Importance of welder trade training

Objectives: At the end of this lesson you shall be able to
- **state the competencies achieved in this welder trade**
- **describe the further learning path ways craftsman training scheme**
- **explain the employment opportunities on completion of welder trade.**

This trade is meant for the candidates who aspire to become a professional WELDER. The duration of the trade is two semesters under craftsman training scheme.

Competencies achieved

After successful completion of this trade trainee shall be able to perform the following skills with proper sequence.

1 Welding of M.S. sheet and M.S. pipe by Gas welding process.

2 Welding of M.S. plate in all position by SMAW process.

3 Straight, bevel & circular cutting on MS. plate by Oxy-acetylene cutting process.

4 Repair & Maintenance works

5 GMAW welding on M.S sheet & M.S plate.

6 Operating skills of spot welding machine, PUG cutting machine,

7 Welding C.I using SMAW process.

Further learning pathways

Also on successful completion of the trade the candidate can pursue apprenticeship training in Registered Industries/ Organization, further for a period of one year under Apprenticeship Training scheme to acquire practical skills and knowledge.

Employment Opportunities

On successful completion of this trade, the candidates shall gain to be fully employed in the following industries:

1 Structural fabrication like bridges, Roof structures, Building & construction.

2 Automobile and allied industries.

3 Site construction activities for power stations, process industries and mining.

4 Service industries like road transportation and railways.

5 Ship building and repair.

6 Infrastructure and defence organizations.

7 In public sector industries like BHEL, NTPC, etc and private industries in India & Abroad.

8 Petrochemical industries like ONGC, LOCL, and HPCL etc

9 Self employment.

General discipline in the Institute

Objectives: At the end of this lesson you shall be able to
- **follow the general discipline laid down by the institute**
- **avoid any undesirable actions as a learner**
- **keep up the moral image and reputation of the institute.**

General discipline: always be polite, courteous while speaking to any person, (Principal, Training and Office staff, your co-trainee and any other person visiting your institute)

Do not get into argument with others on matters related to your training and with the office while seeking clarifications.

Do not bring bad name to your institute by your improper actions.

Do not waste your precious time in gossiping with your friends and on activities other than training.

Do not be late to the theory and practical classes.

Do not unnecessarily interfere in other's activities.

Be very attentive and listen to the lecture carefully during the theory classes and practical demonstration given by the training staff.

Give respect to your trainer and all other training staff, office staff and co-trainees.

Be interested in all the training activities.

Do not make noise or be playful while undergoing training.

Keep the institute premises neat and avoid polluting the environment.

Do not take away any material from the institute which does not belong to you.

Always attend the institute well dressed and with good physical appearance.

Be regular to attend the training without fail and avoid abstaining from the theory or practical classes for simple reasons.

Prepare well before writing a test/examination.

Avoid any malpractice during the test/examination.

Write your theory and practical records regularly and submit them on time for correction

Take care of your safety as well as other's safety while doing the practical.

Scan the QR Code to view the video for this exercise

Elementary first aid

Objectives: At the end of this lesson you shall be able to
- **understand the first aid treatment to be given for**
- **breathing problems**
- **electric shock**
- **burns caused by direct flame or by chemical**
- **large wounds with or without severe bleeding**
- **eye injuries due to hot flying particles.**

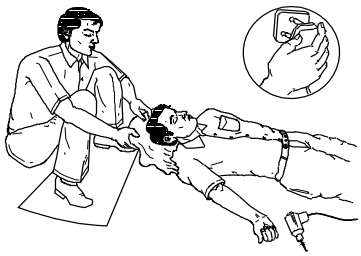
Electrical shock and breathing problems: The severity of an electric shock will depend on the level of the current which passes through the body and the length of time of contact, Do not delay to disconnect the contact.

If the person is still in contact with the electric supply break the contact either by switching off the power by removing the plug or wrenching the cable free. If not, stand on some insulating material such as dry wood, rubber or plastic, or using whatever is at hand to insulate yourself and break the contact by pushing or pulling the person free. (Fig1&2)

Fig 1

WLN110211

Fig 2



WLN110212

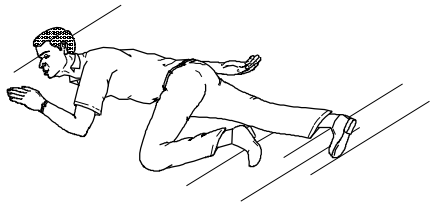
If you remain un-insulated, do not touch the victim with your bare hands until the circuit is made dead or he is moved away from the equipment.

If the victim is at a height from the ground level, proper safety actions must be taken to prevent him from falling or at least make him fall safely.

Electric burns on the victim may not cover a big area but may be deep seated. All you can do is to cover the area with a clean, sterile dressing and treat for shock, Get expert help as quickly as possible.

If the affected person is unconscious but is breathing, loosen the clothing about the neck, chest and waist and place the affected person in the recovery position.(Fig.3)

Fig 3



WLN110213

Keep a constant check on the breathing and pulse rate.

Keep the affected person warm and comfortable.(Fig.4)

Send for help.

Fig 4

WLN110214

Do not give an unconscious person anything by mouth.

Do not leave an unconscious person unattended.

If the casuality is not breathing-act once-don't waste time!

Electric shock: The severity of an electric shock will depend on the level of the current which passes through the body and the length of time of the contact.

Other factors that contribute to the severity of shocks are:

- The age of the person.
- Not wearing insulating footwear or wearing wet footwear.
- Weather condition.
- Floor is wet.
- Main voltage etc.

Effects of an electric shock: The effect of the current at very low levels may only be an unpleasant tingling sensation, but this itself may be sufficient to cause one to lose his balance and fall.

At higher levels of current, the person receiving the shock may be thrown off his feet and will experience severe pain, and possibly minor burns at the point of contact.

At an excessive level of current flow, the muscles may contract and the person may be unable to release his grip on the conductor, He may lose consciousness and the muscles of the heart may contract spasmodically (Fibrillation). This may be fatal.

Electric shock can also cause burning of the skin at the point of contact.

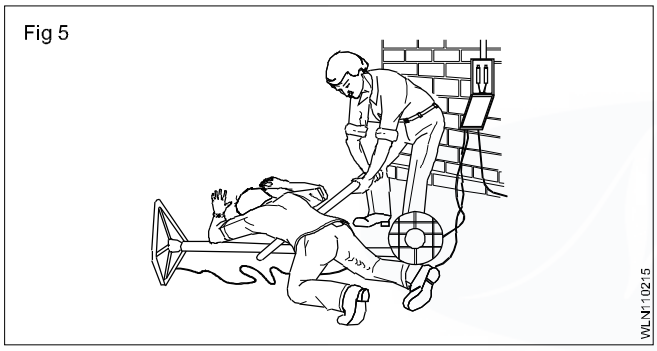
Treatment for electric shock:

Prompt treatment is essential

If assistance is available nearby. send for medical aid, then carry on with emergency treatment.

Switch off the current, if this can be done without undue delay. Otherwise, remove the victim from contact with the live conductor, using dry non-conducting materials such as a wooden bar, rope, a scarf, the victim's coat-tails, any dry article of clothing, a belt, rolled-up newspaper, non-metallic hose, PVC tubling, bakelite paper, tube etc. (Fig 5)

Fig 5



Avoid direct contact with the victim. Wrap your hands in dry material if rubber gloves are not available

Electrical burns: A person receiving an electric shock may also get burns when the current passes through his body. Do not waste time by applying first aid to the burns until breathing has been restored and the patient can breathe normally - unaided.

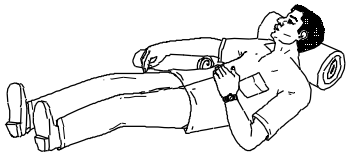
Burns and scalds: Burns are very painful. If a large area of the body is burnt, give no treatment, except to exclude the air. eg, by covering with water, clean paper, or a clean shirt. This relieves the pain.

Severe bleeding: Any wound which is bleeding profusely, especially in the wrist, hand or fingers must be considered serious and must receive professional attention. As an immediate first aid measure, pressure on the wound itself is the best means of stopping the bleeding and avoiding infection.

Immediate action: Always in cases of severe bleeding:

- Make the patient lie down and rest.
- If possible, raise the injured part above the level of the body. (Fig 6)

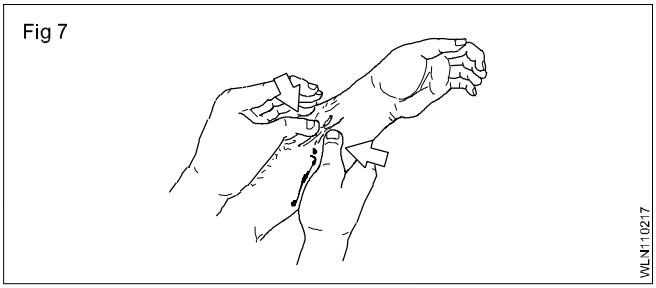
Fig 6



- Apply pressure on the wound.
- Call for assistance.

To control severe bleeding: Squeeze together the sides of the wound. Apply pressure as long as it is necessary to stop the bleeding. When the bleeding has stopped, put a dressing over the wound, and cover it with a pad of soft material. (Fig 7)

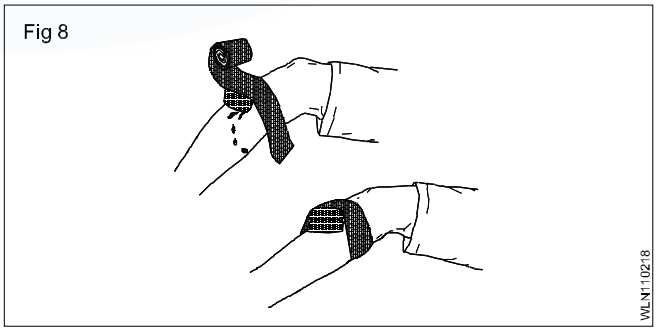
Fig 7



For an abdominal stab wound, which may be caused by falling on a sharp tool, keep the patient bending over the wound to stop internal bleeding.

Large wound: Apply a clean pad (Preferably an individual dressing) and bandage firmly in place, If the bleeding is very severe apply more than one dressing. (Fig 8)

Fig 8



Follow the right methods of artificial respiration.

Eye injury: For eye irritation caused by arc flashes, use a mild eye drop and apply 2 to 3 drops for 3 or 4 times a day. If the injury is due to a metal chip or slag particles entering the eye then take the injured person to an eye doctor immediately for treatment. Never rub the eye for any type of eye injury. It will cause a permanent vision problem. Also do not apply any eye drop or ointment without consulting an eye doctor.

Safety rules for gas cylinders

Objectives: At the end of this lesson you shall be able to
- **state various improper practices, while working in gas cylinders**
- **state different precautions to be taken for the gas cylinders.**

Oxy - acetylene equipment is safe if it is properly handled. But it may become a great destructive power if handled carelessly. It is important that the operator be familiar with all the safety rules before handling gas cylinders.

Keep the cylinders free of oil, grease or any type of lubrication.

Check leakage before use.

Open cylinder valves slowly.

Never fall or trip over gas cylinders.

A valve broken in the oxygen cylinder will cause it to become a rocket with tremendous force.

Keep the gas cylinders away from exposure to high temperature.

Remember the pressure in the gas cylinders increases with the temperature.

Store full and empty gas cylinders separately in a well ventilated place.

Mark the empty cylinders (MT/EMPTY)with chalk.

If a cylinder leaks due to defective valve or safety plug, do not try to repair it yourself, but move it to a safe area with a tag to indicate the fault and then inform the supplier to pick it up.

When the cylinders are not in use or they are being moved, at on the valve protection caps.

Cylinders should always be kept in upright position and properly chained when in use.

Close the cylinder valves both when the gases are full or empty.

Never remove the valves protection cap while lifting cylinders.

Avoid exposing the cylinders to furness heat, open fire or sparks from the torch.

Never move a cylinder by dragging. sliding or rolling it on its sides.

Never apply undue force to open or close a cylinder valve.

Avoid the use of hammer or wrench.

Always use a proper cylinder (or spindle) key to open or close the cylinder valves.

Do not remove the cylinder key from the cylinder valve when it is in use. It may be needed immediately to close the gas in case of emergency.

Smoking or naked lights should be strictly prohibited near gas cylinders.

Never strike an arc or direct gas flame on a gas cylinder.

Safety procedure for handling an internally fired dissolved acetylene (D A) cylinder.

In the case of severe backfire of flashback the DA cylinder may catch fire.

Close the blowpipe valve immediately (oxygen first).

