



# MANUFACTURING PROCESSES: (TA-202)

**TOOL WEAR, TOOL LIFE, HAND TOOLS AND MACHINE TOOLS**

**Dr. V. K. Jain**

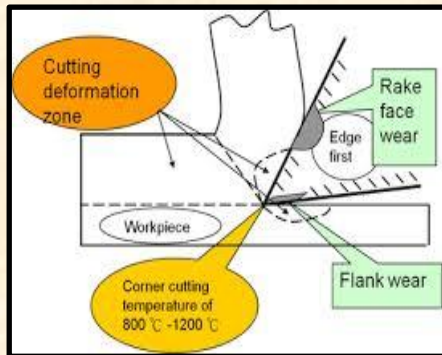
**Mechanical Engineering Department  
Indian Institute of Technology  
Kanpur (India)**

email: [vkjain@iitk.ac.in](mailto:vkjain@iitk.ac.in)

# PROCESS OF CUTTING TOOL FAILURE

## Cutting Tool Failure Mechanisms:

1. By Plastic deformation
2. By chipping due to mechanical breakage
3. Burning of the tool
4. By gradual wear



Typical wear pattern in cutting tool

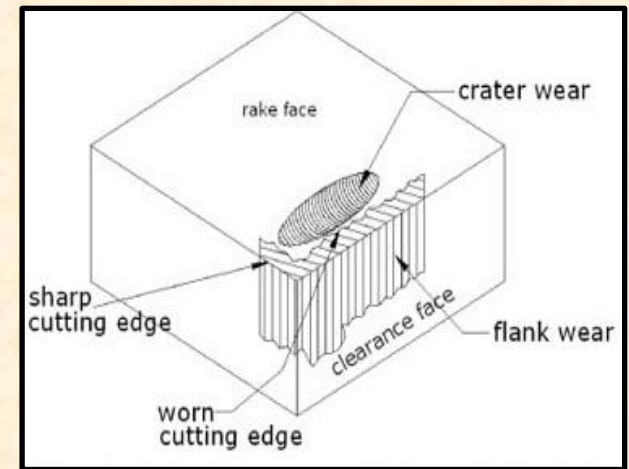


Fig: e) Crater wear & flank wear

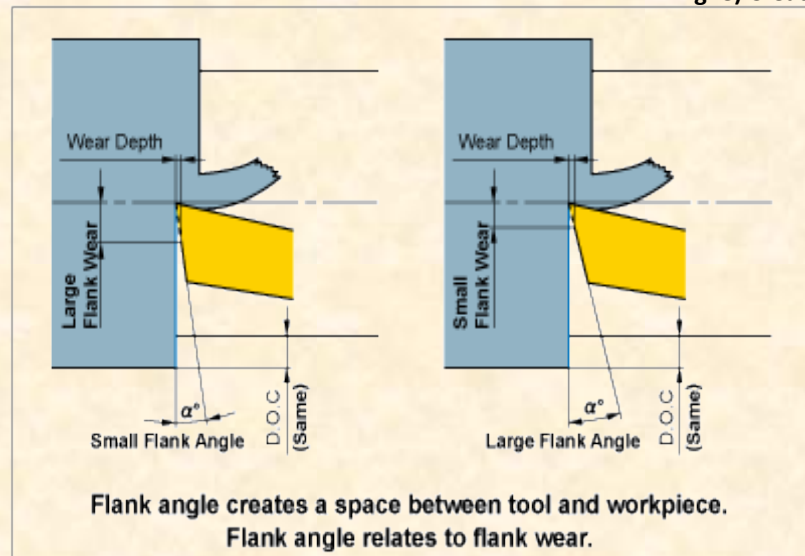


Fig: (f) small & Larger Flank wear

A tool that no longer performs the desired function can be declared as “failed”

# FLANK WEAR AND TIME RELATIONSHIP

## Three stages of flank wear:

1. Rapid growth region (Break in region)
2. Steady state region (Temperature Insensitive region)
3. Catastrophe failure (Temperature sensitive region)

Flank wear characterised by wear land (or Height)  $h_f$  of wear band

## Flank wear formation depends on

- \* Cutting Conditions ( $f$ ,  $d$ ,  $V$ , tool angles)
- \* Properties of work material and tool material

