20AME07- MANUFACTRING PROCESSES

LABORATORY MANUAL

(II B.Tech Mechanical Engineering)

DEPARTMENT OF MECHANICAL ENGINEERING

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY

(AUTONOMOUS)

R.V.S NAGAR, CHITTOOR-517127

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
R.V.S. NAGAR, CHITTOOR-517 127, ANDHRA PRADESH
DEPARTMENT OF MECHANICAL ENGEERING

Vision of Mechanical Engineering

Providing excellent technical education in Mechanical Engineering with the help of state of art infrastructure and carvethe youth to suit the global needs.

Mission of Mechanical Engineering

Provide excellent Teaching-Learning process using state of art facilities to help a holistic growth in the disciplines of Thermal, Design, Manufacturing, Management and Quality areas with an emphasis on practical applications. Stimulate innovative thinkingleading to higher learning.

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)
R.V.S. NAGAR, CHITTOOR-517 127, ANDHRA PRADESH
DEPARTMENT OF MECHANICAL ENGINEERING

Programme Educational Objectives (PEO's) of UG:

PEO1	Pursue higher education in the varied fields of mechanical engineering and management.
PEO2	Secure a career placement in core and allied areas
PEO3	Develop skills to undertake entrepreneurship and lifelong learning

PROGRAMME SPECIFIC OUTCOMES (PSOs) of UG

PSO1	Apply the knowledge of manufacturing, thermal and industrial engineering to formulate, analyze and provide solutions to the problems related to mechanical systems
PSO2	Apply the design concepts and modern engineering software tools to model mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields.

DO'S

- Wear uniform, shoes & safety glasses
- Please follow instructions precisely as instructed by your supervisor.
- If any part of the equipment fails while being used, report it immediately to your supervisor.
- Students should come with thorough preparation for the experiment to be conducted.
- Students will not be permitted to attend the laboratory unless they bring the practical recordfully completed in all respects pertaining to the experiment conducted in the previous class.
- All the calculations should be made in the observation book. Specimen calculations for oneset of readings have to be shown in the practical record.
- Wherever graphs are to be drawn, A-4 size graphs only should be used and the same shouldbe firmly attached to the practical record.
- Practical record should be neatly maintained.
- Students should obtain the signature of the staff-in-charge in the observation book aftercompleting each experiment.
- Theory regarding each experiment should be written in the practical record before procedurein your own words.

DONT'S

- Do not touch hot work piece
- Do not start the experiment unless your setup is verified & approved by your supervisor.
- Do not leave the experiments unattended while in progress.
- Do not crowd around the equipment's & run inside the laboratory.
- Don't wear rings, watches, bracelets or other jewellery
- Don't wear neck ties or loose turn clothing of any kind.
- Do not eat or drink inside labs.
- Do not wander around the lab and distract other students
- Do not use any machine that smokes, sparks, or appears defective

MANUFACTURING PROCESSES LABORATORY

GENERAL INSTRUCTIONS AND SAFETY RULES

1. Students should wear the uniform and closed foot wear. Students inappropriately dressed for lab, at the instructor's discretion, be denied access).
2. When you handle chemicals wear eye protection (chemical splash goggles or full face shield).
3. When you work with furnaces for heat treatment procedures or other thermally activated equipment you should use special gloves to protect your hands.
4. To protect clothing from chemical damage or other dirt, wear a lab apron or lab coat. Long hair should be tied back to keep it from coming into contact with lab chemicals or flames.
5. In case of injury (cut, burn, fire etc.) notify the instructor immediately.
6. In case of a fire or imminently dangerous situation, notify everyone who may be affected immediately; be sure the lab instructor is also notified.
7. If chemicals splash into someone's eyes act quickly and get them into the eye wash station, do not wait for the instructor.
8. In case of a serious cut, stop blood flow using direct pressure using a clean towel, notify the lab instructor immediately.
9. Eating, drinking and smoking are prohibited in the laboratory at all times.
10. Never work in the laboratory without proper supervision by an instructor.
11. Never carry out unauthorized experiments. Come to the laboratory prepared. If you are unsure about what to do, please ask the instructor.
12. Except the scientific calculator, any other electronic devices are not permitted to use inside the Laboratory.
13. Any damage to any of the equipment/instrument/machine caused due to carelessness, the cost will be fully recovered from the individual (or) group of students.

LIST OF EXPERIMENTS

S.No.	Name of the Experiment	Page No.	Date of Exp.	Faculty Signature
1	Pattern Design and Making			
2	Study of Sand Properties (Strength and Permeability) and its Testing Procedure			
3	Sand Mould Making and Casting for Split Piece Pattern			
4	Preparation of V-Butt Joint using Arc Welding			
5	Preparation of T-Joint using Arc Welding			
6	Preparation of V-Butt Joint using TIG Welding			
7	Study of Friction Stir Welding			
8	Preparation of square tray using Spot Welding			
9	Press Tool: Blanking & Piercing operations Manufacturing of Washer using Compound Die			
10	Study of simple, compound, and progressive dies.			
11	Bending of pipe/rod/sheet using Hydraulic Press			
12	Injection Moulding			
13	Blow Molding			
14	Additive manufacturing with reverse engineering			

Experiment No. **Date:**

PATTERN DESIGN AND MAKING

Objective

To design and prepare a pattern for the casting made by malleable cast iron with consideration of suitable allowances.

MATERIALS :

- Teak wood

EQUIPMENT

- Steel rule
- Try square
- Marking gauge
- Rip saw
- Tenon saw
- Mortise chisel
- Mallet
- Jack plane
- Wood rasp file

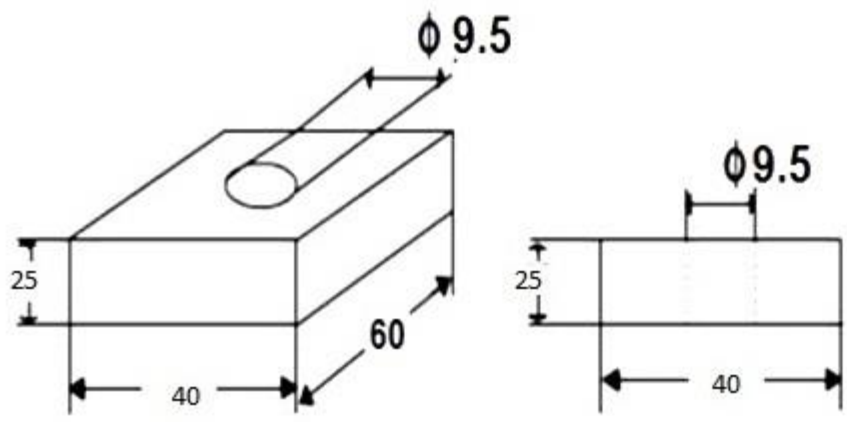
Procedure:

1. **Pattern Design**
   (Shrinkage and Machining allowances are taken into consideration)

   - Calculate the amount of shrinkage allowance for each dimension of given casting drawing based on the cast material.
   - Calculate the amount of shrinkage allowance for given casting material.
   - Calculate the total amount of allowance provided on the pattern.
   - Sum the allowance and actual dimension.
   - Redraw the casting drawing with the dimensions including allowances.

2. **Pattern Making**

- Check the dimensions of wooden piece using for pattern making and mark it according to the dimensions.
- Sides of pieces are planned with jack plane for straightness.
- Wooden piece is cut by using sawing tools according to the dimensions given in redrawn casting drawing..
- Finish the same using wood rasp file.
- Fix a the wooden piece in the drilling machine rigidly and Perform drilling operation according to the dimensions shown in fig.



Casting Drawing

Tabular Form:

Dimension No.	Actual Dimension	Machining Allowance	Total Dimension with M.A	Shrinkage Allowance	Total Dimension with S.A

Calculations

Final Sketch

PRECAUTIONS:

i. Reaper should be free from moisture
ii. Marking is done without parallax error
iii. Care should be taken while cutting and drilling.

