DUMKA ENGINEERING COLLEGE

Department of Mechanical Engineering

LAB MANUAL OF WORKSHOPS

Name:____

Roll No:____

Batch:__________________

Session:__________________

DUMKA ENGINEERING COLLEGE

LATHE

TITLE:-

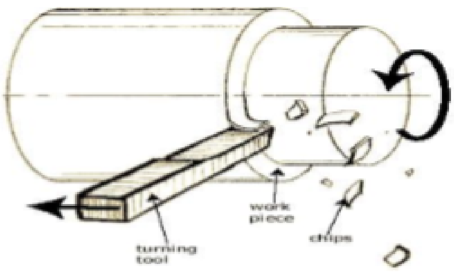
Making a pin from a 20 mm mild steel rod in lathe.

OBJECTIVE :-

Practice step turning, facing and chamfering, grooving and tread cutting operation on a centre lathe.

MACHINE USED:-

Centre lathe



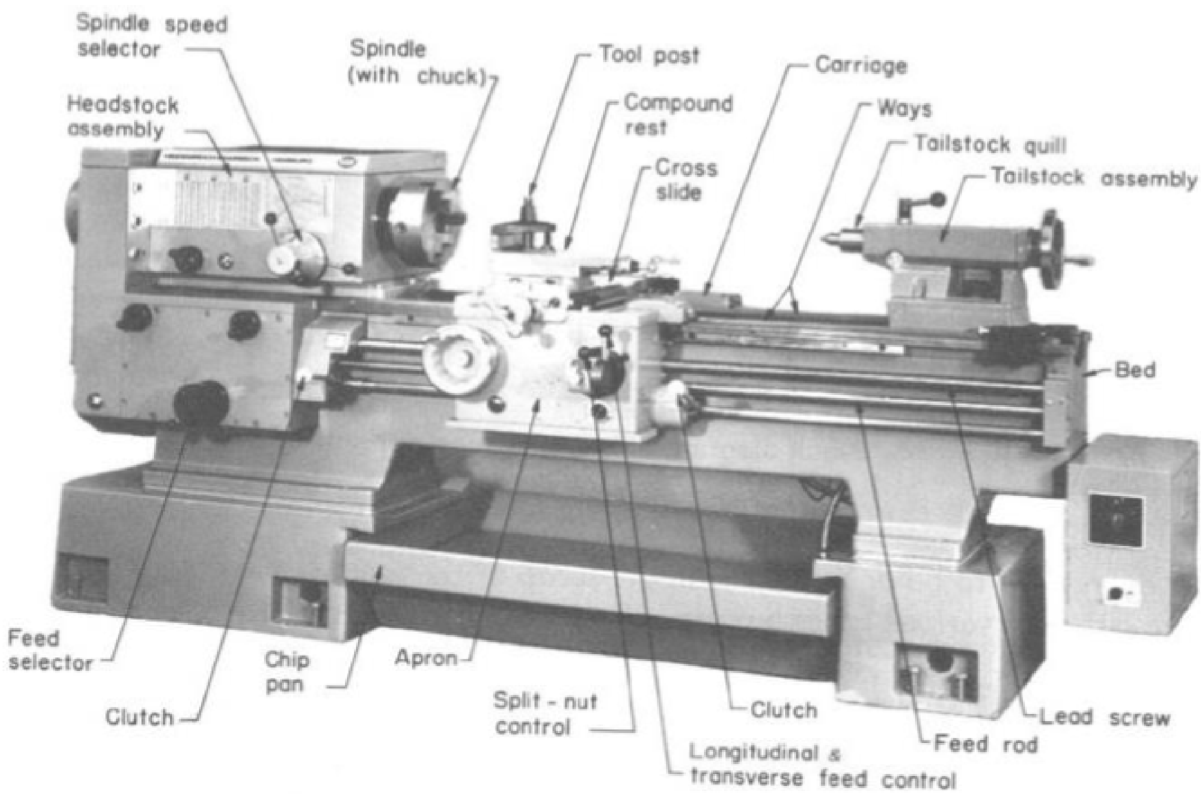


Fig.8 Engine Lathe

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CUTTING TOOL USED:-

Single point cutting tool of HSS, flat file.

ROW MATERIAL:-

Mild steel

THEORY:-

Turning is an operation which is used to remove excess material from the peripheral surface of work piece.

MATERIAL REQUIRED:-

Mild steel rod of 35mm diameter and 80mm long.

a. Measuring tools

   Steel rule, outside calliper (6” or 12”).

b. Marking tools

   Universal surface gauge (300 mm), chalk.

c. Cutting tools

   (1/4)”or (3/8)” HSS single point tool bit.

d. Holding tools/devices

   Three –jaw universal chuck for holding the work piece, adequate tool holder for holding the HSS tool bit.

e. Accessories

   2”brush for post operation cleaning of machine and work place, chuck wrench.

PROCEDURE:-

a. Centring

1.) First of all, we held the cylindrical job of mild steel of given size in between the jaws of the three jaw independent chuck with the help of chuck-wrench.

2.) Next, we marked with the help chalk on the periphery of the job.

3.) We did proper cantering with the help of surface gauge during the ovality, eccentricity.

b. Facing

1.) The tool post was swivelled and we held the tool in such a way that the main cutting edge made an angle of 1-2 degree with the main perpendicular to the job axis. A longitudinal feed of 0.5 mm was provided by cross feed when the centre of feed coincided with the job centre and later on passes. We completed the centre facing and released the longitudinal feed.

c. Turning and step-turning

1.) For both the operation, we feed the tool at an angle of 15-20 degree with the faced surface providing a depth of cut of 0.2-0.4 mm cross slide. We stopped the machine when one turning was completed, checked the diameter with calliper which was set at 35 mm, then at 25 mm. Normally at the junction of two different diameter was obtained after the tool was again set at same angle being used for facing and was provided gradually for the purpose.

d. Chamfering

1.) After the completion of entire operation, we set the tool such that the main cutting edge makes an angle of 45 degree with the faced surface with a cut of depth 2 mm. then, we did chamfering at the extreme edge end.

e. Finishing–off

1.) We took out the job after the completion.

2.) Next, we held the severe end of the of the job in between the jaws of a three-jaw independent chuck

Facing, turning and centring was done following the above process.

3.) We took out the job, punched the job code on it and cleaned the machine properly.

DESCRIPTION ABOUT MACHINE PARTS:

a.) *THE BED*:

The bed forms the base of the machine. The lathe bed being the main member of the tool, for accurate machining work must satisfy the following conditions:

i.) It must be massive, with sufficient depth and width to absorb vibration.

ii.) It should be sufficiently rigid to prevent deflection.

iii.) It must resist the twisting stress setup due to the resultant two forces.

b.)THE HEADSTOCK:

The headstock is secured permanently on the inner ways on the left hand end of the lathe bed, and it provides mechanical means of rotating the work at multiple speeds. It comprises essentially of a hollow spindle and mechanism for driving and altering the spindle speed.

c.) *THE TAILSTOCK*:

The tailstock is located on the inner ways at the right end of the bed. This has two main uses:

i.) It supports the other end of the work when it is being machined between centres.

ii.) It holds a tool for performing operation such as drilling, Reaming, tapping etc.

d.) *CARRIAGE*:

The carriage of lathe has support, move several parts that serve to support, move and control the cutting tool. It consists of the following parts:

i.) Saddle ii.) Cross slide iii.) Compound slide iv.) Tool post v.) Apron

e.) *FEED MECHANISM*:

The movement of tool relative to the work is termed as feed. A lathe tool may have three types of feed:

i.) Longitudinal ii.) Cross iii.) Angular

Operation which are performed on lathe by holding the work piece between the centres of a chuck:

i.) Straight turning
ii.) Shoulder turning
iii.) Chamfering
iv.) Thread cutting
v.) Facing
vi.) Knurling
vii.) Filing
viii.) Tapper turning
ix.) Ecentric turning
x.) Polishing
xi.) Grooving
xii.) Spinning
xiii.) Spring winding
xiv.) Forming

Operations which are performed by holding the work piece by a chuck or a face plate or an angle plate:

i.) Wrilling
ii.) Reaming
iii.) Boring
vi.) Internal thread cutting
vii.) Tapping
viii.) Under cutting

iv.) Counter boring   ix.) Parting off

v.) Tapper boring

Operations which are performed by using special allotments:

i.)Grinding   ii.) Milling

PROCEDURE:-

i.) We selected the speed, feed and depth of cut for different operations.

ii.) The job was loaded on a three jaw chuck.

iii.) We performed the facing operation on both ends of the job one after another by facing tool.

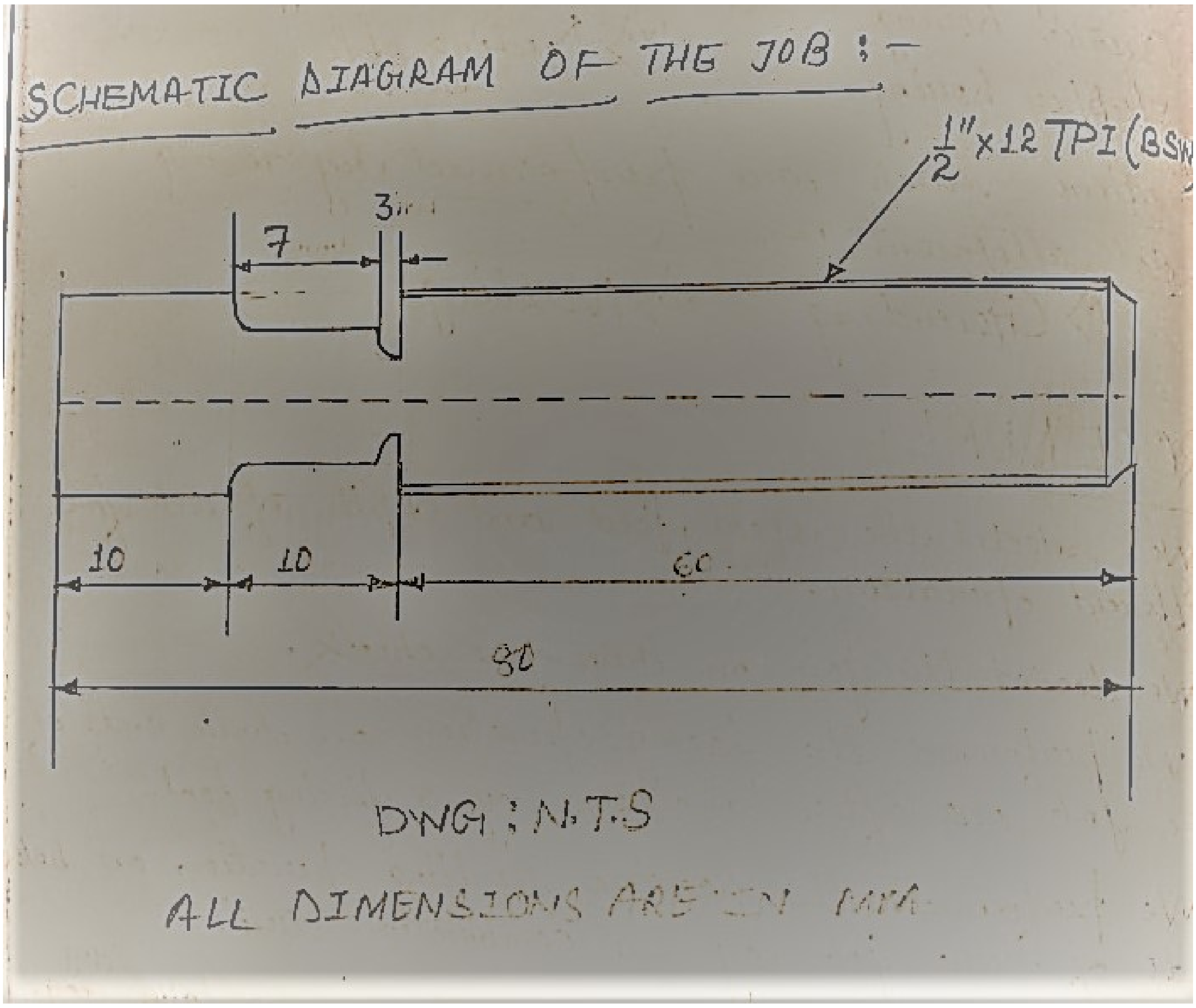
iv.) We performed the centre drilling operation on both ends of the job.

v.) We held the job between centres using lathe dog.

vi.) Then, we did turning to reduce diameter to 35 mm over a length of 25 mm by a turning rod.

vii.) We did chamfering to one end by chamfering tool.

viii.) And finally, we checked all the dimensions.



PRECAUTIONS:

i.) Shoes covering the feet should be worn.

ii.) Apron must be worn.

iii.) One must leave the lathe machine untended as it may lead to injury and may even lead to undesired results.

iv.) One must maintain the alignment between leave centre and dead centre.

v.) The job must be leaded so as to avoid unwanted vibration which may hamper the smooth process of making the round headed pin.

CONCLUSION:

Lathes of various designs and construction had been developed to suit the various conditions of metal machining. The machine was used to remove metal from a piece of work to give it a required shape and size.

MACHINE SHOP

Introduction to Machine shop

A place where hand tools and power-driven tools are used for making, finishing, or repairing machines or machine parts or in other words a facility that has machines, machine tools for working with metal other relatively hard materials such as some ferrous and non ferrous, composites, polymers, etc,. Various kinds of machine shops make and repair all types of metal objects from machine tools, dies and molds etc.

Introduction to Machining:

The machining is the broadest technological process used in manufacturing. Generally, in the field of manufacturing, the term of Machining means removal of material from a raw material, by cutting small chips, in order to obtain the desired shape and dimensions for final part. The machining is strictly necessary when finished Part has to have very tight tolerances of Dimensions or when the roughness of surfaces Need to be very smooth.

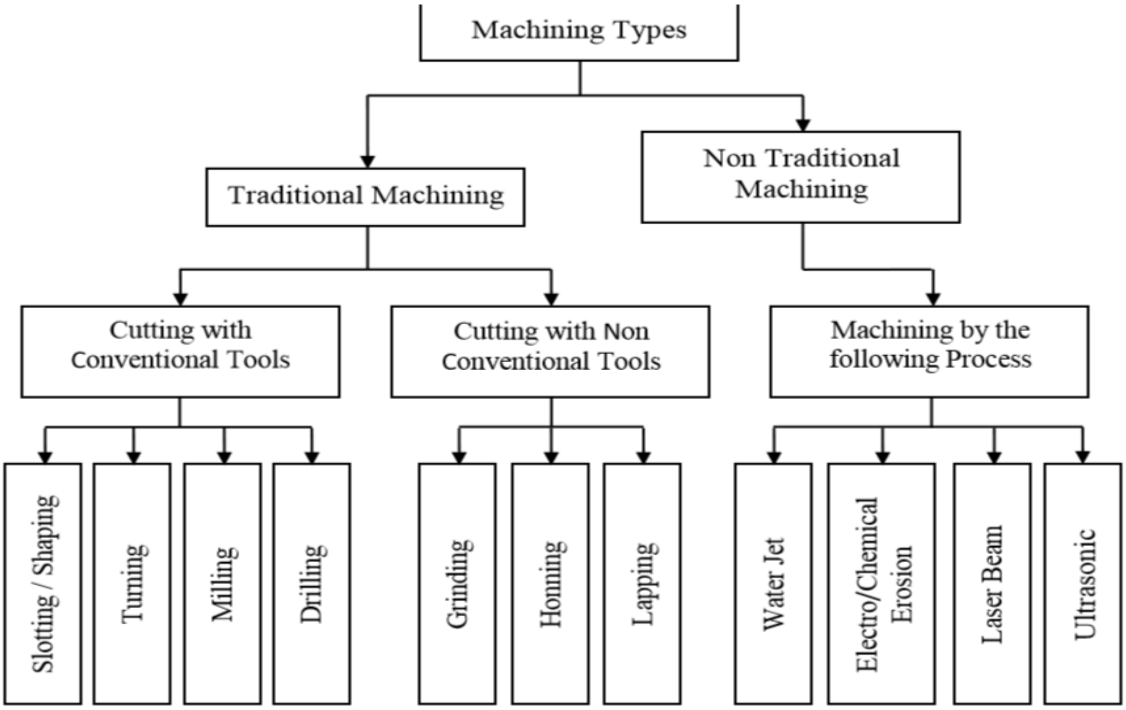


Fig.1 Synoptically Classification

Machine Tool:

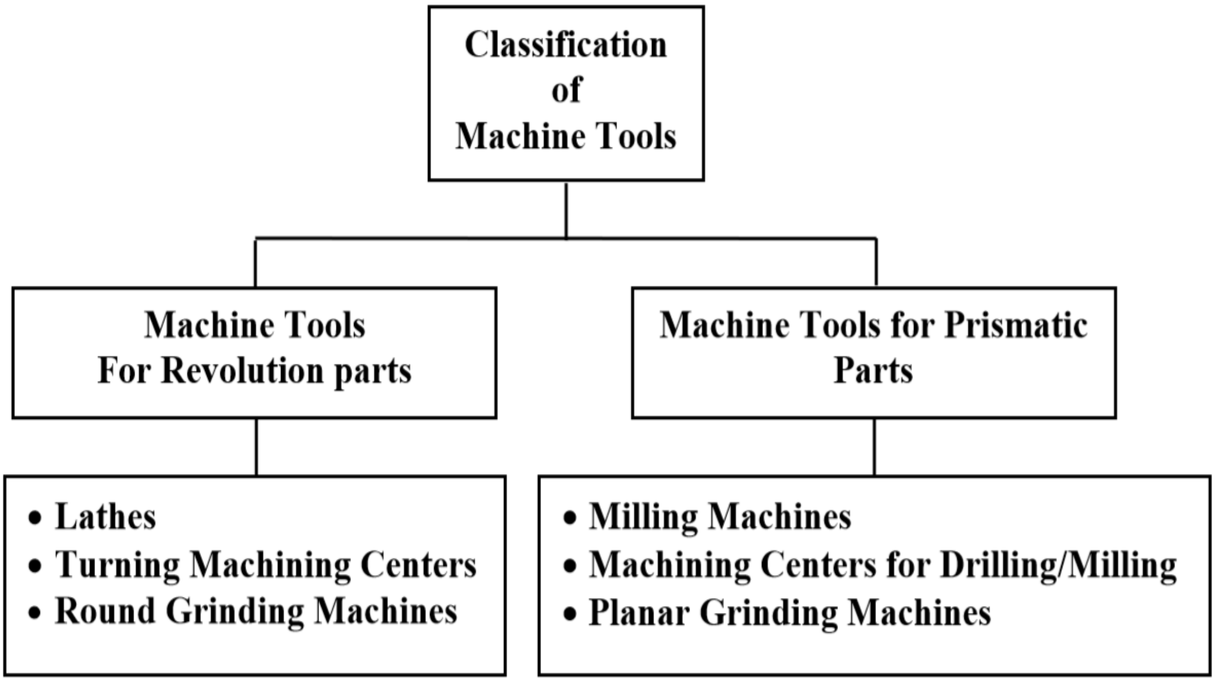
Machine tool is a non-portable power operated device in which the energy is utilized to produce jobs of desired shape and size and surface finish by removing excess material from the formed blanks in the form of chips with the help of cutting tools moved part the work surface.

It is machining equipment that cuts, shears, punches, presses, drills, rolls, grinds, sands, or forms metal, plastic, or wood stock. It may be automatic or semi-automatic.

Machine tools are generally power- driven metal cutting or forming machines used to shape metals by:

- The removal of chips
- Pressing drawing or shearing
- Controlled electrical machining process
- Any machine tool has generally has capability of

- Holding and supporting the work piece
- Holding and supporting a cutting tool
- Imparting a suitable movement (rotating or reciprocating) to the cutting tool or the work
- Feeding the cutting tool so that the desired cutting action and accuracy will be achieved
- The performance of any machine tools generally stated in terms of its metal removal rate, accuracy and repeatability.



Cutting Tool

A tool is a device or a piece of equipment which typically provides a mechanical advantage in accomplishing a physical task, or provides an ability that is not naturally available to the user of a tool. These tools are hand-held, portable powers, or manual tools.

The differences are stated below:

Cutting Tools	Machine Tools
1. Tool is a portable device 2. Tool is a non-powered device 3. Tool can only powered by humans **Examples:** Turning, shaping, drilling, milling tools, Hammers, wrenches, saws and shovels, pens, pencils and knives are tools.	1. It is a stationary device 2. It is a powered device 3. It is powered by a power source or by people if properly setup. **Examples:** Lathes, shapers, planers, power drills or drill presses, milling machines, grinding machines, power saws, and presses (e.g., punch presses).

Tool Materials

The various tool materials used in today's manufacturing operations are high-carbon steel, high-speed steel, cemented carbides, ceramics, diamond & cubic boron nitride (CBN).

Types of Tool Materials:

i.) High Carbon steels ii.)High Speed Steels iii.) Cemented Carbides iv.)Medium Alloy steels v.) Abrasives vi.)Diamonds vii.) Satellite Ceramics

High Carbon Steel

This material is one of the earliest cutting materials used in machining. It is however now virtually superseded by other materials used in engineering because it starts to temper at about 220oC. This softening process continues as the temperature rises. As a result cutting using this material for tools is limited to speeds up to 0.15 m/s for machining mild steel with lots of coolant. High carbon steels are oil- or water-hardened plain carbon steels with 0.9 to 1.4 percent carbon content. They are used for hand tools such as files and chisels, and only to a limited extent for drilling & turning tools. They impart such properties to tools made from them that such tools maintain a keep edge & can be used for metals that can be used for such metals that produce low tool-chip interface temperatures-for example, aluminium, magnesium, copper, and brass. These tools, however, tend to soften at machining speeds above 50 feet per minute (fpm) in mild steels.

