



Balaji Institute of Technology & Science

Estd.: 2001

Laknepally, NARSAMPET, Warangal – 506331

Accredited By NAAC & ISO 9001:2015 Certified Institution

(Affiliated to JNTUH, Hyderabad and Approved by the AICTE, New Delhi)

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LAB MANUAL
PRODUCTION TECHNOLOGY LAB MANUAL
II Year B.Tech



DEPARTMENT OF MECHANICAL ENGINEERING

INSTITUTE VISION

To be a centre for excellence in preparing the graduates professionally committed, intellectually adept and ethically balanced with high standards by imparting quality education with international standards to excel in their career to meet the challenges of the modern world and adapt to the technologically changing environment.

INSTITUTE MISSION

M1: To strive hard to produce technically trained human resources to serve the present and future global needs by providing quality education.

M2: To provide value based training in technological advancements and employment opportunities to students by strengthening institute's interaction with industries.

M3: To disseminate knowledge of need based technical education, innovative learning and research & development.

DEPARTMENT VISION

To excel in preparing mechanical engineering graduates with core knowledge, advanced skills and professional ethics in order to meet the ever changing industrial demands and social needs.

DEPARTMENT MISSION

M1: To provide the students with the best of knowledge by imparting quality education in the area of Mechanical Engineering and allied fields.

M2: To facilitate the students by providing the interaction with Mechanical Engineering related companies to be part of technological advancements which enhances employment opportunities.

M3: To inculcate self learning abilities, leadership qualities and professional ethics among the students to serve the society.

PROGRAM EDUCATIONAL OBJECTIVES

- PEO1:** To make the graduates who are equipped with technical knowledge and engineering skills through the program to achieve a successful career in the field of mechanical engineering.
- PEO2:** To participate in ongoing developments of mechanical engineering to be strong with the fundamentals and relate it with the present trends.
- PEO3:** To gain the practical knowledge through the program by identifying, formulating and solving mechanical engineering related problems.

PROGRAM OUTCOMES

1. **PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering Fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of Mathematics, natural sciences, and engineering sciences
3. **PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **PO11: Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
12. **PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to Engage in independent and life-long learning in the broadest context of technological Change.

PROGRAM SPECIFIC OUTCOMES

PSO1: Identify and analyze the real time engineering problems in Manufacturing, Design and Thermal domains.

PSO2: Execute the work professionally as an employee in industries by applying manufacturing and management practices.

PSO3: Gain the knowledge of latest advancements in Mechanical Engineering using Computer Aided Design and Manufacturing.

COURSE OUTCOMES

After completion of the course students will be able to

C217.1	Extend the properties of molding sands and pattern making.
C217.2	Fabricate joints using gas welding and arc welding.
C217.3	Evaluate the quality of welded joints.
C217.4	Basic idea of press working tools and performs moulding studies on plastics.
C217.5	Know how casting, drilling, spinning, forging, grinding are done and demonstrate primary working skills on lathe machines.

CONTENTS

SI. No.	NAME OF THE EXPERIMENT
1	PATTERN DESIGN AND MAKING –FOR ONE CASTING DRAWING.
2	SAND PROPERTIES TESTING EXERCISE FOR STRENGTHS AND PERMEABILITY.
3	MOULDING MELTING AND CASTING.
4	ARC WELDING LAP & BUTT JOINT.
5	SPOT WELDING
6	TIG WELDING
7	PLASMA WELDING AND BRAZING (WATER PLASMA DEVICE).
8	BLANKING AND PIERCING OPERATION AND STUDY OF SIMPLE, COMPOUND AND PROGRESSIVE PRESS TOOL.
9	HYDRAULIC PRESS: DEEP DRAWING AND EXTRUSION OPERATION.
10	BENDING AND OTHER OPERATIONS.
11	INJECTION MOULDING.
12	BLOW MOULDING.

PATTERN MAKING

Aim:

To make a pattern of given dimensions from the given wooden reaper.

Tools Required:

1. Steel rule
2. Jack plane
3. Try square
4. Marking gauge
5. Firmer chisel
6. Marking knife or scriber
6. Hand saw
7. Mallet.

