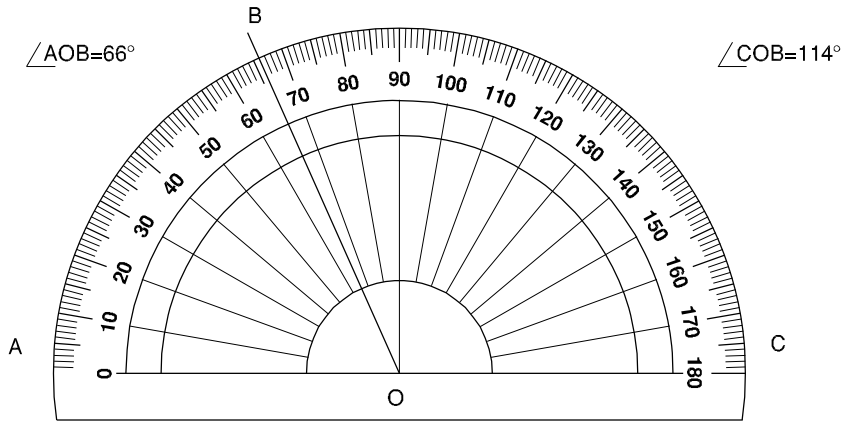
Measurement of angles

Objectives: At the end of this lesson you shall be able to
- **state the units and fractional units of angles**
- **express degrees, minutes and seconds using symbols.**

The unit of an angle

For angular measurements a complete circle is divided into 360 equal parts. Each division is called a degree. (A half circle will have 180°) (Fig 1)

Fig 1



Subdivisions of an angle

For more precise angular measurements, one degree is further divided into 60 equal parts. This division is one MINUTE (‘). The minute is used to represent a fractional part of a degree and is written as 30° 15’.

One minute is further divided into smaller units known as seconds (“). There are 60 seconds in a minute.

An angular measurement written in degrees, minutes and seconds would read as 30° 15' 20".

Examples for angular divisions

1	complete circle	360°
1/2	circle	180°
1/4	of a circle	90°
	(right angle)	

Sub divisions 1 degree or 1° = 60 mts or 60'
1 min or 1' = 60 secs or 60"

Angular measuring instruments (Semi-precision)

Objectives: At the end of this lesson you shall be able to
- **state the names of semi-precision angular measuring instruments**
- **differentiate between bevel and universal bevel gauges**
- **state the features of bevel protractors.**

The most common instruments used to check angles are the:

bevel or bevel gauge (Fig 1)

universal bevel gauge (Fig 2)

bevel protractor. (Fig 3)

Fig 1

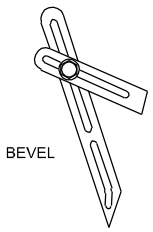
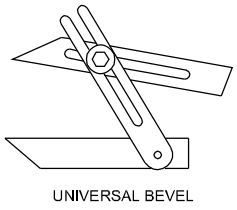
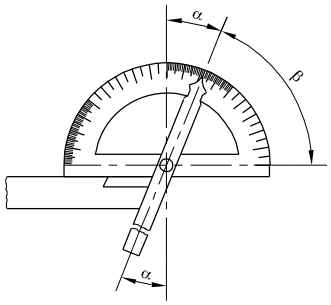


Fig 2



FIN121921

Fig 3



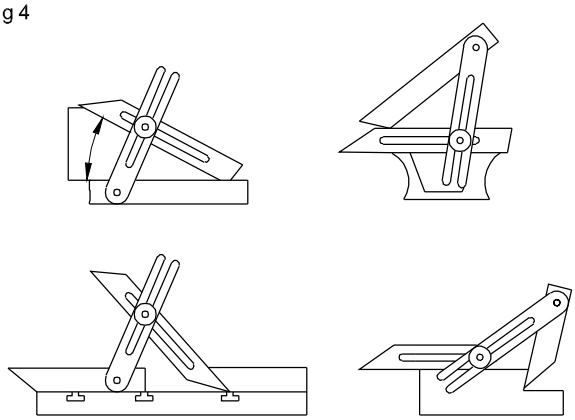
BEVEL PROTRACTOR

FIN121923

Bevel gauges : The bevel gauges cannot measure angles directly. They are, therefore, indirect angular measuring instruments. The angles can be set and measured with bevel protractors.

Universal bevel gauges : The universal bevel gauge has an additional blade. This helps in measuring angles which cannot be checked with an ordinary bevel gauge. (Fig 4)

Fig 4



FIN121924

Bevel protractor (Fig 3)**:** The bevel protractor is a direct angular measuring instrument, and has graduation marked from 0° to 180°. Angles can be measured within an accuracy of 1° using this instrument. (Fig 3)

Combination set

Objectives: At the end of this lesson you shall be able to
- **name the parts of a combination set**
- **state the uses of each attachment in a combination set**

Combination sets can be used for different types of work, like layout work, measurement and checking of angles.

