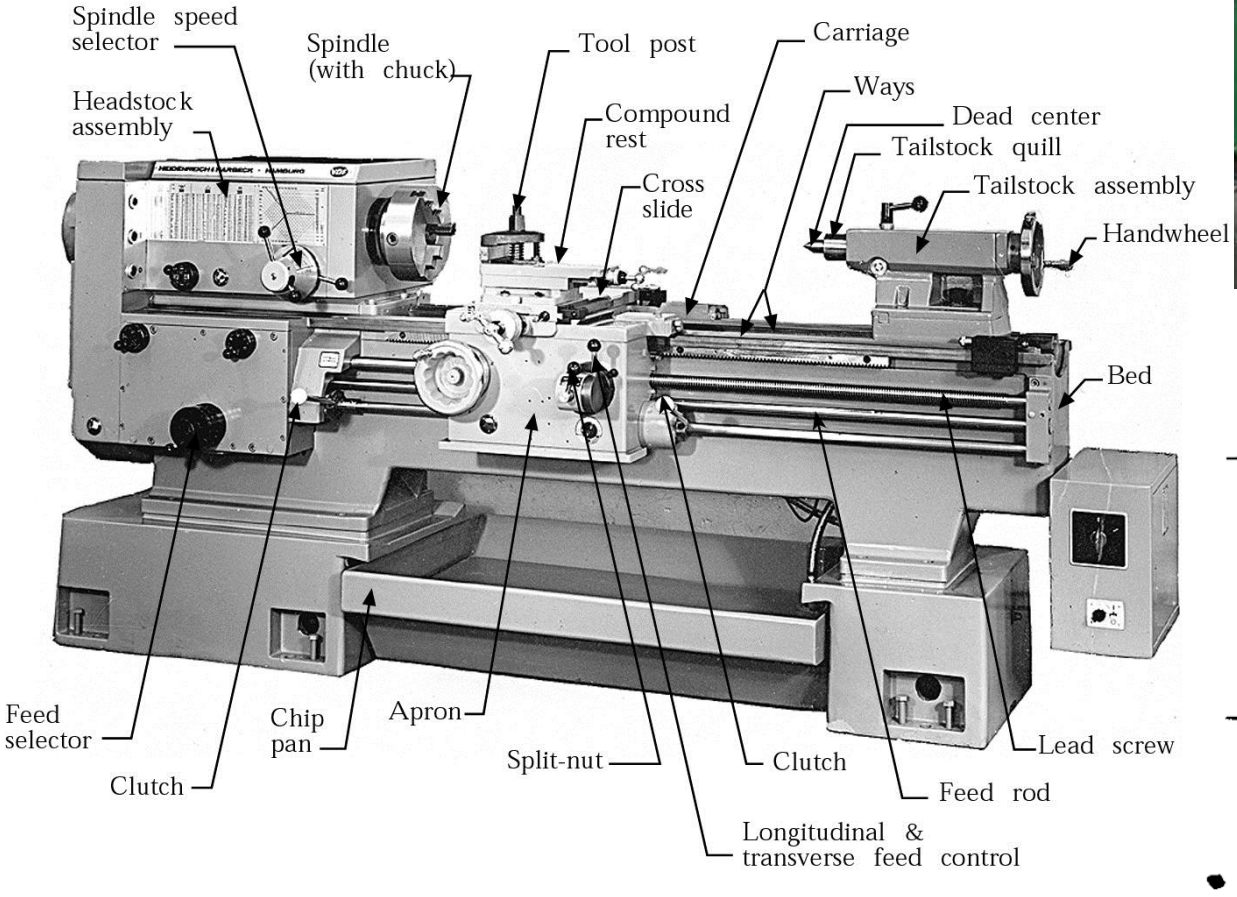
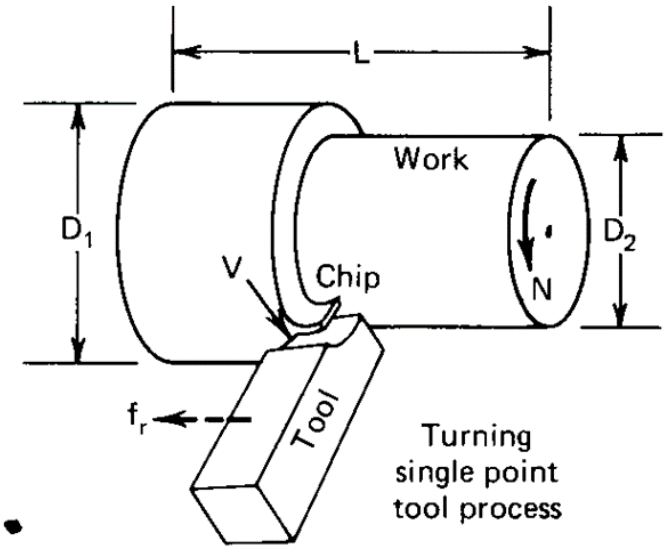
Material removal processes


Spindle speed selector
Spindle (with chuck)
Tool post
Carriage
Headstock assembly
Ways
Compound rest
Dead center
Tailstock quill
Cross slide
Tailstock assembly
Handwheel
Bed
Feed selector
Chip pan
Apron
Split-nut
Clutch
Lead screw
Clutch
Feed rod
Longitudinal & transverse feed control


L
Work
D1
D2
V
Chip
N
fr
Tool
Turning single point tool process

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.

