Fitting tools - marking tools - specification - grades - uses

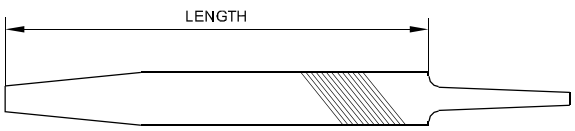
Objectives : At the end of this lesson you shall be able to
- **state the different types of files and their grades, shapes, specification and application.**
- **state the different cuts of files and their uses**
- **state the parts of file**

File : File is a filing tool, which is used to file the rough surface & smooth surface on metals

File specification: Files are specified according to their

- length
- grade
- cut
- shape

Fig 1



Length is the distance from the tip to the heel (Fig 1). It may be 300mm, 250mm, 200mm,150mm or 100mm.

Rough, bastard, second cut, smooth and dead smooth are the different **grades** of files commonly available.

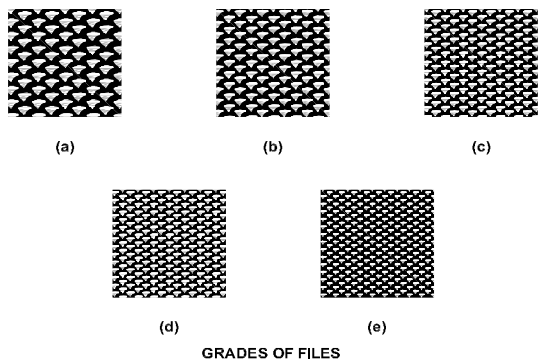
A rough file is used for removing more quantity of metal quickly. (Fig 2a)

A bastard file is used for ordinary filing purposes. (Fig 2b)

A second cut file is used for good finishing purposes. (Fig 2c)

A smooth file is used for removing less metal and for giving good surface finish. (Fig 2d)

Fig 2



A dead smooth file is used for high degree finishing. (Fig 2e)

Cut of file: The rows of teeth determine the cut of a file.

Types of cut

Single cut, double cut, rasp cut and curved cut are the different types of cuts of files.

Single cut: A single cut file has a single row of teeth in one direction on the face of the file at an angle of 60° and this file is used for filing soft material such as lead, tin, aluminium etc. (Figs 3 & 4)

Fig 3

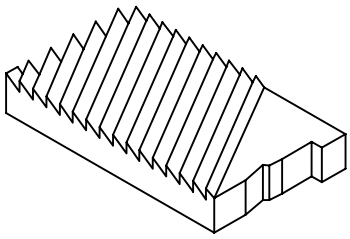
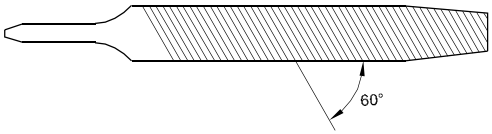
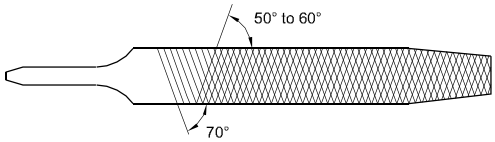


Fig 4



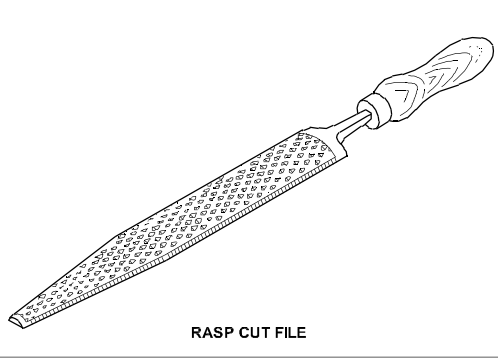
Double cut: A double cut file has rows of teeth in two directions across each other, one at an angle of 50° to 60°, another row at 70° which is used to file hard materials such as steel, brass, bronze, etc. (Fig 5)

Fig 5



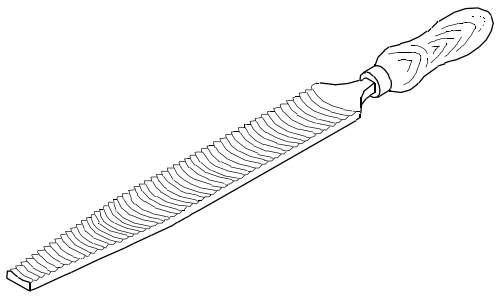
Rasp cut: This has individual, sharp, pointed teeth in a line, and is useful for filing wood, leather and other soft materials. These files are available only in half-round shape. (Fig 6)

Fig 6



Curved cut: These files have deeper cutting action, and are useful for filing soft materials like - aluminium, tin, copper and plastic. These are available only in flat shape. (Fig 7)

Fig 7



CURVED CUT FILE

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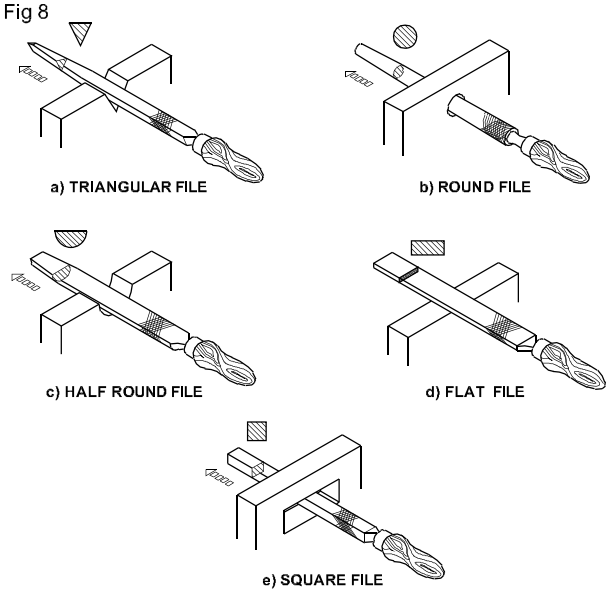
Fig 8



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The selection of the type of cut is based on the material to be filed. Single cut files are used for filing soft materials. But certain special files, for example - those used for sharpening saws, are also of single cut.

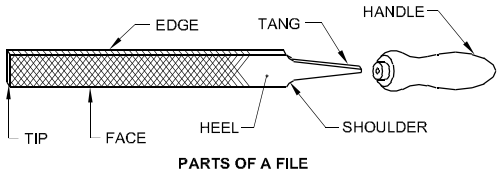
Shape: The various shapes of files with their application are shown below. The cross-section drawn in the file refers to the shape of the file. (Fig 8)

Parts of file

File : A file is a cutting tool with multiple cutting edges used for filing different materials.

Parts of a file (Refer Fig 1 below)

Fig 1



PARTS OF A FILE

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Tip or point: This is the end of the file opposite to tang.

Face or side: The broad part of the file with teeth cut on it.

Edge: The thin part of the file with a simple row of parallel teeth.

Heel: It is the broad part of the file without teeth.

Shoulder : It is the curved part of a file separating the tang from the body.

Tang: Narrow and thin part of a file which fits into the handle.

Handle: The part fitted to the tang to hold and use the file.