High Speed Steel (HSS)

This range of metal contains about 7% carbon, 4% chromium plus additions of tungsten, vanadium, molybdenum and cobalt. These metals maintain their hardness at temperature up to about 600, but soften rapidly at higher temperatures. These materials are suitable for cutting mild steel at speeds up maximum rates of 0.8 m/s to 1.8 m/s. High-speed steel may be used at higher cutting speeds (100 fpm in mild 20 steels) without losing their hardness. High-speed steel is sometimes used for lathe tools when special tool shapes are needed, especially for boring tools. However, high-speed steel is extensively used for milling cutters. These cutters usually have a longer working life.

Cast Alloys

These cutting tools are made of various nonferrous metals in a cobalt base. They can withstand cutting temperatures of up to 760oC and are capable of cutting speeds about 60% higher than HSS.

Satellite

This is a cast alloy of Co (40 to 50%), Cr (27 to 32%), W (14 to 19%) and C (2%). Satellite is quite tough and more heat and wear resistive than the basic HSS (18 – 4 – 1) But such satellite as cutting tool material became obsolete for its poor grind ability and especially after the arrival of cemented carbides.

Cemented carbides (Cermets or Sintered Carbide)

Carbide, generally, is a chemical compound of carbon and a metal. This material usually consists of tungsten carbide or a mixture of tungsten carbide, titanium, or tantalum carbide in powder form, sintered in a matrix of cobalt or nickel. The term Carbide is commonly used to re-present to cemented carbides, the cutting tools composed of tungsten carbide, titanium carbide, or tantalum carbide & cobalt in various combinations. A typical composition of cemented carbide is 85 to 95 percent of tungsten & the remainder a cobalt binder for the tungsten carbide powder. Cemented carbides are extremely hard tool materials (above RA 90), have a high compressive strength & resist wear & rupture. Coated carbide inserts are often used to cut hard or difficult-to-machine work pieces. Titanium carbide (Tic) coating offers high wear resistance at moderate cutting speeds and temperatures. Aluminium oxide (Al_2O_3) coating has high resistance to crater wear and reduces friction between the tool face and the chip, thereby reducing the tendency for built-up edge.

Cemented carbides are the most widely used tool materials in the machining industry. They are particularly useful for cutting tough alloy steels, which quickly break down high-speed tool steels. As this material is expensive and has low rupture strength it is normally made in the form of tips which are brazed or clamped on a steel shank. The clamped tips are generally used as throw away inserts.

Coated Carbides

The cutting system is based on providing a thin layer of high wear-resistant titanium carbide fused to a conventional tough grade carbide insert, thus achieving a tool combining the wear resistance of one material with the wear resistance of another. These systems provide a longer wear resistance and a higher cutting speed compared to conventional carbides.

Ceramics

Ceramic or "cemented oxide" tools are made primarily from aluminium oxide. Ceramics are made by powder metallurgy from aluminium oxide with additions of titanium oxide and magnesium oxide to improve cutting properties. Some manufacturers add titanium, magnesium, or chromium oxides in quantities of 10% or less. The tool materials are melded at pressures over 4000 psi and sintered at temperatures of approximately 30000F. This process partly accounts for the high density and hardness of cemented oxide tools. These have a very high hot resistance and wear resistance and can cut at very high speed. However they are brittle and have little resistance to shock. Their use is therefore limited to tips used for continuous high speed cutting on vibration-free machines. Cemented oxides setups are rigid and free of vibration and are used as a replacement for carbide tools that are wearing rapidly, but not to replace carbide tools that are breaking.

Diamonds Tools

Diamonds have limited application due to the high cost and the small size of the stones. They are used on very hard materials to produce a fine finish and on soft materials especially those inclined to clog other cutting materials. They are generally used at very high cutting speed with low feed and light cuts. Due to the brittleness of the diamonds the machine has to be designed to be vibration free. The tools last for 10 (up to 400) times longer than carbide based tools. Industrial diamonds are sometimes used to machine extremely hard work pieces. Only relatively small removal rates are possible with diamond tools, but high speeds are used and good finishes are obtained. Diamond tools are particularly effective for cutting abrasive materials that quickly wear out other tool materials. Nonferrous metals, plastics, and some non-metallic materials are often cut with diamond tools.

Cubic Boron Nitride (CBN)

CBN is next to diamond in hardness and therefore can be used to machine plain carbon steels, alloy steels, and gray cast irons with hardness's of 45 RC and above. CBN inserts consist of a cemented carbide substrate with an outside layer of CBN formed as an integral part of the tool. Tool life, finishes, and resistance to cracking and abrasion make CBN a superior tool material to both carbides and ceramics.

Abrasive:

Abrasive grains in various forms loose bonded into wheels and stone and embedded in papers and cloths find wide application in industry. They are mainly used for grinding harder materials and where a superior finish is desired on hardened or unhardened materials.

Elements of an Effective Tool:

- High hardness at elevated temperatures
- Wear resistance
- Strength to resist bulk deformation
- Consistent tool life
- Adequate thermal properties
- Correct geometry
- Consistent tool life
- Chemical stability

There are 2 types of cutting tools

a) Single Point Cutting Tool:

The tool generally refers to a non-rotary cutting tool used in metal lathes, shapers, and planers. Such cutters are also often referred to by the set-phrase name of single-point cutting tool. The cutting edge is ground to suit a particular machining operation and may be resharpened or reshaped as needed. The ground tool bit is held rigidly by a tool holder while it is cutting. Single-point tools are used in turning, shaping and planning operations and similar operations to remove material by means of one cutting edge.

Cutting tools must be made of a material harder than the material which is to be cut, and the tool must be able to withstand the heat generated in the metal-cutting process. Also, the tool must have a specific geometry, with clearance angles designed so that the cutting edge can contact the work piece without the rest of the tool dragging on the work piece surface. The angle of the cutting face is also important, as is the flute width, number of flutes or teeth, and margin size. In order to have a long working life, all of the above must be optimized, plus the speeds and feeds at which the tool is run.

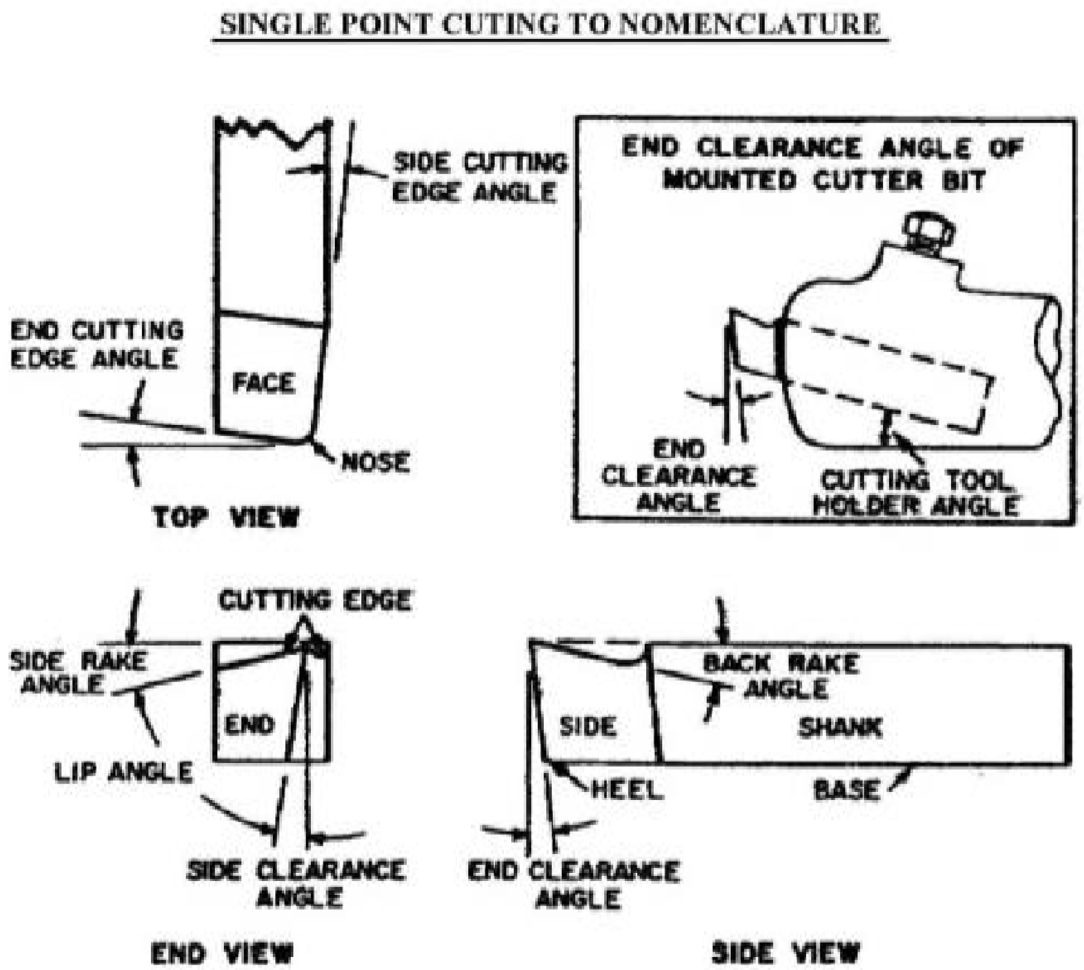


Fig.2 Showing parts &important angles cut on single point cutting tool

Single point cutting tool terms and definitions:

(1) Shank: The shank is the main body of the tool.

(2) Nose: The nose is the part of the cutter bit which is shaped to produce the cutting edges.

(3) Face: The face of the cutter bit is the surface at the upper side of the cutting edge on which the chip strikes as it is separated from the work piece.

(4) Side: The side of the cutter bit is the near-vertical surface which, with the end of the bit, forms the profile of the bit. The side is the leading surface of the cutter bit used when cutting stock.

(5) Base: The base is the bottom surface of the shank of the cutter bit.

(6) End: The end of the cutter bit is the near-vertical surface which, with the side of the bit, forms the profile of the bit. The end is the trailing surface of the cutter bit when cutting.

(7) Heel: The heel is the portion of the cutter bit base immediately below& supporting the face.

Important angles of a Single Point Cutting Tool:

Angle	Details
Back Rake Angle	It is also called as Top Rake Angle. It is the slope given to the face or the surface of the tool. This slope is given from the nose along the length of the tool.
Side Rake Angle	It is the slope given to the face or top of the tool. This slope is given from the nose along the width of the tool. The rake angles help easy flow of chips
Relief Angle	These are the slopes ground downwards from the cutting edges. These are two clearance angles namely, side clearance angle and end clearance angle. This is given in a tool to avoid rubbing of the job on the tool.
Cutting Edge Angle	There are two cutting edge angles namely side cutting edge angle and end cutting edge angle. Side cutting edge angle is the angle, the side cutting edge makes with the axis of the tool. End cutting edge angle is the angle, the end cutting edge makes with the width of the tool.
Lip Angle	It is also called cutting angle. It is the angle between the face and end surface of the tool.
Nose Angle	It is the angle between the side cutting edge and end cutting edge.

Tool Signature

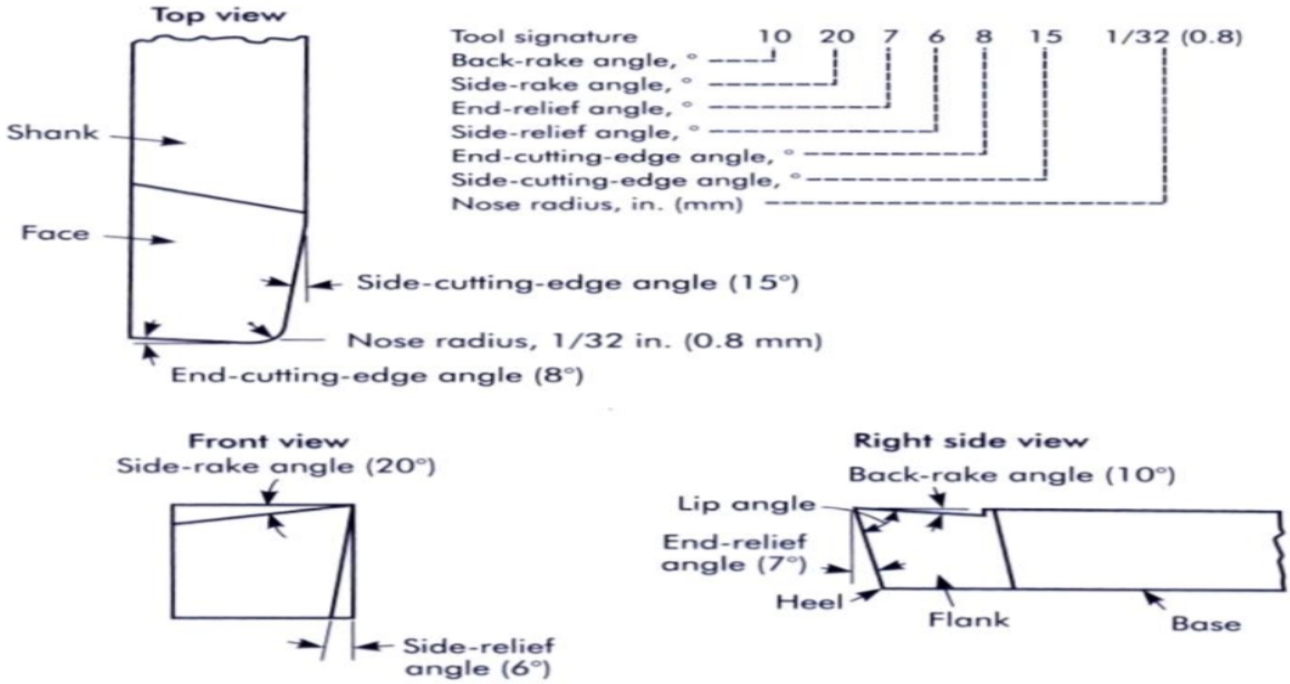


Fig.3 Tool Signature of Single Point Cutting Tool

Shapes of Tool Bits

The overall shape of the lathe tool bits can be rounded, squared, or another shape as long as the proper angles are included. Tool bits are identified by the function they perform, such as turning or facing. They can also be identified as roughing tools or finishing tools. Generally, a roughing tool has a radius ground onto the nose of the tool bit that is smaller than the radius for a finishing or general purpose tool bit. Experienced machinists have found the following shapes to be useful for different lathe operations. A right-hand turning tool bit is shaped to be fed from right to left.

The cutting edge is on the left side of the tool bit and the face slopes down away from the cutting edge. The left side and end of the tool bit are ground with sufficient clearance to permit the cutting edge to bear upon the work piece without the heel rubbing on the work. The right-hand turning tool bit turning tool bit is ideal for taking light roughing cuts as well as general all- around machining. The round-nose turning tool bit is very versatile and can be used to turn in either direction for roughing and finishing cuts. No side rake angle is ground into the top face when used to cut in either direction, but a small back rake angle may be needed for chip removal. The nose radius is usually ground in the shape of a half-circle with a diameter of about 1/32 inch. A left-hand turning tool bit is the opposite of the right-hand turning tool bit, designed to cut when fed from left to right. This tool bit is used mainly for machining close in to a right shoulder.

The right-hand facing tool bit is intended for facing on right hand side shoulders and the right end of a work piece. The cutting edge is on the left-hand side of the bit and the nose is ground very sharp for machining into a square corner. The direction of feed for this tool bit should be away from the centre axis of the work, not going into the centre axis. A left- hand facing tool bit is the opposite of the right-hand facing tool bit and is intend to machine and face the left sides of shoulders.

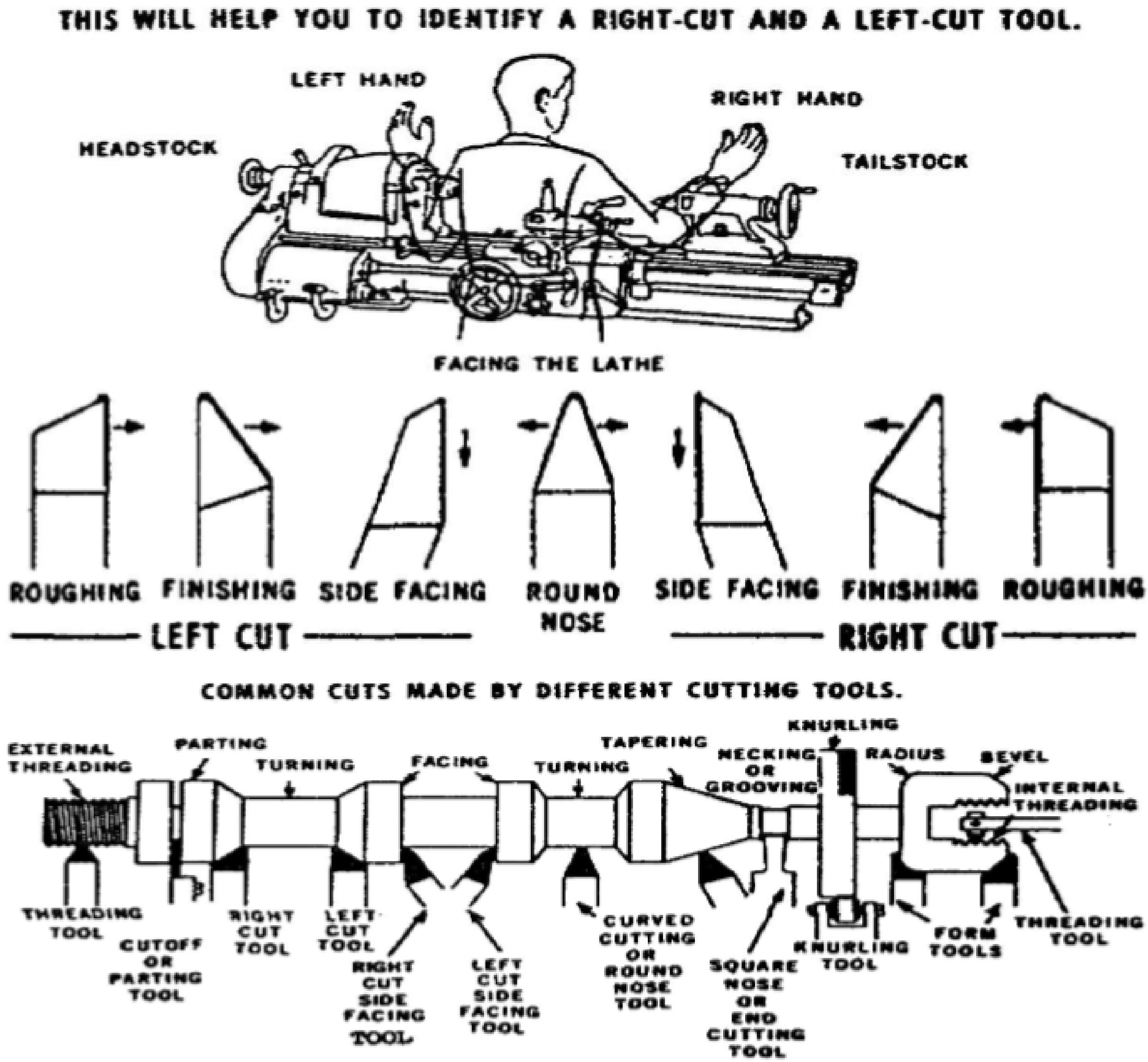


Fig. 3 Left – Hand & Right-hand Cutting tools

Multi Point Cutting Tool

Fig.4 Multipoint cutting tools

In multi point cutting tool the multiple edges are used to remove the material. Multi point cutting tools are used in Milling, drilling, reamers, slotting tool, wood ruff cutter, etc. most important thing to remember is the cutting tools must be made of a material harder than the material which is to be cut, and the tool must be able to withstand the heat generated in the metal-cutting process. Grinding tools are also multipoint tools. Each grain of abrasive functions as a microscopic single-point cutting edge.

A multi-point cutting tool is regarded as a series of two or more cutting elements (chip producing elements) secured to a common body. The term such as face, flanks, and cutting edge, defined earlier for single-point tools, are applicable to multi-points tool as well. The commonly used multi-point cutting tools are drills, reamers, milling cutters, broaches, wood ruff cutter, reamers, etc.

