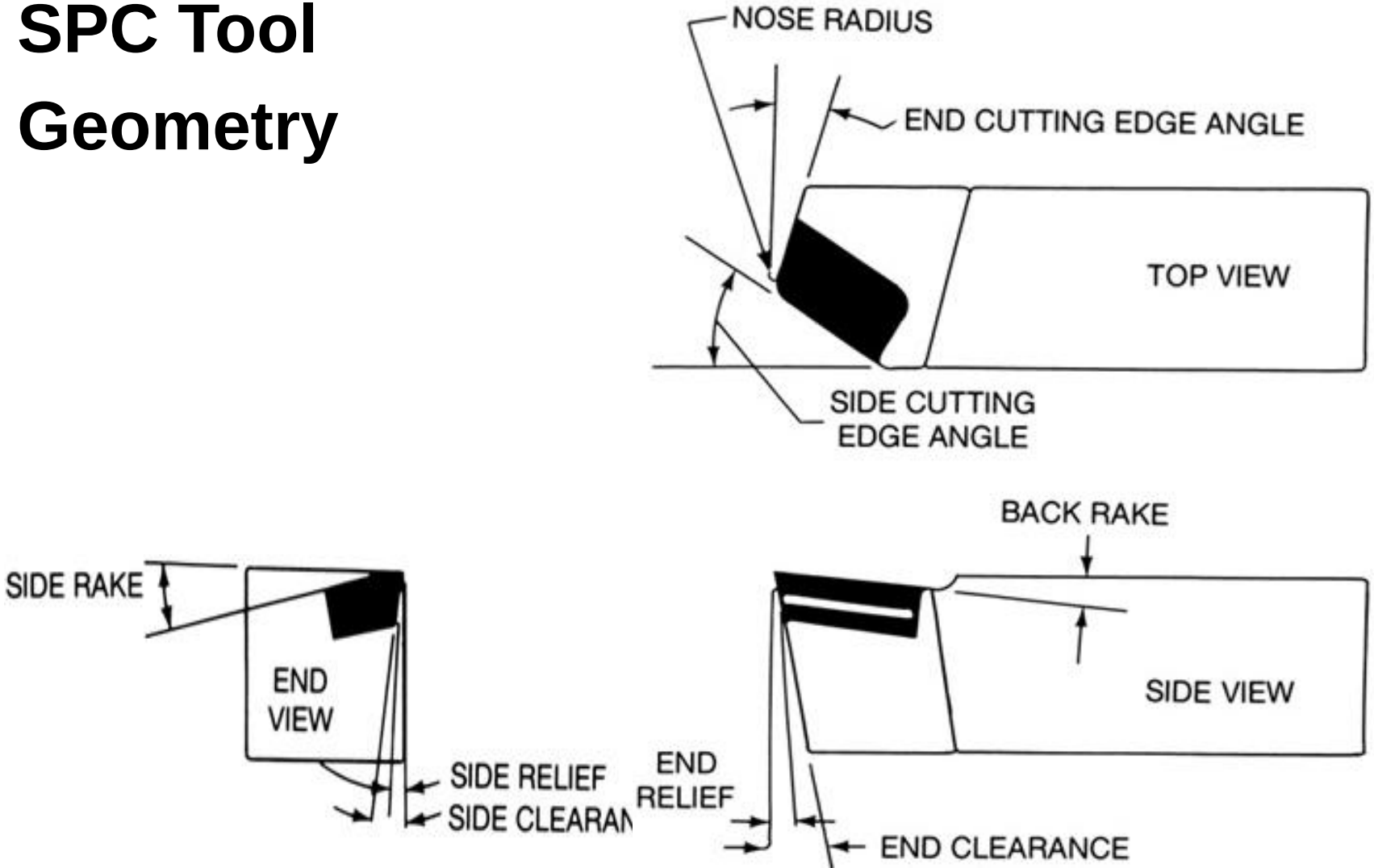
Know the Single Point Cutting Tool



- **Shank:** *Main body of tool, it is part of tool which is gripped in tool holder*
- **Face:** *Top surface of tool b/w shank and point of tool. Chips flow along this surface*
- **Flank:** *Portion tool which faces the work. It is surface adjacent to & below the cutting edge when tool lies in a horizontal position.*
- **Point:** *Wedge shaped portion where face & flank of tool meet.*
- **Base:** *Bearing surface of tool on which it is held in a tool holder.*
- **Nose radius:** *Cutting tip, which carries a sharp cutting point. Nose provided with radius to enable greater strength, increase tool life & surface life.*

  Typical Value : 0.4 mm – 1.6 mm

SPC Tool Geometry



Nomenclature of Single Point Lathe Tool

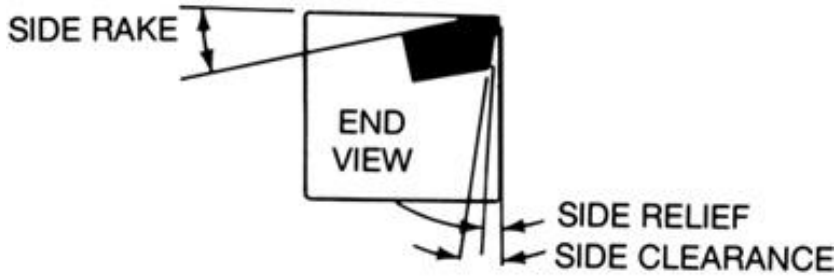
The most significant terms in the geometry of a cutting tool angles are:

- **Relief or clearance angle**
  - **» Side relief**
  - **» End relief**
- **Rake angle**
  - **» Back Rake angle**
  - **» Side Rake angle**
- **Cutting edge angle**
  - **» Side Cutting edge angle**
  - **» End Cutting edge angl**
- **» Nose Radius**

Cutting-Tool Terms

Relief or Clearance angle:

- Ground on the end and side faces of a tool to prevent it from rubbing on the work piece.
- To enable only the cutting edge to touch the work piece.

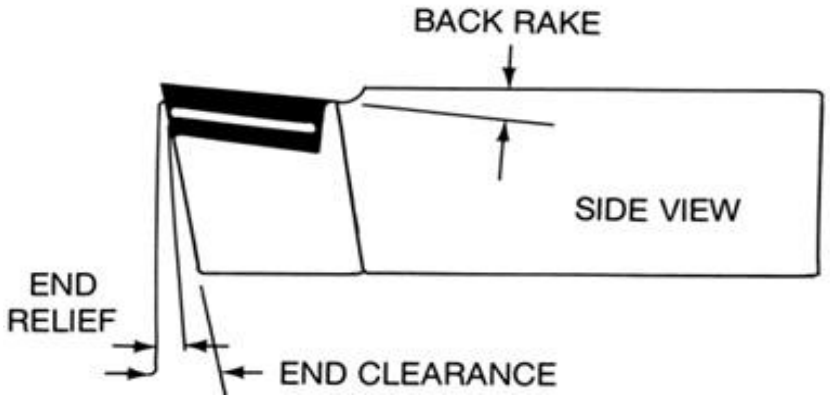


Side Relief angle:

- Angle ground directly below the cutting edge on the flank of the tool

End Relief angle:

- Angle ground from the nose of the tool



Cutting-Tool Terms

Rake angle:

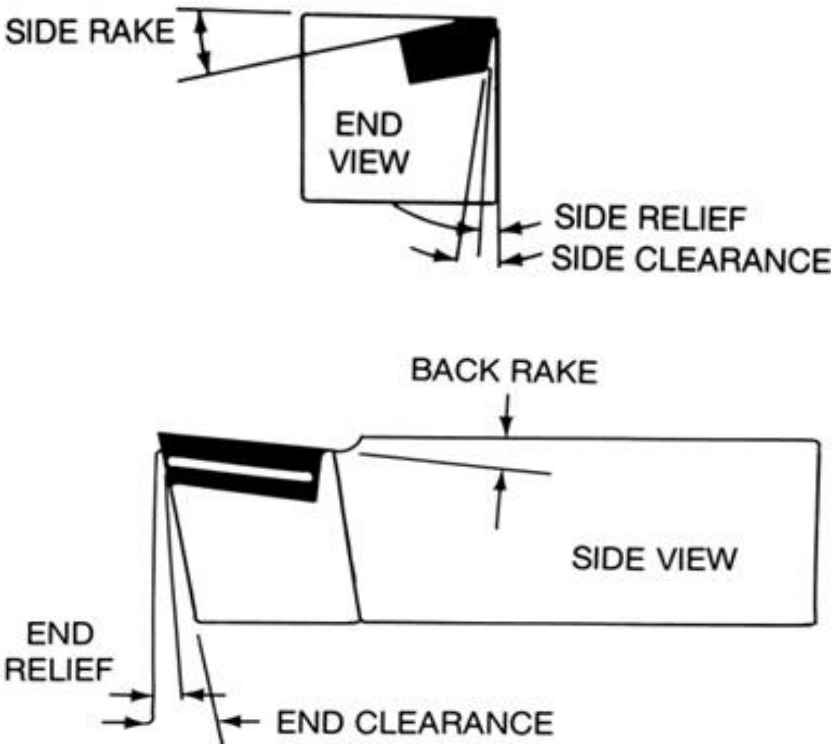
– Ground on a tool to provide a smooth flow of the chip over the tool so as to move it away from the work piece

Back Rake angle

- Ground on the face of the tool
- Influences the angle at which chip leaves the nose of the tool
- Generally 8 - 10^0