Result:

APPENDEX

Table 1. Shrinkage allowance for various metals for Sand Casting

Material	Pattern Dimension, mm	Section Thickness,mm	Shrinkage Allowance, mm/m
Grey cast Iron	Up to 600	-	10.5
	600 to 1200	-	8.5
	Over 1200	-	7.0
White cast iron	-	-	16 to 23
Ductile Iron	-	-	8.3 to 10.4
Aluminum	-	-	13.5
Copper	-	-	16.0
Chromium steel	-	-	20.0
Manganese Steel	-	-	25.0 to 38.0
Malleable Cast Iron	-	6	11.8
		9	10.5
		12	9.2
		15	7.9
		18	6.6
		22	4.0
		25	2.6

Table 2. Machining allowance for various metals for Sand Casting

Material	Pattern Dimension, mm	Machining Allowance, mm		
		Bore	Surface	Cope side
Cast Iron	Up to 300	3	3	5.5
	301 to 500	5	4	6.0
	501 to 900	6	5	6.0
Cast Steel	Up to 150	3	3	6.0
	151 to 500	6	5.5	7.0
	501 to 900	7	6	9.0
Non ferrous	Up to 200	2	1.5	2.0
	201 to 300	.2.5	1.5	3.0
	301 to 900	3.0	2.5	3.0

Experiment No. **Date:**

STUDY OF SAND PROPERTIES (STRENGTH AND PERMEABILITY) AND ITS TESTING PROCEDURE

Objective:

1. To study the sand properties (strength and permeability).
2. To study the testing procedures for sand strength and its permeability properties.

Properties of Moulding Sand:

Molding sand must possess the properties like permeability, flowability, collapsibility, adhesiveness, strength and refractoriness. The properties are determined not only by the chemical composition, but by the amount of clayey matter in the sand, by its moisture content, and lastly by the shape and size of the silica sand grains.

Porosity: Molten metal always contains a certain amount of dissolved gases, which are evolved when the metal freezes. Also, the molten metal ,coming in contact with the moist sand, generates steam or water vapor .If these gases and water vapor evolved by the moulding sand do not find opportunity to escape completely through the mould they will form gas holes and pores in the casting. The sand must, therefore, be sufficiently porous to allow the gases or moisture present or generated within the moulds to be removed freely. When the moulds are poured. This property of sand is called porosity or permeability.

Flowability: Flowability of moulding sand refers to its ability to behave like a fluid so that, when rammed it will flow to all portions of a mould and pack all-round the pattern and take up the required shape. The sand should respond to different moulding processes. Flowability increases as clay and water content increases.

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.

Adhesiveness: The sand particles must be capable of adhering to another body, i.e.. they should cling to the sides of the moulding boxes. It is due to this property that the sand mass can be successfully held in a moulding box and it does not fall out of the box when it is removed.

Cohesiveness or Strength: This is the ability of sand particles to stick together. Insufficient strength may lead to a collapse in the mould or its partial destruction during conveying, turning over or closing. The closing may also be damaged during pouring the molten metal. The strength of moulding sand must, therefore, be sufficient to permit the mould to be formed to the desired shape and to retain this shape even after the hot metal is poured in the mould. This property of sand in its green or moist state is known as green strength. A mould having adequate green strength will retain its shape and will not distort or collapse even after the pattern is removed from moulding box. The strength of sand that has been dried or baked is called dry strength .It must have then strength to withstand erosive forces due to molten metal, and retain its shape.

Refractoriness:-The sand must be capable of withstanding the high temperature of the molten metal without fusing. Moulding, sands with poor refractoriness may burn on to the casting. Refractoriness is measure by the sinter point of the sand rather than its melting point.

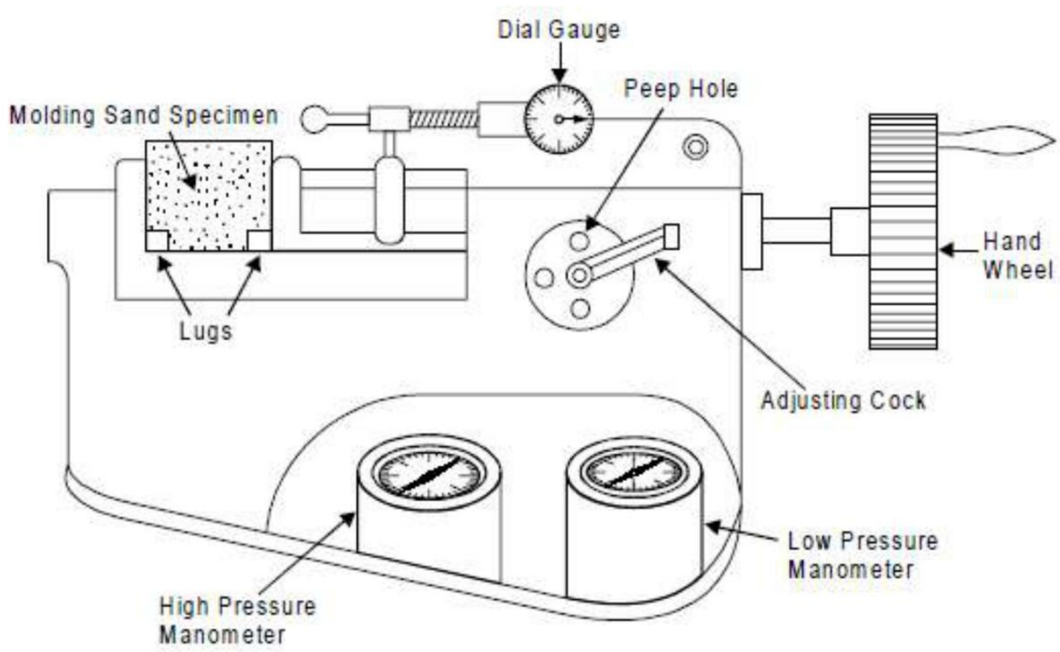
TESTING OF COMPRESSION STRENGTH

Equipment Required:

- Sand Specimen
- Strength Testing Machine

Procedure:

- Prepare the sand specimen with suitable dimensions.
- The specimen is held between the grips.
- Hand wheel when rotated actuates a mechanism which builds up Hydraulic pressure on the specimen.
- Dial indicator fitted on the tester measures the deformation occurring in the specimen.
- As the applied load is continues, the specimen breaks at a particular load.
- At this point note down the reading of dial indicator which directly gives the compression strength of the sand.



Compression Strength Testing Machine

Sketch:

Result:

Experiment No. **Date:**

TESTING OF PERMEABILITY

Equipment Required:

- Sand Specimen (5.08 mm diameter and 50.8 mm height)
- Permeability Meter

Overview:

Permeability is that property which allows gas and moisture to pass through the moulding sand. It is determined by measuring the rate of flow of air through A.F.S. standard rammed specimen under a standard pressure. The volume of air in cm3 / min. passing through a specimen of length 1 cm. and cross sectional area of 1 cm^2 under a pressure difference of 1 cm. water gauge is called Permeability Number. The volume of air passing through a sand specimen 1 sq. cm area and 1 cm. in height at a pressure of 1 gram per square centimeter in 1 min. is called the Permeability Number and is computed by the formula:

P = ______

Where,

P = Permeability Number

V = Volume of air passing through the specimen (cubic centimeter or in mil)

H = Height of specimen (centimeters)

p = Pressure difference between upper and lower surfaces of test specimen (in centimeter of water column)

A = Cross-sectional area of specimen (square centimeter)

t = time (minutes)

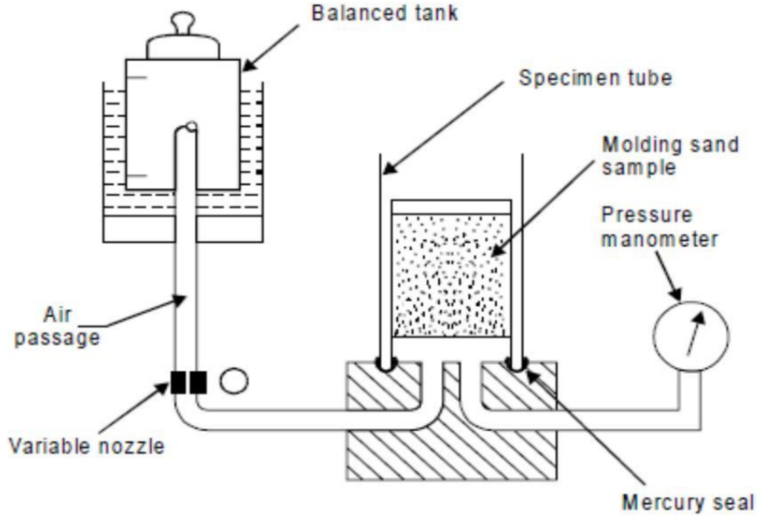
Permeability Meter

The permeability meter comprises of a cylinder and another concentric cylinder inside the outer cylinder and the space between the two concentric cylinders is filled with water. A bell having a diameter larger than that of the inner cylinder but smaller than that of outer cylinder, rests on the surface of water. Standard sand specimen of 5.08 mm diameter and 50.8 mm height together with ram tube is placed on the tapered nose piece of the permeability meter. The bell is allowed to sink under its own weight by the help of multi-position cock. In this way the air of the bell streams through the nozzle of nosepiece and the permeability is directly measured.

