Lab Manual for Production Technology

LAB MANUAL
FOR
PRODUCTION TECHNOLOGY

II B.Tech II SEMESTER
MECHANICAL ENGINEERING

SREYAS INSTITUTE OF ENGINEERING AND TECHNOLOGY

NAGOLE
HYDERABAD

PRODUCTION TECHNOLOGY LAB MANUAL

II B.Tech II SEMESTER

MECHANICAL ENGINEERING

DEPARTMENT
OF
MECHANICAL ENGINEERING

SREYAS INSTITUTE OF ENGINEERING AND TECHNOLOGY

NAGOLE - HYDERABAD

Contents

Composed by
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PREFACE

- In this course we are seeking to understand different production processes through laboratory experiments.
- The students must have a fairly good understanding of the theory underlying the experiments.
- The entire course is designed such that classroom lectures precede lab work.
- Students are advised to pay close attention in class so that they can perform well in the lab.
- Usually the class is divided into groups.
- Each group will do a different experiment every week until all the required experiments are completed.
- Students will be formed into groups of three or four on the first lab day. Once a student has signed up with a group, he or she may not change groups without prior approval of the instructor.
- You will perform the experiment in group, and turn in ONE REPORT PER GROUP. Your report should be self-contained, i.e. an engineering technologist should be able to perform the experiment and duplicate your results by reading your report.
- DO NOT "adjust" your data to make them fit what you believe to be an acceptable value. Your report should be an accurate description of the experiment.
- If your results differ significantly from reference values you should check your settings carefully (calibration, wrong units, wrong calculations, etc.), and do the experiment again.
- Try to explain any discrepancies but do not "adjust" your data.
- It is important that all the information necessary to complete the lab report is obtained before students leave the lab.

REPORT FORMAT

The report must be hand written. A report should include the following in order

1. A title page, which includes the following information, in order:
   (a) Course Number and Section Number
   (b) Experiment Title
   (c) Names of the Group Members (who contributed to do the lab/report)
   (d) Due Date
2. Objective or purpose of the experiment work.
3. Theoretical aspect of the experiment.
4. Experimental procedure that explains briefly the procedure of how the experiment was performed and all the equipment used.
5. Experimental and/or calculated results. (Include all data you have taken, a sample calculation, and the results) The result table must be presented in tabular form. Also, all calculations and graphical work (e.g. graph) must be hand written/drawn.
6. Discussion of results in light of the theoretical predictions. Include an error analysis. Quantify the errors whenever possible.
7. Conclusions, wherein you write what you learned from the experiment. Your conclusions must summarize your report and must be based on your experimental results

Lab reports are due at the beginning of next lab. Late lab reports will not be accepted. Note: In order to get a good grade in the lab, please follow the instructions listed below:

1. Read about the lab prior to the beginning of the lab. Do each lab with an attitude of learning.
2. Please bring your lab manual to the lab. Each group should have at least one lab manual with them.
3. Students are advised to bring blank and graph papers to the lab, on which you can do calculations and draw graphs.

GENERAL INSTRUCTIONS

1. Since additional instructions may be given at the beginning of laboratory sessions, it is important that all students arrive at each session on time.
2. Every student should obtain a copy of the laboratory manual.
3. Dress code: Students must come to the laboratory wearing:
    (a) trousers
    (b) half-sleeve tops and
    (c) Leather shoes.
    (d) Half pants, loosely hanging garments and slippers are not allowed.
4. To avoid any injury, the student must take the permission of the laboratory staffs before handling the machines.
5. Every student is required is STUDENT IS REQUIRED TO HANDLE THE EQUIPMENT WITH CARE.
6. Students must ensure that their work areas are clean.
7. At the end of each experiment, the student must take initials from the staff on your data/observations.
8. Laboratory report must be submitted in standard sheet, available at stores in the subsequent lab turn. Reports on ordinary sheets and computer papers will not be accepted.
9. Each member of any group must submit lab report even if the experiment has been performed in a group.
10. The lab report must contain:
    (a) Title of the experiment,
    (b) Three to four lines stating the objectives,
    (c) A few lines on background;
    (d) Name of all equipments/tools used along with one line description of its use
    (e) Neatly labeled sketches.
11. Student can check their laboratory reports after correction for discussion.

SAFETY PRECAUTIONS

1. Follow all safety instructions given in the class and in the laboratories.
2. All students must read and understand the information in this document with regard to laboratory safety and emergency procedures prior to the first laboratory session.
3. Be careful in touching and handling specimens in hot working operations like casting, arc welding and spotwelding. Use tongs or glouses and wearing glass where ever it requires.
4. Students must adhere to written and verbal safety instructions throughout the academic term.
5. It is your responsibility to read safety and fire alarm posters and follow the instructions during an emergency
6. Know the location of the fire extinguisher, eye wash, and safety shower in your lab and know how to use them.
7. Notify your instructor immediately after any injury, fire or explosion, or spill.
8. Know the building evacuation procedures.
9. Good common sense is needed for safety in a laboratory. It is expected that each student will work in a responsible manner and exercise good judgment and common sense.
10. It is always better to ask questions than to risk harm to yourself or damage to the equipment.
11. Never eat, drink, or smoke while working in the laboratory.
12. Read labels carefully.
13. Do not use any equipment unless you are trained and approved as a user by your supervisor.
14. Wear safety glasses or face shields when working with hazardous materials and/or equipment.
15. Wear gloves when using any hazardous or toxic agent.
16. Clothing: When handling dangerous substances, wear gloves, laboratory coats, and safety shield or glasses.
17. Shorts and sandals should not be worn in the lab at any time.
18. Shoes are must while working in the machine shops.
19. If you have long hair or loose clothes, make sure it is tied back or confined.

20. Keep the work area clear of all materials except those needed for your work.
21. Disposal - Students are responsible for the proper disposal of used material if any in appropriate containers.
22. Equipment Failure - If a piece of equipment fails while being used, report it immediately to your lab assistant or tutor. Never try to fix the problem yourself because you could harm yourself and others.
23. If leaving a lab unattended, turn off all ignition sources and lock the doors.
24. Clean up your work area before leaving.
25. Wash hands before leaving the lab and before eating.
26. Obtain permission before operating any high voltage equipment.
27. Maintain an unobstructed access to all electrical panels.
28. When using compressed air, use only approved nozzles and never direct the air towards any person.
29. Guards on machinery must be in place during operation.
30. Exercise care when working with or near hydraulically- or pneumaticallydriven equipment. Sudden or unexpected motion can inflict serious injury.
31. Dispose of waste and broken glassware in proper containers.
32. If you suspect that you have suffered an eye injury, notify your instructor or teaching assistant IMMEDIATELY! Your ability to recover from an eye injury decreases the longer you wait for treatment.
33. Never do unauthorized experiments.
34. Never work alone in laboratory.
35. Keep your lab space clean and organized.
36. Do not leave an on-going experiment unattended.
37. Maintain unobstructed access to all exits, fire extinguishers, electrical panels, emergency showers, and eye washes.
38. Be careful when lifting heavy objects
39. Clean your lab bench and equipment before you leave the laboratory.

UNIVERSITY PRESCRIBED SYLLABUS

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B.Tech .ME-II Sem	L / T / P / D	C
	- - / 3 / -	2

(A40382) PRODUCTION TECHNOLOGY LAB

Minimum of 12 Exercises need to be performed

1. METAL CASTING LAB:
   (a) Pattern Design and making - for one casting drawing.
   (b) Sand properties testing - Exercise -for strengths, and permeability 1
   (c) Moulding: Melting and Casting - 1 Exercise
2. WELDING LAB:
   (a) Arc Welding: Lap & Butt Joint - 2 Exercises
   (b) Spot Welding - 1 Exercise
   (c) TIG Welding - 1 Exercise
   (d) Plasma welding and Brazing - 2 Exercises (Water Plasma Device)
3. MECHANICAL PRESS WORKING:
   (a) Blanking & Piercing operation and study of simple, compound and progressive press tool.
   (b) Hydraulic Press: Deep drawing and extrusion operation.
   (c) Bending and other operations
4. PROCESSING OF PLASTICS:
   (a) Injection Moulding
   (b) Blow Moulding

L $\rightarrow$ Lecture, T $\rightarrow$ Theory, P $\rightarrow$ Practical, C $\rightarrow$ Credits

EXPERIMENTS AS PER SYLLABUS

Experiment 1

Pattern Design And Making (for one casting drawing)

1.1 Aim

To design and make a pattern for the given casting drawing

1.2 Equipment Required

wooden lathe

1.3 Tools Required

1. Bench vice
2. Saw
3. Metal jack plane
4. Marking tools
5. Chisel
6. Rack file
7. T-square steel rule

1.4 Material Required

wooden block

1.5 Theory

Pattern

A pattern is replica of the object to the made by the casting process,with some modifications. The main modifications are the pattern allowances,the core prints,and the eliminations of fine details which can't be obtained by casting and hence are to be obtained by further processing.the dimension of the pattern are different from the final dimensions of the casting required.this is required because of the following reasons.

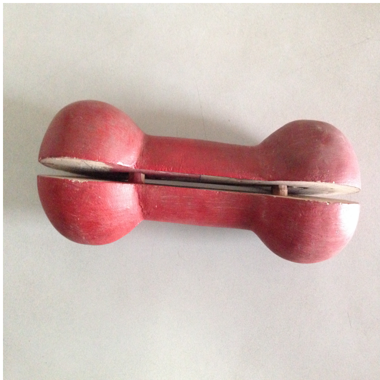


Figure 1.1: Split pattern (Dumble)

shrinkage allowance:

All the metal shrinks when cooling.shrinkage is the reduction in volume caused,when metal loses in solid state.i.e., reduction in temperature from solidus temperature to room temperature.The shrinkage allowance is provided to patterns to take care of this reduction.

