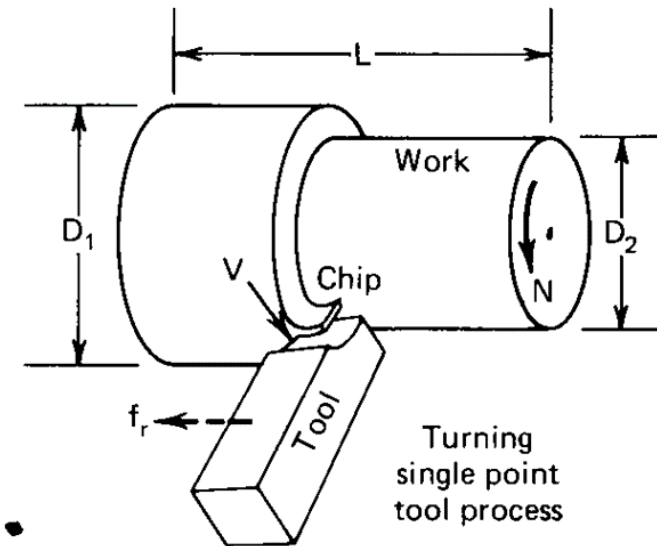
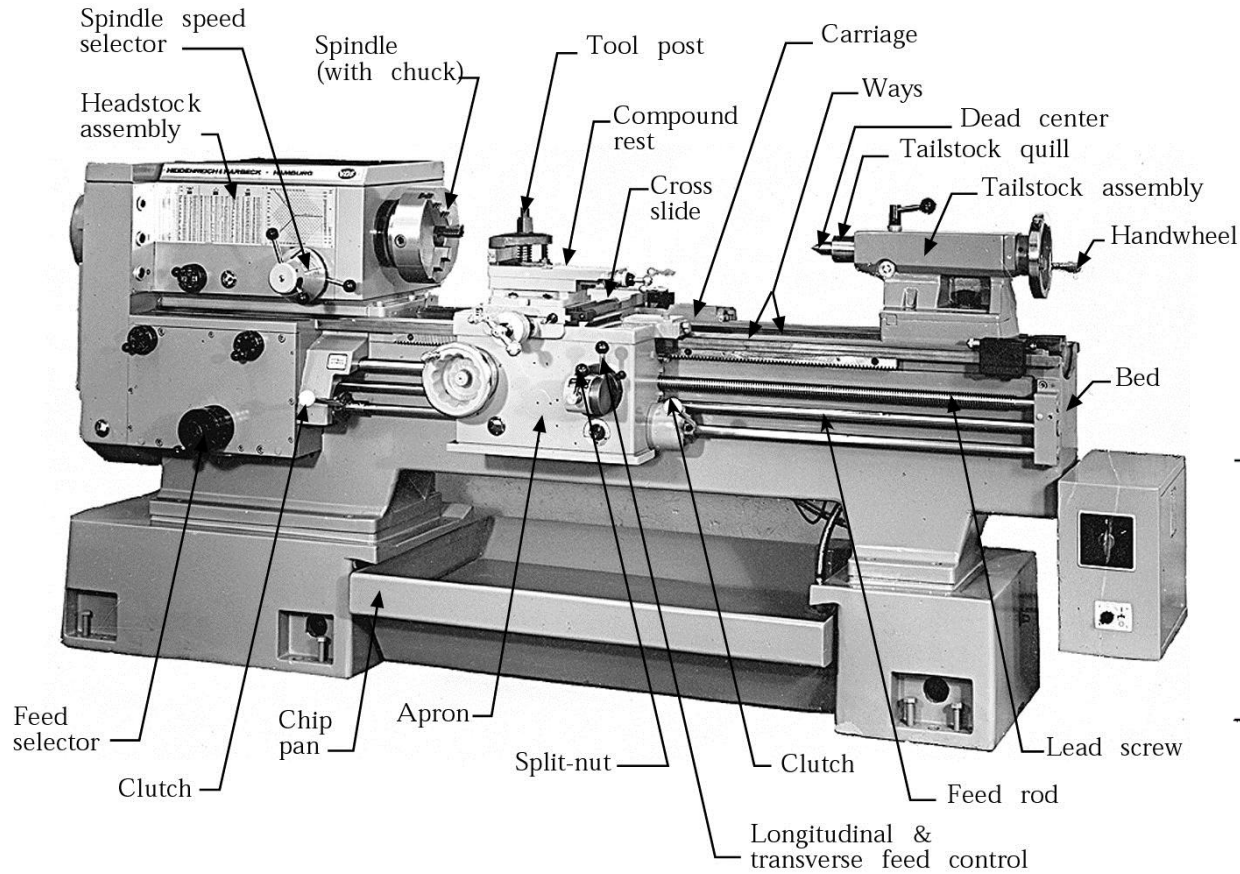


# Material removal processes



# Material Removal Processes (Machining)

- Cutting tools
- Machine Tools
  - Lathe turning
  - Drilling
  - Milling
  - Grinding
  - Broaching, sawing, filing
  - Nontraditional machining process (EDM)

# Cutting Tool

- In the context of metalworking, a **cutting tool**, is any tool that is used to **remove metal** from the workpiece in form of chips.
- **Tool material** should be **harder** than the **material** which is to be cut
- They must be able to **withstand the heat generated** in the **metal cutting process**.
- They also must have a **specific geometry**, designed so that the **cutting edge can contact the workpiece without the rest of the tool dragging** on its surface. The **angle of the cutting face** is also **important**.