Sequence of Operation:

1. Planning
2. Sizing
3. Cutting
4. Marking
5. Chiseling
6. Finishing & Joint fixing.

Procedure:

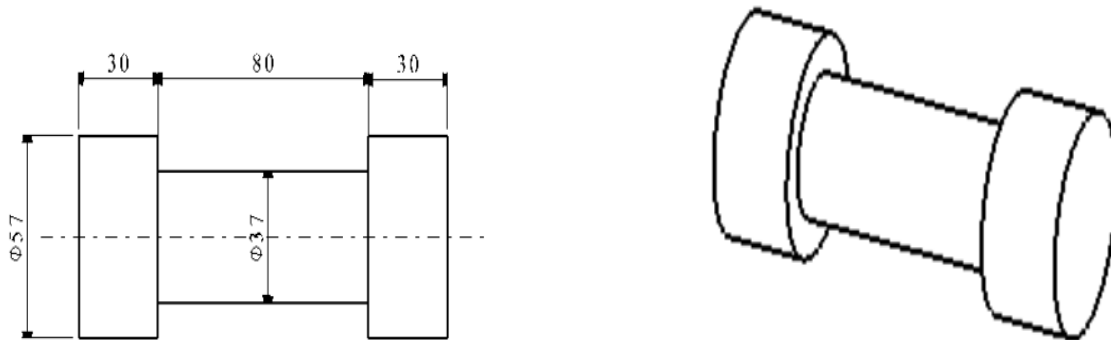
1. The given reaper is checked for dimensions & one side is planed with jack plane & checked for straightness with try square.
2. The adjacent side is also planed & the two surfaces are checked for straightness with try square.
3. The required size of the thickness & width are marked with marking gauge.
4. The excess material is chiseled with firmer chiseled & then planed to correct size.
5. Now the dimensions of the joint are marked & waste pieces are chiseled with firmer chiseled.
6. Excess length on the ends is cut with chisel.

Precautions:

1. While using the chisels take care that cutting is performed in the direction away from your body.
2. The tools should always be kept well sharpened since a blunt or dull tool slip & may cause injury.
3. Take care while measuring, marking & cutting.

Result:

Pattern has been produced according to the given dimensions



Different Patterns

PRACTICE OF MAKING SAND SAMPLES USING SAND RAMMER

Aim:

Sand Rammer is used for preparing standard specimen under standard conditions

Equipment Requirements:

Hand reamer, Specimen Cylinder 100mm Height of a Dia 50mm, Specimen Remover, Flat and Stepped Discs

Composition of Sand Preparation:

Green Sand	79-80%
Water	3-6%
Additives	10-15%
Clay	6-15%

Theory:

The sand rammer is a machine for preparing specimens for testing of the permeability and strength of moulding sand and is comprised mainly of a base, ram, tamping bar and lever. The machine is so constructed that the ram is brought up by the crank and is then caused to drop to strike and drive down the tamping bar at the lower end of which is fixed tamping plate which slides into a sand tube to press the sand tube into a certain size with certain energy.

Operating Instructions:

1. Place the machine on non- vibrating platform.
2. Take the height such that the reading marks of the top bracket should be in eye level.
3. Place the Specimen Tube in the Pedestal Cup.
4. Fill approx. 135-160 grams Sand Sample in the Specimen Tube.
5. Lift the left cam upward;
6. Place the Specimen Tube with Pedestal Cup on the base.
7. Take Ramming head downward with left cam.
8. Ram the sample three times with the help of right cam.
9. See that the top of plunger rod matches the zero of the scale
10. It should match within + 1 mm
11. Lift the left cam upw
12. Take the specimen tube.
12. Place it on stripping post.
13. Pull the tube downward for removing the specimen.

Precaution:

1. Keep the instrument clean
2. Apply rust preventive oil to Moving Parts, Specimen Tube, and Pedestal Cup.

3. Do Not Ram Right Handle Without Specimen
4. Lubricate All Moving Parts At Least Once In The Week.

Assembly:

Place the Ramming Cam & Lifting Cam As shown Position at 1 & 2.