No damage will occur to the cylinder if the backfire is arrested at the blowpipe.

The signs of severe backfire or flashback are:

- a squeezing or hissing noise in the blowpipe
- a heavy black smoke and sparks coming out of the nozzle
- over heating of the blowpipe handle.

To control this:

- Close the cylinder valves
- Disconnect the regulator from the cylinder valve
- Check the hosepipes and blowpipe before re-use.

If the cylinder catches fire externally due to the leakage of gas at the connection:

- Close the cylinder valve immediately(wearing asbestos gloves as a safety measure)
- Use carbon dioxide fire extinguisher to extinguish the fire
- rectify the leakage thoroughly before putting into further use.

If the cylinder becomes overheated due to internal or external fire:

- close the cylinder valve
- detach the regulator from the cylinder
- remove the cylinder to an open space, away rom smoking or naked light
- cool the cylinder by spraying with water
- inform the gas cylinder supplier immediately.

Never keep such defective cylinders with the other cylinders.

Scan the QR Code to view the video for this exercise

Importance of welding in Industry

Objectives: At the end of this lesson you shall be able to
- **realise and state the importance of welding in industry**
- **state the advantages of welding over other methods of joining metals.**

In engineering industry, joining of different type of metals is necessary to make various components/parts having different shapes. Various type of parts are joined by bolting or riveting if thickness of metal is more. Example: Iron bridges, steam boilers, roof trusses, etc. For joining thin sheets (2mm thick and below) sheet metal joints are used. Example: Tin containers, oil drums, buckets, funnels, hoppers etc, also thin sheets can be joined by soldering and brazing.

But very heavy thick plates used in heavy industries are not joined by riveting or bolting as the joints will not be able to withstand heavy loads. Also the cost of production will be more. So many special materials for special applications like space ships, atomic power generation, thin walled containers for storing chemicals. etc have been developed in the recent years. They can be joined easily at a lower cost with good joint strength by using welding. A welded joint is the strongest joint of all the other types of joints, The efficiency of a welded joint is 100% whereas the efficiency of other types of joints are less than 70%

So all industries are using welding for the fabrication of various structures.

Advantages of welding over methods of joining metals

Welding method: Welding is metal joining method in which the joining edges are heated and fused together to form permanent (homogeneous) bond/joint.

Comparison between welding and other metal joining methods

Riveting, assembling with bolt, seaming, soldering and brazing all result in temporary joints. Welding is the only method to join metals permanently.

The temporary joints can be separated if:

- the head of the rivet is cut
- nut of the bolt is unscrewed
- hook of the seam is opened
- more heat is given than that required for soldering and brazing.

Advantages of welding

Welding is superior to other metal joining methods because it:

- is a permanent pressure tight joint
- occupies less space
- gives more economy of material
- has less weight
- Withstands high temperature and pressure equal to joined material
- can be done quickly
- gives no colour change to joints

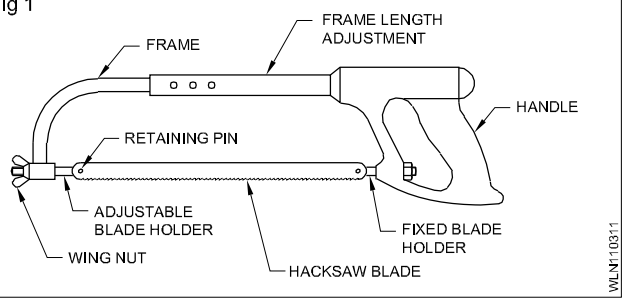
It is the strongest joint and any type of metal of any thickness can be joined.

Hacksaw frames and blades

Objectives: At the end of this lesson you shall be able to
- **identify the parts of a hacksaw frame**
- **specify hacksaw blades**
- **state the different types of hacksaw frames and their uses.**

The hand hacksaw is used along with a blade to cut metals of different sections. It is also used to cut slots and contours. See fig 1 to identify the parts.

Fig 1



Types of hacksaw frames: The two different types of hacksaw frames are solid frames and adjustable frames.

Solid frame: Only a particular standard length of blade can be fitted to this frame.

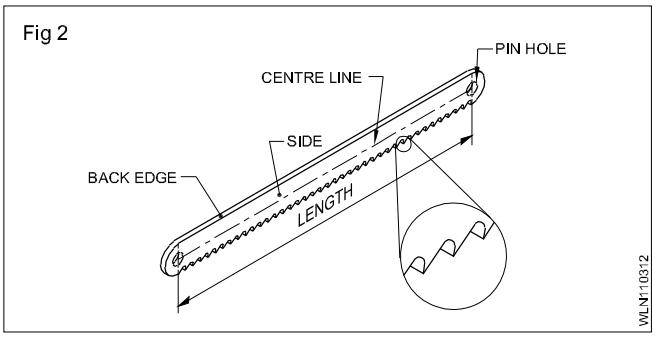
Adjustable frame (Flat type): Different standard lengths of blades can be fitted to this frame.

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

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

Hacksaw blades (Fig 2): A hacksaw blade is a thin narrow steel band with teeth cut on one edge and two pin holes at the ends. It is used along with a hacksaw frame. The blade is made of either low alloy steel or high speed steel and is available in standard lengths of 250 mm and 300 mm.

Fig 2



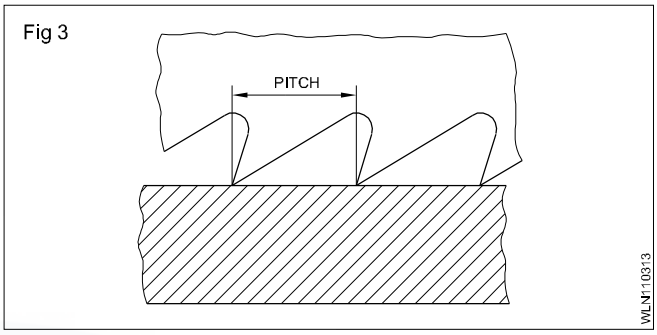
Type of Hacksaw Blades: Two types of hacksaw blades are available - all hard blades and flexible blades.

All hard blades: The full blade is hardened between the pin holes.

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.

Pitch of Blade (Fig 3): The distance between adjacent teeth is known as the 'pitch' of the blade.

Fig 3



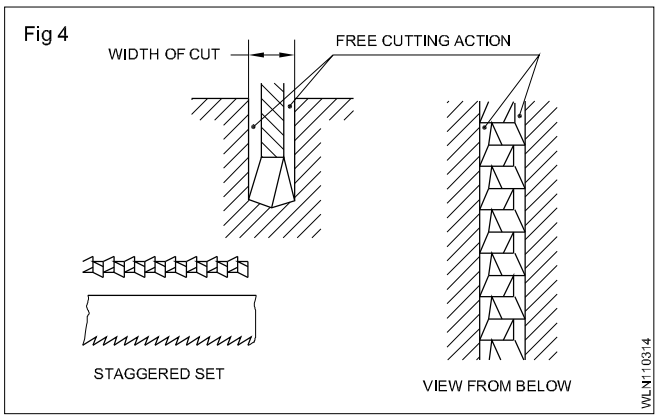
Classification	**Pitch**
Coarse	1.8 mm
Medium	1.4 mm & 1.0 mm
Fine	0.8 mm

Hacksaw blades are specified according to the length, pitch and type.

Setting of the saw: To prevent the saw blade bending between the cut edges when penetrating into the material and to allow free movement of the blade, the width of cut is to be broader than the thickness of the saw blade. This is achieved by the setting of the saw teeth. There are two types of saw settings.

Staggered set (Fig 4): Alternate teeth or groups of teeth are staggered. This arrangement helps for cutting, and provides for good chip clearance.

Fig 4



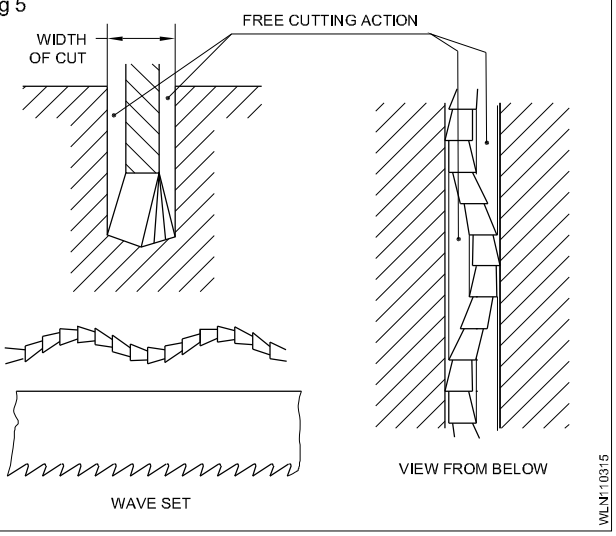
Wave Set (Fig 5): In this, the teeth of the blade are arranged in a wave form.

The set of blades can be classified as follows.

Pitch	Type of Set
0.8 mm	Wave set
1.0 mm	Wave or staggered
Over 1.0 mm staggered	

For best result, the blade with the right pitch should be selected and fitted correctly onto the hacksaw frame.

Fig 5



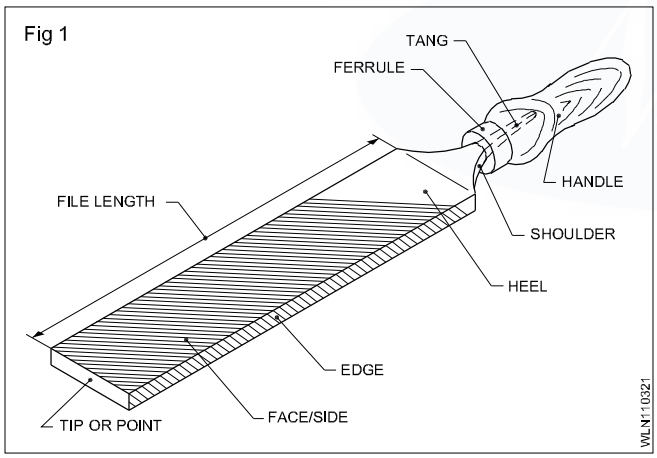
Files - Grades and specification

Objective: At the end of this lesson you shall be able to
- **identify the parts of a file.**

Parts of a file (Fig 1): **The parts of a file as can be seen in fig 1, are**

Tip or point: The end opposite to tang.

Fig 1



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

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

Heel: The portion of the broad part without teeth near the tang.

Shoulder: The curved part of the file joining tang from the body.

Tang; The narrow and thin part of a file which fits into the handle

Handle: The part fitted to the tang for holding the file

Ferrule; A protective metal ring to prevent cracking of the handle.

Materials: Generally files are made of high carbon or high grade cast steel. The body portion is hardened and tempered. The tang is, however, not hardened.

Cut of files

Objectives: At the end of this lesson you shall be able to
- **name the different cuts of files**
- **state the uses of each type of cut.**

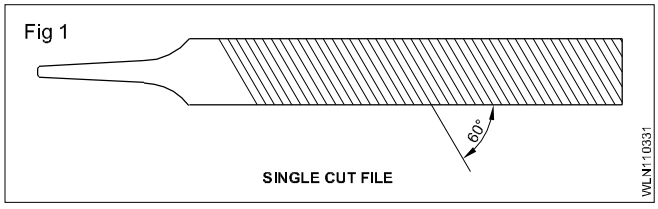
The teeth of a file is formed by cuts made on its face. Files have cuts of different types. Files with different cuts have different uses.

Type of cuts: Basically there are four types.

Single cut, double cut, Rasp cut and curved cut.

Single cut File (Fig. 1): a single cut file has rows of teeth cut in one direction across its face. The teeth are at an angle of 60° to the center line. It can cut chips as wide as the cut of the file. Files with this cut are useful for filing soft metals like brass, aluminium, bronze and copper.

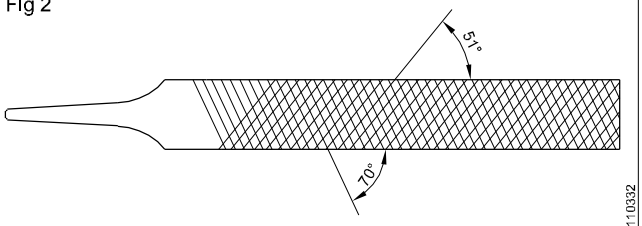
Fig 1



Single cut files do not remove stock as fast as double cut files, but the surface finish obtained is much smoother.

Double cut file (Fig 2): A double cut file has two rows of teeth cut diagonal to each other. The first row of teeth is known as OVERCUT and they are cut at an angle of 70° The other cut, made diagonal to this, is known as UPCUT, and is at an angle of 51°. This removes stock faster than the single cut file.

