MADHAV INSTITUTE OF TECHNOLOGY AND SCIENCE, GWALIOR (M.P.)
A Govt. Aided UGC Autonomous Institute, Estd. In 1957
(Affiliated to R.G.P.V. Bhopal)

DEPARTMENT OF MECHANICAL ENGINEERING

WORKSHOP MANUAL

BE ALL BRANCHES

LIST OF SHOPS

1. CARPENTRY SHOP
2. FITTING SHOP
3. SMITHY SHOP
4. FOUNDRY SHOP
5. WELDING SHOP

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous &NAAC Accredited Institute Affiliated to RGPV, Bhopal)

Department of Mechanical Engineering

VISION
"To develop innovative and creative Mechanical Engineers catering the global industrial requirements and social needs"

MISSION
M1: To prepare effective and responsible graduate engineers for global requirements by providing quality education.
M2: To enhance knowledge through project and internship in the field of mechanical and allied engineering
M3: To guide students in acquiring career oriented jobs in the field of mechanical engineering.
M4: To provide academic environment of excellence, leadership, ethical values and lifelong learning to cater the need of society by sustainable solutions.

PROGRAM EDUCATIONAL OBJECTIVES - PEOs

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1:	Graduate of the program will be able to have successful professional career.
PEO 2:	Graduate of the program will be able to develop attitude of learning and become adaptable to dynamic industrial and social environment.
PEO 3:	Graduate of the program will be able to design and develop mechanical system by using skills and knowledge of core competency along with allied engineering skill.
PEO 4:	Graduate of the program will be able to undertake interdisciplinary research needed to build a sustainable society.

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Department of Mechanical Engineering

Program Outcomes (POs)

PO	Statement
PO1	Graduates will be able to apply knowledge of mathematics and science in mechanical systems
PO2	Graduates will be able to identify, formulate and solve mechanical related engineering problems.
PO3	Graduates will be able to design mechanical system, components or processes that meet the specified needs of society.
PO4	Graduates will be able to design and conduct experiments on mechanical systems, as well as to analyse and interpret data.
PO5	Graduates will be able to apply the techniques, skills and modern engineering tools necessary for engineering projects.
PO6	Graduates will be able to utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.
PO7	Graduates will be able to understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.
PO8	Graduates will be able to apply ethical principles and commit to professional ethics and responsibility and norms of the engineering practice.
PO9	Graduates will be able to function on multi-disciplinary teams as a team member/leader and create user friendly environment.
PO10	Graduates will be able to communicate effectively in both verbal and written form.
PO11	Graduates will be able to provide leadership in managing complex engineering projects at multi-disciplinary environment and to become a professional engineer.
PO12	Graduates will be able to recognize the need and will be able to engage in lifelong learning to keep abreast with technological changes.

Program Specific Outcomes (POs)-

PSO	Statement
PSO 1	Graduates will be able to find out, articulate the local industrial problems and solve with the use of Mechanical Engineering tools for realistic outcomes.
PSO 2	Graduates will be able to make a product related to Mechanical Engineering and allied engineering fields.

100106: Manufacturing Practices

Course Outcome:

After successful completion of this course students will be able to:

CO1. Discussthe hand tools, machine tools and power tools.

CO2. Utilize appropriate tools required for specific operation.

CO3. Apply safety measures required to be taken while using the tools in floor shops, Machine ships andcarpentry shop.

CO4. Use the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering.

CO5. Conduct experiments in the field of Production engineering.

CO6. Design a system, components, or process to meet desired needs, ethical, health and safety, manufacturability and sustainability

Madhav Institute of Technology & Science, Gwalior-474005

(An autonomous institution affiliated with RGPV, Bhopal)

Department of Mechanical Engineering

Holistic Assessment Rubric for Practical

Criteria	Poor 0 pts Marks: <15	Fair 1 pts Marks: 15-20	Good 2 pts Marks: 20-25	Excellent 3 pts Marks: 25-28	Outstanding 4 pts Marks: 28-30
Follow directions/ instructions	• Disinterested	• Shows little interest	• appears interested	• makes sure that every instruction is followed	• followed each instruction with utmost care
Following Procedure / Procedural knowledge	• Lacks the appropriate knowledge of the lab procedures. • Has no idea what to do. • Often requires help from the teacher to complete basic procedures.	• Demonstrates general knowledge of lab procedures. • Has some idea of what to do. • Asks questions to teacher that is answered in the procedure, more than once.	• Demonstrates good knowledge of the lab procedures. • Will ask peers for help with problems in lab procedures, before asking the teacher. • Works to follow each step before moving on to the next step.	• Demonstrates sound knowledge of lab procedures. • Will discuss with peers to solve problems in procedures. • Carefully follows each step and checks them off as they are completed.	• Demonstrates superb knowledge of the lab procedures. • Willingly helps other students to follow and understand procedures. • Thoroughly and carefully follows and checks off each step before moving on to next step and encourages other group members to do the same.
Lab Techniques / use of equipment/ instruments/ software/ analytical skill	• Measurements, skills or techniques are incomplete, inaccurate and/or imprecise.	• Measurements, skills or techniques are somewhat inaccurate and very imprecise.	• Measurements, skills or techniques are mostly accurate.	• Measurements, skills or techniques are accurate with reasonable precision.	• Measurements, skills or techniques are both accurate and precise and may show innovation.

Madhav Institute of Technology & Science, Gwalior-474005
[illegible]
Department of Mechanical Engineering

Criteria	Poor 0 pts Marks: <15	Fair 1 pts Marks: 15-20	Good 2 pts Marks: 20-25	Excellent 3 pts Marks: 25-28	Outstanding 4 pts Marks: 28-30
Safety/ethical aspects	• Proper safety precaution are consistently missed. using equipment not for intended purpose	• Proper safety precautions are often missed, [illegible] listed at left	• Proper safety precautions are generally used	• Proper safety precautions are consistently used	• Proper safety precautions are consistently used. Thinks ahead to ensure safety and reminds other group members to do the same
Clean-up	• Proper clean-up procedures are seldom used • All items left at station or station not cleaned	• Needs to be reminded more than once during the lab [illegible] proper clean-up procedures • Few items left at station or not cleaned	• Proper clean-up procedures generally used • Station generally left clean	• Consistently uses proper clean-up procedures • Reminds others of their responsibility. Station generally neat and clean	• Consistently uses proper clean-up procedures • Station left neat and clean, [illegible] helps others clean up and directs others to do the same
Troubleshooting	• Not able to identify problem	• Identifies problem but does not know solution	• Identifies problem but not sure of solution	• Identifies problem and able to rectify with minor errors	• Identifies problem and rectify completely
Documentation of lab work	• Poor documentation • [illegible] incomplete or not [illegible]	• Documented but [illegible] to many • [illegible] incomplete	• Documented • [illegible] generally complete • Work [illegible] organized • Only [illegible] minor errors	• Documented • [illegible] thorough • Work is generally neat and organized	• Documented • Observation [illegible] thorough and may recognize possible errors in data collection

CARPENTARY

INTRODUCTION:

Wood work or carpentry deals with making joints for a variety of applications like door frames, cabinet making furniture, packing etc.,

Timber:-

Timber is a name obtained from well grown plants or trees. The timber must cut in such a way that the grains run parallel to the length. The common defects in timber are knots, wet rot, dry rot etc.,

Market sizes of timber:-

Timber is sold in market in various standard shapes and sizes. They are:-

Log:-

The trunk of a tree, which is free from branches.

Balk:-

The log sawn to have roughly square cross section.

Post:-

A timber piece, round or square in cross section with more than 275 mm in width, 50 to 150 mm in thickness and 2.5 to 6.5 mts length.

Board:-

A sawn timber piece, below 175 mm in width and 30 mm to 50 mm in thickness.

Reapers:-

Sawn timber pieces of assorted and nonstandard sizes, which don't conform to the above shapes.

WORK HOLDING TOOLS:

Carpentry vice:-

It is a work holding device. When handle vice is turned in a clockwise direction, the sliding jar forces the work against the fixed sawn. The greater the force applied to the handle, the tighter to the work held.

Bar clamp:-

It is a rectangular (or) square block with V-groove on one or both sides opposite to each other. It holds cylindrical work pieces.

C-Clamp:-

This is used to hold work against an angle plate or V-block.

MARKING AND MEASURING TOOLS:

Try square:-

It is used for marking and testing the square ness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for flatness. The size of a try square usedfor varies from 150 mm to 300 mm, according to the length of the blade. It is less accurate when compared to the try square used in fitting shop.

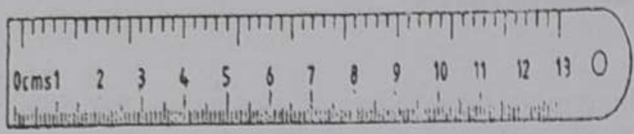


Fig : 1 steel rule

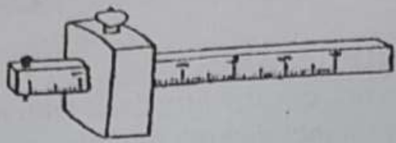


fig: 2 marking Gauge

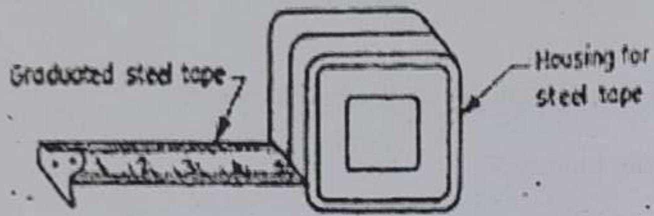


Fig: 3 steel tape

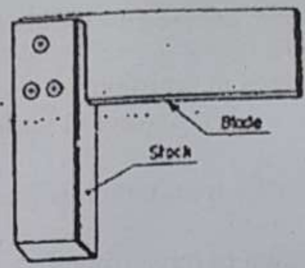


fig: 4 Try square

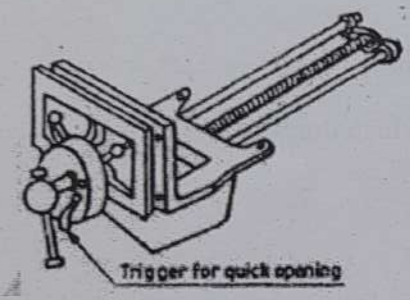


Fig: 5 corpenter vice

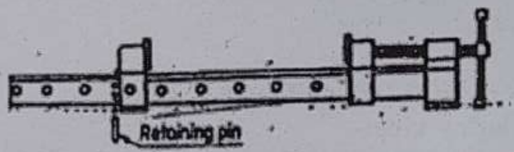


Fig: 6 Bar clamp

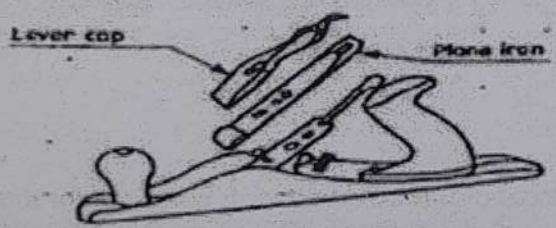


Fig: 7 metal jack plane

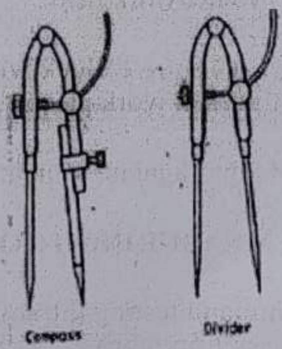


Fig: 8 compass and divider

Marking gauge:-

It is a tool used to mark lines parallel to the edges of wooden pieces. It consists of a square wooden stem with a riding wooden stock on it. A marking pin, made of steel is fitted on the stem. A mortise gauge consists of two pins. In these it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