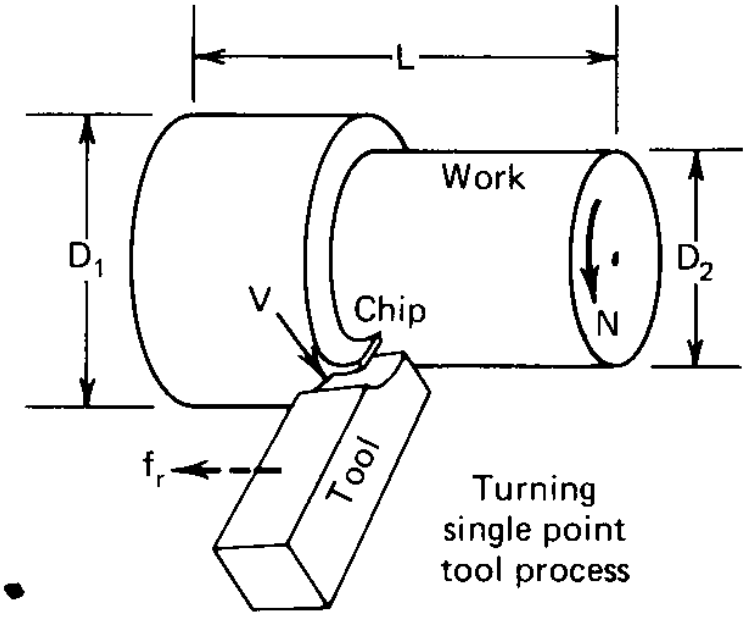
Classification of Cutting tools

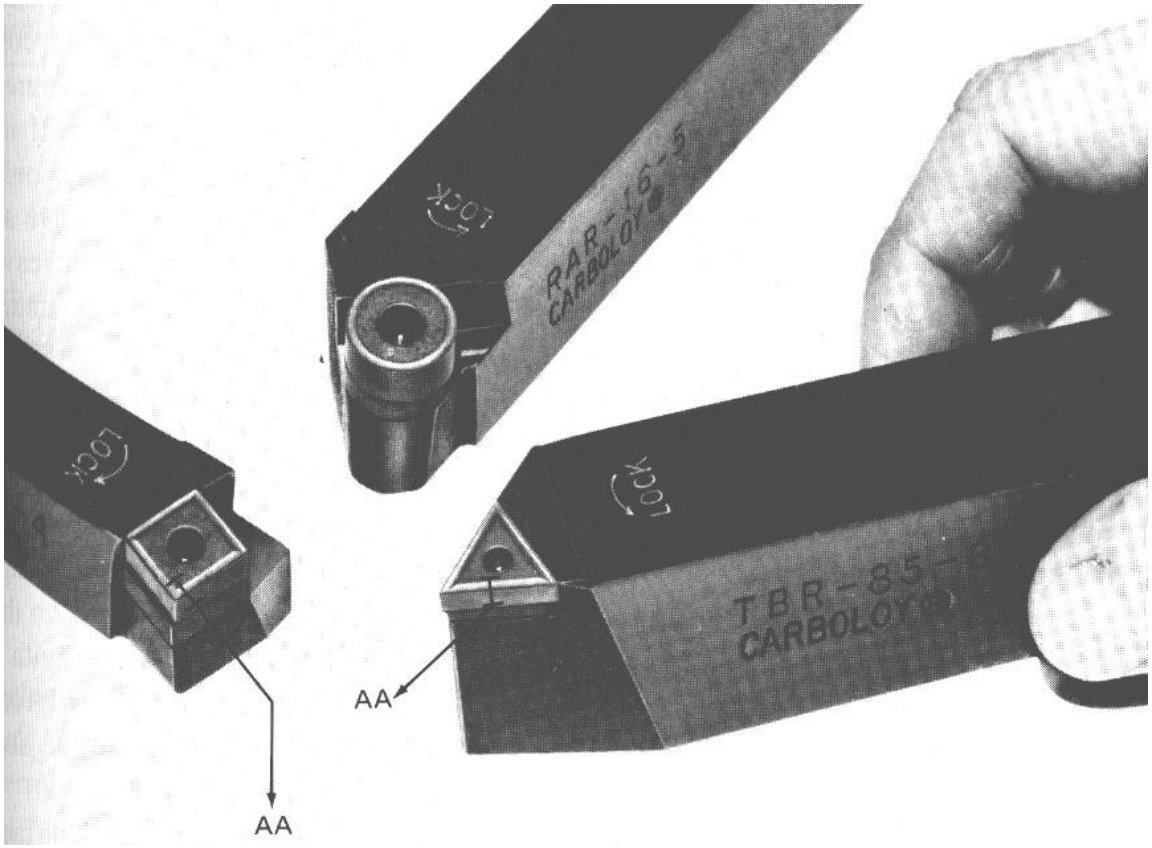
- single point cutting tool
- multiple point cutting tool.

A single-point cutting tool

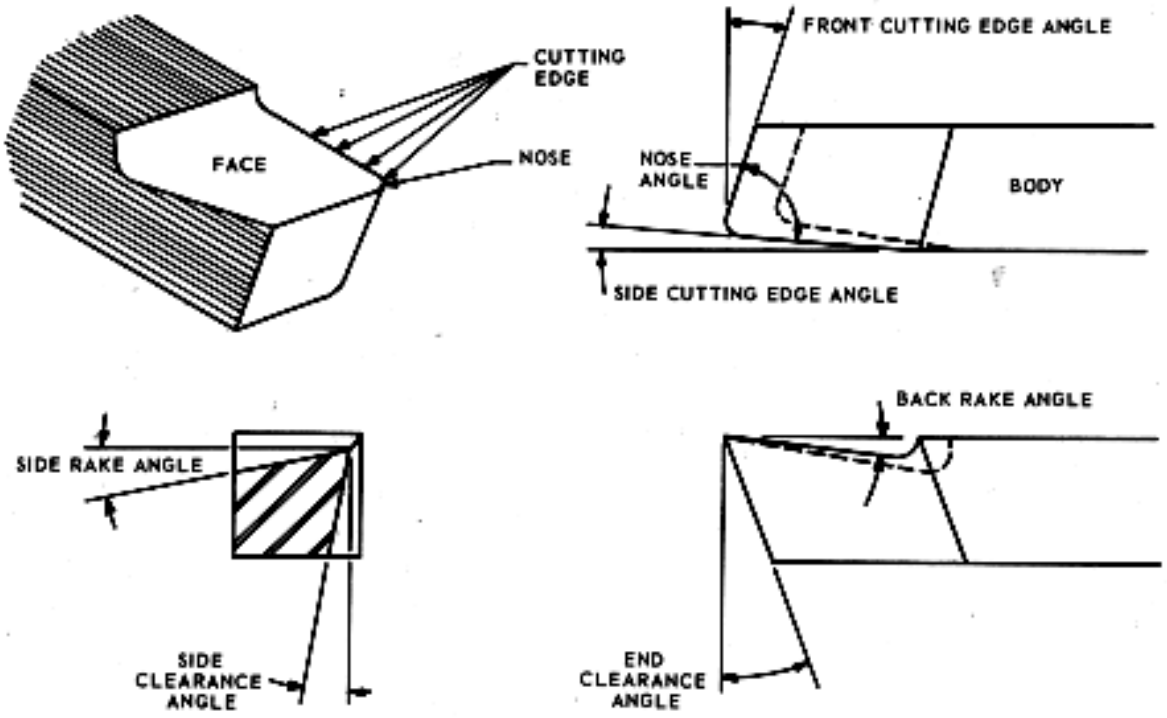
- has only one cutting edge
- used for increasing the size of holes, or boring, thread making, turning etc.

