## Marking material

**Objectives:** At the end of this lesson you shall be able to
- **name the common types of marking material**
- **select the correct marking material for different applications.**

### Common types of Marking Materials

The common marking materials are Whitewash, Cellulose Lacquer, Prussian Blue and Copper Sulphate.

### Whitewash

Whitewash is prepared in many ways.

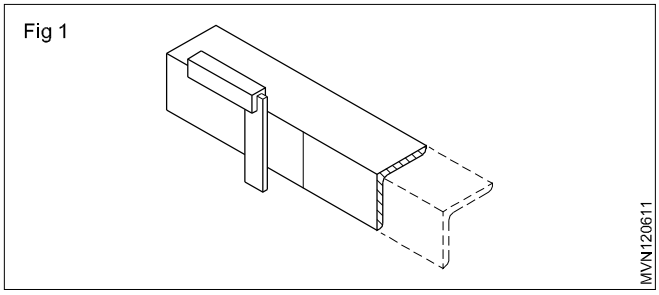
Chalk powder mixed with water

Chalk mixed with methylated spirit

White lead powder mixed with turpentine

Whitewash is applied to rough forgings and castings with oxidised surfaces. (Fig 1)

Fig 1




Whitewash is not recommended for workpieces of high accuracy.

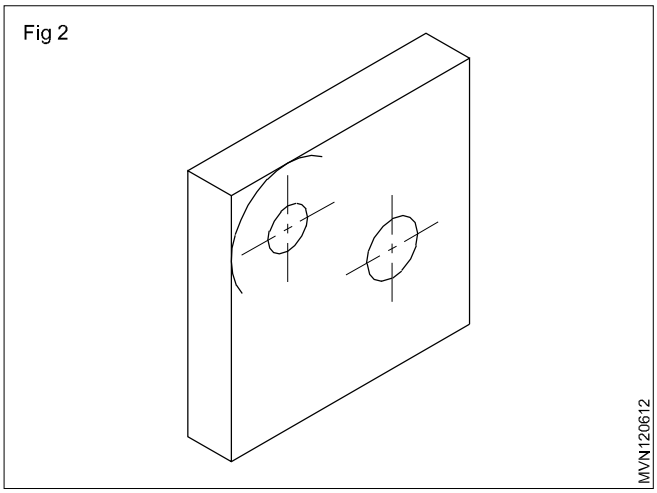
### Cellulose Lacquer

This is a commercially available marking medium. It is made in different colours, and dries very quickly.

### Prussian Blue

This is used on filed or machine-finished surfaces. This will give very clear lines but takes more time for drying than the other marking media. (Fig 2)

Fig 2




### Copper Sulphate

The solution is prepared by mixing copper sulphate in water and a few drops of nitric acid. The copper sulphate is used on filed or machine-finished surfaces. Copper sulphate sticks to the finished surfaces well.

Copper sulphate needs to be handled carefully as it is poisonous. Copper sulphate coating should be dried well before commencing marking as, otherwise, the solution may stick on the instruments used for marking.

The selection of marking medium for a particular job depends on the surface finish and the accuracy of the workpiece.

## Cleaning tools

**Objectives:** At the end of this lesson you shall be able to
- **state the different types of Cleaning Tools and their use**
- **state the precautions to be observed in the use of Cleaning Tools.**

Mechanical Cleaning Involves, brushing and abrasive Cleaning. It should be used very carefully on soft metals. Heavy deposits that exists even after chemical Cleaning can be removed by mechanical cleaning.

### The General Cleaning Tools are

1) Wire brushes

2) Emery sheets.

### Wire Brushes

Wire brushes are generally used for cleaning the work surfaces.

It is made of steel wires (or) Nylon bristles fitted on a wooden piece.

The steel wires are hardened and tempered for long life to ensure good cleaning action. Different types of wire brushes is shown in Fig 1.

**Applications**

1 Wire brushes can be used for cleaning uneven Surfaces

2 A hand wire brush can be used on exterior of the block and on the head.

3 A round wire brush fixed with a hand drill motor spindle can be used for cleaning of combustion chamber and parts of the head.

4 A wire wheel can be used to clean the valves.

5 Nylon bristles with impregnated abrasive brush can be used for Engine boring

6 A washing brush can be used to clean the cylinders by using Soap and Water.

7 Oil passages of cylinder block can be cleaned by running a long bottle type brush through all holes in the cylinder block.

8 It is used to clean work surface before and after welding

**Safety precautions**

Steel wire brushes should be used carefully on soft metals.

It should not make any scratches on the finished surface.

**EMERY Sheet (**Fig 2**)**

This is a type of paper used for sanding down hard and rough surfaces and also used for resistant technology purposes to give a smooth, shiny finish to manufactured products.

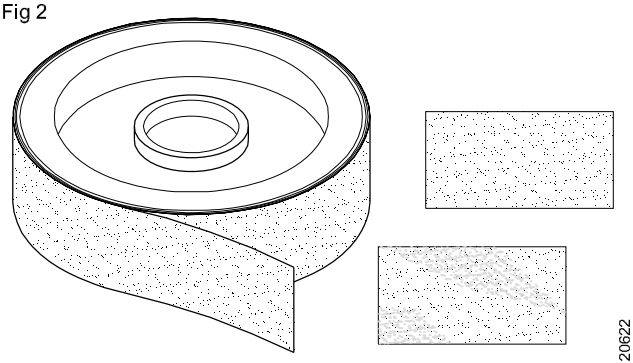
Emery paper is defined as a paper coated with abrasive particles in one side and used to produce smooth, shiny finish to manufactured products.

**Description**

The each and every abrasive particle act as a cutting edge. The emery is considered for a suitable abrasive for workshop practices and the final adjustment of steel parts for a perfect fit. The emery paper is also used for cleaning, to remove rust from polished metal components.

The emery is graded by numbers and the Common sizes are from coarse to fine: 40, 46, 54, 60, 70, 80, 90. 100. 120, F and FF.