Compass and dividers:-

This is used for marking circles, arcs, laying out perpendicular lines on the planed surface of the wood.

CUTTING TOOLS:

Hack saw:-

It is used to cross cut the grains of the stock. The teeth are so set that the saw kerfs will be wider than the blade thickness. Hard blades are used to cut hard metals. Flexible blades are having the teeth of hardened and rest of the blade is soft and flexible.

Chisels:-

These are used for removing surplus wood. Chisels are annealed, hardened and tempered to produce a tough shank and a hard cutting edge.

Rip saw:-

It is used for cutting the stock along the grains. The cutting edge of this saw makes a sleeper angle about 60o whereas that saw makes an angle of 45o with the surface of the stock.

Tenon saw:-

It is used for cutting tenons and in fine cabinet works. The blade of this saw is very thin and so it is used stiffed with back strip. Hence, this is sometimes called back saw. The teeth shapes similar to cross cut saw.

DRILLING AND BORING TOOLS:

Auger bit:-

It is the most common tool used for boring holes with hard pressure.

Gimlet:-

This is a hand tool used for boring holes with hand pressure.

Hand drill:-

Carpenters 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 these tools. It is small light in weight and may be conveniently used than the brace. The drill is clamped in the chuck.

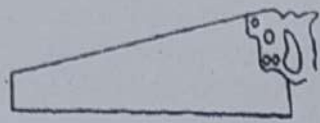


Fig: 9 cross cut saw

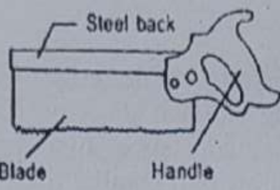


Fig: 10 Tenon saw

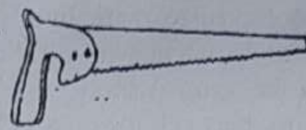


Fig: 11 compass saw

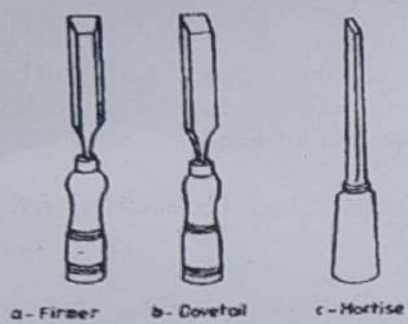


Fig: 12 Chisels

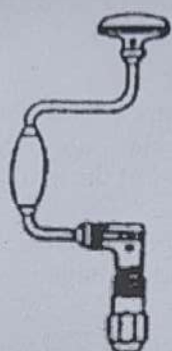


Fig: 13 Carpenter's brace

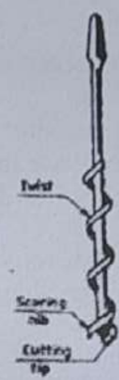


Fig: 14 Auger bit

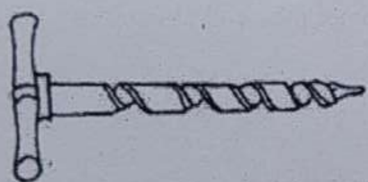


Fig: 15 Gimlet

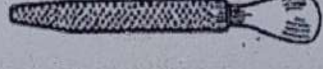


Fig: 16 wood rasp file

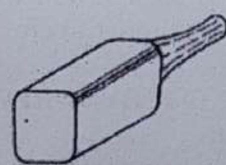


Fig:17 Mallet

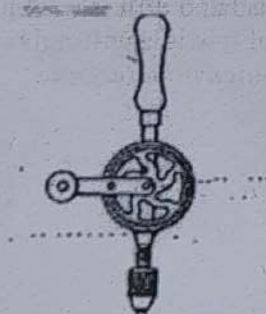


Fig: 18 Hand drill

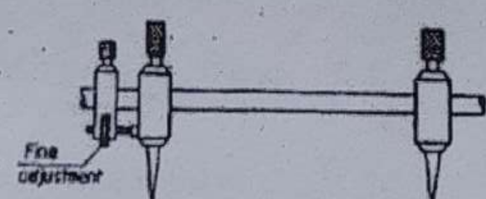


Fig: 19 Trammel

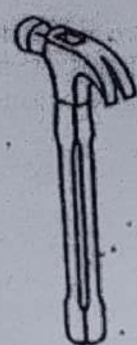


Fig: 20 Claw hammer

MISCELLANEOUS TOOLS:

Ball peen hammer:-
It has a flat face, which is used for general work and a ball end is used for riveting.

Mallet:-
It is used to drive the chisel, when considerable force is to be applied, steel hammer should not be used for these purpose, as it may damage the chisel handle. Further, for better to apply a series of light taps with the mallet rather than a heavy single blow.

Claw hammer:-
It is a striking flat at one end and the claw at the others. The face issued to drive nails into wood and for other striking purpose and the claw for extracting nails out of wood.

Pinches:-
It is made of steel with a hinged and is used for pulling out small nails from wood.

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

CARPENTRY SECTION

T-LAP JOINT

EXPERIMENT NO: 1 DATE:

Aim: - To make a T- lap joint

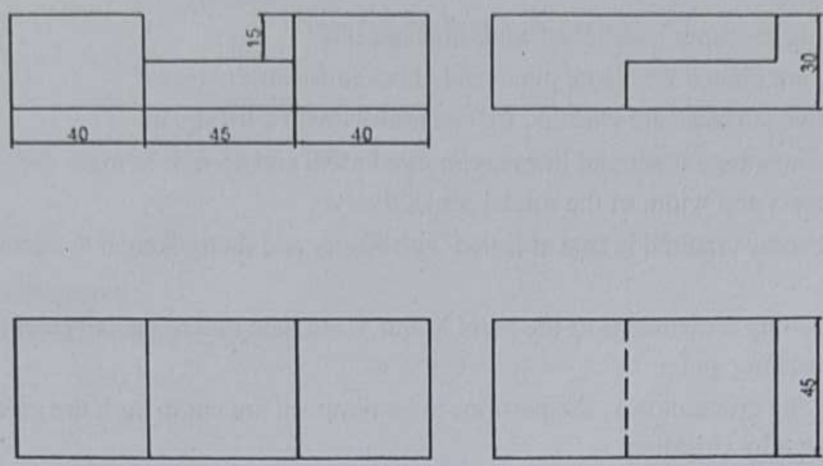
Tools required: -

1. Carpenter's vice
2. Steel Rule
3. Try square
4. Jack plane
5. Scriber
6. Cross cut saw
7. Marking gauge
8. Firmer chisel
9. Mallet
10. Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

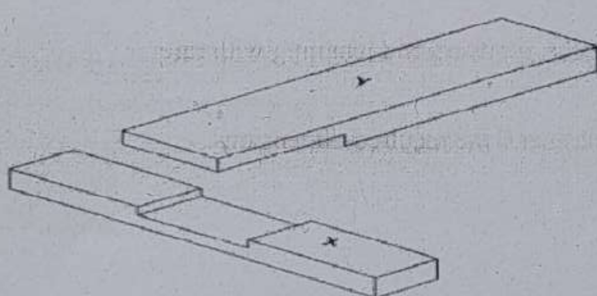
Sequence of operations: -

1. Measuring and Marking
2. Planning
3. Check for squareness
4. Removal of extra material
5. Sawing
6. Chiseling
7. Finishing



T-LAP JOINT

ALL DIMENTIONS ARE IN MM



T-LAP JOINT

Procedure: -

1. The given reaper is checked for dimensions.
2. They are planed with jack plane and checked for straightness.
3. The two surfaces are checked for squareness with a try square.
4. Marking gauge is set and lines are marked at 30 and 45 mm to mark the thickness and width of the model respectively.
5. The excess material is first chiseled with firmer and then planned to correct size.
6. The mating dimensions of the parts X and Y are then marked using steel rule and marking gauge.
7. Using the crosscut saw, the portions to be removed are cut in both the pieces, followed by chiseling.
8. The ends of both the parts are chiseled to the exact lengths.
9. The fine finishing is given to the parts, if required so that, proper fitting is obtained.
10. The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

1. Loose cloths are to be avoided.
2. Tools to be placed at their proper placed.
3. Hands should not be placed in front of sharp edged tools.
4. Use only sharp tools.
5. Care should be taken, when thumb is used as a guide in cross cutting and ripping.
6. Handle while chiseling, sawing and planning with care.
7.

Result: - T- lap joint is made as per the required dimensions.

CARPENTRY SECTION

DOVETAIL LAP JOINT

EXPERIMENT NO: **DATE:**

Aim: - To make a Dovetail lap joint from the given reaper of size 50 x35 x250 mm.