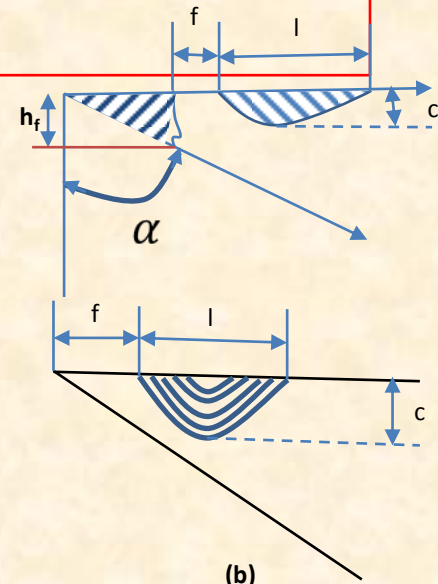
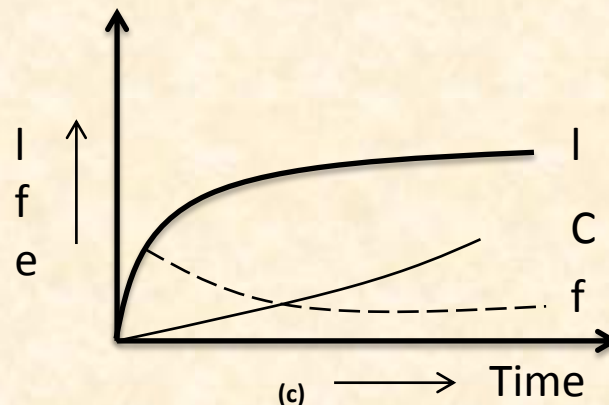
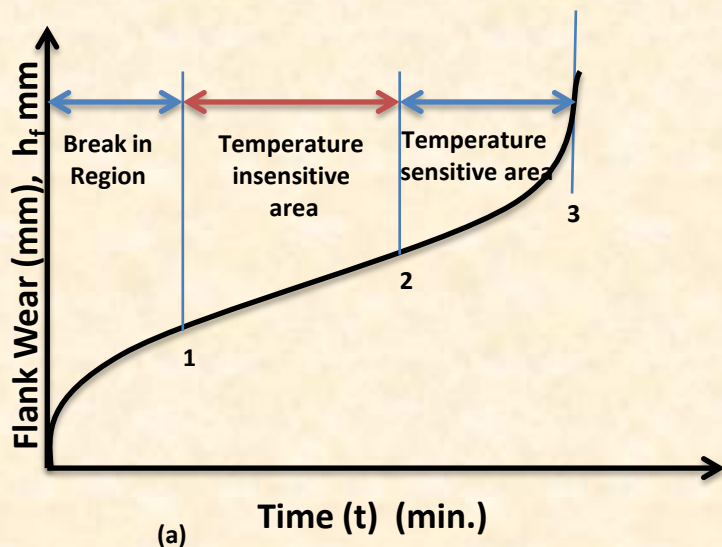


Fig: (a) Three stage flank wear curve, (b) Various elements of flank wear and crater wear, (c) Variation of various crater wear with time

# Tool wear Index, feed marks and surface finish

## ➤ TYPE OF WEAR DEPENDS MAINLY ON CUTTING SPEED

- If cutting speed increases, predominant wear may be “**CRATER**” wear else “**FLANK**” wear.
- Failure by crater takes place when index  $h_k$  reaches 0.4 value, before flank wear limit of  $h_f=1\text{mm}$  for carbide tools is attained.