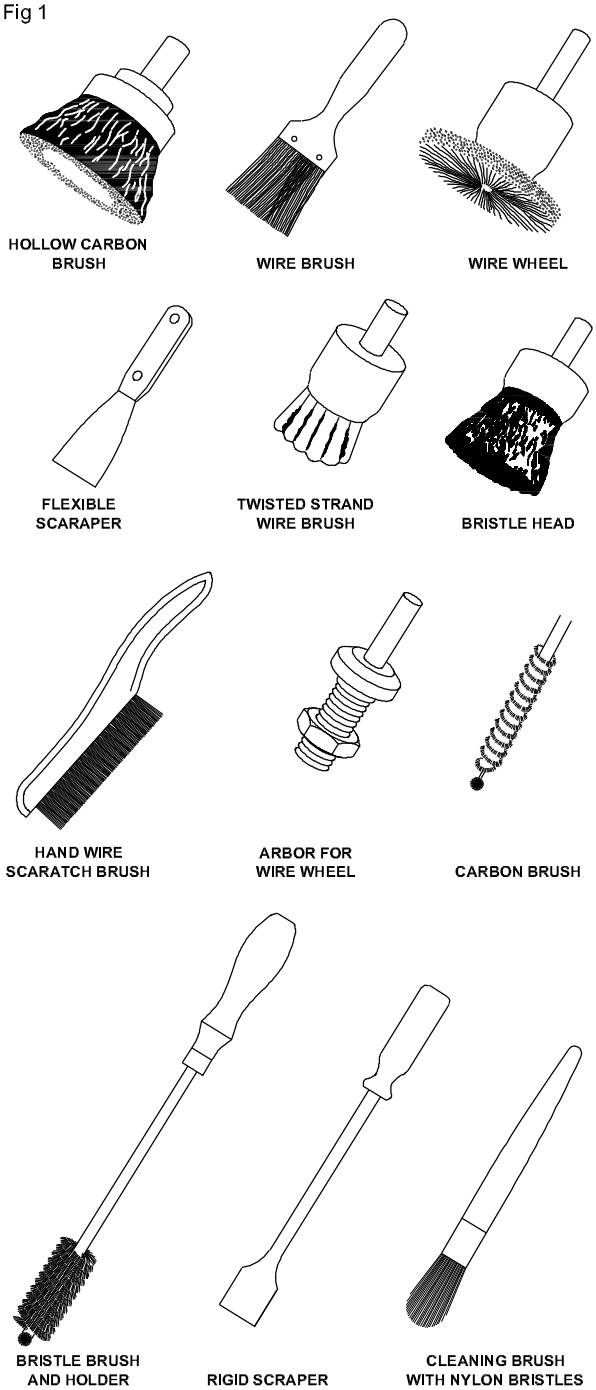
Fig 2



EMERY SHEET

MVN120622

Fig 1




CLEANING TOOLS

MVN120621

**Safety Precautions**

**After cleaning with emery paper, component should be rinsed properly.**

# Scraper

**Objectives:** At the end of this lesson you shall be able to
- **name the different type of scrapers**
- **state the features of each type of scraper**
- **state the precaution to be observed while uses scraper.**

Scraper is a hand tool which is used to scrap the workpiece surface by removing the smallest metal particles.

### Application

It is used to obtain a smooth non scored and uniformly bearing surface which is required for sealing, sliding and guiding surface.

In automobiles it is used to remove carbon particles from cylinder head, piston head and manifold pipes

It is also used to scrap the bearings of cranks halt and sometimes the cylinder liner.

### Type of scrapers

1 Flat scraper

2 Special scraper

### Flat scraper

The cross section of this scraper is Flat. The cutting edge has Flat surface.

### Use

It is used to scrap the high spots of a flat Surface

### Special Scraper

Special scraper is available for scraping and finishing curved surfaces.

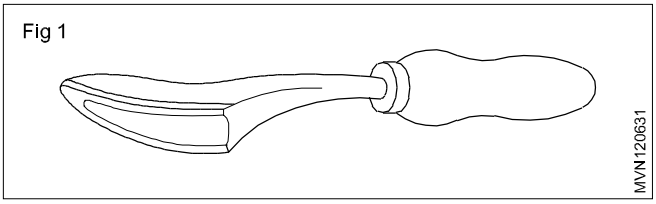
They are

- half round scraper
- three-square scraper
- bull nose scraper

### Half round scraper

The cross- section of this scraper is a segment and it tapers to a rounded point (Fig 1)

Fig 1

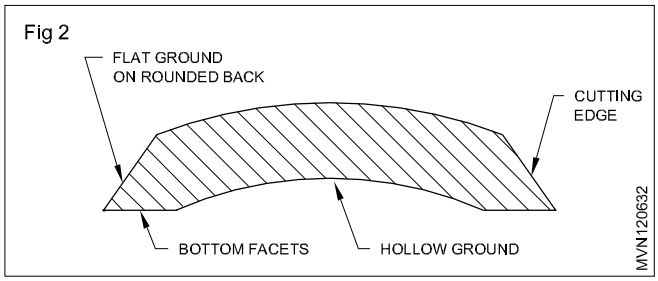



The round bottom face is curved and is hollow in the middle.

The bottom facet and the flat surfaces are ground along the edge to form the cutting edge. (Fig 2)

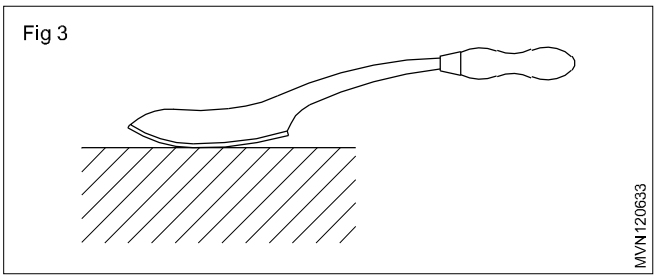
The cutting angle is between $45^0$ and $65^0$.

Fig 2




The curvature at the cutting edge helps to make point contact while scraping, and also helps to remove small spots. (Fig 3)

Fig 3

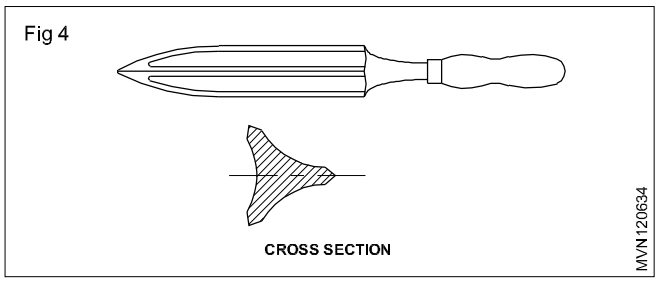



**Three- square scraper** (Fig 4)

This scraper is used for scraping small diameter holes and deburring the edges of holes.

The cross-section of this is triangular. This has more number of cutting edges and the hollow portion between the cutting edges helps in re-sharpening easily.

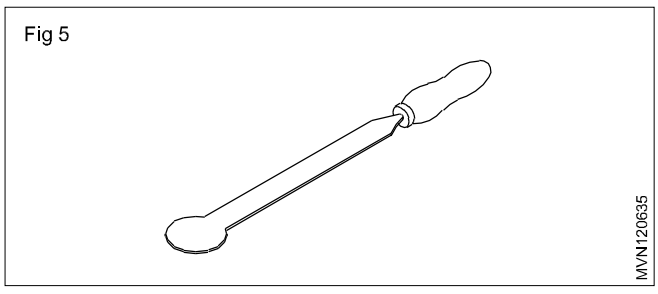
Fig 4




**Bull nose scraper** (Fig 5)

This scraper has the cutting edge shaped into a flat circular disc. The cutting edge forms about two thirds of the circle.

Fig 5



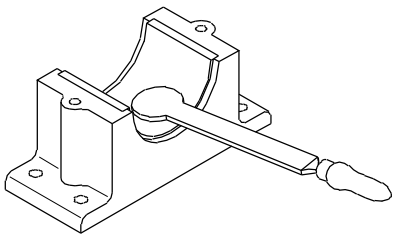
It is useful for scraping large bearings. (Fig 6) This scraper can be used in a longitudinal direction like a flat scraper or with a circumferential movement like a half round scraper. This dual action helps to prevent ridges on the scraped surfaces.