Procedure:

- 2000 cc of water held in the inverted bell jar is allowed to pass through the sand specimen.
- A situation comes when the liquid entering the specimen equals the air escaped through the specimen.
- This gives a stabilized pressure reading on the manometer and the same can be read on the vertical scale.

- Simultaneously, using as stop watch the time required for 2000cc of water to pass through the sand of specimen is also recorded.



Permeability Meter

Calculations:

Sketch:

Result:

Experiment No. **Date:**

SAND MOULD MAKING AND CASTING

Objective

1. To prepare a mould for sand casting for given pattern.
2. To melt and pour iron metal into the mold.

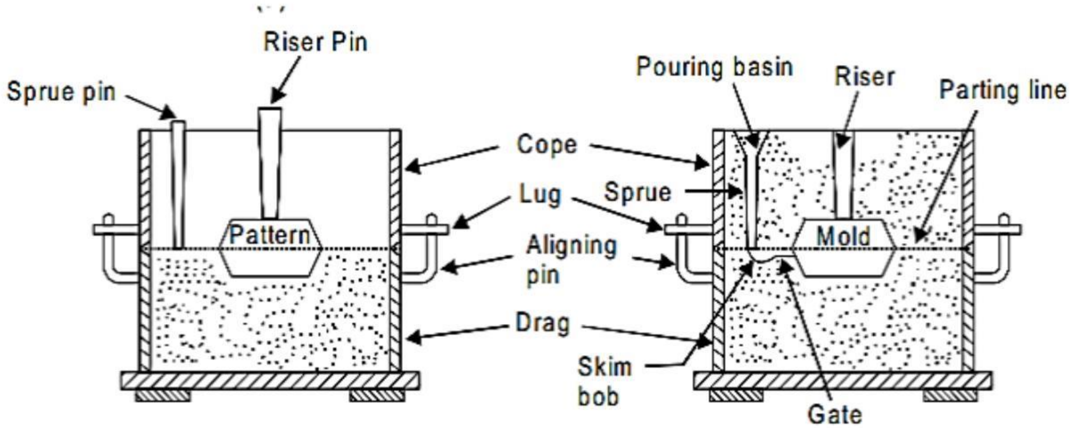
Equipment and Materials

- Split piece Pattern
- molding flasks
- molding tools
- melting furnace
- fluxes
- pouring ladle
- Pyrometer.

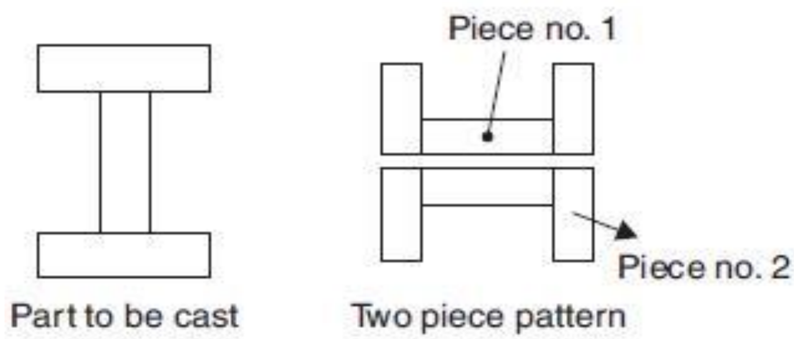
Mould Making

- The first step in making mold is to place the pattern on the molding board.
- The drag is placed on the board ((Figure 3(a)).
- Dry facing sand is sprinkled over the board and pattern to provide a non sticky layer.
- Molding sand is then riddled in to cover the pattern with the fingers; then the drag is completely filled.
- The sand is then firmly packed in the drag by means of hand rammers. The ramming must be proper i.e. it must neither be too hard or soft.
- After the ramming is over, the excess sand is leveled off with a straight bar known as a strike rod.
- With the help of vent rod, vent holes are made in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during pouring and solidification.
- The finished drag flask is now rolled over to the bottom board exposing the pattern.
- Cope half of the pattern is then placed over the drag pattern with the help of locating pins. The cope flask on the drag is located aligning again with the help of pins ((Figure 2 (b)).
- The dry parting sand is sprinkled all over the drag and on the pattern.
- A sprue pin for making the sprue passage is located at a small distance from the pattern. Also, riser pin, if required, is placed at an appropriate place.
- The operation of filling, ramming and venting of the cope proceed in the same manner as performed in the drag.
- The sprue and riser pins are removed first and a pouring basin is scooped out at the top to pour the liquid metal.

- Then pattern from the cope and drag is removed and facing sand in the form of paste is applied all over the mold cavity and runners which would give the finished casting a good surface finish.
- The mold is now assembled. The mold now is ready for pouring.



Components of Sang Mould



Spilt piece pattern

Melting and Pouring

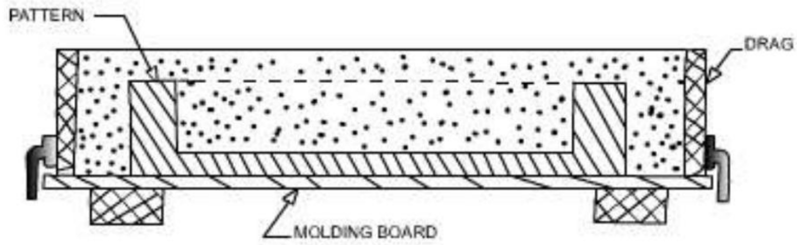
i. Melt the metal in the furnace. Use appropriate fluxes at proper stages and measure metal temperature from time to time.

ii. Pour the molten metal into the pouring ladle at a higher temperature (say 100^{O} C higher) than the pouring temperature. (Fig. (c)). As soon as the desired pouring temperature is reached, pour the liquid metal into the mold in a steady stream with ladle close to the pouring basin of the mold. Do not allow any dross or slag to go in.

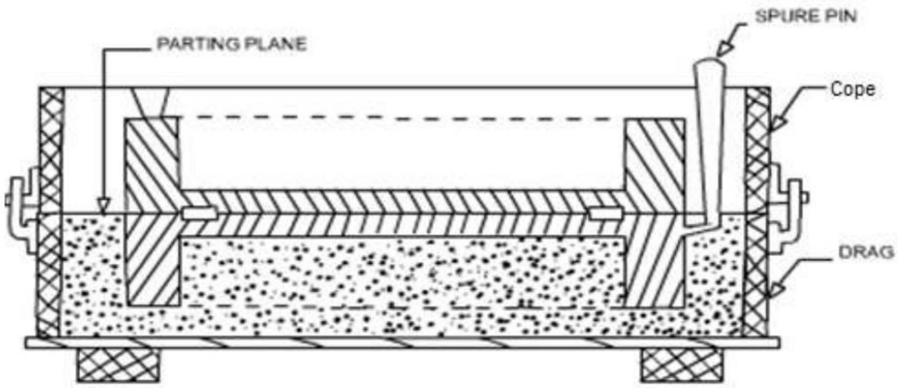
iii. Allow sufficient time for the metal to solidify in the mold. Break the mold carefully and remove the casting.

iv. Cut-off the riser and gating system from the casting and clean it for any sand etc.