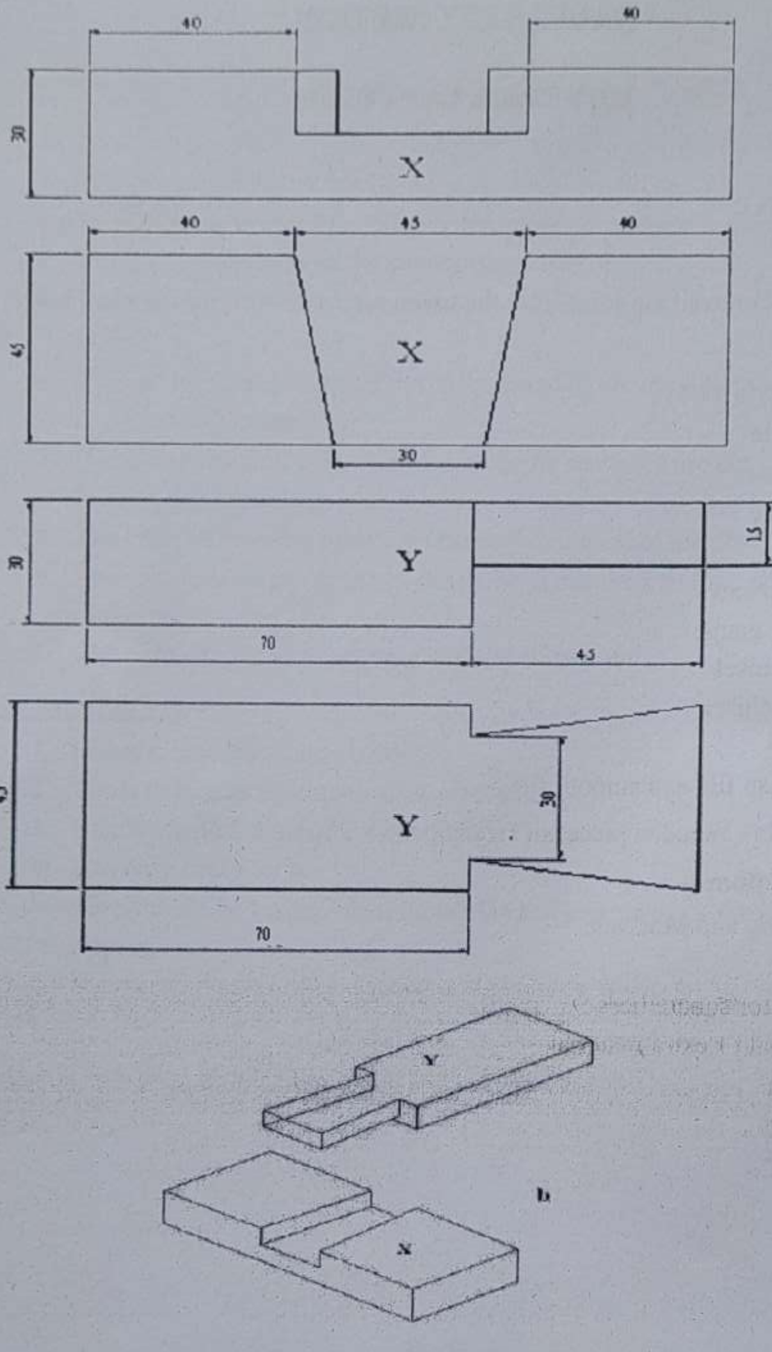
Tools required: -

1. Carpenter's vice
2. Steel Rule
3. Try square
4. Jack plane
5. Scriber
6. Cross cut saw
7. Marking gauge
8. Firmer chisel
9. Mortise chisel
10. Mallet
11. Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

Sequence of operations: -

1. Measuring and Marking
2. Planning
3. Check for square ness
4. Removal of extra material
5. Sawing
6. Chiseling
7. Finishing



DOVETAIL LAP JOINT

Procedure: -

1. The given reaper is checked for dimensions.
2. They are planed with jack plane and checked for straightness.
3. The two surfaces are checked for square ness with a try square.
4. Marking gauge is set and lines are marked at 30 and 45 mm to mark the thickness and width of the model respectively.
5. The excess material is first chiseled with firmer chisel and then planned to correct size.
6. The mating dimensions of the parts X and Y are then marked using steel rule and marking gauge.
7. Using the crosscut saw, the portions to be removed are cut in both the pieces, followed by chiseling.
8. The ends of both the parts are chiseled to the exact lengths.
9. The fine finishing is given to the parts, if required so that, proper fitting is obtained.
10. The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

1. Loose cloths are to be avoided.
2. Tools to be placed at their proper placed.
3. Hands should not be placed in front of sharp edged tools.
4. Use only sharp tools.
5. Care should be taken, when thumb is used as a guide in cross cutting and ripping.
6. Handle while chiseling, sawing and planning with care.

Result: - Dovetail lap joint is made as per the required dimensions.

FITTING

INTRODUCTION:
Machine tools are capable of producing work at a faster rate, but there are occasions when components are processed at a bench. Sometimes it becomes necessary to replace or repair a component that must fit accurately with one another or reassemble. This involves a certain amount of hand fitting. The assembly machine tools, jigs, gauges etc., involves certain amount of bench work.

FITTING TOOLS:
Holding tools:-
- Bench vice
- V-block with clamp
- C-clamp

Bench vice:-
It is a work holding device, when vice handle is turned in a clockwise direction the sliding jaw forces the work against the fixed jaw, the greater the force applied to the handle, the tighter is the work held.

V-block with clamp:-
It is a rectangular (or) square block with v-groove on one or both sides, opposite to each other. It holds cylindrical work pieces.

C-clamp:-
This is used to hold work against an angle plate or v-block.

MARKING AND MEASURING TOOLS:
1. Surface plate
2. Try square
3. Angle plate
4. Scriber
5. Universal scribing block
6. Odd leg caliper
7. Divider
8. Calipers
9. Dot punch
10. Vernier caliper

Surface plate:-
It is used for testing flatness of work piece, for marking out small works.

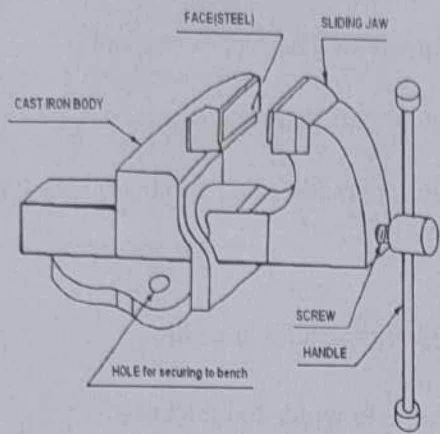


Fig: 1 Bench wise

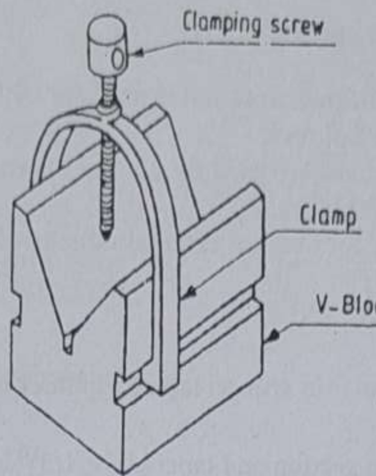


Fig: 2 V- Block

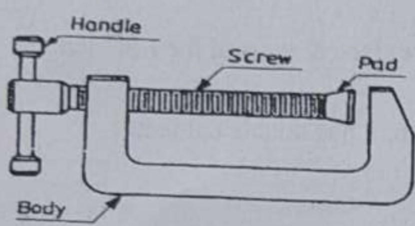


Fig: 3 C – Clamp

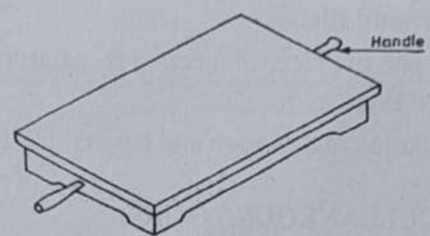


Fig: 4 Surface plate

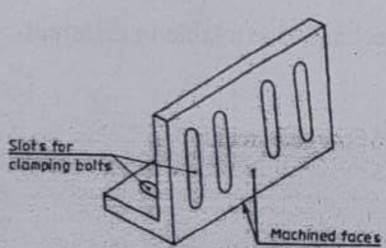


Fig: 5 Angle plate

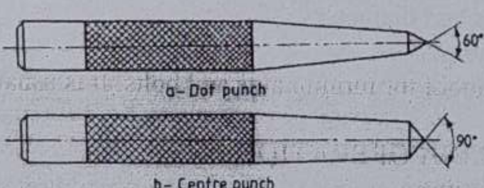


Fig: 6 Dot punch

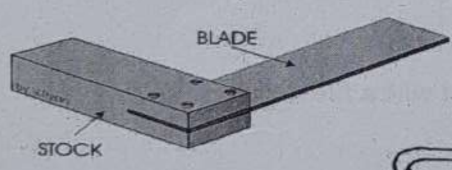


Fig: 6 try square

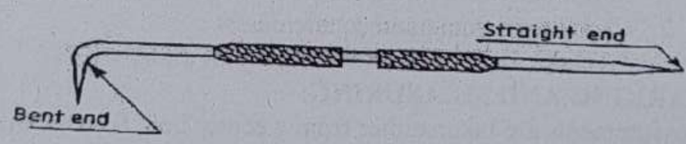


Fig: 7 scriber

Combination cutting pliers: -

This is made of tool steel and is used for cutting as well as for ripping work.

Taps and die holders: -

Tap and wrenches are used for cutting internal threads in a drilled hole.

Dies and die holders:-

They are used for making external threads. Dies are made either solid (or) split type.

TYPES OF FILES:

Hand file:-

It is a rectangular in section tapered in thickness but parallel in width.

Flat file:-

Rectangular in section and tapered for $1/3^{rd}$ length in width and thickness.

Square file:-

Square in section and tapered for $1/3^{rd}$ length on all sides.

Half round file:-

It has one flat face, connecting by a curved (surface) face & tapered for $1/3^{rd}$ length.

Round file:-

Circular in cross section and tapered for $1/3^{rd}$ length, it has double cut teeth.

MISCELLANEOUS TOOLS:

Ball peen hammer:-

It has a flat face, which is used for general work and a ball end is used for riveting.

Screw driver:-

It is designed to turn the screws. The blade is made of steel and is available in different lengths and diameters.

Spanners:-

It is a tool for turning nuts and bolts. It is usually made of forged steel.

FITTING OPERATIONS:

Chipping:-

Removing metal with a chisel is called chipping and is normally used where machining is not possible.