**Always use scrapers with firmly fitted handles.**

**Protect the cutting edges with a rubber cover when not in use.**

**Apply oil or grease on the cutting edges when not is use.**

Fig 6



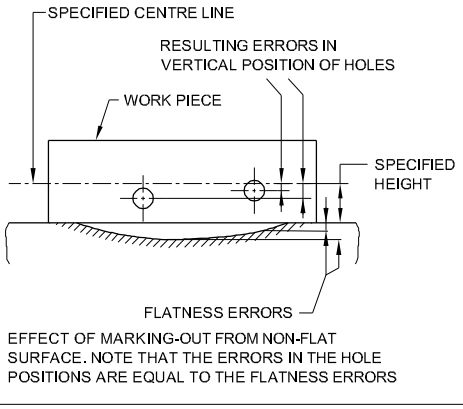

## Surface plates

**Objectives:** At the end of this lesson you shall be able to
- **state the constructional features of surface plates**
- **state the application of different grades of surface plates**
- **specify surface plates and state the uses of marking tables.**

### Surface plates - their necessity

When accurate dimensional features are to be marked or to be checked it is essential to have a datum plane with a perfectly flat surface. Marking using datum surfaces which are not perfectly flat will result in dimensional inaccuracies. (Fig 1) The most widely used datum surfaces in machine shop work are the surface plates and marking tables.

Fig 1

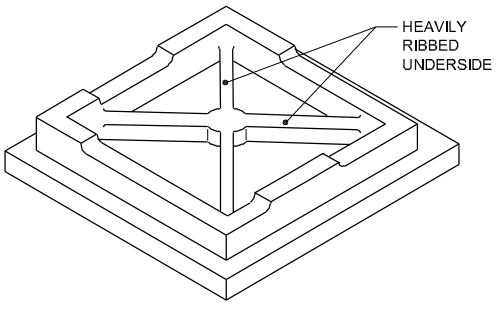



EFFECT OF MARKING-OUT FROM NON-FLAT SURFACE. NOTE THAT THE ERRORS IN THE HOLE POSITIONS ARE EQUAL TO THE FLATNESS ERRORS

### Materials and construction

Surface plates are generally made of good quality cast iron which are stress-relieved to prevent distortion. The work-surface is machined and scraped. The underside is heavily ribbed to provide rigidity. (Fig 2)

Fig 2




CAST IRON SURFACE PLATE

For the purpose of steadiness and convenience in leveling. a three point suspension is given.

Smaller surface plates are placed on benches while the larger surface plates are placed on stands.

### Other materials used

Granite is also used for manufacturing surface plates. Granite is a dense and stable material. Surface plates made of granite retain their accuracy, even if the surface is scratched. Burrs are not formed on these surfaces.

### Classification and uses

Surface plates used for machine shop work are available in three grades - Grades 1, 2 and 3. The grade 1 surface plate is more acceptable than the other two grades.

### Specifications

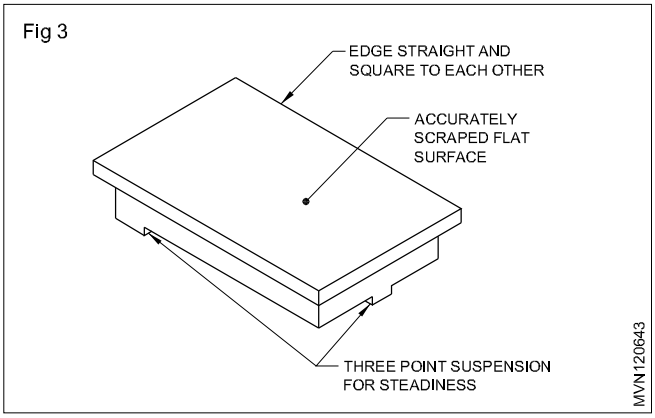
Cast iron surface plates are designated by their length, breadth, grade and the Indian Standard number.

### Example

Cast iron surface plate 2000 x 1000 Gr1. I.S.2285.

### Marking-off tables (Fig 3)

Fig 3



# Wheelbase, wheel track and measuring tape

**Objectives:** At the end of this lesson you shall be able to
- **define wheelbase**
- **define wheeltrack**
- **state measuring tape, its types and uses.**

The wheelbase of a vehicle equals the center distance between its front and rear wheels. (Fig 1)

Wheel/Track : The wheeltrack of a vehicle equals the center distance between its front wheels. As shown in the diagram. (Fig 4)

Measuring tape is a flexible ruler. It is made of ribbon cloth plastic fiber glass metal strip with lines for measurements. It is very common measuring tool used by many people. The available range are 3m, 5m and 10m.

**Types**

1. Plastic Tape (Fig 3)
2. Metal Tape (Fig 2)
3. Fibre glass
4. Ribbon cloth

Fig 1

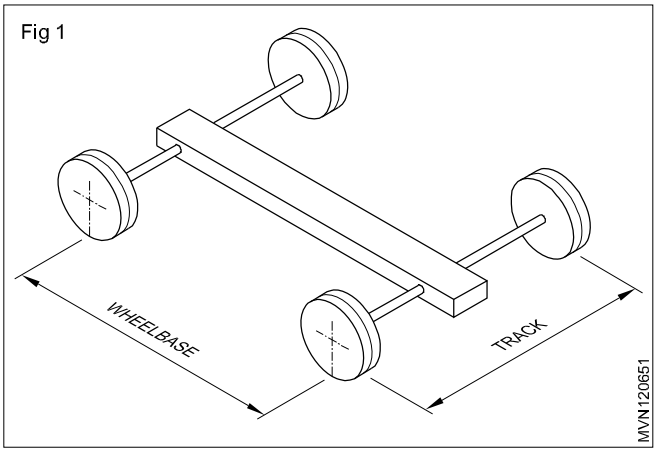



Fig 2

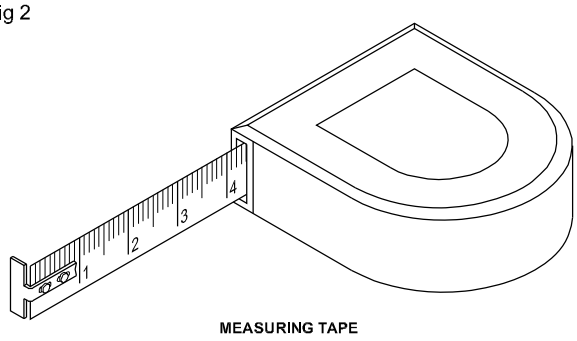



Fig 3

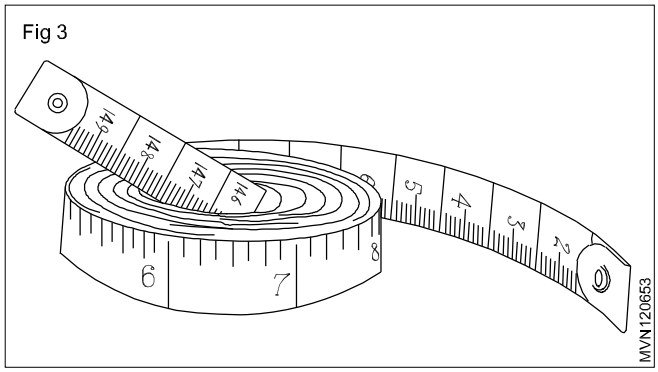
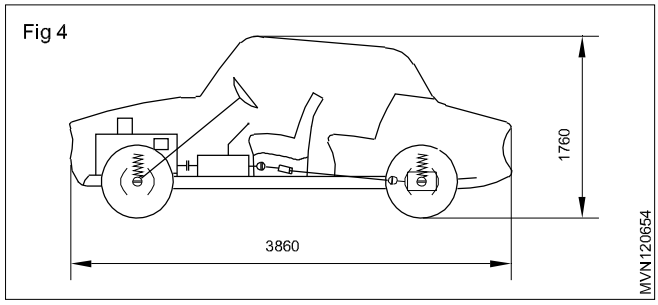



Fig 4




**Application**

Dress makers

Civil Engineers

Mechanical Engineers

Surveyors

Carpenters

Medical field

**Accuracy**

Measuring tapes are marks in metric and British system. The accuracy in metric system is 1mm and in British system is 1/8".