Calculation:

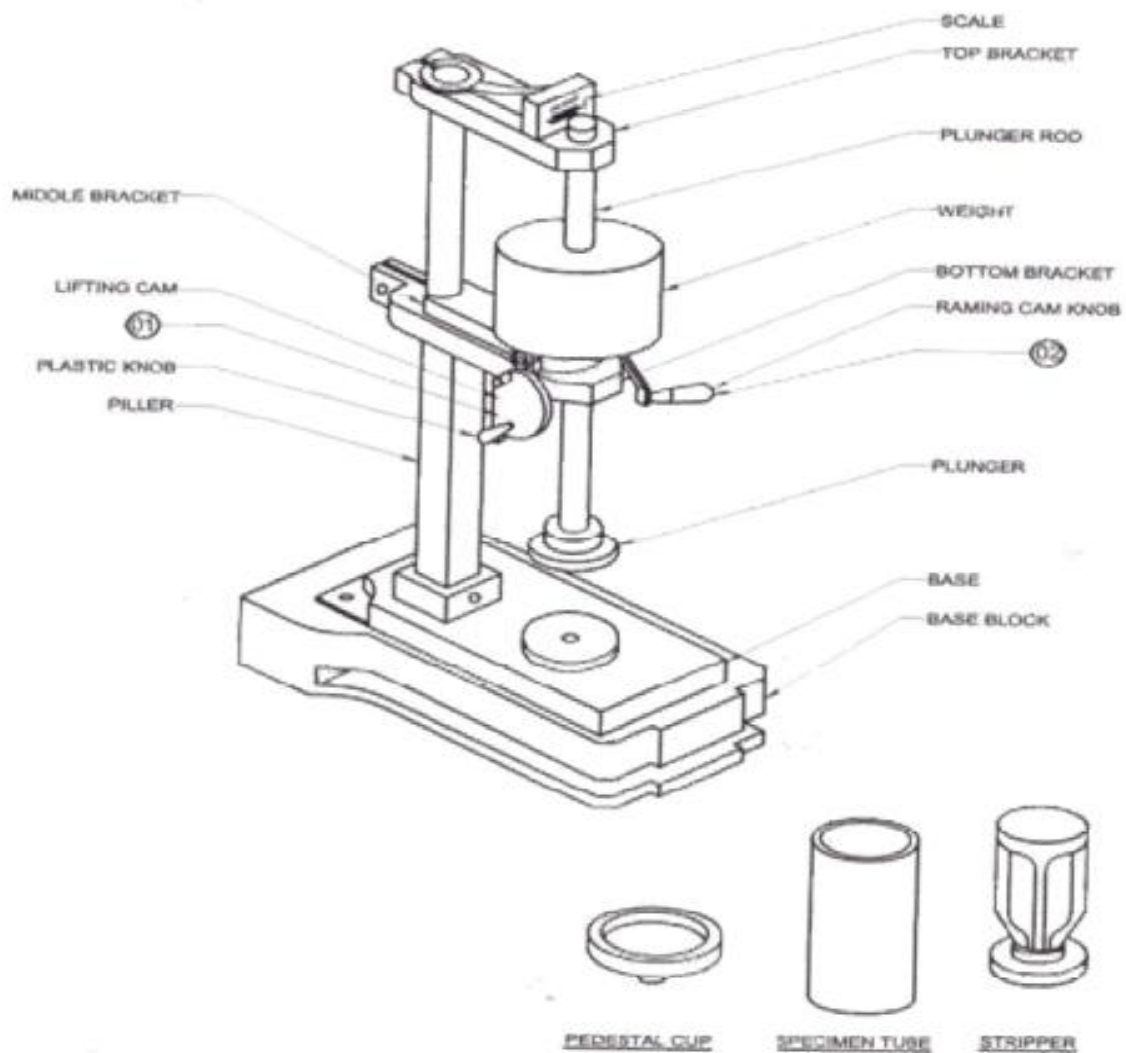


Figure: SAND RAMMER



Sand rammer & Sand testing machine

UNIVERSAL STRENGTH MACHINE

Aim:

This instrument is used for determining the various strengths of prepared specimen.