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# Classification of Cutting tools

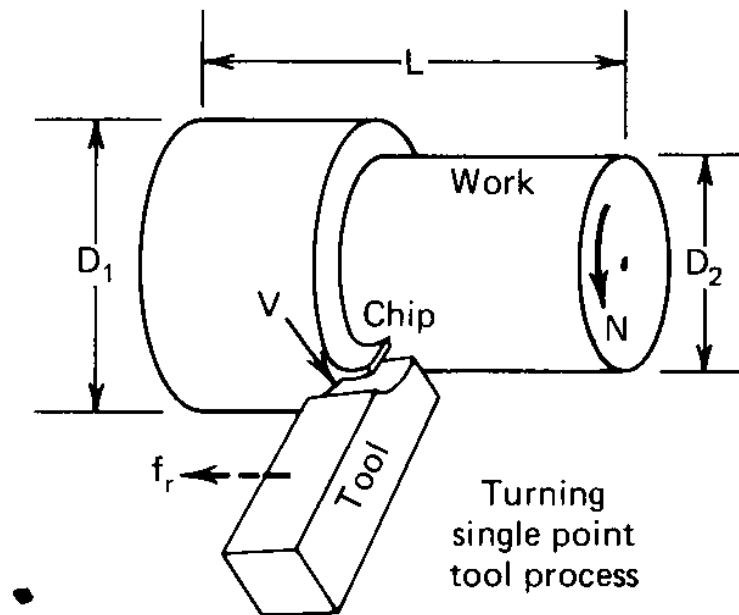
- single point cutting tool
- multiple point cutting tool.

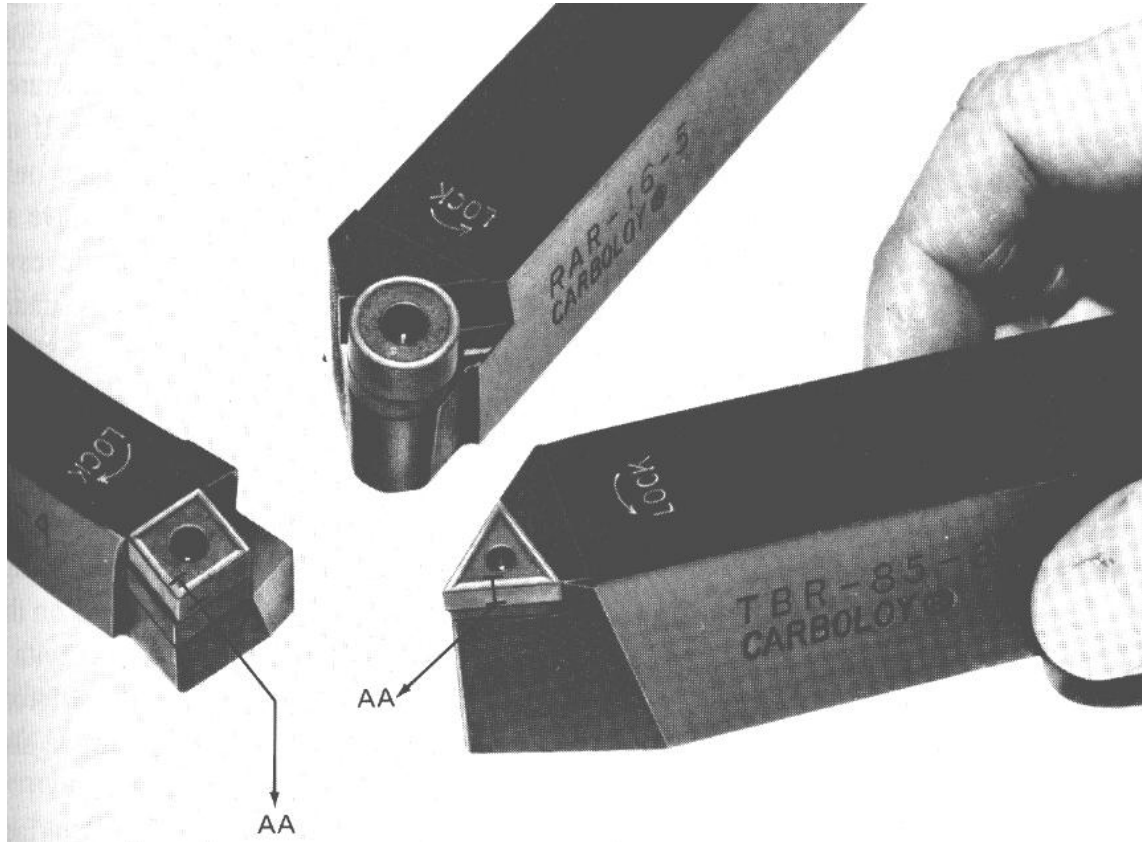
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# A single-point cutting tool

- has only one cutting edge
- used for increasing the size of holes, or boring, thread making, turning etc.