$$h_k = \frac{C}{(l/2) + f}$$

Where, C = Depth

l = Width

f = Distance

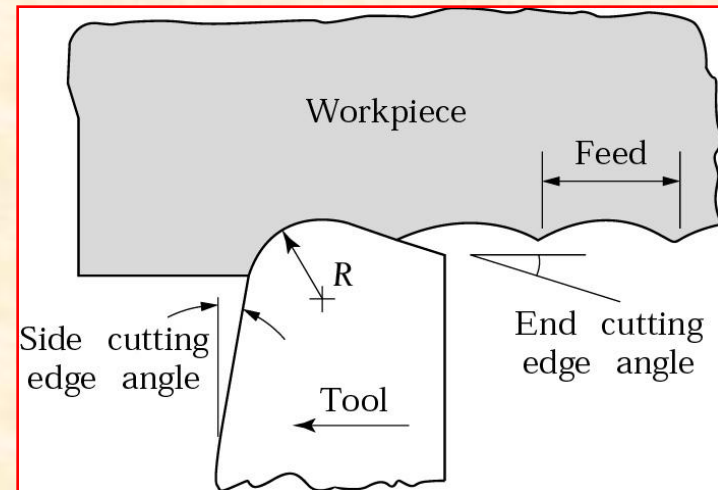
for HSS  $h_k = 0.6$

$$R_{CLA} = \frac{8f^2}{R18\sqrt{3}}$$

$$R_{\max} = 4R_{CLA}$$

Where, f = Feed

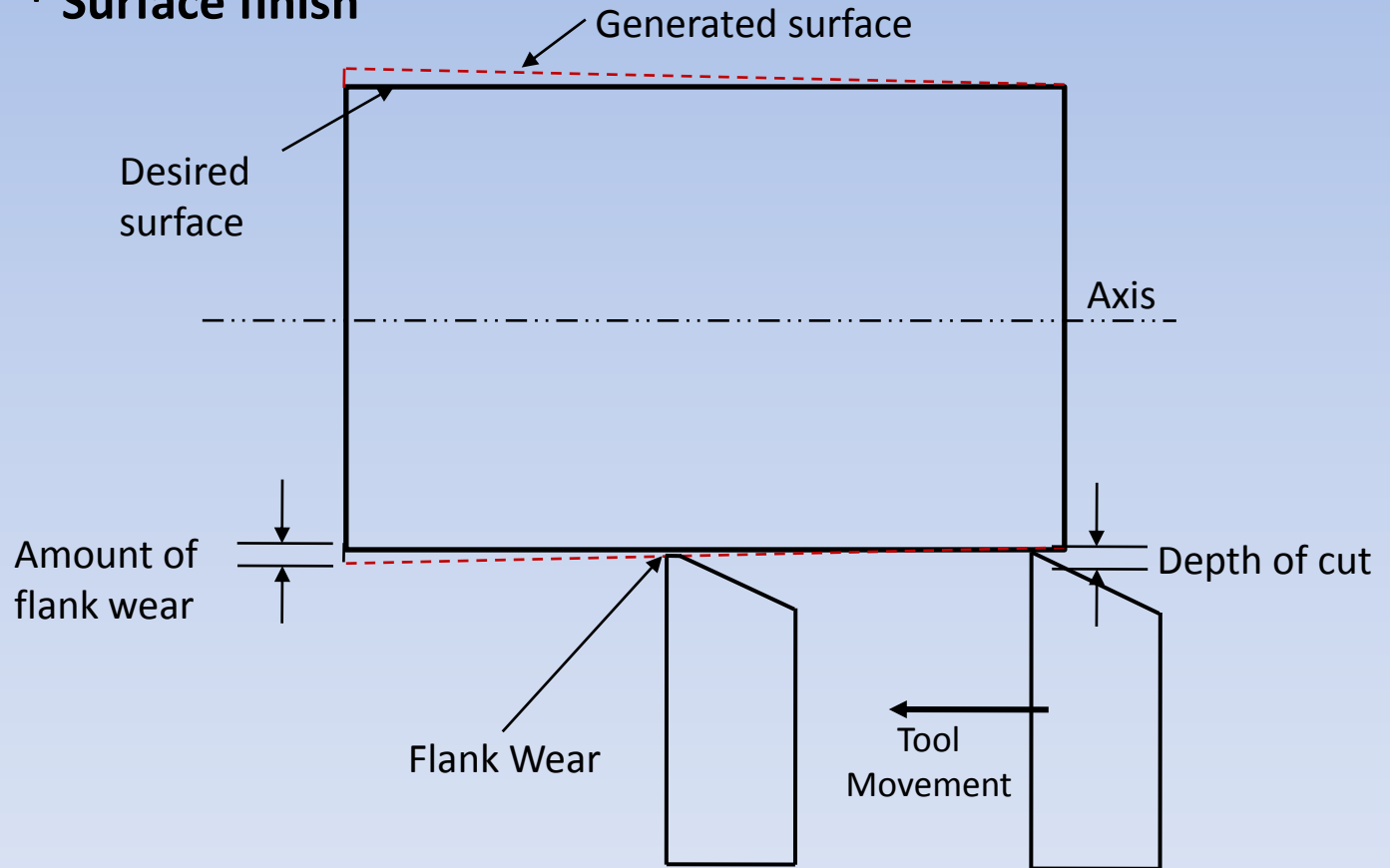
R = Tool Nose Radius



# Effect of tool wear on machined surface

## FLANK WEAR AFFECTS:

- \* Dimensional accuracy
- \* Process stability
- \* Surface finish



Effect of tool wear on machined component dimensions (Exaggerated view)

# TOOL LIFE & MACHINABILITY

**Tool no longer performs desired function** → **failed**  
**Re-sharpen and use it again.**

## TOOL LIFE:

- **Useful life of a tool** expressed in terms of time from start of a cut to termination point (defined by failure criterion). Sometimes also expressed in terms of no. Of the parts machined.
- **Tool failure criterion** depends on
  1. The requirements of the component being produced.
  2. Type of Operation:
    - **Roughing**: force and power requirement.
    - **Finishing** : Surface finish & dimensional accuracy.