Limitation: Accuracy is not possible, because the tape is flexible and likely to elongate while measuring long ranges and distances.

## Length measurement

**Objectives:** At the end of this lesson you shall be able to
- **name the base unit length measurement as per the International system of units of measurement (SI)**
- **state the multiples of a metre and their values.**

When we measure an object, we are actually comparing it with a known standard of measurement.

The base unit of length as per SI is the METRE Length SI UNIT and MULTIPLES

**Base Unit**

The base unit of length as per the System International is the metre. The table given below lists some multiples of a metre.

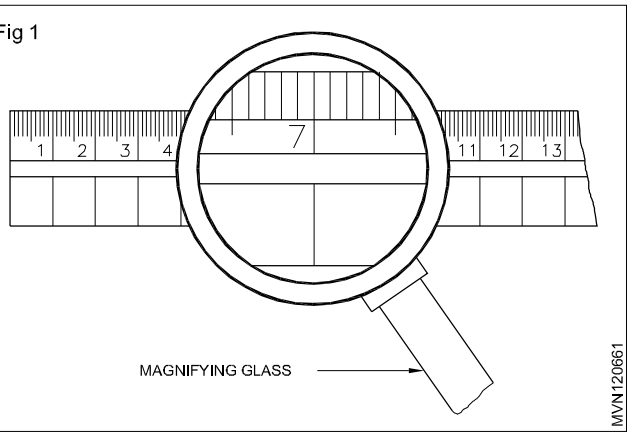
| | | |
|---|---|---|
| METRE (m) | = | 1000 mm |
| CENTIMETRE(cm) | = | 10 mm |
| MILLIMETRE (mm) | = | 1000 mm |
| MICROMETRE (m) | = | 0.001 mm |

**Measurement in engineering practice**

Usually, in engineering practice, the preferred unit of length measurement is the millimetre (Fig. 1).

Both large and small dimensions are stated in millimetres

Fig 1




**The British system of length measurement**

An alternative system of length measurement is the British system. In this system, the base unit is the Imperial Standard Yard. Most countries, including Great Britain itself, have, however, in the last few years, switched over to SI units.

However in a regular Steel rule & in vernier caliper the main scale readings of metric in the bottom and imperial in inches in the top with corresponding vernier scales.

## Engineer's steel rule

**Objectives:** At the end of this lesson you shall be able to
- **state the constructional features of an engineer's steel rule**
- **explain the uses of a steel rule**
- **state the maintenance aspects to be considered in respect of steel rules.**

When dimensions are given in a drawing without any indication about the tolerance, it has to be assumed that measurements are to be made with a steel rule.

Steel rule are made of spring steel or stainless steel. The edges are accurately ground to form straight edges.

The surface of the steel rule is satin-chrome finished to reduce glare, and to prevent rusting.

**Sizes of steel rules (Fig.1)**

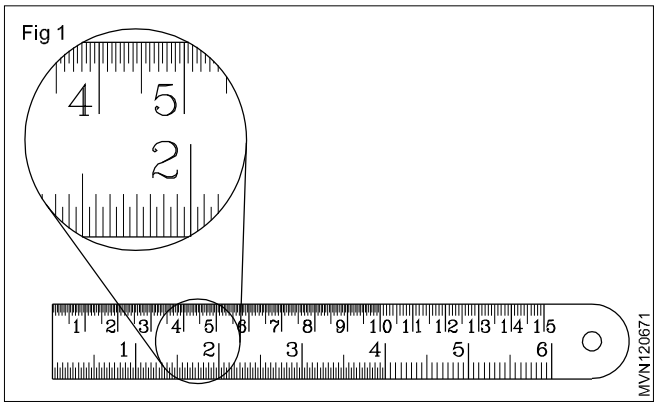
Steel rules are available in different length, the common sized being 150mm, 300 mm and 600 mm.

The engineer's steel rule is graduated in 10 mm, 5 mm, 1mm and 0.5 mm.

The reading accuracy of the steel rule is 0.5 mm.

These are heavily ribbed cast iron tables fitted with strong rigid legs. The top surface is accurately machined flat, and the sides square.

Fig 1




These are used for carrying out marking on heavy components. On certain types-parallel lines are engraved in both directions at a set distance.

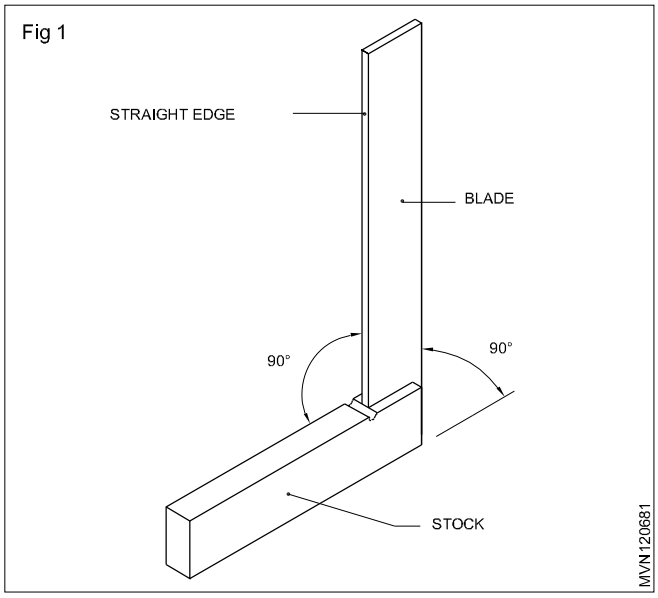
These lines serve as guides for positioning components while setting and marking.

# Try square

**Objectives:** At the end of this lesson you shall be able to
- **name the parts of a try square**
- **state the uses of a try square.**

The try square (Fig.1) is a precision instrument which is used to check squareness (angles of $90^0$) of a surface.

Fig 1

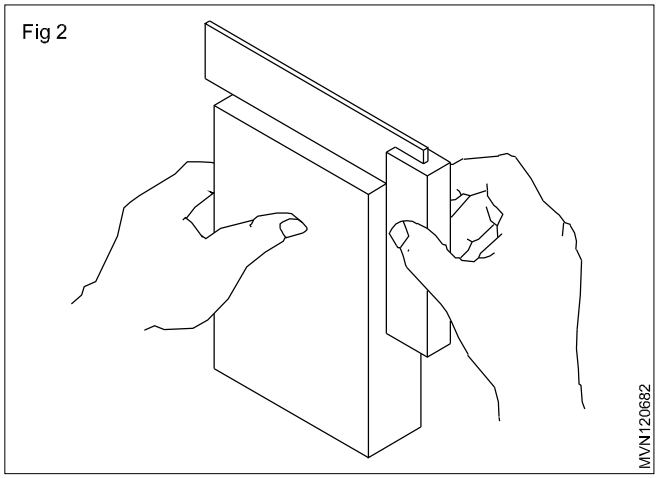



The accuracy of measurement by a try square is about 0.002 mm per 10 mm length, which is accurate enough for most workshop purposes. The try square has a blade with parallel surfaces. The blade is fixed to the stock at $90^0$.