Fitting:-

1. Pinning of files:-
   Soft metals cause this; the pins are removed with a file card.
2. Checking flatness and square ness:-
   To check flatness across thickness of plate.

MARKING AND MEASURING:

Measurements are taken either from a center line, for visibility of the non-ferrous metals and oxide coated steels are used.

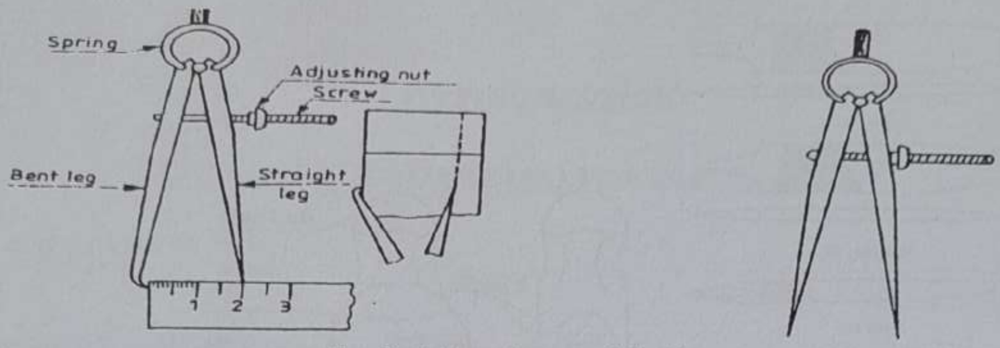
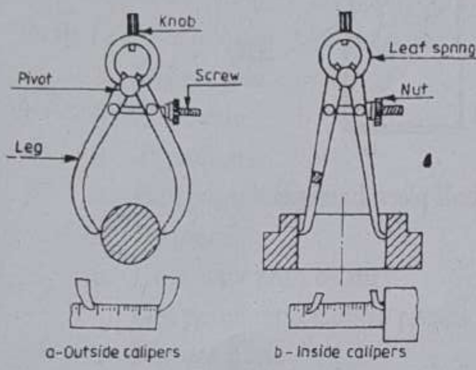


Fig: 8 odd leg clamp and divider



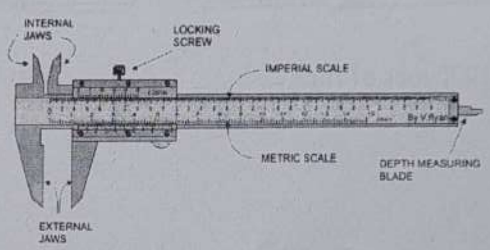


Fig: 9 calipers

Fig: 10 Vernier caliper

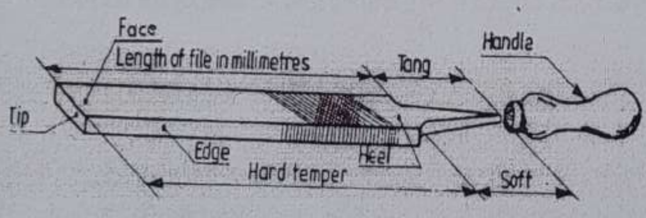


Fig: 11 Parts of hand file

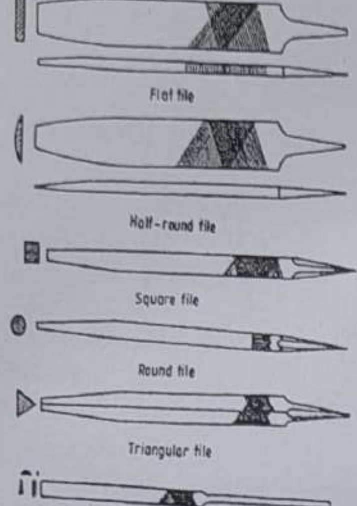


Fig: 12 Types of files

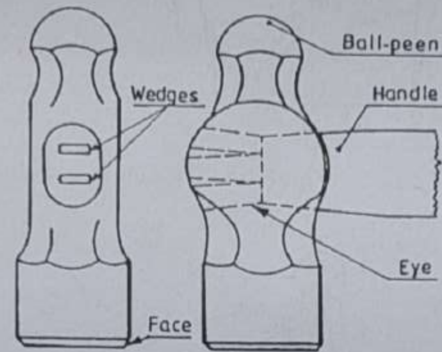


Fig: 13 ball peen hammer

FITTING SECTION

SQUARE (T) - FITTING

EXPERIMENT NO: **DATE:**

Aim: - To make M.S Plate into required model by T-fitting.

To make a T-fitting from the given two M.S pieces.

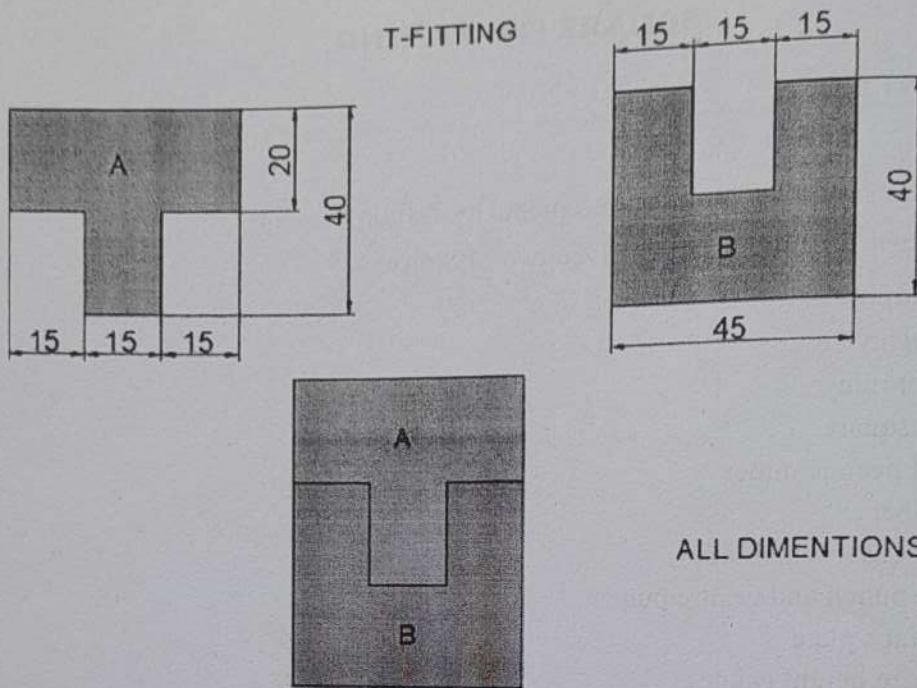
Tools required: -

1. Bench vice
2. Steel rule
3. Try square
4. Ball peen hammer
5. Scriber
6. Hack saw with blade
7. Dot punch and Centre punch
8. Surface plate
9. Venire height gauge
10. Rough and smooth flat files
11. Flat chisel and triangular file

Material required: - Mild steel (M.S) plate of size 48 x 34–2 Nos.

Sequence of Operations: -

1. Filing
2. Checking flatness and square ness
3. Marking and measuring
4. Punching
5. Sawing
6. Chipping
7. Finishing



ALL DIMENTIONS ARE IN MM

Fig: SQUARE (T) - FITTING

Procedure: -

1. The burrs in the pieces are removed and the dimensions are checked with a steel rule.
2. The pieces are clamped one after the other and the outer mating edges are filed by using rough and smooth files.
3. The flatness, straightness and square ness i.e. right angle between adjacent sides are checked with help of Try-square.
4. Chalk is then applied on the surfaces of the two pieces.
5. The given dimensions of the T-fitting are marked with help of vernier height gauge carefully.
6. Using the dot punch, dots are punched along the above scribed lines.
7. Using the hack saw, the unwanted portions are removed.
8. Using the flat chisel, the unwanted material in the piece Y is removed.
9. The cut edges are filed by the half round file.
10. The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.
11. The pieces (X and Y) are fitted together and the mating is checked for the correctness of the fit.

Safety precautions: -

1. Care is taken to see that the marking dots are not crossed, which is indicated by the half of the punch dots left on the pieces.
2. Apply pressure in forward direction during hack sawing.
3. Don't rub steel rule on the job.
4. Fix blade in hack saw frame with correct tension.
5. During hack sawing the coolant like water or lubricating oil is to be used.
6. Use precision instruments like vernier calipers and vernier height gauge carefully.
7. Files are to be cleaned properly after using.

Result: - T-fit is made as per the required dimensions.

FITTING SECTION

V- FITTING

EXPERIMENT NO: DATE:

Aim: - To make M.S Plate into required model by V- fitting.

To make a V- fitting from the given two M.S pieces.

Tools required: -

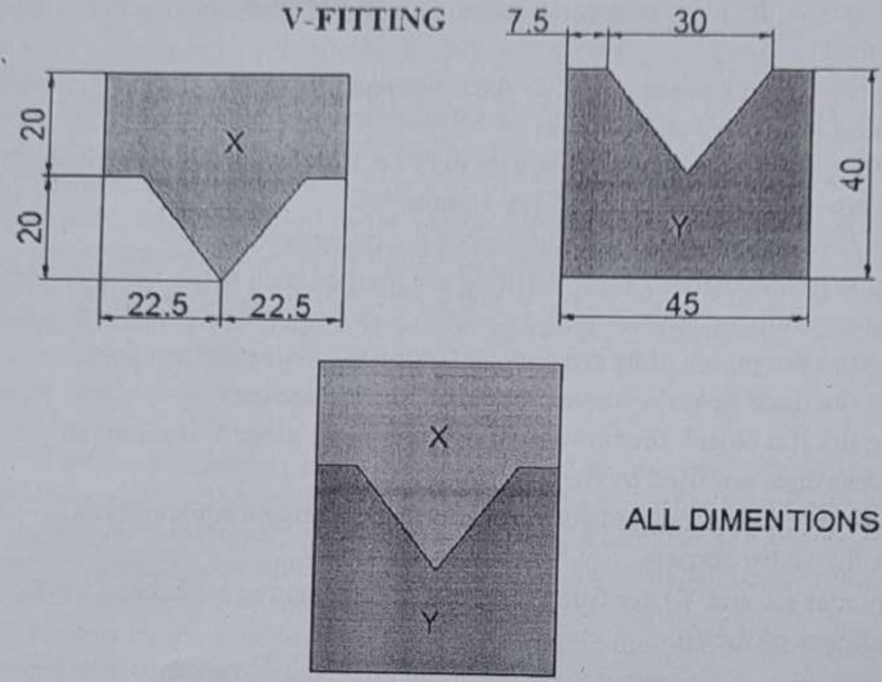
1. Bench vice
2. Steel rule
3. Try square
4. Ball peen hammer
5. Scriber
6. Hack saw with blade
7. Dot punch and Centre punch
8. Surface plate
9. Vernier height gauge
10. Rough and smooth flat files
11. Flat chisel and triangular file

Material required: - Mild steel (M.S) plate of size 48 x 34–2 Nos.