A single-point cutting tool




LOCK
RAR-16-5
CARBOLOY
LOCK
TBR-85-3
CARBOLOY
LOCK
AA
AA

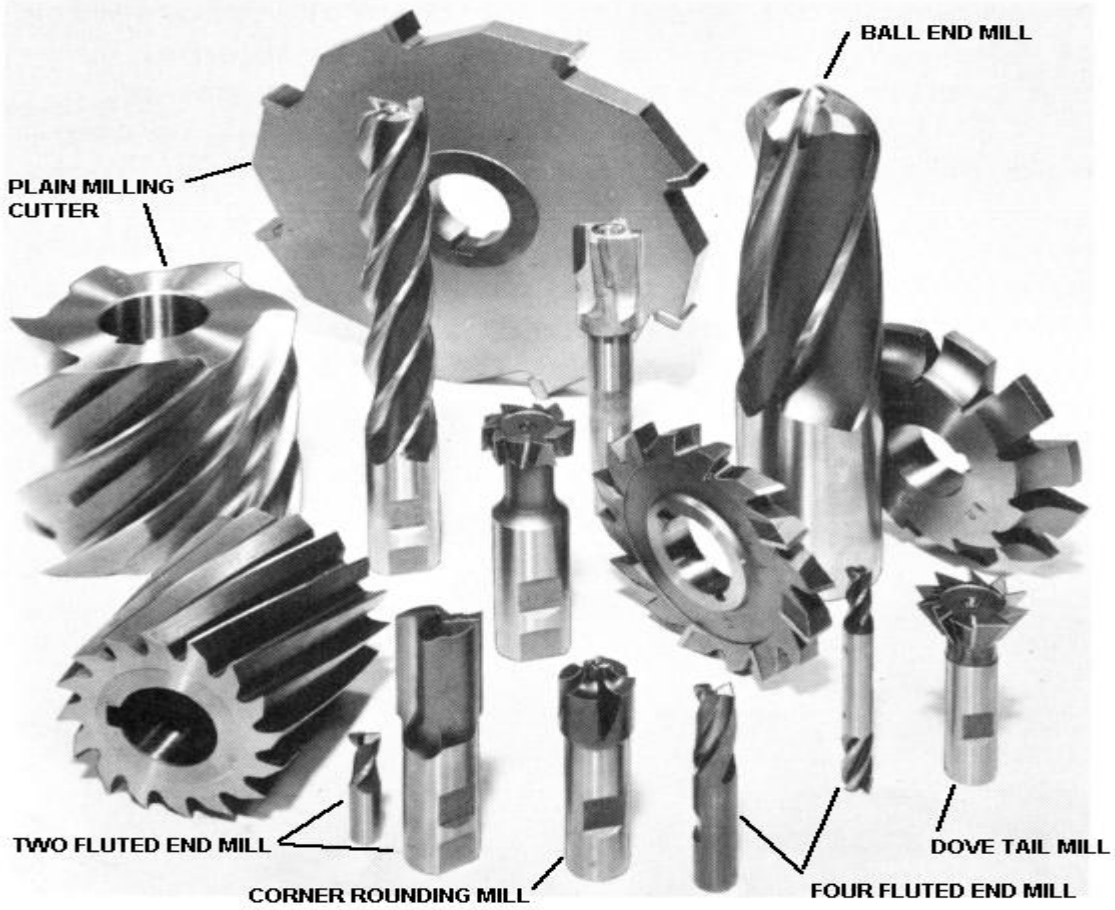
Nomenclature of cutting tool



Multiple-point cutting tools

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

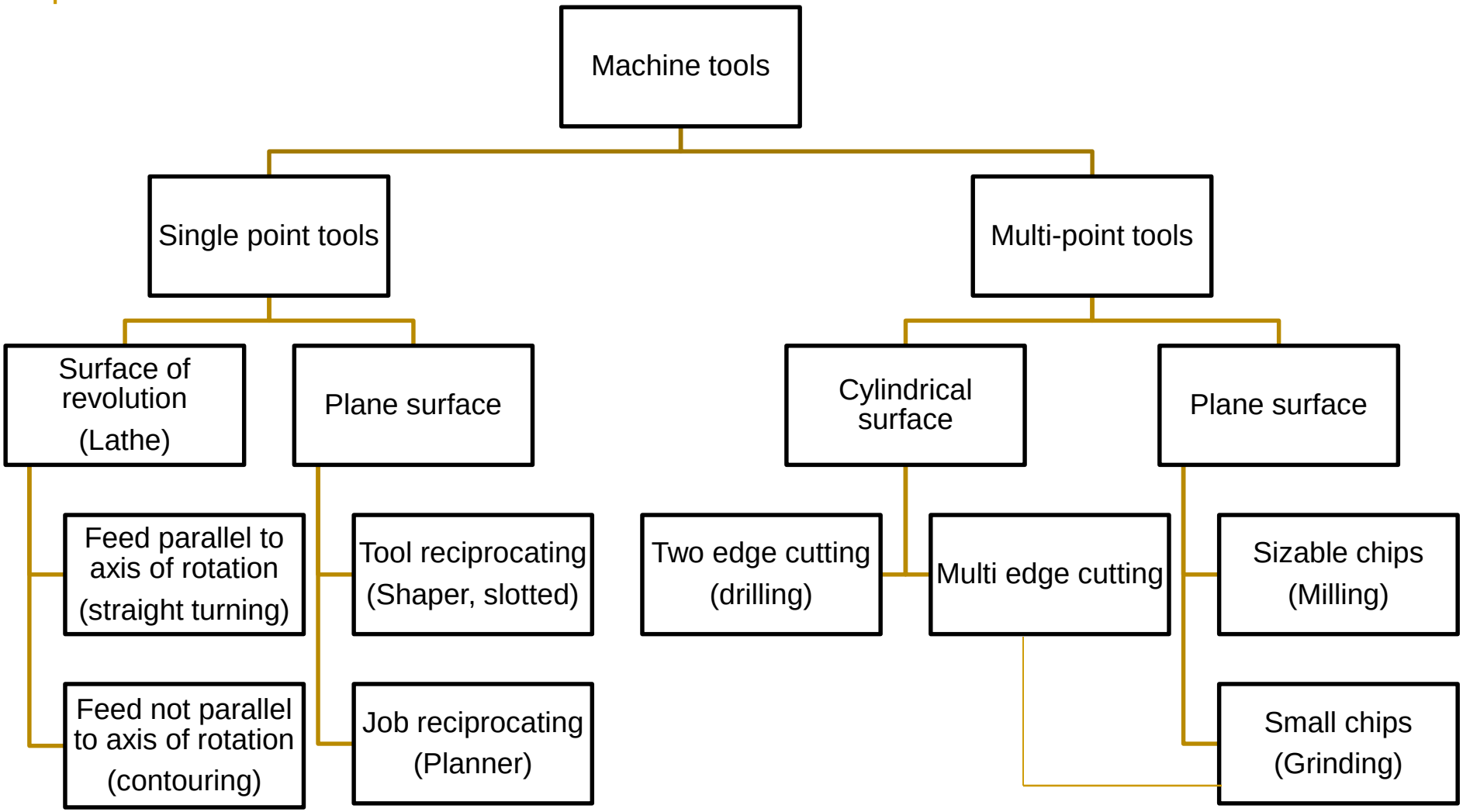