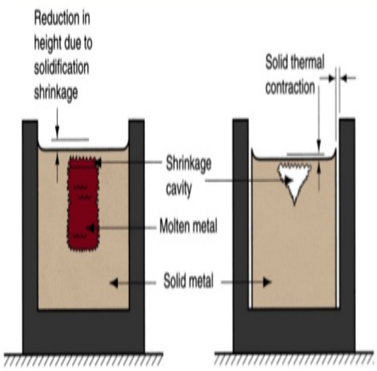


Figure 1.2: Shrinkage phenomenon

Draft allowance:

At the time of withdrawing the pattern from the sand mould, the vertical faces of the pattern are in continual contact with the sand, with the damage of mould cavity as show in figure (a). To reduce the chances of this happening, the vertical faces of the pattern are always tapered from the parting line figure (b). This provision is called draft allowance.

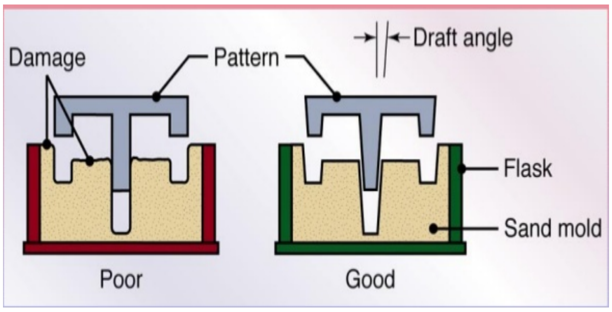


Figure 1.3: Draft allowance for pattern design

Finish or machining allowance:

The finish and accuracy achieved in sand casting are generally poor and therefore when the casting is functionally required to be of good surface finish or dimensionally accurate,it is generally achieved by subsequent machining.The machining allowance provided would ultimately have to be removed by machining.Hence the cost of providing additional machining allowance should be carefully examined before finalizing.

Shake allowance

Before withdrawal from the sand mould,the pattern is rapped all around the vertical faces to enlarge the mould cavity slightly which facilities its removal.since it enlarges the final casting made, it is desirable that the original pattern dimensions should be reduced to account for this is increase.

Distortion allowance

A metal when it has just solidified,is very weak and therefore is likely to be distorted.this is perticulerly so,for weaker section such as long flat portions v,u sections or in a complicated casting which may have thin and long sections.the foundry practice should be to make extra material provision for reducing the distortion.

Core prints

For all those castings when coring is required provision should be made to support the core inside the mould cavity.one of the methods that is universally followed is to provide where possible.The size of the core prints provided is to be estimated based on the specific casting.

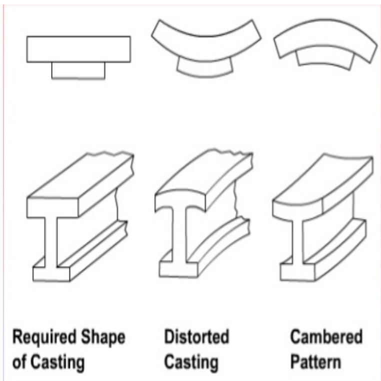


Figure 1.4: Draft allowance for pattern design

1.6 Procedure

1. For the given dimension of the required product the pattern drawings are prepared.
2. Depending on the pattern material or the final product material, allowances (shrinkage, draft, machining) are calculated.
3. Final production drawings are prepared with all the allowances calculated.
4. All the allowances are incorporated on the pattern to bring the casting to the shape nearest to the drawing shape.They are normally finalized by trial and error.
5. Core prints are provided to support the core inside the mould cavity.
6. Final dimension of the pattern layout are marked given wooden block.
7. Finally the pattern is prepared by using necessary tooling like cutting,planing,filing, etc. depending on the given casting drawing.

1.7 Precautions

1. wherever there is a sharp corner,a fillate should be provided,and the corners may be rounded of for easy with drawl of patterns as well as easy flow of metal in the mould.
2. abrupt changes in the thickness of the pattern should be avoided by having a gradual change.
3. Pattern should have a good surface finish, because finish of the casting depends on the finish of the pattern.

1.8 Results

the pattern is prepared by considering draft angle 40.k the dimensions on given wooden work piece

1.9 Review questions

1. What are the distinguishing features between pattern and casting?
2. Name the pattern allowances which can be quantitatively specified.
3. List out the types of patterns.
4. List a few patterns which are usually used.

Experiment 2

Preparation Of Mould, Melting And Casting

2.1 Aim

To prepare a mould cavity and manufacture the component by melting and casting.

2.2 Equipment required

1. Cope box
2. Drag box
3. Bottom board
4. open hearth furnace
5. open hearth furnace
6. Blower
7. Crucible
8. ladle

2.3 Tools required

1. Sprue
2. Riser
3. Chaplets
4. Gate cutter
5. Trovel
6. vent rod

7. Sleek
8. bellow
9. Tongues
10. Lifters

2.4 Materials required

1. Moulding sand
2. Facing sand
3. Backing sand
4. pattern
5. Charcoal
6. Aluminum scrap
7. Flux.

2.5 Theory

Flask

A moulding flask is one which holds sand intact.Depending upon the position of the flask in the mould structure it is referred to by various names such as drag, cope and cheek. it is made up of wood for temporary application or more generally of metal for long term use.

Drag

Lower moulding flask

Cope

Upper moulding flask

Cheek

Intermediate moulding flask used in three piece moulding.

Pattern

Pattern is a replica of the final object to be made with some modification.The mould cavity is made with the help of pattern.

Parting line

This is the dividing line between the two moulding flasks that makes up the sand mould.

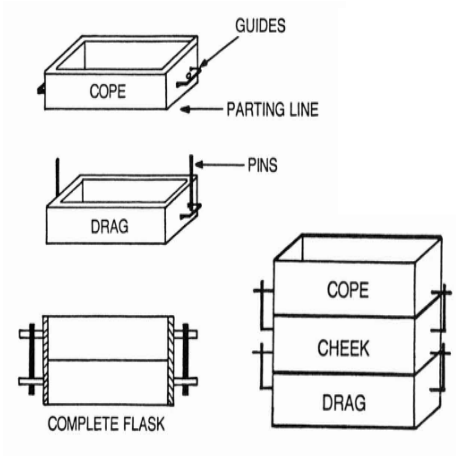


Figure 2.1: Mold box with cope drag and cheek

Bottom board

The board normally made by wood which is used at the start of mould making.The pattern is first kept on the bottom board sand is poured on it and then the ramming is done in the drag.

Facing sand

It is specially prepared sand which is placed around the pattern which has superior properties with regards to refractoriness, permeability etc. This will ensure better surface in the casting.

Cole dust

The small amount of carboneous material sprinkled on the inner surface of the mould cavity to give the better surface finish to the castings.

Moulding sand

It is the mixture of silica, clay and moisture in appropriate portions to get the desired results to get the desired results and it surrounds the pattern facing sand while making the mould. The moulding sand is the mixture.

Backing sand

It is what which constitutes most of the refractory material found in the mould .They made up of used and burnt sand.

Pouring basin

A small funnel shaped cavity at the top of mould into which the molten metal is poured.

Sprue

The passage through which the molten metal is from the pouring basin reaches the mould cavity.In many cases it controls the flow of metal into the mould.

Runner

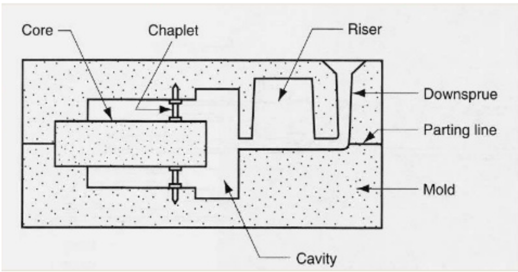
The passage ways in the parting line through which molten metal flow is regulated before they reach the mould cavity through the in gates.

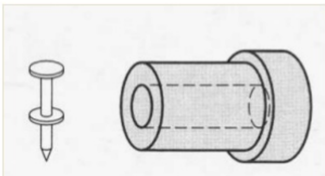
Ingates

The actual entry point through which the molten metal flows in the mould cavity.

Chaplet

Chaplets are used to support the cores inside the mould cavity to take care of weight of core and also to overcome the forces.





Possible chaplet design and casting with core

Figure 2.2: Core and chaplet arrangement in mould

Riser

It is the reservoir of molten metal provided in the casting so that the hot metal can flow in to the casting when there is a reduction in volume of metal due to solidification.The riser must remain molten for longer time than the casting part The riser , if properly designed, will avoid formation of shrinkage cavities.

Chill

These are the metallic object which are inserted in the mould to increasing the cooling rate of metal at certain locations of mould cavity to ensure directional solidification.

Laddle

The molten metal from the furnace is tapped in to the ladles at requisite intervals and then poured in to the moulds.depending on the amount of metal to be handled,There are different sizes of ladles. They may range between 50Kg s to 30 tones depending on casting size.For Grey cast iron, since the slag can be easily separated, top pouring ladle would be enough.but for steels to separate the slag effectively,the metal is to be poured from the bottom with the help of the bottom pour ladle.the bottom pour ladle has an opening in the bottom that is fitted with a refractory nozzle.A stopper rod suspended in the ladle, pulls the stopper head up from its position thus allowing the molten alloy to flow from the ladle.