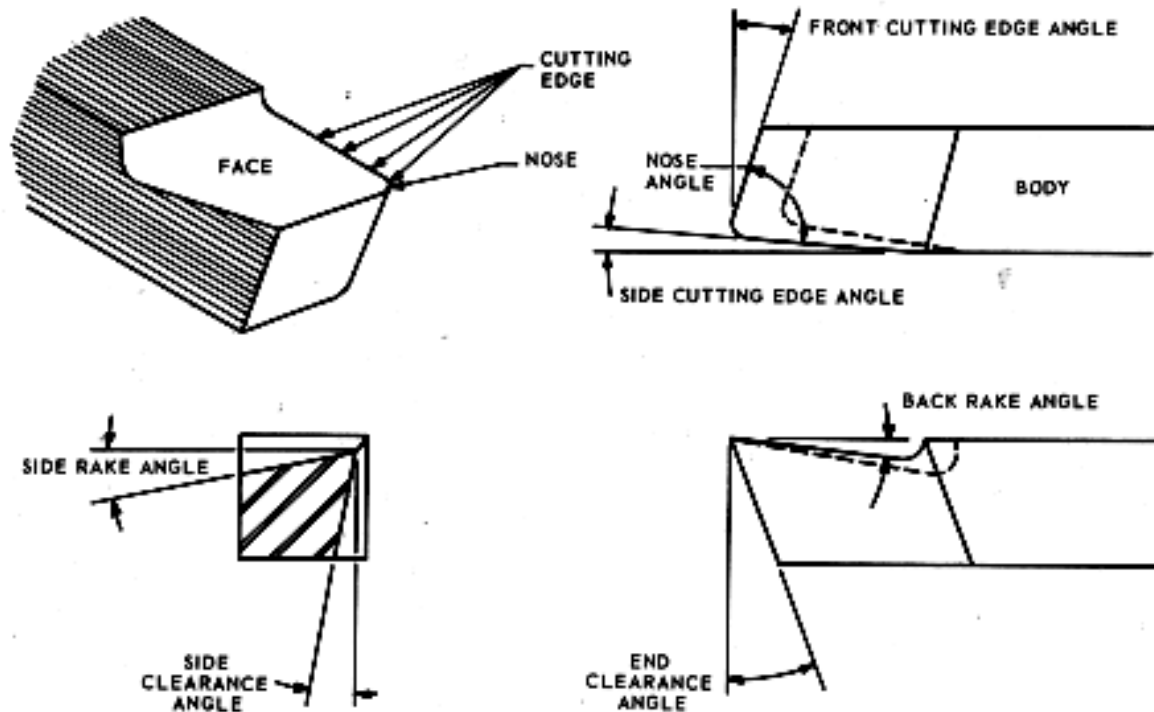
# A single-point cutting tool







# Nomenclature of cutting tool

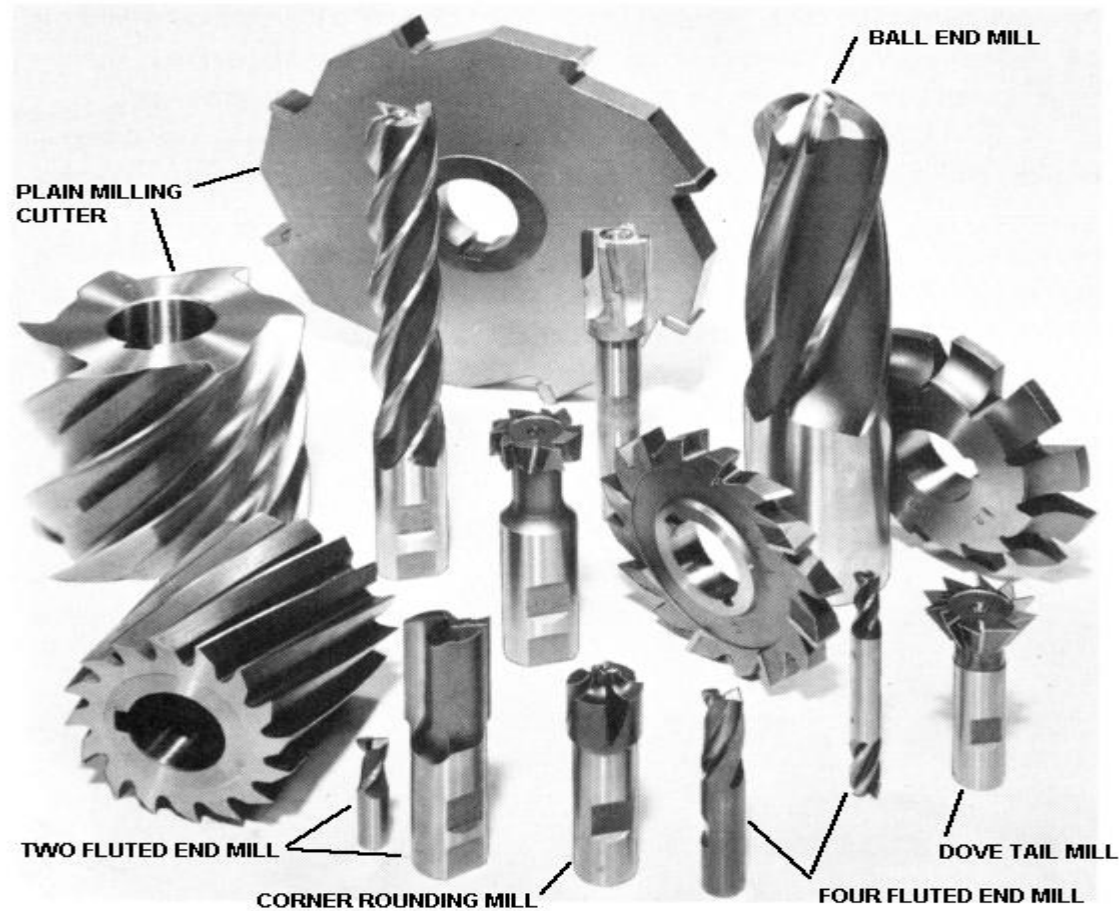


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# Multiple-point cutting tools

- have two or more cutting edges.
- Example:- milling cutters, drills, and broaches.