Bench vice

Objectives: At the end of this lesson you shall be able to
- **name the parts and state the uses of a bench vice**
- **specify the size of a bench vice**
- **state the uses of vice clamps.**

Bench vice: Vices are used for holding workpieces. They are available in different types.

The vice used for bench work is the bench vice (Engineer's vice).

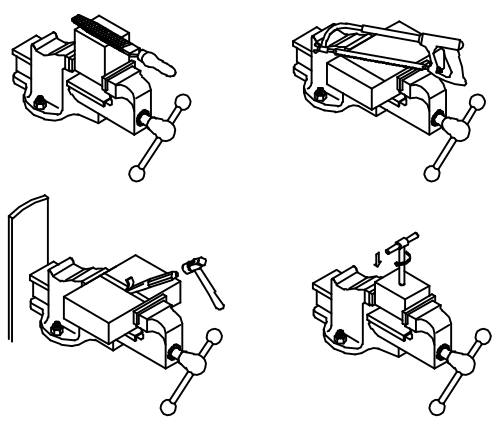
A bench vice is made of cast iron or cast steel, and it is used to hold work for filing, sawing, threading and other hand operations. (Fig 1)

The size of the vice is stated by the width of the jaws.

Parts of a bench vice (Fig 2)

- Fixed jaw (1)
- Movable jaw (2)
- Hard jaw (3)

Fig 1



VICES

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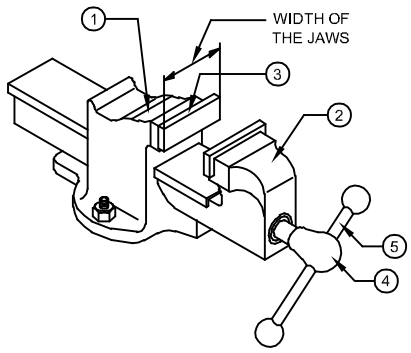
- Spindle (4)
- Handle (5)
- Box nut (6)
- Spring (7)

Fig 2



BENCH VICE

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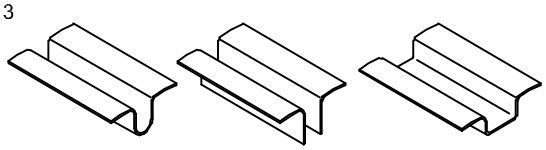
The box nut and the spring are the internal parts.

Vice clamps or soft jaws: To hold a finished work use soft jaws (vice clamps), (Fig 3) made of aluminium over the regular hard jaws. This will protect the work surface from damage. Do not over-tighten the vice so as to prevent damage to the spindle.

Fig 3



VICE CLAMPS

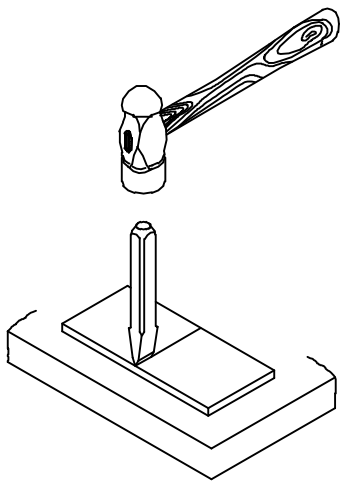
ELN121233

Hammer

Objectives: At the end of this lesson you shall be able to
- **state the uses of an engineer's hammer**
- **name the parts of an engineer's hammer and state their functions**
- **name the types of engineer's hammers with specifications**

Hammer: Engineer's hammer is a hand tool used for various striking purposes like punching, bending, straightening, chipping, forging and riveting. (Fig 1)

Fig 1



STRIKING WITH HAMMER

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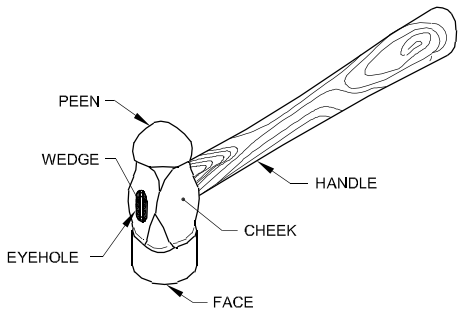
Major parts of a hammer (Fig 2)
- Head
- Handle

The head is made of drop-forged carbon steel, and the wooden handle must be capable of absorbing shock.

The parts of the hammer head are:
- face
- peen

Fig 2



HAMMER

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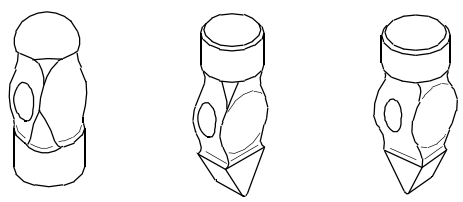
- cheek
- eyehole

Face: Face is the striking portion. A slight convexity is given to it, to avoid digging of the edge.

Peen: Peen is the other end of the head. It is used for shaping and forming work like riveting and bending. The peen is of different shapes. (Fig 3) They are:

Fig 3



BALL PEEN CROSS-PEEN STRAIGHT PEEN

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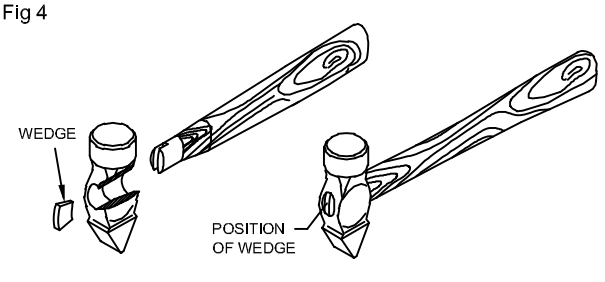
- ball peen
- cross-peen
- straight peen

Cheek: Cheek is the middle portion of the hammer head. The weight of the hammer is stamped here.

Eyehole: Eyehole is meant for fixing the handle. It is shaped to fix the handle rigidly. The wedge fixes the handle in the eyehole. (Fig 4)

Fig 4



HAMMER WEDGE

Specifications: The face and peen are hardened.

The cheek is left soft.

Engineer's hammers are specified by the weight of the head and shape of the peen. The weight varies from 125 gms to 1.5 kg.

The weight of the engineer's hammer used for marking purposes is 250 gms.

The ball peen hammer is used for general work in machine fitting shops.

Before using a hammer:

- make sure the handle is properly fitted
- select the correct weight of hammer suitable for the type of work
- check the head and handle for any crack
- ensure the face of the hammer is free from oil or grease.

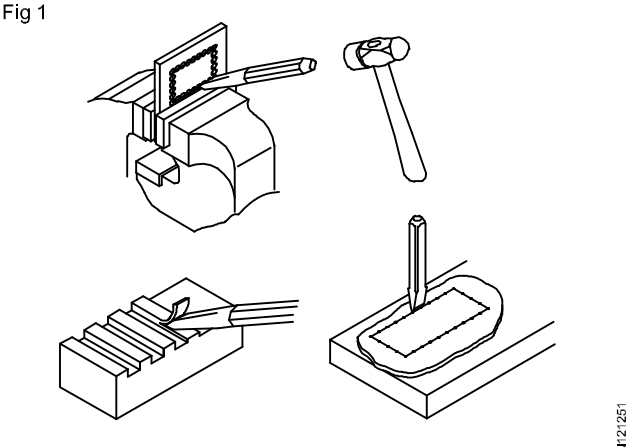
Chisel

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 and it's types**
- **state the different types of hacksaw frames, blades and their uses.**

The cold chisel is a hand cutting tool used by fitters for chipping and cutting operations.