Fig 2

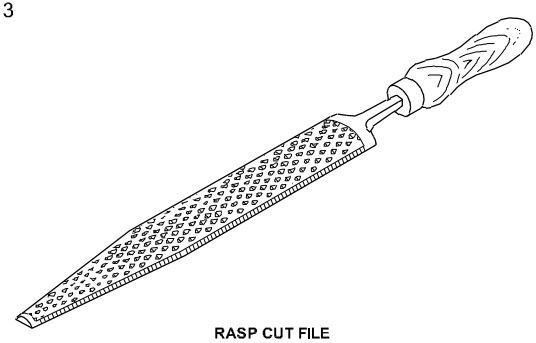


DOUBLE CUT FILE

Rasp cut file (Fig 3): The rasp cut 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.

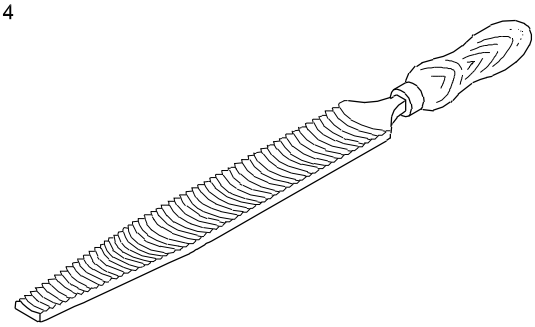
Curved cut file (Fig 4): These files have deeper cutting action and are useful for filing soft materials like-aluminium, tin, copper and plastic. The curved cut are available only in a flat shape.

Fig 3



RASP CUT FILE

Fig 4



CURVED CUT FILE

The selection of a file with a particular type of cut is based on the material to be filed. Single cut files are used for filing soft materials.

File specifications and grades

Objectives: At the end of this lesson you shall be able to
- **state how files are specified**
- **name the different grades of files**
- **state the application of each grade of file.**

Files are manufactured in different types and grades to meet the various needs.

Files are specified according to their length, grade, cut and shape.

Length is the distance from the tip of a file to the heel. Fig1 under lesson parts of a File.

File grades are determined by the spacing of the teeth.

A rough file is used for removing rapidly a larger quantity of metal. It is mostly used for trimming the rough edges of soft metal castings.

A bastard file is used in cases where there is a heavy reduction of material.

A second cut file is used to give a good finish on metals, It is excellent to file hard metals. It is useful for bringing the jobs close to the finishing size.

A smooth file is used to remove small quantity of material and to give a good finish.

A dead smooth file is used to bring to accurate size with a high degree of finish.

The most used grades of files are bastard, second cut, smooth and dead smooth. These are the grades recommended by the Bureau of Indian Standards. (BIS)

Different sizes of files with the same grade will have varying sizes of teeth. In longer files, the teeth will be coarser.

File shapes

Objectives: At the end of this lesson you shall be able to
- **state the features of flat and hand files**
- **state the application of flat and hand files.**

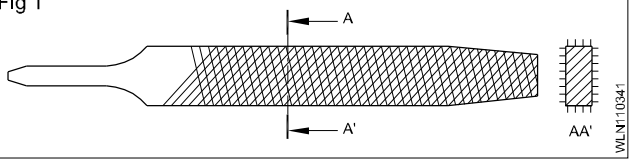
Files are made in different shapes so as to be able to file and finish components to different shapes,

The shape of files is usually specified by their cross section as flat, square, triangular, round, half round and knife edge.

The files useful for this this exercise i,e., filing to square are flat files and hand files.

Flat files (Fig. 1): These files are of a rectangular cross section. The edges along the width of these files are parallel up to two-thirds of the length. And then they taper towards the point. The faces are double cut, and the edges single cut. These file are used for general purpose work. They are useful for filing and finishing external and internal surfaces.

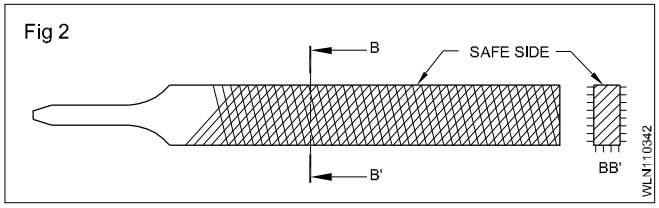
Fig 1



Hand files (Fig. 2): These files are similar to the flat files in their cross section. The edges along the width are parallel throughout the length. The faces are double cut.

One edge is single cut whereas the other is safe edge. Because of the safe edge, they are useful for filing surfaces which are at right angles to surfaces already finished.

Fig 2



Cleaning of files

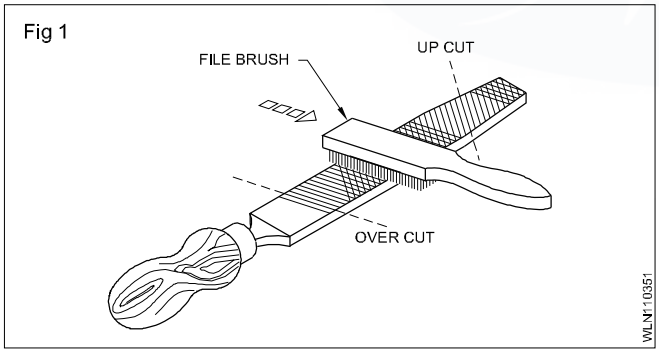
Objective: At the end of this lesson you shall be able to
- **understand how to clean files**

During filing, the metal chips (Filings) will clog between the teeth of the files. This is known as 'pinning' of the files. Files which are pinned will produce scratches on the surface being filed, and also will not bite well to cut the metal properly.

Method of removing pinning: Pinning of the files is removed by using a file brush. (File card)

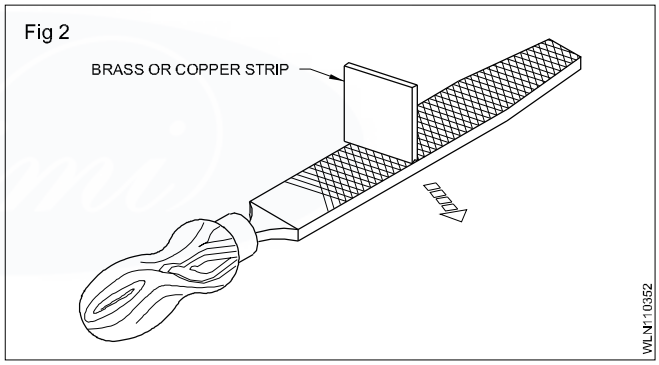
Press the file brush on the surface of pinned file and pull it along the direction of the overcut. (Fig 1)

Fig 1



When filing a work piece to a smooth finish more' pinning' will take place because the pitch and depth of the teeth are less. The file can also be cleaned by rubbing a copper or brass strip over the pinned surface. (Fig 2)

Fig 2



Application of chalk on the face of the file will help reduce the penetration of the teeth and 'pinning'.

Clean the file frequently in order to remove the filings embedded in the chalk powder.

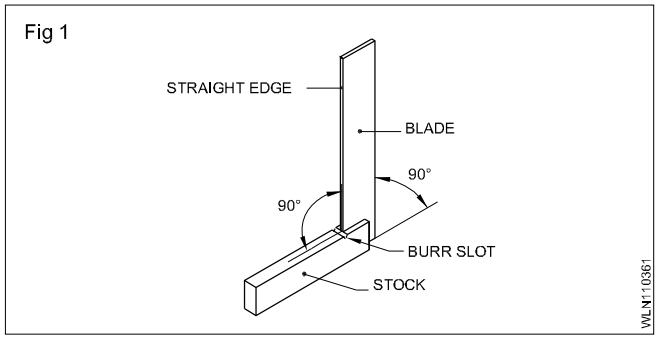
Try square

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

Try square Fig 1 is a precision instrument which is used to check the squares and the flatness of surfaces very accurately.

The try square has a blade with parallel edges. This blade is fixed to the stock at 90°. Burr slot is provided on the stock at meeting point of blade to accommodate the burr, if present on the component, to avoid inaccuracy in measuring squares.

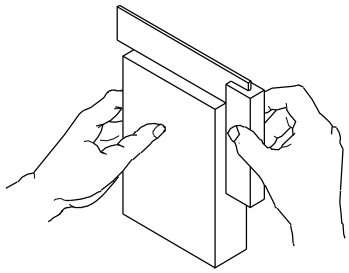
Fig 1



Uses: The try square is used to check the squares of machined of filed surfaces (Fig 2) and check flatness of surfaces (Fig 3), mark line at 90° to the edges of work pieces (Fig 4) and set work pieces at right angles on work holding devices. (Bench vice) Fig 5

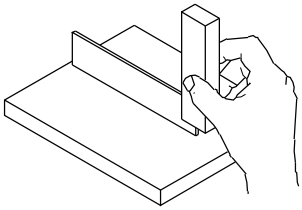
Try squares are made of hardened steel. Try squares are specified according to the length of the blade i.e. 100mm, 150mm, 200mm.

Fig 2



WLN1 10362

Fig 3



WLN1 10363

Fig 4

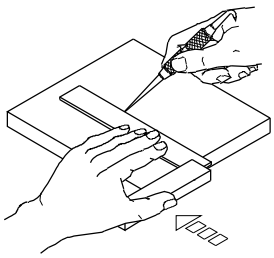


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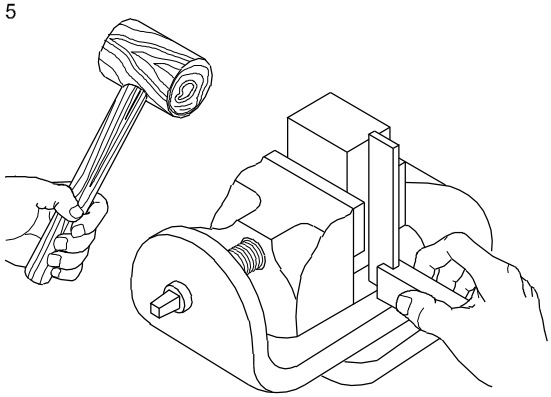
Fig 5



WLN1 10365

Mallets

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

- **state the different types of mallets**
- **state the uses of mallets**
- **state the care and maintenance.**

Mallet is a shaping tool used for general purpose work like flattening, bending and forming to required shape of sheet metal.

These are made of hard wood

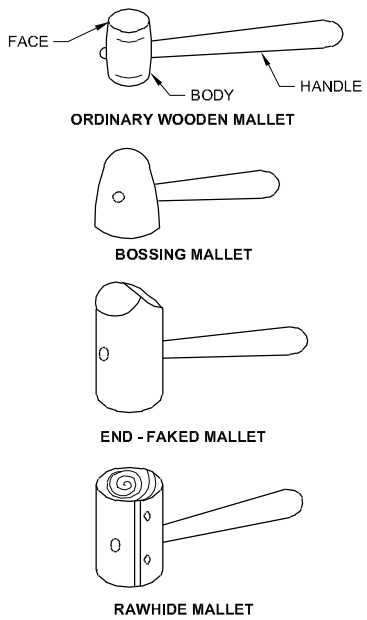
When using any metal hammer for flattening the sheet metal, the face of the hammer may damage or leave impression in the sheet more than what is required for the job. To avoid such damage and a impression, mallets are used.

Types (Fig 1)

- Ordinary mallet
- Bossing mallet
- End-faked mallet
- Raw hide mallet,

Ordinary mallet: Both the faces of the mallets, are provided a little convexity. If the face is not in convex shape the edges of the mallet face will get broken while beating the job.

Fig 1



WLN1 10371

Mallets are specified by the dia and the shape of the face. Mallets are available in 50mm, 75mm and 100 mm dia

Avoid using the mallet as hammer for doing chipping and to drive nails and work on the sharp corners. If the mallet is used for the above work its face will get damaged.

Bench vice

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

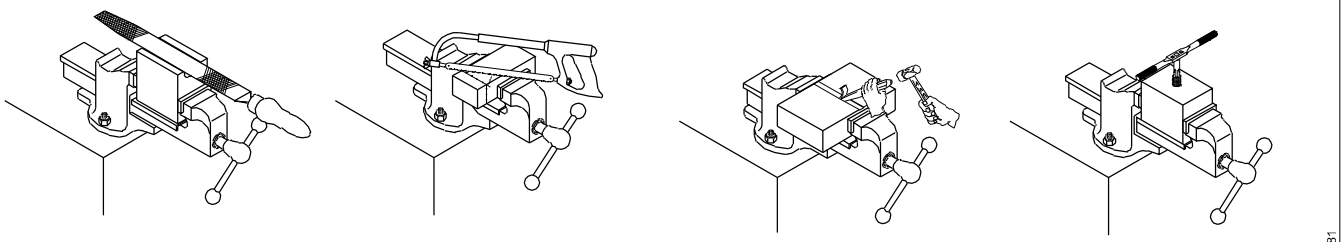
- **name the parts and uses of a bench vice**
- **specify the size of a bench vice**
- **state the uses of vice clamps.**

These are used for holding work pieces. They are available in different types. The vice used for bench work is bench vice. (Engineer's vice)

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.