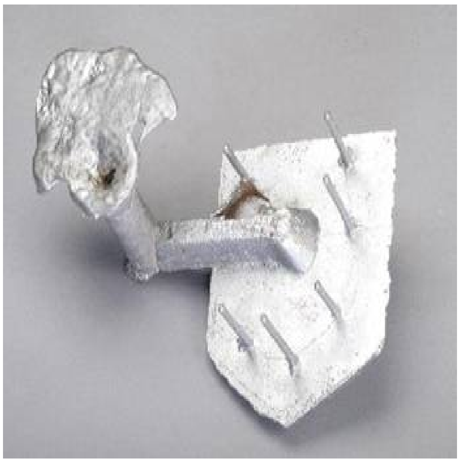


Figure 2.3: A sand casting with risers and the runner system still attached

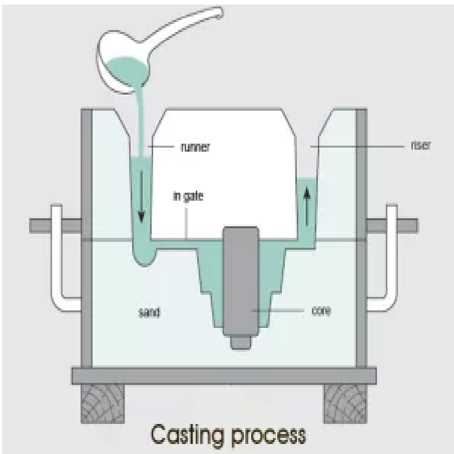


Figure 2.4: Sand casting with runner, riser and vertical core

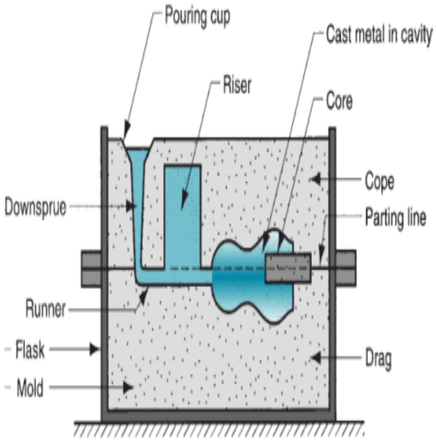


Figure 2.5: Sectional view of sand casting

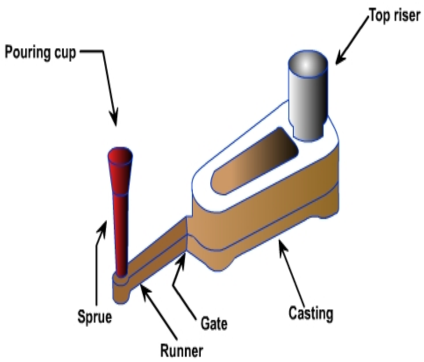


Figure 2.6: A typical pattern attached with gating and risering system

2.6 Procedure

Procedure For single piece pattern

1. First the bottom board placed on the the moulding flat form or on the floor, making the surface even.
2. The drag moulding box kept outside down on the bottom board along with the drag part of the pattern at the center of the flask on the board.
3. Dry facing sand sprinkled over the board and pattern to provide a non sticky layer.
4. Freshly prepared moulding sand of requisite quality is now poured in to the drag and out the pattern to a thickness 30 to 50 mm.
5. Rest of the sand completely filled with the back up sand and uniformly rammed to compact the sand.
6. After the ramming is over, the excess sand in the flask is completely scraped using a flat bar to the level of flask edges.
7. Now by using a vent wire of diameter of 1 to 2mm diameter with a pointed end ,vent holes are made in the drag to the full depth of flask as well as to the pattern facilitate to removal of gas during casting solidification. this completes the preparation of drag.
8. Now finished drag is rolled over the bottom board to expose the pattern.
9. Using a stick,the edges of the sand around pattern is repaired and cope half of the pattern is placed over the drag pattern, aligning it with the help of dwell pins.
10. The cope flask on the top of the drag is located aligning again with the help of pins of the drag box.
11. Dry parting sand sprinkle all over the drag surface and on the pattern.
12. Sprue of the gating system for making the sprue passing is located at a small distance of about 50 mm from the pattern.The sprue base , runners and ingates are also located as shown risers are also placed.freshly prepared facing sand is poured around the pattern . The moulding sand is then poured in the cope box.The sand is adequately rammed, excess sand is scraped and vent holes are made over in the cope as in the drag.
13. The sprue and the riser carefully withdrawn from the flask.
14. Later the pouring basin is cut near the top of the sprue.
15. The cope is separated from the drag and any lose sand on the cope and drag interface is blown of with the help of the bellows.
16. Now the cope and drag pattern halves are with drawn by draw spikes and rapping the pattern all around to enlarge the mould cavity so that the mould walls not spoiled by the with drawing pattern.
17. The runners and the gates are to be removed or to be cut in the mould carefully without spoiling the mould.

18. Any excess or mould sand loose sand found in the furnace runners and mould cavity is blown away by using bellows.
19. Now the facing paste is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.
20. A dry sand core is prepared using a core box. After suitable baking, it is placed in the mould cavity as shown in the figure
21. The cope is placed back on the drag taking care of the alignment of the two by means of the pins.
22. The mould is ready for poring molten metal.
23. The liquid metal is allowed to cool and to become solid which is the casting desired.

Procedure For split piece pattern

1. First a bottom board is placed either on the moulding platform or floor.
2. The drag moulding box is kept upside down on the bottom board along with the drag part of the pattern at the center of the flask on the board.
3. Dry facing sand is sprinkled over the board and pattern to provide a non sticky layer.
4. Freshly prepared moulding sand of requisite quantity is poured in the drag and out the pattern to a thickness of 30 to 50mm.
5. Rest of the drag flask is completely filled with the back up sand and uniformly rammed to compact the sand.
6. After the ramming is over the excess sand in the flask is completely scraped using a flat bar to the level of flask edges.
7. Now with a vent wire Which is of diameter of 1 to 2mm diameter with a pointed end, vent holes are made in the drag to the full depth of flask as well as to the pattern to facilitate the removal of gases during solidification. this completes the preparation of the drag.
8. Now finished drag flask is rolled over the bottom board expose the pattern.
9. Using a stick, edges of sand around the pattern is repaired and cope half the pattern is placed over the drag pattern and align it by dwell pins.
10. The cope flask on the top of the drag is located aligning again with the help of the pins of the drag box.
11. Dry parting sand is sprinkled all over the drag surface and on the pattern.
12. sprue is the gating system for making the sprue passing is located at a small distance of about 50mm from the pattern. the sprue base,runners and ingates are also located as shown risers are also placed.Freshly prepared sand is poured around the pattern.the moulding sand is then poured in the cope box.The sand is adequately rammed, excess sand is scraped vent holes are made all over the cope in the drag.
13. The sprue and riser are carefully withdrawn from the flask.

14. Later the pouring basin cut near the top of the sprue.
15. The cope is separated from the drag and any loose sand on the cope and drag interface is blown of with the help of bellows.
16. Now the cope and the drag pattern halves are withdrawn by using draw spikes and rapping the pattern all around to slightly enlarge the cavity so that the mould cavities are not spoiled by with drawing the pattern.
17. The runners and gates are to be removed or to be cut in the mould carefully with out spoiling the mould carefully.
18. Any excess sand or loose sand found in the runners and mould are blown away by using bellows.
19. Now the facing sand is applied all over the mould cavity and the runners which would give the finished casting a good surface finish.
20. A dry sand core is prepared using a core box.After a suitable baking, it is placed in the mould cavity.
21. The cope is placed back on the drag taking care of alignment of two halves by means of pins.
22. The mould is ready for pouring the molten metal.
23. The liquid metal allow for cooling and to become solid which is the required casting desired.

Procedure For Melting and casting

The charge materials and chemicals should be free from the moisture and oil corrosion powders should be preheated before charging. The calculation of charge should be done considering the melting loss of each element in the melting furnace for the final desired analysis.

1. The furnace crucible should be clean and red hot for charging.
2. Aluminum alloys are get readily oxidized and from dross.using proper covering top with flux and chemicals to reduce this.Different propriatory chemicals are available for different alloys.
3. Melting should be done under steady conditions without agitation is stirring to reduce the gas pickup.
4. Once melting is complete using solid chemicals like Hexachloroethane which involves chlorine by purging with Nitrogen and Argon gas is done to removed the dissolved hydrogen.Hydrogen is evolved from the moisture.

   $$3H_2O + 2Al \rightarrow 6H + Al_2O_3 \tag{2.1}$$

   Hydrogen is absorbed liquid metal causes serious porosity in casting during solidification. Degassing should be done in the temperature range of 730^{o}C to 750^{o}C.
5. Liquid metal after degassing is treated with sodium contain chemicals to improve mechanical properties.

6. Liquid metals once ready should not be super heated,agitated or kept long in the furnace which will cause drossing and gas pick up.dross should be skimmed properly before pouring.
7. Alloys containing magnesium should be melted carefully as it is highly reacting.Special fluxes and chemicals like sulpher are used to inhibit the re-activity and prevent spontaneous ignition, melting loss and dross.

2.7 Precautions

1. There should be enough clearance between the pattern and the walls of the flask.
2. The ramming sand should be done properly so as to not compact it too hard,which makes the escape of gasses difficult.
3. The furnace crucible should be clean and red hot for charging.
4. Charge material should be from oil, moisture etc.
5. Melting must be done under steady conditions to reduce gas pickup.