## TAYLOR'S TOOL LIFE EQUATION

$$VT^n = C$$

← **After 12 Years of Experiments**

Where,  $V$  = Cutting Speed

$T$  = Tool life (Minutes)

$n$  = Exponent for conditions tested

$C_t$  = Taylor's constant

$C_t$  → represents cutting speed for 1 minute as tool life

# TOOL LIFE & MACHINABILITY

Does not account for:

Feed (f)

Depth of cut (d)

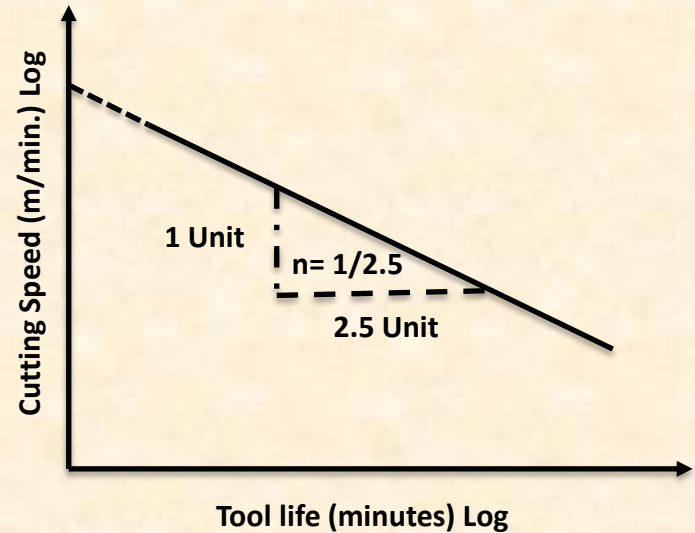
Tool geometry (Rake Angle  $\alpha$  )

$$VT^n = C \quad (n < 1), C_t \text{ is very large}$$

Taking logarithm on both sides

$$\log V + n \log T = \log C_t$$

This becomes a straight line on the log-log scale



$$VT^{n_1}d^{n_2} = C$$

N, n<sub>1</sub>, n<sub>2</sub>: Constants depending upon tool material (=0.1 to 0.4).

C: constant that depends on tool-work material combination and tool geometry (>100)

# VARIABLES AFFECTING TOOL LIFE

- Cutting Conditions ( $V$ ,  $d$ ,  $f$ )
- Tool Geometry (all six angles, and nose radius)
- Workpiece Material
- Cutting fluid
- Machine tool and Work piece region
- Tool Material

## MACHINABILITY

. Mainly concerned with workpiece material properties not the tool properties.

It depends on workpiece material properties and good machinability means:

1. Low tool wear
2. Good surface finish produced
3. Low cutting forces

**Machinability is defined as “THE EASE WITH WHICH A GIVEN WORKPIECE MATERIAL CAN BE MACHINED WITH A SPECIFIED CUTTING TOOL.**



# TOOL SPECIFICATION

- Apart from tool material, one has to give tool angles and tool nose radius **in the following sequence** while going to purchase or asking some one to make a tool :
- Tool specifications (all six angles, and nose radius) : **7-8-5-6-9-4-1 mm.**
- Back rake angle ( $7^{\circ}$ ),
- Side rake angle ( $8^{\circ}$ ),
- End clearance (relief) angle ( $5^{\circ}$ ),
- Side clearance (relief) angle ( $6^{\circ}$ ),
- End cutting edge angle ( $9^{\circ}$ ),
- Side cutting edge angle ( $4^{\circ}$ ),
- Nose radius (1 mm)