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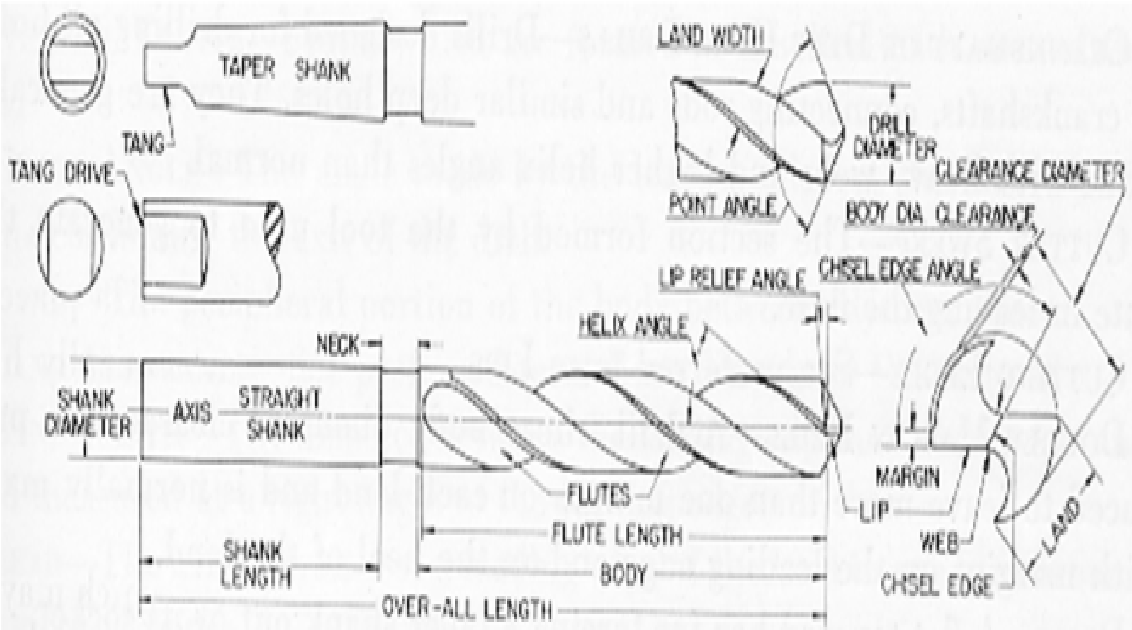

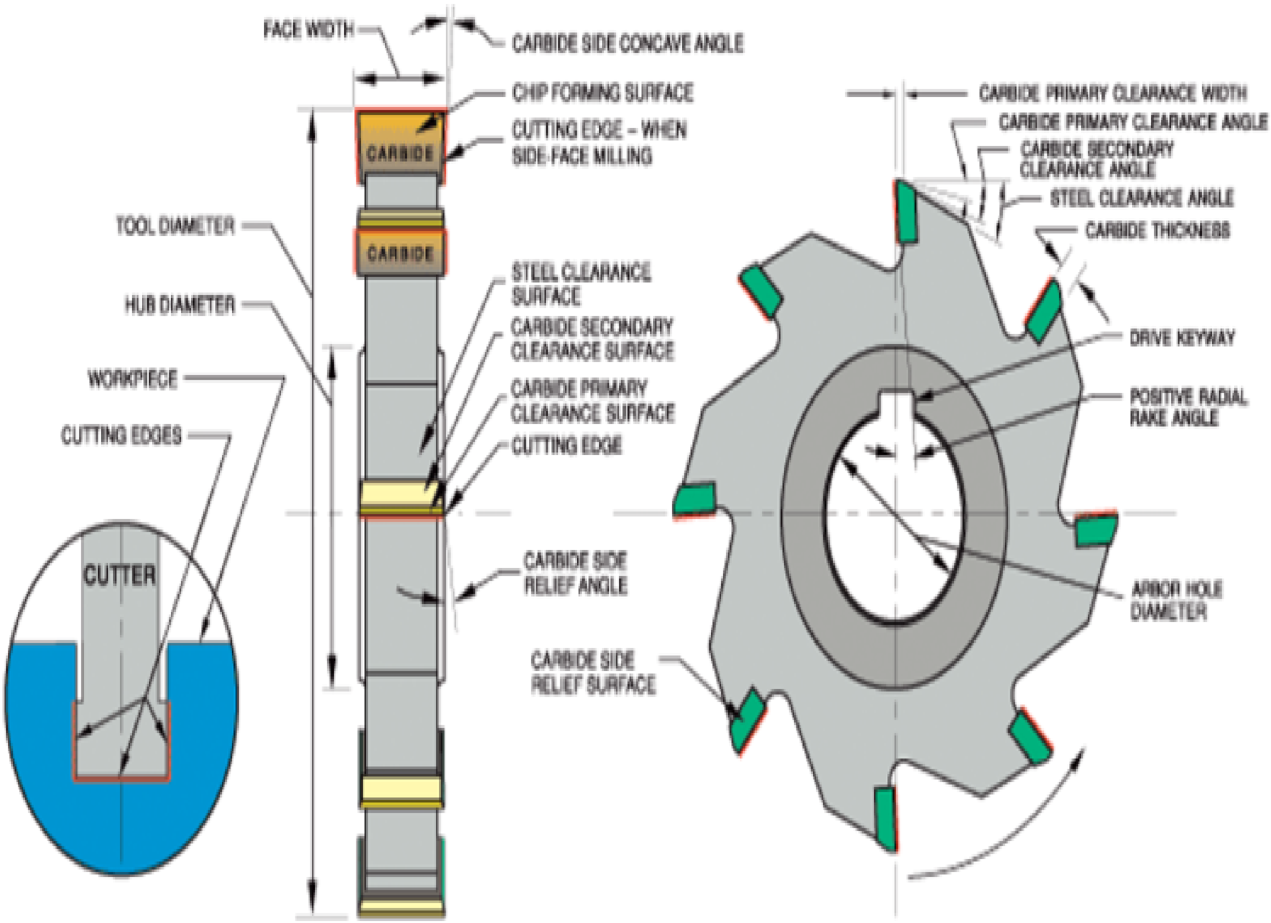

Fig.5Showing parts & important angles of Multi Point Cutting Tools

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ORTHOGANAL CUTTING (Two Dimensional Cutting)

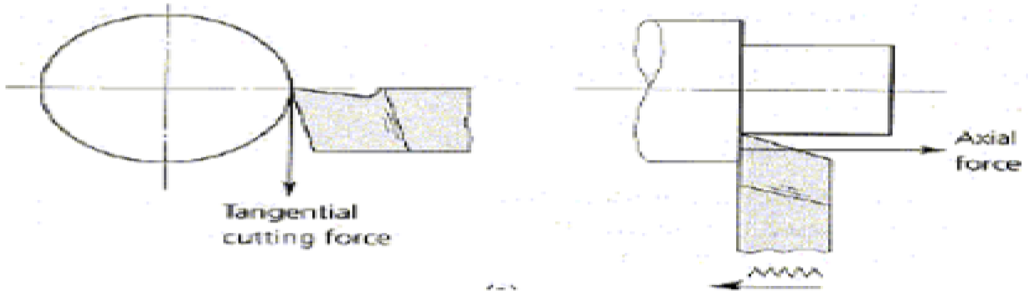


Fig.6 Orthogonal Cutting

OBLIQUE CUTTING (Three Dimensional Cutting)

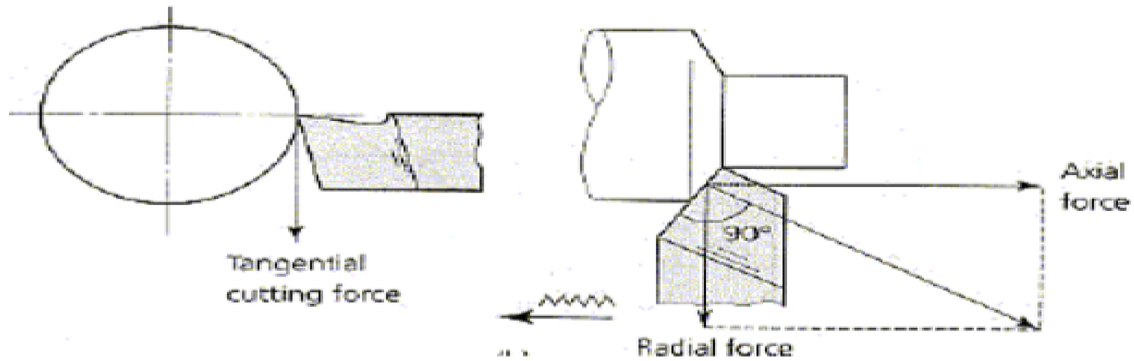


Fig.7 Oblique Cutting

Orthogonal Metal Cutting	Oblique Metal Cutting
Cutting edge of the tool is perpendicular to the direction of tool travel.	The cutting edge is inclined at an angle less than 90° to the direction of tool travel.
The direction of chip flow is perpendicular to the cutting edge.	The chip flows on the tool face making an angle.
The chip coils in a tight flat spiral	The chip flows sideways in a long curl.
For same feed and depth of cut the force which shears the metal acts on a smaller area. So the life of the tool is less.	The cutting force acts on larger area and so tool life is more.
Produces sharp corners.	Produces a chamfer at the end of the cut
Smaller length of cutting edge is in contact with the work.	For the same depth of cut greater length of cutting edge is in contact with the work.
Generally parting off in lathe, broaching and slotting operations are done in this method.	This method of cutting is used in almost all machining operations.

Cutting Fluids:

Cutting fluids are used in metal machining for a variety of reasons such as improving tool life, reducing work piece thermal deformation, improving surface finish and flushing away chips from the cutting zone.

Types of cutting fluids:

Practically all cutting fluids presently in use fall into one of the four categories:

1. Cutting Oils
   a. Straight oils
   b. Compounded
2. Water Base Cutting Fluids
   a. Soluble oils
   b. Chemical (Synthetic) fluids
   c. Semi- Chemical (Semi-Synthetic) fluids
3. Gases
4. Paste & Solid Lubricants

Functions of cutting fluids:

1. Reduce friction between tool & material
2. Reduce temperature of cutting zone
3. Wash away chips
4. Improve surface finish
5. Reduce power required
6. Increase tool life
7. Prevent welding of chip to tool
8. Prevent corrosion

Desired Properties of Cutting Fluids:

1. Harmless to the operator
2. Harmless to the machine
3. Good heat transfer characteristics
4. Non-Volatile
5. Non-forming
6. Good lubricating properties
7. Inexpensive

CARPENTRY

Carpentry is the process of shaping Timber, using hand tools. The products produced are used in building construction, such as doors and windows, furniture manufacturing, patterns for moulding in foundries, etc. Carpentry work mainly involves the joining together of wooden pieces and finishing the surfaces after shaping them. Hence, the term joining is also used commonly for carpentry. A student studying the fundamentals of wood working has to know about timber and other carpentry materials, wood working tools, carpentry operations and the method of making common types of joints.

Materials Used in Carpentry: Basic materials used in carpentry shop are timber and plywood. Auxiliary materials used are nails, screws, adhesives, paints, varnishes, etc.

Timber:

Timber is the name given to wood obtained from exogenous (outward growing) trees. In these trees, the growth is outward from the centre, by adding almost concentric layers of fresh wood every year known as annual rings. After the full growth, these trees are cut and sawed to convert into rectangular sections of various sizes for engineering purposes.

Timber is available in market in various shapes and size. The common shapes and sizes an: given below:

1. Log: This is the trunk of die tree which is tree from branches.

2. Balk: This is the log after sawing roughly to square cross section.

3. Deal: This is the log after sawing into rectangular cross section of width about 225 mm and thickness up to 100 mm.

4. Plank: This is the timber piece having width more than 275 mm and thickness 50 lo 150 mm.

5. Board: This is the timber piece below 50 mm in thickness and above 125 mm in width.

6. Batten: This is the timber piece below 175 mm in width and thickness between 30 mm to 50 mm in thickness.

7. Scantlings: These are timber pieces of various assorted and nonstandard sizes other than the types given above.

Classification of Wood

The timber used for commercial purposes can he divided into two classes as soft wood and hard wood.

Soft wood

A soft wood is light in weight and light colour. They may have distinct annual rings but the medullar rays (radial lines) are not visible and the colour of the sap wood (outer layers) is not distinctive from the heart wood (inner layers). These woods cannot resist stresses developed across their fibres; hence, not suitable for wood working.

Hard wood

In this type of wood the annual rings are compact and thin and the medullar rays (radial lines} are Visible in most cases Figure6.1.

Hard woods are nearly equally strong both along and across the fibres. Hand wood is the material used for wood working

Classification of timber

According to the manner of growth of trees, timber can be classified as

i.) Exogenous or out ward growing

In exogenous trees the growth take place from the centre by the addition of concentric layers of fresh wood every year, known as annual rings. These varieties of trees are suitable for building and other engineering uses the exogenous trees are again classified as

a) Conifers or ever green trees

b) Deciduous or broad leaf trees

The conifer give soft woods and the deciduous gives hard wood common example of hard wood are Sal, teak, rose wood, sandal, shisham, oak beach, ash ebony, mango, neem, babool, etc., soft wood include kail pine, deodar chair, walnut seemal etc.

ii.) Endogenous or in ward growing

Timber these trees grow in wards i.e. .every fresh layer of sap wood is added inside instead of outside cane, bamboo, coconut

Seasoning

Seasoning of wood carried out for removing the sap and reducing the moisture content the presence of sap and moisture will render the wood unsuitable for engineering works due to uneven shrinkage, crack, wrapping and decay.

Different methods of seasoning

1. Air seasoning or Natural seasoning
2. Water seasoning

3. Electrical seasoning
4. Kiln seasoning

Ply wood

Thick sheet formed by pasting veneers of wood is called ply. Three or more ply's joined by glues is called plywood. The grains of adjacent layers are kept at right angle to each other in order to get better strengthening both directions the outer layer are called facing plys and good hard wood veneers are used for this inner ones are called core ply's and low quality wood is used for this the ply wood is made by either cold pressing or hot pressing.

Tools for wood working

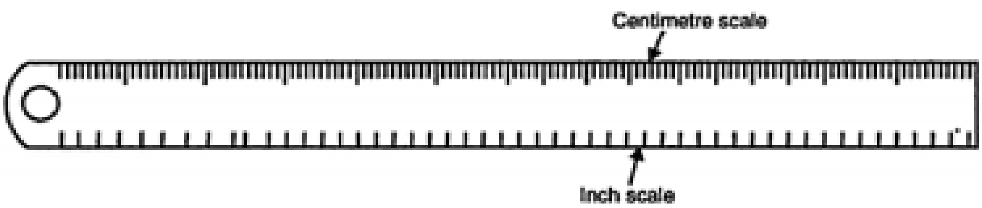
The principle hand tools used in a carpentry workshop can be classified into

i)Marking and measuring tool
ii) Cutting tool
iii) Planning tool
iv) Boring tool
v) Striking tool
vi) Holding tool

Marking and measuring tool

a)Rules

Rules are used for measuring dimensions. For measuring and setting out dimensions various types of rules are used in carpentry shop. Steel Rule Stainless Steel Rule of length 30cm and 60cm. Flexible Measuring Rule for measuring large dimensions as well as curved or angular surface dimensions.



b)Straight Edge and Squares

This is a machined flat piece wood or metal having perfectly straight and parallel edges.

c)Steel Tape:

It is used for large dimensions, such as marking on boards and checking the overall dimensions of the work.

d)Gauges

Gauges are used to mark lines parallel to the edges of a wooden piece. It mainly consists of a wooden stem sliding inside a wooden stock. The stem carries a steel point for marking lines. The stock position on the stem can be varied and fixed rigidly by tightening the thumb screw.

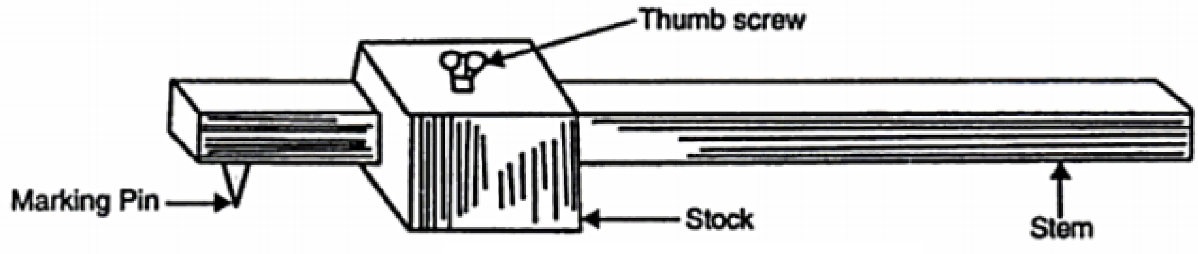


Fig. Marking Gauge

To mark a line parallel to an edge the gauge stock is held freely against the edge and pushed along it, pressing the steel points to the surface

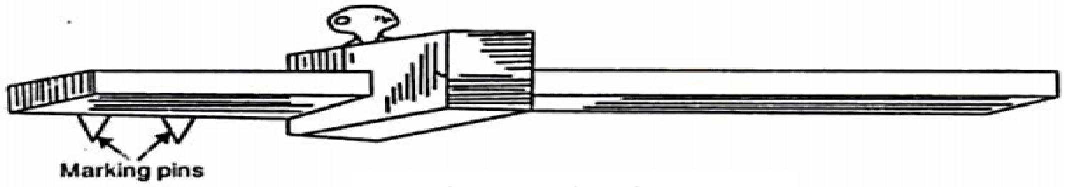


Fig. Mortise Gauge

e) Try square

Try square consists of rectangular steel blade fixed rigidly to cast iron stock. The length of blade varies from 150mm to 300mm.

f) Marking Knife or Scriber

Marking Knives are used to convert the pencil lines drawn on the wooden surface into deep scratch lines on the surface. They are made of steel with a sharp point at one end and flat blade at the other end.

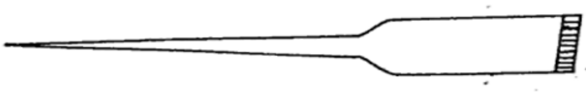


Fig. Marking Knife

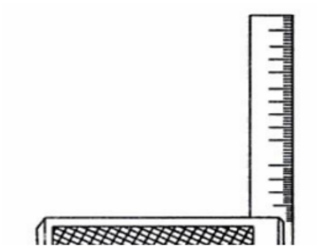


Fig. Try Square

Bevel Square:

it is also called sliding level. It is an adjustable try-square used for measuring/marking angles between 00 and 1800 .

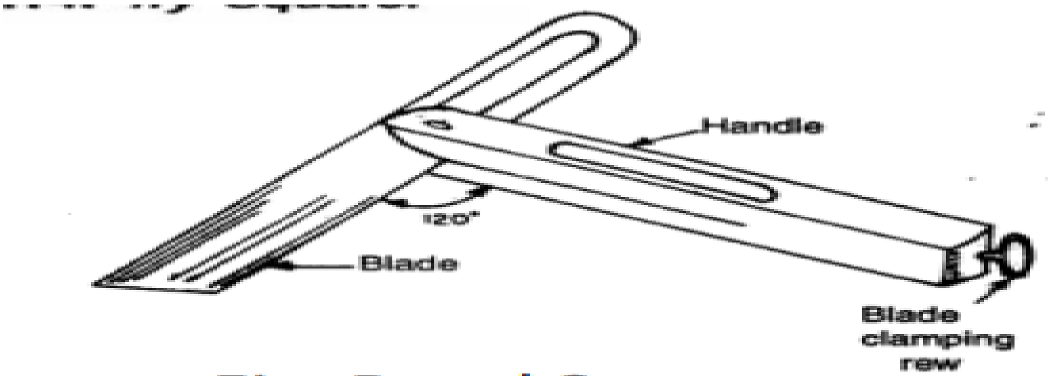


Fig. Bevel Square

Holding tools

a)Work Bench

This is a table of having size and raised construction made of hard wood. The size ranges from 50- 80 cm in length and about 90cm in width. Two or four carpenters can work at a time on the work bench.

Carpenters Bench Vice

It consists of jaw fixed on the table side and movable jaw kept in position by means of screw and handle. The body of vice is made of cast iron or steel. The jaws are lined with hard wood which can be removed when it is damaged.

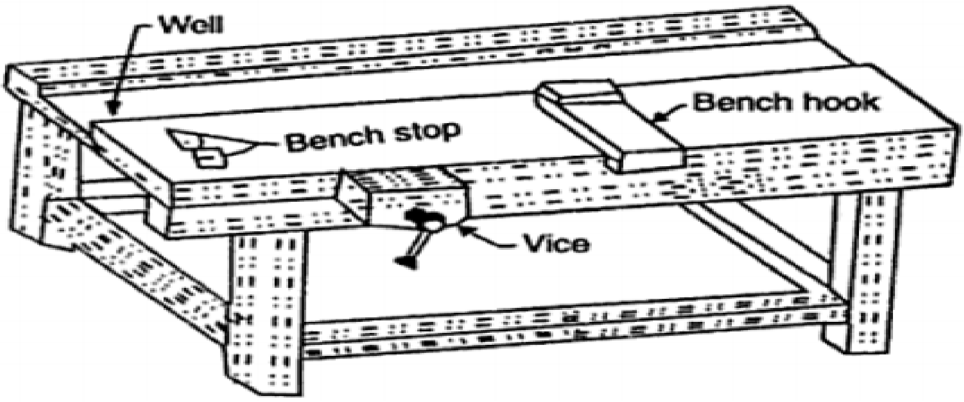


Fig. Work Bench with Bench Hook

The screw moves inside the fixed half nut which can be engaged or disengaged by operating the lever. This is made up of a bar of steel. The work is clamped between jaws by rotating the screw using the handle. It is used for clamping glued pieces or holding the work piece of larger size together for various operations.

a) Sash-cramp
b) C Clamp:

The clamp of the shape of letter C or G is used to clamp short pieces together as the bar clamp. These clamps are available is sizes varying from 70 mm to 800 mm. it is used for holding the planks after gluing.