2.8 Results

mould cavity is prepared with the given pattern

2.9 Review questions

1. What is a cope?
2. What is a drag?
3. Define a sprue.
4. What are the tools used in preparing mould cavity?
5. Where are the chaplets used?
6. Define a riser
7. What is the necessity of bottom board
8. Define the casting term chaplet.
9. What is the difference between facing sand, moulding sand, backing sand?
10. What is a parting line?
11. what is a gate?

Experiment 3

Lap Joint Preparation by Arc Welding

3.1 Aim

To study the effect of polarity on the weld strength and heat affected zone in arc welding.

3.2 Equipment required

D.C Welding machine, Bench vice,tensile testing machine, metallurgical microscope.

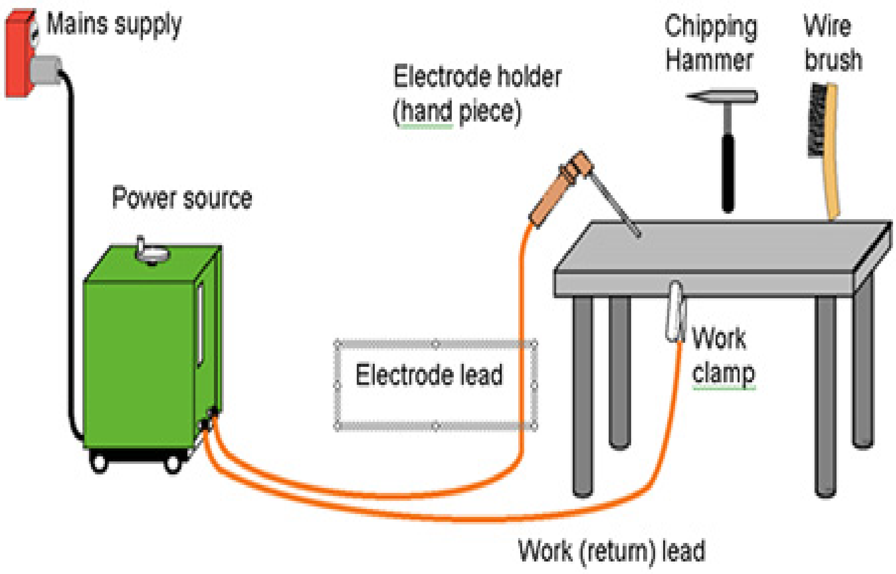


Figure 3.1: Arc welding setup

3.3 Tools required

1. Hack saw
2. chipping hammer
3. Wire brush
4. Safety goggles
5. hand gloves
6. face shield
7. files

3.4 Material required

M.S Plates of 100 mm X 50 mm X 5 mm (2 no.)

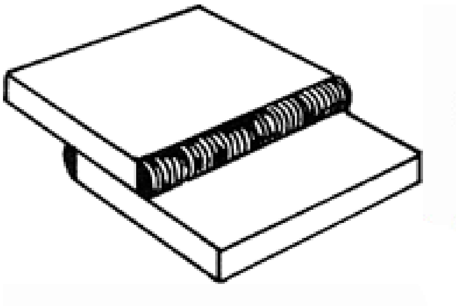


Figure 3.2: Lap joint

3.5 Theory

Principle of arc

An arc is generated between two conductors of electricity, cathode, anode,(considering direct current,DC),when they are touched to establish the flow of current and then separated by a small distance .An arc is a sustained electric discharge through the ionized gas column called plasma between two electrodes.Electrons liberated from the cathode move towards anode and are accelerated in their movement .When they strike the anode at high velocity, large amount of heat is generated.in order to produce the arc the potential difference between the two electrodes should be sufficient to allow them to move across the air gap.the larger air gap requires full higher potential differences.If the air gap becomes too large for the voltage the arc may be extinguished.

Straight and reversed polarity

When more heat is required at the work piece side for welding thicker sheets or for the work materials which have high thermal conductivity such as aluminum and copper the work is made as anode liberating the large heat near it.This is termed as straight polarity.This gives rise to higher penetration required in this work pieces. How ever for the thinner materials where less heat required in the weld zone the polarity is reversed in making the work negative. This is termed as reversed polarity. In reversed polarity the penetration is small.

Selection of electrodes

The electrodes for welding operation should be selected properly depending on the requirements of welding.The main points to be considered are

1. The composition of the base metal which determines electrode composition.
2. The tensile strength of the required joint.
3. The thickness of the base metal.For thinner metals the current setting should be lower.
4. The required metal deposition rate.
5. The type of arc welding method used.
6. The weld position (flat, horizontal, vertical,overhead) a flat position can accommodate large size electrode.

Heat affected zone

A heat affected zone of the weld is the part of welding joint which has been temperature up to the solidus of parent metal resulting in various degree of micro structure as a consequence of heating and cooling cycle.When the metals and alloys with out polymorphous transformation (Cu,Ni,Al) are welded, The micro structure in the HAZ remains unaltered through through grain growth or re-crystallization takes place,while in the case of metals and alloys with polymorphous transformation (steel) significant micro structure takes place in HAZ that in turn influence the mechanical property and consequently the service behavior of the welded joint.

Tensile test

Tensile test are carried out to determine the ultimate tensile strength under static loading of the base metal, Weld metal on the welded joint.To determine the tensile strength of joint usual procedure of finding tensile strength used.

3.6 Procedure

1. Given two M.S plates, one of the plates is filed at an angle 45 degree at the surface to be joined.
2. The electrodes is to be fixed at the holder.
3. The connections to be given such that electrode is negative and work piece is positive.
4. Now the welding is done carefully for half length of pates.

5. The work piece is to be cut in to two halves by power hacksaws.
6. The beds are polished etched with Hydrochloric acid and studied under the microscope Whose magnification factor X10 for observing heat affected zone.
7. By gripping the beads between jaws of tensile testing machine, load is applied until the work piece breaks and the reading is to be noted.
8. The same procedure is repeated for the remaining half which is welded by the reversed polarity and the results are to be compared.

Table 3.1: Welding parameters

S.No	Open current voltage(V)	Current (A)	Weld strength

3.7 Precautions

1. Edge penetration should be done very carefully
2. Before welding ensure that the surfaces are extremely clean.
3. While Welding always use face shield or goggles.

3.8 Results

the lap-joint is made by arc welding technique

3.9 Review questions

1. What is a weld bead?
2. What is the difference between weld and butt joint?
3. What is straight polarity?
4. What is reversed polarity?
5. When should we use straight and reversed polarity?
6. What is the effect of polarity on weld strength and HAZ?

Experiment 4

Butt Joint By Arc Welding

4.1 Aim

To study the effect of polarity on weld strength and heat affected zone in the arc welding.

4.2 Equipment required

1. D.C Molding machine
2. Bench vice
3. Tensile testing machine
4. Metallurgical microscope

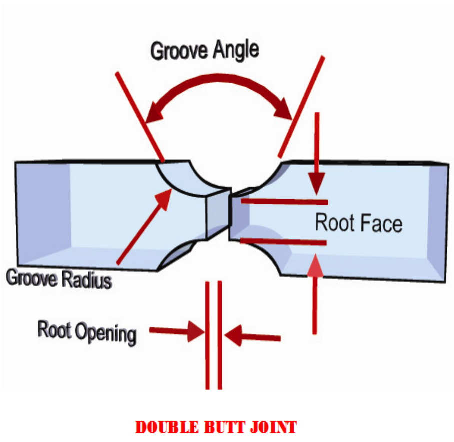


Figure 4.1: Butt joint

4.3 Tools Required

1. Hack saw
2. Chipping hammer
3. Wire brush
4. Safety goggles
5. Hand gloves
6. Face shield
7. Files

4.4 Materials required

M.S.Plates of 100 x 50 x 5mm (2 no.)

4.5 Procedure

1. Given two M.S Plates are filed at an angle of 45degree at the surfaces to be joined.(V-groove is formed when we put two pieces together)
2. The electrodes is to be fixed in holder.
3. The connections to be given such that electrode is negative and work piece is positive.
4. Now welding is done carefully for the half length of the plates.
5. The work piece is to be cut in to two half by power hacksaw.
6. The beds are polished, etched with two percent nital solution and studied under the microscope whose magnification factor X 10 for heat effected zone.
7. By gripping the beads between the jaws of the tensile testing machine , load is applied until the work piece breaks and the reading to be noted.
8. The same procedure applied remaining half which is welded by the reversed polarity and the results are to be compared.

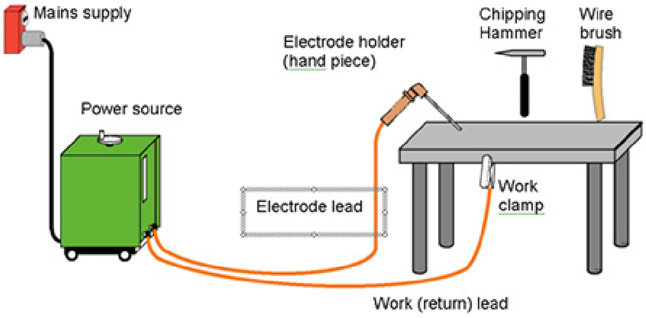


Figure 4.2: Arc welding operation

4.6 Table

Table 4.1: Arc welding parameters

S.No	Open current voltage(V)	Current (A)	Weld strength
1			
2			
3			

4.7 Precautions

1. Edge preparation should be done carefully.
2. Before welding ensure that the surfaces are extremely clean.
3. While welding always use face shield or goggles.

4.8 Results

the required butt-joint is obtained

4.9 Review Questions

1. What is a bead?
2. How is arc obtained in the arc welding?
3. What are the advantages of AC equipment over Dc equipment in arc welding?
4. How is the polarity is defined in case of DC welding source?