# Milling cutters



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# Cutting Tool Materials

- Tool Steels
- High Speed Steel (HSS)
- Carbides
- Coated Carbide
- Ceramics and cermet
- TiN Coated High-Speed Steel
- CBN
- Diamond tool

# Machine Tool

# Machine tools

## Single point tools

Surface of revolution  
(Lathe)

Feed parallel to  
axis of rotation  
(straight turning)

Feed not parallel  
to axis of rotation  
(contouring)

Plane surface

Tool reciprocating  
(Shaper, slotted)

Job reciprocating  
(Planner)

## Multi-point tools

Cylindrical  
surface

Two edge cutting  
(drilling)

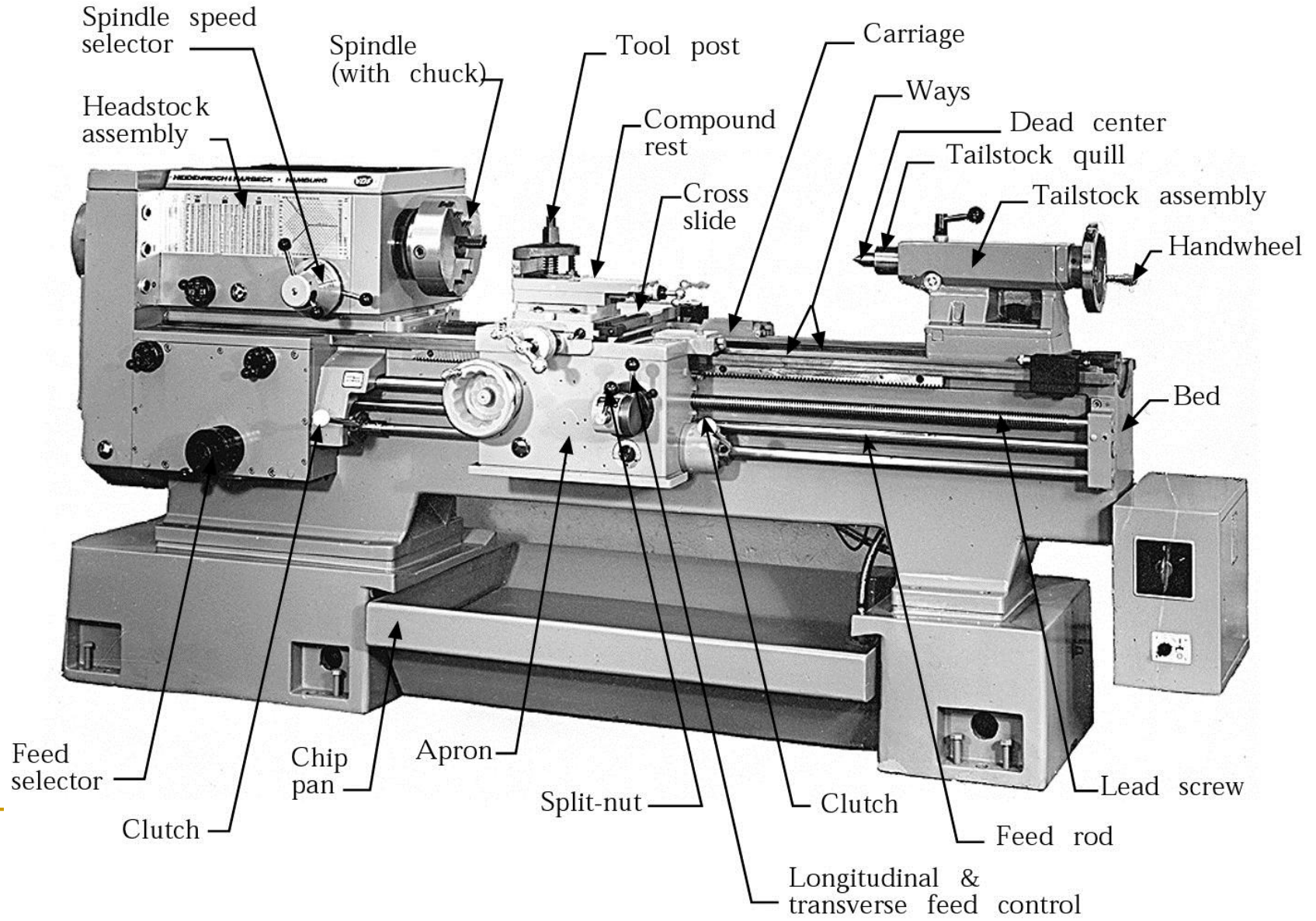
Multi edge cutting

Plane surface

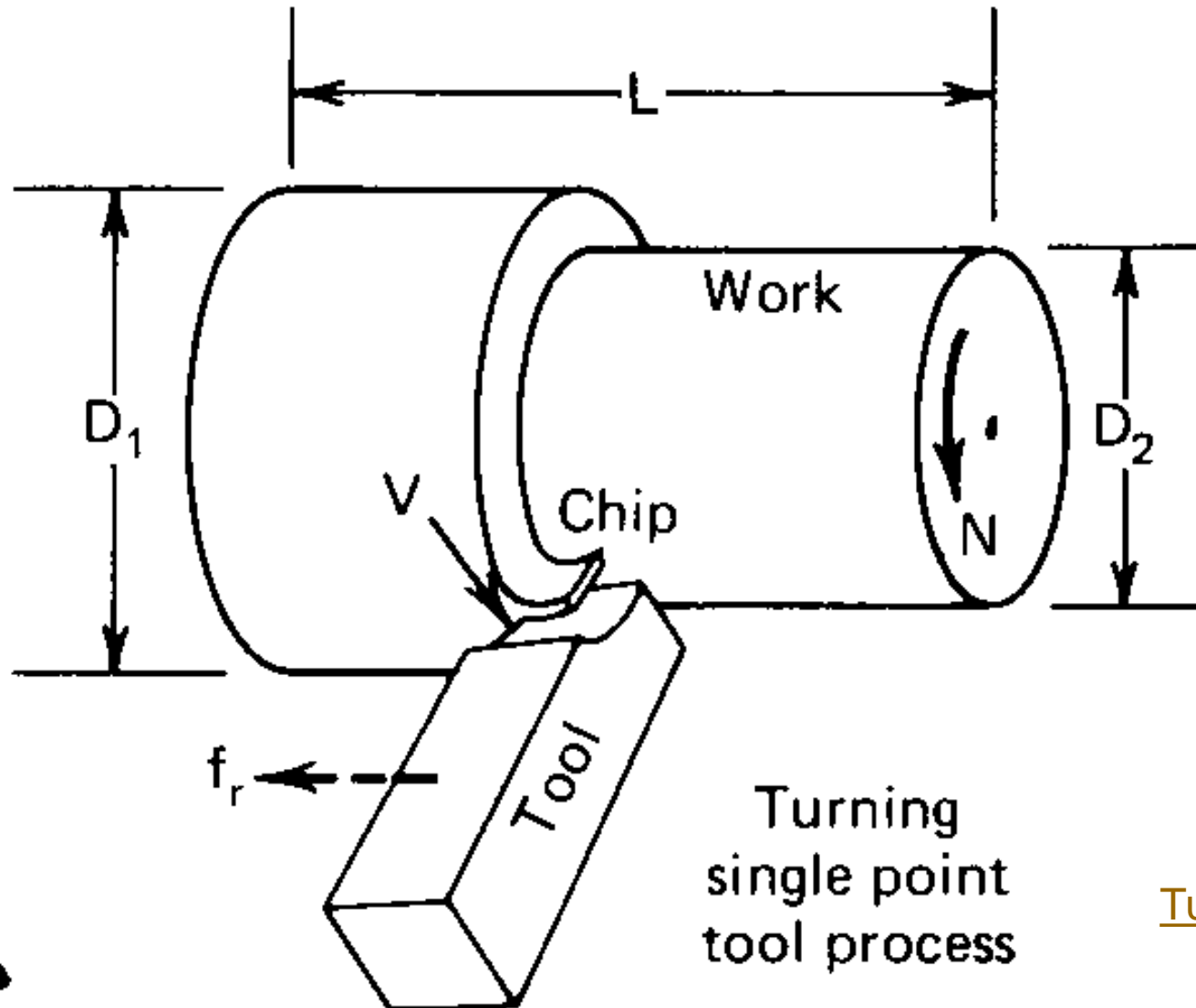
Sizable chips  
(Milling)

Small chips  
(Grinding)