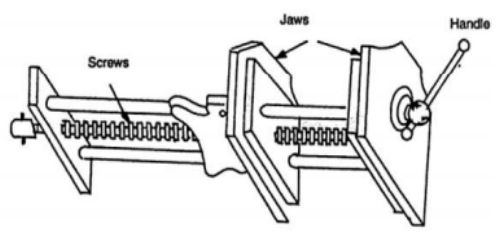


Fig. Carpenters Bench Vice

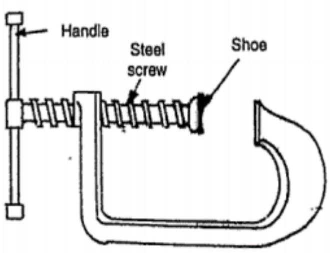


Fig. C- Clamp

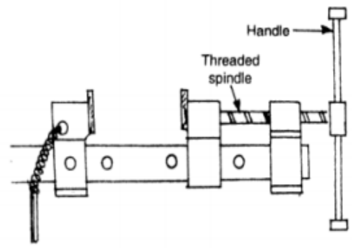


Fig. Bar or T-Cramp

Bar or T-cramp:

it consists of a steel bar fitted with a threaded spindle and an adjustable shoe. It is used for holding the glued pieces tightly or holding firmly two or more unglued pieces for fitting dowels or doing other operations on them in assembled position.

Cutting tools

a) Saws

Saw is a cutting tool which has teeth on one edge and cutting is affected by reciprocating motion of the edge relative to the work piece. Cutting occurs during the forward motion; such a saw is called push type saw, the cutting occurs during the backward motion.

i. Hand Saw- This saw is used for short straight cuts. It has a blade of 25-40cm length 6- 10cm width. The number of teeth per cm length ranges from 3-5.
ii. Tendon Saw (Back Saw)- It has a parallel blade of 25-40cm length and 6-10cm width. The number of teeth per cm length ranges from 5-8.

b) Chisels

The common type of chisels used is briefly explained below.

i. Firmer Chisels- they are most common and general purpose chisel used by a carpenter. They have flat blade of 15-50mm width and 125mm length.
ii. ii. Dove Tail Chisel (bevelled edge firmer chisel) - These chisels are used for fine and delicate works as well as for cutting corners.
iii. iii. Mortise chisel – These chisels are used for heavy and deep cut to remove large quantity of wood. These chisels have width of about 15mm but the blade thickness may range from 6- 15mm.

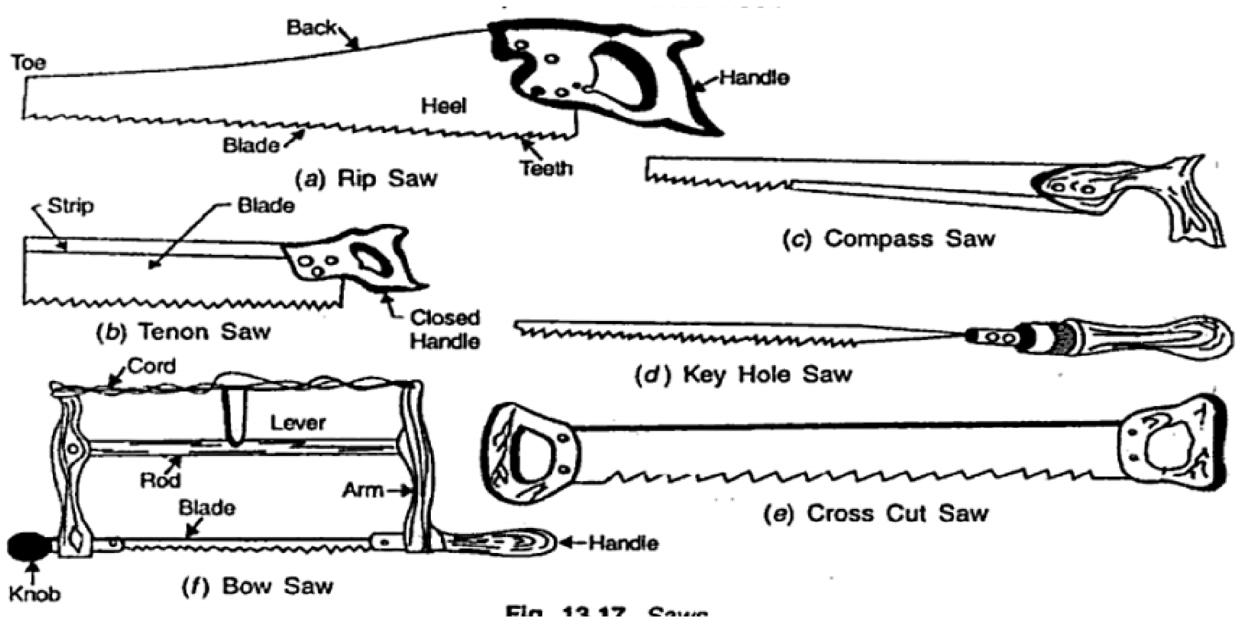


Fig. Saws

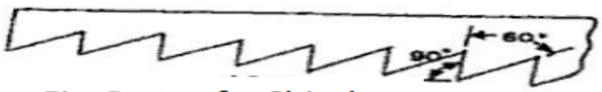


Fig. Parts of a Chisel

(b) The tooth profie

Fig. Rip Saw

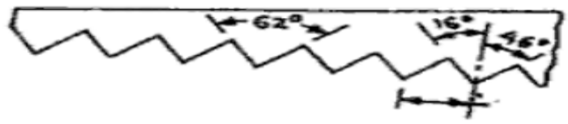


Fig. Cross-cut Saw

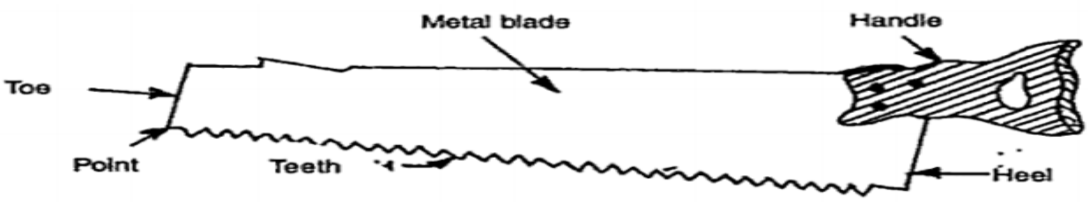


Fig. Parts of Saw

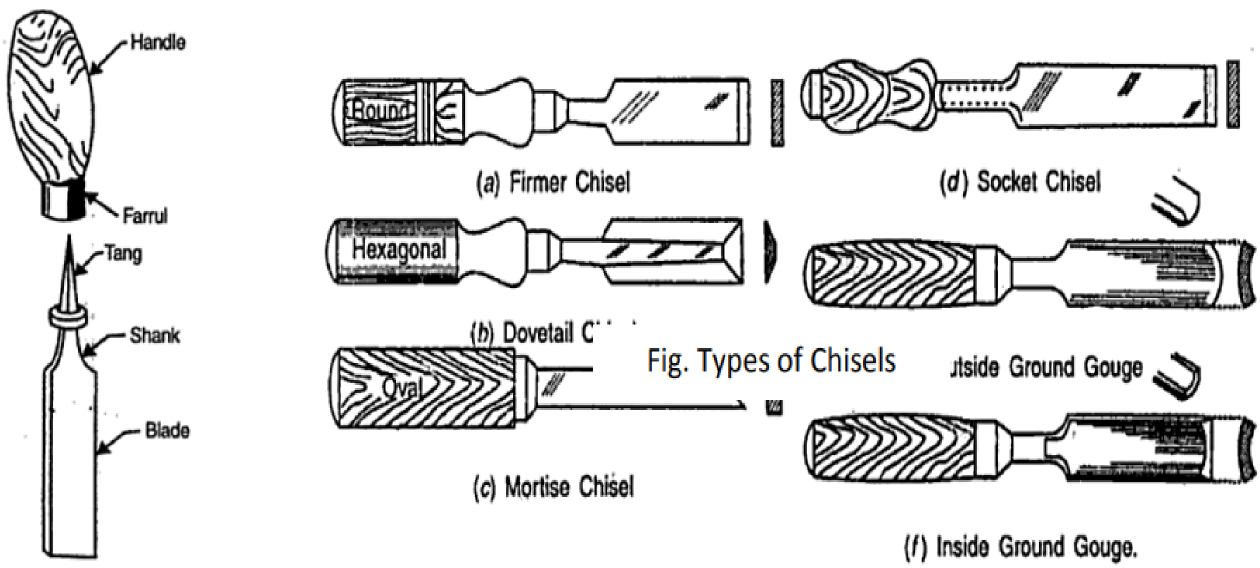
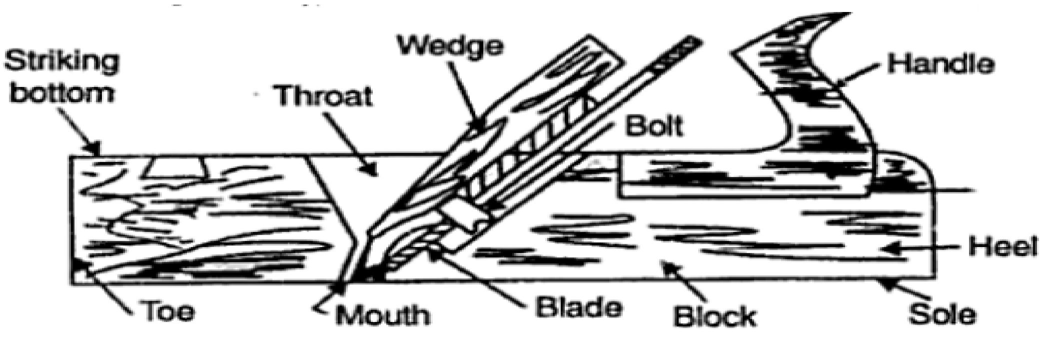


Fig. Types of Chisels

Planning Tools

Planning tool is used to smoothen the wooden surfaces.



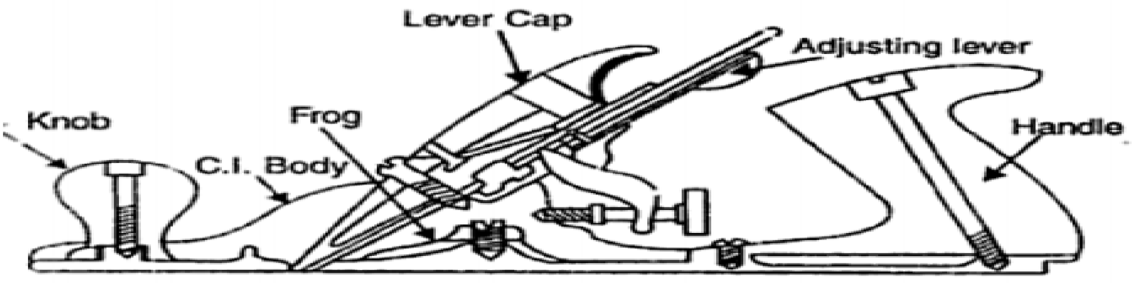
(*a*) Wooden Jack Plane (Sectional View)

a) Wooden jack plane

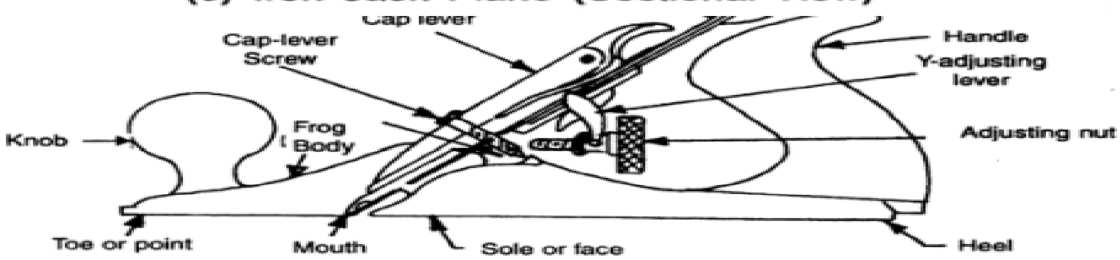
This is the most commonly used plane in carpentry shop. The main part of a wooden jack plane is a wooden block called sole, in which steel blade having knife edge is fixed at an angle with the help of wooden edge. The angle of the blade is kept about 45 ° to bottom surface of the blade.

b) Metal Jack Plane

It serves the same purpose as the wooden jack plane but facilitates a smoother operations and better finish. The body of a metal jack plane is made from a grey iron casting with the side and sole machined and ground to better finish.



(*c*) Iron Jack Plane (Sectional View)



DRILLING AND BORING TOOLS:

a) **Bradawl:** It is a hand operated tool, used to bore small holes for starting a screw or large nail.

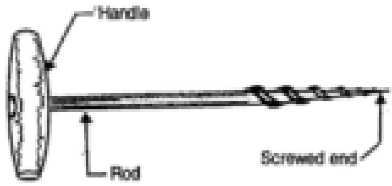
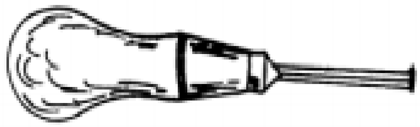


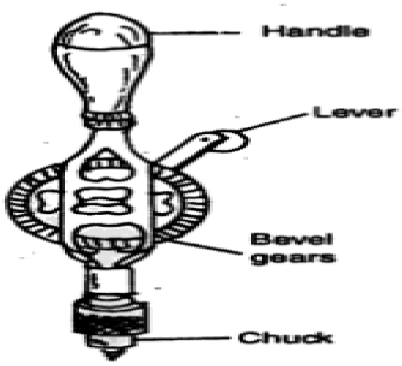
Fig. Gimlet Drill



b) **Carpenters brace:** it is used for rotating auger bits, twist drills, etc., to produce holes in wood. In some designs, braces are made with ratchet device.

c) **Auger bit:** it is the most common tool used for making holes in wood. During drilling, the lead screw of the bit guides into the wood, necessitating only moderate pressure on the brace. The helical flutes on the surface carry the chips to the outer surface.

d) **Hand drill:** carpenter's brace is used to make relatively large size holes; whereas hand drill is used for drilling small holes. A straight shank drill is used with this tool. It is small, light in weight and may be conveniently used than the brace. The drill bit is clamped in the chuck at its end and is rotated by a handle attached to gear and pinion arrangement.

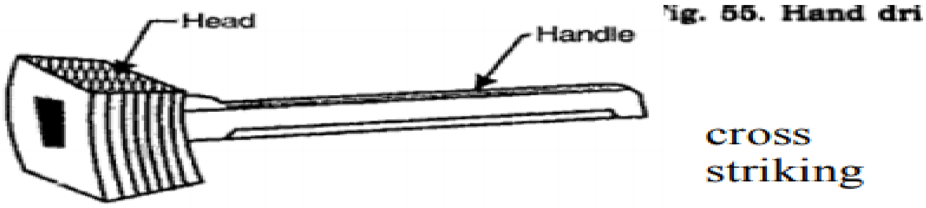


e) **Gimlet:** it has cutting edges like a twist drill. It is used for drilling large diameter holes with the hand pressure.

Striking Tools

a) Mallet

This is wooden headed hammer of round or rectangular cross section. The striking face is made flat. Mallet is used for striking the cutting tools and has wooden handle.



b) Claw Hammer

This is a hammer having steel head and wooden handle. The flat face of the head is used to drive nails and claw portion for extracting nails out of the wood.

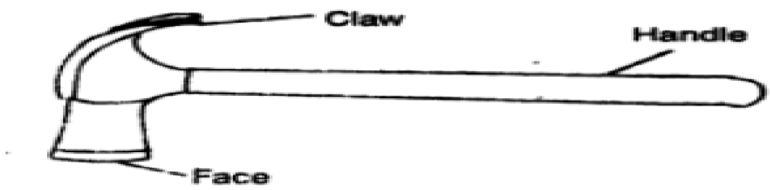
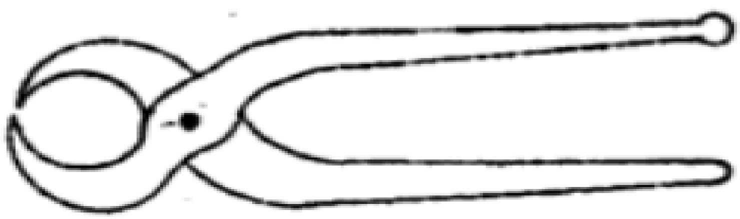


Fig. Claw Hammer

c) Pincer:

it is made of two forged steel arms with a hinged joint and is used for pulling-out small nails from wood. The inner faces of the pincer jaws are bevelled and the outer faces are plain. The end of one arm has a ball and the other has a claw. The bevelled jaws and the claw are used for pulling out small nails, pins and screws from the wood.



d) Screw Driver:

it is used for driving wood screws into wood or unscrewing them. The length of a screw driver is determined by the length of the blade. As the length of the blade increases, the width and thickness of the tip also increase.

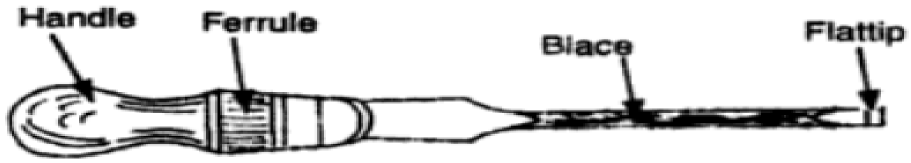


Fig. Screw Driver

Wood rasp files: it is a finishing tool used to make the wood surface smooth, remove sharp edges, and finish fillets and other interior surfaces. Sharp cutting teeth are provided on its surface for the purpose. This file is exclusively used in wood work.

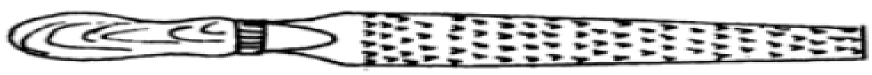


Fig. Wood Rasp files

DOVETAIL LAP JOINT

AIM: To make a dovetail lap joint.

MATERIALS REQUIRED: Teak wood (30mm*150mm*50mm)

TOOLS AND EQUIPMENT USED:

1. Steel rule
2. Try square
3. Marking gauge
4. Rip saw
5. Tendon saw
6. Mortise chisel

7. Mallet

8. Jack plane

9. Wood rasp file

OPERATIONS TO BE CARRIED OUT:

1. Planning

2. Marking

3. Sawing

4. Chiselling

5. Finishing

PROCEDURE:

1. The wooden pieces are made into two halves and are checked for dimensions.

2. One side of pieces is planned with jack plane and for straightness.

3. An adjacent side is planned and checked for squareness with a try square.

4. Marking gauge is set and lines are marked at 40-50 mm to make the thickness and width according to given figure.

5. The excess material is planned to correct size.

6. Using tendon saw, the portions to be removed are cut in both the pieces

7. The excess material in X is chiselled with mortise chisel.

8. The excess material in Y in chiselled to suit X

9. The end of both the pieces is chiselled to exact lengths.

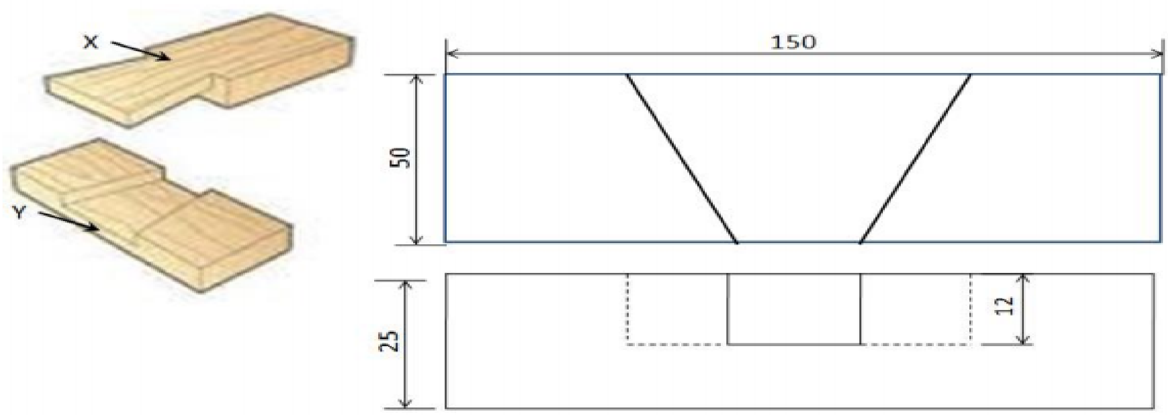
PRECAUTIONS:

1. Wood should be free from moisture

2. Marking is done with out parallax error

3. Care should be taken while chiselling

4. Matching of X and Y pieces should be tight.



RESULT:

The dovetail lap joint is made success fully.

FITTING

The term fitting, is related to assembly of parts, after bringing the dimension or shape to the required size or form, in order to secure the necessary fit. The operations required for the same are usually carried out on a work bench, hence the term bench work is also added with the name fitting. The bench work and fitting plays an important role in engineering. Although in today's industries most of the work is done by automatic machines which produces the jobs with good accuracy but still it (job) requires some hand operations called fitting operations. The person working in the fitting shop is called fitter.

FITTING TOOLS:

Fitting shop tools are classified as below:

- Work Holding Devices/ Clamping Tools.
- Measuring and Marking Tools.
- Cutting Tools.

- Striking Tools.
- Drilling Tools.
- Threading Tools.