Experiment 5

Spot Welding

5.1 Aim

To study the effect of weld current on weld strength in spot welding.

5.2 Equipment required

1. Spot welding machine
2. Tensile machine

5.3 Tools required

1. Wire brush
2. Hand gloves

5.4 Material required

GI Sheets of 150 x 50 x 1mm (2no.)

5.5 Theory

It is a solid state welding process which the work pieces to the welded arc forced together by apply a compressive load.Current is passed through the contact area. In this welding at low voltage (100 V) very high current(15000A) is passed through the joint for a short time(25sec). This high amperage heats the joining due to the contact resistance at the joint.The pressure on the joint is continuously maintain and the metal welds together under this pressure.The heat generated in the resistance welding can be expressed as

$$H = I^2RT \tag{5.1}$$

where
H= Total heat generated in the work in Joules(J)

I= Electric current
T= Time for which the Electric current is passing through the joint
R= The resistance of the joint in ohms
K= A constant to account for the heat losses from the welded joint
.

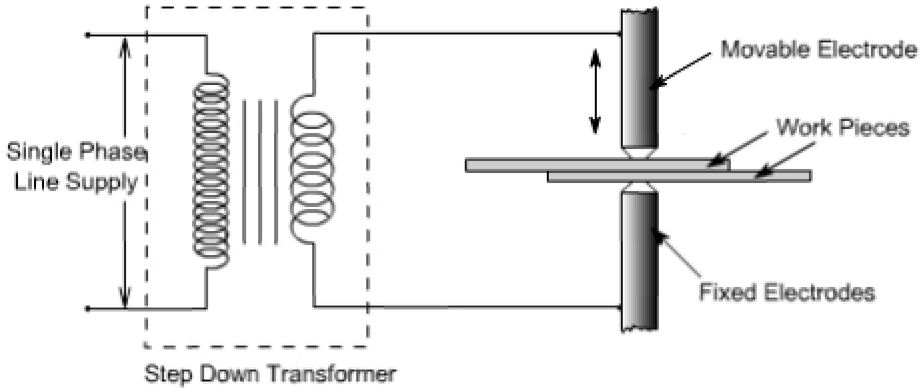


Figure 5.1: Spot welding process

Figure 5.2: Spot welding setup

The main requirement of this process is low voltage and high current power supply. This is obtained by means of step down transformer with a provision to have the different tapping on the primary side, as required depending on the thickness and the properties of the work pieces to be weld. The secondary winding's are to be connected to the electrodes which are made up of copper which have less resistance.

The time of electric supply needs to be closely controlled so that the heat released is just enough to make the joint and sub sequence fusion takes place to the force on the joint.The force required can be provided either mechanically,hydraulically or pneumatically.To precisely control the time,sophisticated electronic timers are available.

Spot welding machine consist of two electrodes out of which one is fixed.The other electrode fixed to rocker arm for transmitting the mechanical forces from pneumatic cylinder.This is simplest type of arrangement. The other possibility is that a pneumatic or hydraulic cylinder being connected to the electrode without any rocker arm. a resistance welding consist of sequence of events that takes place.These events are

The squeeze time time required for the electrode to align and clamp the two work piece together under them and provide necessary electric contact. The weld time is the time of the current is flow through work pieces till they are heated to the melting temperature of the work piece to be welded. The hold time is the time when the pressure is maintained on the molten metal without the electric current.during this time these pieces are expected to be forge welded because the application of the pressure. The off time is the time during which,the pressure on the electrode is taken of so that the plates can be positioned for the next spot.

Tension and shear test

The tension and shear test is most widely used method for determining the strength of resistance spot welds.It is made by overlapping suitable sized strips and making a spot weld in the center of the over lapped area.A tensile machine is used to carryout the test.

5.6 Table

Table 5.1: Parameters of spot welding

S.No	Current position	Shear strength(N)	Shear stress(N/mm^2)
1			
2			
3			

5.7 Procedure

1. Two sheets of 150*150*1mm are taken are lap welded by setting in the current knob at the position of 1,2,3,4.
2. The welded joint are tests for shearing in tensile testing machine.
3. The shear stress is calculated by using the formula Shear stress=load/nugget area
4. After calculating the shear stresses at different current values the results are tabulated.

5.8 Precautions

1. The weld time for all the weld to be consistent.
2. Ensure the overlap sheets to be proper.

5.9 Results

given work piece are welded using spot welding

5.10 Review questions

1. What is the principal of resistance welding?
2. What is the thickness of the sheets that can be spot welded?
3. What is meant by nugget?
4. Explain squeeze time,weld time, hold time and off time?
5. Write any applications of spot welding?

Experiment 6

Brazing Process

6.1 Aim

To join two sheets by brazing process.

6.2 Equipment and Material required

Oxy-acetylene torch,Flux,filler rod,GI sheets150*150*1mm(2no.)

6.3 Tools required

1. wire brush
2. hand gloves
3. chipping hammer
4. Spark lighter

6.4 Theory

Brazing is the coalescence of a joint with the help of filler metal whose liquidus temperature is 450 degrees and is below the solidus temperature of the base metal.The filler metal drawn in to the joint by means of capillary action.Brazing is much widely used joining process in various industries because of its many advantages.dissimilar metals such as stain less steel to cast iron can be brazed because of its lower temperature used.Depending upon the type of base metals various type of fillers are available in market. copper based metal are used brazing ferrous metals.aluminum silicon filler metals are used for brazing aluminum.silver brazing makes the use of silver based materials and is used to give high strength.the carbide bits are brazed to tool shank using silver brazed alloy.

6.5 Procedure

1. The surface to be joined to be cleaned properly.

2. Now the sheets to be joined are laid by giving proper clearance.
3. Now flux is applied to the joint
4. Joint to be heated welding torch to heat the filler metal to its liquidus temperature when the filler metal is placed at the joint.
5. The filler metal is flows into the crevice by capillary action and the joint is made.

Figure 6.1: Brazing process

6.6 Precautions

1. As the filler metal fills the joint by capillary action,give only needed clearance.
2. see that the joints to be extremely clean.

6.7 Results

two sheets are joined using brazing process

6.8 Review questions

1. What are the heat sources used for brazing?
2. What are the main advantages of brazing?
3. What are the difference between welding, brazing and soldering?
4. What are the difference between brazing and braze welding?
5. what are the fluxes used in braze welding?
6. What are the different filler materials used in brazing?

Experiment 7

Blanking And Piercing Operation

7.1 Aim

To study the blanking and piercing operations.

7.2 Equipment required

Hydraulic press

7.3 Tools required

Press tool for blanking and piercing.

7.4 Raw materials required

Mild steel strip(25mm width and 1mm thickness)

7.5 Theory

Stamping is the general term used in number of operations,such as punching, Blanking, Piercing, Shearing, Bending, Forming.Stamping die consist of punches usually held in the upper half of the die, and the matching dies which are normally located in the lower half.In punching and blanking process, metal is removed by using die and punch.The shape and size of the portion is removed are determined by the geometry of the die and punch.

Blanking operation

If the final product happens to be the removed portion are the shearing of the closed close contour,when the metal in side the contour is desired part is called blanking.

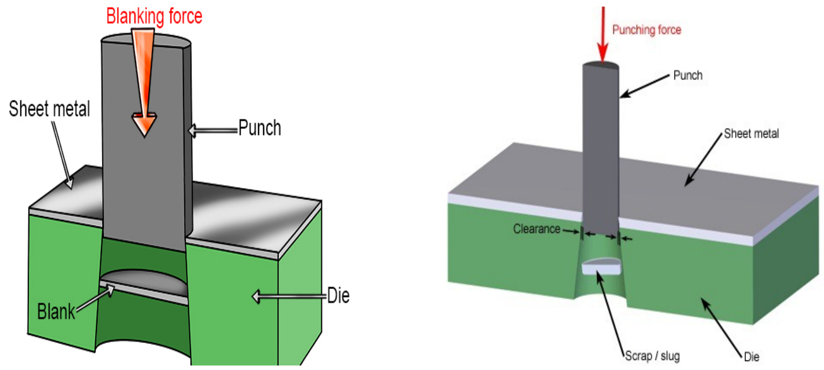


Figure 7.1: Blanking and piercing operations

Piercing

If the pierced sheet metal is final product or if the material inside the contour is discarded, then the operation is known as piercing. Punching and blanking operations are shearing operations where the curved line along with a edges of a punch and die.Both involve the same basic cutting action,the primary difference being one of the definition, in blanking, the piece is being punched out becomes the work piece and any major burrs or undesirable features should be left on the remaining strips.In punching, the punch out is the scrap and the remaining strip is the work piece.punching and blanking are usually done by using the same form of mechanical press.

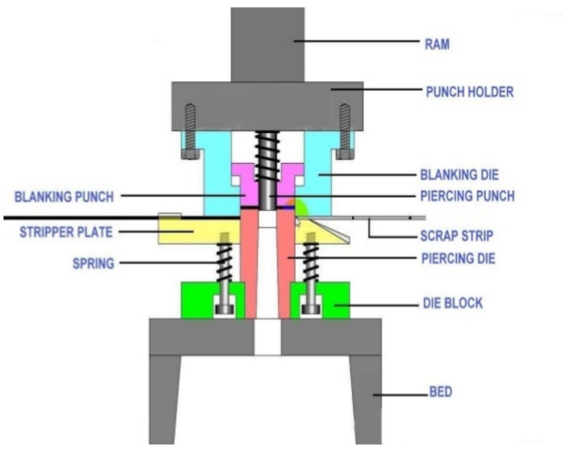


Figure 7.2: Compound die

Role of clearance

The die opening must be sufficiently larger than the punch to permit a clean fracture of metal.The difference in dimensions between the mating members of a die set is called clearance. When the hole has to be held to size i.e. the hole in a sheet metal is to be accurate (punching operation) and slug is to be discarded,the punch is made of hole and the die opening size is obtained by adding the Clearance to the punch size. In blanking operation, when the slug or blank is the desired parts and has to be held the size,the die opening size equals to the blank size and punch size is obtained by subtracting the clearance from the die opening size.In other words punch controls the hole size and die openings controls the blank size.