**Uses**

The try squareness is used (Figs 2 & 3)

Fig 2




- check flatness of surfaces (Fig. 3)
- mark lines at $90^0$ to the edges of workpieces (Fig. 4)
- set workpieces at right angles on work, holding devices. (Fig. 5)

Try squares are made of hardened steel.

Try squares are specified according to the lengths of the blade, i.e 100 mm, 150 mm, 200 mm.

Use of a try square and steel rule.

Fig 3

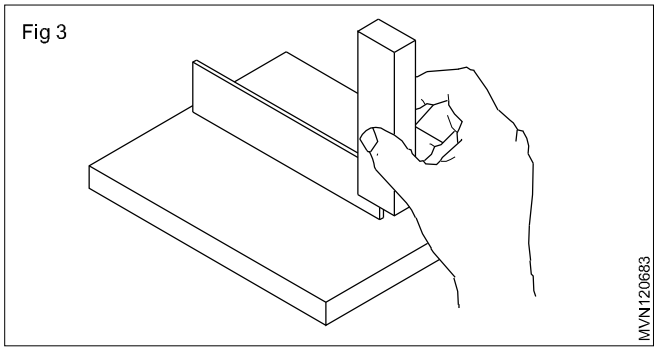



Fig 4

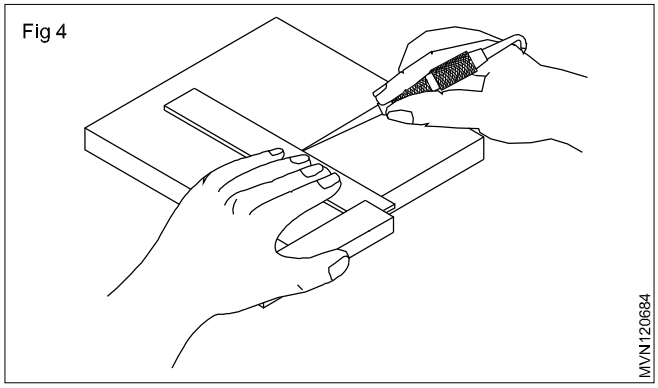



Fig 5

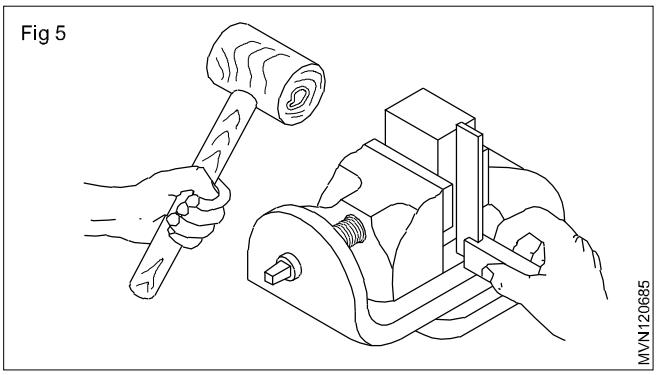
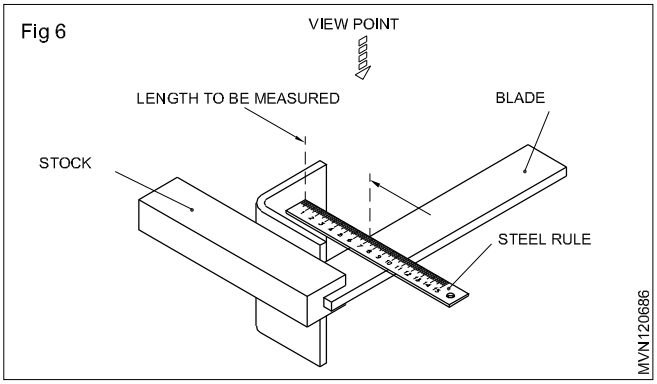



Fig 6 shows the method of using a try square and a steel rule for accurate measurements.

Fig 6




**For maintaining accuracy it is important to see it, that the edges and surfaces of instruments are protected from damage and rust.**

An experienced person can transfer measurements from a steel rule very accurately.

The steel rule graduations are accurately engraved, with the line thickness ranging from 0.12 to 0.18 mm.

Do not place a steel rule with any cutting tools. Apply a thin layer of oil when not in use.

For Accurate reading it is necessary to read vertically to avoid errors due to parallax

## Types of calipers

**Objectives:** At the end of this lesson you shall be able to
- **name the commonly used calipers**
- **compare the features of firm joint and spring joint calipers**
- **state the advantage of spring joint calipers**
- **state the uses of inside and outside calipers.**

Calipers are simple measuring instruments used to transfer measurements from a steel rule to objects, and vice versa.

Calipers are of different types depending on the type of joint and the shape of leg.

**Types of joint**

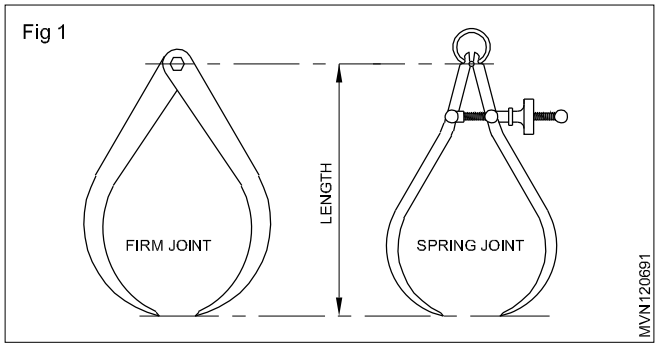
The commonly used calipers are:

- firm joint calipers
- spring joint calipers.

**Firm Joint calipers (Fig. 1)**

In the case of firm joint calipers, both legs are pivoted at one end. To take measurements of a workpiece. It is opened roughly to the required size. Fine setting is done by tapping the caliper lightly on a wooden surface.

Fig 1



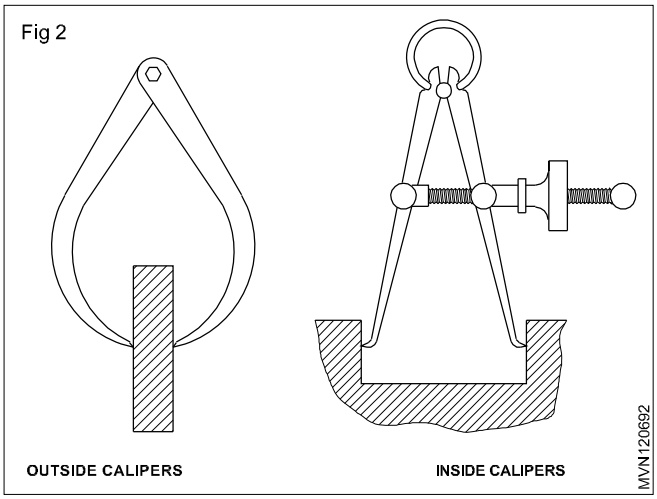

**Spring joint calipers (Fig. 2)**

For this type of calipers, the legs are assembled by means of a pivot loaded with a spring. For opening and closing the caliper legs, a screw and nut are provided.