The combination set (Fig 1) has a

Protractor head	(1)
Square Head	(2)
Centre head, and a	(3)
Rule	(4)

Protractor Head

The protractor head can be rotated and set to any required angle.

The protractor head is used for marking and measuring angles within an accuracy of 1^0. The spirit level attached to this is useful for setting jobs in a horizontal plane. (Fig.6)

Square Head

The square head has one measuring face at 90^0 and another at 45^0 to the rule.

It is used to mark and check 90^0 and 45^0 angles. It can also be used to set workpieces on the machines and measure the depth of slots. (Fig 2,3 and 4)

Centre Head

This along with the rule is used for locating the centre of cylindrical jobs. (Fig 5)

For ensuring accurate results, the combination set should be cleaned well after use and should not be mixed with cutting tools, either while using or storing.

Fig 1

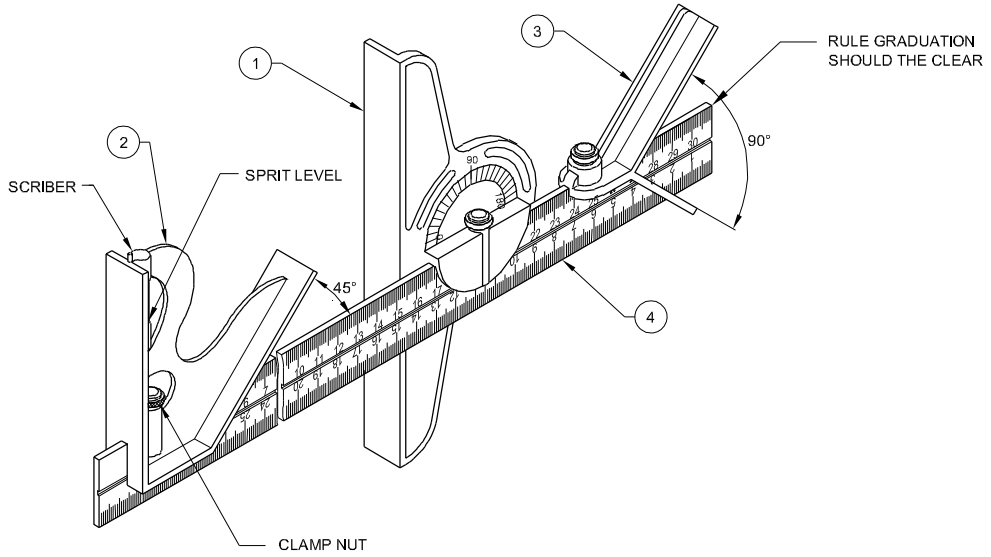


Fig 2

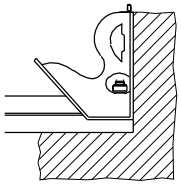


Fig 4

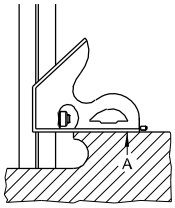


Fig 3

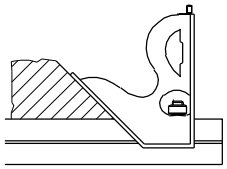


Fig 5

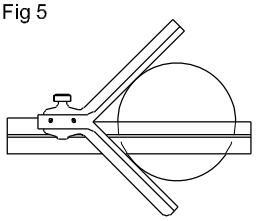
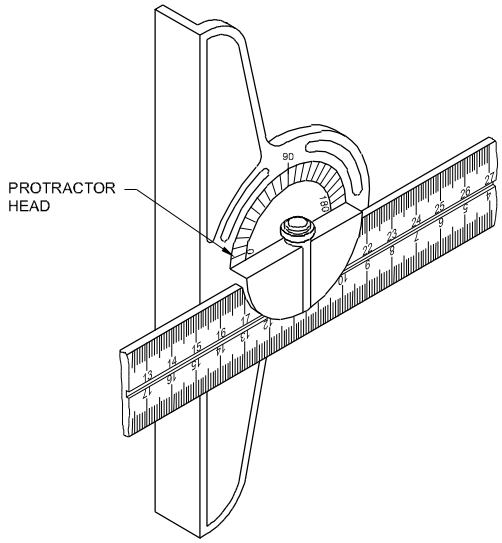


Fig 6



Measuring standards (English & metric)

Objective: At the end of this lesson you shall be able to

- **describe the measuring standards of english and metric units.**

Necessity

All physical quantities are to be measured in terms of standard quantities.