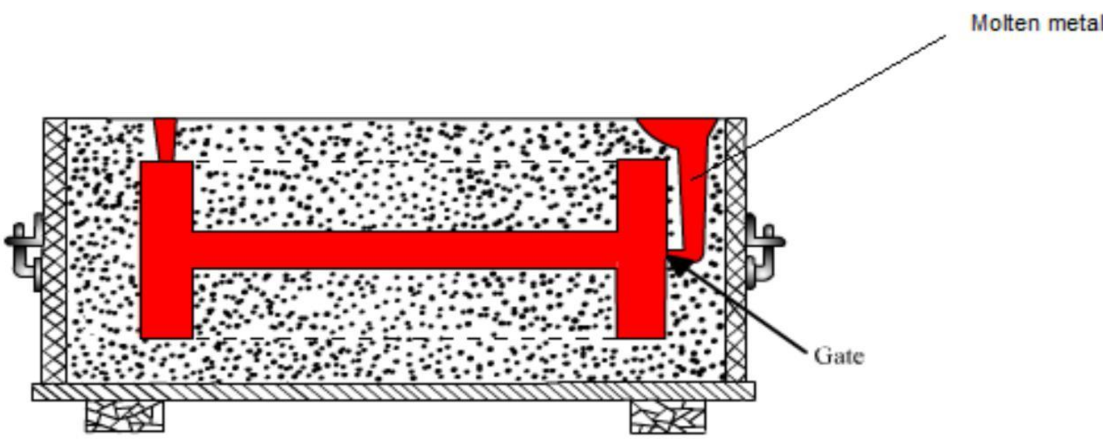
v. Inspect the casting visually and record any surface and dimensional defects observed.



a)



b)



c)

Steps involved in Mould making and Casting

Sketch:

Precautions:

- Ramming should be uniform to impart uniform strength to the mould.
- Apply parting sand at the partitions for ease separation of boxes.
- Locate the two halves of pattern properly to avoid mismatch.

Result:

Experiment No. **Date:**

PREPARATION OF V-BUTT JOINT USING ARC WELDING

Objective

To prepare a butt joint with mild steel strip using ARC Welding technique.

Material

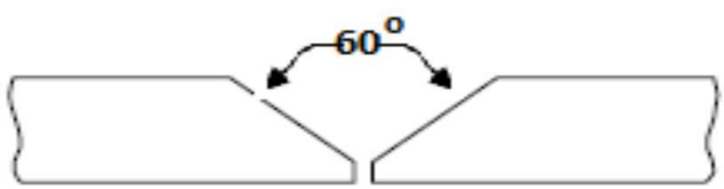
Two pieces of Mild steel

Equipment

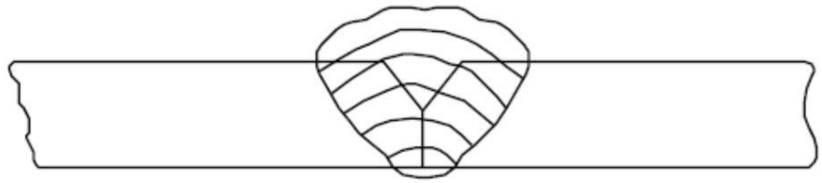
Welding unit, Electrode, Wire Brush, Tongs, goggles.

Procedure

i. The edges of joining surfaces of metals are prepared.
ii. Clean the mild steel flats to be joined by wire brush.
iii. Arrange the flat pieces properly providing the gap for full penetration for butt joint (gap ½ thicknesses of flats).
iv. Practice striking of arc, speed and arc length control
v. Set the welding current, voltage according to the type of metal to be joined.
vi. Strike the arc and make tacks at the both ends to hold the metal pieces together during the welding process.
vii. Lay beads along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
viii. Clean the welded zone and submit.



Edge Preparation for Single V



Single V Butt Joint

Sketch:

Precautions:

- Use goggles and gloves to protect the human being from the generated arc**.**
- Maintain constant arc length to get uniform weld bead.

Result:

Experiment No. Date:

PREPARATION OF T- LAP JOINT USING ARC WELDING

Objective

To prepare a butt joint with mild steel strip using ARC Welding technique.

Material

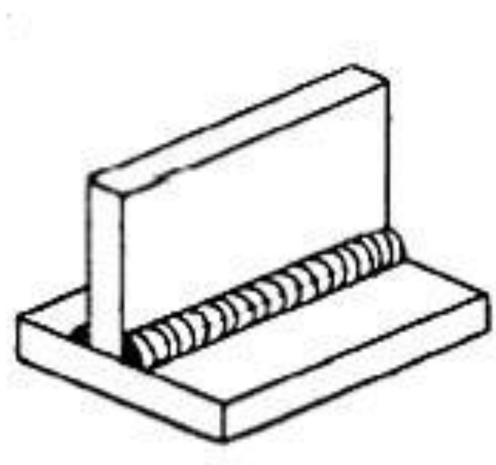
Two pieces of Mild steel

Equipment

Welding unit, Electrode, Wire Brush, Tongs, goggles.

Procedure

i. The edges of joining surfaces of metals are prepared.
ii. Clean the mild steel flats to be joined by wire brush.
iii. Arrange the flat pieces properly providing the gap for full penetration for butt joint (gap ½ thicknesses of flats).
iv. Practice striking of arc, speed and arc length control
v. Set the welding current, voltage according to the type of metal to be joined.
vi. Strike the arc and make tacks at the both ends to hold the metal pieces together during the welding process
vii. Lay beads along the joint maintaining proper speed and arc length (Speed 100-150 mm/min).
viii. Clean the welded zone and submit.



T - Joint

Sketch:

Precautions:

- Use goggles and gloves to protect the human being from the generated arc.
- Maintain constant arc length to get uniform weld bead.

Result:

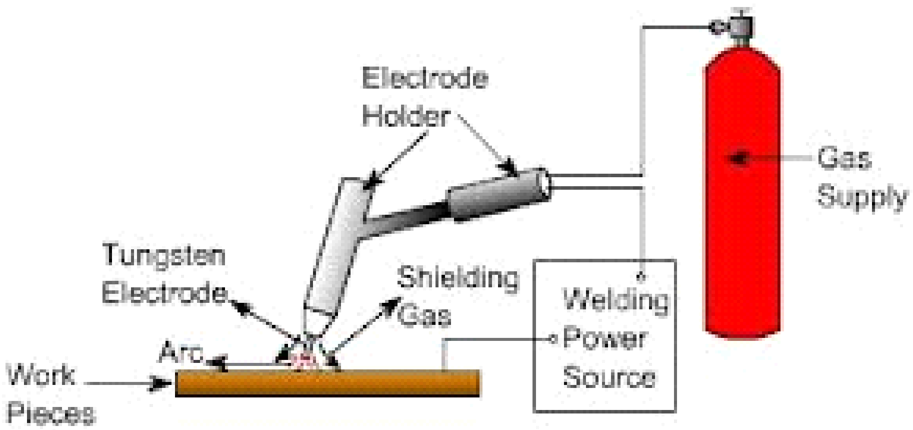
Experiment No. **Date:**

TIG WELDING

Aim: To make butt - Welding using TIG welding equipment.

Equipment and Material Required:
Inert gas(helium, argon) welding outfit, MS Sheets 150x50x5mm (2No)

Tools Required: Wire brush, hand gloves, and chipping hammer, spark lighter.



Procedure:

1. Inert gas valve on the torch is opened slightly and lightened with the help of a spark lighter.
2. The torch tip is to be positioned above the plates so that white cone is at a distance of 1.5mm to 3mm from the plates.
3. To rch is to be held at an angle of 30 to 45 degree to the horizontal plane.
4. Now filler rod is to be held at a distance of 10mm from the flame and 1.5 mm to 3 mm from the surface of the weld pool.
5. As the backward welding allows better penetration, back ward welding is to be used.
6. After the completion of welding, slag is to be removed by means of chipping hammer, wire brush.