Equipment Requirements:

Hand reamer, Specimen Cylinder 100mm Height of a Dia 50mm, Specimen Remover, Universal Testing Machine, Flat and Stepped Discs

Machine Contains:

1. Hydraulic Unit With Loading Assembly, Quick Release Coupling.
2. Pressure Gauges (Low & High)
Low gauge — Range:-0- 1600 Gms/cm²
High gauge — Range: - 0- 13kg/cm²
3. Compression Pads
4. Oil Filling Funnel

Composition Of Sand Preparation:

Green Sand	79-80%
Water	3-6%
Additives	10-15%
Clay	6-15%

Operating Instruction:

1. Take the instrument on plane platform.
2. Place the oil-filling funnel in quick release coupling.
3. Pour the oil in funnel; rotate the wheel clockwise & anticlockwise.
4. Repeat the procedure until the air bubbles do not appear in oil.
5. Then remove the oil-filling funnel and place the Low pressure gauge.
6. Place the compression pads in its location.
7. Put the cylindrical specimen in between two compression pads.
8. Rotate the wheel clockwise.
9. Loading piston applying the load on cylindrical specimen. See at the pressure gauge.
10. Pointer of the pressure gauge moves with reference pointer (Red pointer). When the specimen breaks, the Pointer of the pressure gauge will come back to its home position and reference pointer indicates compression strength of specimen.

Precaution:

1. Keep instrument clean
2. Do not cross maximum range of pressure gauges.

3. Use only hydraulic oil no. 150 – 220

Results:

Calculation:

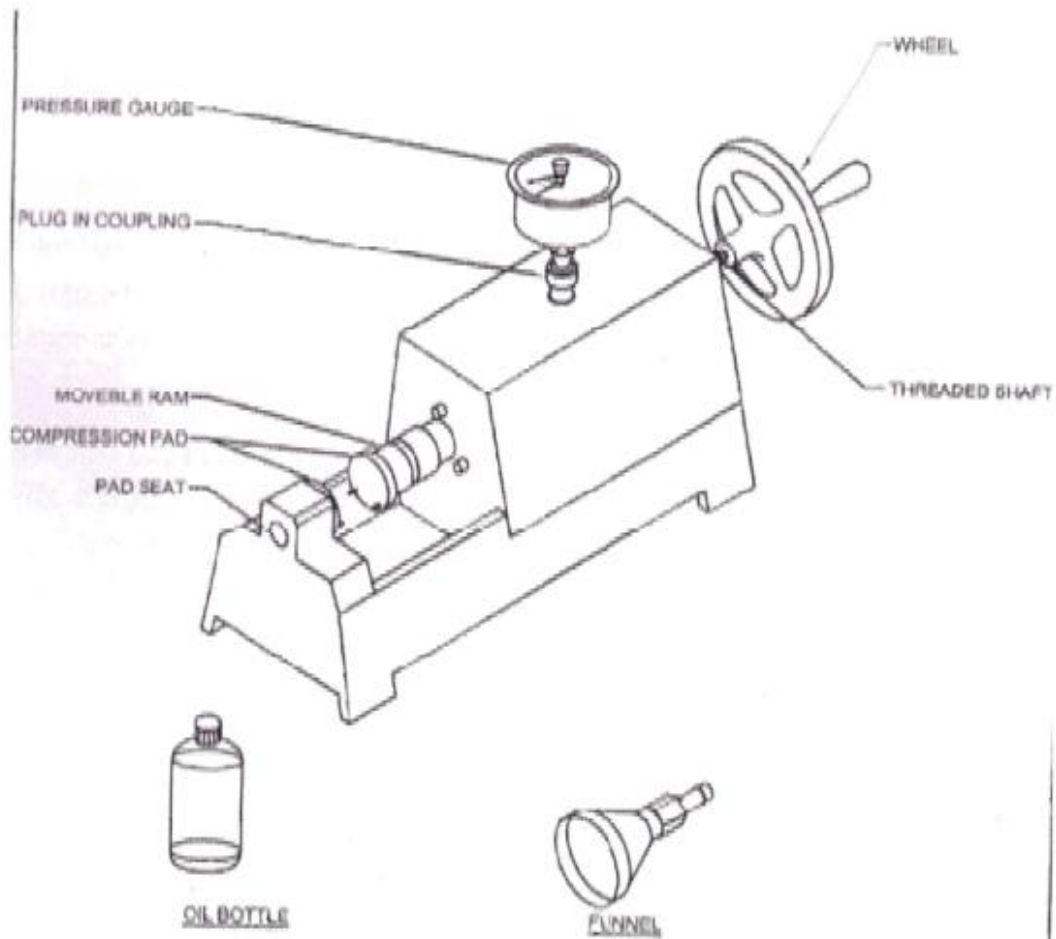


Figure: UNIVERSAL STRENGTH MACHINE



PERMEABILITY METER

Aim:

To determine permeability number of green sand, core sand and raw sand.