Sequence of Operations: -

1. Filing
2. Checking flatness and square ness
3. Marking and measuring
4. Punching
5. Sawing
6. Chipping
7. Finishing

V-FITTING



ALL DIMENTIONS ARE IN MM

Procedure: -

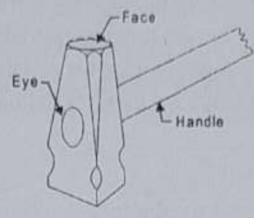
1. The burrs in the pieces are removed and the dimensions are checked with a steel rule.
2. The pieces are clamped one after the other and the outer mating edges are filed by using rough and smooth files.
3. The flatness, straightness and square ness i.e. right angle between adjacent sides are checked with help of Try-square.
4. Chalk is then applied on the surfaces of the two pieces.
5. The given dimensions of the V-fitting are marked with help of vernier height gauge carefully.
6. Using the dot punch, dots are punched along the above scribed lines.
7. Using the hack saw, the unwanted portions are removed.
8. Using the flat chisel, the unwanted material in the piece Y is removed.
9. The cut edges are filed by the half round file.
10. The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.
11. The pieces (X and Y) are fitted together and the mating is checked for the correctness of the fit.

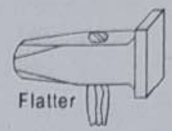
Safety precautions: -

1. Care is taken to see that the marking dots are not crossed, which is indicated by the half of the punch dots left on the pieces.
2. Apply pressure in forward direction during hack sawing.
3. Don't rub steel rule on the job.
4. Fix blade in hack saw frame with correct tension.
5. During hack sawing the coolant like water or lubricating oil is to be used.
6. Use precision instruments like vernier calipers and vernier height gauge carefully.
7. Files are to be cleaned properly after using.

Result: - V- fit is made as per the required dimensions.

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

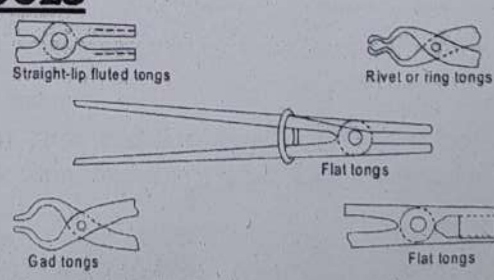
Almost all metals and alloys can be forged. The low and medium carbon steels are readily hot forged without difficulty, but the high-carbon and alloy steels are more difficult to forge and require greater care. Forging is generally carried out on carbon alloy steels, wrought iron, copper-base alloys, aluminum 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 forgeability. The forgeability of a material can also be defined as the capacity of a material to undergo deformation under compression without rupture. Forgeability 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.



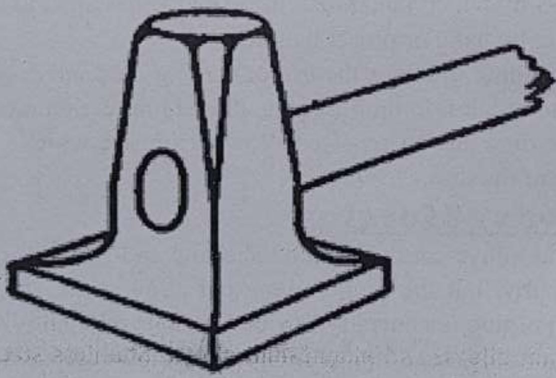
Tongs

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

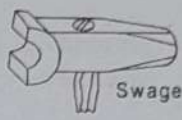


Swage

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.

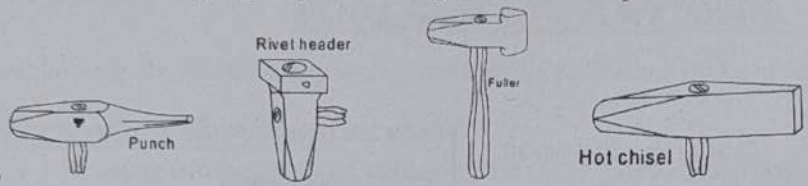
Fuller

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.

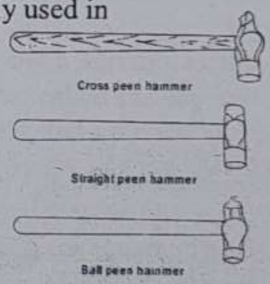


Rivet header

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.

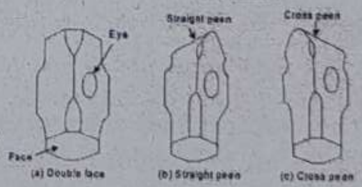


Hand hammers

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.

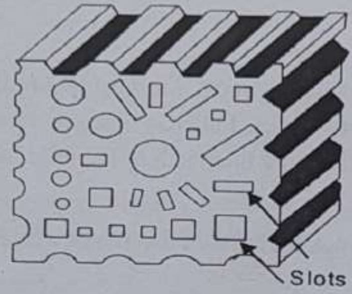
Sledge hammers may further be classified as (a) Double face hammer, (b) straight peen hammer, and (c) cross peen hammer.
Hammer heads are made of cast steel and, their ends are hardened and tempered. The striking face is made slightly convex. The weight of a hand hammer varies from about 0.5 to 2 kg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

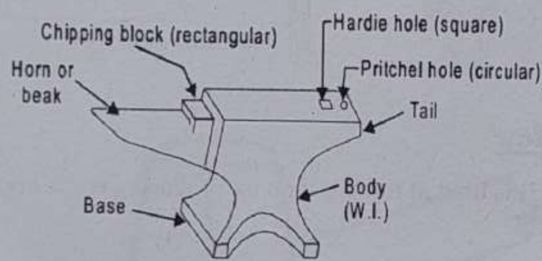
Set hammer

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 0.75 mt. 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 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 0.25 mt. 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
	1.0	760-800	250-300	blades 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 machinability.
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.

EXP: S-Hook

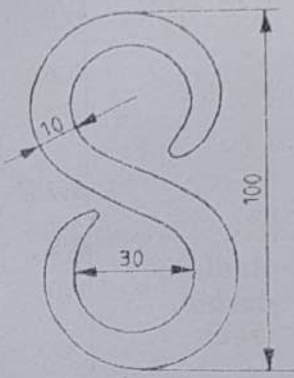
Aim: To make an S-hook from a given round rod, by following hand forging operation.

Tools required:

Smith's forge, Anvil, 500gm and I kg ball-peen hammers, Flatters, Swage block, Half round tongs, Pick- up 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 hoök is proper.



S- HOOK

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.

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

Introduction: -

Foundry practice deals with the process of making casting in moulds, formed in either sand or other material. This is found to be the cheapest method of metal shaping. The process involves the operations of pattern making, sand preparation, molding, melting of metals, pouring in moulds, cooling, shake out, fettling, heat treatment, finishing, and inspection.

Mould is a cavity in a molding core, formed by a pattern. It is similar in shape and size that of the actual casting plus some allowance for shrinkage, machining etc., molding is the process of making molds.

Moulds are classified as: -

- Temporary moulds
- Permanent moulds

Temporary mould are made of sand and other binding materials and may be produced either through hand molding (or) machine molding.

Permanent moulds are made of ferrous materials and alloys i.e., cast iron, steel etc.,

Molding Sand: -

Sand is the principle material used in foundry. The principle ingredients of molding sands are

1) Silicon sand 2) Clay 3) Sand

Clay imparts the necessary bonding strength to the molding sand, moisture when added to correct preparation provides the bonding action to the clay sand can withstand high temperature and doesn't react with molten metal.

Natural molding sand is either available in river beds are dug from pits. It possesses and appreciable amount of clay and are used as received with the addition of water. Synthetic sands are prepared by adding clay. Water and other materials to silica sand so that the desirable strength and banding properties are achieved.

Most of molding is done with green sand i.e.; sand containing 6 to 8%, moisture and 10% clay content to give it sufficient bond. Green sand moulds are used for pouring the molten metal – immediately after preparing the moulds. Green sand moulds are cheaper and take less time to prepare. These are used for small and medium size casting.

Parting sand, which is clay tree, fence grained silica sand, is used to keep the green sand from sticking to the pattern and also to prevent the cope and drug from cleaning. Core sand is used for making cores. This is silica missed with core oil and other oddities.