7.6 Procedure

1. Select correctly the blanking die set.
2. clamp die plate firmly on press machine table.
3. Clamp punch plate with shank.
4. Check the alignment of punch and die hole so that axis of both mu7st be in one line.
5. Feed MS Strip in die portion and apply pressure for performing operation.
6. Release the pressure after completing the stroke.
7. Remove the MS strip and collect the blank as desired part.
8. Unclamp the die set from machine.
9. Select correctly punching die set.
10. Clamp the die plate firmly on the press machine table. Clamp punch plate with shank.
11. Check the alignment of punch and die hole so that the axis of both must be in one line.
12. Feed the Ms strip in die portion and apply pressure for performing operation.
13. Release the pressure after completion of job.
14. Remove the MS strip and collect the blank as desired part.
15. Unclamp the die set from the machine.

7.7 Precautions

1. Check the clamping of punching plate and die set before starting operation.
2. Don't keep the hand or finger on the die set
3. Handle the blank strip carefully which are having burr on sides.
4. If the die is not clamped ,don't apply pressure and don't start machine.

7.8 Results

the piercing and blanking operation is completed for the given dimensions

7.9 Review questions

1. What is stamping?
2. What is blanking operation?Explain with suitable example.
3. What is piercing operation?Explain with suitable example.
4. What is the difference between blanking and piercing operations?
5. Why Clearance is important in press tools between punch and die?
6. Which are the important parameter to consider for selecting clearance in blanking and punching?

Experiment 8

Deep Drawng Operation

8.1 Aim

To Determine the Blank Size, Drawing Force and Blank Holding Force in deep drawing operation

8.2 Material Required

Aluminium sheet of required size

8.3 Equipment And Tools Required

1. Hydraulic Press
2. Deep drawing tool setup

8.4 Theory

Deep Drawing operation is the process of forming a flat piece of material into a hollow shape by means of a punch which causes the blank to flow into the die cavity. The depth of draw may be shallow, moderate or deep. If the depth of the formed cup is up to half of its diameter, the process is called Shallow drawing. If the depth of the formed cup exceeds the diameter it is termed as "Deep drawing". Parts of various geometries and sizes are made by drawing operation, two extreme examples being bottle caps and automobile panels.

As the drawing progress i.e. as the punch forces the blank into die cavity, the blank diameter decreases and causes the blank to become thicker at its outer portions. This is due to the circumferential compressive stress to which the material element in the outer portions is subjected. If this stress becomes excessive the outer portions of the blank will have the tendency to buckle or wrinkle. To avoid this, a pressure pad or blank holder is provided. The holding down of pressure is obtained by means of springs, rubber pad, compressed air cylinder or the auxiliary ram on a double action press. The portion of the blank between the die wall and punch is subjected to nearly purely tension and tends to stretch and becomes thinner. The portion of the formed cup which wraps around the punch radius is under tension in the presence of bending. This part becomes the thinnest portion of the cup. This action is termed as 'necking' and in the presence of unsatisfactory drawing operation, is usually the first place to fracture. The outer portions of the blank under the blank holder become thicker during the operation. When these portions are drawn into the die cavity, 'ironing' of this section will occur if the clearance between the punch die is not enough to accommodate this increased thickness of the work piece. This ironing is useful if uniform thickness of the product is desired after the drawing operation.

DEEP DRAWBILITY

Deep drawability or drawing ratio of the metal is defined as the ratio of the max blank diameter to diameter of the cup drawn from the blank, i.e. D/d. For a given material there is a limiting drawing ratio (LDR), after which the punch will pierce a hole in the blank instead of drawing the blank.

This ratio depends upon many factors, such as material, amount of friction present etc. The usual range of the max drawing ratio is 1.6 to 2.3.

A simple push through drawing die is shown. The drawing punch should be properly vented with drilled passengers. Venting serves double purpose it eliminates suction which would hot the cup on the punch and damage the cup when it is stripped from the punch. Secondly, venting provides passages for lubricants. Many presses are used for the deep drawing operations are hydraulically operated and these presses have an additional hydraulic cylinder and piston for the additional slide. Product applications of deep drawing process are: cups, shells, automotive bodies, gas tanks, house hold hard ware etc.

REDRAWING

In deep drawing the percentage reduction in one draw is defined as:
% reduction = [D-d)/D] X 100
Now D/d =1.6 to 2.3, d/D=0.435 to 0.625 = 0.5 (average)
The average reduction in deep drawing= [1-d/D] X 100 = 50%
To make tall cups of smaller diameter it is necessary to use successive drawing operations. Reducing the drawn cup to the smaller diameter and increased height is known as "redrawing".

Blank Size

One of the first jobs of the draw die designer is to find the size of the blank to be used for making a given cup. It is often difficult to find a blank of exact size required for making a given shell, because of thinning and thickening of sheet during drawing. The calculation should be based on volume, surface area or by layout. The following gives the useful relations in calculating the blank diameter for cylindrical shells for relatively thin materials.

$$
\begin{aligned}
D &= \sqrt{d^2 + 4dh} && When \quad d \geq 20r \\
D &= \sqrt{d^2 + 4dh - 0.5r} && When \quad 15r \leq d \leq 20r \\
D &= \sqrt{d^2 + 4dh - r} && When \quad 10r \leq d \leq 15r \\
D &= \sqrt{(d-2r)^2 + 4d(h-r) + 2\pi r(d-0.7r)} && When \quad d < 10r
\end{aligned} \tag{8.1}
$$

Where r = corner radius on the punch, mm
h = height of the shell, mm
d = outer diameter of the shell, mm
D = blank diameter, mm

Drawing Force

The drawing force depends on the cup material, its dimensions and the configuration. The drawing force can empirically be calculated using the following equation for cylindrical shells.

$$P = \pi dts[\frac{D}{d} - c] \tag{8.2}$$

Where P = drawing force, N
t = thickness of the blank material, mm
s = yield strength of the metal, Mpa
C = constant to cover friction and bending. Its value is between 0.6 and 0.7

Blank Holding Force

The blank holding pressure required depends on the wrinkling tendency of the cup, which is difficult to determine and hence it is obtained more by trail and error. The maximum limit is generally one-third of the drawing force.

OBSERVATIONS AND CALCULATIONS

Using above relations calculate,

1. r = corner radius on the punch =. . . . . mm
   h = height of the shell = ... mm
   d = outer diameter of the shell = ... mm
   d/r =
   then D = blank diameter = ...mm
2. Drawing Force = ... N
3. Blank Holding Force = ...N

8.5 PROCEDURE

1. Fix the punch to the ram of the press.
2. Fix the die on the bed of the machine using clamps, bolts and nuts. Calculate the required blank size and place the same between the punch and die block.
3. Apply the hydraulic pressure on the punch through ram so that the punch slowly descends on the blank and forces it take the cup shape formed by the end of the punch, by the it reaches the bottom of the die.
4. When the cup reaches the counter bored portion of the die, the top edge of the cup formed around the punch expands slightly due to spring back.
5. Observe the reading of the pressure gauge which directly gives the force required to perform the operation.
6. Calculate the drawing force required, to perform the operation using above relations.
7. Compare the two readings
8. Then move the punch in the return direction so that the cup will be stripped by counter bored portion.

8.6 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.

8.7 Results

the piercing and blanking operation is completed

8.8 Review Questions

1. what is brazing?
2. what type of flame is used for brazing?
3. what is difference between brazing and welding?
4. difference between brazing and soldering?

Experiment 9

EXTRUSION OPERATION

9.1 AIM

To perform extrusion operation and find extrusion force

9.2 MATERIAL REQUIRED

Aluminium billet of required size

9.3 EQUIPMENT AND TOOLS REQUIRED

1. Hydraulic Press
2. Extrusion tool setup

9.4 THEORY

Extrusion is a plastic deformation process in which a block of metal (billet) is forced to flow by compression through the die opening of a smaller cross-sectional area than that of the original billet as shown in Fig. 1. Extrusion is an indirect-compression process. Indirect-compressive forces are developed by the reaction of the workpiece (billet) with the container and die; these forces reach high values. The reaction of the billet with the container and die results in high compressive stresses that are effective in reducing the cracking of the billet material during primary breakdown from the billet. Different types of components produced by extrusion are shown below.

Extrusion is the best method for breaking down the cast structure of the billet because the billet is subjected to compressive forces only. The two basic types of extrusion are direct and indirect, which are commonly used in aluminum industries for solid and hollow shapes used in wide range of applications.