Fig 1



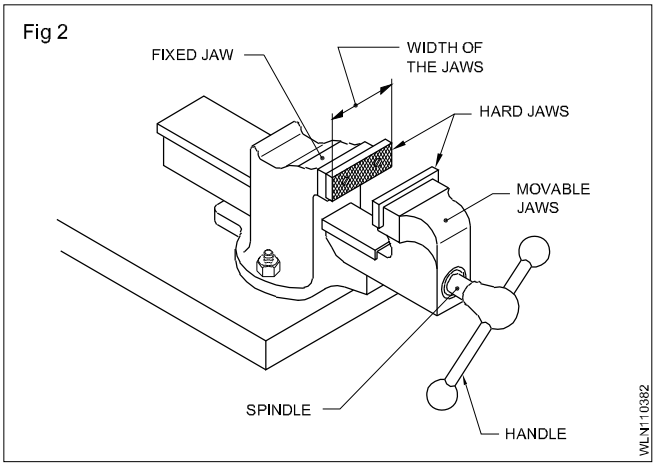
Parts of a bench vice (Fig 2)

The following are the parts of vice:

Fixed jaw, Movable jaw, Hard jaws, Spindle, Handle, Box nut and Spring.

The box nut and the spring are the internal parts.

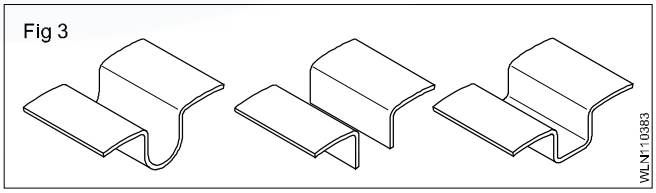
Fig 2



Vice clamp or soft jaws (Fig 3)

To hold a finished work use soft jaws (Vice claps) made of aluminium over the regular hard jaws. This will protect the work surface from damage.

Fig 3



Do not over-tighten the vice, otherwise, the spindle may be damaged.

Scan the QR Code to view the video for this exercise

Introduction and definition of welding

Objectives: At the end of this lesson you shall be able to
- **state the invention of welding**
- **describe the different ways to weld.**

The history of joining metals goes back several millennia. Called forge welding, the earliest come from the Bronze and Iron Ages in Europe and the Middle East. The middle Ages brought advances in forge welding. in which blacksmiths used to heat the metal repeatedly until bonding occurred

In 1801, Sir Humphry Davy discovered the electrical arc. In 1802, Russian Scientist Vasily Petrov also discovered the electric arc and subsequently proposed possible practical applications such as welding. In 1881-82, a Russian Inventor Nlkolai Benardos and polish Stainshlaw olszewski created the first electric arc, welding method known as carbon arc welding; they used carbon electrodes.

The advances in arc welding continued with the invention of metal electrodes in the late 1800's by a Russian, Nikolai Slavyanov (1888), and an American, C.L. Coffin (1890). Around 1900, A.P. Strohmenger released a coated metal electrode in Britain, which gave a more stable arc.

In 1905, Russian scientist Vladmir mitkevich proposed using a three-phase electric arc for welding. In 1919, alternating current welding was invented by C.J. Holslag but did not become popular for another decade.

Welding is a fabrication process that joins materials normally metals. This is often done by melting the work pieces and adding a filler material to form pool of molten material that cools to become a strong joint, with pressure sometimes used in conjunction with the heat or by itself, to produce the weld. This is in contrast with soldering & brazing, which involve melting a lower-melting-point material to form a bond between them, without melting the work pieces.

There are many different ways to weld. Such as; Shielded Metal Arc Welding (SMAW). Gas Tungsten Arc Welding (GTAW), and Gas Metal Arc Welding (GMAW).

GMAW involves a wire fed "gun" that feeds wire at an adjustable speed and sprays a shielding gas (generally pure Argon or a mix of Argon and Co_2) over the weld puddle to protect it from the effect of atmosphere.

GTAW involves a much smaller hand-held gun that has a tungsten rod inside of it. With most, you use a pedal to adjust your amount of heat and hold a filler metal with your other hand and slowly feed it.

Stick welding or Shielded Metal Arc Welding has an electrode that has flux, the protecting for the puddle, around it. The electrode holder holds the electrode as it slowly melts away. Slag protects the weld puddle from the affection of atmosphere. Flux-core is almost identical to stick welding except once again you have a wire feeding gun; the wire has a thin flux coating around it that protects the weld puddle.

Many different sources of energy can be used for welding, including a gas flame, an electrical arc, a laser, an Electron Beam (EB), Friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including in open air, under water, and on outer space,. Welding is a potentially hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.

Safety in Shielded Metal Arc Welding

Objectives : At the end of this lesson you shall be able to
- **identify the safety apparels and accessories used in arc welding**
- **select the safety apparels and accessories to protect from burns and injuries**
- **learn how to protect yourself and others from the effect of harmful arc rays and toxic fumes**
- **select the shielding glass for eye and face protection.**

Non-fusion welding

This is a method of welding in which similar or dissimilar metals are joined together without melting the edges of the base metal by using a low melting point filler rod but without the application of pressure.

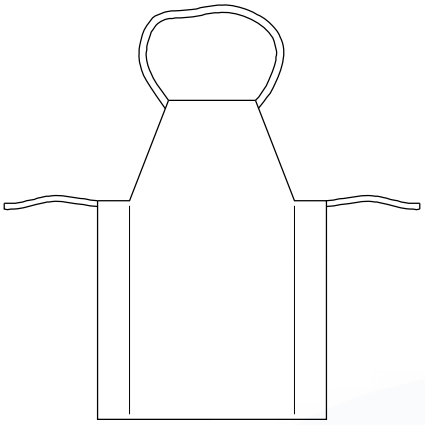
Example: Soldering, Brazing and Bronze welding.

During arc welding the welder is exposed to hazards such injury due to harmful rays (Ultra violet and infra red rays) of the arc, burns due to excessive heat from the arc and contact with hot jobs, electric shock. Toxic fumes, flying hot spatters and slag particles and objects falling on the feet.

The following safety apparels and accessories are used to protect the welder and other persons working near the welding area from the above mentioned hazards.

1 Safety apparels
   a Leather apron
   b Leather gloves
   c Leather cape with sleeves
   d Industrial safety shoes
2 a Hand screen
   b Adjustable helmet
   c Portable fire proof canvas screens
3 Chipping/grinding goggles
4 Respirator and exhaust ducting

Fig 1



APRON

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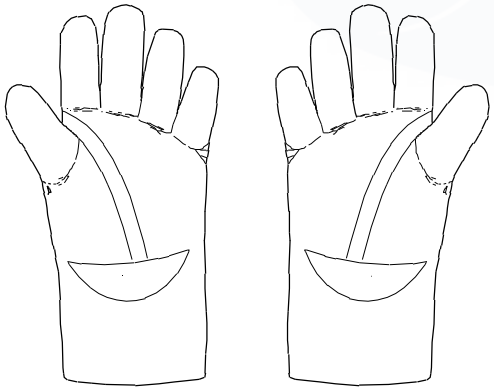
Fig 2

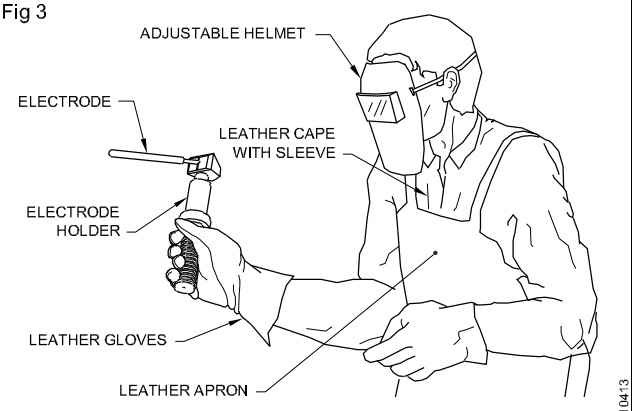


GLOVES

WLN110412

The leather apron, gloves, cape with sleeves and leg guard Fig 3,4,5 and 6 are used to protect the body, hands, arms, neck and chest of the welder from the heat radiation and hot spatters, from the arc and also from the hot slag particles flying from the weld joint during chipping off the solidified slag.

Fig 3



CAPE WITH SLEEVES

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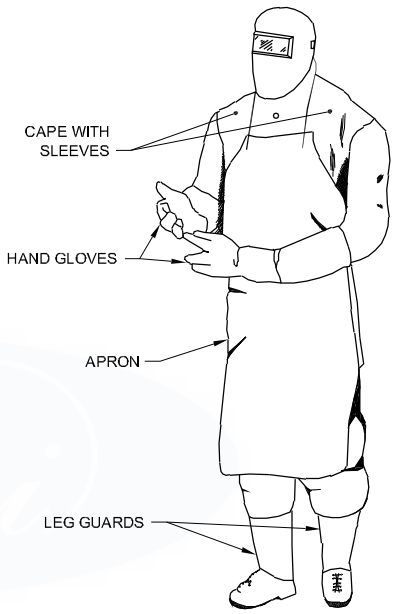
Fig 4



LEG GUARDS

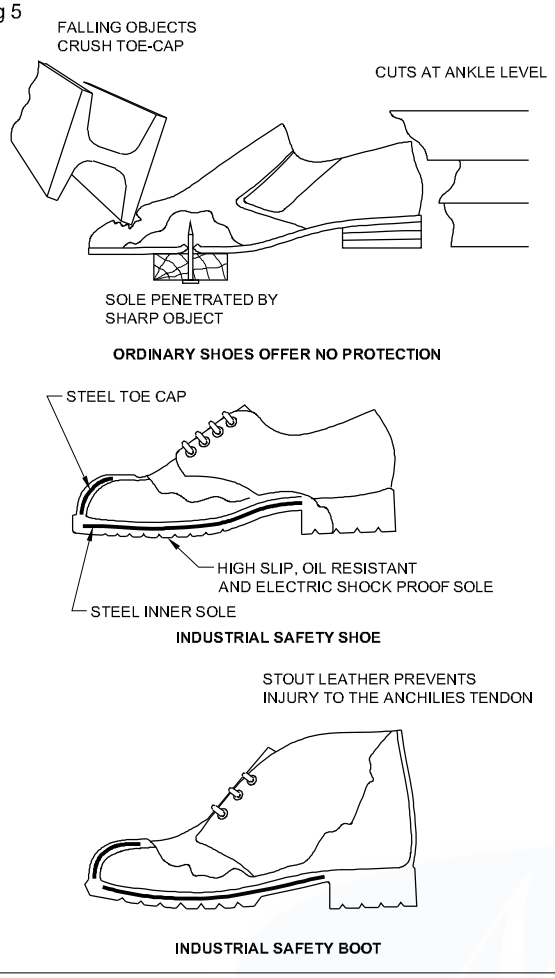
WLN110414

All the above safety apparels should not be loose while wearing them and suitable size has to be selected by the welder.

The industrial safety boot (Fig 5) is used to avoid slipping injury to the toes and ankle to the foot. It also protects the welder from the electric shock as the sole of the shoe is specially made of shock resistant material.

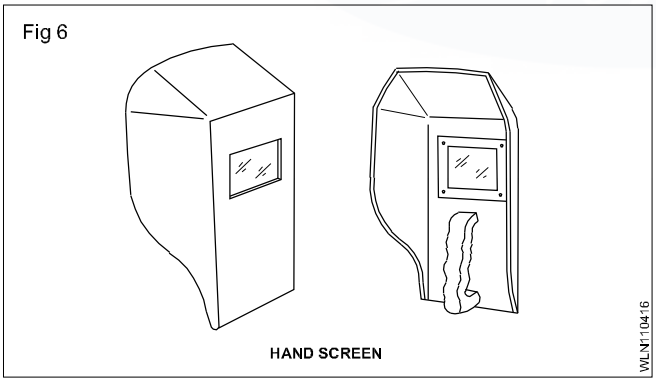
Welding hand screens and helmet: These are used to protect the eyes and face of a welder from arc radiation and sparks during arc welding.