Chipping is an operation of removing excess metal with the help of a chisel and hammer. (Fig 1) The chipped surfaces being rough, they should be finished by filing.

Fig 1



CHIPPING PROCESS

Parts of a chisel (Refer Fig 2)

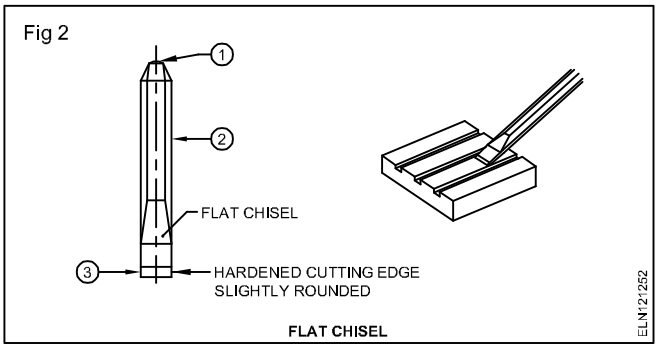
– Head (not hardened) (1)

– Body (2)

– Point or cutting edge (3)

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

Fig 2



FLAT CHISEL

Common types of chisels

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

Flat chisels are used to:

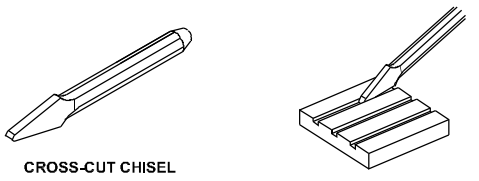
- remove metal from large flat surfaces
- chip excess metal off from welded joints and castings
- part off metal after chain drilling. (Fig 1)

Cross-cut or cape chisels are used for cutting keyways, grooves and slots. (Fig 3)

Half round, nose chisels are used for cutting curved grooves (oil grooves). (Fig 4)

Diamond point chisels are used for squaring materials at the corners. (Fig 5)

Fig 3



CROSS-CUT CHISEL

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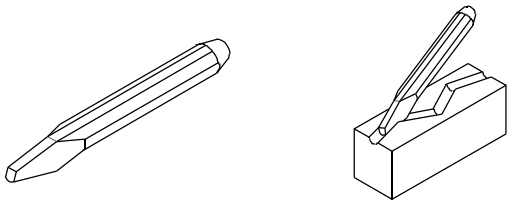
Fig 4



HALF ROUND CHISEL

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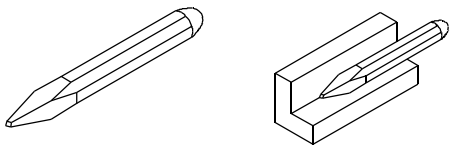
Fig 5



DIAMOND POINT CHISEL

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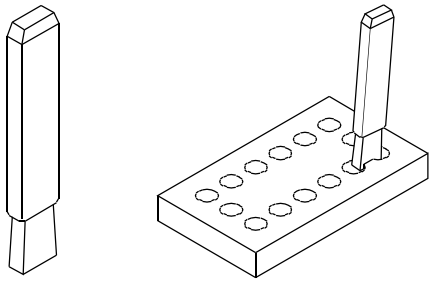
Web chisels/punching chisels are used for separating metals after chain drilling. (Fig 6)

Fig 6



WEB CHISEL

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Chisels are specified according to the:

- length
- width of the cutting edge
- type
- cross-section of the body.

The length of chisels ranges from 150 mm to 400 mm.

The width of the cutting edge varies according to the type of chisels.

Hacksaw frame and blade

The hand hacksaw is used along with a blade to cut metals of different sections. It is also used to cut slots and contours.

Types of hacksaw frames

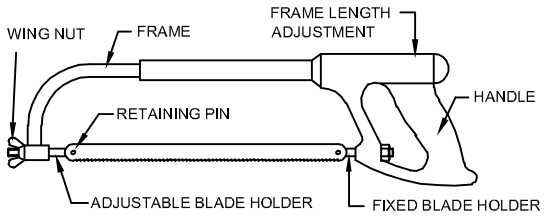
Bold frame: Only a particular standard length of blade can be fitted.

Adjustable frame (flat)**:** Different standard lengths of blades can be fitted.

Adjustable frame tubular type (Fig 1)**:** This is the most commonly used type. It gives a better grip and control while sawing.

Hacksaw blades : The hacksaw blade is a thin, narrow, steel band with teeth and two pin holes at the ends. It is

Fig 1



HACKSHAW FRAME

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used along with a hacksaw frame. These blades are made of either low alloy steel (la) or high speed steel (hs) and are available in standard lengths of 250mm and 300mm.

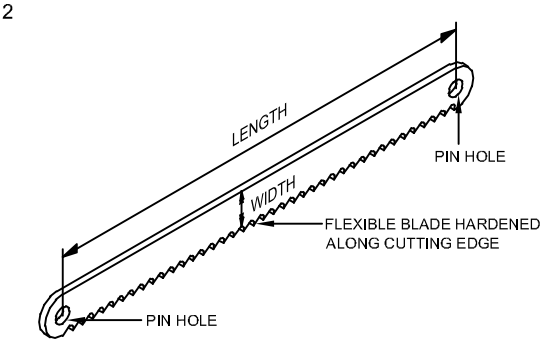
For proper working, it is necessary to have frames of rigid construction.

Types of hacksaw blades

All-hard blades: The width between the pin holes is hardened all allong the length of the blade.

Flexible blades: For these types of blades only the teeth are hardened. Because of their flexibility, these blades are useful for cutting along curved lines (Fig 2).

Fig 2



HACKSHAW BLADE

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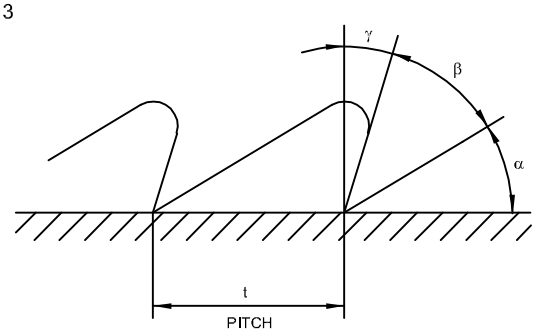
Pitch of the blade: This is the distance between two adjacent teeth. (Refer Fig 3) Hacksaw blades are designated according to length, pitch and the type of blade

Fig 3



PITCH OF BLADE

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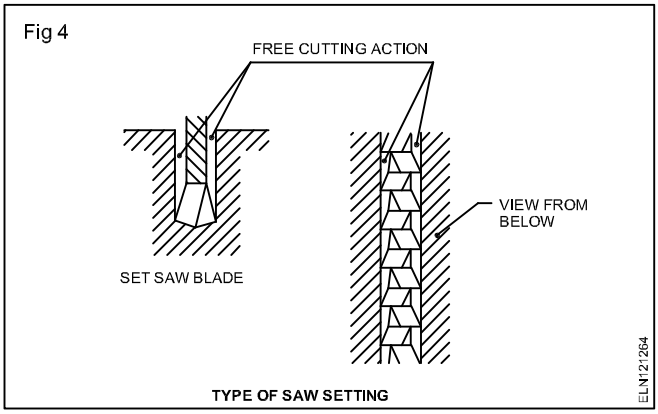
Pitches of blades

Classification	Pitch
Coarse	1.8mm
Medium	1.4 mm & 1.0 mm
Fine	0.8mm

Setting of the saw: To prevent the saw from binding when penetrating into the material and to allow free movement of the blade, the cut is to be broader than the thickness of the saw blade. This is achieved by a proper setting of the saw teeth (Fig 4). There are two types of saw settings.