Equipment Requirements:

Hand reamer, Specimen Cylinder 100mm Height of a Dia 50mm, Specimen Remover, Permeability Tester, Flat and Stepped Discs

Machine Contains:

1. Water tank
2. Air tank
3. Manometer
4. Standard chart
5. Rubber boss
6. O-P-D valve
7. Orifices

Composition of Sand Preparation:

Green Sand	79-80%
Water	3-6%
Additives	10-15%
Clay	6-15%

Theory:

Permeability is that property which allows gas and moisture to pass through the moldings and . 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 cm² under a pressure difference of 1 cm. water gauge is called Permeability Number.

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 $P = (v \times h) / (p \times a \times t)$

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 body of the Permeability Meter is an aluminum casting of a water tank and base. Inside water tank floats a balanced air drum carefully weighed and designed to maintain constant pressure of 10cm during its fall. The outlet from the air drum is connected to a centre post in the base via three way air valve. The centre post incorporates a pipe for measuring pressure, which is connected to the water manometer and an expandable “O” ring for sealing the specimen tube. It also accommodates the orifices

Operating Instructions:

1. Place the instrument on leveled platform.
2. Take 'O-P-D' valve knob at 'D' position.
3. Close the opening of the air tube inside water tank by thumb and pour water up to the W' mark.
4. Insert air tank into water tank carefully.
5. A screw is provided at the left side of the manometer to fill the water in manometer. Unscrewing the knob operates this screw and water is filled in the manometer.
6. The water level should coincide with the zero of the manometer scale the screw is closed by tightening.
7. Final zero level is adjusted by opening 'zero adjusts screw' provided in front of manometer
8. Selection of orifice it is recommended to use small orifice for permeability below 50Nos. and large orifice for permeability above 50Nos.
9. Tighten the orifice by fingers only. Take the specimen tube with rammed specimen and place it inverted over the rubber boss.
10. Put the valve on 'P' position. Read the height of the water column in the manometer tube. Find out corresponding permeability number from the chart provided with the instrument.
11. Put the valve on 'O' position. Whenever the air tank is flush with water tank, keep the valve on 'D' position and slowly lift the air tank to the top position.
12. Lift the air tank drum slowly up keeping the valve in 'D' position

Precautions:

1. Keep the instrument dust proof.
2. Keep the instrument clean.
3. Lift the air drum only in 'D' Position to avoid any water entering the air passage
4. For removal of the water tank completely from manometer
5. Use zero adjustment knob valves.

Results:

Calculation:

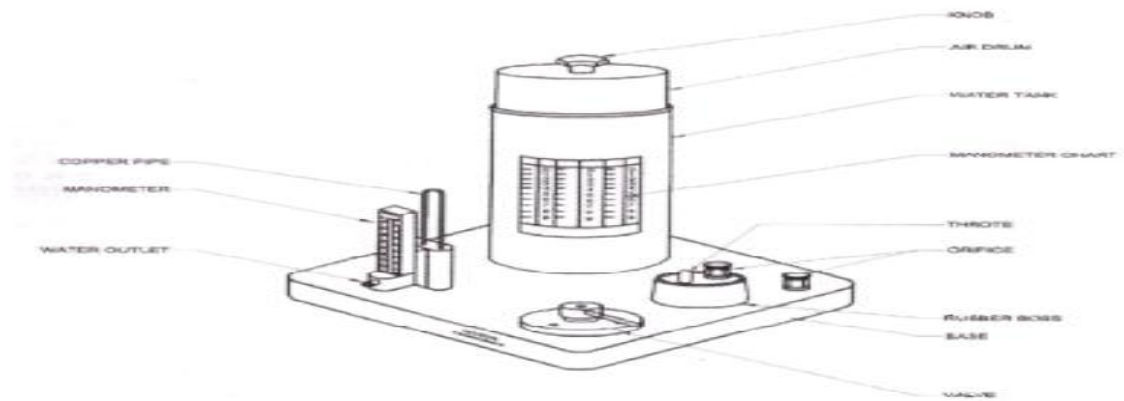


Figure: PERMEABILITY METER

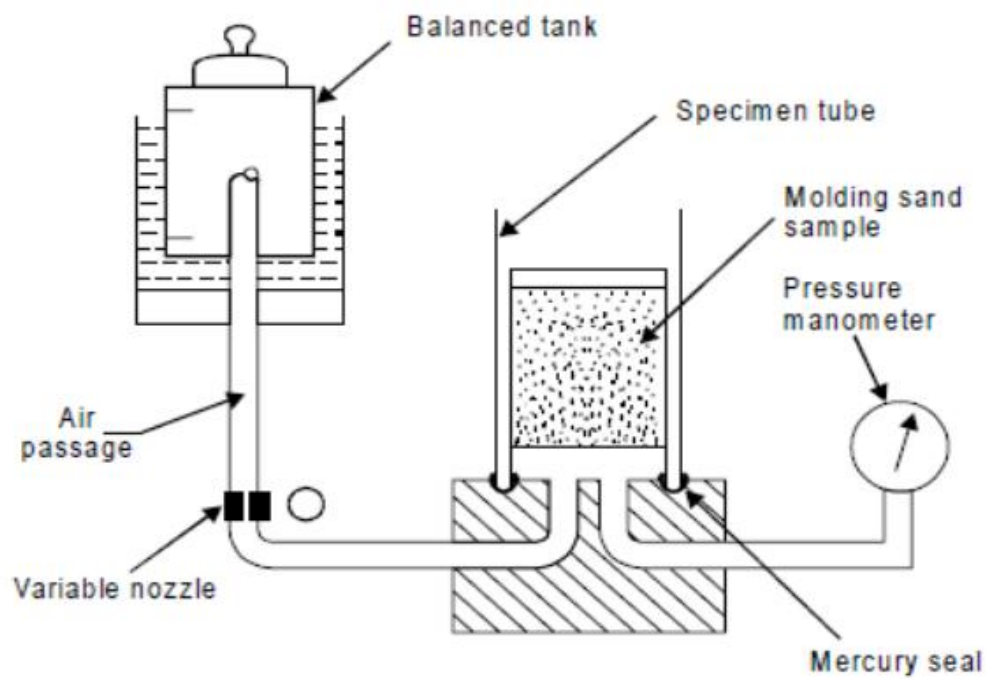


Fig.5. Permeability Meter



MOULDING MELTING AND CASTING

Aim:

To produce a carting from sand mould.

Equipment:

- A. Sand Moulds with different shapes of cavities
- B. Crucible

Materials:

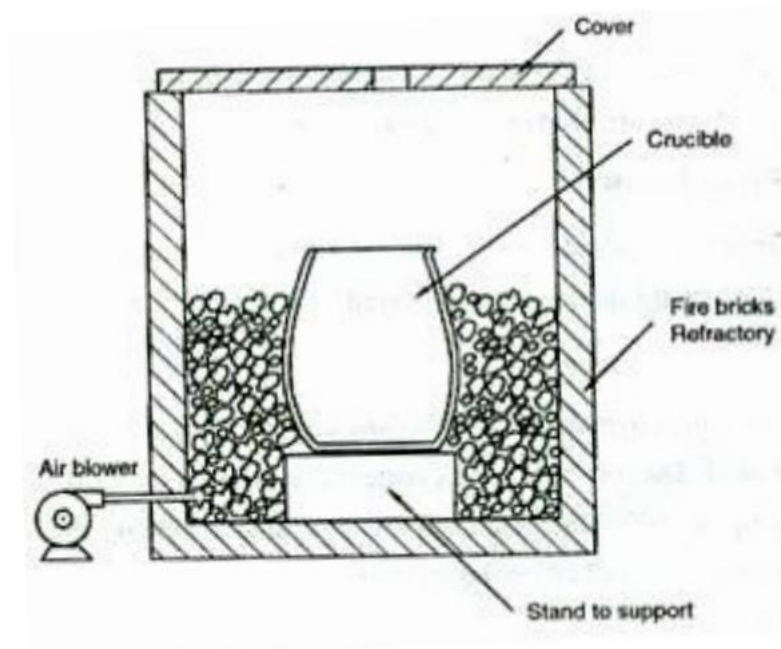
Moulding Sand, Aluminium metal

Theory:

The casting process is the oldest, most versatile, and the most flexible process for forming metals. Basically, it consists of introducing molten metal into a cavity or mould of desired form and allowing the metal to solidify. There is practically no limit to the size, shape, and alloy of the casting that may be made. Castings regularly produced range from tiny dental inlay of rare metals to complicated steel castings exceeding 2000 ton in weight. Almost any article may be cast with proper technique. In sand casting, a mould is produced by shaping a suitable refractory material to form a cavity of desired shape, such that a liquid metal can be introduced into this cavity. The mould cavity has to retain its shape until the molten metal has solidified and the casting is separated from the mould. There are also some other types of casting processes: e.g. permanent mould casting, die casting, plaster casting, investment casting, squeeze / semi solid casting, slush casting, shot casting etc.

Procedure:

1. First of all, prepare sand for sand moulding
2. Then, prepare a sand mould
3. After the preparation of sand mould, melt aluminium metal or any available aluminium in furnace.
4. When the metal is liquid enough to pour into the mould, put off the fire and hold the crucible with the help of a holder.
5. Place some weight on the mould and pour the molten metal into the mould through the spruce or pouring basin.
6. Continue pouring until the molten metal comes out of risers of the mould.
7. Allow the metal to solidify in the sand mould for some time.
8. When the metal in the mould is solidified, break the sand mould with the help of breakers to remove the required metal casting.
9. Finally, the casting is machined to get the finished shape.



Melting furnaces

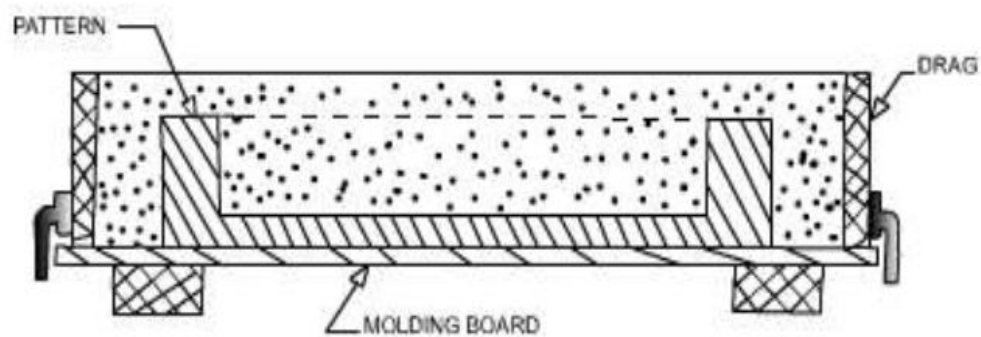
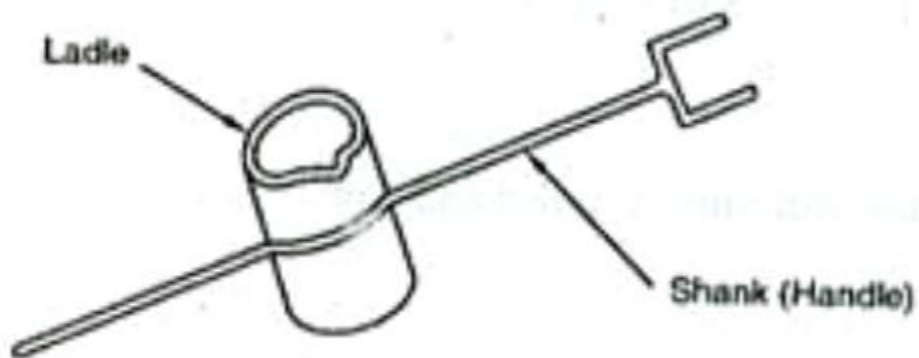