Fig 5



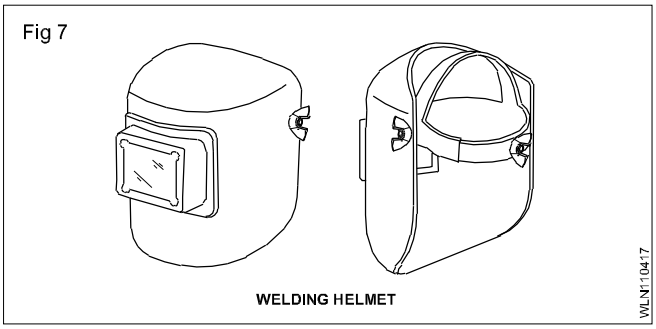
A hand screen is designed to hold in hand. (Fig 6)

Fig 6



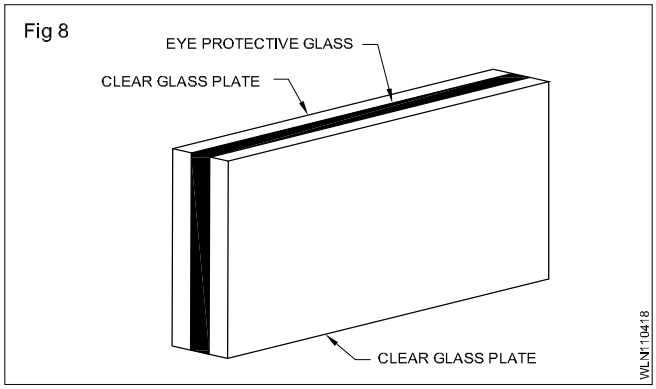
A helmet screen is designed to wear on the head. (Fig 7)

Fig 7



Clear glasses are fitted on each side of the coloured glass to protect it from weld spatters. (Fig 8)

Fig 8



The helmet screen provides better protection and allows the welder to use his both hands freely.

Coloured (filter) glasses are made in various shades depending on the welding current ranges. (Table1)

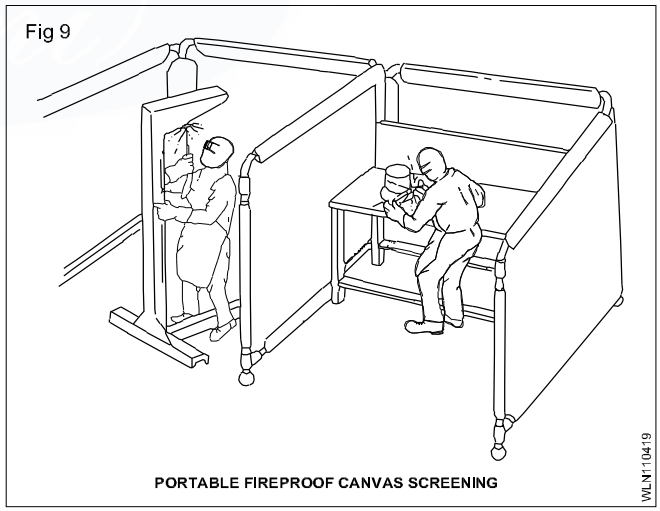
Table 1

Recommendations of filter glasses for manual metal arc welding

Shade No. of coloured glass	Range of welding current in amperes
8-9	Up to 100
10-11	100 to 300
12-14	Above 300

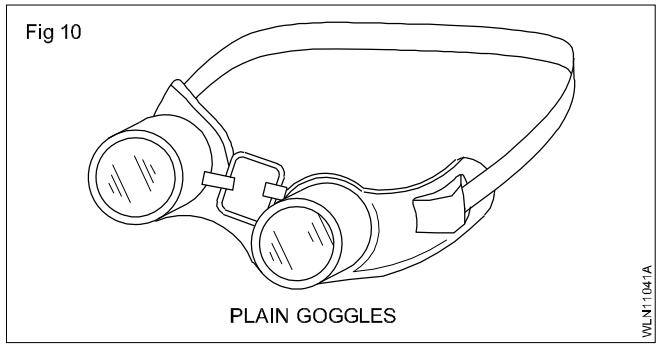
Portable fire proof canvas screens Fig. 9 are used to protect the persons who work near the welding area from arc flashes.

Fig 9



Plain goggles are used to protect the eyes while chipping the slag or grinding the job. Fig, 10

Fig 10



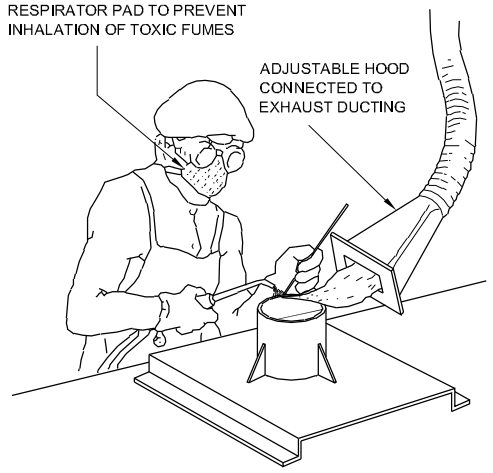
It is made of bakelite frame fitted with clear glasses and an elastic band to hold it securely on the operator's head.

It is designed for comfortable fit, proper ventilation and full protection from all sides.

Sometimes toxic fumes and heavy smoke may be liberated (given out) from the weld while welding non-ferrous alloys like brass etc. Use a respirator and use exhaust ducts and fans near the weld area to avoid inhaling the toxic fumes and smoke Fig 11.

Inhaling toxic fumes will make the welder become unconscious and fall on the hot welded job/on the floor. This causes burns or injury.

Fig 11



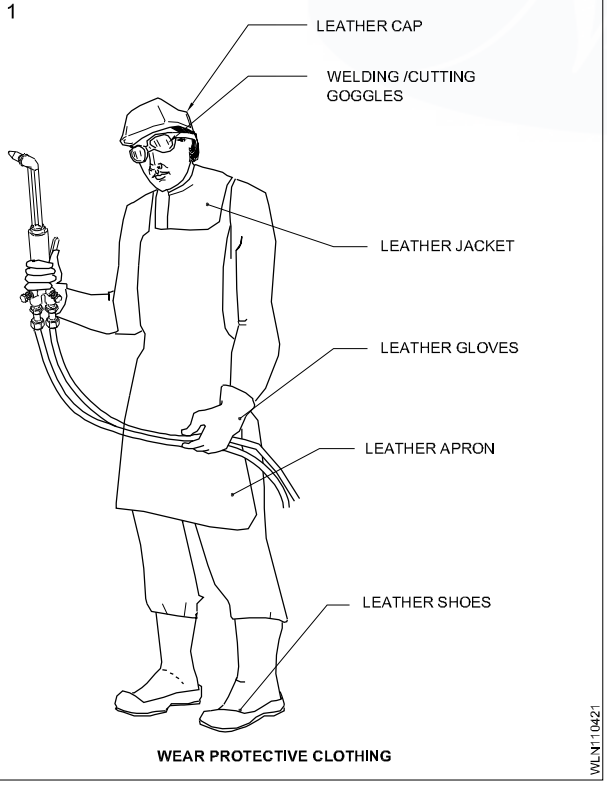
Safety in Gas cutting process

Objectives: At the end of this lesson you shall be able to
- **describe the safety precautions to be followed by handling gas cutting equipment**
- **explain the safety precautions to be followed by the operator**
- **state the safety required during gas cutting operation.**

Equipment safety: Safety precautions for gas cutting equipment are the same as those adopted in the case of gas welding equipment.

safety for the operator (Fig 1)

Fig 1



Always use safety apparel

Goggles, gloves and other protective clothing must be warn.

Safety during operation: Keep the work area free from flammable materials.

Ensure that the combustible material is at least 3 meters away from the cutting operation area.

In case the flammable material is difficult to remove, suitable fire resisting guards/partitions must be provided.

- protection of your eyes
- protection from burns
- protection of clothing
- protection of inhaling burnt gases.

protect yourself and others from the flying sparks.

Ensure that the metal being cut is properly supported and balanced so that it will not fall on the feet of the operator or on the hoses.

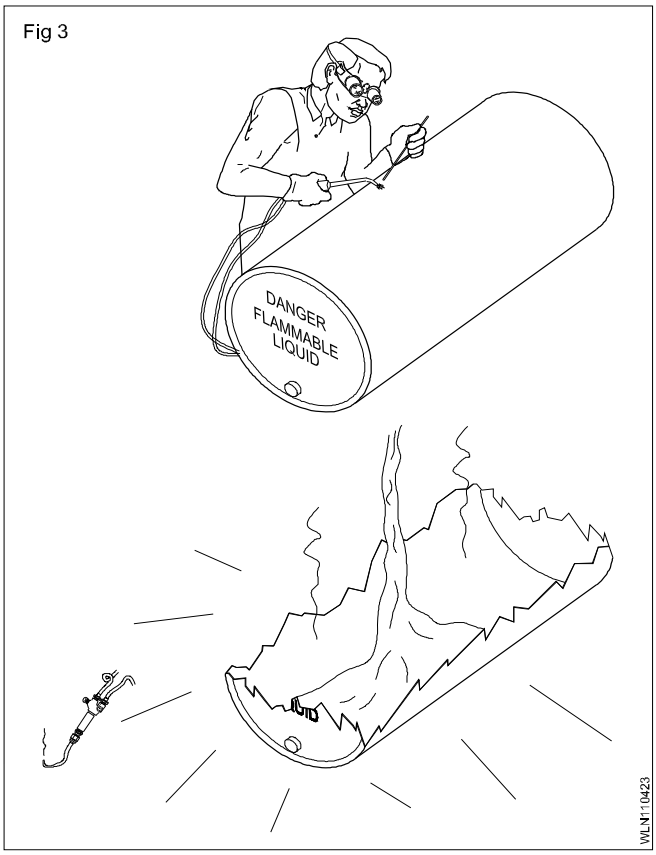
Keep the space clear underneath the cutting job so as to allow the slag to run freely, and the cutting parts to fall safely.

Be careful about flying hot metal and sparks while starting a cut. Containers which hold combustible substance should not be taken directly for cutting or welding. (Fig 2) Wash the containers with carbon tetrachloride and caustic soda before welding or cutting and fill them with water before repairing. (Fig 3)

Keep fire- fighting equipment handy and ready.

Fig 2

Fig 3



Length measurement

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

- **name the base unit of length measurement as per the International System of units of measurement (SI)**
- **state the multiples of a meter 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 UNITS and MULTIPLES

Base unit: The base unit of length as per the Systems International is the meter. The table given below lists some multiples of a metre.

METRE (m)	= 1000 mm
CENTIMETRE(cm)	= 10 mm
MILLIMETRE (mm)	= 1000u
MICROMETRE (um)	= 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 2)

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.

Fig 1

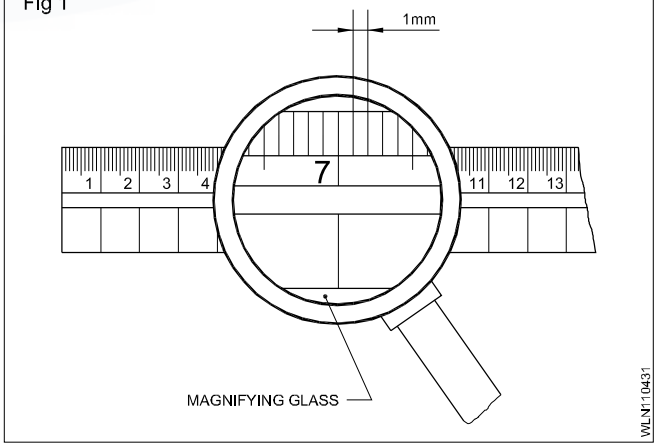
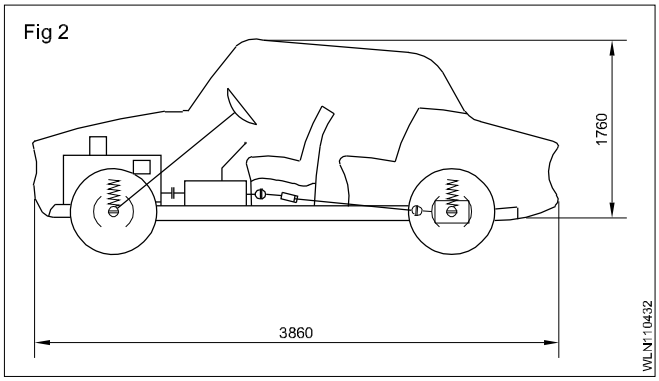


Fig 2



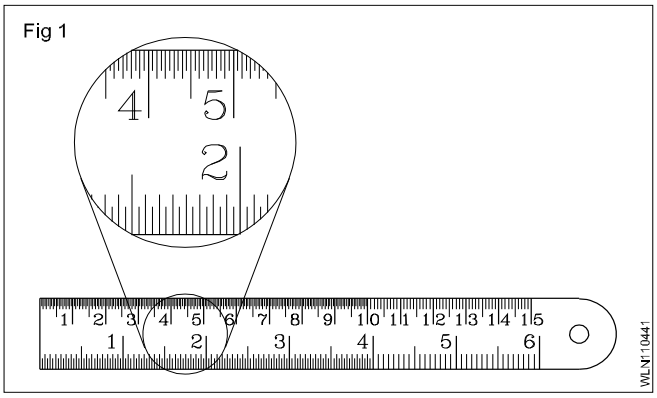
Steel rule

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

- **state the purpose of steel rule**
- **state the types of steel rule**
- **state the precautions to be followed while using a steel rule.**

Engineer's steel rule (Fig 1) is used to measure the dimensions of work pieces.