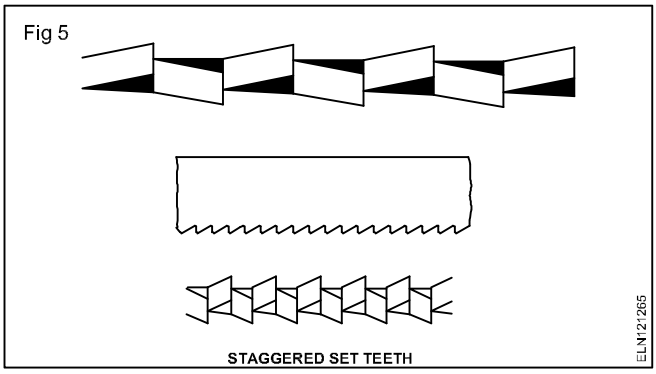
Fig 4



TYPE OF SAW SETTING

Staggered set: Alternate teeth or groups of teeth are staggered. This arrangement helps for free cutting, and provides for good chip clearance. (Fig 5)

Fig 5



STAGGERED SET TEETH

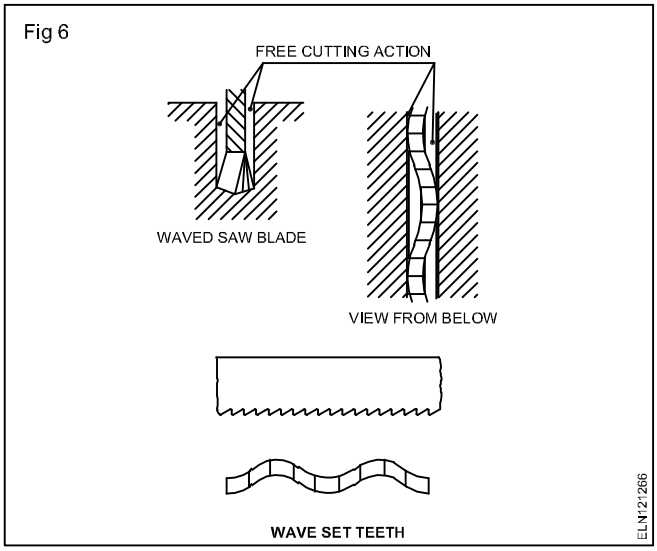
Classification of sets

Pitch	0.8mm	wave set.
Pitch	1.0mm	wave or staggered.
Pitch over	1.0mm	staggered.

Wave set: In this, the, teeth of the blade are arranged in a wave-form. (Fig 6).

For satisfactory results a blade of the correct pitch should be selected and fitted correctly.

Fig 6

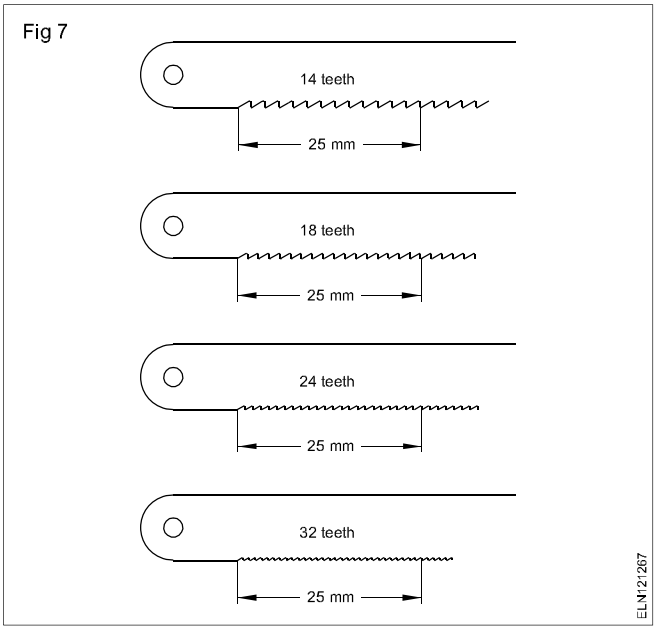


WAVE SET TEETH

Saw blades for hacksaws are available with small and large cutting of teeth, depending on the type and size of material they are to cut. The size of the teeth is directly related to their pitch, which is specified by the number of teeth per 25mm of the cutting edge. Hacksaw blades are avaialable in pitches of: (Fig 7)

- 14 teeth per 25 mm
- 18 teeth per 25 mm
- 24 teeth per 25 mm
- 32 teeth per 25 mm.

Fig 7



Marking tools - steel rule - punches - calipers - try square - gauges

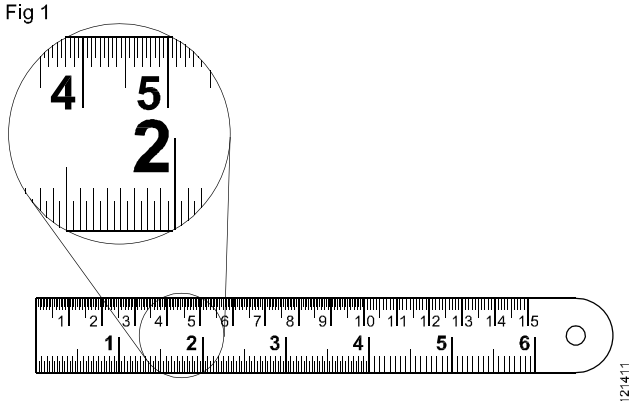
Objectives: At the end of this lesson you shall be able to
- **state the constructional features of an engineer's steel rule**
- **explain the uses of the steel rule**
- **state the maintenance aspects to be considered in respect of the steel rule.**

Engineer's steel rule: 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.

Material and sizes of steel rules: Steel rules are made of spring steel or stainless steel. The edges are accurately ground to form a straight line.