# FITTING SHOP EQUIPMENT



**BENCH VICE**



**HAND VICE**



**PIPE VICE**



**File**



**File Card**



**Hammer**



**Hand File**



**Flat File**



**Half-round File**



**Round File**



**Square File**



**Hack Saw**



**Pitches of Hack Saw**



**Three Square File**

# Fitting Shop Equipment



Twist Drill



Counter bore Drill



Countersink Drill

Hand Reamer



Machine Reamer



Adjustable Reamer



Chisels



Die



Die Nut

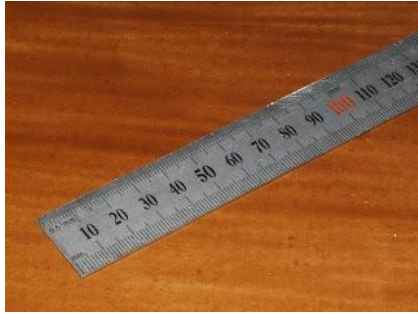


Taps

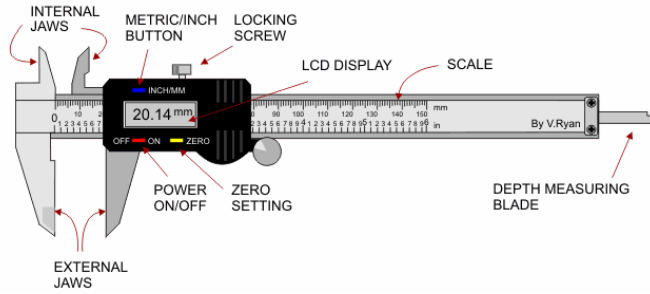


Tap Wrench

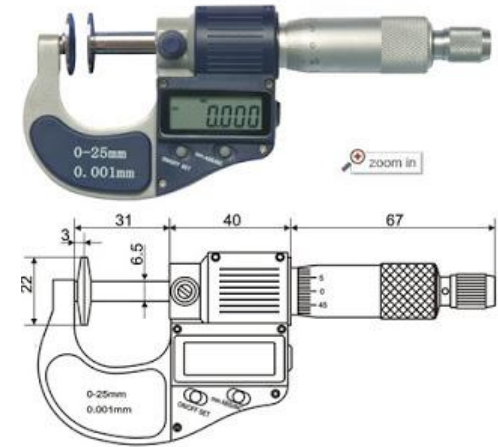
# Measuring Equipment



Ruler Scale