Milling cutters



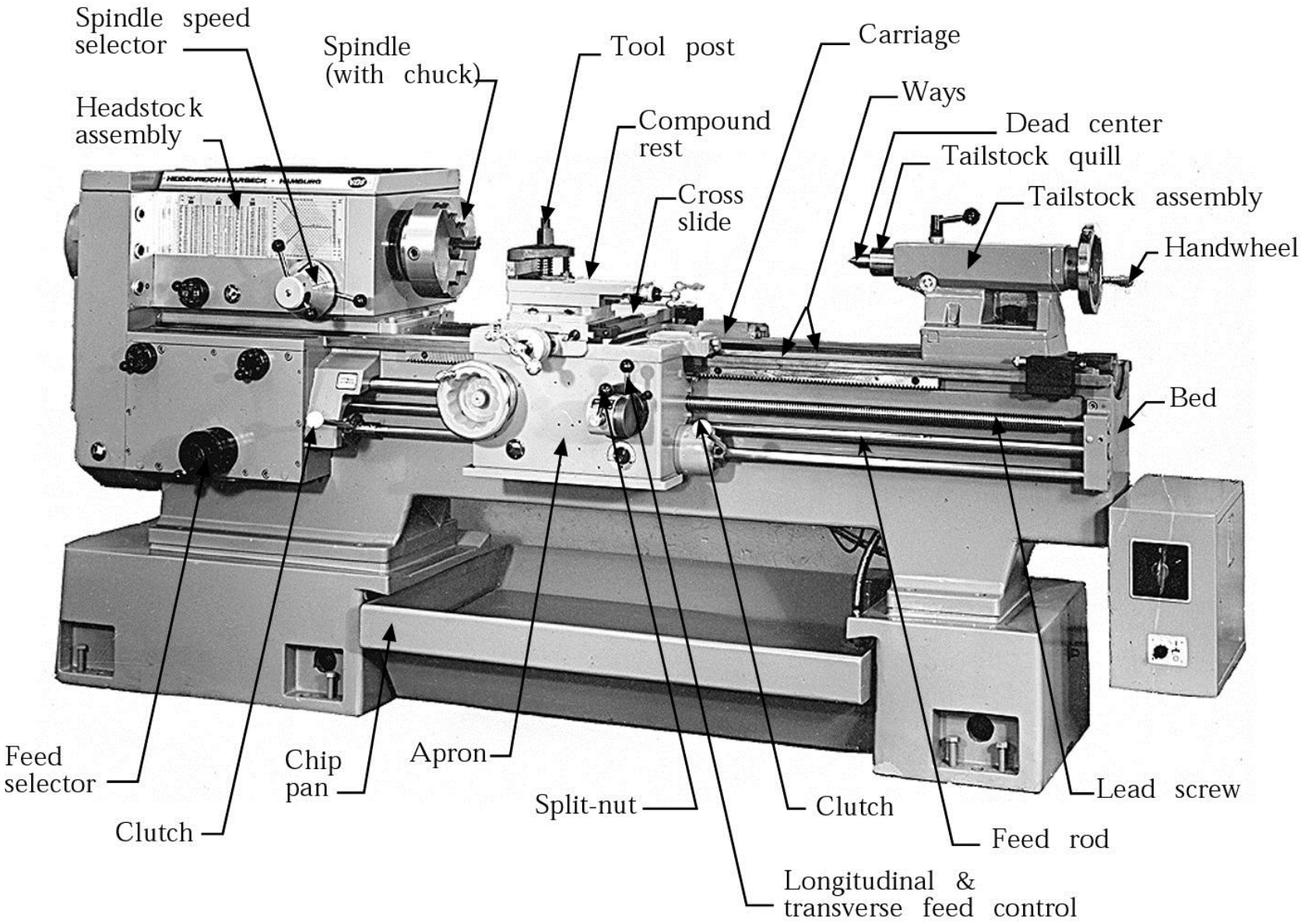
Cutting Tool Materials

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

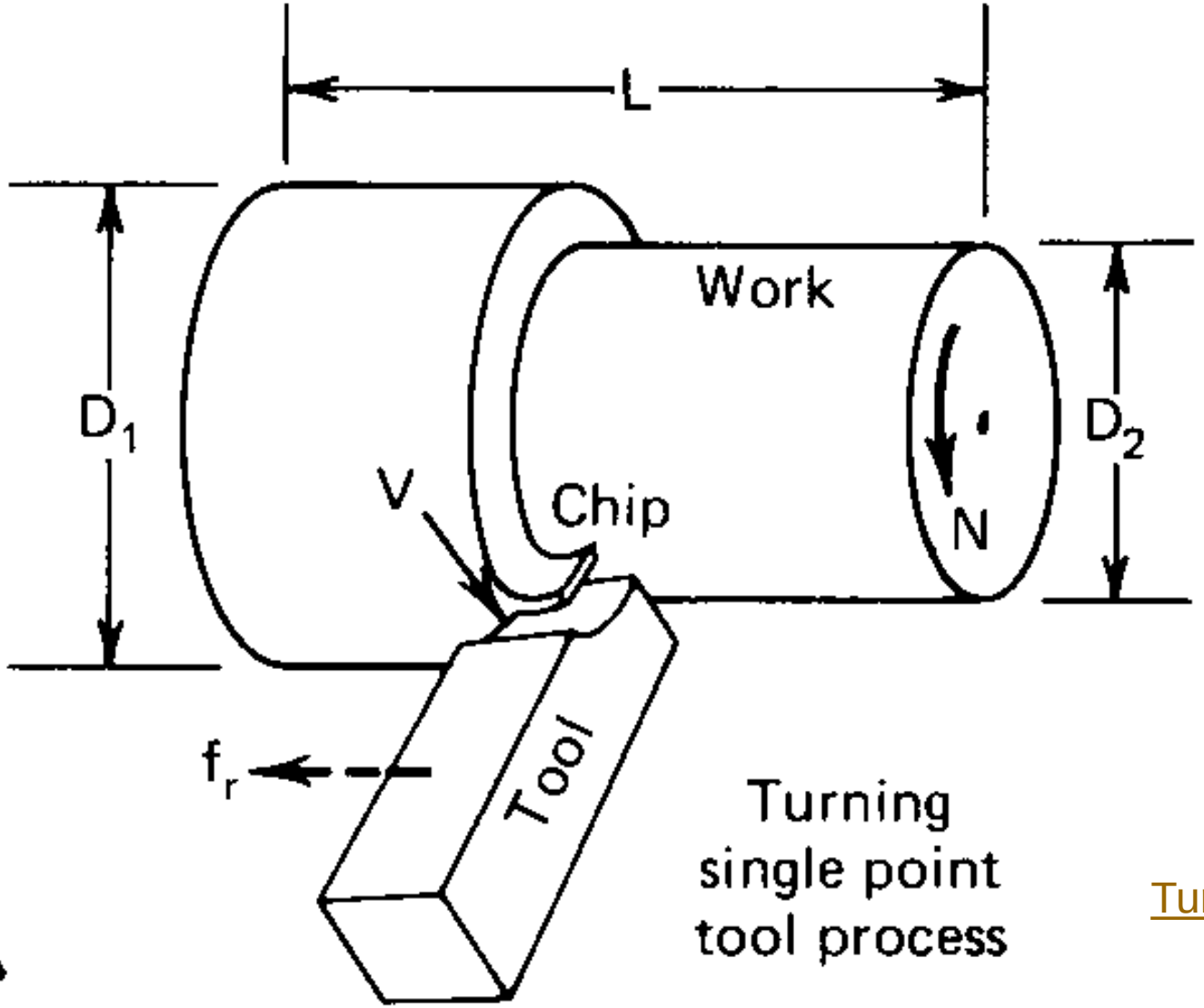
Machine Tool


Machine tools
Single point tools
Multi-point tools
Surface of revolution (Lathe)
Plane surface
Cylindrical surface
Plane surface
Feed parallel to axis of rotation (straight turning)
Feed not parallel to axis of rotation (contouring)
Tool reciprocating (Shaper, slotted)
Job reciprocating (Planner)
Two edge cutting (drilling)
Multi edge cutting
Sizable chips (Milling)
Small chips (Grinding)