Steel rules are available in different lengths; the common sizes are 150mm, 300mm and 600mm. (Refer Fig 1)

Fig 1



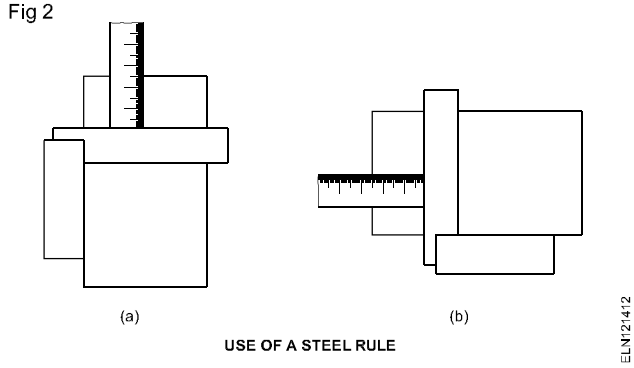
ENGINEER'S STEEL RULE

The surfaces of the steel rules are satin-chrome finished to reduce glare and also to prevent rusting. The engineer's rule is graduated in 10mm, 5mm, 1mm and 0.5mm. Thus the reading accuracy of a steel rule is 0.5mm.

Graduation: The minimum graduation is 0.5mm.

Uses: Use a try square on one datum edge and measure the distance from the other datum edge using a steel rule. (Figs 2a & b)

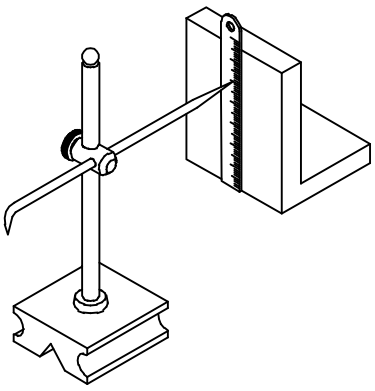
Fig 2



USE OF A STEEL RULE

A steel rule is used to take the desired height for the marking surface gauge. (Fig 3)

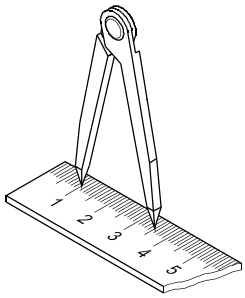
Fig 3



MARKING SURFACE GAUGE

Transfer of measurement from the steel rule to the divider is shown in Fig 4.

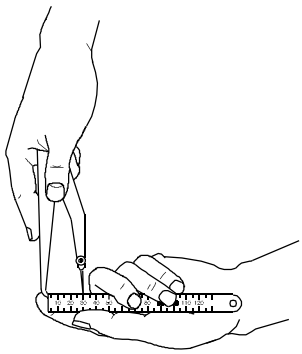
Fig 4



TRANSFER OF MEASUREMENT - DIVIDER

Steel rule is used to transfer measurements from the rule to the odd leg calipers. (Fig 5)

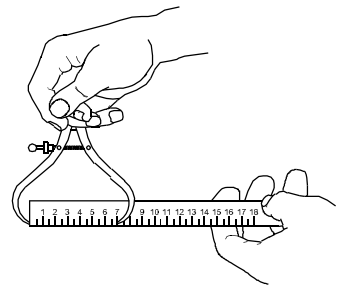
Fig 5



TRANSFER OF MEASUREMENT - ODD LEG CALIPER

Steel rule is used to transfer measurements from the steel rule to outside calipers. (Fig 6)

Fig 6



TRANSFER OF MEASUREMENT - OUTSIDE CALIPER

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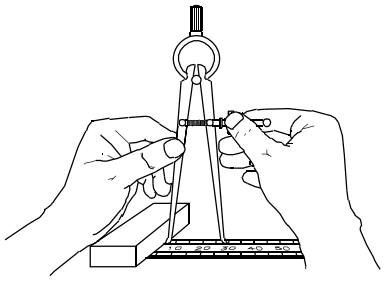
A steel rule is also used to transfer measurements to inside calipers. (Fig 7)

Fig 7



TRANSFER OF MEASUREMENT - INSIDE CALIPER

ELN121417

Marking media

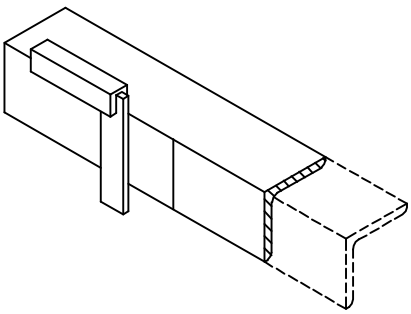
Objectives: At the end of this lesson you shall be able to
- **name the common types of marking media**
- **select the correct marking media for different applications.**

Different types of marking media

Whitewash: This is applied to rough forgings and castings with oxidised surfaces. (Fig 1) Whitewash is prepared in many ways.

- Chalk powder mixed with water
- Chalk mixed with methylated spirit
- White lead powder mixed with turpentine

Fig 1

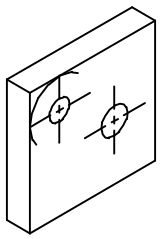


SURFACE MARKING

ELN121421

Prussian blue: 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



MARKED SURFACE

ELN121422

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

Copper sulplate 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.

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

The selection of marking media depends on the:

- the surface finish
- the accuracy of the workpiece.

Types of marking punches

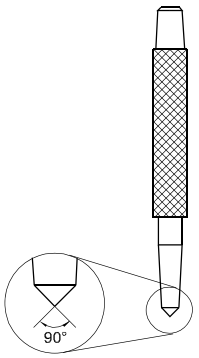
Objectives: At the end of this lesson you shall be able to
- **name the different punches used in marking**
- **state the features of each punch and its uses.**

Types of marking punches: In order to make certain dimensional features of the layout permanent, punches are used. There are two types of punches.

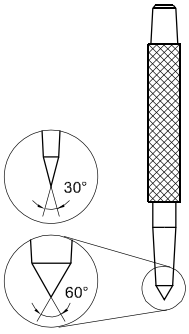
Centre punch: The angle of the point is 90°. The punch mark made by this is wide and not very deep. This punch is used for locating holes. The wide punch mark gives a good seating for starting the drill. (Figs 1a)

Prick punch: The angle of the prick punch is 30° or 60° (Fig 1b). The 30° point punch is used for making light punch marks needed to position dividers. The divider leg will get proper seating in this punch mark. The 60° punch is used for Witness Marks. Witness marks should not be too close. (Fig 2)

Fig 1



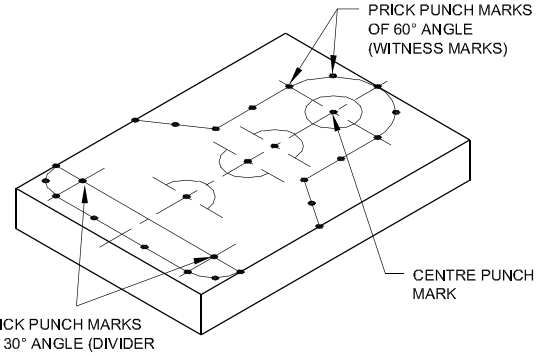
a) CENTRE PUNCH



b) PRICK PUNCH

ELN121431

Fig 2



ELN121432

Types of calipers

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

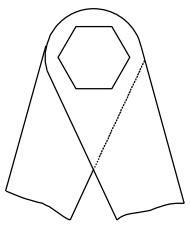
- **name the commonly used calipers**
- **compare the features of firm joint and spring joint calipers**
- **state the advantages of spring joint calipers.**

Calipers (firm and spring joints) : Calipers are simple measuring instruments used to transfer measurements from the steel rule to objects and vice versa.