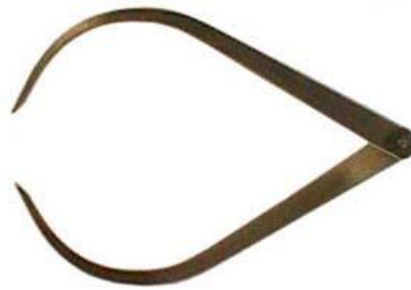
Vernier Caliper



Outside Micrometer



Dial Gauge



Outside Caliper



Inside Caliper



Vernier Height Gauge



Inside Micrometer



Depth Micrometer

# Measuring & Marking Equipment



Divider



Surface Plate



Bevel Protector



Scriber



Engineer's try Square



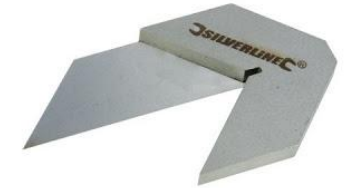
Combination Set



V-Block



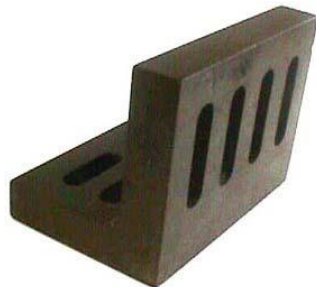
Wire Gauge



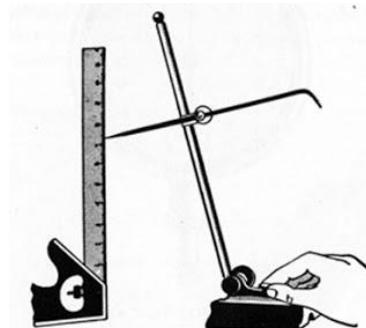
Center Square



Striking Tools/Hammers



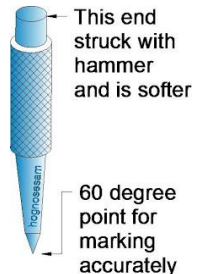
Angle Plate



Universal Marking Surface Gauge