# Lathe Turning

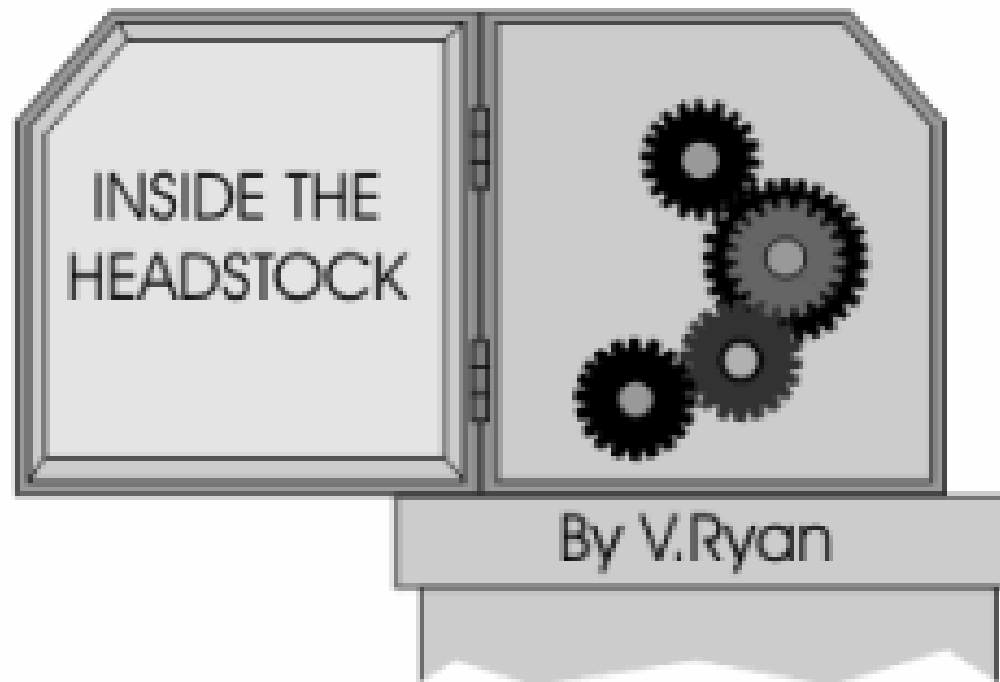


# Lathe Turning

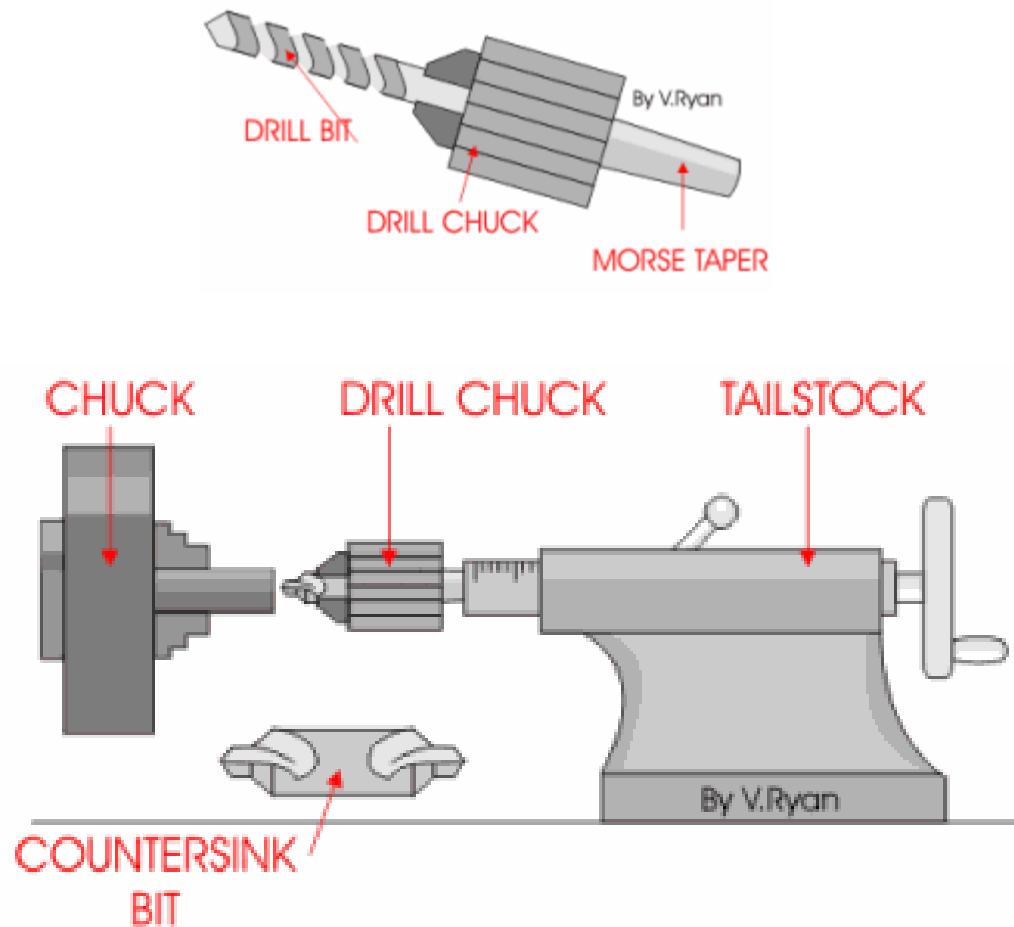




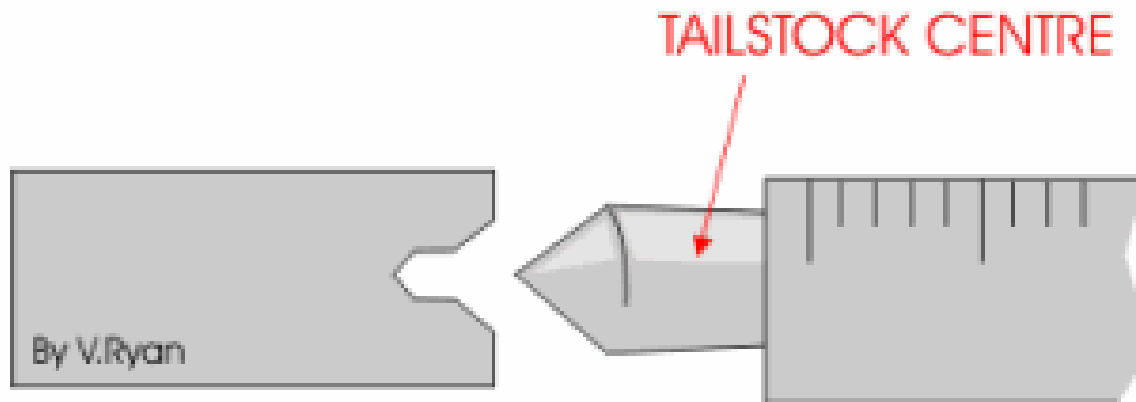
# Gear System



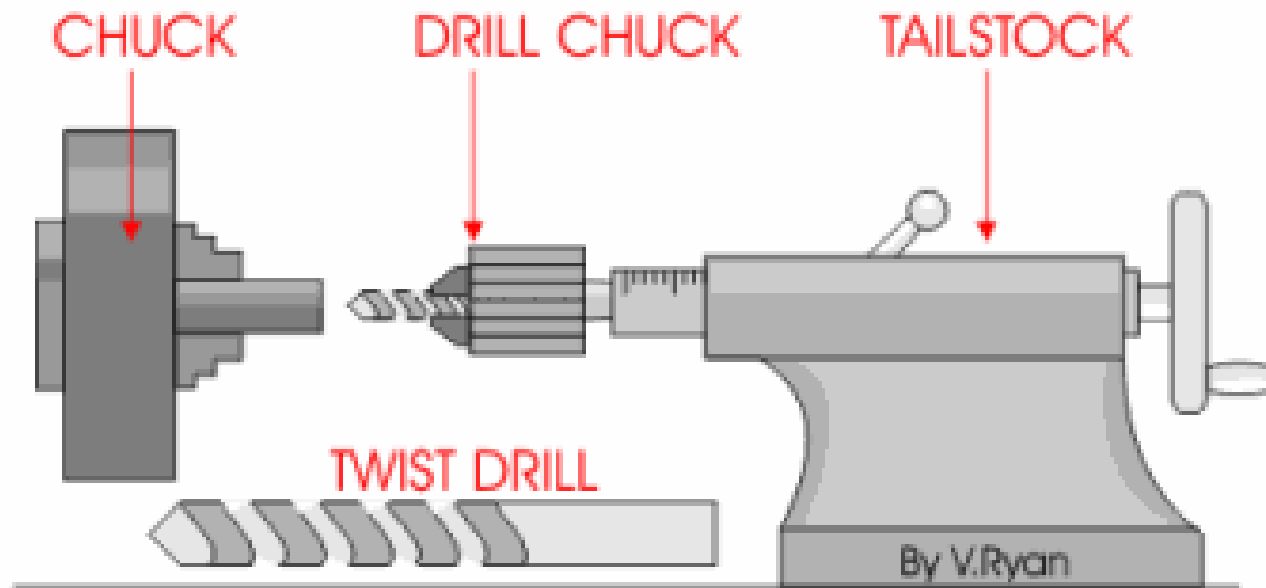
# Tailstock



# Long Job is supported by tailstock



# Drilling