Spring joint calipers have the advantage of quick setting. The setting made will not change unless the nut is turned. The size of a caliper is specified by its length - which is the distance between the pivot centre and the tip of the leg.

The accuracy of the measurement taken depends very much on the sense of feel an touch. While measuring the job, you should get the feel when the legs are just touching the surface.

Fig 2



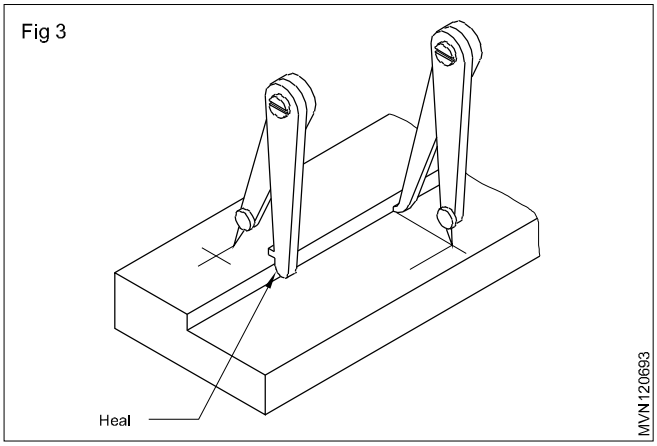

**Types of legs**

Outside and inside calipers are differentiated by the shape of the legs.

Calipers used for outside measurements are known as outside calipers. The calipers used be internal measurements are known as inside calipers.

Calipers are use along with steel rules, and the accuracy is limited to 0.5 mm; parallelism of jobs etc. can be checked with higher accuracy by using a caliper.

Fig 3

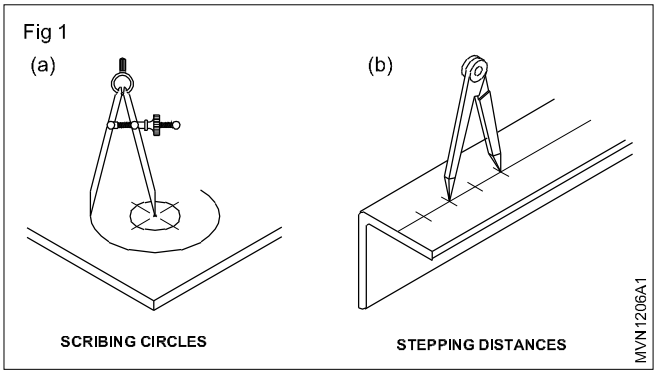



Jenny calipers are used for marking lines on inside and outside edges.

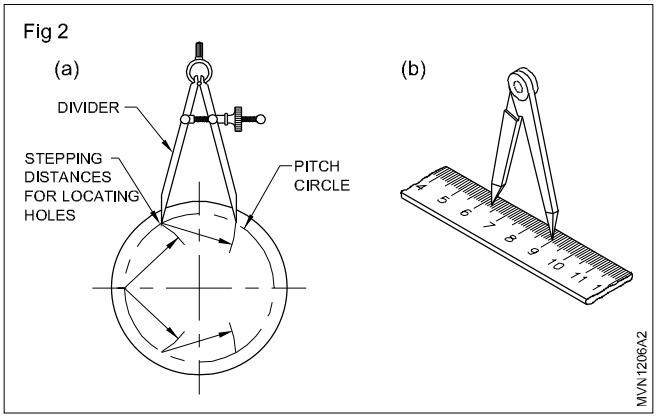
# Dividers

**Objectives:** At the end of this lesson you shall be able to
- **name the parts of a divider**
- **state the uses of dividers**
- **state the specifications of dividers**
- **state the important aspects of be considered in respect of divider points.**

Dividers are used for scribing circles, arcs and transferring and stepping of distances. (Figs 1 a,b)

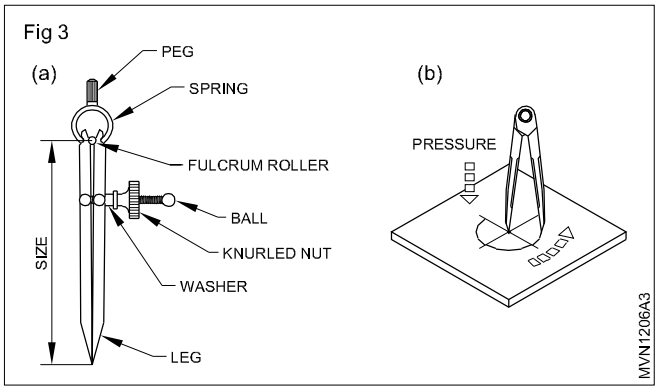



Dividers are available with firm joints and spring joints. The measurements are set on the dividers with a steel rule. (Fig 2 a,b)




The sizes of dividers range between 50 mm to 200 mm. The distance from the point to the centre of the fulcrum roller (pivot) is the size of the divider. (Fig 3a)

For the correct location and seating of the divider legs, prick punch marks of 30° are used. (Fig 3b)




Both the legs of the divider should always be of equal length.

Dividers are specified by the type of their joints and length.

The divider point should be kept sharp in order to produce timelines. Frequent sharpening with an oil stone is better than sharpening by grinding. Sharpening by grinding will make the points soft.

**Do not sharpen the divider points on grinding wheels.**

# Surface Gauges

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

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

scribing lines parallel to a datum surface

Types of surface gauges

- Surface gauges/scribing blocks are of two types.
- Fixed
- Universal (Fig.1)

**Surface gauge-fixed type (Fig.2)**

- setting jobs on machines parallel to a datum surface
- checking the height and parallelism of jobs
- setting jobs concentric to the machine spindle.

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.

**Universal surface gauge (Figs 3&4)**

This has the following additional features.

- The spindle can be set to any position.
- Fine adjustments can be made quickly.
- can also be used on cylindrical surfaces.