Precautions:

1.Never look at the arc with the naked eye. Always use a shield while welding.
2.Always wear the safety hand gloves, apron and leather shoes.
3.Ensure proper insulation of the cables and check for openings.
4.Care is taken to avoid arc blow, which will cause serious defect in the weldment.
5. Ensure that torch movement is uniform.
6. See that the joints are extremely clean.

Sketch:

Result: A butt joint is prepared using gas welding process.

Experiment No. **Date:**

FRICTION STIR WELDING

Aim:
To perform friction stir welding (FSW) on two similar aluminum sheets of same gauge.

Instruments required:
FSW machine, Fixture for clamping the workpiece on the machine table, Al sheets of dimensions (100 mm x 50 mm x 2.5 mm), FSW tool (having flat shoulder surface and straight circular pin), Few others necessary equipments for tightening and loosing the desired nuts and bolts.

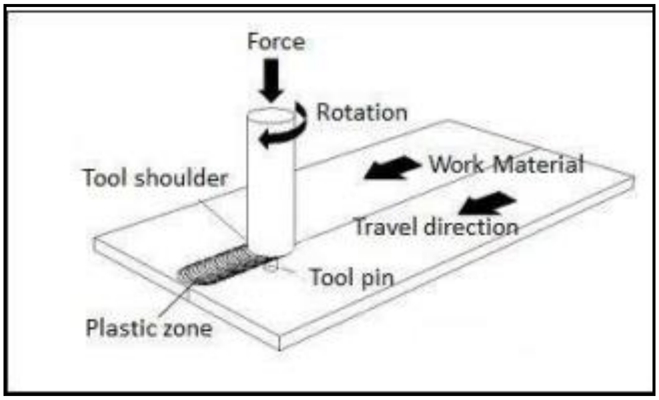


Figure. Schematic diagram of FSW process

Experimental procedure:
1. Switch on the MCB switch (electric input to the machine), On/Off switch on the machine body at the left side and start the computer monitor attached with the machine.
2. Then, double click on the stir welding icon on the desktop in order to start the software. Once the software gets started; it will ask for pressing hydraulic knob for switching it on, and then for spindle home.
3. Fix the FSW tool into the spindle through proper dimension of collet, and then tight the adapter nut using semicircle spanner.
4. Place the workpiece on the anvil of machine worktable. Make sure the sheets are being placed in such a manner that the joining line is parallel to the machine X-axis, and then clamp the workpiece using bolts.
5. Once it will be done, choose the manual mode option from the available options. Insert suitable values for worktable movement and move the worktable against fixed FSW tool for obtaining the Xstart, Xend and Zend position values. Here, Xstart, Xend denotes start and end point of welding on the work-piece clamped, and Zend position denotes the point up to which the FSW tool will reach during plunging.
6. Come out from the manual mode and then go to the parameter for specifying the parameters for weld to be conducted. If required change the spindle tilt angle.
7. After specifying the parameters go to the auto mode and click on icon continue, to start the weld. But, before pressing cycle on switch, make sure that the coolant pump for spindle is switched on.
8. After finishing of the weld, switch off the coolant pump, and hydraulic knob.

Precautions:

1. Before clamping the workpiece on the anvil the edges of the faying surfaces should be straight, so that there should not be any gap between faying surfaces; in order to achieve good weld.

2. The joining line should be parallel to the machine X-axis, and the anvil should be placed in such a position so that the FSW tool pin center should not be off-set from the expected joining line.

3. When coming out from the manual mode, move the spindle up in the Z-axis; otherwise, while selecting auto mode the spindle will directly move to the last Z-value the spindle had in the manual mode.

4. Before pressing the cycle on knob in the monitor panel the work-piece should be rigidly clamped on the anvil, and the allen bolts (placed at the right bottom side of the anvil) must be tightened in order to prevent the vibration of anvil along Y-axis.

Sketch:

Result: A butt joint is prepared using FSW process.

Experiment No. **Date:**

PREPARATION OF SQUARE TRAY USING SPOT WELDING

Aim:

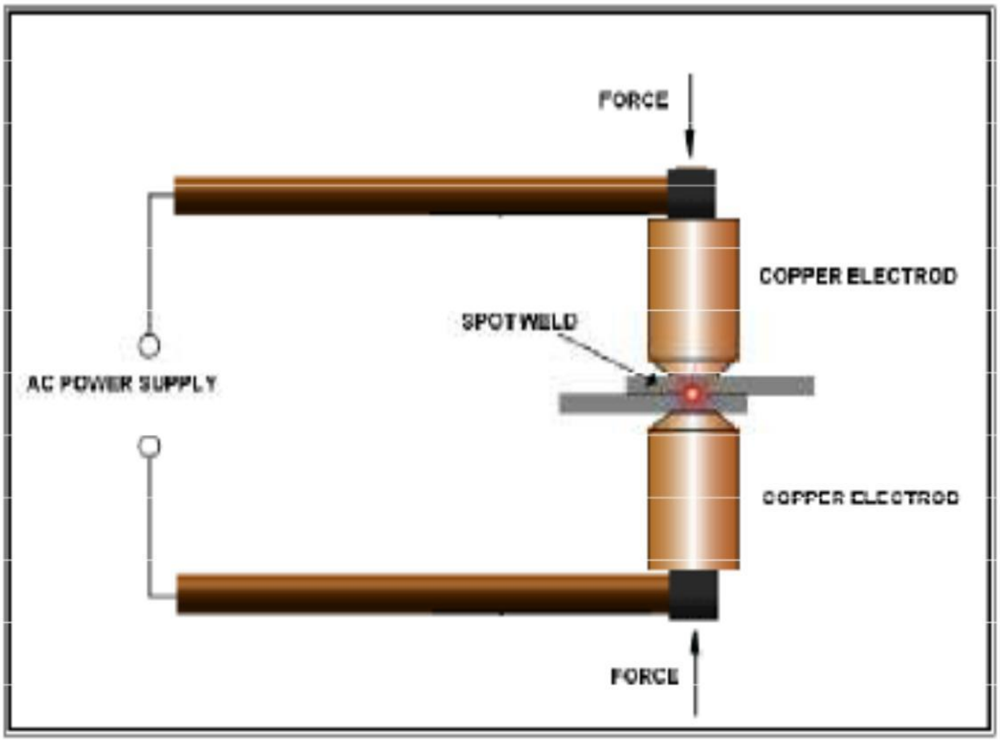
To prepare the square tray using spot welding technique.

Equipment:

Spot welding machine

Material Required:

Two G.I sheets of size

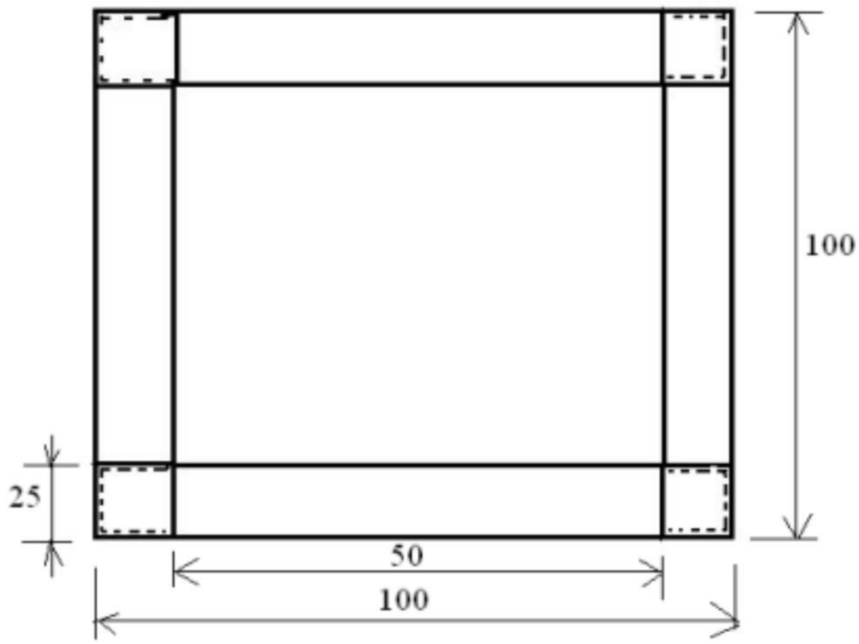


Spot welding machine setup

PROCEDURE:

- Switch on the machine and set the current in the machine to 2 Ampere
- Set the timer to two seconds
- Overlap the two metal pieces to the requires size and place them between the two electrodes.
- Apply pressure by foot on the lever such that two electrodes come into contact if the over lapped metals.
- After 2 seconds remove the pressure on the lever slowly.