Unit

A unit is defined as a standard or fixed quantity of one kind used to measure other quantities of the same kind.

Classification

Fundamental units and derived units are the two classifications.

Fundamental units

Units of basic quantities of length, mass and time.

Derived units

Units which are derived from basic units and bear a constant relationship with the fundamental units.

Ex : Area, Volume, Pressure, Force, etc.

System of units

F.P.S. system is the British system in which the basic units of length, mass and time are foot, pound and second respectively.

C.G.S. system is the metric system in which the basic units of length, mass and time are centimetre, gram and second respectively.

M.K.S system is another metric system in which the basic units of length, mass and time are metre, kilogram and second respectively.

S.I. units is referred to as Systems International units which is again of metric and the basic units, their names and symbols are Listed in table - 1

Table 1

Basic Quantity	Metric Unit		British unit	
	Name	Symbol	Name	Symbol
Length	Metre	m	Foot	F
Mass	Kilogram	kg	Pound	P
Time	Second	S	Second	S
Current	Ampere	A	Ampere	A
Temperature	Kelvin	K	Farenheit	F^o
Light intensity	Candela	Cd	Candela	Cd

Fundamental units and derived units are the two classification of units.

Length, mass and time are the fundamental units in all the systems (ie) F.P.S, C.G.S, M.K.S and S.I systems.

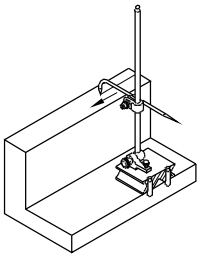
Surface gauges

Objectives: At the end of this lesson you shall be able to
- **state the uses of surface gauges**
- **name the types of surface gauges**
- **state the advantages of universal surface gauges.**
- **state care and maintenance of surface gauges**

The surface gauge is one of the most common marking tools used for:

scribing lines parallel to a datum surface (Fig.1)

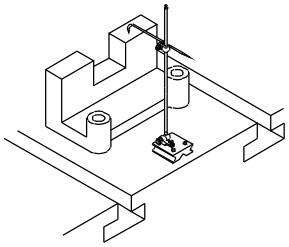
Fig 1



FIN'22011

Setting jobs on machines parallel to a datum surface (Fig.2)

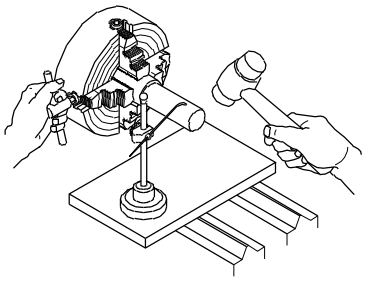
Fig 2



FIN'22012

Checking the height and parallelism of jobs, setting jobs concentric to the machine spindle. (Fig 3)

Fig 3



FIN'22013

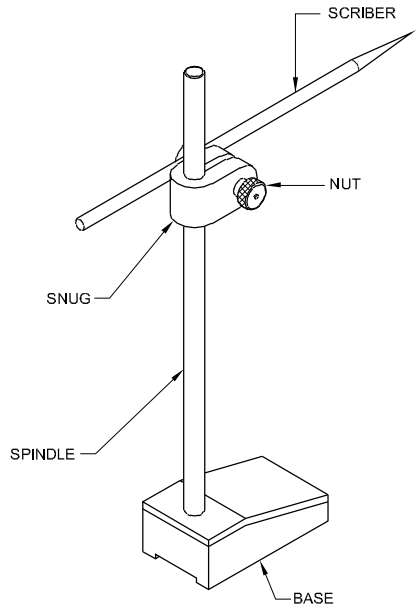
Types of surface gauges

Surface gauges/scribing blocks are of two types, fixed and universal.

Suface gauge - fixed type (Fig 4)

The fixed Type of surface gauge consists of a heavy flat base and a spindle, fixed upright, to which a scriber is attached with a snug and a clamp nut.

Fig 4

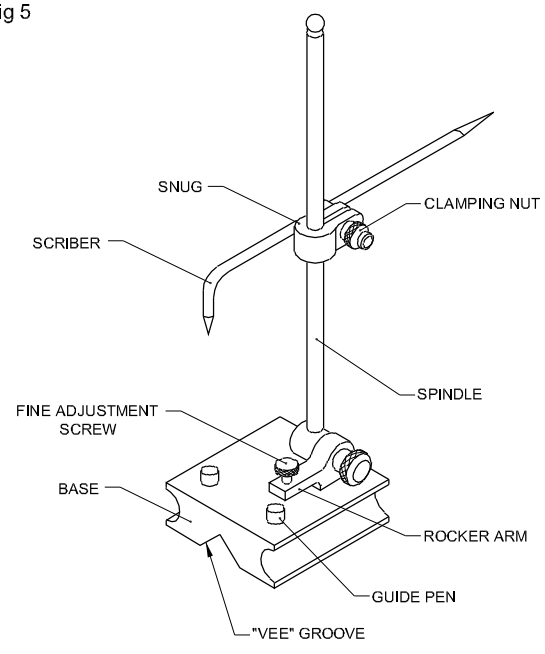


FIN'22014

Universal surface gauge (Fig 5)

This has the following additional features: The spindle can be set to any position. Fine adjustment can be made quickly. Can also be used on cylindrical surfaces.