Lathe Turning



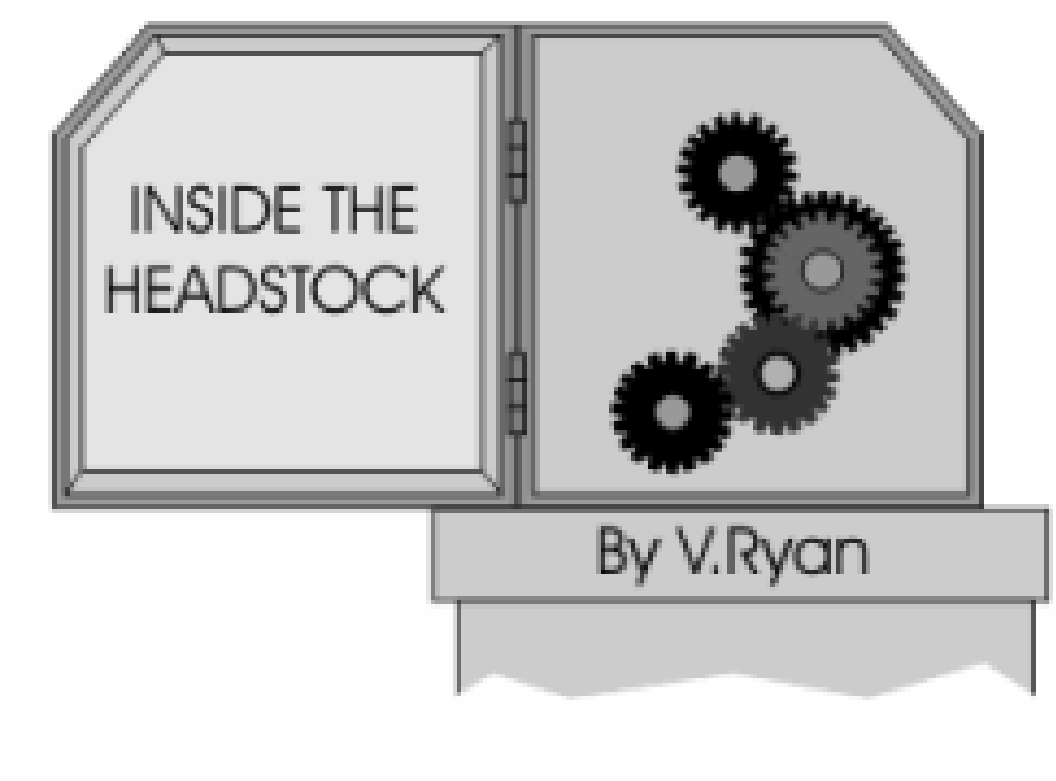
Lathe Turning



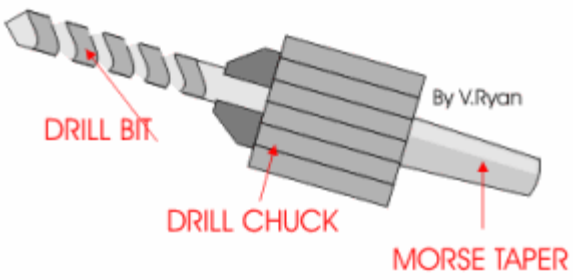
Turning single point tool process

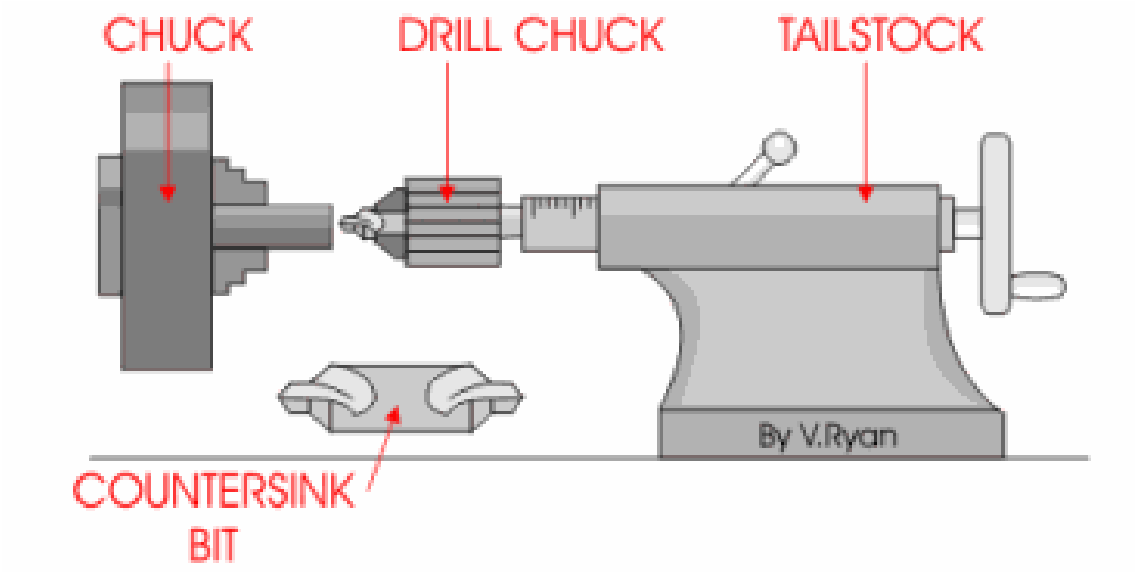
Turning

Gear System

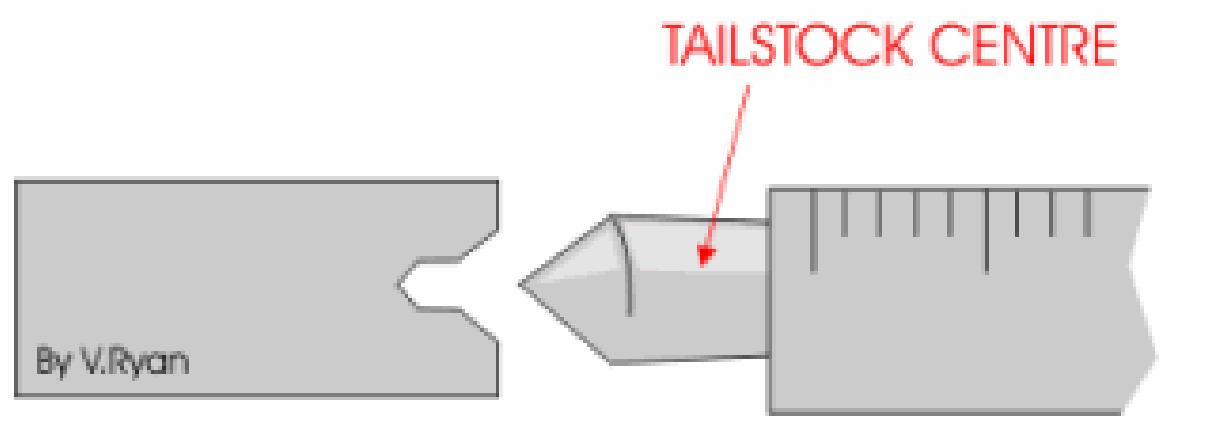


Tailstock

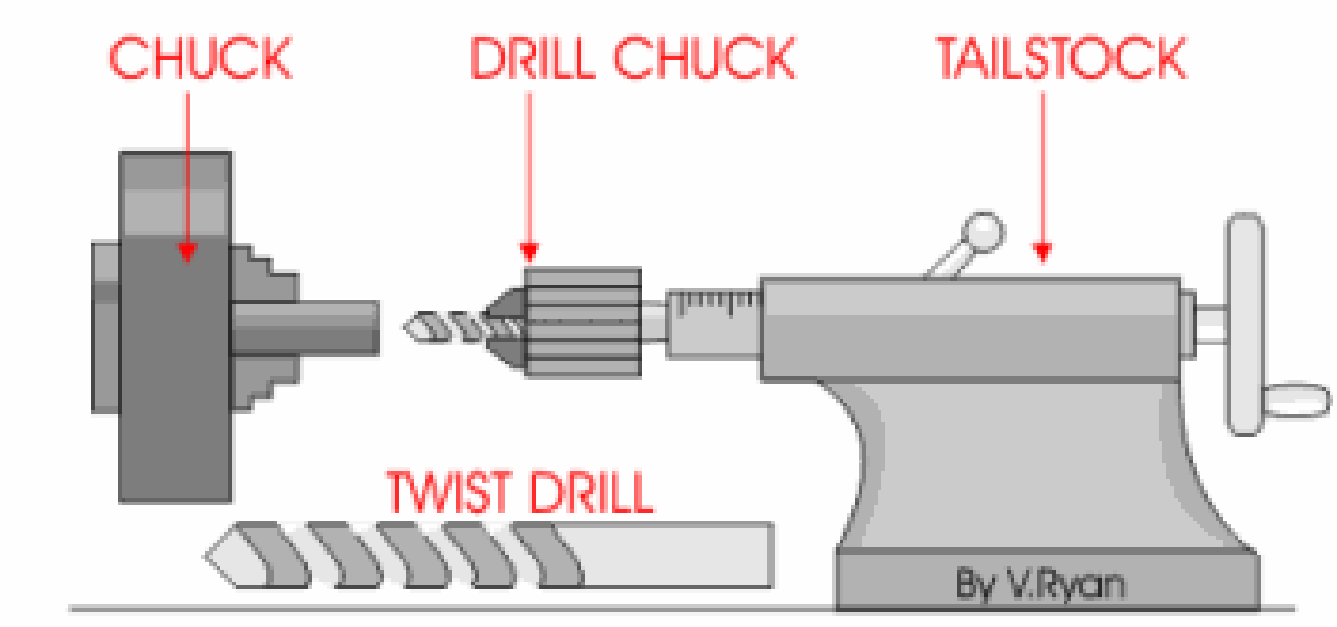

DRILL BIT
By V.Ryan
DRILL CHUCK