Center Punch

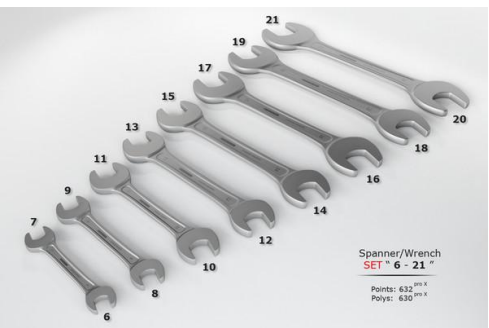


Dot Punch

This end struck with hammer and is softer

60 degree point for marking accurately

# Measuring, Marking Equipment, tools and cutters



Universal Marking Surface Gauge



Dog Carrier



Dog Plate



Drill Chuck & Key



Revolving Centre



Cylindrical Cutter



Slitting Saw Cutter



Threading Tool



Parting Tool



Boring Tool



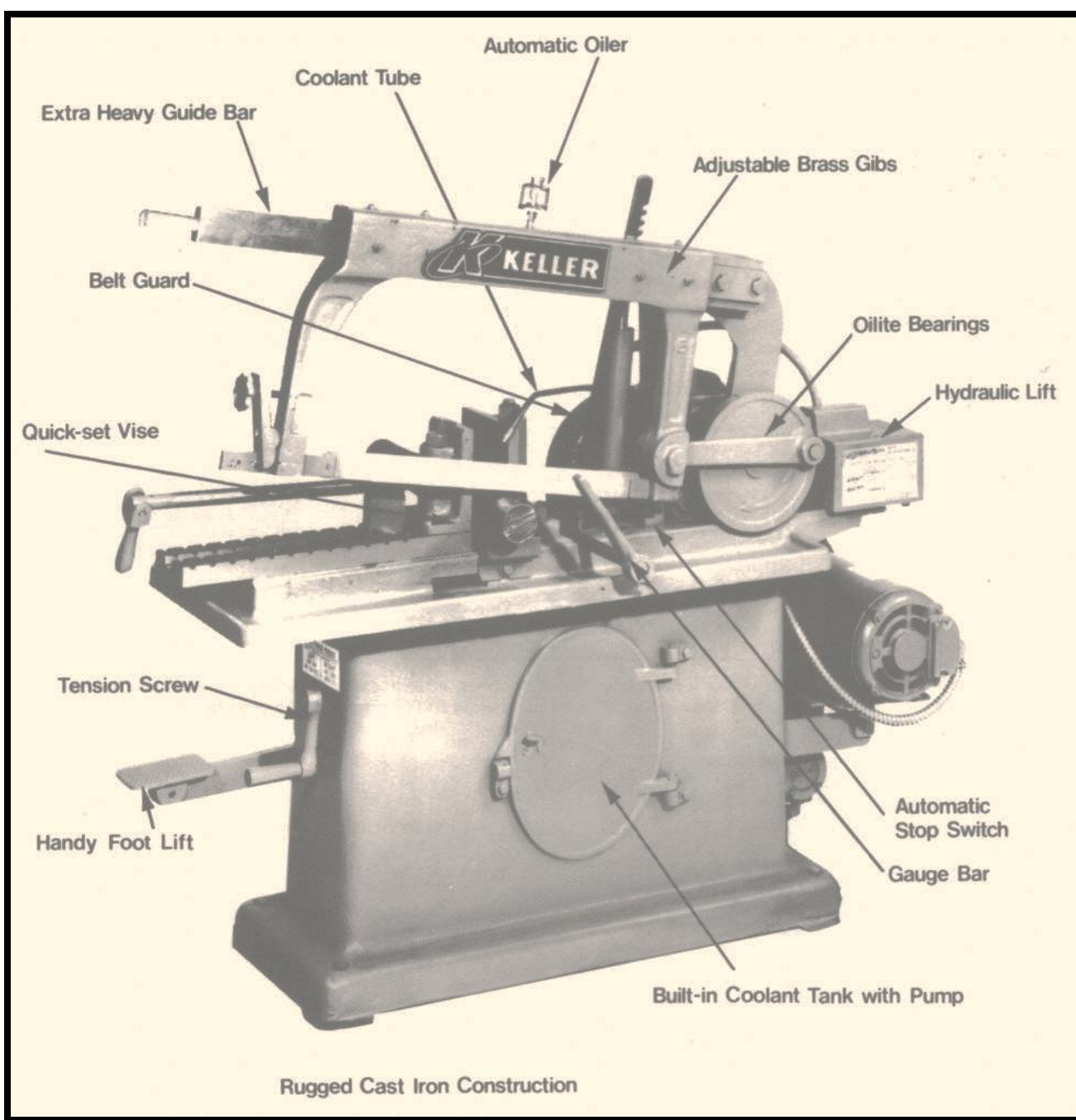
Turning Tool



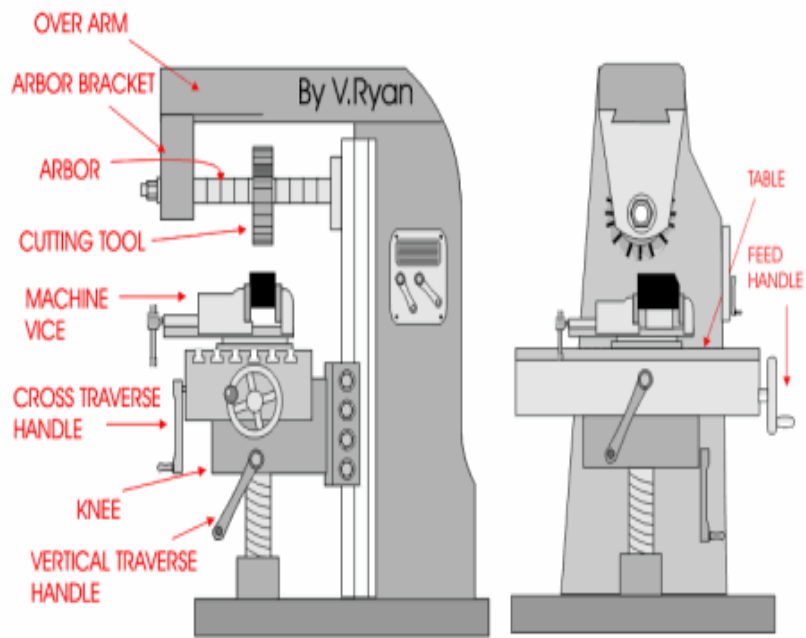
Knurling Tool



Screw Driver

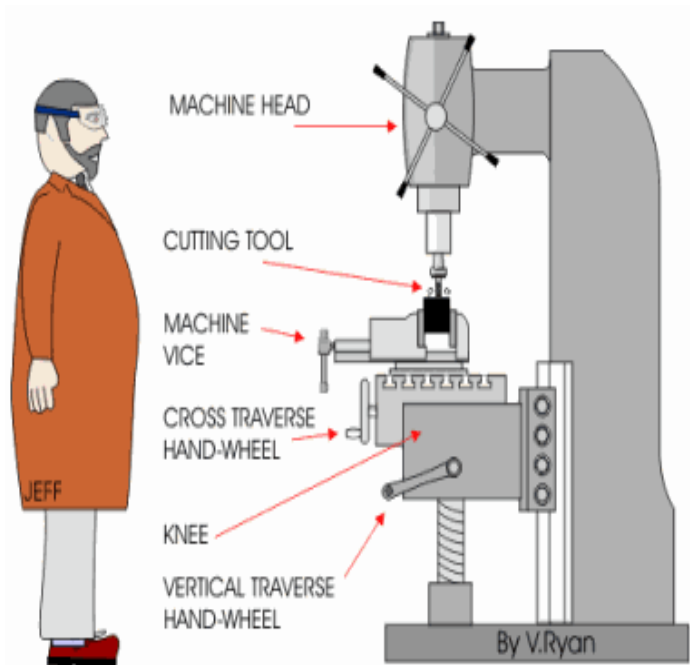
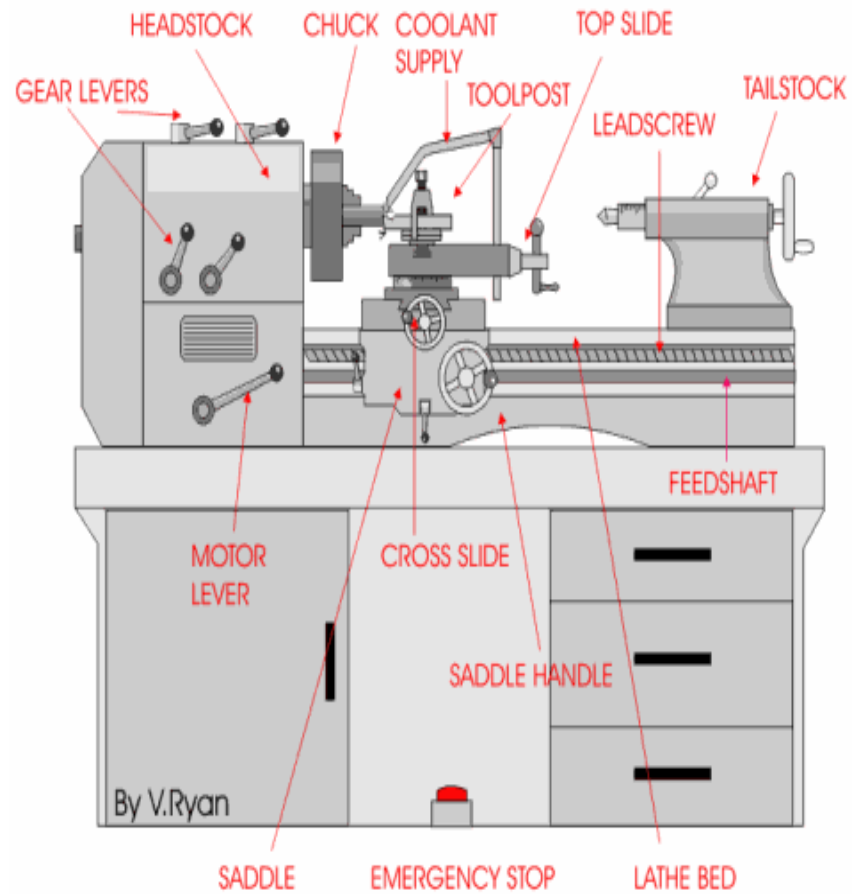