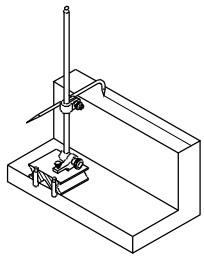
Fig 5



FIN'22015

Parallel lines can be scribed from any datum edge with the help of guide pins. (Fig 6)

Fig 6



FIN-22016

Parts and functions of a Universal Surface Gauge

Base

The base is made of steel or cast iron with a 'V groove at the bottom. The 'V' groove helps to seat on circular work.The guide-pins, fitted in the base, are helpful for scribing lines from any datum edge.

Rocker arm

The rocker arm is attached to the base along with a spring and a fine adjustment screw. This is used for fine adjustments.

Spindle

The spindle is attached to the rocker arm.

Scriber

The scriber can be clamped in any position on the spindle with the help of a snug and a clamping nut.

Care and maintenance

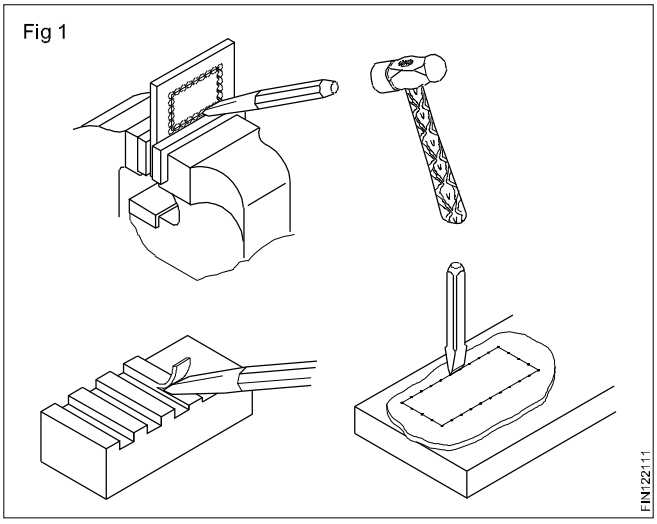
- Clean before and after the use
- Apply thin layer of oil to the bottom of the surface base before using for marking.
- Sharpen the Scriber if necessary.
- Do not exert more pressure while marking

Cold Chisel

Objectives: At the end of this lesson you shall be able to
- **list the uses of a cold chisel**
- **name the parts of a cold chisel**
- **state the different types of chisels**
- **specify the chisel**

The cold chisel is a hand cutting tool used by fitters for chipping and cutting off operations. (Fig 1)

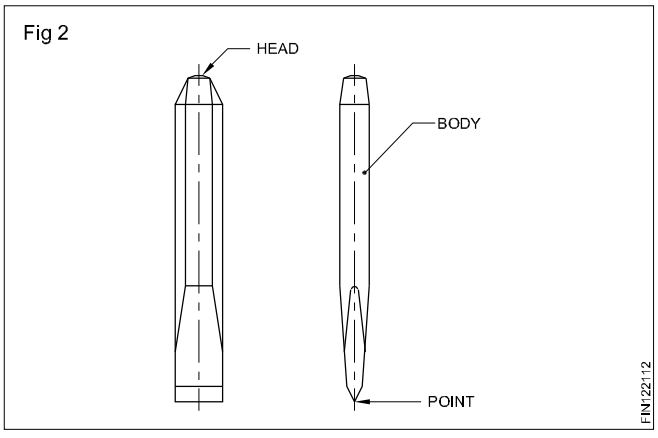
Fig 1



Chipping is an operation of removing excess metal with the help of a chisel and hammer. Chipped surfaces being rough, they should be finished by filing.

Parts of a Chisel (Fig 2)**:** A chisel has the following parts.

Fig 2



Head, body, point or cutting edge.

Chisels are made from high carbon steel or chrome vanadium steel. The cross-section of chisels is usually hexagonal or octagonal. The cutting edge is hardened and tempered.