MORSE TAPER


CHUCK
DRILL CHUCK
TAILSTOCK
By V.Ryan
COUNTERSINK
BIT

Long Job is supported by tailstock



Drilling in lathe machine



Cutting parameters

- **Speed**

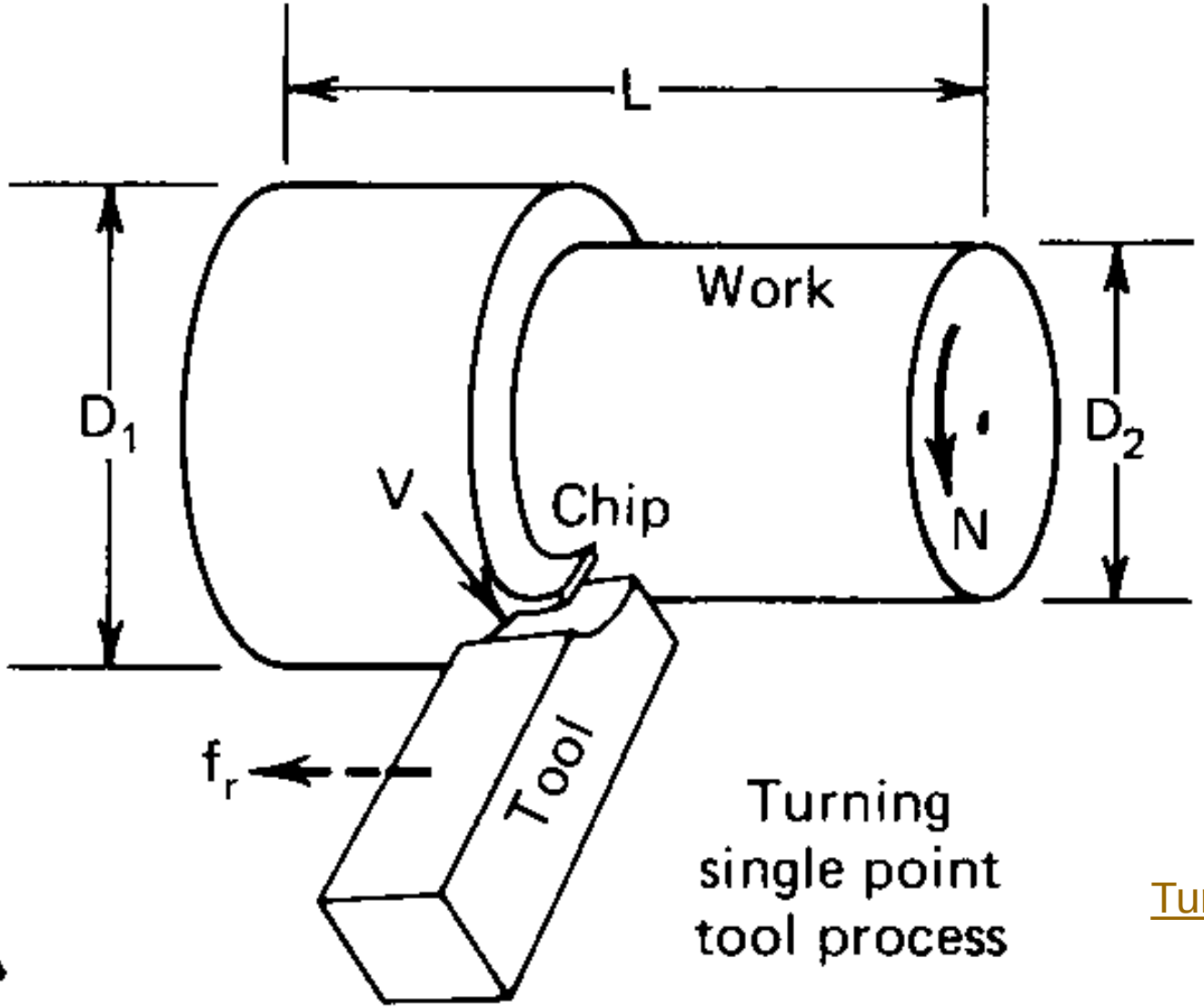
  Cutting speed is defined as the speed at which the work moves with respect to the tool (usually measured in meters per minute).