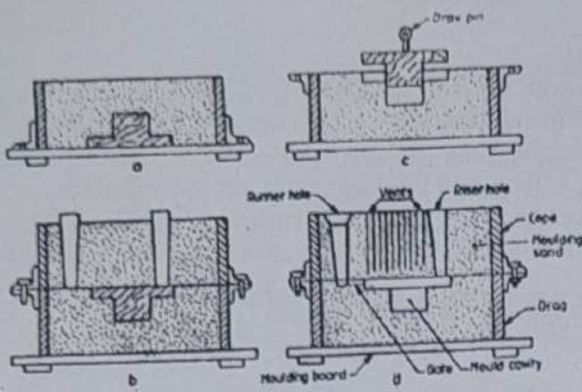
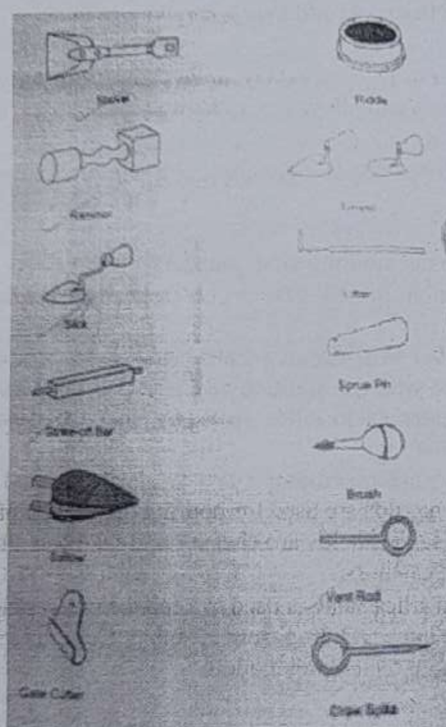


Fig. 11.8 Mold for a solid flange



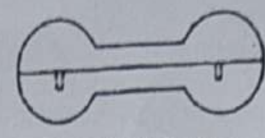


Fig. 11.14 Split pattern

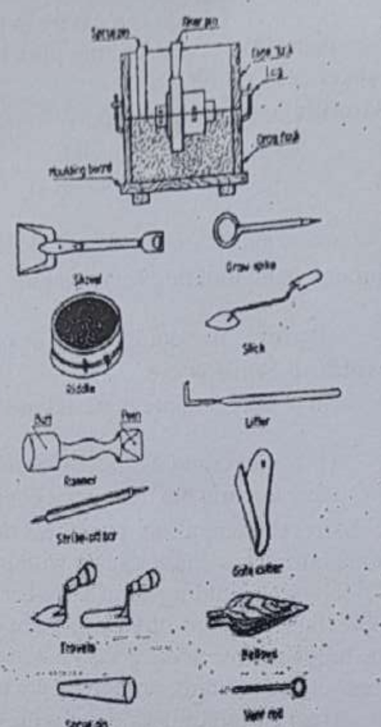


Fig. 11.3 Moulder's tools and equipment

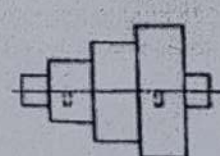


Fig. 11.9 Split pattern

Pattern; -

A pattern is the replica of the desired coasting, which when packed in a suitable materials produces a cavity called mould. This cavity when filled with molten metals, produces their desired coasting of the solidification.

Types of pattern; -

Wood are metal patterns are used in foundry practice, single piece, split loose piece and cored patterns are some of the common types.

Tools and equipment; -

The tools are equipment needed for molding are; -

Molding board: -

It is wooden board with smooth surfaces. It supports the flasks and the pattern, while the mould is being made.

Molding Flask: -

It is a base, made of wood or metal, open at both ends. The sand is rammed in after placing the pattern to produce a mould it is made of 2 parts; cope is the top half of the flask, having guides for the aligning paints to enter. Drag is the bottom half of the flask having aligning pins.

Shovel: -

It is used for mixing and tempering molding sand and for transferring the sand in to the flask. It is made of steel blade with a wooden handle.

Rammer: -

It is used for pocking or ramming the sand, around the pattern one of its ends called the peen end, is wedge shaped and is used for packing sand in spaces, pockets and corners in the early stages of ramming. The other end called the But – end has a surface and is used for computing the sand towards the end of molding.

Strike of edge / strike of bar: -

It is a piece of metal or wood with straight edge. It is used remove the excess sand from the mould after ramming to provide a level surface.

Spruce pin: -

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

Riser pin: -

It is tapered wooden pin used to make a hole in the cope sand over the mould cavity for the molten metal to rise and feed the casting to compassable the shrinkage that take place during solidification.

Trowel: -

It is used to smoothen the surface of the mould. It may also be used for reproducing the damaged portion of the mould. A trowel is made in many different styles and sizes each one recallable for a particular hole.

FOUNDRY

ONE STEPPED PATTERN

(SINGLE PIECE PATTERN)

EXPERIMENT No: **DATE:**

Aim: - To prepare a sand mould cavity using One Stepped Shaft (single piece pattern).

Tools required: -

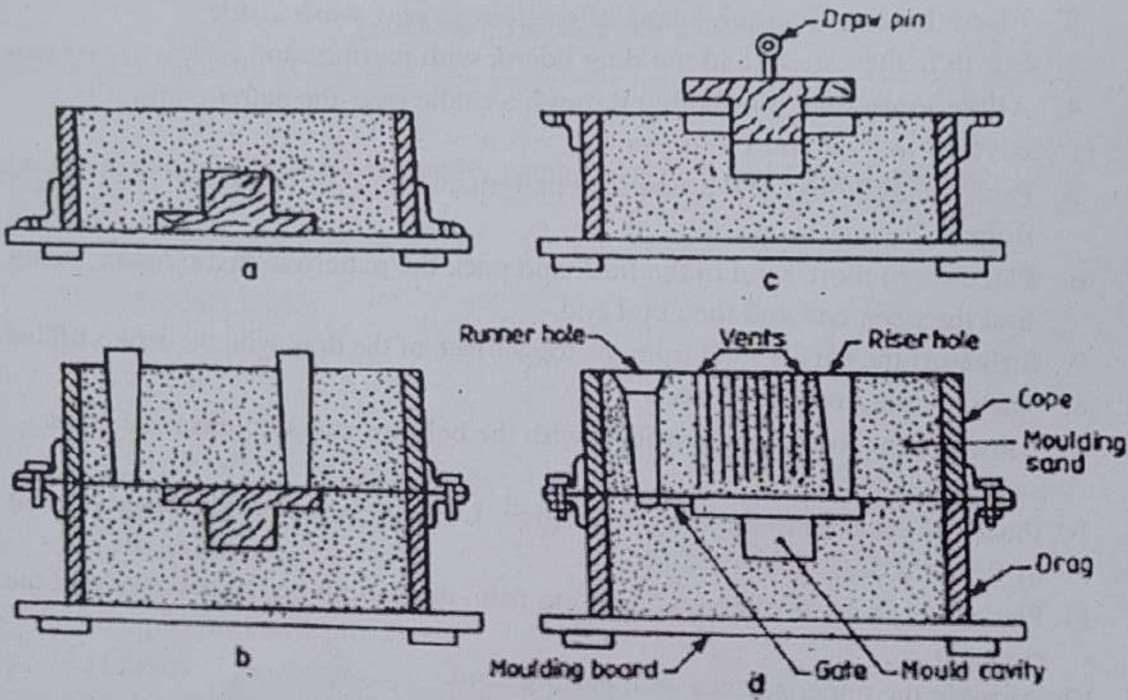
1. Molding board
2. Molding flask
3. Shovel
4. Riddle
5. Rammer
6. Strike-off bar or Strike Edge
7. Sprue pin
8. Riser pin
9. Trowel
10. Spike or Draw pin
11. Slick
12. Lifters
13. Gate cutter
14. Bellows
15. Vent rod

Material required: -

1. Molding sand
2. Parting sand
3. Dum-Bell

Sequence of operation: -

1. Sand preparation
2. Sandmixing
3. Pouring
4. Finishing



Mold for a solid flange

Procedure: -

1. Place the pattern on the molding board, with its flat side on the board.
2. Place the drag over the board, after giving a clay wash inside.
3. Sprinkle the pattern and molding board, with parting sand.
4. Allow loose sand, preferably through a riddle over the pattern, unit it is covered to a depth of 2 to 3 cm.
5. Pack the molding sand around the pattern and into the corners of the flask, with fingers.
6. Place some more sand in the flask and pack the pattern with a rammer, using first the peen end and then butt end.
7. Strike-off the excess sand from the top surface of the drag with the strike-off bar.
8. Turn the drag upside down.
9. Blow-off the loose sand particles with the bellows and smoothen the upper surface.
10. Place the cope on to the drag in position. Locate riser pin on the highest point of the pattern.
11. Place the sprue pin at about 5 to 6 cm from the pattern on the other side of the riser pin.
12. Sprinkle the upper surface with parting sand.
13. Repeat steps 3 to 7, approximately.
14. Make holes with the vent rod to about 1 cm from the pattern.
15. Remove the sprue and riser pins by carefully drawing them out. Funnel shaped hole is made at the top of the sprue hole, called the pouring cup.
16. Lift the cope and place it aside on its edge.
17. Insert the draw pin into the pattern. Wet the edges around the pattern. Loosen the pattern by rapping. Then draw the pattern straight up.
18. Adjust and repair the mold by adding bits of sand, if necessary.
19. Cut gate in the drag from the sprue to the mold. Blow off any loose sand particles in the mold.
20. Close the mold by replacing the cope and placing weights on it.

Precautions:-

1. Do not get the sand too wet. Water is an enemy of molten metals.
2. Provide adequate ventilation to remove smoke and fumes.
3. Never stand near or look over the mold during the pouring because of the molten metal might be too hot.
4. Do not shake out a casting too hastily, which may result in second and third degree burns.

Result: - A sand mold cavity is prepared by using one–Stepped Shaft.

FOUNDRY

DUM-BELL

(SPLIT PIECE PATTERN)

EXPERIMENT No: DATE:

Aim: - To prepare a sand mould cavity using Dum-Bell (split piece pattern).

Tools required: -

1. Molding board
2. Molding flask
3. Shovel
4. Riddle
5. Rammer
6. Strike-off bar or Strike Edge
7. Sprue pin
8. Riser pin
9. Trowel
10. Spike or Draw pin
11. Slick
12. Lifters
13. Gate cutter
14. Bellows
15. Vent rod