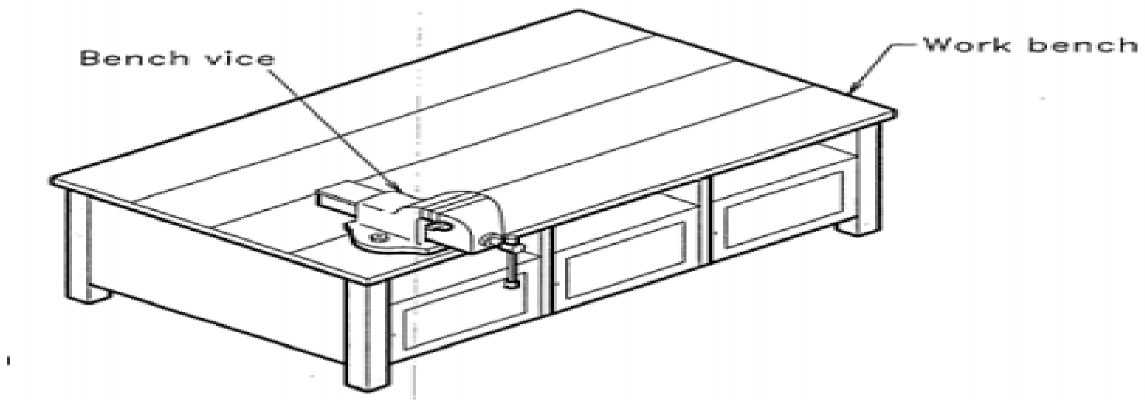
I. WORK HOLDING DEVICES /CLAMPING TOOLS:

1. Work Bench

A fitting process can be done at various places, but most of the important operations of fitting are generally carried out on a table called work bench.

The work bench is a strong, heavy and rigid table made up of hard wood.

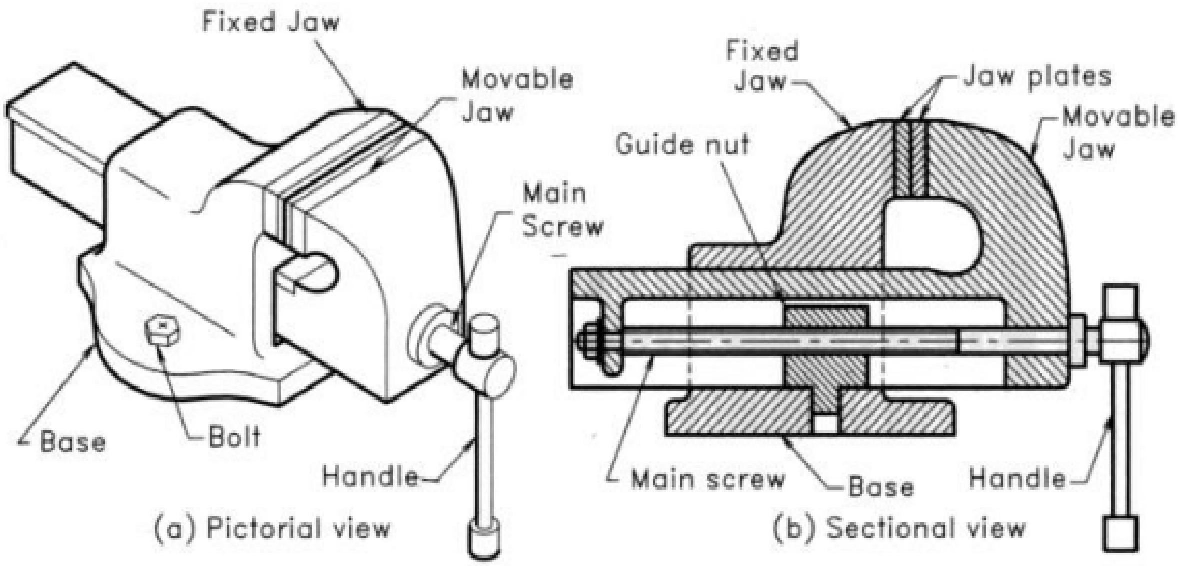
The size of the work bench required is about 150 to 180 cm length, nearly 90 cm width and approximately 76 to 84 cm height.



2. BENCH VICE:

It is firmly fixed to the bench with the help of nuts and bolts. It consists of a cast Iron body and cast iron jaws. Two jaw plates are fitted on both the jaws. The holding surface of the jaw plates is knurled in order to increase the gapping. Jaw plates are made up of carbon steel and are wear resistant. One jaw is fixed to the body and the second slides on a square threaded screw with the help of a handle.

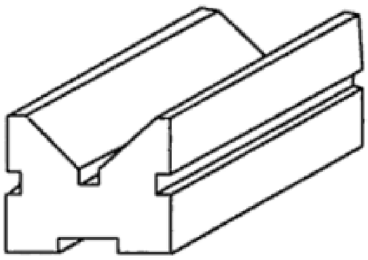
The jaws are opened up to required length; job is placed in the two jaws and is fully tightened with the help of handle. Handle is used to move the movable jaw.

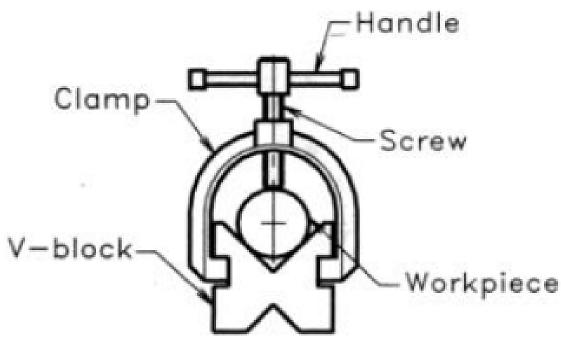


(a) Pictorial view (b) Sectional view

3. V Block

In V Block, V grooves are provided to hold the round objects longitudinally. The screw of the clamp applies the holding pressure. When the handle is rotated there is movement in the screw.

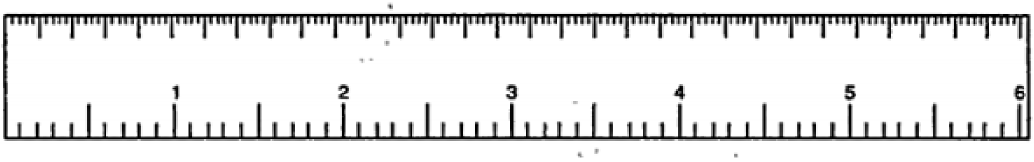

(a) V Block



II. MEASURING TOOLS

1. Steel Rule

These are made up of stainless steel and are available in many sizes ranging from 1/2 ft. to 2 ft. These are marked in inches or millimetres. All the faces are machined true. The edges of steel rule should be protected from rough handling.



2. Callipers

These are generally used to measure the inside or outside diameters. Different types are:

i. Outside Calliper: It is used to measure the outside dimensions.

ii. Inside Calliper: It is used to measure the inside dimensions.

iii. Spring Calliper: Spring is provided to apply the pressure and lock nut is provided to lock any desired position.

IV. Hermaphrodite, Jenny or Odd leg Calliper: One leg is bent at the tip inwardly and the other has a straight pointed end. It is used to scribe lines parallel to the straight edges.

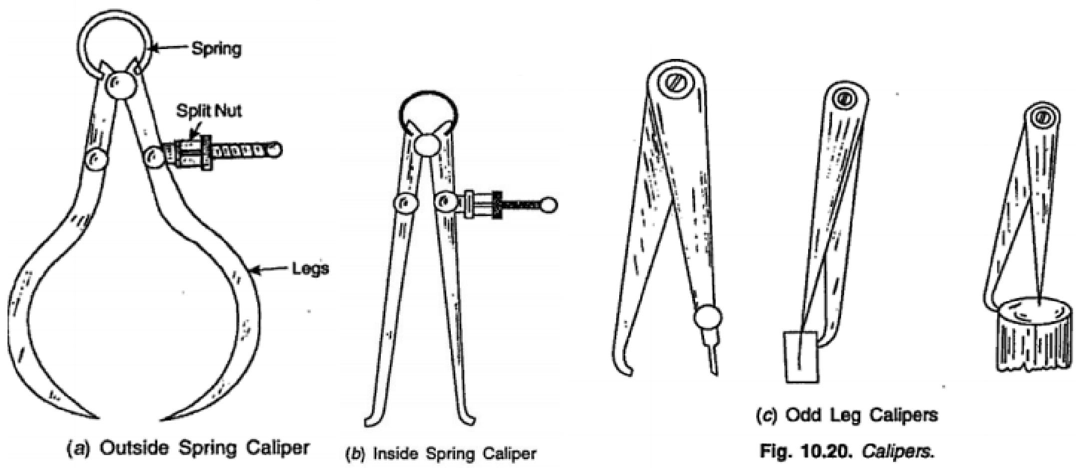
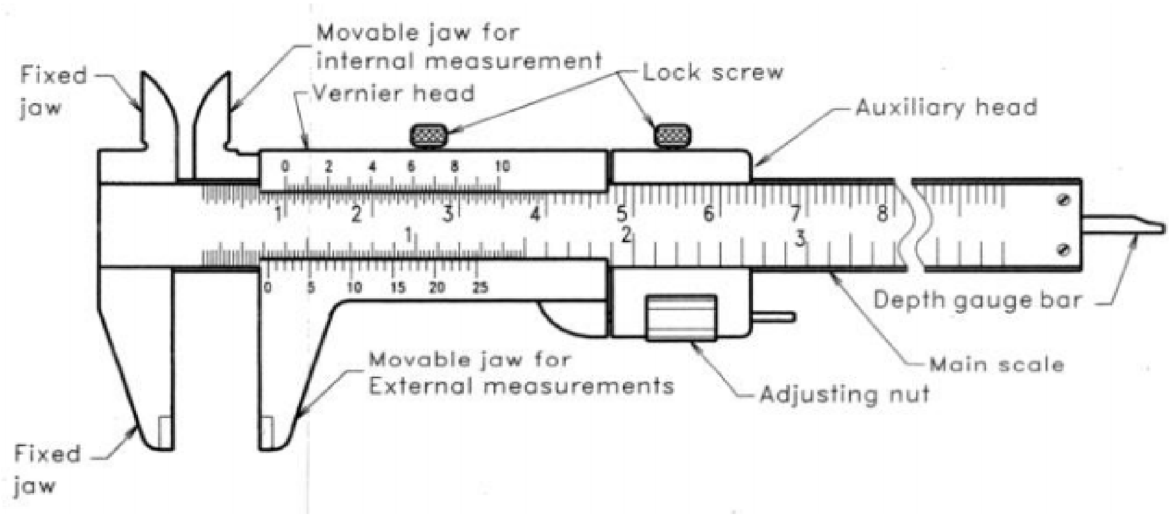


Fig. Calipers

3. Vernier Calliper:

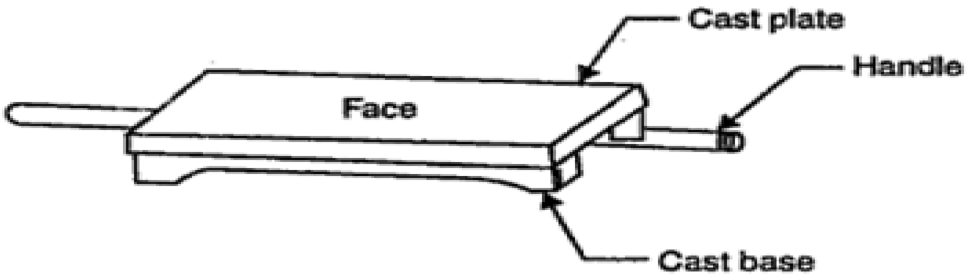
It is used for measuring the outer dimensions of round, flat, square components and also the inner size of the holes and bore. A narrow blade is used to measure the depth of bar slots etc. The reading accuracy in metric system is 0.02 mm and British system it is 0.001”. It is made of stainless steel.



III. MARKING TOOLS:

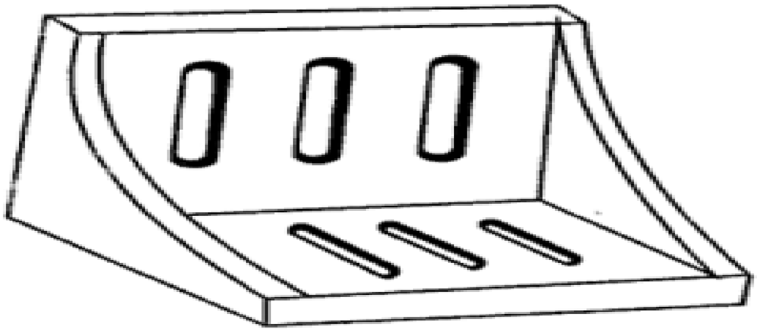
1. Surface Plate

It is used for testing the flatness, trueness of the surfaces. It is made up of cast iron or graphite. Its upper face is planed to form a very smooth surface. It is also used in scribing work. While not in use, it should be covered with a wooden cover.



2. Angle Plate

It is made up of cast iron in different sizes; it has two planed surfaces at right angles to each other and has various slots in each surface to hold the work by means of bolts and clamps. Never do hammering on the angle plate to fasten (lighten) the nuts and bolts.



3. Scriber and Surface Gauge

It consists of a cast iron bass on the centre of which a steel rod is fixed vertically. Scriber is made up of high carbon steel and is hardened from the front edge. It is used for locating the centres of round bars or for marking of the lines.

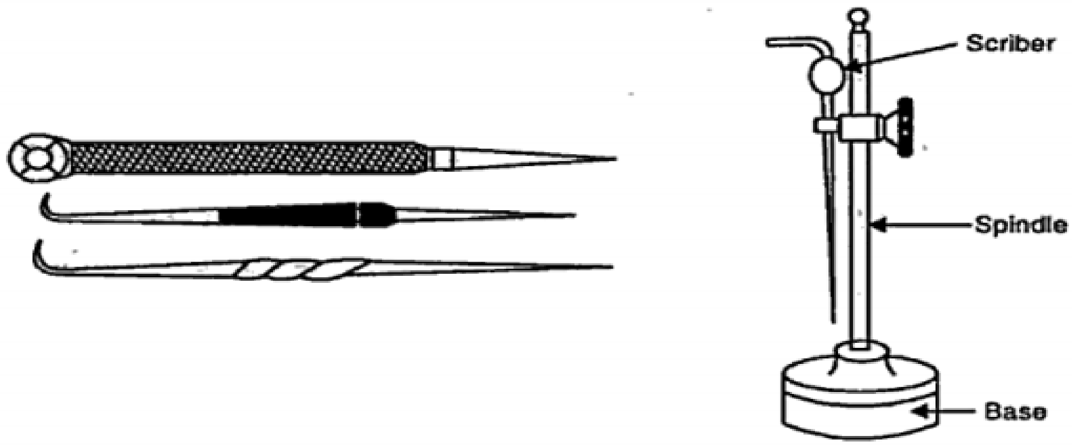
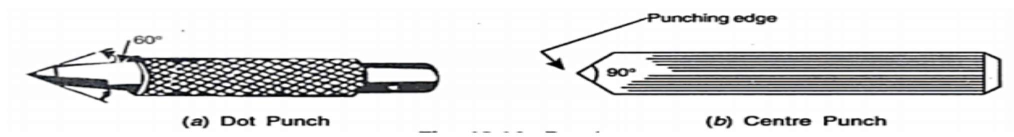


Fig. Scriber and Surface Gauge

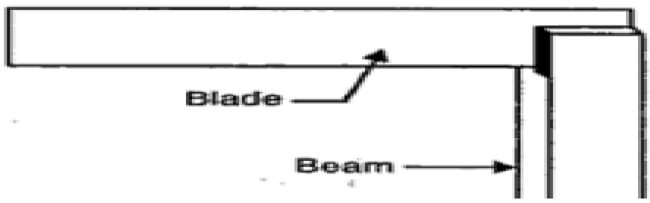
4. Punches

Punches are used for marking purposes. Dot punches are used for marking dotted line and centre punch is used to mark the centre of hole before drilling. Punches are made up of high carbon steel or high speed steels. One end is sharpened. Hammering is done on the second end while working. For dot punch, angle of the punching end is 60 degree while in centre punch; angle of punching end is 90 degree.



5. Try Square

It is used for checking square of two surfaces. It consists of a blade made up of steel, which is attached to a base at 90 degree. The base is made up of cast iron or steel. It is also used to mark the right angles and measuring straightness of surfaces. Never use try square as a hammer.



6. Vernier Height gauge:

A Vernier height gauge consists of a heavy base, a graduated beam, a sliding head with Vernier sliding jaws holding the scriber and a fine adjustment clamp. It is similar to large Vernier callipers in construction, except that it consists of a heavy base which allows the gauge to stand upright instead of a fixed jaw in a Vernier. The movable jaw of Vernier height gauge consists of a projection or extension which is levelled to sharp edge for scribing lines at any required height.

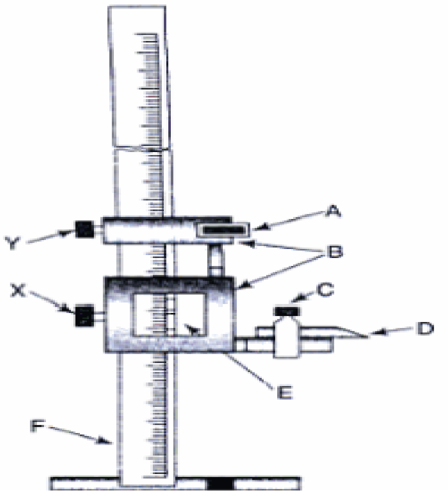


Fig. Vernier height gauge
A-Fine Adjustment of nut B-Vernier slide C-Scriber clamp screw D – Scriber E – Vernier Scale F – Main Scale G – Base X,Y – Lock Screws

METHOD OF MARKING

Marking means setting out dimensions with the help of a working drawing or directly transferring them from a similar part. The procedure of marking is as follows:

1. The surface to be marked is coated with the paste of chalk or red lead and allowed to dry.

2. Then the work is held In a holding device depending upon shape and size. If it is flat, use surface plate, if it is round use V block and clamp, else use angle plate etc.

3. Lines in horizontal direction are scribed by means of a surface gauge. Lines at right angles can be drawn by turning the work through 90 degree and then using the scriber. If true surface is available, try square can also be used.

4. The centre on the end of a round bar can be located by using an odd leg calliper, surface gauge etc. 5. The circles and arcs on a flat surface are marked by means of a divider.

6. After the scribing work is over, indentations on the surface are made using dot punch and hammer.

IV. CUTTING TOOLS

1. Hacksaw

Hacksaw is used for cutting of rods, bars, pipes, flats etc. It consists of a frame, which is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The blade is made up of high carbon steel or high speed steel.

The points of the teeth are bent in a zigzag fashion, to cut a wide groove and prevent the body of the blade from rubbing or jamming in the saw cut. The teeth of the blades are generally forward cut so in the case, pressure is applied in the forward direction only. Depending upon the direction of cut, blades are classified as:

o Forward cut

o Backward cut.

Depending upon the pitch of the teeth (Distance between the two consecutive teeth) blades is classified as:

- Coarse (8-14 teeth per Inch)
- Medium (16-20 teeth per inch)
- Fine (24-32 teeth per inch)

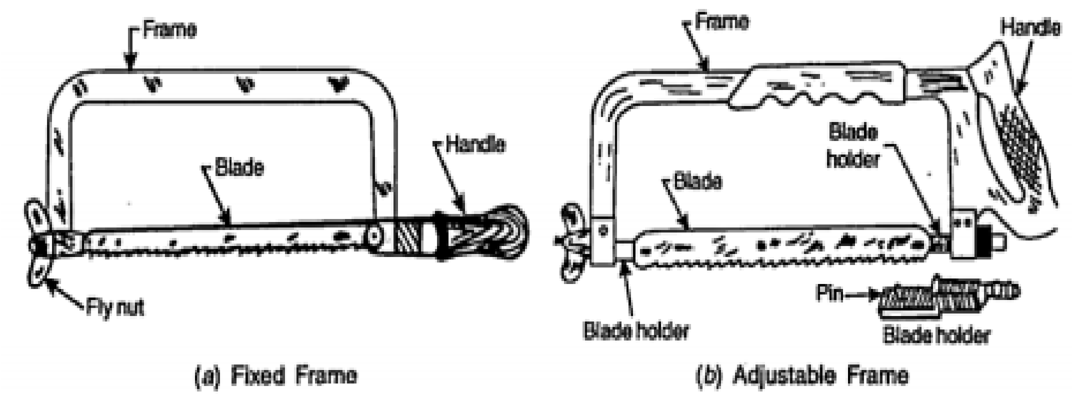
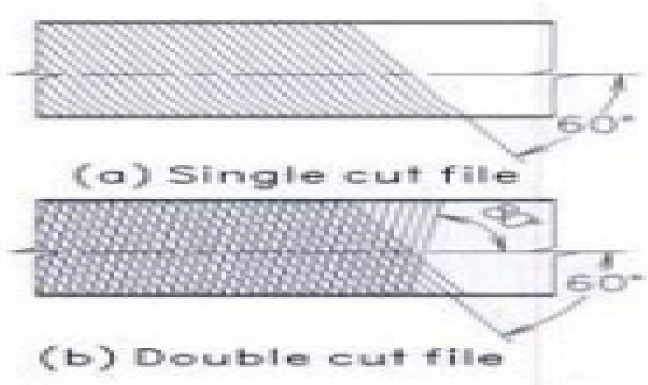


Fig. Hand Hacksaws

2. Files

Files are multi points cutting tools. It is used to remove the material by rubbing it on the metals. Files are available in a number of sizes, shapes and degree of coarseness.