Fig 1

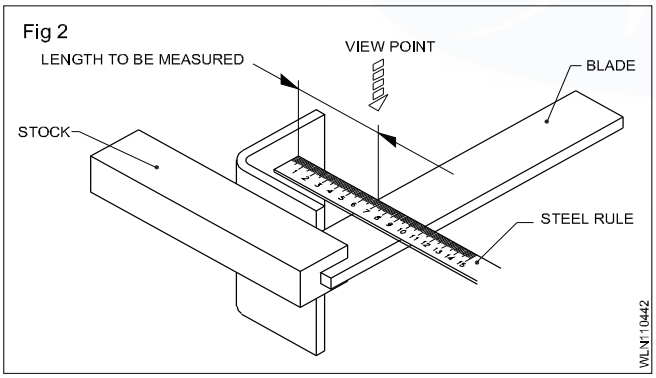


Steel rules are made of spring steel or stainless steel. These rules are available in length 150mm, 300mm and 600mm. The reading accuracy of steel rule is 0.5 mm and 1/64 inch.

For accurate reading it is necessary to read vertically to avoid errors arising out of parallax. (Fig1)

Steel rule in English measure, they can also be furnished with metric and English graduation in a complete range of size 150, 300, 500 and 1000 mm. (Fig 2)

Fig 2



Other types of rule

- narrow steel rules

- short steel rules

- full flexible steel rule with tapered end.

Narrow steel rule: Narrow steel rule is used to measure the depth of key-ways and depth of smaller dia, blind holes and other jobs, where the ordinary steel rule cannot reach. Width approximately 5mm thickness to 2mm. (Fig 3)

Short steel rule (Fig 4): This set of five small rules together with a holder is extremely useful for measurements in confined or hard to reach locations which prevent use of ordinary steel rules. It is used suitably for measuring grooves, short shoulder, recesses, key ways etc, in machining operation on shapers, millers and tool and die work.

Fig 3

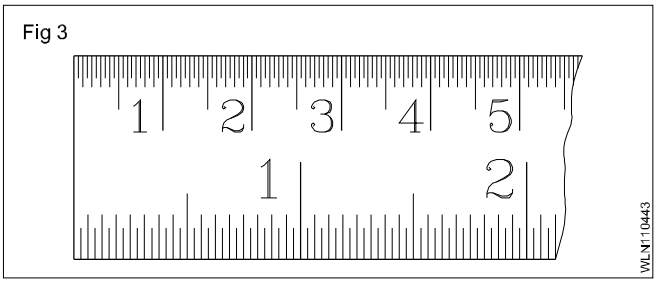
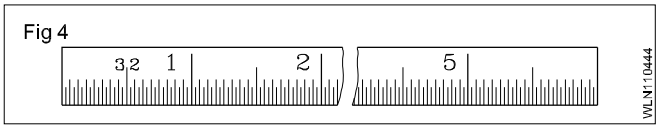
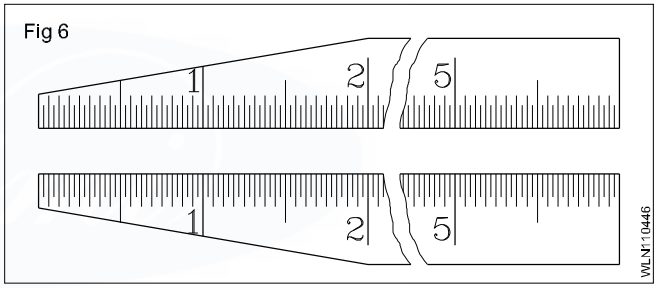


Fig 4



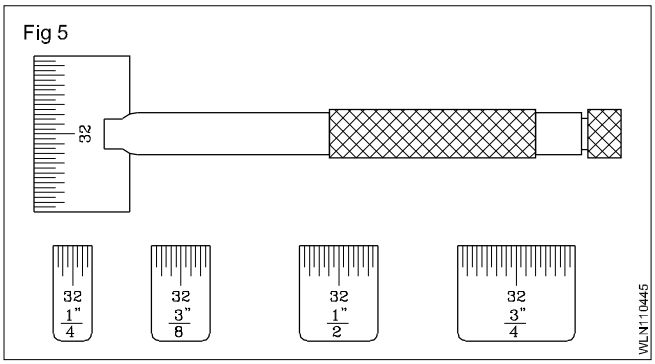
The rules are easily inserted in the slotted end of the holder and are rigidly clamped in place by a slight turn of the knurreled nut at the end of the handle. Five rule lengths are provided 1/4", 3/8", 1/2", 3/4", and 1" and each rule is graduated in 32" ^{nds} on the reverse side.

Fig 6



Steel rule with tapered end: This rule is a favorite with all mechanics since its tapered end permits measuring of inside size of small holes, narrow sots, grooves, recesses etc. This rule has a taper from 1/2 inch width at the 2 inch graduation to 1/8 inch width at the end. (Fig 6)

Fig 5



For maintaining the accuracy of a steel rule, it is important to see to it that its edges and surfaces are protected from damage and rust.

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

Types of calipers

Objectives: At the end of this lesson you shall be able to
- **name the commonly used calipers**
- **state the advantages of spring joint calipers.**

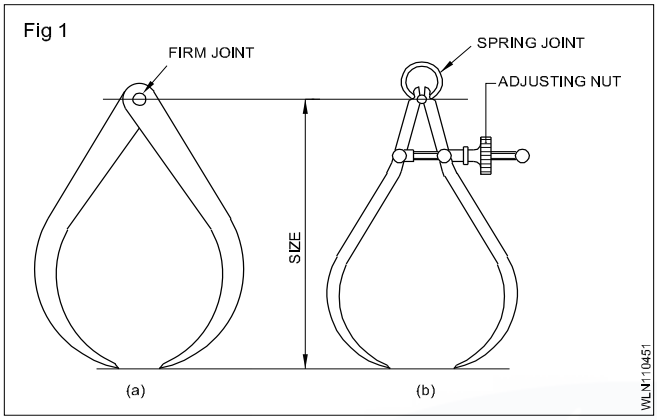
Calipers are indirect measuring instruments used for transferring measurements from a steel rule to a job, and vice versa.

Calipers are classified according to their joints and their legs.

Joint

- Firm joint calipers (Fig 1a)
- Spring joint calipers (Fig 1b)

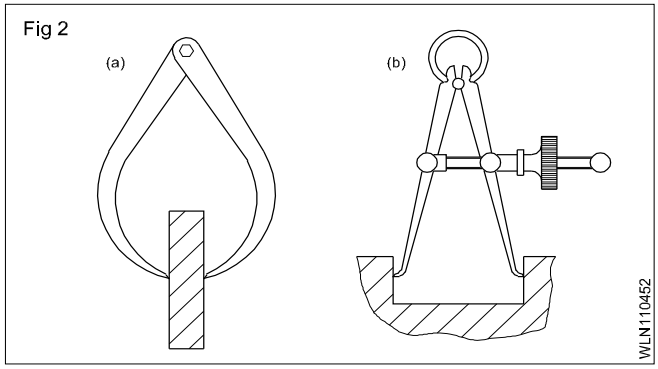
Fig 1



Legs

- Outside caliper for external measurement. (Fig 2a)
- Inside caliper for internal measurement. (Fig 2b)

Fig 2



Calipers are used 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 calipers with sensitive feel.

Spring joint calipers have the advantage of quick setting with the help of an adjusting nut. For setting a firm joint caliper, tap the leg lightly on a wooden surface.

Marking media

Objectives: At the end of this lesson you shall be able to
- **name the common type of marking media**
- **state the Correct marking media for different applications.**

Different marking media: The different marking media are Whitewash, Prussian Blue, Copper Sulphate and Cellulose Lacquer.

Whitewash: White wash is prepared in many ways

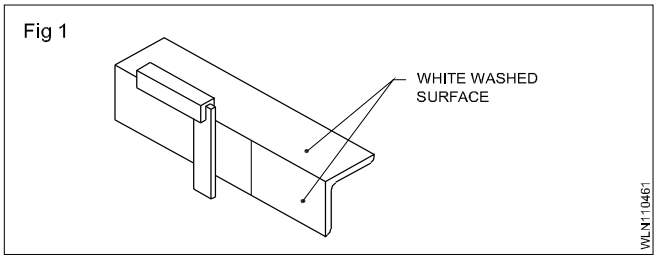
Chalk powder mixed with water

Chalk mixed with mentholated spirit

White lead powder mixed with turpentine.

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

Fig 1

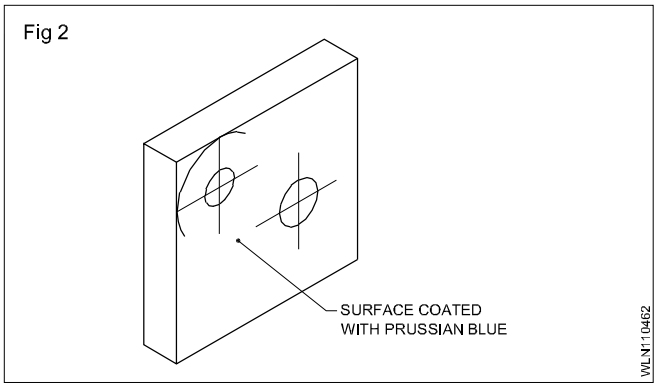


Whitewash is not recommended for work pieces of high accuracy.

Prussian Blue: This is used on file or machine-finished surfaces. This will give very clear lines but takes more time for drying than the other marking media. (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.

Fig 2



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.

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

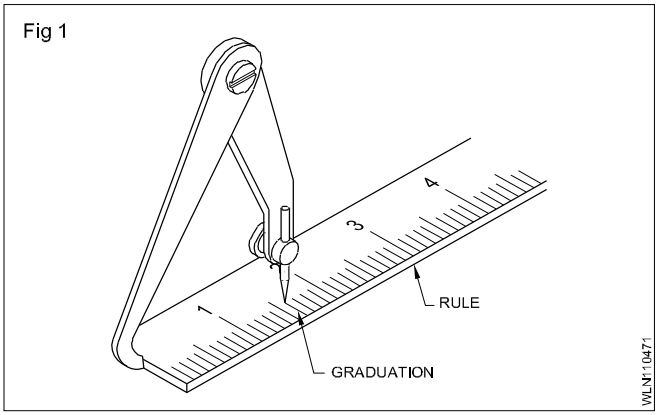
The selection of marking medium for a particular job depends on the surface roughness and the accuracy of the workpiece.

Jenny calipers

Objectives: At the end of this lesson you shall be able to
- **state the uses of a jenny caliper**
- **state the two types of legs of a jenny caliper.**

Jenny calipers have one leg with an adjustable divider point while the other is a bent leg. (Fig 1) These are available in sizes kg/150mm, 200mm, 250mm and 300mm.

Fig 1



Jenny calipers are used:

- For marking lines parallel to the inside and outside edges (Fig 2)
- For finding the center of round bars. (Fig 3)

These calipers are available with the usual bent leg or with a heel.

Calipers with bent leg (Fig 2B) are used for drawing lines parallel along an inside edge. and the heel type (Fig 2A) is used for drawing parallel lines along the outer edges.