Material required: -

1. Molding sand
2. Parting sand
3. Dum-Bell

Sequence of operation: -

1. Sand preparation
2. Sand mixing
3. Pouring
4. Finishing

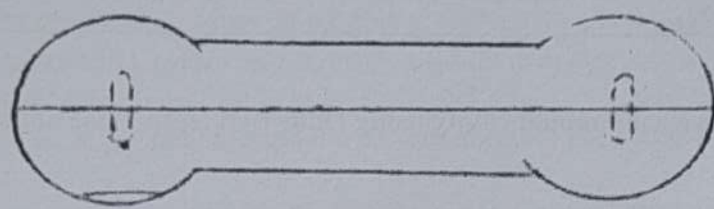


Fig: 1 Dum – Bell pattern

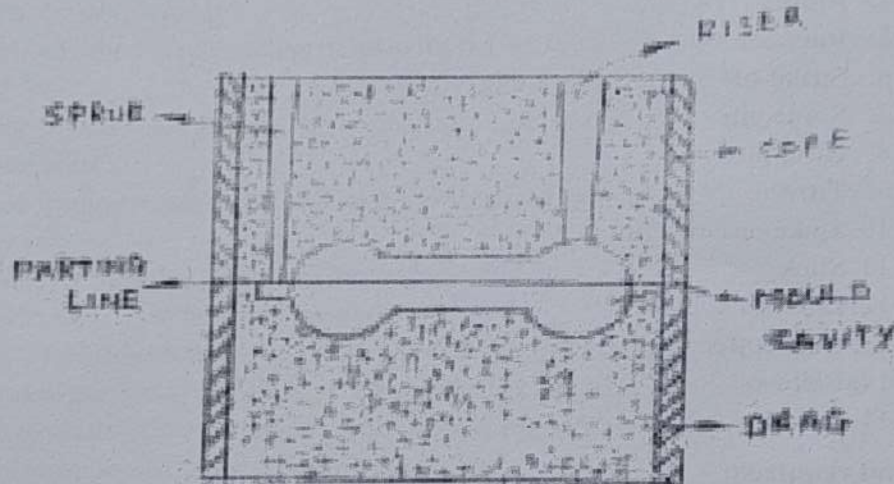


Fig: 2 mould of two piece pattern

Procedure: -

1. Place the pattern on the molding board, with its flat side on the board.
2. Place the drag over the board, after giving a clay wash inside.
3. Sprinkle the pattern and molding board, with parting sand.
4. Allow loose sand, preferably through a riddle over the pattern, unit it is covered to a depth of 2 to 3 cm.
5. Pack the molding sand around the pattern and into the corners of the flask, with fingers.
6. Place some more sand in the flask and pack the pattern with a rammer, using first the peen end and then butt end.
7. Strike-off the excess sand from the top surface of the drag with the strike-off bar.
8. Turn the drag upside down.
9. Blow-off the loose sand particles with the bellows and smoothen the upper surface.
10. Place the cope on to the drag in position. Locate riser pin on the highest point of the pattern.
11. Place the sprue pin at about 5 to 6 cm from the pattern on the other side of the riser pin.
12. Sprinkle the upper surface with parting sand.
13. Repeat steps 3 to 7, approximately.
14. Make holes with the vent rod to about 1 cm from the pattern.
15. Remove the sprue and riser pins by carefully drawing them out. Funnel shaped hole is made at the top of the sprue hole, called the pouring cup.
16. Lift the cope and place it aside on its edge.
17. Insert the draw pin into the pattern. Wet the edges around the pattern. Loosen the pattern by rapping. Then draw the pattern straight up.
18. Adjust and repair the mold by adding bits of sand, if necessary.
19. Cut gate in the drag from the sprue to the mold. Blow off any loose sand particles in the mold.
20. Close the mold by replacing the cope and placing weights on it.

Precautions:-

1. Do not get the sand too wet. Water is an enemy of molten metals.
2. Provide adequate ventilation to remove smoke and fumes.
3. Never stand near or look over the mold during the pouring because of the molten metal might be too hot.
4. Do not shake out a casting too hastily, which may result in second and third degree burns.

Result: - A sand mold cavity is prepared by using Dum-Bell.

WELDING

INTRODUCTION

Welding is the process of joining similar metals by the application of heat, with or without application of pressure or filler metal, in such a way that the joint is equivalent in composition andcharacteristics of the metals joined. In the beginning, welding was mainly used for repairing all kinds ofworn or damaged parts. Now, it is extensively used in manufacturing industry, construction industry(construction of ships, tanks, locomotives and automobiles) and maintenance work, replacing rivetingand bolting, to a greater extent.

The various welding processes are:

1. Electric arc welding,
2. Gas welding
3. Thermal welding
4. Electrical Resistance welding and
5. Friction welding

However, only electric arc welding process is discussed in the subject point of view.

Electric arc welding

Arc welding is the welding process, in which heat is generated by an electric arc struck between an electrode and the work piece. Electric arc is luminous electrical discharge between two electrodes

through ionized gas.

Any arc welding method is based on an electric circuit consisting of the following parts:

a. Power supply (AC or DC);

b. Welding electrode;

c. Work piece;

d. Welding leads (electric cables) connecting the electrode and work piece to the power supply.

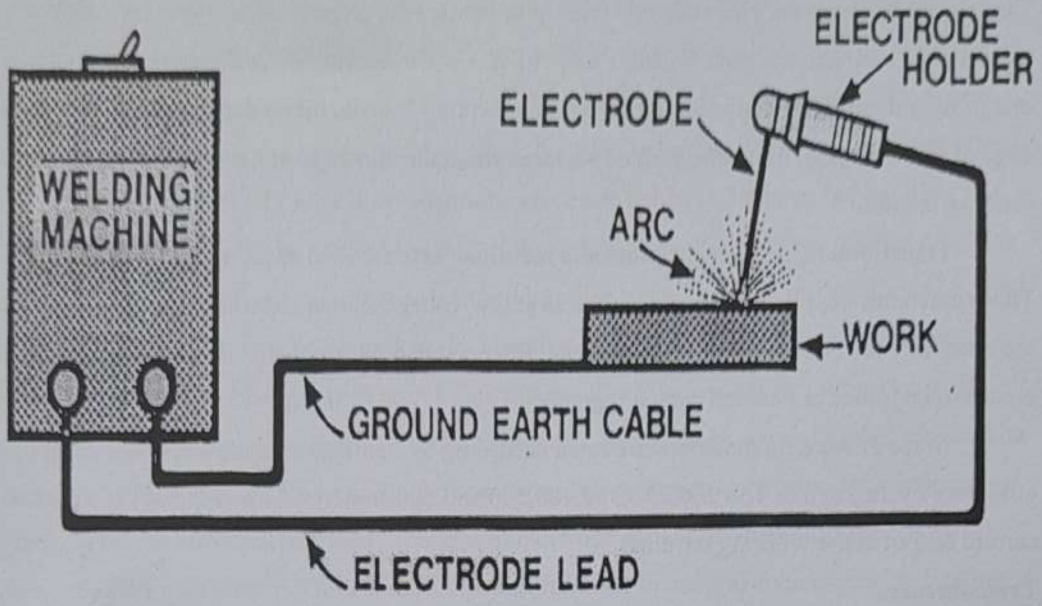


Fig:1 Arc welding set up

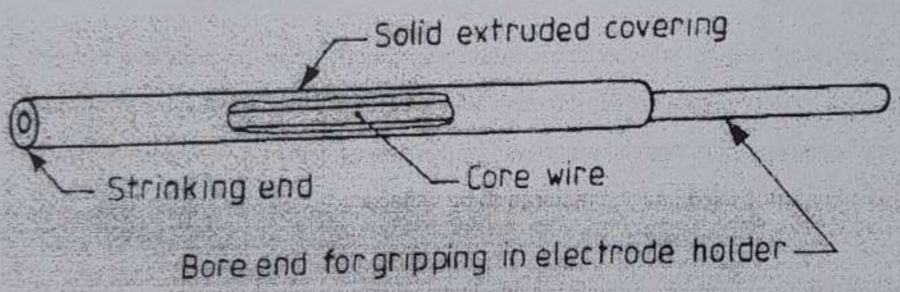


Fig :2 parts of an electrode

Electric arc between the electrode and work piece closes the electric circuit. The arc temperature may reach 10000°F (5500°C), which is sufficient for fusion the work piece edges and joining them. When a long joint is required the arc is moved along the joint line. The front edge of the weld pool melts the welded surfaces when the rear edge of the weld pool solidifies forming the joint.

Transformers, motor generators and rectifiers' sets are used as arc welding machines. These machines supply high electric currents at low voltage and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and the arc melts the surface so that, the metals to be joined are actually fixed together.

Sizes of welding machines are rated according to their approximate amperage capacity at 60% duty cycle, such as 150,200,250,300,400,500 and 600 amperes. This amperage is the rated current output at the working terminal.

Transformers

The transformers type of welding machine produces A.C current and is considered to be theleast expensive. It takes power directly from power supply line and transforms it to the voltage required for welding. Transformers are available in single phase and three phases in the market.

Motor generators

These are D.C generators sets, in which electric motor and alternator are mounted on the same shaft to produce D.C power as pert the requirement for welding. These are designed to produce D.C current in either straight or reversed polarity. The polarity selected for welding depends upon the kind of electrode used and the material to be welded.

Rectifiers

These are essentially transformers, containing an electrical device which changes A.C into D.C by virtue of which the operator can use both types of power (A.C or D.C, but only one at a time).In addition to the welding machine, certain accessories are needed for carrying out the welding work.

Welding cables

Two welding cables are required, one from machine to the electrode holder and the other, from the machine to the ground clamp. Flexible cables are usually preferred because of the case of usingand coiling the cables. Cables are specified by their current carrying capacity, say 300 A, 400 A, etc.

Electrodes

Filler rods are used in arc welding are called electrodes. These are made of metallic wire called core wire, having approximately the same composition as the metal to be welded. These are coated uniformly with a protective coating called flux. While fluxing an electrode; about 20mm of length is left at one end for holding it with the electrode holder. It helps in transmitting full current from electrode holder to the front end of the electrode coating. Flux acts as an insulator of electricity. In general, electrodes are classified into five main groups; mild steel, carbon steel, special alloy steel, cast iron and non-ferrous. The greatest range of arc welding is done with electrodes in the mild steel group. Various constituents like titanium oxide, potassium oxide, cellulose, iron or manganese, Ferro silicates, carbonates, gums, clays, asbestos, etc., are used as coatings on electrodes. While welding, the coating or flux vaporizes and provides a gaseous shield to prevent atmospheric attack. The size of electrode is measured and designated by the diameter of the core wire in SWG andlength, apart from the brand and code names; indicating the purpose for which there are most suitable

Electrodes may be classified on the basis of thickness of the coated flux. As

1. Dust coated or light coated
2. Semi or medium coated and
3. Heavily coated or shielded

Electrodes are also classified on the basis of materials, as

1. Metallic and
2. Non-metallic or carbon

Metallic arc electrodes are further sub-divided into

1. Ferrous metal arc electrode (mild steel, low/medium/high carbon steel, cast iron, stainless steel, etc)
2. Non-ferrous metal arc electrodes (copper, brass, bronze, aluminum, etc).

In case of non-metallic arc electrodes, mainly carbon and graphite are used to make the electrodes.