- Now the joint is ready for use.
- Repeat the same procedure at various amperes
- Test the strength of the joints using universal testing machine



A typical square tray

Sketch:

PRECAUTIONS:

1. Ensure that the electrodes should not be touched.

2. Don’t touch the welded potion by hand immediately after the welding is done.

Result:

Experiment No. **Date:**

MANUFACTURING OF WASHERS USING COMPOUND DIE

Objective:

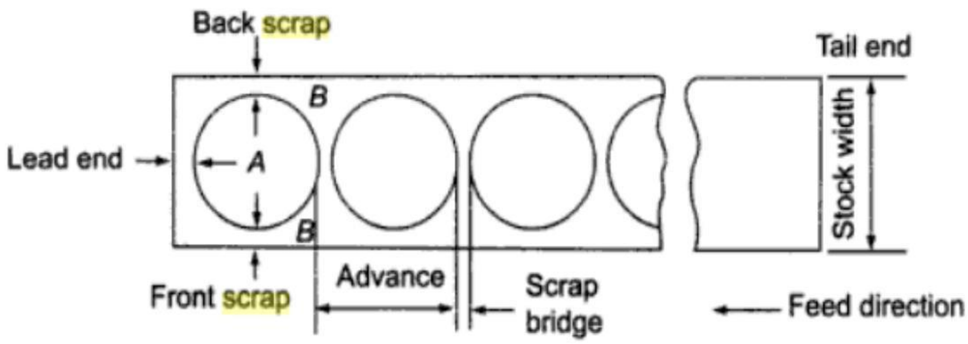
1. To prepare a scrap strip layout for the given sheet material.
2. To manufacture the washers with optimum utilization of sheet using compound die.

Equipment:

- Hydraulic Press,
- Compound Die,
- G.I Sheet.

PROCEDURE:

Preparation of Scrap Strip Layout:



Scrap Strip layout Terminology

- Plan the layout accordingly that the percentage utilization of the sheet should not be less than 75%
- **%Utilization : = Area utilized/Total Area of Sheet**

  Total Area of sheet = L (Stock Length) × W (Stock Width)

  Area Utilized depends on the shape of component which is blanked or pierced from the sheet.
- Draw the layout with optimum layout and it will used while manufacturing the components.

Manufacturing of Washers:

- Position the bottom part of the compound die just under the ram of the press.
- Place the material between the punch and die.
- Fix the top part of the die (punch) in the die holder and tighten it.
- Close the release valve of the pump.
- Operate the low pressure lever i.e. plunger with bigger dia. The ram will move very fast and touch the job.
- Then operate the high pressure lever i.e. plunger with smaller dia. The gauge will start indicating the load.
- Open the release valve, the ram will return to the original position.

Calculations:

Sketch:

Component:

Scrap Strip Layout:

PRECAUTIONS

1. Punch and die should be aligned.
2. Apply the load up to the mark. Do not exceed the red mark given in the dial gauge.

Result:

Experiment No. **Date:**

STUDY OF SIMPLE, COMPOUND, AND PROGRESSIVE DIES

Introduction:

Dies is a machine tool used in many manufacturing industries to cut metal in the desired shape

Types of Dies

For different purposes, mainly the following types of dies are used:

1.Simple die

2.Compound Die

3.Progressive die

1. Single Drop-Through Die:

The construction of a single drop-through die is shown in Fig. 1. It includes all basic elements like die punch, die block, upper and lower die shoes, the guide posts, stripper plate, container and some other auxiliary components for safety requirements.

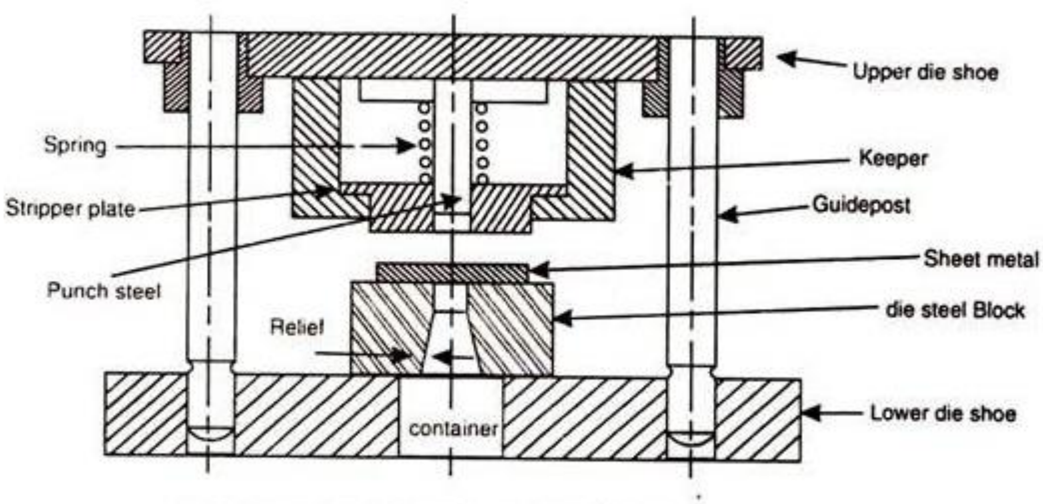


Fig. 1 . A simple drop-through blanking die.

The metal sheet is held between the die block and the stripper plate. The punch goes down and cuts the metal sheet.

The generated blanks fall through the die hole. A relief is provided in the die block to easy fall of blanks into container. The shipper plate holds the sheet metal firmly until the punch is totally withdrawn from the hole made in the strip.

Limitations:

(i) Single operation die is used when only blanking or piercing operation is to be done.

(ii) If larger diameter blank is to be produced, this may result in a defect called dishing. This defect involves slackening of the blank in the middle and the obtained blank becomes curved, and not flat.

2. Compound Die:

The compound die is used to perform two or more operations simultaneously in a single stage. It has a more complicated construction than single drop-through die and is shown in Fig. 2. As can be seen it, allows blanking and punching operation simultaneously. The product i.e., washer, and the central scarp are removed by return blocks. The advantages of compound die are close dimensional tolerances, greatest accuracy of parts, as all work is done in a single stroke.

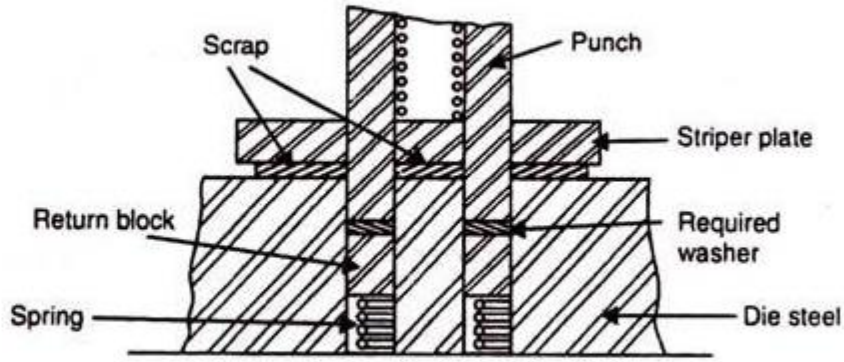


Fig. 2 . A compound die for producing a washer.

Limitations:

(i) The compound dies are limited to relatively simple processes such as blanking and piercing.

(ii) It can perform only cutting operations not shaping or bending operations.

3. Progressive Die:

The progressive die is a multiple-station die, used for parts have depth to diameter ratio is too large. It performs number of operations at two or more stations, during each stroke of the press.