9.5 Mechanics of Extrusion

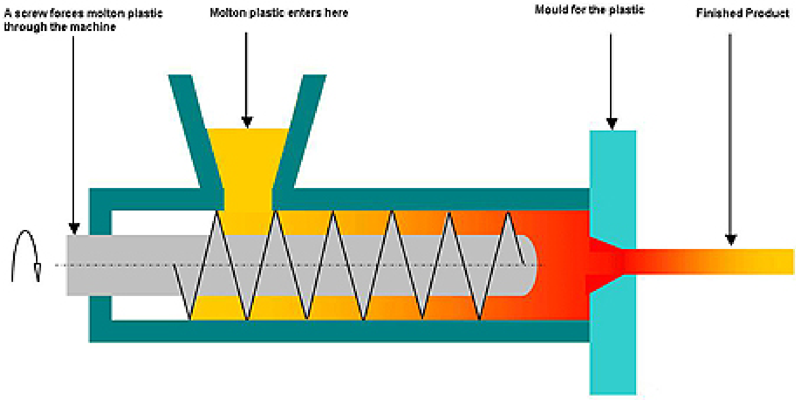


Figure 9.1: Principal of extrusion

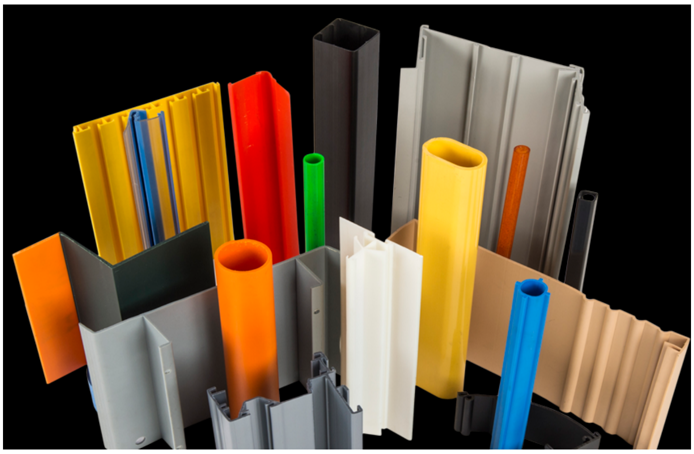


Figure 9.2: Different parts produced in extrusion process

Plastic Deformation and Metal Flow

In metal forming, plasticity theory is applied to investigate the mechanics of plastic deformation. The investigation allows the analysis and prediction of the following:

- Metal flow, including velocities, strain rates, and strain
- Temperature and heat transfer
- Variation of local material strength or flow stress of material
- Stresses, forming load, pressure, and energy

The mechanics of plastic deformation provide the means for determining how the metal flows in different forming operations, the means of obtaining desired geometry through plastic deformation, and the means for determining the expected mechanical and physical properties of the metal produced. Metal flow during extrusion depends on many factors, such as the following:

- Billet material property at billet temperature
- Billet-container interface and metal-die interface friction
- Extrusion ratio

Factors affecting properties of extruded shapes

The properties of the extruded aluminum shapes are affected greatly by the way in which the metal flows during extrusion. The metal flow is influenced by many factors:

- Type of extrusion, direct or indirect
- Press capacity and size and shape of container
- Frictional effects at the die or both container and die
- Type, layout, and design of die
- The length of billet and type of alloy
- The temperature of the billet and container
- The extrusion ratio
- Die and tooling temperature
- Speed of extrusion

9.6 PROCEDURE

1. fill the hopper with HDPE plastic pellets
2. turn on the heater of the moulding machine
3. leave the machine undisturbed for 20 min
4. place the mould at the nozzle

5. turn the lever of the hand moulding machine in CCW direction & apply pressure
6. the molten plastic passes through the die of the required shape attached to the nozzle of moulding machine
7. required shape is obtained

9.7 PRECAUTIONS

1. allow sufficient time for the material to harden before extrude the component
2. ensure injection pressure between 30 kg/cm

9.8 RESULT

The required object is obtained by extrusion molding process

9.9 REVIEW QUESTION

1. what are the advantages of hydraulic press?
2. what is the difference between compound die and progressive die?
3. define Deep-drawing operation?
4. give the classification of presses?

Experiment 10

INJECTION MOLDING

10.1 Aim

To study the plastic processing with injection moulding method.

10.2 Equipment required

]Injection moulding machine with compressor attachment.

10.3 Tools required

Die set

10.4 Material required

Plastic granules

10.5 Theory

Injection moulding is the process used for forming thermoplastic materials.The basic process involves six major steps in the moulding cycle.

1. The hopper is loaded granules of plastic materials.
2. Heat is applied to the plastic until it becomes soft to flow
3. The softened plastic is forced through the nozzle into the mould cavity.
4. When cool the halves of mould are separated.
5. The part is ejected from the mould.
6. Gates connecting the product to the runner system are removed.

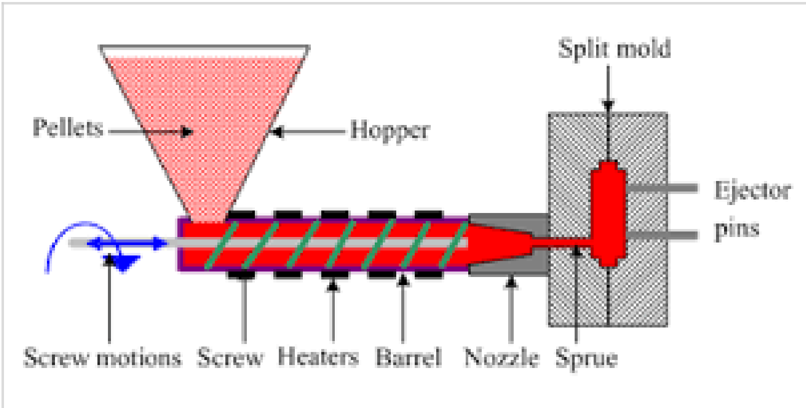


Figure 10.1: Principle of injection molding

Figure 10.2: Parts produced in injection molding

For injection moulding two most important units are required along with raw material.One is injection moulding machine and the other is injection moulding tool. commonly named as mould.Injection moulding machines are made in many sizes.these are rated according to size by the amount of material, which can be injected in one cycle.The re two basic units to an injection moulding machine,One for injecting the heated plastic and one for opening and closing the mould.The first unit includes a feeding hopper,heated injection cylinder and an injection plunger or screw system.The second unit comprises a hydraulic operated moving pattern and a stationary plate on which the halves of mould are mounted. Injection moulding machine are available in horizontal or vertical models.

Injection moulds

Moulds are used in injection moulding consist of two halves, one is stationary and another is movable.The stationary half is directly connected to the stationary pattern directly and is in direct contact with the nozzle of the mould is secured to the movable half of the mould and usually contains the ejector mechanism.There are many possible mould designs ,includes multiple piece mould for complicated parts.

10.6 procedure

1. Turn on switches of heater
2. Pour the raw material in hopper of machine pour and fill it.
3. Adjust the temperature of heater around 320 to 350 degree.
4. Clamp injection moulding tool at correct position so that the axis of sprue hole and barrel hole is in one line.
5. open mould halves and start pump
6. Adjust the pressure and by lever manually apply pressure to inject molten plastic.

10.7 Precautions

1. Don't touch the barrel when it is heated.
2. Clamp the mould perfectly before applying the blow.

10.8 Results

required product is made using injection moulding process

10.9 Review questions

1. What is injection moulding process?
2. For which components injection-moulding process is used?
3. Which parameters considered /fixed before starting injection moulding process?

4. What is the function of ejection system?
5. Describe the six major steps in the injection moulding cycle?
6. What is the effect of melt temperature on part quality?
7. what is the effect of injection pressure on part quality?
8. How the injection moulding machine is rated?
9. Explain injection moulding cycle.
10. What is injection mould describe its components?

Experiment 11

BLOW MOLDING

11.1 Aim

To study the plastic processing with blow moulding method.

11.2 Machine required

Blow moulding machine with compressor attachment.

11.3 Tools required

Die set.

11.4 Material required.

Plastic granules.

11.5 Theory

Blow moulding is a process used to produce thin wall hollow thermoplastic parts.A cylinder are the tube of plastic , called PARISON is placed between the jaws of the mould. The mould is closed to pinch of ends of the heated plastic and compressed air pressure is used to force the material against the mould faces.When the mould becomes cool the plastic becomes rigid.Fig describes blow moulding process in detail.

1. Molten hollow tube is placed between the two halves.
2. Mould close around the parison C.
3. Parison, still molten, is pinched off and inflated by air blast which forces walls against inside contours of cold mould.
4. When the piece has cold enough to become solid , the mould is opened and the product is ejected.

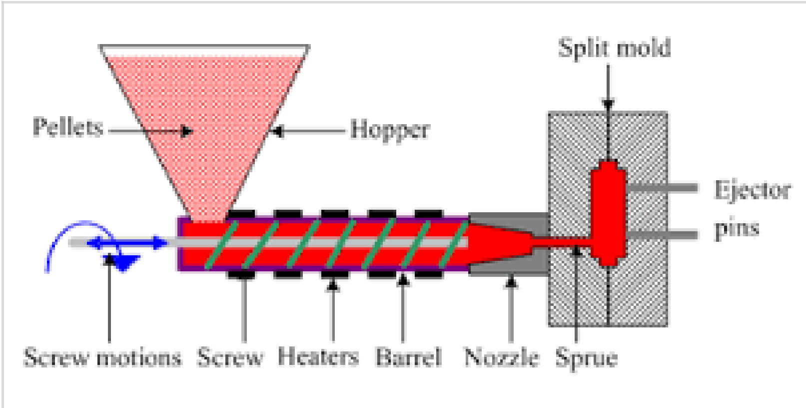


Figure 11.1: Principle of blow molding

Three main phases of the commercial processes are

1. Softening the resin by the use of heat.
2. Forming the parison.
3. Blowing the patrison in the mould.

Figure 11.2: Parts produced in blow molding

11.6 Procedure

1. Turn on the switches of heater.
2. Pour the raw material in to the hopper.
3. Adjust the temperature of heater around 320 to 350 degree

4. Clamp blow moulding tool at correct position so that the axis of sprue hole and barrel hole is in one line.
5. Open mould haves and start pump.
6. Adjust the pressure and by lever manually apply air pressure to inject molten plastic to get parison.
7. Once the parison is formed,immediately close the mould and apply air pressure and wait 20 to 30 sec for cooling.