in lathe machine



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# Cutting parameters

- **Speed**

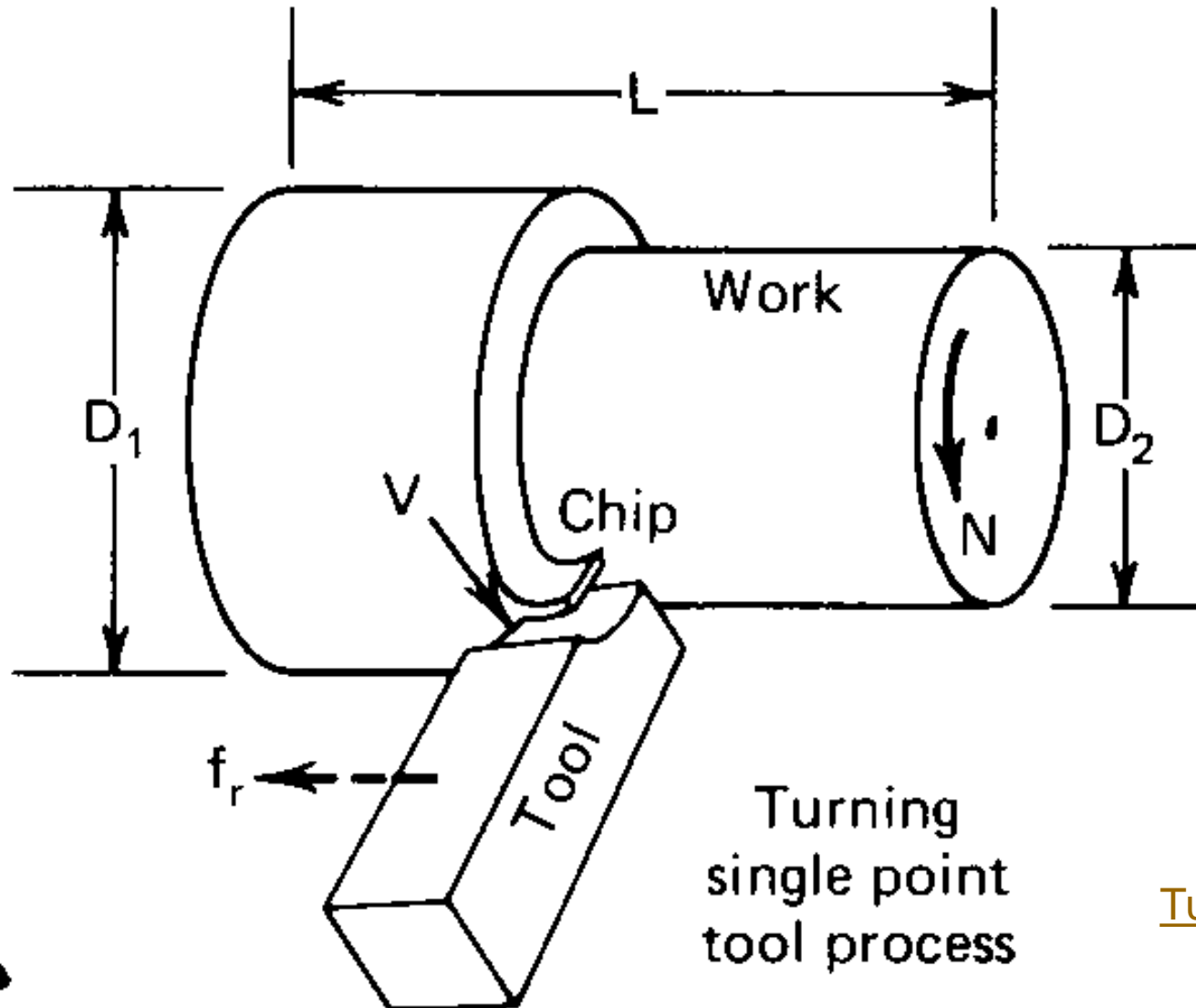
Cutting speed is defined as the speed at which the work moves with respect to the tool (usually measured in meters per minute).