Classification of files

i. On the basis of length 4”,6”,8”,12”

ii. On the basis of grade:

- Rough (R)(20 teeth per inch)
- Bastard (B)(30 teeth per inch)
- Second cut (Sc) (40 teeth per inch)
- Smooth file (S)(50 teeth per inch)
- Dead smooth (DS)(100 teeth per inch)

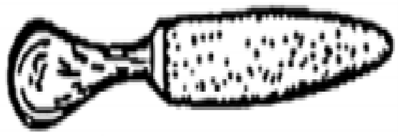
Rough and bastard files are the big cut files. When the material removal is more, these files are used. These files have bigger cut but the surface produced Is rough.

Dead smooth and smooth files have smaller teeth and used for finishing work. Second cut file has degree of finish in between bastard and smooth file.

iii. On the basis of number of cuts:

- Single cut files.
- Double cut files.
- Rasp files.

In single cut files the teeth are cut in parallel rows at an angle of 60 degree to the face. Another row of teeth is added in opposite direction in case of double cut files. Material removal is more in case of double cut files.

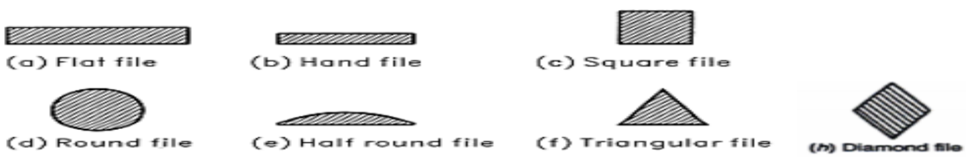


(c) Rasp cut file

(g) Knife edge file

iv. On the basis of shape and size:

The length of the files varies from 4' to 14*. The various shapes of cross-section available are hand file, flat file, triangular, round; square, half round, knife-edge, pillar, needle and mill file.



a. Flat file: This file has parallel edges for about two-thirds of the length and then it tapers in width and thickness. The faces are double cut while the edges are single cut.

b. Hand file: for a hand file the width is constant throughout, but the thickness tapers as given in flat file. Both faces are double cut and one edge is single cut. The remaining edge is kept uncut in order to use for filing a right-angled corner on one side only.

c. Square file: It has a square cross-section. It is parallel for two-thirds of its length and then tapers towards the tip. It is double cut on all sides. It is used for filing square corners and slots.

d. Triangular file: It has width either parallel throughout or up to middle and then tapered towards the tip. Its section is triangular (equilateral) and the three faces are double cut and the edges single cut. It is used for filing square shoulders or comers and for sharpening wood working saws.

e. Round file: It has round cross-section. It carries single cut teeth all round its surface. It is normally made tapered towards the tip and is frequently known as rat-tail file. Parallel round files having same diameter throughout the length are also available. The round files are used for opening out holes, producing round comers, round-ended slots etc.

f. Half-round file: Its cross-section is not a true half circle but is only about one-third of a circle. The width of the file is either parallel throughout or up to middle and then tapered towards the tip. The flat side of this file is always a double cut and curved side has single cut. It is used for filing curved surfaces.

g. Knife edge file: It has a width tapered like a knife blade and it is also tapered towards the tip and thickness. It carries double cut teeth on the two broad faces and single cut teeth on the edge. It is used for finishing sharp corners of grooves and slots

h. Diamond file: Its cross-section is like a diamond. It is used for special work.

i. Needle file: These are thin small files having a parallel tang and a thin, narrow and pointed blade made in different shapes of its cross-section to suit the particular need of the work. These are available in sizes from 100 mm to 200 mm of various shapes and cuts. These files are used for filing very thin and delicate work.

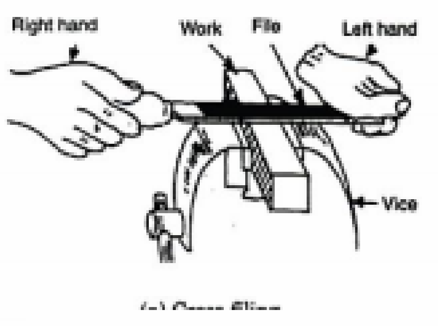
Methods of filing

The following are the two commonly used methods of filing:

1. Cross-filing
2. Draw filing.

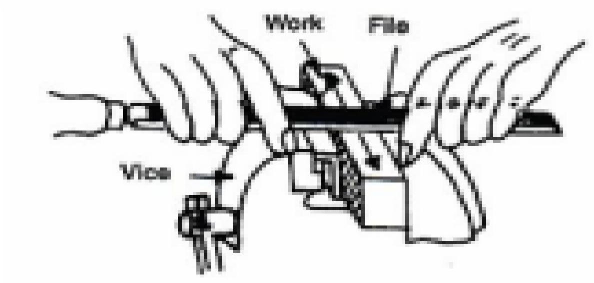
Cross - filing. Refer Fig. (a).

This method is used for efficient removal of maximum amount of metal in the shortest possible time. It may be noted that the file must remain horizontal throughout the stroke (long, slow and steady) with pressure only applied on the forward motion.



Draw filing. Refer Fig. (b)

This method is used to remove file marks and for finishing operations. Here, the file is gripped as close to the work as possible between two hands. In this filing method, a fine cut file with a flat face should be used.



(b) Draw filing

FILE CARD:

It is a device fashioned like a wire brush used to clean dirt and chips from the teeth of a file. When particles of metal clog the teeth the file is said to the pinned, a condition that causes scratching of the surface of the work. Files, therefore, require cleaning by means of a file card or by dislodging the material between the teeth by means of a piece of soft iron, copper, brass, tin plate and so on, sharpened at the end. Hardened steel should never be used.

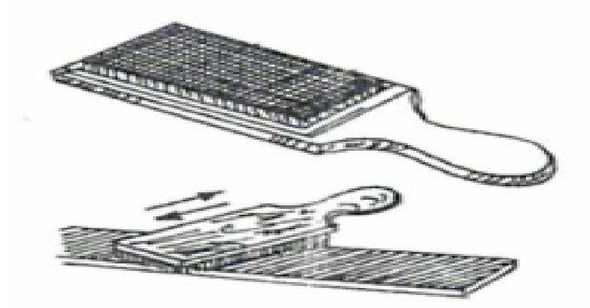


Fig. File Card

V-FITTING

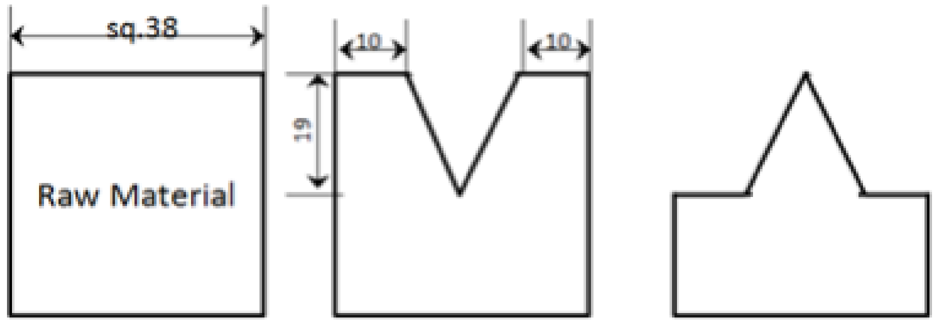
AIM:

To make a V-Fit from the given mid steel pieces.

DUMKA ENGINEERING COLLEGE

MATERIALS REQUIRED:

Mild steel flat (40*40*3mm).



TOOLS AND EQUIPMENT REQUIRED:

1.6”try square
2. 6”sriber
3. Odd leg calliper
3.12”hack saw Frame
4 Blades (12 TPI)
5.10”rough file
6.10”smooth file
7.10”triangle file
8. Knife Edge file
9. Dot punch
10. Ball peen hammer (0.5Ib)
11. Steel Rule

Sequence of Operations:

1. Filling
2. Marking
3. Punching
4. Sawing
5. Filling
6. Finishing

PROCEDURE:

1. The given mild steel flat piece is checked for given dimensions.
2. One edge of given is filled with rough and smooth files and checked with try square for straightness.
3. An adjacent edge is also filled such that it is square to first edge and checked with try square.
4. Wet chalk is applied on one side of the flat and dried for marking.
5. Lines are marked according to given figure, using odd leg calliper and steel rule.
6. Using the dot punch, punches are made along the marked lines.
7. The excess materials removed from the remaining two edges with try square level up to half of the marked dots.
8. Finally buts are removed by the filling on the surface of the fitted job.

PRECAUTIONS:

1. The perpendicular of face ends edges is checked perfectly by using try square. 2. Finishing is given by using only with smooth files.
3. Marking is done without parallax error.

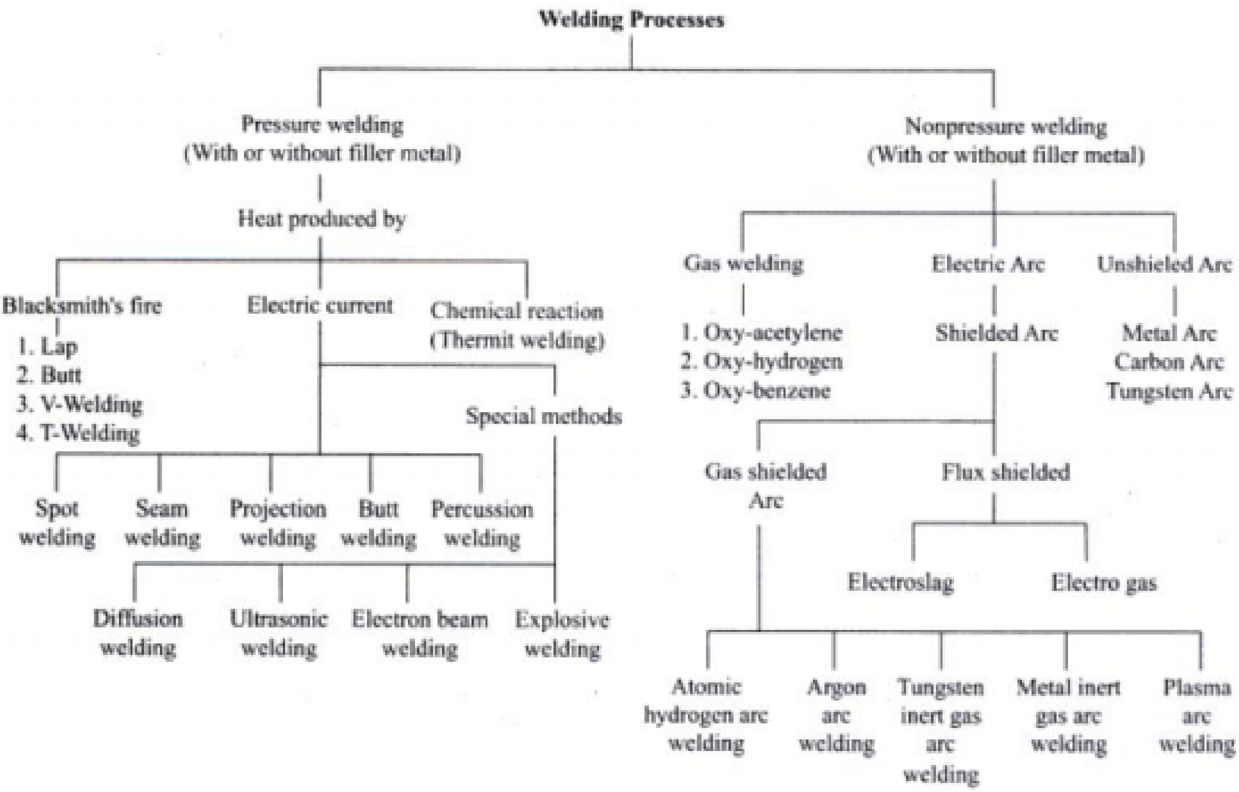
RESULT:

The V-fit is done successfully.

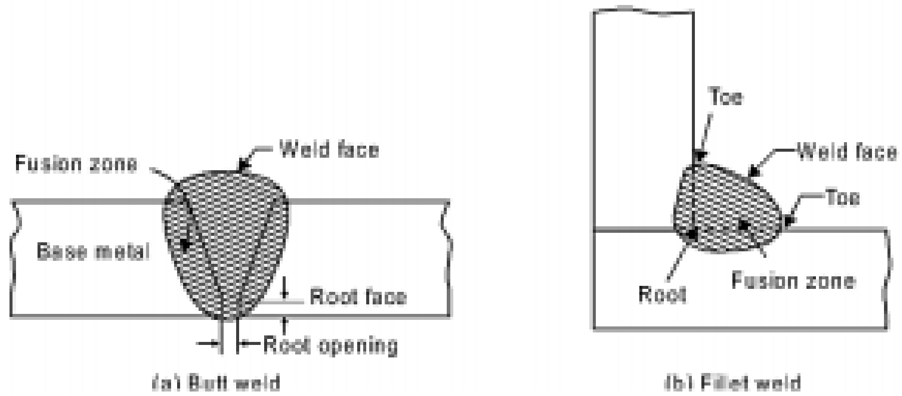
WELDING

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction.

Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc.



Most of the metals and alloys can be welded by one type of welding process or the other. However, some are easier to weld than others. To compare this ease in welding term 'weld ability' is often used. The weld ability may be defined as property of a metal which indicates the ease with which it can be welded with other similar or dissimilar metals. Elements of welding process used with common welding joints such as base metal, fusion zone, weld face, root face, root opening toe and root are depicted in Figure.



Terminology of welding process

Edge preparations

For welding the edges of joining surfaces of metals are prepared first. Different edge preparations may be used for welding butt joints, which are given in Figure.

Welding joints

Some common welding joints are shown in Figure. Welding joints are of generally of two major kinds namely lap joint and butt joint. The main types are described as under.

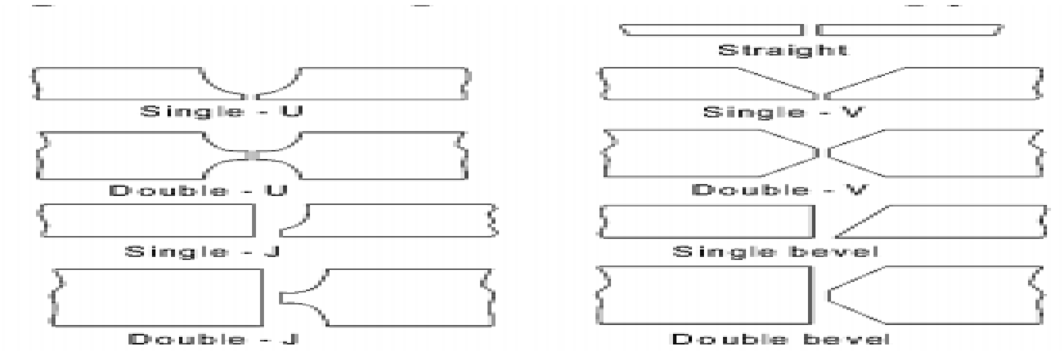
1. Lap weld joint

Single-Lap Joint

This joint, made by overlapping the edges of the plate, is not recommended for most work. The single lap has very little resistance to bending. It can be used satisfactorily for joining two cylinders that fit inside one another.

Double-Lap Joint

This is stronger than the single-lap joint but has the disadvantage that it requires twice as much welding.



Tee Fillet Weld

This type of joint, although widely used, should not be employed if an alternative design is possible.

2. Butt weld joint

a. Single-V

Butt Weld It is used for plates up to 15.8 mm thick. The angle of the v depends upon the technique being used, the plates being spaced approximately 3.2 mm.

b. Double-V

Butt Weld It is used for plates over 13 mm thick when the welding can be performed on both sides of the plate. The top v angle is either 60° or 80°, while the bottom angle is 80°, depending on the technique being used.

Welding Positions

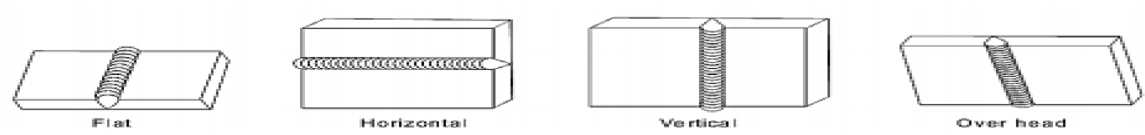
As shown in Fig. 17.4, there are four types of welding positions, which are given as:

a. Flat or down hand position

b. Horizontal position

c. Vertical position

d. Overhead position



Flat or Down-hand Welding Position

The flat position or down hand position is one in which the welding is performed from the upper side of the joint and the face of the weld is approximately horizontal.

Horizontal Welding Position

In horizontal position, the plane of the work piece is vertical and the deposited weld head is horizontal. This position of welding is most commonly used in welding vessels and reservoirs.

Vertical Welding Position

In vertical position, the plane of the work-piece is vertical and the weld is deposited upon a vertical surface. It is difficult to produce satisfactory welds in this position due to the effect of the force of gravity on the molten metal.

Overhead Welding Position

The overhead position is probably even more difficult to weld than the vertical position. Here the pull of gravity against the molten metal is much greater.

ARC WELDING PROCESSES

The process, in which an electric arc between an electrode and a work-piece or between two electrodes is utilized to weld base metals, is called an arc welding process. The basic principle of arc welding is shown in Figure1. However the basic elements involved in arc welding process are shown in Figure2. Most of these processes use some shielding gas while others employ coatings or fluxes to prevent the weld pool from the surrounding atmosphere.

1) Switch box. 2) Secondary terminals

3) Welding machine. 4) Current reading scale.

5) Current regulating hand wheel. 6) Leather apron.

7) Asbestos hand gloves. 8) Protective glasses strap

9) Electrode holder. 10) Hand shield

11) Channel for cable protection. 12) Welding cable.

13) Chipping hammer. 14) Wire brush.

15) Earth clamp. 16) Welding table (metallic).

17) Job.

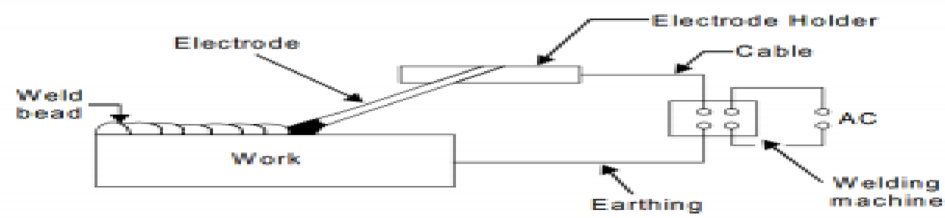


Fig1.The basic principle of arc welding

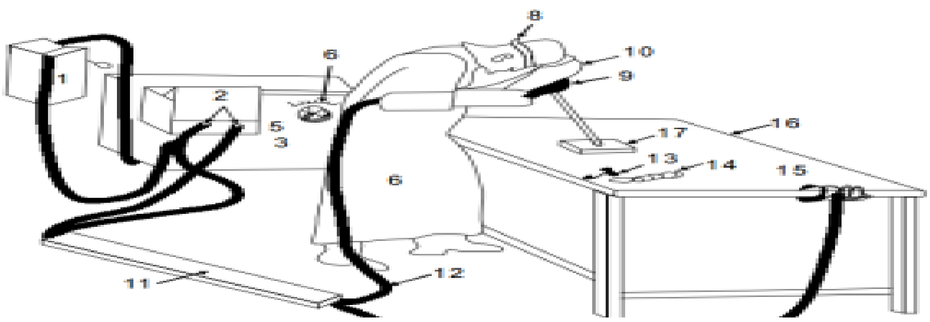


Fig2.The basic elements of arc welding

Arc Welding Equipment

Arc welding equipment, setup and related tools and accessories are shown in Figure. However some common tools of arc welding are shown separately through Figure. Few of the important components of arc welding setup are described as under.

1. Arc welding power source

Both direct current (DC) and alternating current (AC) are used for electric arc welding, each having its particular applications. DC welding supply is usually obtained from generators driven by electric motor or if no electricity is available by internal combustion engines. For AC welding supply, transformers are predominantly used for almost all Arc-welding where mains electricity supply is available. They have to step down the usual supply voltage (200-400 volts) to the normal open circuit welding voltage (50-90 volts). The following factors influence the selection of a power source:

a. Type of electrodes to be used and metals to be welded
b. Available power source (AC or DC)
c. Required output
d. Duty cycle
e. Efficiency
f. Initial costs and running costs
g. Available floor space
h. Versatility of equipment

2. Welding cables

Welding cables are required for conduction of current from the power source through the electrode holder, the arc, the work piece and back to the welding power source. These are insulated copper or aluminium cables.

3. Electrode holder

Electrode holder is used for holding the electrode manually and conducting current to it. These are usually matched to the size of the lead, which in turn matched to the amperage output of the arc welder. Electrode holders are available in sizes that range from 150 to 500 Amps.

Fig. Electrode Holder

4. Welding Electrodes

An electrode is a piece of wire or a rod of a metal or alloy, with or without coatings. An arc is set up between electrode and work piece. Welding electrodes are classified into following types-

(i) Consumable Electrodes

(a) Bare Electrodes

(b) Coated Electrodes

(ii) Non-consumable Electrodes

(a) Carbon or Graphite Electrodes

(b) Tungsten Electrodes

Consumable electrode is made of different metals and their alloys. The end of this electrode starts melting when arc is struck between the electrode and work piece. Thus consumable electrode itself acts as a filler metal. Bare electrodes consist of a metal or alloy wire without any flux coating on them. Coated electrodes have flux coating which starts melting as soon as an electric arc is struck. This coating on melting performs many functions like prevention of joint from atmospheric contamination, arc stabilizers etc.