The other names for this caliper are:

- Hemaphrodite calipers

Fig 2

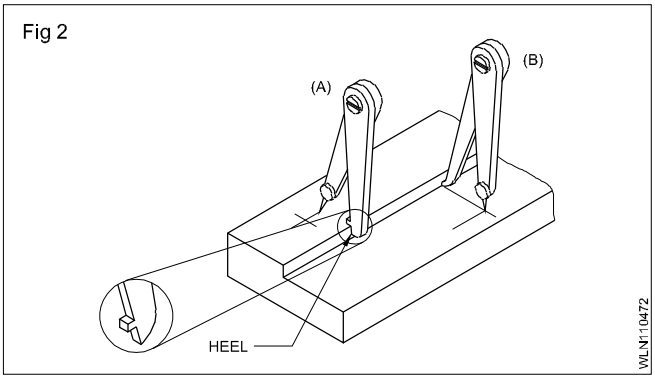
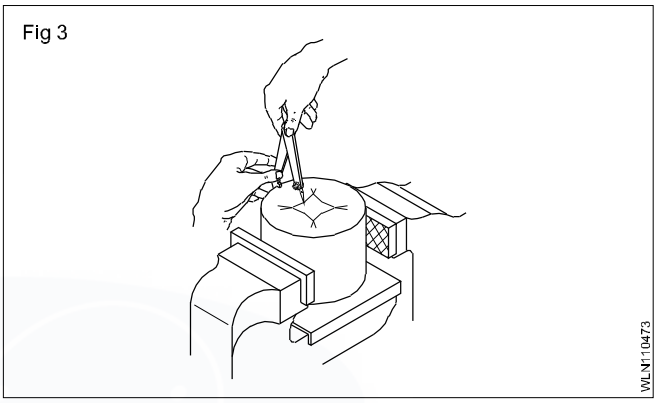


Fig 3



- Leg and point calipers
- Odd leg caliper

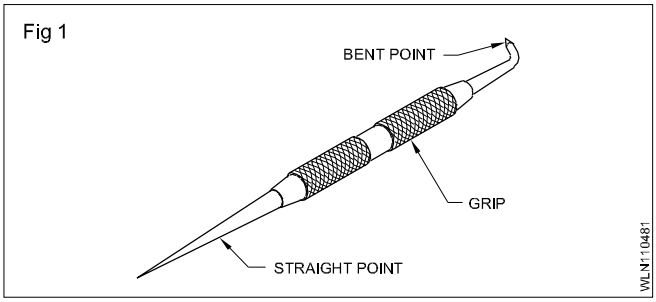
Scribers

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

In lay out work it is necessary to scribe lines to indicate the dimensions of the work piece to be filed or machined. The scriber is a tool used for this purpose. It is made of high carbon steel and is hardened. For drawing clear and sharp lines, the point should be ground and used frequently for maintaining its sharpness.

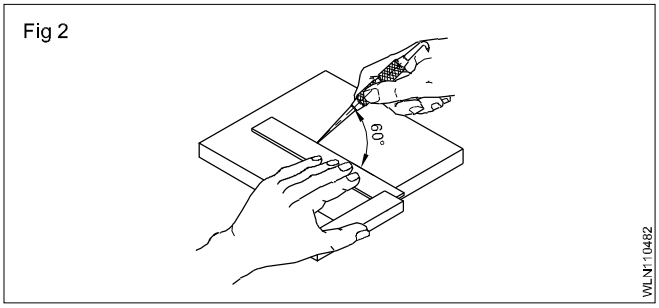
Scribers are available in different shapes and sizes. The most commonly used one is the plain scriber. (Fig 1)

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)

Fig 2



scriber points are very sharp: therefore, do not put the plain scriber in your pocket.

Place a cork on the point when not in use to prevent accidents.

Dividers

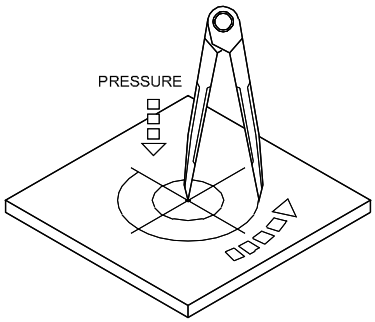
Objectives: At the end of this lesson you shall be able to

- **identify the parts of a divider**
- **state the uses of dividers**
- **state the specifications of dividers**
- **state some important hints on divider points.**

Dividers are used for scribing circles, arc and for transferring and stepping of distances. (Fig 1,2 and 3)

Dividers are available with firm joints and spring joints. (Fig 1& 4). The measurements are set on the dividers with a steel rule. (Fig 2)

Fig 1



FIRM JOINT DIVIDER

Fig 2

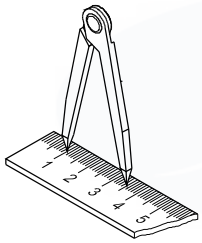
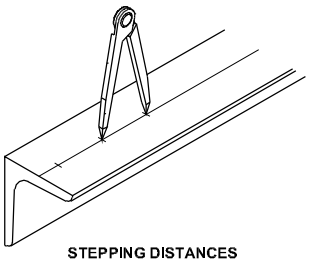


Fig 3



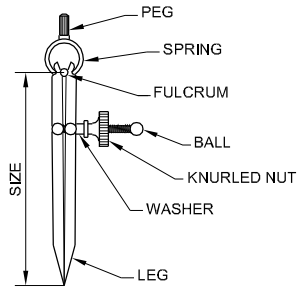
STEPPING DISTANCES

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 4)

For the correct location and seating of the divider point prick punch marks of 30° are used.

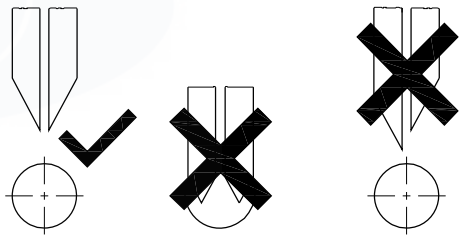
Fig 4



SPRING JOINT DIVIDER

The two legs of the divider should always be of equal length. (Fig 5) Dividers are specified by the type of their joints and length.

Fig 5



The divider point should be kept sharp in order to produce fine lines, frequent sharpening with an oilstone is better than sharpening by grinding. Sharpening by grinding will make the points soft.

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. (Figs 1&2)
- Setting jobs on machines parallel to a datum surface and checking the height and parallelism of jobs (Fig 3)
- Setting jobs concentric to the machine spindle. (Fig 4)

Types of surface gauges: Surface gauges/scribing blocks are of two types,

- Fixed and universal

Fig 1

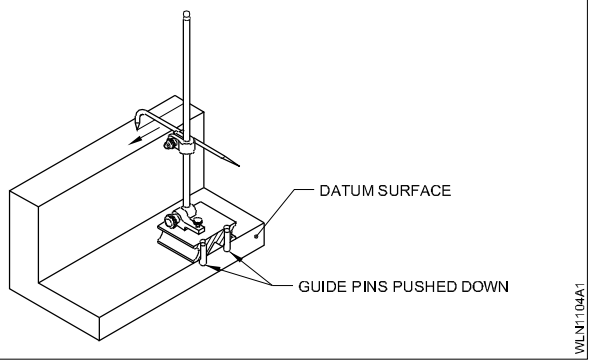


Fig 2

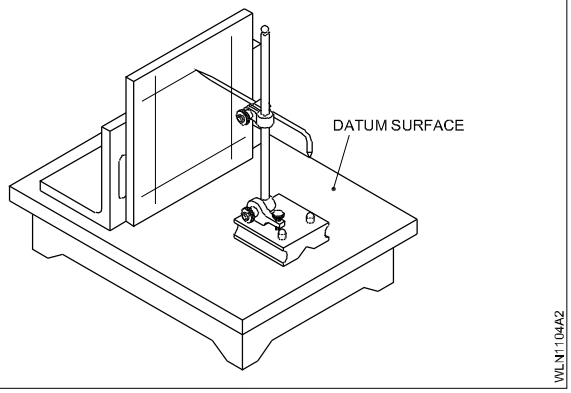


Fig 3

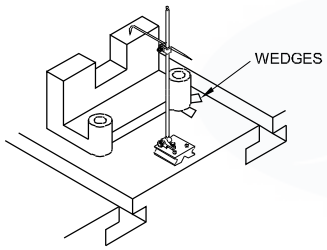
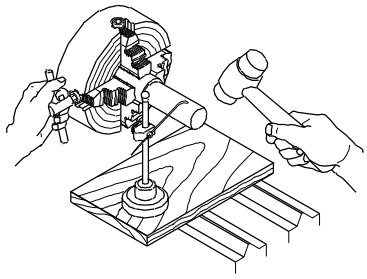
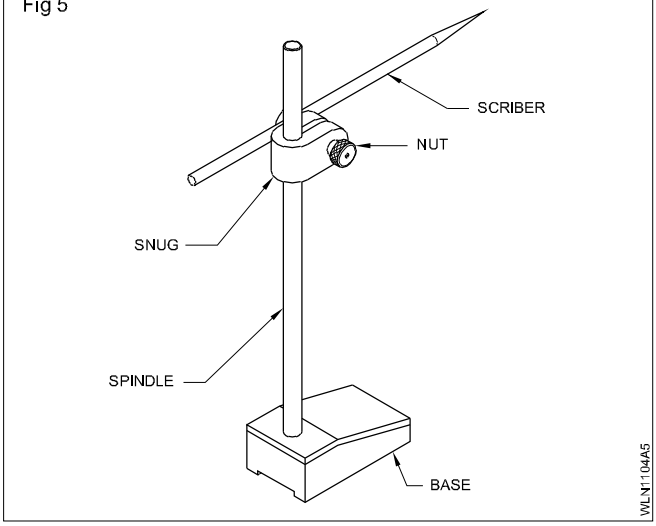


Fig 4



Surface gauge - Fixed type (Fig 5): The fixed type of surface gauges consist of a heavy flat base and a spindle, fixed upright, to which a scriber is attached with a snug and a clamp nut.

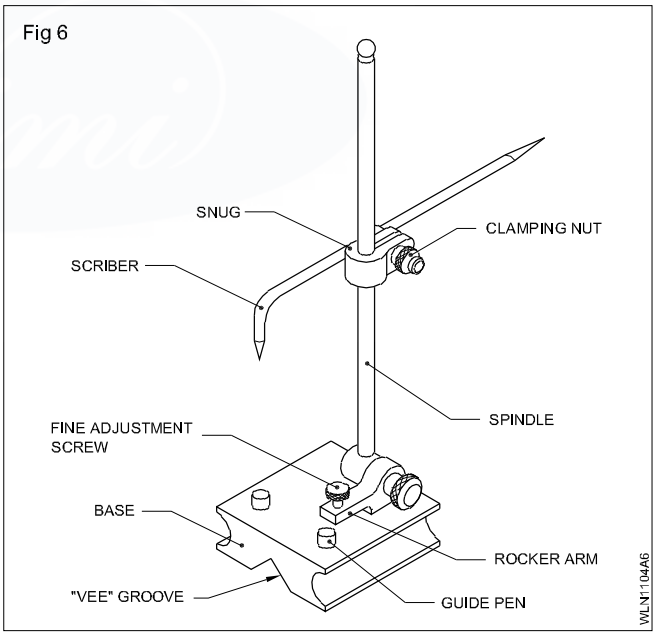
Fig 5



Universal Surface Gauge (Fig 6**):** This has the following

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

Fig 6

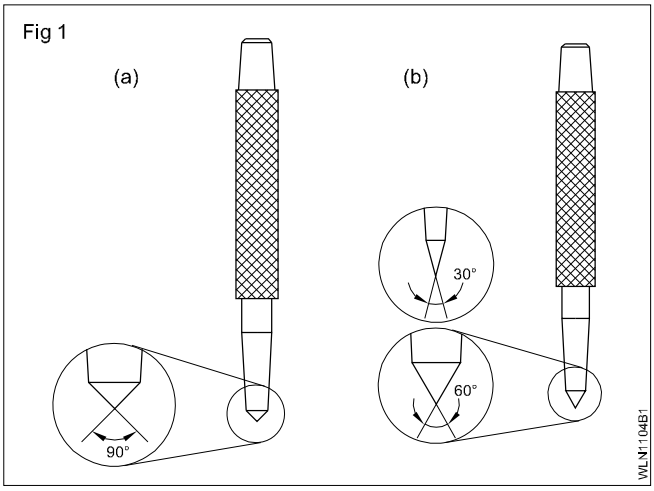


Types of marking punches

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

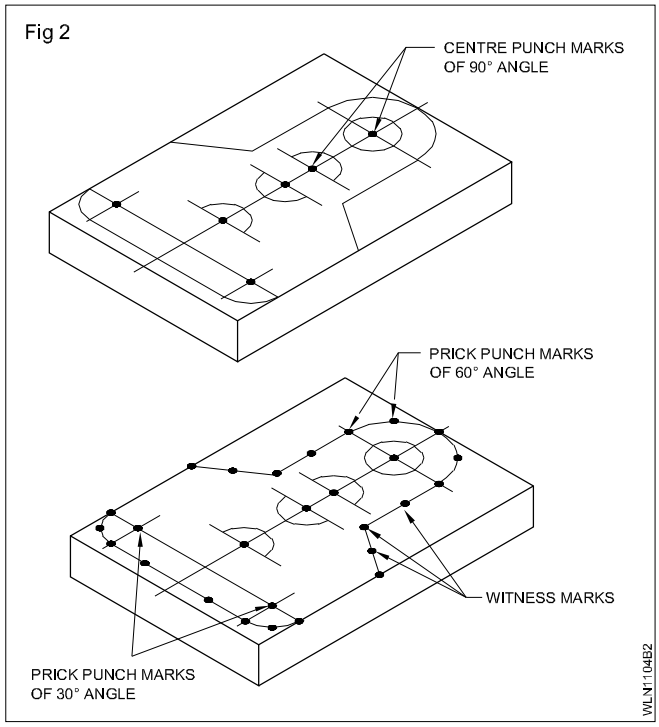
Punches are used in order to make certain dimensional features of the layout permanently. There are two types of punches. They are center punch and prick punch made up of high carbon steel, hardened and ground.