The product is completed in several successive draws. This die can perform very complex work, includes piercing, blanking, forming and like operations. A two stage progressive blanking and piercing die is shown in Fig. 3.

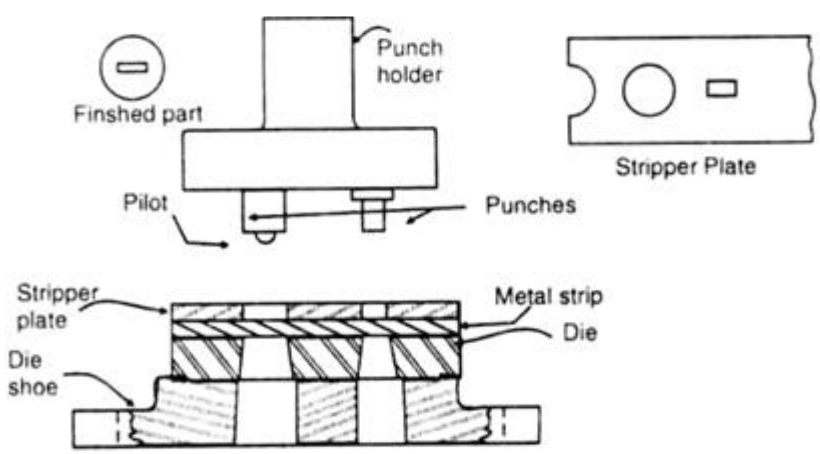


Fig. 3. A progressive die.

The operational steps are:

Progressive Die

(i) The sheet metal strip is fed between the die and the stripper plate.

(ii) A stop is provided to position the leading end of the strip.

(iii) During first stroke the slot is punched only.

(iv) Now, the strip is next advanced the distance, between adjacent previous stage to another stop.

(v) During the next stroke, two operations are carried out on the strip stock, one at each stage.

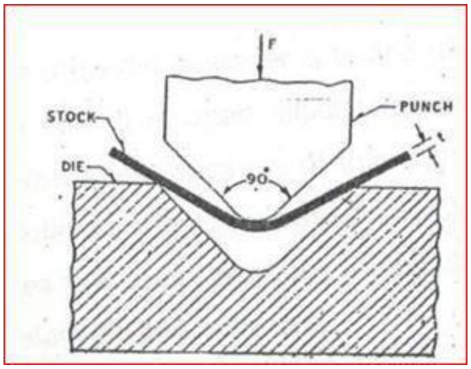
Experiment No. **Date:**

BENDING OPERATION

AIM: To make rod/pipe/sheet bending using Hydraulic press (or) To perform Bending Operation.

MATERIAL REQUIRED: Mild Steel round bar of suitable (25mm) diameter.

EQUIPMENT AND TOOLS REQUIRED: Hydraulic Press.



V- Bending:

BENDING OPERATION:

1. Fix the wedge-shaped punch to the ram of the press.
2. Fix the wedge-shaped die cavity on the bed of the press using clamps, bolts and nuts.
3. Place the MS round bar between the punch and die.
4. Apply pressure on the bar by moving the ram in downward direction through the punch.
5. As the punch descends, the contact forces at the die corner produce a sufficiently large bending movement at the punch corner to cause the necessary deformation.
6. Then the bar will take the shape of die cavity.

PRECAUTIONS:

1. The die should be properly clamped to the bed of the machine, and it is not disturbed during the process.
2. The punch is properly fixed to the ram of the machine.
3. The load should be applied uniformly on the bar.
4. The bar should be held properly on the die block.

SKETCH:

RESULT: The bending operation was made in rod/pipe/sheet using Hydraulic press.

Experiment No. **Date:**

INJECTION MOULDING

Objective:

To Prepare a Plastic product using Injection Molding machine

Equipment:

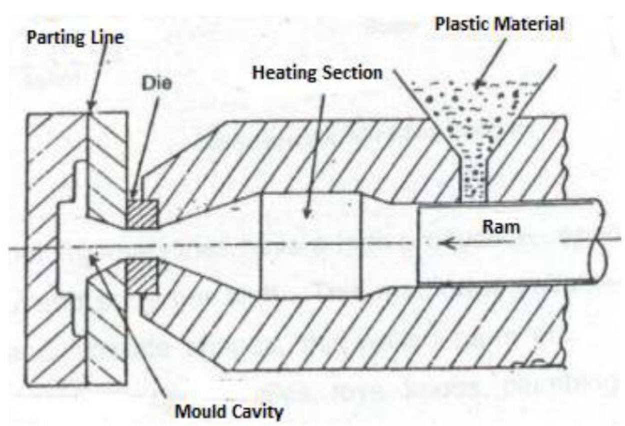
Injection molding machine Setup.

Material Required:

High grade poly ethylene

Procedure:

- Pour the raw material in the hopper.
- Place the die in such a way that its hole coin sides with the central axis of the cylinder.
- Heat the cylinder by pouring plastic pallets in it.
- When the metal is heated at 80^0C to 100^0C it is converted into molten metal.
- Press the lever so that the softened plastic will enter into the die and gets the desired shape of the mould.
- Allow it to cool for some time.
- Open the die and eject the article.



Injection Moulding Setup

Sketch:

Precautions:

1. Align the opening of the die and an orifice of the cylinder carefully.
2. Use gloves while holding die.

Result:

Experiment No. **Date:**

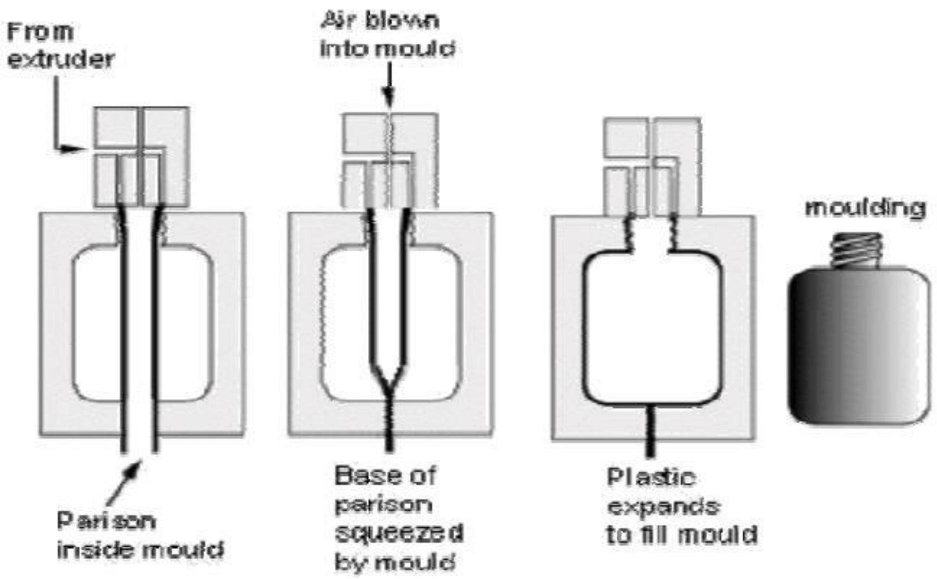
BLOW MOULDING MACHINE

AIM: To prepare a bottle of 200ml using blow moulding machine.

APPARATUS REQUIRED: Die, blow-moulding equipment, air compressor.

MATERIALS REQUIRED: Plastic pellets

TOOLS REQUIRED: Blow Molding machine, grained plastic, Die (bottle shaped)



PROCEDURE:

1. Set the die in position. Adjust the guide rod nuts to suit die height. Align the tapered face of the die for sealing the parison while blowing also checks for the face opening and closing of the die.
2. Ensure minimum die height is 80mm. provide spacing plates if necessary.
3. Set the injection, release and blow pressure by rotating (clockwise) the regulator knob to suit the requirement of moulding the container.
4. Feed correct quantity & quality of plastic material and switch on the power supply.
5. Switch on the heater.
6. Set the required timings controller to control the bottom heater.
7. Allow sufficient time to stabilizer.
8. When temperature reached, operate the hand lever valve.
9. Extrude the parison (Tubular form) to the required length and close the two die halves. Release the injection cylinder.
10. Operate the hand lever valve and blow the air so that the parison to form the shape of the container as designed in the die.
11. Allow the component to cool.