Fig :3 Electrode holder

Fig :4 Ground Clamp

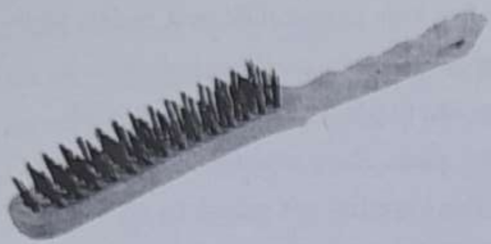


Fig :5Wire brush

Fig :6Chipping hammer

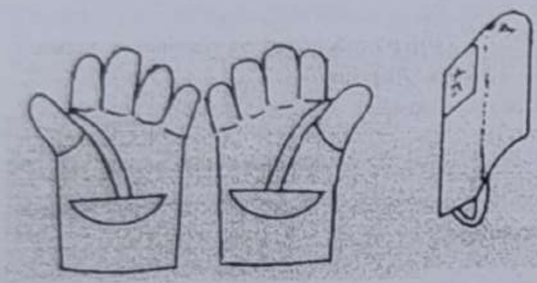


Fig :7Hand gloves

Fig :8Face shield

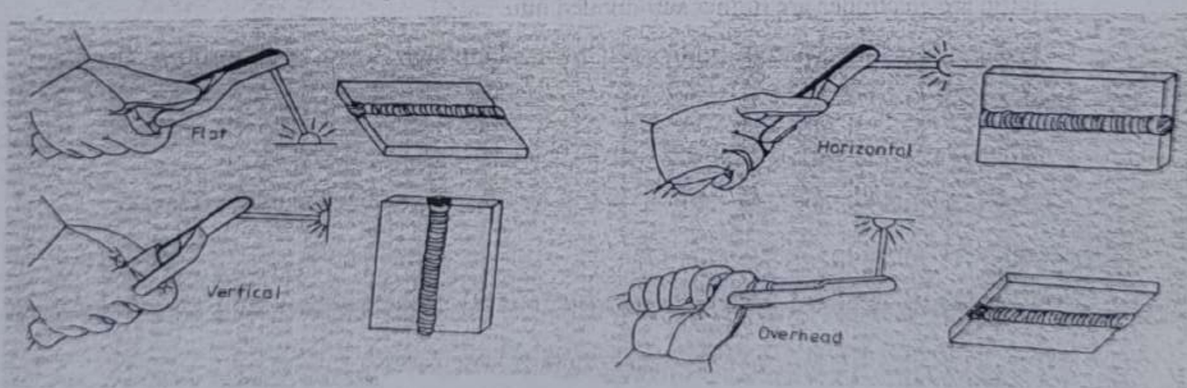


Fig :9Weld positions

WELDING TOOLS

Electrode holder

The electrode holder is connected to the end of the welding cable and holds the electrode. Itshould be light, strong and easy to handle and should not become hot while in operation. Figure shows one type of electrode holder. The jaws of the holder are insulated, offering protection from electric shock.

Ground clamp

It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit. It should be strong and durable and give a low resistance connection.

Wire brush and chipping hammer

A wire brush is used for cleaning and preparing the work for welding. A chipping hammer is used for removing slag formation on welds. One end of the head is sharpened like a cold chisel and the other, to a blunt, round point. It is generally made of tool steel. Molten metal dispersed around the welding heads, in the form of small drops, is known as spatter. When a flux coated electrode is used in welding process, then a layer of flux material is formed over the welding bead which contains the impurities of weld material. This layer is known as slag. Removing the spatter and slag formed on and around the welding beads on the metal surface is known as chipping.

Welding table and cabin

It is made of steel plate and pipes. It is used for positioning the parts to be welded properly. Welding cabin is made-up by any suitable thermal resistance material, which can isolate the surrounding by the heat and light emitted during the welding process. A suitable draught should also be provided for exhausting the gas produced during welding.

Face shield

A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available either in hand or helmet type. The hand type is convenient to use wherever the work can be done with one hand. The helmet type though not comfortable to wear, leaves both hands free for the work.

Shields are made of light weight non-reflecting fiber and fitted with dark glasses to filter out the Harmful rays of the arc. In some designs, a cover glass is fitted in front of the dark lens to protect it from spatter.

Hand gloves

These are used to protect the hands from electric shocks and hot spatters

TECHNIQUES OF WELDING

Preparation of work

Before welding, the work pieces must be thoroughly cleaned of rust, scale and other foreign material. The piece for metal generally welded without beveling the edges, however, thick work pieceshould be beveled or veed out to ensure adequate penetration and fusion of all parts of the weld. But, in either case, the parts to be welded must be separated slightly to allow better penetration of the weld. Before commencing the welding process, the following must be considered

a) Ensure that the welding cables are connected to proper power source.

b) Set the electrode, as per the thickness of the plate to be welded.

c) Set the welding current, as per the size of the electrode to be used.

WELDING POSITIONS

Depending upon the location of the welding joints, appropriate position of the electrode and hand movement is selected. The figure shows different welding positions.

Flat position welding

In this position, the welding is performed from the upper side of the joint, and the face of the weld is approximately horizontal. Flat welding is the preferred term; however, the same position is sometimes called down hand.

Horizontal position welding

In this position, welding is performed on the upper side of an approximately horizontal surface and against an approximately vertical surface.

Vertical position welding

In this position, the axis of the weld is approximately vertical as shown in figure.

Overhead position welding

In this welding position, the welding is performed from the underside of a joint

WELDING

Lap joint

EXPERIMENT No: **DATE:**

Aim

To make a double lap joint, using the given mild steel pieces and by arc welding.

Material used: Two mild steelpieces of 100X40X6 mm.

Tools and equipment used

1. Arc welding machine,
2. Mild steel electrodes,
3. Electrode holder,
4. Ground clamp,
5. flat nose Tong,
6. Face shield,
7. Apron,
8. Hand gloves,
9. Metallic work Table,
10. Bench vice,
11. Rough flat file,
12. Try square,
13. Steel rule,
14. Wire brush,
15. Ball peen hammer,
16. Chipping hammer.

Operations to be carried out

1. Cleaning the work pieces
2. Tack welding
3. Full welding
4. Cooling
5. Chipping
6. Finishing

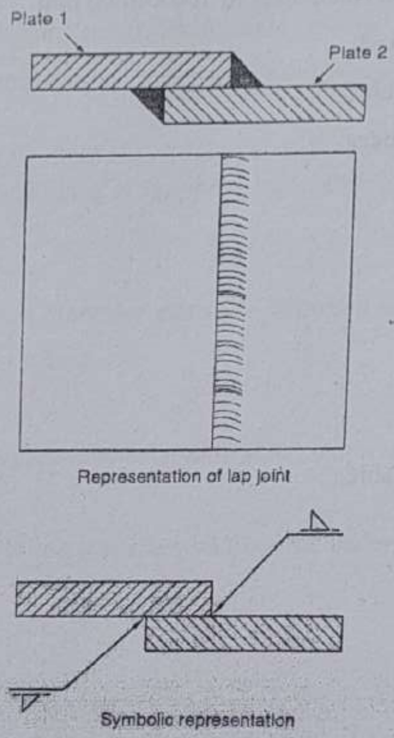


Fig: lap joint

Procedure

1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.
2. Remove the sharp corners and burrs by filing or grinding and prepare the work pieces.
3. The work pieces are positioned on the welding table, to form a lap joint with the required over lapping.
4. The electrode is fitted in to the electrode holder and the welding current is set to a proper value.
5. The ground clamp is fastened to the welding table.
6. Wearing the apron, hand gloves, using the face shield and holding the over lapped pieces the arc is struck and the work pieces are tack-welded at the ends of both the sides
7. The alignment of the lap joint is checked and the tack-welded pieces are reset, if required.
8. Welding is then carried out throughout the length of the lap joint, on both the sides.
9. Remove the slag, spatters and clean the joint.

Precautions:

1. Use goggles, gloves in order to protect the human body.
2. Maintain the constant arc length.

Result The lap joint is thus made, using the tools and equipment as mentioned above.

WELDING

BUTT JOINT

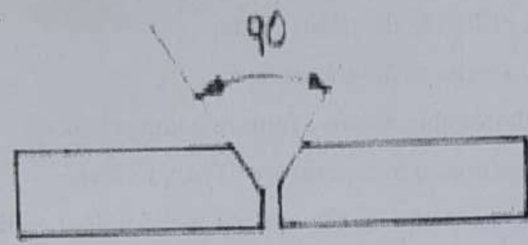
EXPERIMENT No: DATE:

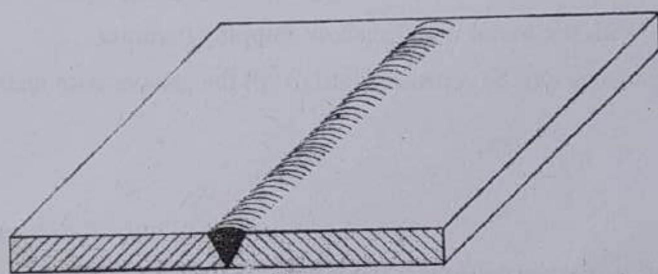
Aim: preparation of butt joint as shown in figure using shielded metal arc welding process.

Material required: 2m.s flat pieces of given size.

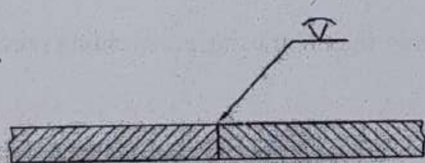
Tools required:

1. welding transformer,
2. connecting cables,
3. electrode holder,
4. ground clamp,
5. electrodes,
6. hipping hammer,
7. Welding shield etc.





Representation of single V butt joint



Symbolic representation

V – butt joint

Procedure:

1. The given metallic pieces filled to the desired size.
2. On both pieces beveled in order to have V groove.
3. The metallic pieces are thoroughly cleaned from rust grease, oil, etc.
4. The metallic pieces are connected to terminals of Trans former.
5. Select electrode dia based on thickness of work piece and hold it on the electrode holder. Select suitable range of current for selected dia.
6. Switch on the power supply and initiates the arc by either striking arc method or touch and drag method.
7. Take welding to be done before full welding.
8. In full welding process after completion one part before going to second part. Slag is removed from the weld bed. With the metal wire brush or chipping hammer.
9. Then the above process will be repeated until to fill the groove with weld bed or weld metal.

Precautions:

1. Use goggles, gloves in order to protect the human body.
2. Maintain the constant arc length.

Result: butt joint is prepared as shown in figure by using arc-welding process.