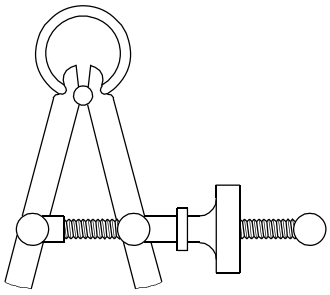
The commonly used calipers are:

- firm joint calipers (Fig 1a)
- spring joint calipers. (Fig 1b)

Fig 1



a) FIRM JOINT

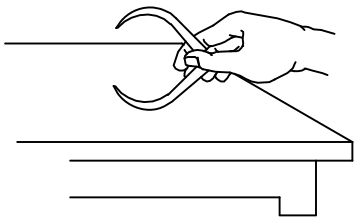


b) SPRING JOINT

ELN121441

Firm joint calipers : In the case of firm joint calipers both legs are pivoted on one end. To take measurement of the workpiece, it is opened roughly to the size. Fine setting is done by lightly tapping it on a wooden surface. (Figs 2 & 3)

Fig 2

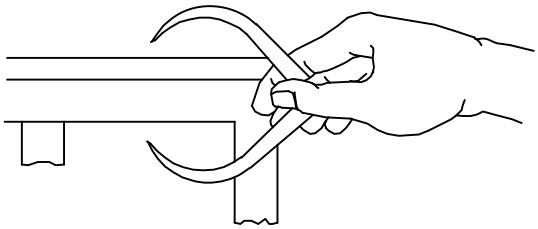


FIRM JOINT CALIPERS

ELN121442

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

Fig 3



FRIM JOINT CALIPER

ELN121443

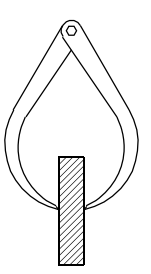
Spring calipers have the advantage of quick setting. The setting made will not change unless the nut is turned. Caliper sizes are specified by the length which is the distance between the pivot centre and the tip of the leg.

Accuracy of the measurement taken depends very much on the sense of `FEEL' or `TOUCH' while measuring the job. You should get the feel when the legs are just touching the surface.

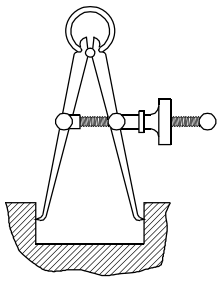
Outside and inside measurements: Calipers used for outside measurements are known as outside calipers while calipers used for internal measurements are the inside calipers. (Figs 4a & 4b)

Calipers are used with steel rules whose accuracy is limited to 0.5 mm; parallelism can be checked with a higher degree of accuracy.

Fig 4



a) OUTSIDE CALIPERS



b) INSIDE CALIPERS

ELN121444

Jenny calipers

Objectives: At the end of this lesson you shall be able to
- **state the constructional features of jenny calipers**
- **name the types of jenny calipers**
- **state the uses of jenny calipers.**

Jenny calipers: Jenny calipers are used for marking and layout work.

These calipers are also known as

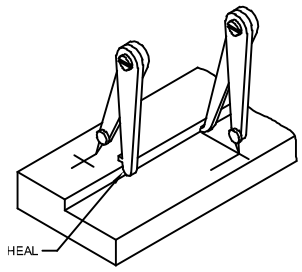
- hermaphrodite calipers
- odd leg calipers
- leg and joint calipers

Jenny calipers have one leg with an adjustable divider point while the other is a bent leg. The legs are joined together to make a firm joint.

Uses

- To mark lines parallel to edges inside and outside. (Fig 1)

Fig 1

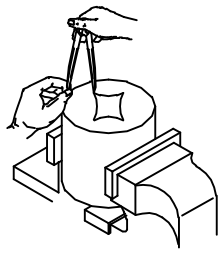


JENNY CALIPERS

ELN121451

- To locate the centre of round bars. (Fig 2)

Fig 2



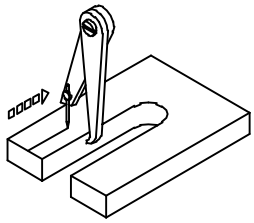
CENTRE LOCATION OF ROUND BAR

ELN121452

Calipers are available with the usual bent leg or with a heel. Calipers with ordinary bent legs are used for drawing lines parallel along an inside edge, while the heel type is used for drawing parallel lines along the outer edges.

Jenny calipers can also be used for scribing lines along curved edges. While setting dimensions and scribing lines, both legs should be of equal length. (Fig 3)

Fig 3

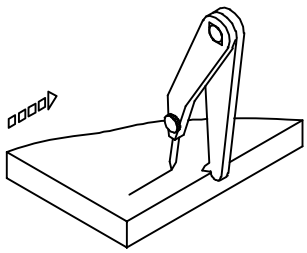


JENNY CALIPER

ELN121453

The jenny caliper should be slightly inclined while scribing lines, Fig 4.

Fig 4

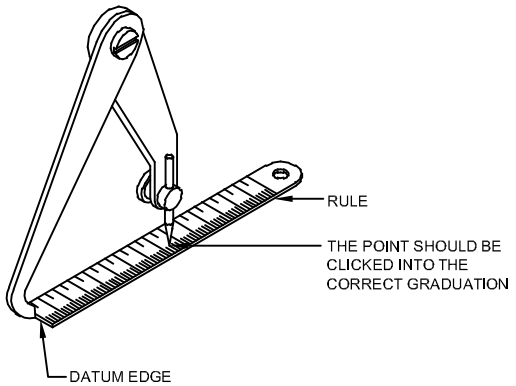


SCRIBING WITH JENNY CALIPER

ELN121454

While setting dimensions for accurate setting, the jenny caliper's point should `click' into the graduation, Fig 5.

Fig 5



ACCURATE MEASUREMENT SETTING

ELN121455

Length measurement

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

Length measurement SI units: 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 Internationale is the metre.

Metre (m)	=	1000 mm
Centimetre (cm)	=	10 mm
Millimetre (mm)	= 0.001 m	= 10^{-3} m
1 Micrometre µm	= 10^{-6} m	= 0.000001 m
1 Micrometer	= 10^{-3} mm	= 0.001 mm

Measurement in engineering practice: Usually, in engineering practice, the preferred unit of length measurement is the millimetre. Both large and small dimensions are stated in millimetres.

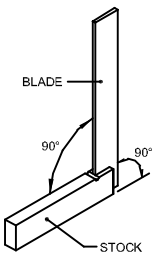
The British system of length measurement: The other system of length measurement is the British system. In this system the base unit is the imperial standard yard. Most countries including Great Britain have, however, switched over to the SI units in recent years.