- **Feed**

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

- **Depth of Cut**

Lathe Turning

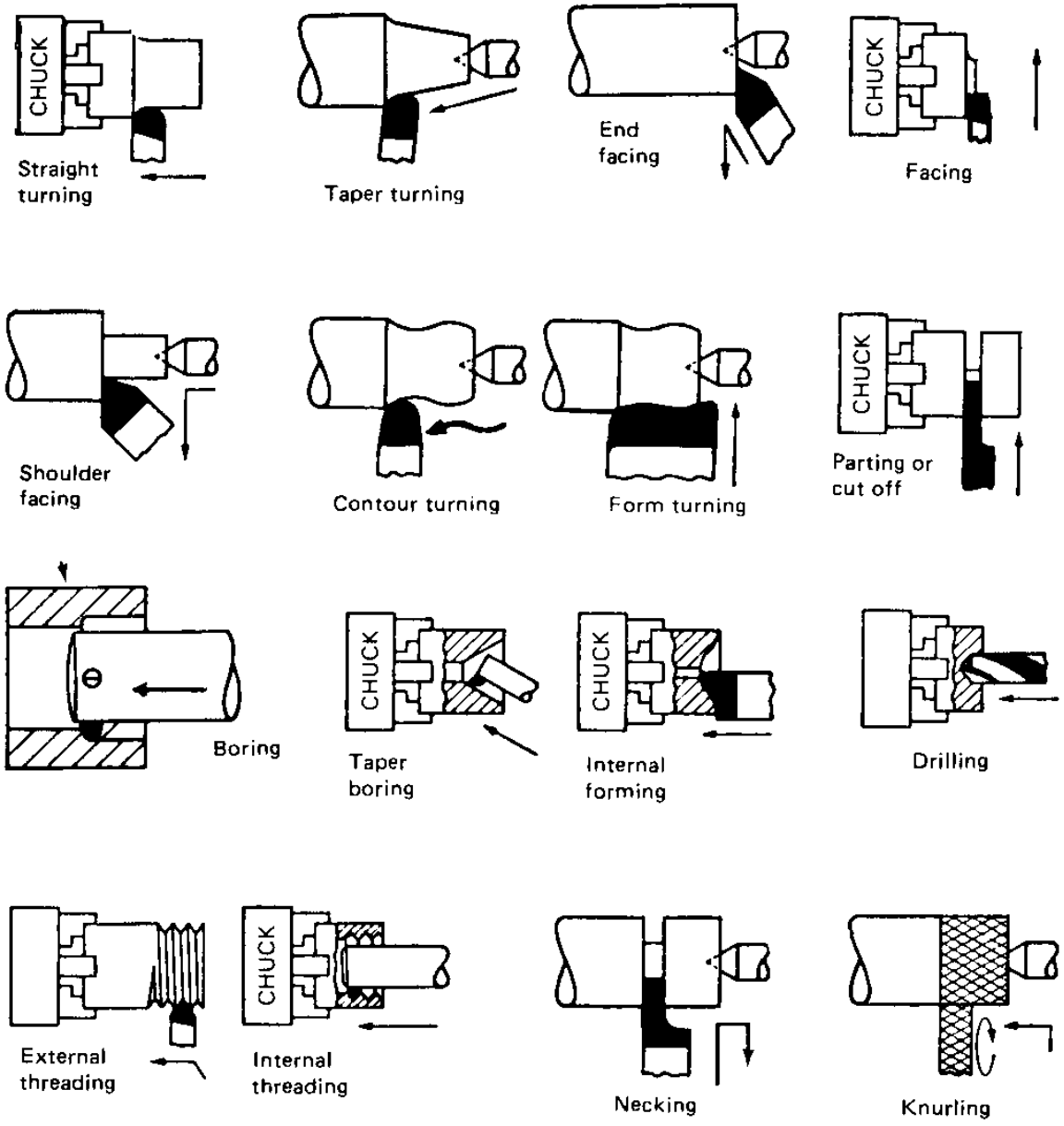


Turning single point tool process

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

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. Aroughing 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 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 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 GJ/ m^3. Calculate machining time and power consumption at the beginning of the operation.

Hints: Power requirement = Specific cutting energy × MRR