12. Open the die & take the product out of the die.
13. Now the machine is ready for nest cycle.

PRECAUTIOS:

1. The material should not be heated rapidly.
2. The die should be placed exactly below the nozzle.
3. Proper temperature should be maintained while heating the plastic.

Sketch:

RESULT: Required product is made using blow moulding process.

STUDY OF 3D PRINTING

Introduction:-

3D printing allows for rapid prototyping and onsite manufacturing of products. Initially done with plastic, 3D printing now uses new techniques with new materials, such as aluminum, bronze, and glass. Biomaterials are also being incorporated, such as 3D printing ear cartilage and liver tissue. As the 3D printing industry grows, 3D printing will become a big part of many engineering fields Introduction:- 3D printing allows for rapid prototyping and onsite manufacturing of products. Initially done with plastic, 3D printing now uses new techniques with new materials, such as aluminum, bronze, and glass. Biomaterials are also being incorporated, such as 3D printing ear cartilage and liver tissue. As the 3D printing industry grows, 3D printing will become a big part of many engineering fields components of 3D Printer:

1. Axes

Fixed Rods The three axes that the 3D printer utilizes are on the Cartesian coordinate system.

The linear fixed rods are maintained at right angles to each other, and each represents a coordinate axis.

Movement The timing belts and pulleys allow the movement of the hot end (or the print bed, depending on the type of 3D printer) along each axes according to the g-code (generated by slicing software). The stepper motors power this movement.

2. Extruder

Extrusion is the feeding of filament into the hot end of the 3D printer. This movement is also powered by a stepper motor.

Retraction This mechanism is the pulling of the melted filament from the hot end. This movement is primarily programmed through the g-code to prevent the formation of unwanted filament creating a bridge between two areas. The bridging of unwanted filament is referred to as stringing or the formation of cobwebs.

Dual Extrusion Some models of 3D printers are equipped with dual extrusion capabilities.

This allows for mixed material objects to be printed. Dual extrusion can used to print out complex objects with a different colour material as the support, making it easy to differentiate between the object and the support.

3. Hot End

The hot end is heated to temperatures ranging from 160 C to 250 C, depending on the type of filament to be used. The hot end melts the filament and pushes the melted filament through the nozzle. The hot end needs to be thermally insulated from the other components of the 3D printer to prevent any damage.

4. Print Bed

Heated Print beds that are heated improve print quality of 3D printed objects. The heated bed is heated to the glass transition temperature of the filament being used. This allows the model layers to slightly melt and stick to the heated bed.

Non-Heated Print beds that are not heated require adhesion in the form of glue, tape, hairspray, etc. In the innovation lab, painters tape is frequently used for adhesion.

5. Filament

Filament is a consumable used by the 3D printer to print layers. Filament comes in a variety of materials and colors. Filament can be composed of metal, wood, clay, biomaterials, carbon fiber, etc.

i). ABS: - ABS is a thermoplastic that needs to be heated to temperatures from 210C to 250C. ABS can only be printed on a 3D printer with a heated bed, which prevents the cracking of the object. When ABS is heated, it emits a strong unpleasant odor. ABS requires a complete enclosure while printing.
ii). PLA: - PLA is a thermoplastic that needs to be heated to temperatures from 160C to 220C. PLA is also biodegradable and emits slight odors. PLA is most frequently used in the all 3D printers.
PVA PVA is a water soluble plastic that is frequently used for support in dual extrusion 3D printers.
The printed object is left in water where the PVA support is dissolved and the finished object printed in the other filament remains.

Preparing your 3D Model in CAD Software:
CAD software is used to create 3D models and designs. This software is available on our computers and the level of difficulty varies. With the exception of Sketch up Pro and the industry standard software mentioned, all of these programs are available on the innovation lab computers.

Solid works main idea is user to create drawing directly in 3D or solid form. From this solid user can assemble it directly on their workstation checking clashes and functionality of it. Creating drawing is pretty easy just drag and drop the solid to drawing block.

The sequence for creation of an object via additive manufacturing comprises of a few steps – Figure 1.

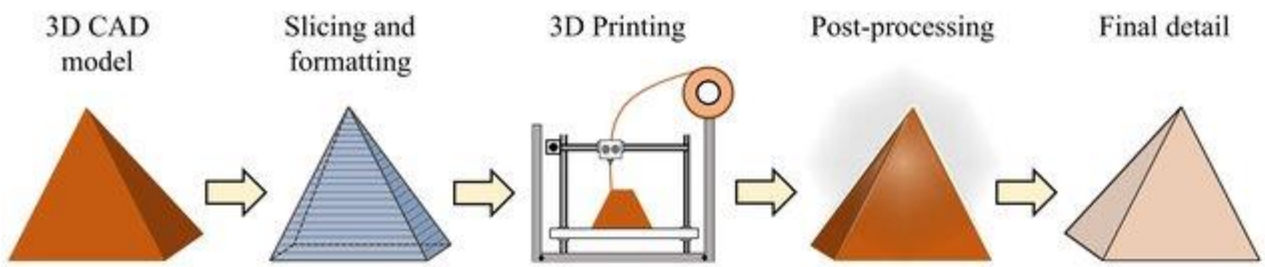


Figure 1. Production sequence for a 3D printed object

Preparing your 3D Model for print in Idea maker software:-

These are following step for 3D printing of model
1. Install the 3D print software idea maker
2. Check repair option in this software
3. Set the nozzle parameter and build tack temperature according to the printer guide

Step:-1 Prepare the design Model using Designing Software(Solids Work,Autocad etc.)
Step:-2 Convert the designed Model file in Stl ,obj format.
Step:-3 Prepare the design model for printing Using Software Idea Maker and Ultimaker. Then set all parameter (nozzle temp., build task temp and support) and also repair your design using software option. Then after generating the file in G-code format.
Step:-4 ON the 3D Printer and load the filament in nozzle and give the command print by using 3D Printing Machine.

Extrusion-based 3D printing is the most common technique for 3D printing. A typical extrusion-based FDM printing machine is shown in Figure 2

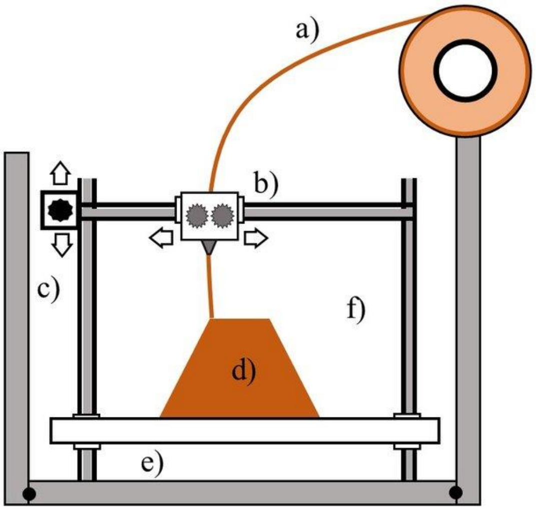


Figure 2. Simple schematic of a 3D printer utilizing an extrusion-based technique

a) Material is fed in the form of cord through an extruder
b) A heater and a nozzle – Deposition head
c) Deposition head fixed on an axis profile with controlled movement by a motor
d) Desired object
e) Desired object is printed on the print bed
f) Object printed in the print area - layer by layer due to the cooling of the material and the adhesion

Precaution of 3D Printer machine:

These are some following precaution when you print the design in 3D Printer

1. Mechanical: Do not place limbs inside the build area while the nozzle is in motion. The printer nozzle moves in order to create the object.
2. High Temperature: Do not touch the printer nozzle -it is heated to a high temperature in order to melt the build material.
3. Always buy replacement parts from the manufacturer for safety related equipment
4. Choose an area that has adequate ventilation and exhaust capability

Safety Equipment:

Safety Glasses

Gloves (recommended for post processing

Applications of 3D Printer:

Automotive, Medical, Engineering, Customize parts, Less transport, Freedom for design.