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.**

Try square: The try square is a precision instrument which is used to check squareness (angles of 90°). The accuracy 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 in the stock at 90°. (Fig 1)

Fig 1



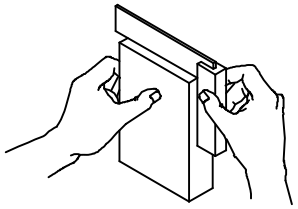
TRY SQUARE

ELN121461

The try square is used to

- check the squareness of machined or filed surfaces. (Fig 2)

Fig 2

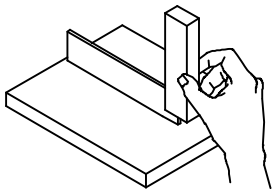


CHECKING SQUARENESS

ELN121462

- check the flatness of surfaces (Fig 3)

Fig 3

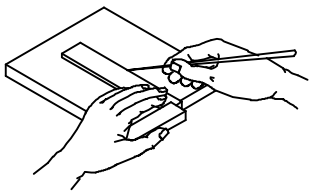


CHECKING FLATNESS

ELN121463

- mark lines at 90° to the edges of workpieces (Fig 4)

Fig 4

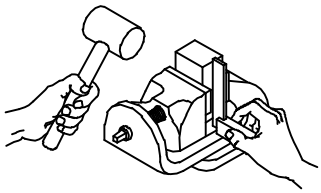


MARKING LINES

ELN121464

- set workpieces at right angles on work-holding devices. (Fig 5)

Fig 5



RIGHT ANGLES ON WORK HOLDING DEVICES

ELN121465

Try squares are made of hardened steel.

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

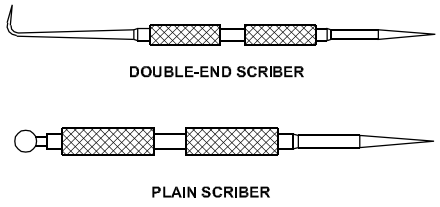
Scriber, divider

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

Scriber: A scriber is a sharp, pointed, steel tool made from carbon tool steel. There are two types of scribers.

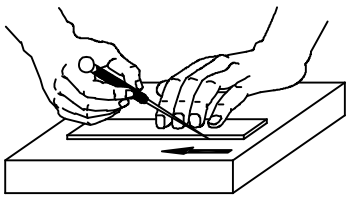
- Double end and plain scribers (Fig 1)

Fig 1



Uses: Used for scribing lines on the metal being laid out. (Fig 2)

Fig 2

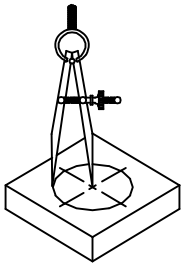


Divider: A divider consists of a pair of steel legs adjusted by a screw and nut, and held together by a circular spring at one end. A handle is inserted on the spring.

Uses: A divider is used for

- measuring distances between points
- transferring measurements directly from a rule
- scribing circles and arcs on metals. (Fig 3)

Fig 3



Radius gauges

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

Radius gauges: Radius gauges are used to check the internal and external radius of workpieces.

These gauges are made of high quality steel sheets and are finished to accurate radius.

The radius of parts are checked by comparing the radius of the gauges.

Radius gauges are available in sets of several blades held in a holder. Each blade can be separately pulled out of the holder when in use.

The size of the radius is marked on individual blades of the gauges. (Fig 1)

Fig 1

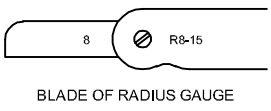
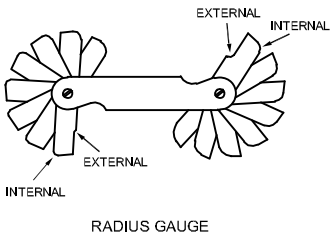


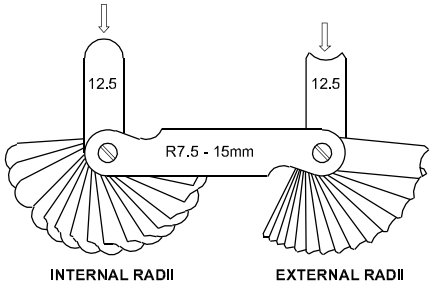
Fig 2



The radius gauges are available in different combinations.

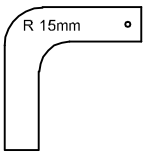
– Sets with internal and external radius.(Figs 2 & 3)

Fig 3



– Individual gauges for each radius. (Fig 4)

Fig 4



Before using radius gauges:

- ensure the gauges are perfectly clean
- remove burrs, if any, from the workpiece
- check and make sure there is no damage to the profile of the gauge.

Universal surface gauge

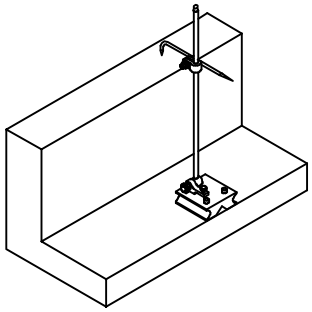
Objectives: At the end of this lesson you shall be able to

- **state the constructional features of surface gauges**
- **name the different types of surface gauges**
- **state the uses of surface gauges**
- **state the advantages of universal surface gauges.**

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

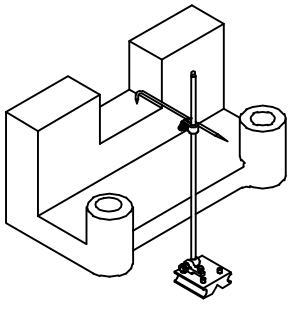
- scribing lines parallel to a datum surface (Fig 1)

Fig 1



- setting jobs on machines parallel to a datum surface (Fig 2)

Fig 2

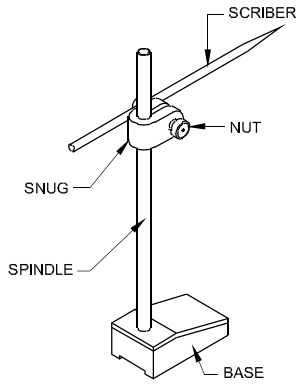


- checking the height and parallelism of jobs
- setting jobs concentric to the machine spindle.

Types of surface gauges: A surface gauge/scribing block is of two types.

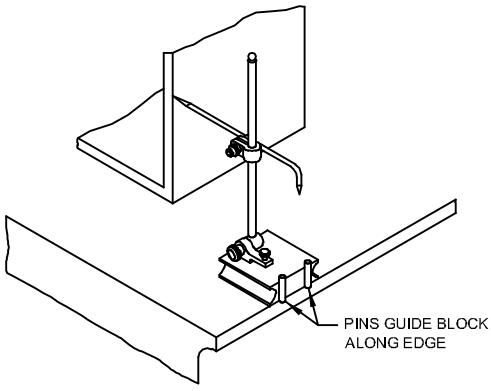
- Fixed Surface gauge (Fig 3)

Fig 3



- Universal Surface gauge(Fig 4)

Fig 4



Surface gauge (fixed type)**:** This 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: This has the following additional features.

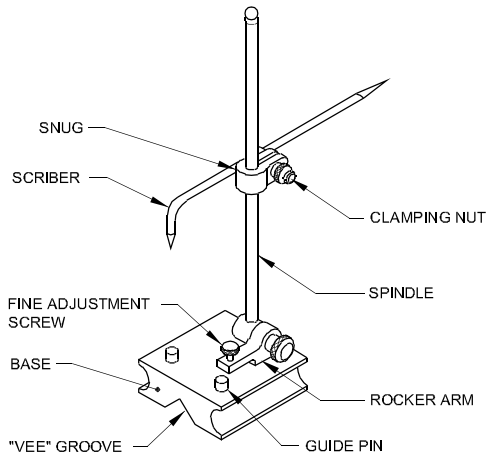
- The spindle can be set to any position.
- Fine adjustments can be made quickly.
- Can also be used on cylindrical surfaces.
- Parallel lines can be scribed from any datum edge with the help of guide pins.(Fig 4)

Parts and functions of a universal surface gauge (Fig 5)

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

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

Fig 5



UNIVERSAL SURFACE GAUGE

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 clamp nut.