Non-consumable electrodes are made up of high melting point materials like carbon, pure tungsten or alloy tungsten etc. These electrodes do not melt away during welding. But practically, the electrode length goes on decreasing with the passage of time, because of oxidation and vaporization of the electrode material during welding. The materials of non-consumable electrodes are usually copper coated carbon or graphite, pure tungsten, throated or zirconiated tungsten.

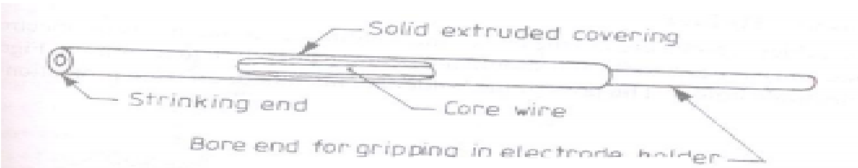


Fig. Parts of a electrode

5. Hand Screen

Hand screen used for protection of eyes and supervision of weld bead.

6. Chipping hammer

Chipping Hammer is used to remove the slag by striking.

7. Wire brush

Wire brush is used to clean the surface to be weld.

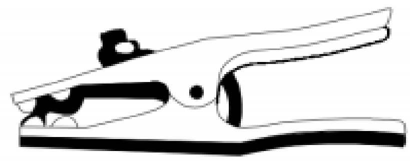


Fig. Earth Clamp

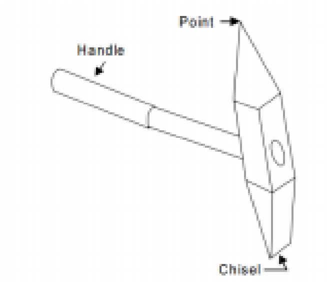


Fig. Chipping Hammer

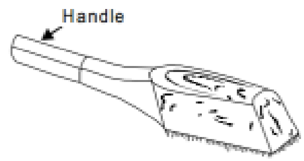


Fig. Wire Brush

8. Protective clothing

Operator wears the protective clothing such as apron to keep away the exposure of direct heat to the body.

Safety Recommendations for ARC Welding

The beginner in the field of arc welding must go through and become familiar with these general safety recommendations which are given as under.

1. The body or the frame of the welding machine shall be efficiently earthed. Pipe lines containing gases or inflammable liquids or

conduits carrying electrical conductors shall not be used for a ground return circuit All earth connections shall be mechanically strong and electrically adequate for the required current.

2. Welding arc in addition to being very is a source of infra-red and ultra-violet light also; consequently the operator must use either helmet or a hand-shield fitted with a special filter glass to protect eyes

3. Excess ultra-violet light can cause an effect similar to sunburn on the skin of the welder

4. The welder's body and clothing are protected from radiation and burns caused by sparks and flying globules of molten metal with the help of the following:

5. Gloves protect the hands of a welder.

6. Leather or asbestos apron is very useful to protect welder's clothes and his trunk and thighs while seated he is doing welding.

7. For overhead welding, some form of protection for the head is required

8. Leather skull cap or peaked cap will do the needful.

9. Leather jackets and 1ather leggings are also available as clothes for body protection.

10. Welding equipment shall be inspected periodically and maintained in safe working order at all times.

11. Arc welding machines should be of suitable quality.

12. All parts of welding set shall be suitably enclosed and protected to meet the usual service conditions.

BUTT JOINT

Aim:

To make a Butt joint using the given two M.S pieces by arc welding.

Material Required:

Mild steel plate of size 100X50X5 mm – 2 No’s

Welding Electrodes:

M.S electrodes 3.1 mm X350 mm

Welding Equipment:

Air cooled transformer Voltage-80 to 600 V 3 phase supply, amps up to 350

Tools and Accessories required:

1. Rough and smooth files.
2. Protractor
3. Arc welding machine (transformer type)
4. Mild steel electrode and electrode holder
5. Ground clamp
6. Tongs
7. Face shield
8. Apron
9. Chipping hammer.

Sequence of operations:

1. Marking
2. Cutting
3. Edge preparation (Removal of rust, scale etc.) by filling
4. Try square levelling
5. Tacking
6. Welding

7. Cooling

8. Chipping

9. Cleaning

Procedure:

1. The given M.S pieces are thoroughly cleaned of rust and scale.

2. One edge of each piece is believed, to an angle of 300 , leaving nearly ¼ th of the flat thickness, at one end.

3. The two pieces are positioned on the welding table such that, they are separated slightly for better penetration of the weld.

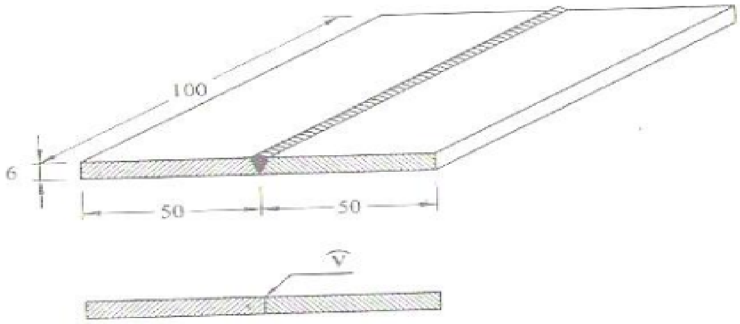
4. The electrode is fitted in the electrode holder and the welding current is ser to be a proper value. 5. The ground clamp is fastened to the welding table.

6. Wearing the apron and using the face shield, the arc is struck and holding the two pieces together; first run of the weld is done to fill the root gap.

7. Second run of the weld is done with proper weaving and with uniform movement. During the process of welding, the electrode is kept at 150 to 250 from vertical and in the direction of welding. 8. The scale formation on the welds is removed by using the chipping hammer.

9. Filling is done to remove any spanner around the weld.

DRAWING:



Welded Joint Representation

Result:

The single V-butt joint is thus made, using the tools and equipment as mentioned above.

BLACKSMITHY

Black smithy or Forging is an oldest shaping process used for the producing small articles for which accuracy in size is not so important. The parts are shaped by heating them in an open fire or hearth by the blacksmith and shaping them through applying compressive forces using hammer.

Thus forging is defined as the plastic deformation of metals at elevated temperatures into a predetermined size or shape using compressive forces exerted through some means of hand hammers, small power hammers, die, press or upsetting machine. It consists essentially of changing or altering the shape and section of metal by hammering at a temperature of about 980°C, at which the metal is entirely plastic and can be easily deformed or shaped under pressure. The shop in which the various forging operations are carried out is known as the smithy or smith's shop.

Hand forging process is also known as black-smithy work which is commonly employed for production of small articles using hammers on heated jobs. It is a manual controlled process even though some machinery such as power hammers can also be sometimes used. Black-smithy is, therefore, a process by which metal may be heated and shaped to its requirements by the use of blacksmith tools either by hand or power hammer.

Forging by machine involves the use of forging dies and is generally employed for mass production of accurate articles. In drop forging, closed impression dies are used and there is drastic flow of metal in the dies due to repeated blow or impact which compels the plastic metal to conform to the shape of the dies.

Applications of forging

Almost all metals and alloys can be forged. The low and medium carbon steels are readily hot forged without difficulty, but the high-carbon and alloy steels are more difficult to forge and require greater care. Forging is generally carried out on carbon alloy steels, wrought iron, copper-base alloys, aluminium alloys, and magnesium alloys. Stainless steels, nickel-based super alloys, and titanium are forged especially for aerospace uses.

FORGEABILITY

The ease with which forging is done is called forge ability. The forge ability of a material can also be defined as the capacity of a material to undergo deformation under compression without rupture. Forge ability increases with temperature up to a point at which a second phase, e.g., from ferrite to austenite in steel, appears or if grain growth becomes excessive.

COMMON HAND FORGING TOOLS

For carrying out forging operations manually, certain common hand forging tools are employed. These are also called blacksmith's tools, for a blacksmith is one who works on the forging of metals in their hot state. The main hand forging tools are as under.

Tongs

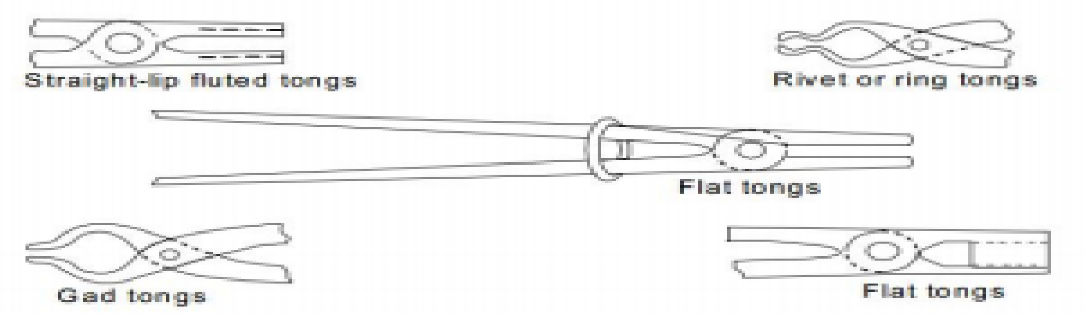
The tongs are generally used for holding work while doing a forging operation. Various kinds of tongs are shown in Figure.

a) Straight-lip fluted tongs are commonly used for holding square, circular and hexagonal bar stock.

b) Rivet or ring tongs are widely used for holding bolts, rivets and other work of circular section.

c) Flat tongs are used for mainly for holding work of rectangular section.

d) Gad tongs are used for holding general pick-up work, either straight or tapered.



Flatter

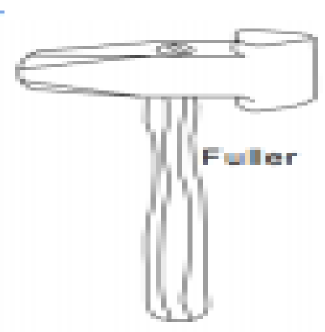
Flatter is shown in Fig. 14.7. It is commonly used in forging shop to give smoothness and accuracy to articles which have already been shaped by fullers and swages.

Swage

Swage is used for forging work which has to be reduced or finished to round, square or hexagonal form. It is made with half grooves of dimensions to suit the work being reduced. It consists of two parts, the top part having a handle and the bottom part having a square shank which fits in the hardie hole on the anvil face.

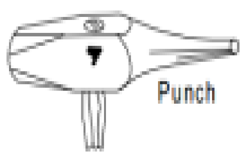
Fuller

Fuller is used in forging shop for necking down a forgeable job. It is made in top and bottom tools as in the case of swages. Fuller is made in various shapes and sizes according to needs, the size denoting the width of the fuller edge.



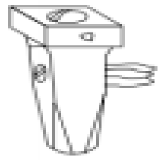
Punch

Punch is used in forging shop for making holes in metal part when it is at forging heat.



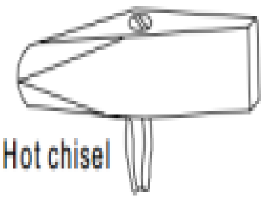
Rivet header

Rivet header (Fig. 14.7) is used in forging shop for producing rivets heads on parts.



Chisels

Chisels are used for cutting metals and for nicking prior to breaking. They may be hot or cold depending on whether the metal to be cut is hot or cold. A hot chisel generally used in forging shop is shown in Fig. 14.7. The main difference between the two is in the edge. The edge of a cold chisel is hardened and tempered with an angle of about 60°, whilst the edge of a hot chisel is 30° and the hardening is not necessary. The edge is made slightly rounded for better cutting action.



Hand hammers

There are two major kinds of hammers are used in hand forging:

a. The hand hammer used by the smith himself and

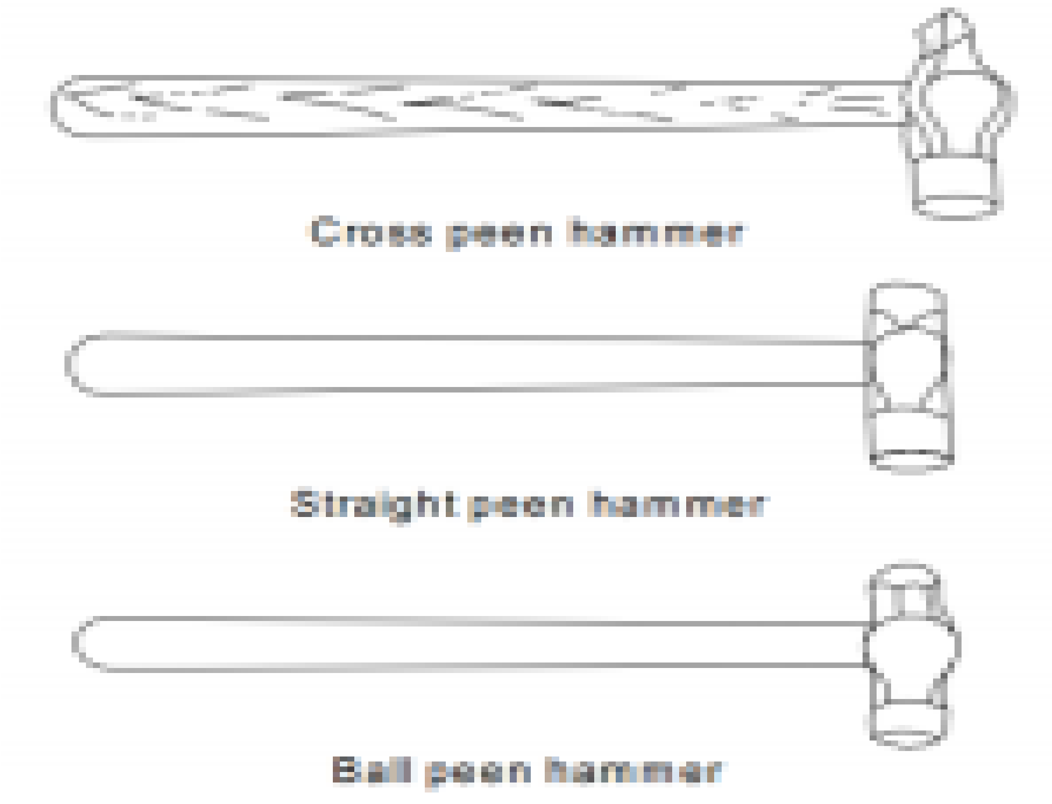
b. The sledge hammer used by the striker.

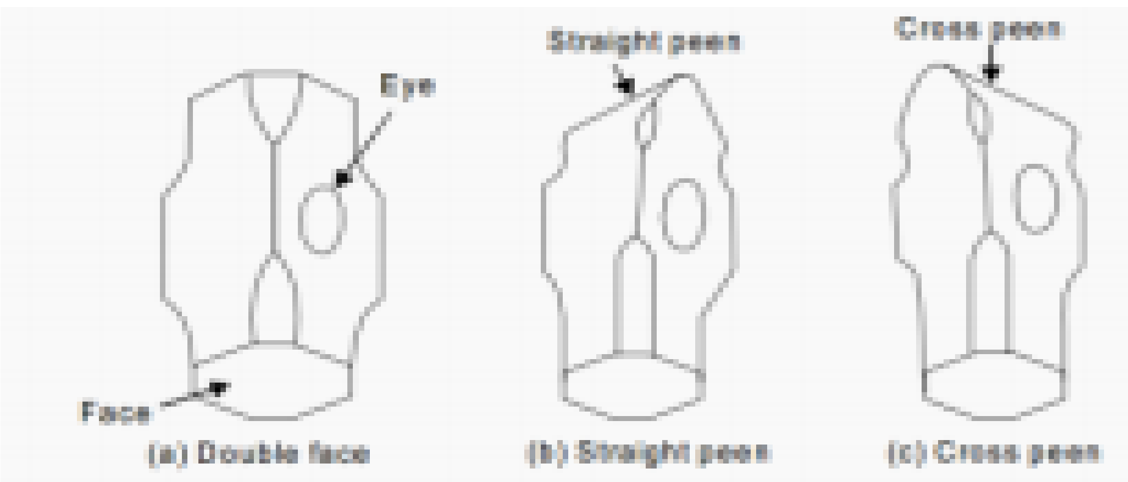
Hand hammers may further be classified as (a) ball peen hammer, (b) straight peen hammer, and (c) cross peen hammer.

Sledge hammers may further be classified as (a) Double face hammer, (b) straight peen hammer, and (c) cross peen hammer. Hammer heads are made of cast steel and, their ends are hardened and tempered. The striking face is made slightly convex. The weight of a hand hammer varies from about 0.5 to 2 kg whereas the weight of a sledge hammer varies from 4 to 10 kg.

Set hammer

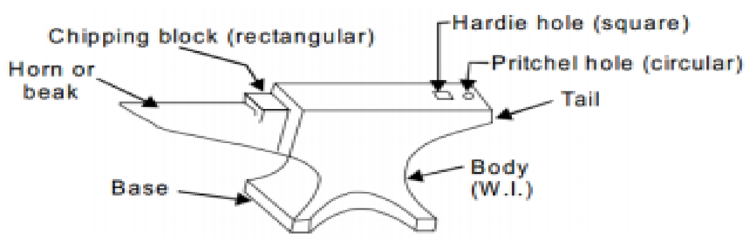
A set hammer generally used in forging shop is shown in Fig. 14.9. It is used for finishing corners in shouldered work where the flatter would be inconvenient. It is also used for drawing out the gorging job.

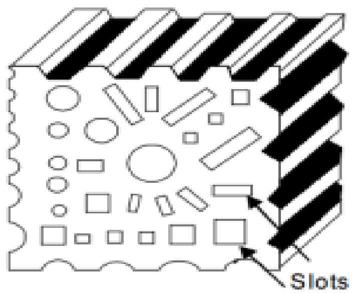




Anvil

An anvil is a most commonly tool used in forging shop which is shown in. It acts as a support for blacksmith's work during hammering. The body of the anvil is made of mild steel with a tool steel face welded on the body, but the beak or horn used for bending curves is not steel faced. The round hole in the anvil called pritchel hole is generally used for bending rods of small diameter, and as a die for hot punching operations. The square or hardie hole is used for holding square shanks of various fittings. Anvils in forging shop may vary up to about 100 to 150 kg and they should always stand with the top face about 0.75mt. from the floor. This height may be attained by resting the anvil on a wooden or cast iron base in the forging shop.





Swage block

Swage block generally used in forging shop is shown in figure. It is mainly used for heading, bending, squaring, sizing, and forming operations on forging jobs. It is 0.25mt. or even more wide. It may be used either flat or edgewise in its stand.

FORGING OPERATIONS:

The following are the basic operations that may be performed by hand forging:

1. Drawing-down:
   Drawing is the process of stretching the stock while reducing its cross-section locally. Forging the tapered end of a cold is an example of drawing operation.

2. Upsetting:
   It is a process of increasing the area of cross-section of a metal piece locally, with a corresponding reduction in length. In this, only the portion to be upset is heated to forging temperature and the work is then struck at the end with a hammer. Hammering is done by the smith (student) himself, if the job is small, or by his helper, in case of big jobs, when heavy blows are required with a sledge hammer.
3. Fullering:
   Fullers are used for necking down a piece of work, the reduction often serving as the starting point for drawing. Fullers are made of high carbon steel in two parts, called the top and bottom fullers. The bottom tool fits in the hardie hole of the anvil. Fuller size denotes the width of the fuller edge.
4. Flattering:
   Flatters are the tools that are made with a perfectly flat face of about 7.5 cm square. These are used for finishing flat surfaces. A flatter of small size is known as set-hammer and is used for finishing near corners and in confined spaces.
5. Swaging:
   Swages like fullers are also made of high carbon steel and are made in two parts called the top and swages. These are used to reduce and finish to round, square or hexagonal forms. For this, the swages are made with half grooves of dimensions to suit the work.
6. Bending:
   Bending of bars, flats, etc., is done to produce different types of bent shapes such as angles, ovals, circles etc. Sharp bends as well as round bends may be made on the anvil, by choosing the appropriate place on it for the purpose.
7. Twisting:
   It is also one form of bending. Sometimes, it is done to increase the rigidity of the work piece. Small piece may be twisted by

heating and clamping a pair of tongs on each end of the section to be twisted and applying a turning moment. Larger pieces may be clamped in a leg vice and twisted with a pair of tongs or a monkey wrench. However, for uniform twist, it must be noted that the complete twisting operation must be performed in one heating.

8. Cutting (Hot and Cold Chisels):
   Chisels are used to cut metals, either in hot or cold state. The cold chisel is similar to fitter's chisel, except that it is longer and has a handle. A hot chisel is used for cutting hot metal and its cutting edge is long and slender when compared to cold chisel. These chisels are made of tool steel, hardened and tempered.
9. Iron-Carbon Alloy:
   If the carbon is less than 2% in the iron-carbon alloy, it is known as steel. Again, based on the carbon content, it is called mild steel, medium carbon steel and high carbon steel. The heat treatment to be given to these steels and their applications are shown in table below.