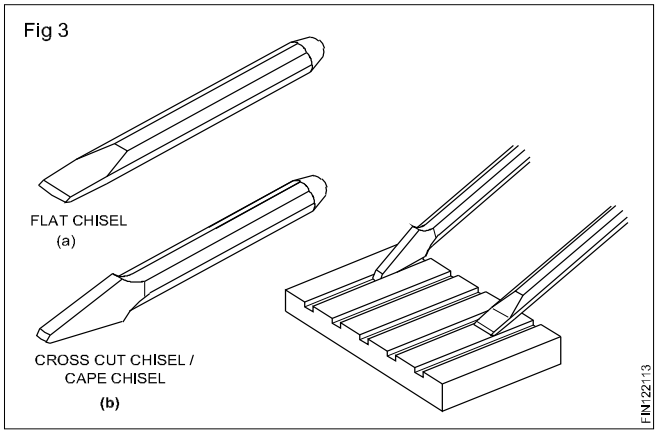
Common types of chisels: There are five common types of chisels.

– Flat chisel
– Cross-cut chisel
– Half-round nose chisel
– Diamond point chisel
– Web chisel

Flat chisels (Fig.3a)**:** They are used to remove metal from large flat surfaces and chip-off excess metal of welded joints and castings.

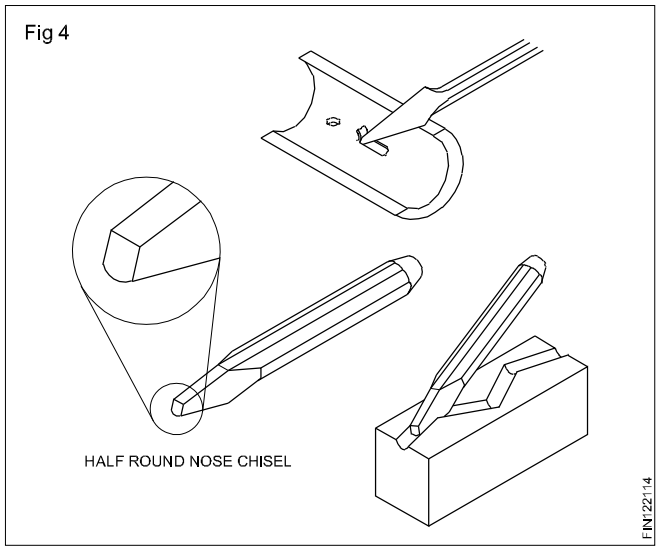
Cross-cut or cape chisels (Fig.3b)**:** These are used for cutting key ways, grooves and slots.

Fig 3

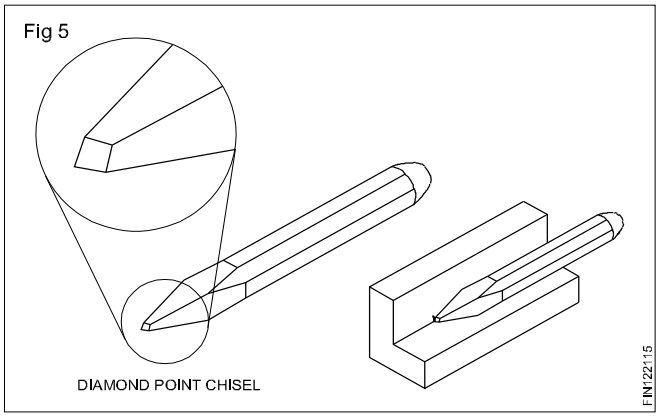


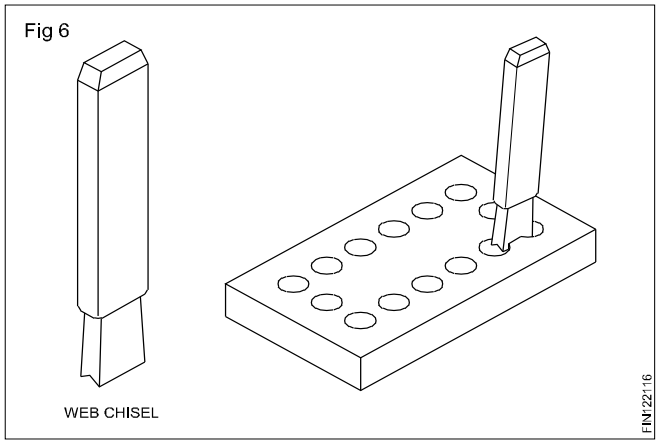
Half-round nose chisels (Fig 4)**:** They are used for cutting curved grooves (oil grooves).

Fig 4



Diamond point chisels (Fig 5)**:** These are used for squaring materials at the corners, joints.





Web chisels/ punching chisels (Fig 6)**:** These chisels are used for separating metals after chain drilling.