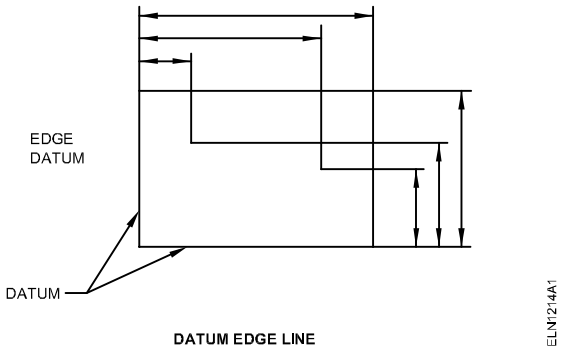
Datum

Objectives: At the end of this lesson you shall be able to
- **state the need for datum while marking**
- **name the different datum points, surfaces or lines**
- **state the basis of determining the datum while marking.**

Datum: The height of a person is measured from the floor on which he stands. The floor becomes the common basis for measurement, i.e. it becomes the DATUM.

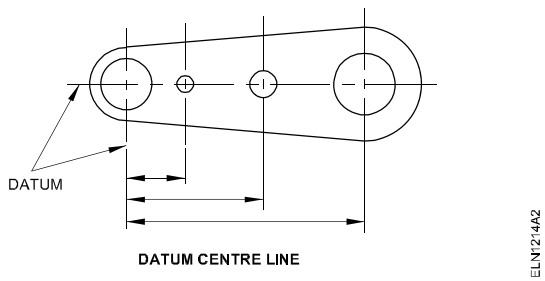
A datum is a reference surface, line or point and its purpose is to provide a common position from which measurements may be taken. The datum may be an edge or centre line depending on the shape of the work. For positioning a point, two datum references are required. (Figs 1 and 2)

Fig 1



DATUM EDGE LINE

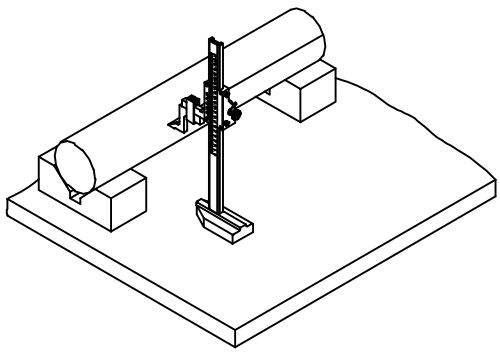
Fig 2



DATUM CENTRE LINE

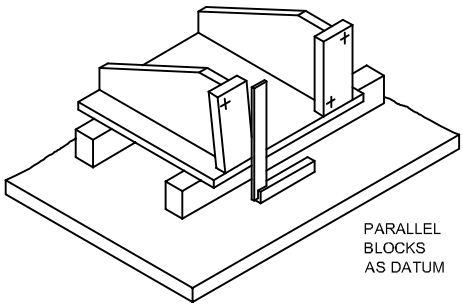
Marking table, surface plate, angle, plate, vee blocks and parallel blocks - all these serve as datum references. (Figs 3 and 4)

Fig 3



DATUM MARKING ANGLE

Fig 4



DATUM MARKING PLATE

The datum should be indicated in the drawing.

The same datum must be used for transferring dimensions to the workpiece.

Carpenter tools - wood saws - planes - wooden joints

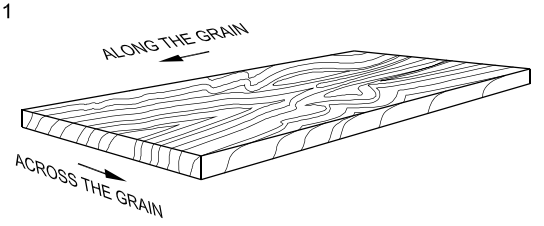
Objective : At the end of this lesson you shall be able to
- **state about the timber**
- **state the grain direction of wood and the common defects in timber**

Timber is a raw material used for manufacturing wooden articles. Timber is a product of a tree.

Wood is made up of numerous tube like cells packed closely together. During the growth of the tree, these cells are positioned in a certain direction. The direction of these cells is referred to as the `grain'. The direction of the grain can be identified by the visible lines on the surface of the timber.

Any operation performed in the grain direction is called an operation `along the grain'. (Fig 1)

Fig 1



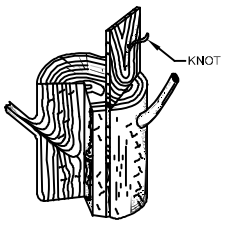
GRAIN DIRECTION IN WOOD

Any operation performed at right angle to the grain direction is called `across the grain'.

Any irregularity occuring in the timber is a defect in the timber. These defects in the timber reduce its strength, durability and utility value.

Common defects in timber : A knot is caused due to the growth of branches on the tree. It appears on the surface of planks and on boards when the logs are sawn. (Fig 2)

Fig 2

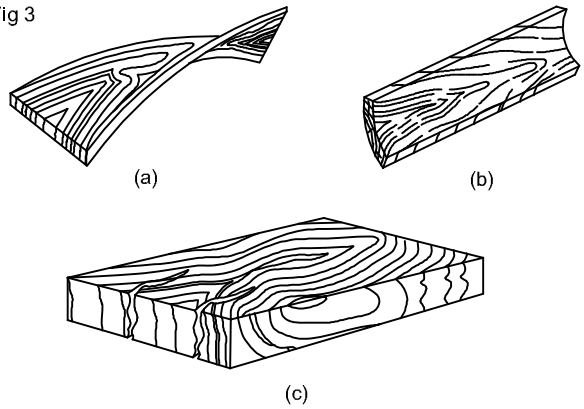


TIMBER WITH KNOT

The following defects are caused due to uneven shrinkage, improper seasoning and defective storage.

- Twisting (Fig 3a)
- Cupping (Fig 3b)
- Cracking (Fig 3c)

Fig 3



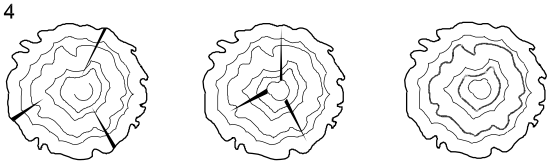
DEFECTS IN TIMBER

Shakes

- Radial shake (Fig 4a)
- Star shake (Fig 4b)
- Cup shake (Fig 4c)

Avoid defective pieces while selecting timber to get better results.

Fig 4



Marking and measuring tools

Objectives : At the end of this lesson you shall be able to
- **name the marking and measuring tools and their functions**
- **state the functions of straight edge, marking gauge and wooden folding rule**

Marking and measuring tools are used in woodwork for marking, measuring and checking the work at various stages.

Common marking tools

- Wooden folding rule
- Steel rule