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



Prick punch/Dot punch: The angle of the prick punch is 30° or 60°. (Fig 1b) The 30° point punch is used for marking light punch marks needed to position dividers. The divider point will get a proper seating in the punch mark. The 60° punch is used for marking witness marks and called as dot punch (Fig 2)

The witness marks should not be too close to one another.



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.**

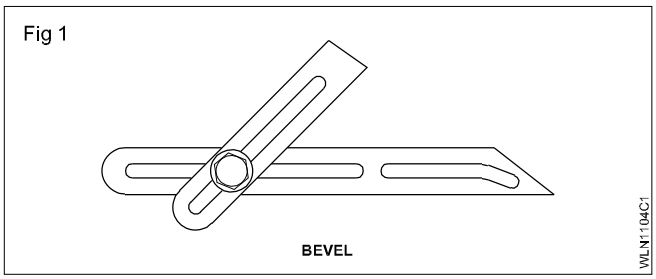
The most common instruments used to check angles are the:

- bevel or bevel gauge (Fig 1)

- Universal bevel gauge (Fig 2)

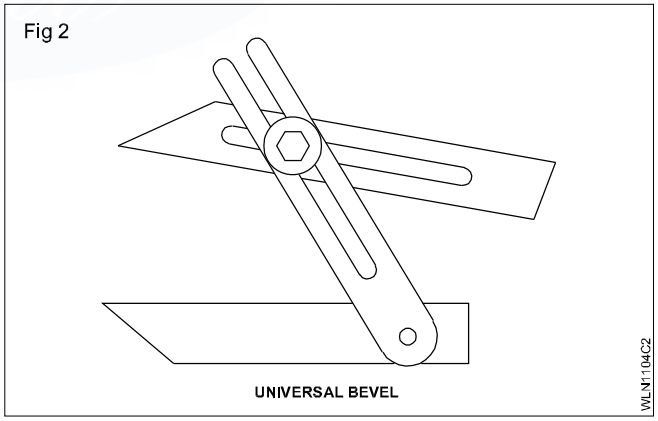
- bevel protractor. (Fig 3)

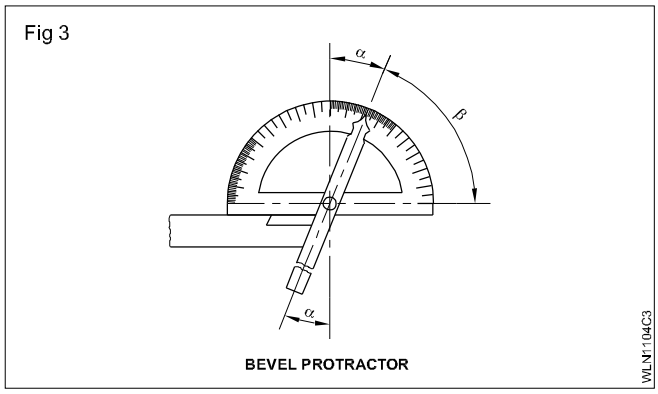
Bevel gauges (Fig 1): The bevel gauges cannot measure angle directly. They are. therefore, indirect angular measuring instruments. The angles can be set and measured with bevel protractors.



Universal bevel gauges (Fig 2): The universal bevel gauge has an additional blade. This helps in measuring angles which cannot be checked with an ordinary bevel gauge.

Bevel protractor (Fig 3): The bevel protractor is a direct angular measuring instrument, and has graduation marked from 0° to 180°. This instrument can measure angle within an accuracy of 1.0°.





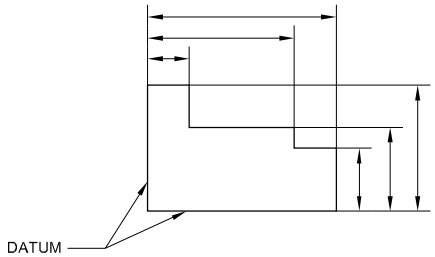
Datum

Objectives: At the end of this lesson you shall be able to
- **state the need for datum while marking**
- **name the different datum references.**

Say, the height of a person is measured from the floor on which he stands, the floor then becomes the datum of the common basis for measurement.

A datum is a referable surface. Line of 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. (Fig 1,2 and 3)

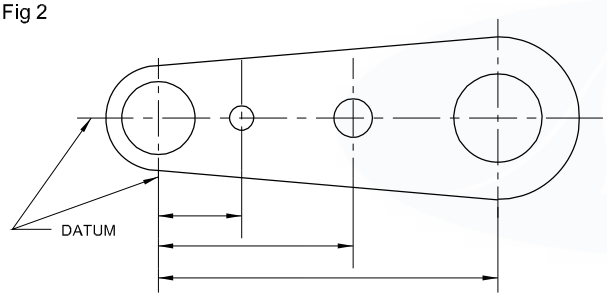
Fig 1



EDGE DATUM

WLN1104D1

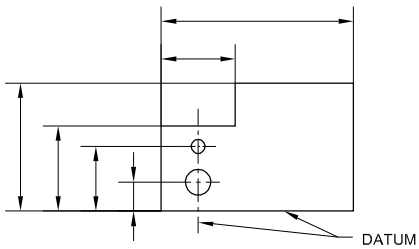
Fig 2



CENTRE LINE DATUM

WLN1104D2

Fig 3

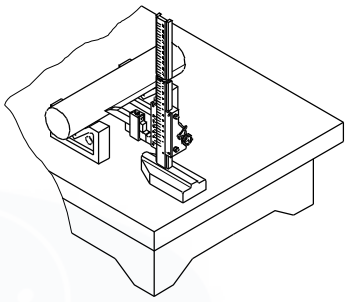


EDGE DATUM AND CENTRE LINE DATUM

WLN1104D3

Marking tables, surface plates, angle plates, 'V' blocks, and parallel blocks serve as a datum. (Fig 4) Marking tables are made up of cast iron since they are i)Self lubricating ii) Easy to cast and iii) cheaper.

Fig 4



WLN1104D4

Hammer

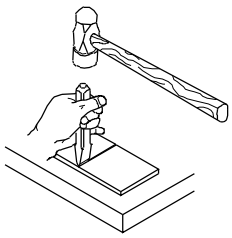
Objectives: At the end of this lesson you shall be able to
- **state the uses of an engineer's hammer**
- **identify the parts of an engineer's hammer and state their functions**
- **name the types of engineer's hammers**
- **specify the engineer's hammer.**

An engineer's hammer is a hand tool used for striking purposes while

- punching
- bending
- straightening
- chipping
- forging
- riveting.

(See Fig 1)

Fig 1



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Major parts of a hammer

The major parts of a hammer are a head and handle.

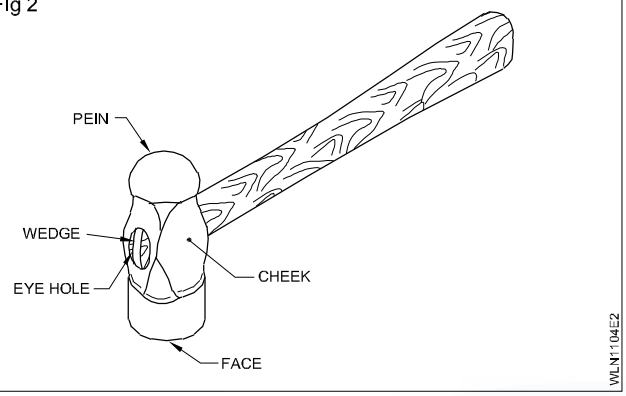
The head is made of drop-forged carbon steel, while the wooden handle must be capable of absorbing shock.

The parts of a hammer-head are the

- face
- pein
- cheek
- eye hole.

(See Fig 2)

Fig 2



Face

The face is the striking portion. Slight convexity is given to it to avoid digging of the edge.

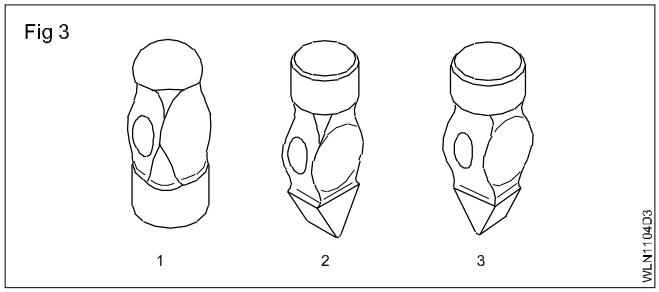
Pein

The pein is the other end of the head. It is used for shaping and forming work like riveting and bending. The pein is of different shapes like the

- ball pein
- cross pein
- straight pein. (Fig 3)

The face and the pein are hardened.

Fig 3



Cheek

The cheek is the middle portion of the hammer-head. The weight of the hammer is stamped here. This portion of the hammer-head is left soft

Eye hole

An eye hole is meat for fixing the handle; Eye is shaped to fit the handle rigidly. The wedges fix the handle in the eye hole. (See figs 4 and 5.)

Fig 4

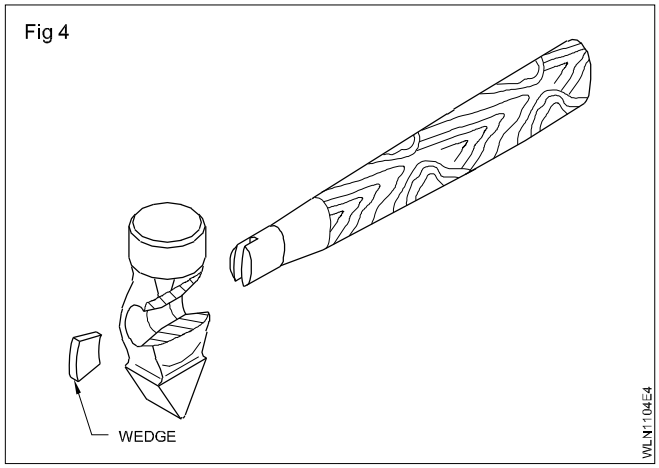
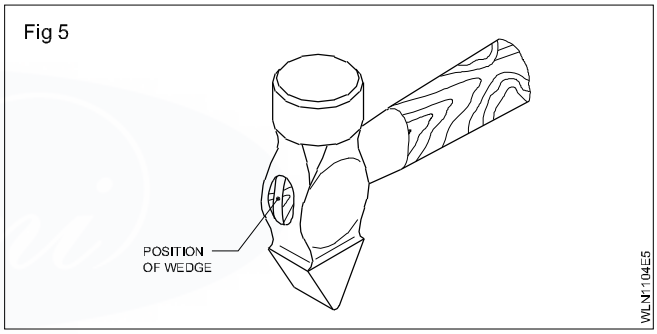


Fig 5



Specification

An engineer's hammer is specified by their weight and the shape of the pein. Their weight varies from 125 gms to 1500 gms.

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

The ball pein hammers are used for general work in a machine/fitting shop.

Before using a hammer

Make sure the handle is properly fixed and select a hammer with correct weight suitable for the job

Check the head and handle for any cracks and ensure the face of the hammer is free from ail or grease.

Scan the QR Code to view the video for this exercise