Chisels are specified according to their

– length

– width of the cutting edge

– type

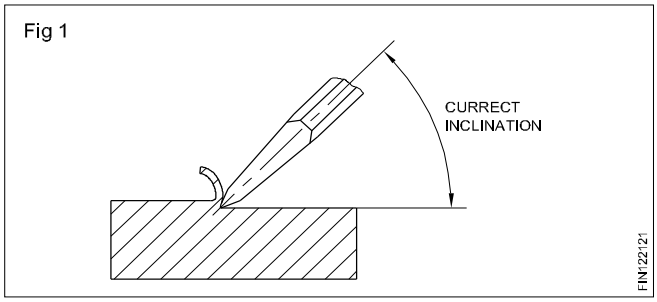
– cross-section of the body.

Angles of chisels

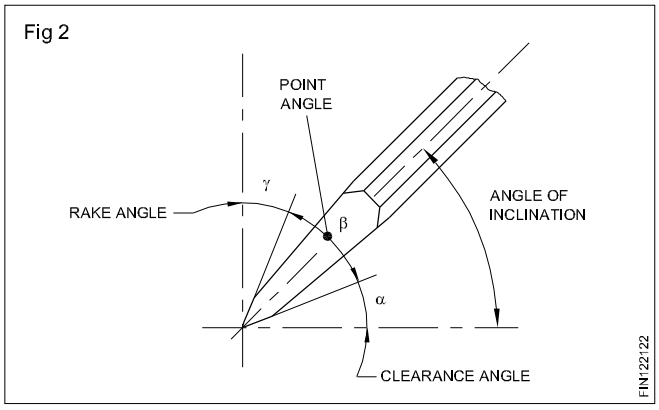
Objectives: At the end of this lesson you shall be able to
- **select the point angles of chisels for different materials**
- **state the effect of rake and clearance angles**
- **brief the care and maintenance of chisels.**

Point angles and materials: The correct point/cutting angle of the chisel depends on the material to be chipped. Sharp angles are given for soft materials, and wide angles for hard materials.

The correct point and angle of inclination generate the correct rake and clearance angles. (Fig 1)

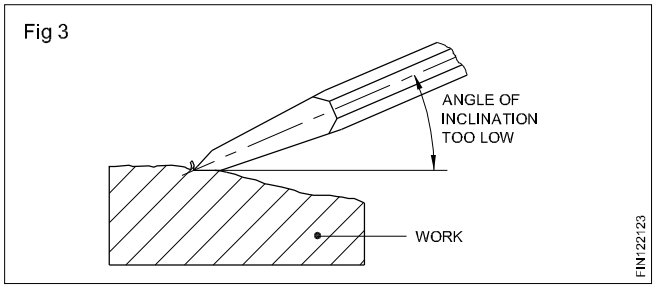


Rake angle: Rake angle is the angle between the top face of the cutting point, and normal (90°) to the work surface at the cutting edge. (Fig 2)

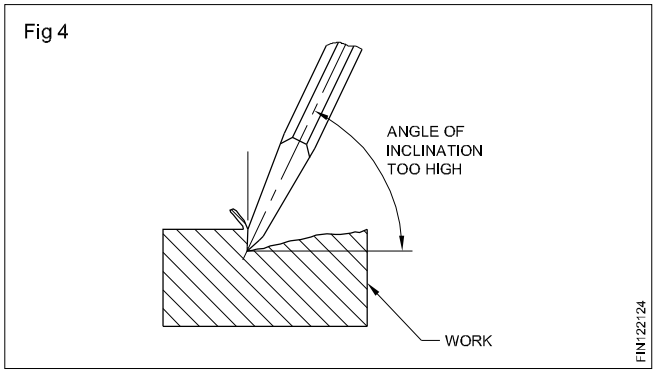


Clearance angle: Clearance angle is the angle between the bottom face of the point and the tangent to the work surface originating at the cutting edge. (Fig 2)

If the clearance angle is too low or zero, the rake angle increases. The cutting edge cannot penetrate into the work. The chisel will slip. (Fig 3)



If the clearance angle is too great, the rake angle reduces. The cutting edge digs in and the cut will become deeper and deeper. (Fig 4) The correct point angle and angle of inclination for different materials for chipping is given in Table 1.



Crowning: A slight curvature is ground called “Crowning” to the cutting edge of the chisel, to prevent digging of corners, which leads to breakage of chisel point. “Crowning” allows the chisel to move freely along a straight line while chipping.

Table 1

Material to be cut	Point angle	Angle inclination
High Carbon Steel	65°	39.5°
Cast iron	60°	37°
Mild steel	55°	34.5°
Brass	50°	32°
Copper	45°	29.5°
Aluminium	30°	22°

Care & maintenance

- Sharpen the chisel before use.
- Apply oil to avoid rust.
- Don't use the mushroom head chisel.
- Use safety goggles while chipping.
- While chipping.
- No greasy subject on the head of the chisel.