Fig 1

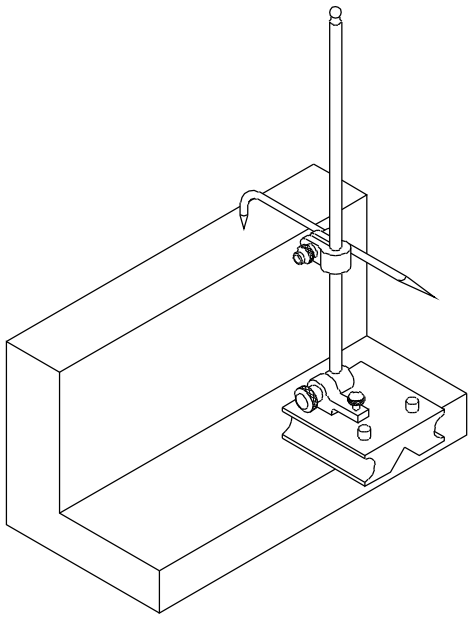


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Fig 2

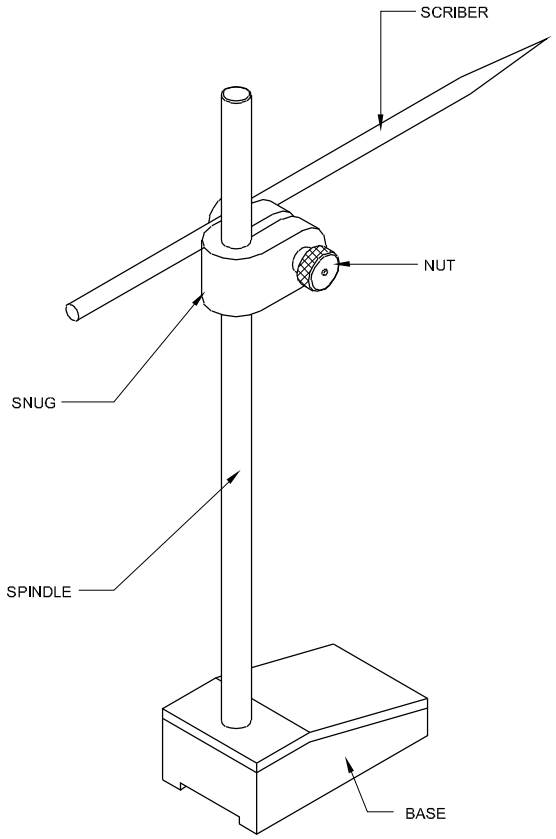


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Fig 3

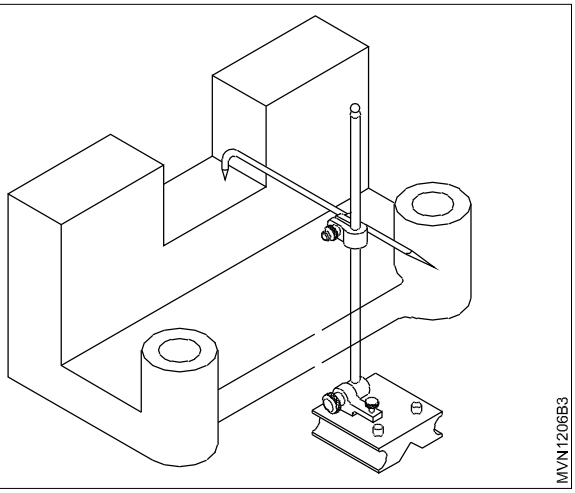

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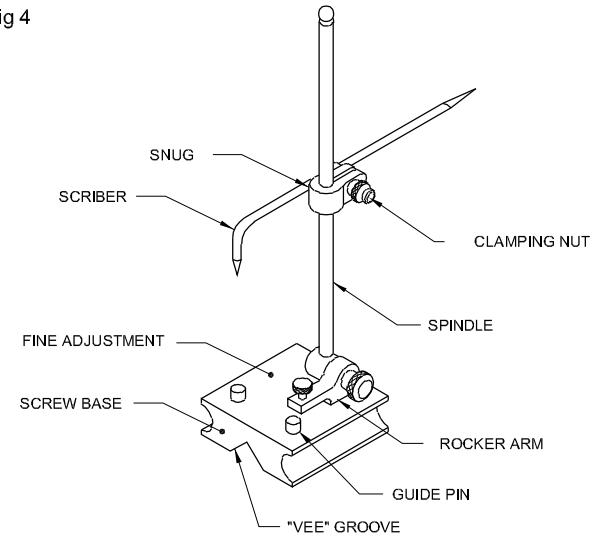
Fig 4




UNIVERSAL SURFACE GAUGE

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## Scriber

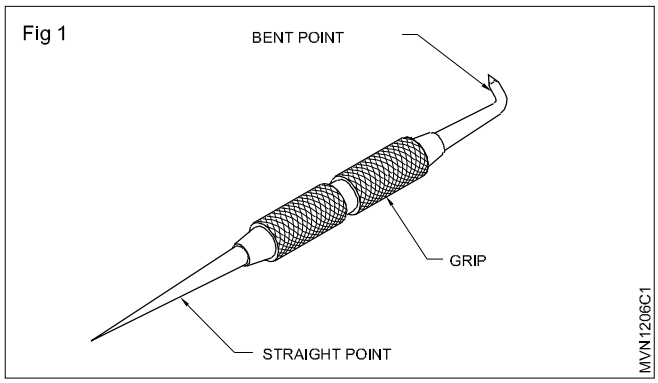
**Objectives:** At the end of this lesson you shall be able to
- **state the features of scribers**
- **state the uses of scribers.**

In layout work, it is necessary to scribe lines to indicate the dimensions of workpieces to be filed or machined .

The scriber is a tool used for this purpose. It is made of high carbon steel which is hardened. For drawing clear and sharp lines, a fine point is ground at one end.

Scribes are available in different shapes and sizes. The one most commonly used is the plain scriber (Fig.1).

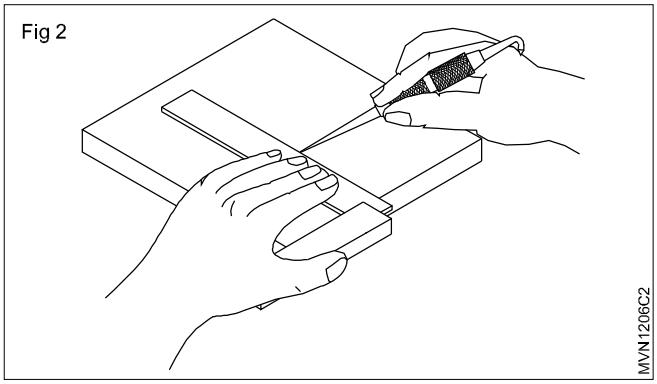
Fig 1




While scribing lines, the scriber is used like a pencil so that the lines drawn are close to the straight edge (Fig.2).

The point of the scriber should be ground and honed frequently for maintaining its sharpness.

Fig 2




**Scriber points are very sharp, and they are to be handled very carefully. Do not put the scriber in your pocket. Place a cork on the point when not in use to prevent accidents. (when it is not in use)**

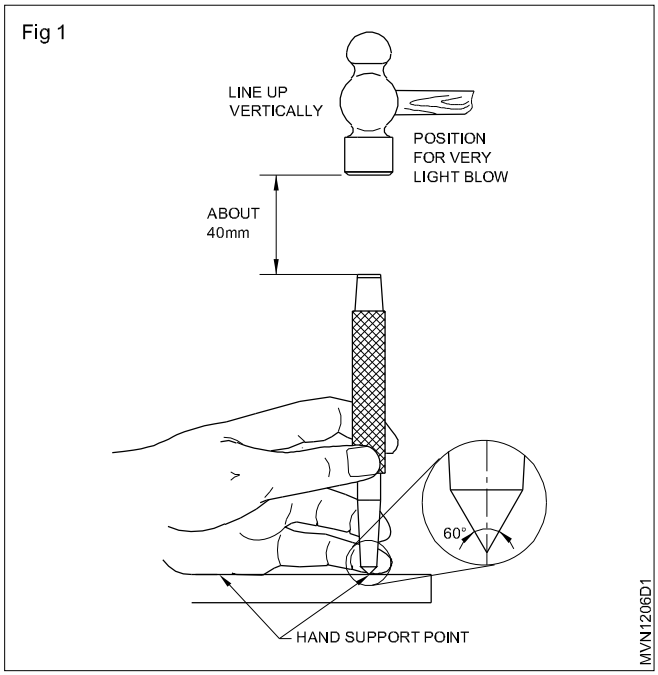
## Hand tools

**Objective:** At the end of this lesson you shall be able to
- **state the application of punches.**

Punches are used in sheet metals and other work to mark position on work. (Fig 1)