	Carbon %	**Hardening temp. 0C**	**Tempering temp. 0C**	**Applications.**
Mild Steel	0.1	800-840	250-300	Chains, rivets, soft wire, sheet
	0.25	800-840	250-300	Tube, rod, strip
	0.5	800-840	250-300	Girders
	0.6	800-840	250-300	Saws, hammers, smith's and general purpose tools
Medium Carbon steel	0.75	760-800	250-300	Cold chisels, smith's tools shear blades, table cutlery
	0.9	760-800	250-300	Taps, dies, punches, hot shearing blades
	1.0	760-800	250-300	Drills, reamers, cutters, blanking and slotting tools, large turning tool
High Carbon	1.2	720-760	250-300	Small cutters, lathe and engraving tools, files drills
	1.35	720-760	250-300	Extra hard, planning, turning and slotting tools, dies and mandrels
	1.5	720-760	250-300	Razor blades

NOTE: The forging produced either by hand forging or machine forging should be heat treated.

The following are the purposes of heat treatment:

i. To remove internal stresses set-up during forging and cooling.
ii. To normalize the internal structure of the metal.
iii. To improve mach inability.
iv. To improve mechanical properties, strength and hardness.

SAFE PRACTICES:

1. Hold the hot work downwards close to the ground, while transferring from the hearth to anvil, to minimize danger of burns; resulting from accidental collisions with others.

2. Use correct size and type of tongs to fit the work. These should hold the work securely to prevent its bouncing out of control from repeated hammer blows.

3. Care should be exercised in the use of the hammer. The minimum force only should be used and the flat face should strike squarely on the work; as the edge of the hammer will produce heavy bruising on hot metal.

4. Water face shield when hammering hot metal.

5. Wear gloves when handling hot metal.

6. Wear steel-toed shoes.

7. Ensure that hammers are fitted with tight and wedged handles.

S-Hook

Aim:

To make an S-hook from a given round rod, by following hand forging operation.

Tools required:

Smith's forge, Anvil, 500gm and I kg ball-peen hammers, Flatters, Swage block, Half round tongs, Pickup tongs, Cold chisel.

Sequence of operations:

1. One end of the bar is heated to red hot condition in the smith's forge for the required length.

2. Using the pick-up tongs; the rod is taken from the forge, and holding it with the half round tongs, the heated end is forged into a tapered pointed end.

3. The length of the rod requires for S-hook is estimated and the excess portion is cut-off, using a cold chisel.

4. One half of the rod towards the pointed end is heated in the forge to red hot condition and then bent into circular shape as shown.

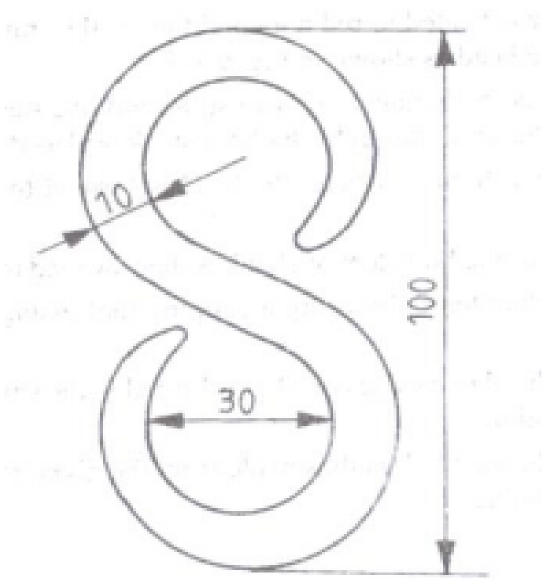
5. The other end of the rod is then heated and forged into a tapered pointed end.

6. The straight portion of the rod is finally heated and bent into circular shape as required.

7. Using the flatter, the S-hook made as above, is kept on the anvil and flattened so that, the shape of the hook is proper.

NOTE: In-between the above stage, the bar is heated in the smith's forge, to facilitate forging operations.

Result: The S-hook is thus made from the given round rod; by following the stages mentioned above.



S- HOOK

Precautions:

1. Hold the job carefully while heating and hammering
2. Job must be held parallel to the face of the anvil.
3. Wear steel-toed shoes.
4. Wear face shield when hammering the hot metal
5. Use correct size and type of tongs to fit the work.

FOUNDRY

PATTERN

A pattern is a model or the replica of the object (to be casted). It is embedded in molding sand and suitable ramming of molding sand around the pattern is made. The pattern is then withdrawn for generating cavity (known as mold) in moulding sand.

COMMON PATTERN MATERIALS

The common materials used for making patterns are wood, metal, plastic, plaster, wax or Mercury.

TYPES OF PATTERN

The types of the pattern and the description of each are given as under.

1. One piece or solid pattern
2. Two piece or split pattern
3. Cope and drag pattern
4. Three-piece or multi- piece pattern
5. Loose piece pattern
6. Match plate pattern
7. Follow board pattern
8. Gated pattern
9. Sweep pattern
10. Skeleton pattern
11. Segmental or part pattern

1. Single-piece or solid pattern: Solid pattern is made of single piece without joints, partings lines or loose pieces. It is the simplest form of the pattern. Typical single piece pattern is shown in Fig. 10.1.

2. Two-piece or split pattern: When solid pattern is difficult for withdrawal from the mold cavity, then solid pattern is split in two parts. Split pattern is made in two pieces which are joined at the parting line by means of dowel pins. The splitting at the parting line is done to facilitate the withdrawal of the pattern. A typical example is shown in Fig. 10.2

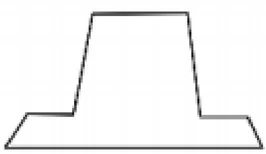


Fig. Single Piece Pattern

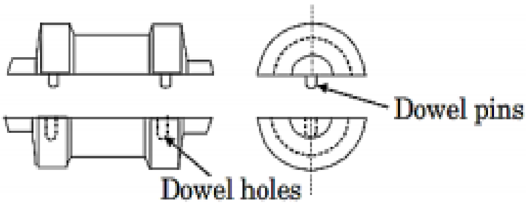


Fig. Two Piece Pattern

MOLDING SAND

The general sources of receiving molding sands are the beds of sea, rivers, lakes, granular elements of rocks, and deserts.

Molding sands may be of two types namely natural or synthetic. Natural molding sands contain sufficient binder. Whereas synthetic molding sands are prepared artificially using basic sand molding constituents (silica sand in 88-92%, binder 6-12%, water or moisture content 3-6%) and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipments.

Binder

In general, the binders can be either inorganic or organic substance. The inorganic group includes clay sodium silicate and port land cement etc. In foundry shop, the clay acts as binder which may be Kaolonite, Ball Clay, Fire Clay, Limonite, Fuller's earth and Bentonite. Binders included in the organic group are dextrin, molasses, cereal binders, linseed oil and resins like phenol formaldehyde, urea formaldehyde etc. Organic binders are mostly used for core making.

Among all the above binders, the bentonite variety of clay is the most common. However, this clay alone cannot develop bonds among sand grins without the presence of moisture in molding sand and core sand.

Additives

Additives are the materials generally added to the molding and core sand mixture to develop some special property in the sand. Some common used additives for enhancing the properties of molding and core sands are discussed as under.

1. Coal dust: Coal dust is added mainly for producing a reducing atmosphere during casting.

2. Corn flour: It belongs to the starch family of carbohydrates and is used to increase the collapsibility of the molding and core sand

3. Dextrin: Dextrin belongs to starch family of carbohydrates that behaves also in a manner similar to that of the corn flour. It increases dry strength of the molds.

4. Sea coal: Sea coal is the fine powdered bituminous coal which positions its place among the pores of the silica sand grains in molding sand and core sand

5. Wood flour: This is a fibrous material mixed with a granular material like sand; its relatively long thin fibers prevent the sand grains from making contact with one another.

6. Silica flour: It is called as pulverized silica and it can be easily added up to 3% which increases the hot strength and finish on the surfaces of the molds and cores

KINDS OF MOULDING SAND

Molding sands can also be classified according to their use into number of varieties which are described below.

1. Green sand: Green sand is also known as tempered or natural sand which is a just prepared mixture of silica sand with 18 to 30 percent clay, having moisture content from 6 to 8%. The clay and water furnish the bond for green sand. It is fine, soft, light, and porous.

2. Dry sand: Green sand that has been dried or baked in suitable oven after the making mold and cores, is called dry sand. It possesses more strength, rigidity and thermal stability.

3. Loam sand: Loam is mixture of sand and clay with water to a thin plastic paste. Loam sand possesses high clay as much as 30-50% and 18% water.

4. Facing sand: Facing sand is just prepared and forms the face of the mould. It is directly next to the surface of the pattern and it comes into contact molten metal when the mould is poured. Initial coating around the pattern and hence for mold surface is given by this sand.

This sand is subjected severest conditions and must possess, therefore, high strength refractoriness.

5. Backing sand: Backing sand or floor sand is used to back up the facing sand and is used to fill the whole volume of the molding flask.

6. Parting sand: Parting sand without binder and moisture is used to keep the green sand not to stick to the pattern and also to allow the sand on the parting surface the cope and drag to separate without clinging

7. Core sand: Core sand is used for making cores and it is sometimes also known as oil sand. This is highly rich silica sand mixed with oil binders such as core oil which composed of linseed oil, resin, light mineral oil and other bind materials.

PROPERTIES OF MOULDING SAND

The basic properties required in molding sand and core sand are described as under.

1. Refractoriness: Refractoriness is defined as the ability of molding sand to withstand high temperatures without breaking down or fusing thus facilitating to get sound casting. It is a highly important characteristic of molding sands. Refractoriness can only be increased to a limited extent

2. Permeability: It is also termed as porosity of the molding sand in order to allow the escape of any air, gases or moisture present or generated in the mould when the molten metal is poured into it. All these gaseous generated during pouring and solidification process must escape otherwise the casting becomes defective

3. Cohesiveness: It is property of molding sand by virtue which the sand grain particles interact and attract each other within the molding sand

4. Green strength: The green sand after water has been mixed into it, must have sufficient strength and toughness to permit the making

and handling of the mould. For this, the sand grains must be adhesive, i.e. they must be capable of attaching themselves to another body

5. Dry strength: As soon as the molten metal is poured into the mould, the moisture in the sand layer adjacent to the hot metal gets evaporated and this dry sand layer must have sufficient strength to its shape in order to avoid erosion of mould wall during the flow of molten metal

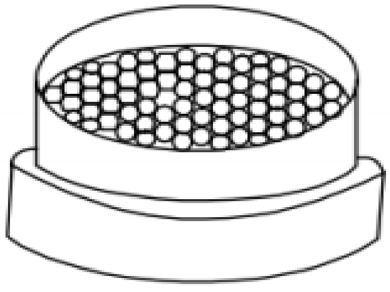
6. Flow ability or plasticity: It is the ability of the sand to get compacted and behave like a fluid. It will flow uniformly to all portions of pattern when rammed and distribute the ramming pressure evenly all around in all directions

7. Adhesiveness: It is property of molding sand to get stick or adhere with foreign material such sticking of molding sand with inner wall of molding box

8. Collapsibility: After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs and this would naturally avoid the tearing or cracking of the contracting metal.

HAND TOOLS USED IN FOUNDRY SHOP

Hand riddle: It consists of a screen of standard circular wire mesh equipped with circular wooden frame. It is generally used for cleaning the sand for removing foreign material such as nails, shot metal, splinters of wood etc. from it. Even power operated riddles are available for riddling large volume of sand.



Shovel: It consists of a steel pan fitted with a long wooden handle. It is used in mixing, tempering and conditioning the foundry sand by hand. It is also used for moving and transforming the molding sand to the container and molding box or flask.

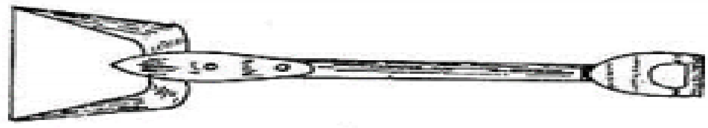


Fig. Showel
Showel

Rammers: Rammers are shown in Fig. These are required for striking the molding sand mass in the molding box to pack or compact it uniformly all around the pattern.

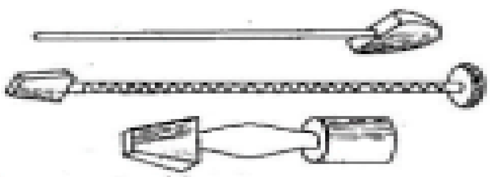


Fig. Rammers

Sprue pin: It is a tapered rod of wood or iron which is placed or pushed in cope to join mold cavity while the molding sand in the cope is being rammed.

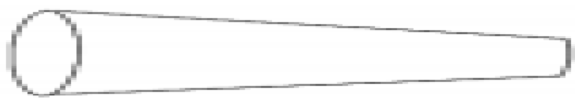
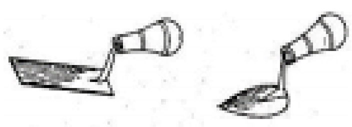


Fig. Sprue Pin

Trowels: These are used for finishing flat surfaces and comers inside a mould. Common shapes of trowels are shown as under. They are made of iron with a wooden handle.



+ Trowels

Lifter: A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould.

Fig. Lifter

Strike off bar: It is a flat bar, made of wood or iron to strike off the excess sand from the top of a box after ramming. It's one edge made bevelled and the surface perfectly smooth and plane.

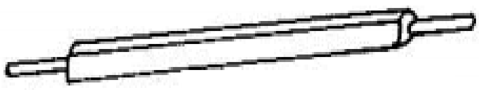


Fig. Strike off bar

Vent wire: It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is used to make small holes, called vents, in the sand mould to allow the exit of gases and steam during casting.

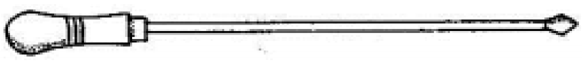
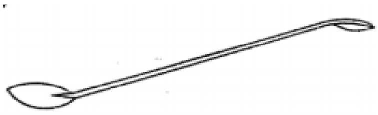


Fig. Vent Wire

Slicks: They are also recognized as small double ended mold finishing tool which are generally used for repairing and finishing the mold surfaces and their edges after withdrawal of the pattern.



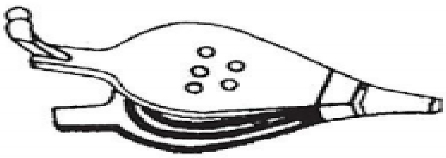
Swab: Swab is shown in Fig. 11.1(u). It is a small hemp fiber brush used for moistening the edges of sand mould, which are in contact with the pattern surface before withdrawing the pattern. It is used for sweeping away the molding sand from the mold surface and pattern.

Fig. Swab

Gate cutter: Gate cutter (Fig. 11.1(v)) is a small shaped piece of sheet metal commonly used to cut runners and feeding gates for connecting sprue hole with the mold cavity.

Fig. Gate Cutter

Bellows: Bellows gun is shown in Fig. 11.1(w). It is hand operated leather made device equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose or unwanted sand from the surfaces of mold cavities.

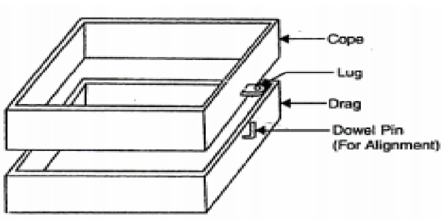


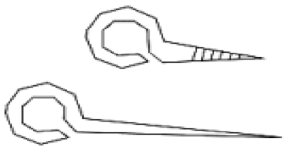
Draw spike: Draw spike is shown Fig. 11.1(f). It is a tapered steel rod having a loop or ring at its one end and a sharp point at the other. It may have screw threads on the end to engage metal pattern for it withdrawal from the mold.

Sprue Pin: It is a tapered wooden pin, used to make a hole in the cope through which the molten metal is poured into the mould.

MOULDING BOX:

Moulding box is also called moulding flask. It is frame or box of wood or metal. It is made of two parts cope and drag as shown in figure.





DUMKA ENGINEERING COLLEGE

MOULD FOR A SOLID

Aim:
To prepare a sand mold, using the given single piece pattern.

Raw material required:
Moulding sand, Parting sand, facing sand, baking sand, single piece solid pattern, bottom board, moulding boxes etc.

Tools Required:
1. Molding board

2. Drag and cope boxes

3. Molding sand

4. Parting sand

5. Rammer

6. Strike-off bar

7. Bellows

8. Riser and sprue pins

9. Gate cutter

10. Vent rod

11. Draw spike

12. Wire Brush

Sequence of operations:

1. Sand preparation

2. Placing the mould flask (drag) on the moulding board/ moulding platform

3. Placing the pattern at the centre of the moulding flask

4. Ramming the drag

5. Placing runner and riser

6. Ramming the cope

7. Removal of the pattern, runner, riser

8. Gate cutting

Procedure: Mould Making

1. First a bottom board is placed either on the molding platform or on the floor, making the surface even.

2. The drag molding flask is kept upside down on the bottom board along with the drag part of the pattern at the centre of the flask on the board.

3. Dry facing sand is sprinkled over the board and pattern to provide a non-sticky layer.

4. Freshly prepared molding sand of requisite quality is now poured into the drag and on the pattern to a thickness of 30 to 50 mm.

5. Rest of the drag flask is completely filled with the backup sand and uniformly rammed to compact the sand.

6. After the ramming is over, the excess sand in the flask is completely scraped using a flat bar to the level of the flask edges.

7. Now with a vent wire which is a wire of 1 to 2 mm diameter with a pointed end, vent holes are in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during casting solidification. This completes the preparation of the drag.

8. Now finished drag flask is rolled over to the bottom board exposing the pattern.

9. Using a slick, the edges of sand around the pattern is repaired

10. The cope flask on the top of the drag is located aligning again with the help of the pins of the drag box.

11. Sprue of the gating system for making the sprue passage is located at a small distance of about 50 mm from the pattern. The sprue base, runners and in-gates are also located as shown risers are also placed. Freshly prepared facing sand is poured around the pattern.

12. The moulding sand is then poured in the cope box. The sand is adequately rammed, excess sand is scraped and vent holes are made all over in the cope as in the drag.

13. The sprue and the riser are carefully withdrawn from the flask

14. Later the pouring basin is cut near the top of the sprue.

15. The cope is separated from the drag any loose sand on the cope and drag interface is blown off with the help of the bellows.

16. Now the cope and the drag pattern halves are withdrawn by using the draw spikes and rapping the pattern all around to slightly enlarge the mould cavity so that the walls are not spoiled by the withdrawing pattern.

17. The runners and gates are to be removed or to be cut in the mould carefully without spoiling the mould.

18. Any excess or loose sand is applied in the runners and mould cavity is blown away using the bellows.

19. Now the facing paste is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.

20. A dry sand core is prepared using a core box. After suitable baking, it is placed in the mould cavity.

21. The cope is placed back on the drag taking care of the alignment of the two by means of the pins.

22. The mould is ready for pouring molten metal. The liquid metal is allowed to cool and become solid which is the casting desired.

Result:

The required mould cavity is prepared using the given Single /solid Pattern.

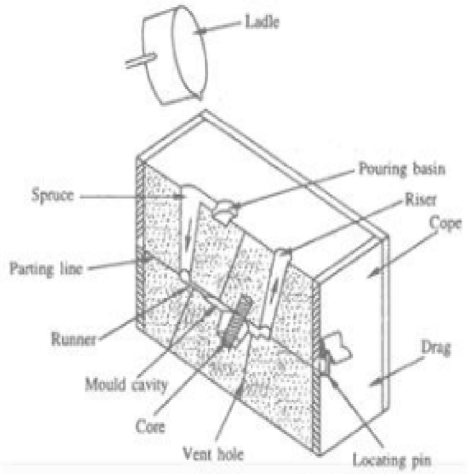
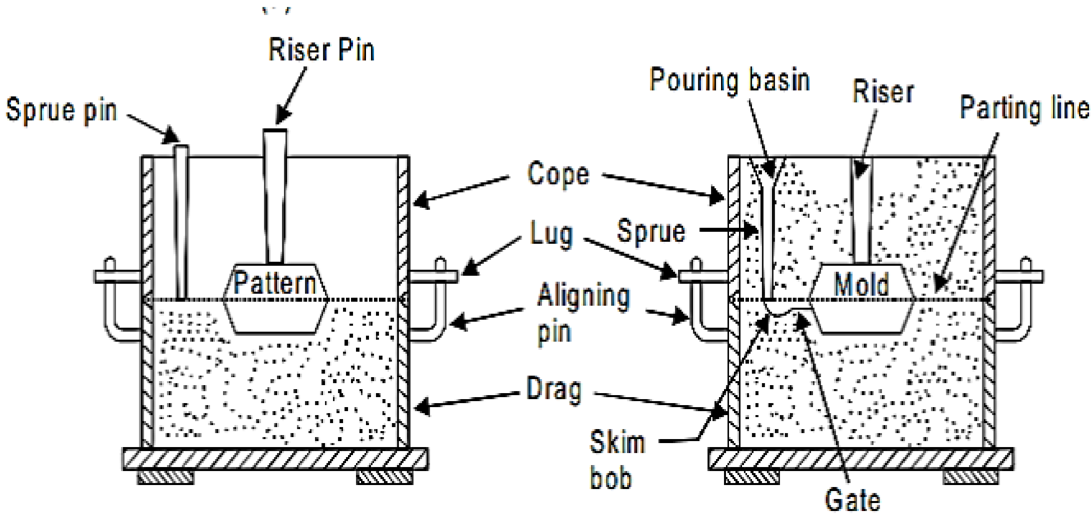


Fig. 6.1 Cross section of a sand mould



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Department of Mechanical Engineering

THEORY OF MACHINE LAB MANUAL

Name:____

Roll No:____

Batch:___________________ **Session:___________**