Ordinary depth gauge

Objectives: At the end of this lesson you shall be able to
- **state the uses of ordinary depth gauge**
- **name the parts of depth gauge.**

Ordinary depth gauge

Ordinary depth gauge is semi precision instrument used for measuring of depth of recesses, slots and steps.

Parts of ordinary depth gauge

1 Graduated beam

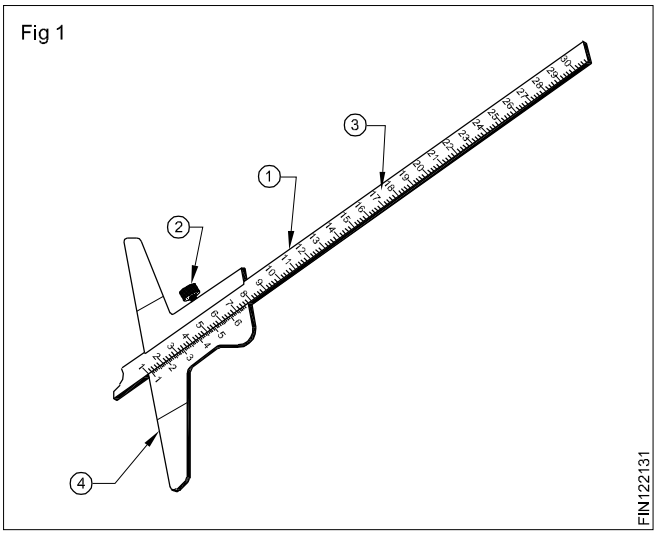
2 Clamping screw

3 Scale

4 Base

Available in the ranges of 0-200 mm. Ordinary depth gauge is used to measure an accuracy of 0.5 mm.

Fig 1



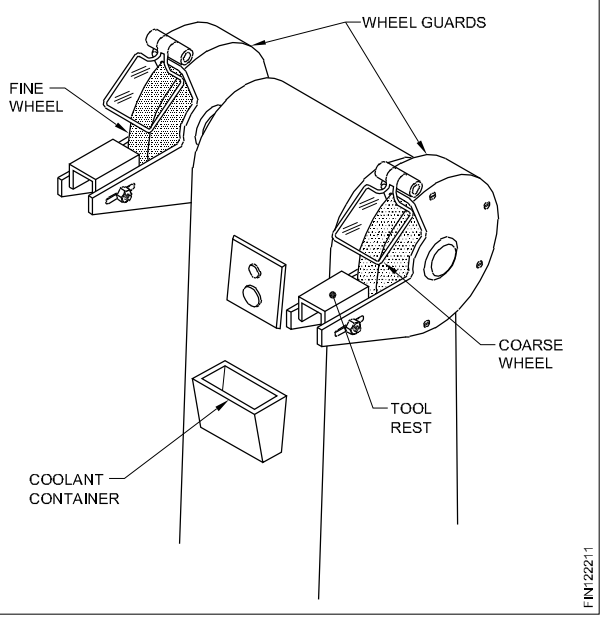
Sharpening of chisels

Objective: At the end of this lesson you shall be able to
- **state the procedure for resharpening the cold chisels on pedestal grinding machines.**

Chisels will become blunt due to use. For efficiency in chipping. the chisels are to be re-sharpened regularly.

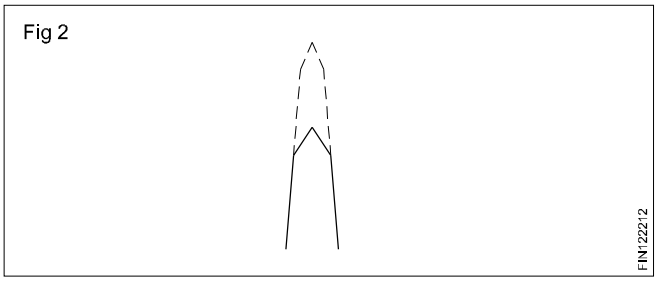
Chisels are sharpened on grinding machines. (Fig 1)

Fig 1



After re-grinding many times, the cutting edges become too thick. Such chisels are unsuitable for resharpening. They should be forged and brought to shape before grinding. (Fig 2)

Fig 2



Before commencing grinding, the following procedure should be observed.

Ensure the wheel guards are in place, and are securely fastened.

Inspect the condition of the grinding wheel for breakage and cracks.