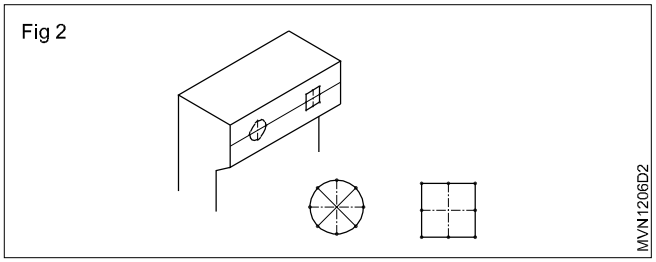
**Prick punches**

Fig 1




These punches are used to make witness marks on scribed lines. (Fig 2)

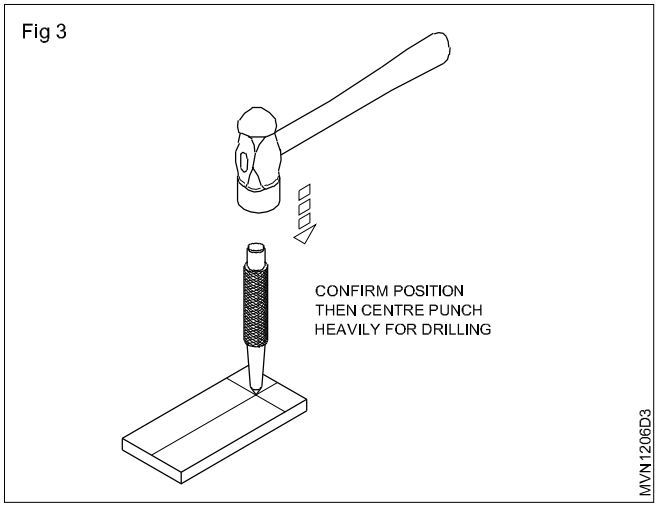
Fig 2




This makes it easier to see accurate marking out lines.

- to check the location of the centre positions before centre punching. (Fig 3)

Fig 3




- to locate the pivot points of compasses for scribing circles. (Fig 4)

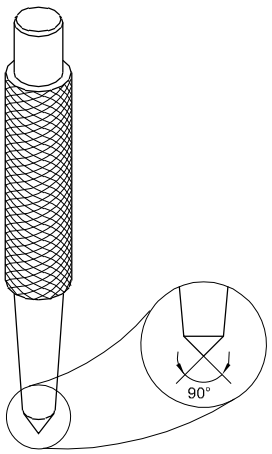
A 100 mm prick punch with a 7 mm diameter body could have a 2.5 mm diameter point ground to an angle of 60° or 30°

**Centre punches**

These punches are similar to prick punch, and it is generally larger then prick punch.

A 100 mm centre punch could have a 10 mm diameter body and a 6 mm diameter point ground to an angle of 90°

Fig 4

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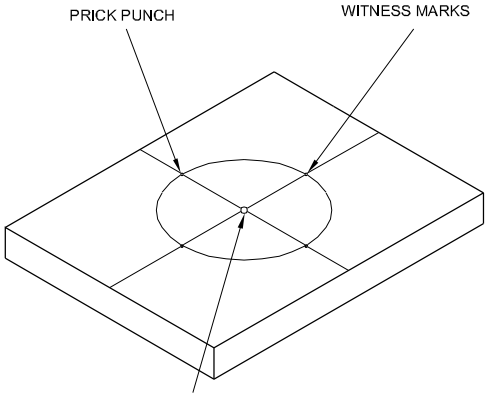
Centre punches are used

- to make deeper witness marks on scribed lines and to locate a centre position and make it easier for the drill to start correctly. (Fig 5)

Fig 5

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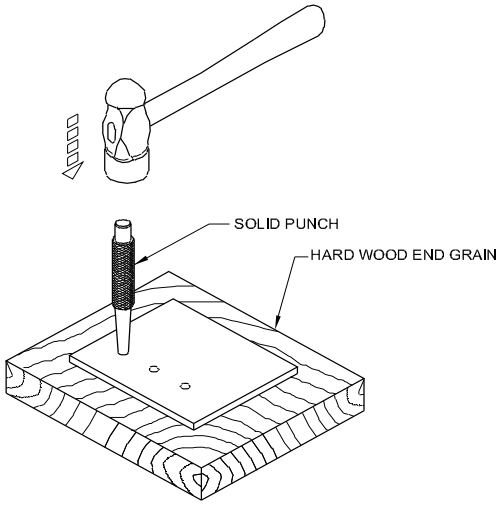
**Solid punch (Fig 6)**

In riveting sheet metal, holes must be equally spaced and lined up. The holes in the metal are usually punched with solid punches.

Fig 6

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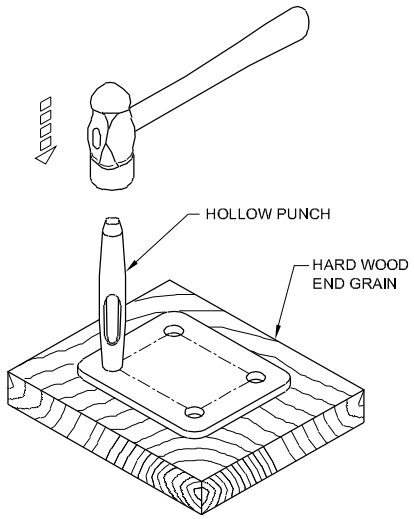
PUNCHING HOLES FOR RIVETS WITH A SOLID PUNCH

**Letter and number punches**

Also known as letter stamps or number stamps, letter punches are used to emboss the impression of a letter of number into a workpiece. They are most common in the reverse image, this allows the end result to be immediately readable, however they may be made as a positive image. This is essential in the case of die or mold making and ensure that the finished product will be readable, as a die is a negative image.

**Hollow punch (Fig 7)**

Fig 7

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USING A HOLLOW PUNCH

These punches are also used to punch holes in thin sheet metal, leather, plastic cork etc. Gaskets, seals and spacers are made using hollow punches.

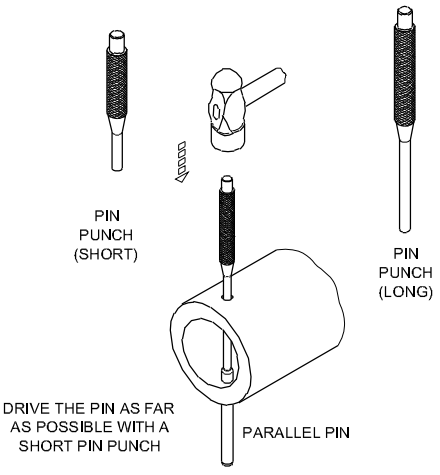
While using solid or hollow punches, the materials is rigidly supported with a block of wood (with the end of grain up) or lead. This will also avoid any damage to the tip of the punch while punching.

**Pin punches (Fig 8)**

Pin punches are used to drive locating or locking pins, dowels and rivets out of their holes.

Pin punches are available in a set of 5 pins of dia.3,4,5,6 and 8 mm with a knurled body to a length of approximately 150 mm.

Fig 8

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