11.7 Precautions

1. Don't touch the barrel of machine when it is heated
2. Don't touch the parison before closing the tool.
3. Clamp the mould perfectly before applying the blow.

11.8 Results

required product is made using blow moulding process

11.9 Review questions

1. What is blow moulding process?
2. For which component blow moulding process is used?
3. Which parameters considered/fixed before starting blow moulding processes?
4. What is a PARISON?
5. What are the defects that may occur during blow moulding process?

Part I

EXPERIMENTS BEYOND THE SYLLABUS

Experiment 1

GAS WELDING

1.1 Aim

To make the butt joint by using gas welding equipment

1.2 Equipment required

Oxy-acetylene gas welding outfit

1.3 Tools required

1. Wire brush
2. Hand gloves
3. Chipping hammer
4. Spark lighter

1.4 Material required

MS Sheets150*50*1mm(2no.)

1.5 Theory

Gas welding devices the heat from the combustion's of fuel gas such as acetylene in combination with oxygen. The process is fusion welding process where in the joint is completely melted to obtain the fusion.The heat produced by the combination of the gas is sufficient to melt any metal and as such is universally applicable. The fuel gas is generally use is acetylene because of the high temperature is generated in the flame.This process is called acetylene welding.The oxygen requirement is different for various fuel gases for complete combustion. In all the oxy fuel gas welding processes The combustion takes place in two stages. For the oxy-acetylene welding, the following reactions takes place in this zone.

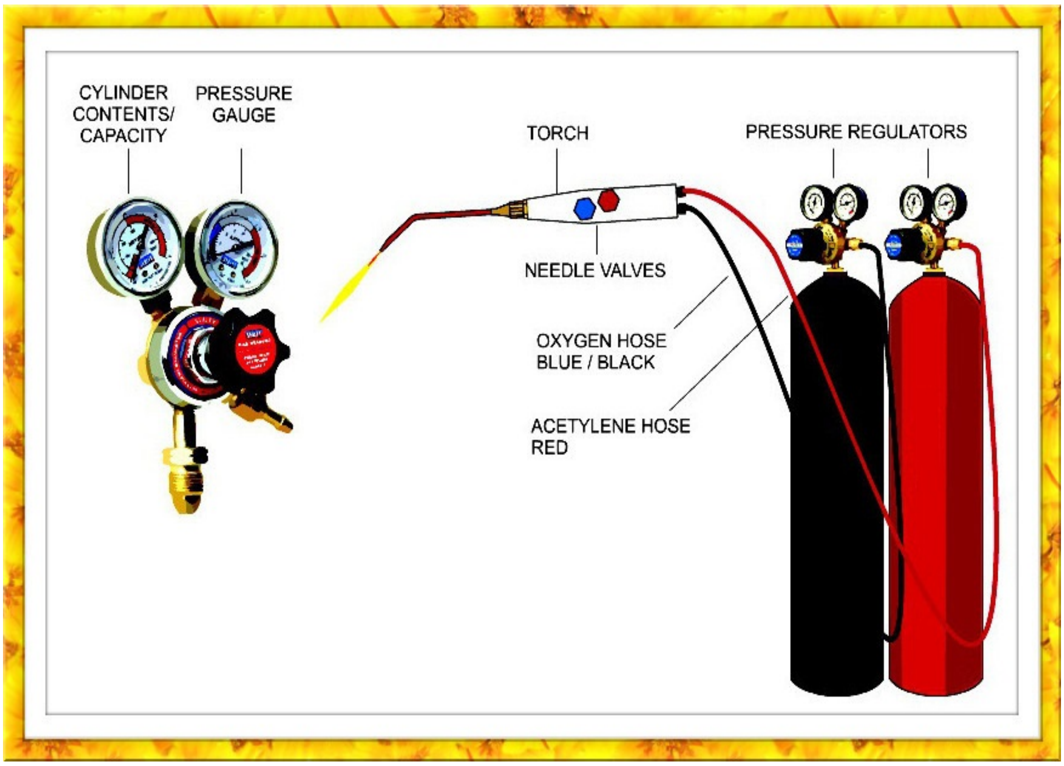


Figure 1.1: Gas welding setup

$$C_2H_2 + 2O_2 \rightarrow 2CO + H_2 + 448Kj/molofacetylene \tag{1.1}$$

the carbon monoxide(CO) and hydrogen produced in the first stage further combine with the atmospheric oxygen and give rise to the outer bluish flame,with the following reaction.

$$4CO + 2H_2 3O_2 \rightarrow 4CO_2 + 2H_2O + 812kj/mol(35.77MJ/m^3) \tag{1.2}$$

Different types of oxyacetylene flame

A certain amount of oxygen is for complete combustion of fuel gasses. when the oxygen supply varies,The flame appearance is also varies.Fig(a) shows the ideal condition i.e The complete combustion,called neutral flame. In neutral flame all acetylene is burned and thus the available heat in the acetylene is released.Thus ,this is the most desirable flame to be used in oxyacetylene welding. However, it is also provide more or less oxygen then that theoretically required for complete combustion.When less oxygen is provided part of the combustible matter is left as it is and it results in a reducing or carburizing flame as shown in figure .

This flame is similar to the neutral flame only with the addition of the third phase in between the outer blue flame and the inner white cone as shown in figure. It is called intermediate flame feather.It is reddish in colour The length of the flame feather is the indication of excess acetylene present.since the unburnt carbon is present,goes in to the weld metal pool, the metal appears to boil.This excess carbon causes the steel to become extremely hard brittle.

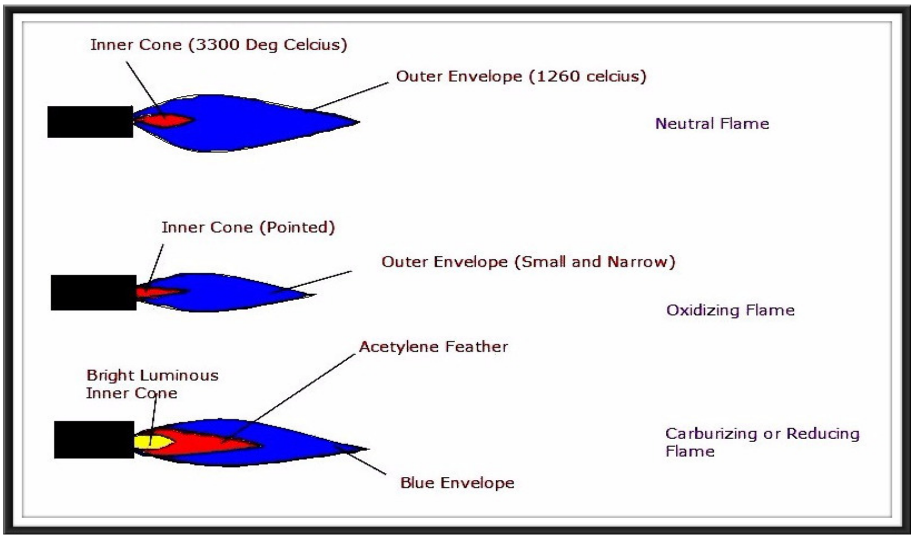


Figure 1.2: Types of flames in gas welding

When oxygen is excess, it is called oxidizing flame whose appearance is shown in figure. The flame is similar to the neutral flame with the exception that the inner white cone is some what small,giving rise to high tip temperatures .There is an excess amount of heat is present in the flame which badly oxidizes the weld metal.This flame is useful in nonferrous alloys such as copper base alloys zinc base alloys.The presence of oxygen in the oxidizing flame causes an oxidized film to form quickly which provides a protective cover over the base metal pool.

1.6 Procedure

1. Acetylene valve on the torch is opened slightly and lightened with the help of spark lighter.
2. Now acetylene valve is opened to get the required flow of acetylene.
3. Oxygen valve is opened till the intermediate flame feather reduces into inner cone to get a neutral flame.
4. The torch tip to be positioned above the plates so that the white cone is at the distance of 1.5mm to 3mm.
5. Torch to be held at an angle of 30degrees to 45degrees to the horizontal plane.
6. Now filler rod is to be held at a distance of 10mm from the flame and 1.5 to 3mm from the surface of the weld pool.
7. As back ward welding allows better penetration,backward welding is to be used for welding.
8. After completion of welding slag is to be removed by means of chipping hammer and wire brush.

1.7 Precautions

1. The use of safety equipment such as goggles with shaded with lenses, Face shields, glows and protective clothing, is essential.
2. Proper connection of hoses to the cylinders Is also an important factor in safety.
3. Oxygen and acetylene has different threads, so that the hoses cannot be connected to the wrong cylinders.
4. Gas cylinders should be anchored securely and should not be dropped or mishandled.

1.8 Results

given work piece are welded using gas welding

1.9 Review questions

1. What are the different types of flames used in gas welding?
2. What are the approximate ratio of oxygen and acetylene in oxidizing flame?
3. What is the principal advantage of gas welding set up?
4. What is the approximate ratio of Oxygen and acetylene in carburizing flame?
5. What is the differences between backward, Forward welding?
6. What is the approximate temperature of inner cone in oxidizing flame?

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