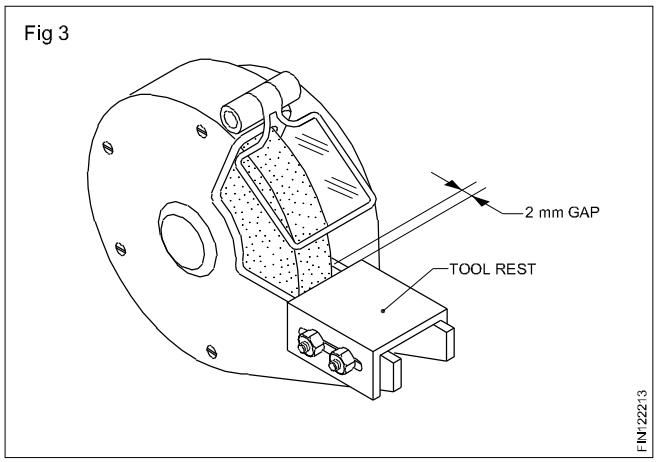
Wear safety goggles.

When switching on the grinding machine, stand aside untill the wheel reaches the operating speed.

Inspect the tool rest

If there is too much of gap between the tool-rest and the wheel, adjust it, and position it as close to the wheel as possible. (Fig.3)

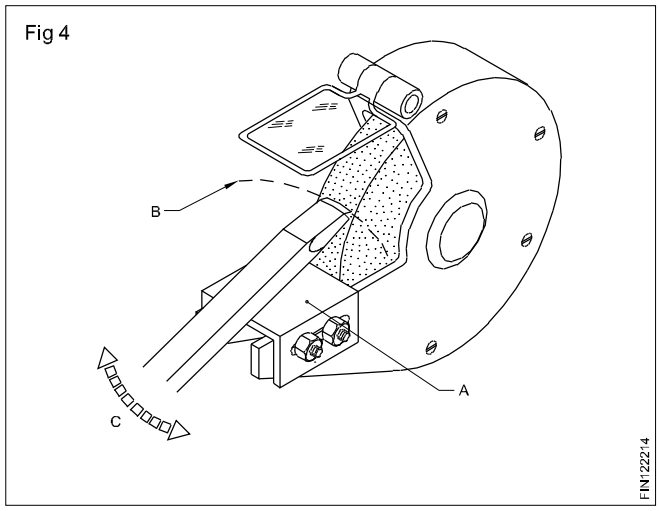
Fig 3



Ensure that there is sufficient coolant in the container.

While grinding, rest the body of the chisel on the tool-rest (A) and allow the point to touch the wheel. (Fig. 4)

Fig 4



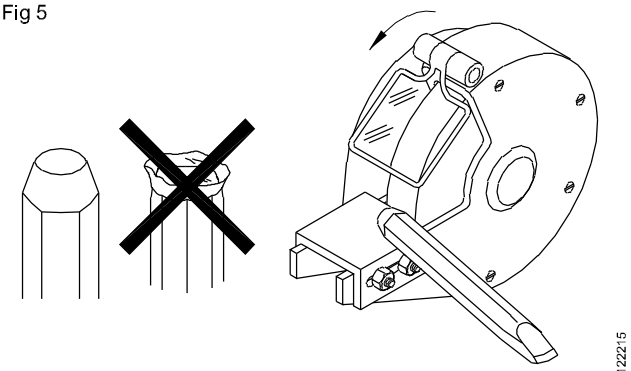
Rock the point slightly on both sides in an arc (B) to provide a slight convexity at the cutting edge. This will help to avoid digging in the sides while chipping. (Fig 4)

Keep moving the chisel across the face (C) of to Prevent formation of curves and grooves at the cutting edge.

Dip the chisel frequently in the coolant to avoid overheating. Overheating will draw the temper of the chisel.

If the chisel-head is mushroomed, it should be cleaned by grinding. (Fig 5)

Fig 5



FIN1222215

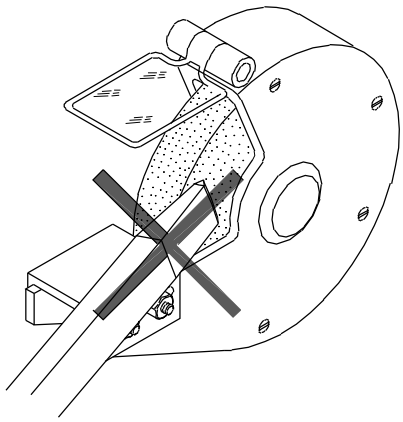
Use only the front of the grinding wheel. (Fig 4) Do not grind on the sides. (Fig 6)

Use goggles while using a grinder

Any damage to the grinding wheel, if noticed should be reported to the instructor.

Do not use cotton waste or other material for holding the chisel while grinding.

Fig 6



FIN1222216