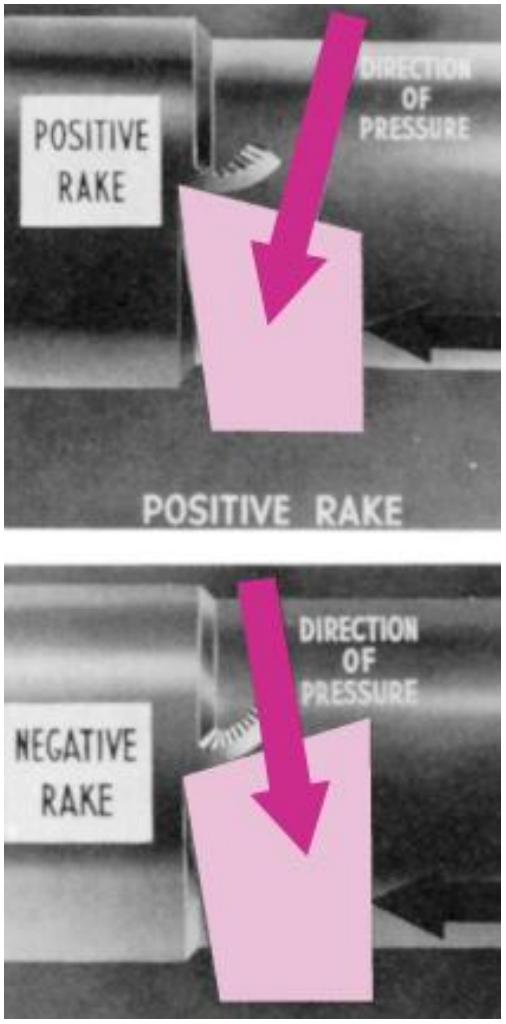
Side Rake angle

- Ground on the tool face away from the cutting edge
- Influences the angle at which the chip leaves the work piece



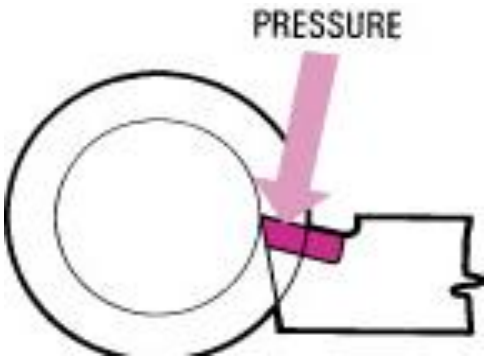
Side Rake

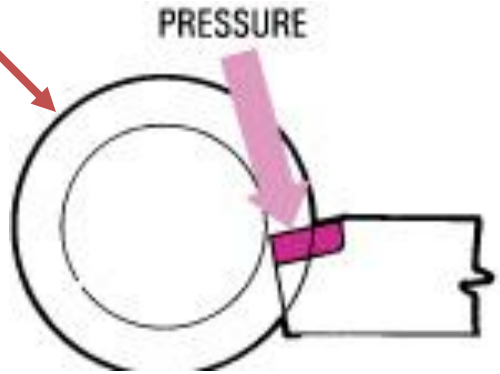
- Large as possible to allow chips to escape
- Amount determined
  - Type and grade of cutting tool
  - Type of material being cut
  - Feed per revolution
- Angle of keenness
  - Formed by side rake and side clearance



Back Rake

- Angle formed between top face of tool and top of tool shank
  - Positive
    - Top face slopes downward away from point
  - Negative
    - Top face slopes upward away from point
  - Neutral





Rake Angles

- Small to medium rake angles cause:
  - high compression
  - high tool forces
  - high friction
  - result = Thick—highly deformed—hot chips

Negative Rake Tools

- Typical tool materials which utilize negative rakes are:
    - Carbide
    - Diamonds
    - Ceramics
- These materials tend to be much more brittle than HSS but they hold superior hardness at high temperatures. The negative rake angles transfer the cutting forces to the tool which help to provide added support to the cutting edge.

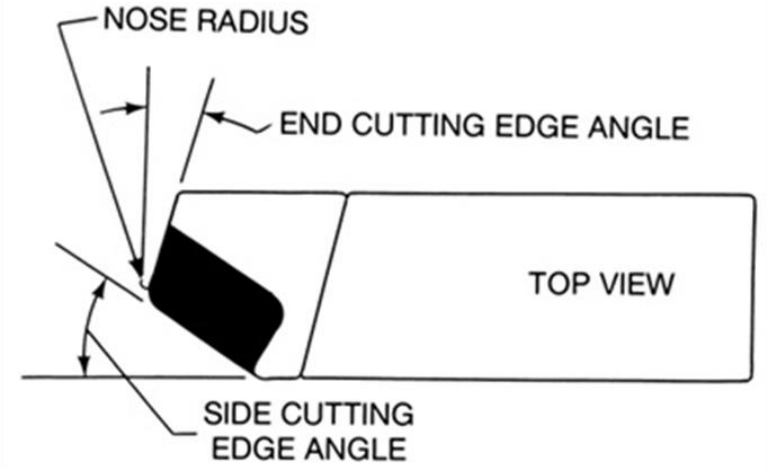
Cutting-Tool Terms

Nose Radius:

- **Rounded tip on the point of the tool**

Functions:

- Strengthens finishing point of tool
- Improves surface finish on work
- Should be twice amount of feed per revolution
  - Too large – chatter; too small – weakens point



Tool Angle Application

- Factors to consider for tool angles
  - The hardness of the metal
  - Type of cutting operation
  - Material and shape of the cutting tool
  - The strength of the cutting edge