- **Feed**

Feed rate is defined as the distance the tool travels during one revolution of the part.

- **Depth of Cut**

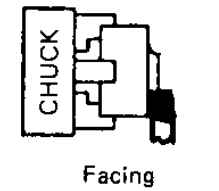
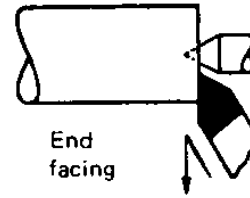
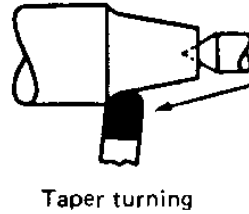
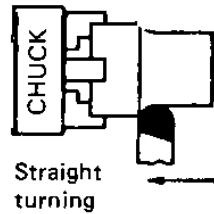
# Lathe Turning



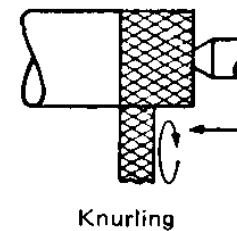
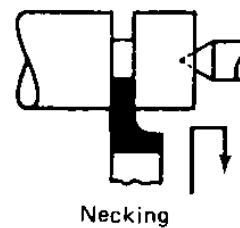
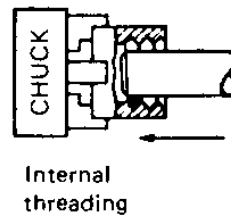
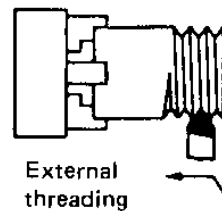
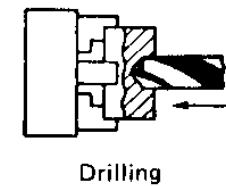
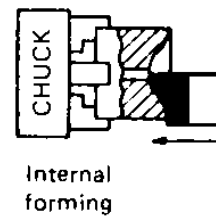
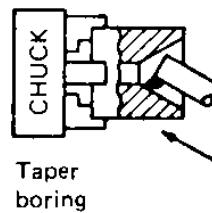
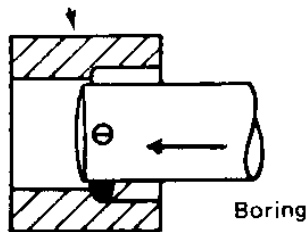
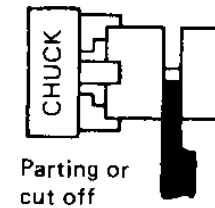
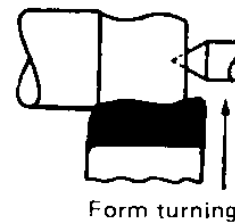
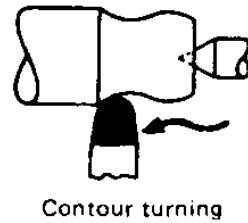
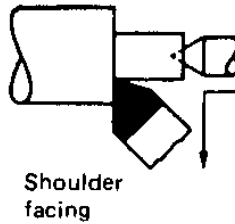
Turning

- Cutting speed and feed determines the surface finish, power requirements, and material removal rate.
- The primary factor in choosing feed and speed is the material to be cut.
- However, one should also consider material of the tool, rigidity of the workpiece, size and condition of the lathe, and depth of cut.

# Lathe operations



Facing





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# Specification of Lathe Machine

1. Swing over bed
2. Swing over carriage
3. Distance between centers
4. Hole through spindle
5. Travel of cross-slide
6. Taper of tailstock spindle
7. Length overall
8. Width overall
9. Height overall
10. Shipping weight
11. Motor/Speed Control
12. Spindle speed range

# Numerical problems:

1. A work piece in the form of a bar 100 mm in diameter is to be turned down to 70 mm diameter for 50 mm of its length. A roughing cut using maximum power and a depth of cut 12 mm is to be followed by a finishing cut using a feed of 0.1 mm and cutting speed of 1.5 m/s. The specific cutting energy for the material is  $2.3 \text{ GJ/m}^3$ , and the lathe has a 3 kW motor and a 70% efficiency. Estimate the machining time for rough cut and finish cut.
2. A 1.5 m diameter disc with a 600 mm diameter hole in the center is to be faced, starting at the outside. The rotary frequency of machine is  $0.5 \text{ s}^{-1}$ , the feed is 0.25 mm, and the back engagement (depth of cut) is 6 mm. The specific energy for the work material is  $3.5 \text{ GJ/m}^3$ . Calculate machining time and power consumption at the beginning of the operation.

Hints: Power requirement = Specific cutting energy  $\times$  MRR