**Power Hack Saw**

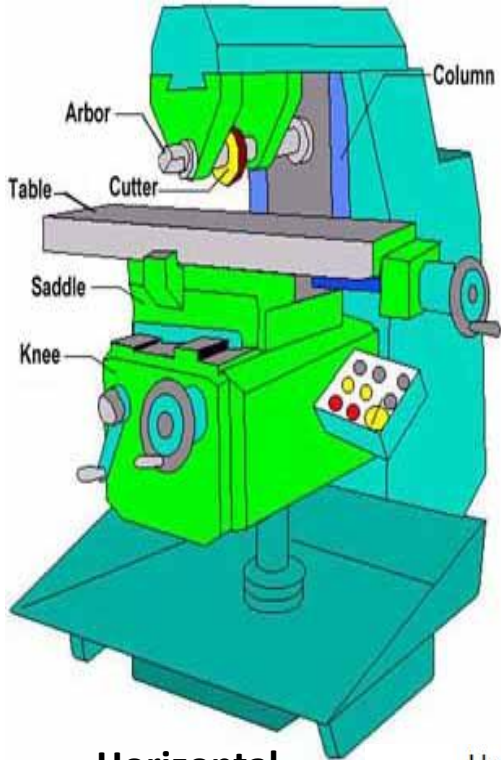


FRONT VIEW

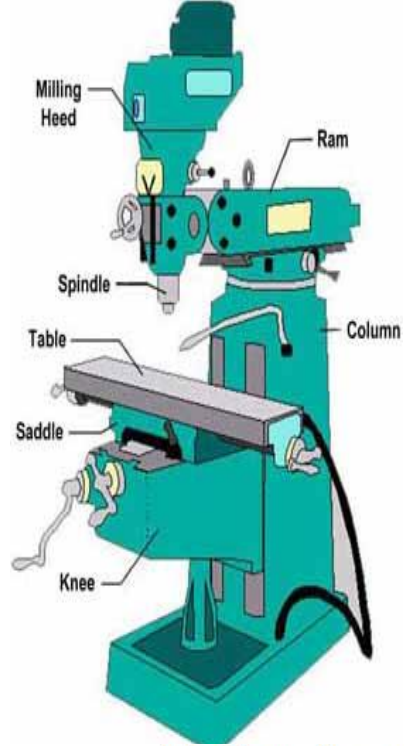
SIDE VIEW



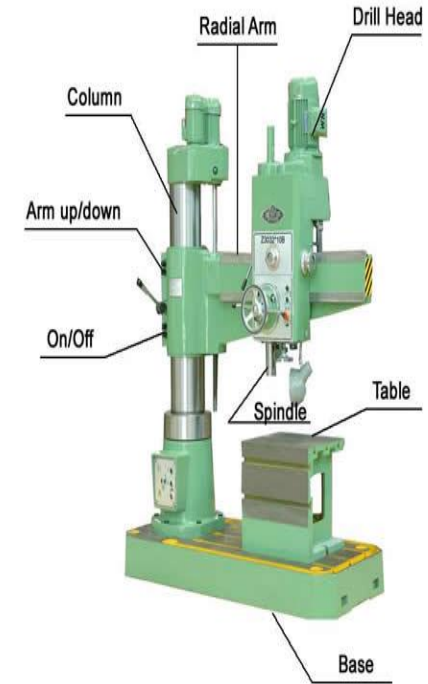




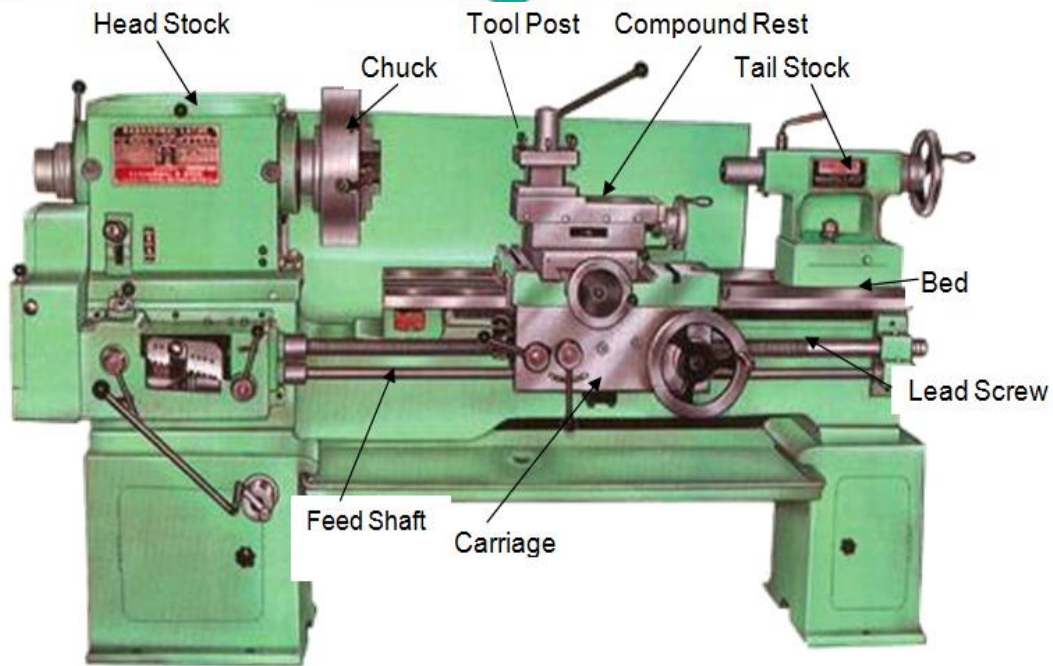
**Horizontal Milling Machine**



**Vertical Milling machine**



**Drilling Machine**



**Lathe Machine**

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**THANK YOU**



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**SUPPLEMENTARY MATERIAL**