Fig3 a

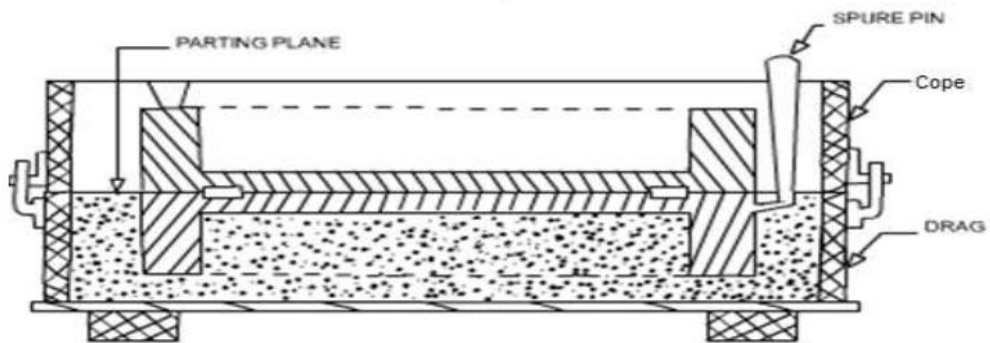


Fig3 b

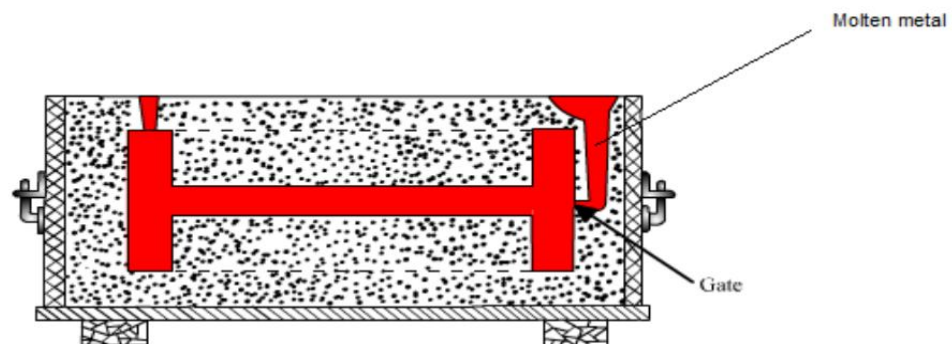


Fig 3 c. Steps involved in Mould making and Casting

Result:

A product has been produced by casting.





ARC WELDING LAP JOINT

Aim:

To prepare a lap joint.

Materials Required:

Mild Steel flat 100 mm X 50 mm X 5 mm.

Equipment Required:

Flat, rough file, try square, step down transformer electrode holder, electric lugs, shield, goggles, gloves, electrode tongs.

Theory:

The welding in which the electric arc is produced to give heat for the purpose of joining two surfaces is called electric arc welding.

Principle

Power supply is given to electrode and the work. A suitable gap is kept between the work and electrode. A high current is passed through the circuit. An arc is produced around the area to be welded. The electric energy is converted into heat energy, producing a temperature of 3000°C to 4000°C. This heat melts the edges to be welded and molten pool is formed. On solidification the welding joint is obtained.

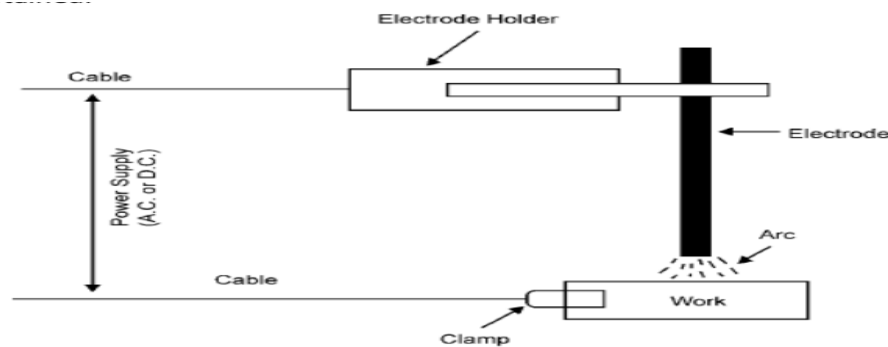


Figure 3.1: Arc Welding

Electric Power for Welding

AC current or DC current can be used for arc welding. For most purposes, DC current is preferred. In D.C. welding, a D.C. generator or a solid state rectifier is used. D.C. machines are made up to the capacity range of 600 amperes. The voltage in open circuit is kept around 45 to 95 volts and in closed circuit it is kept 17 to 25 volts. D.C. current can be given in two ways:

- (a) Straight polarity welding.
- (b) Reverse polarity welding.

In straight polarity welding work piece is made anode and the electrode is made cathode as shown in the fig. Electrons flow from cathode to anode, thus, heat is produced at the materials to be welded.

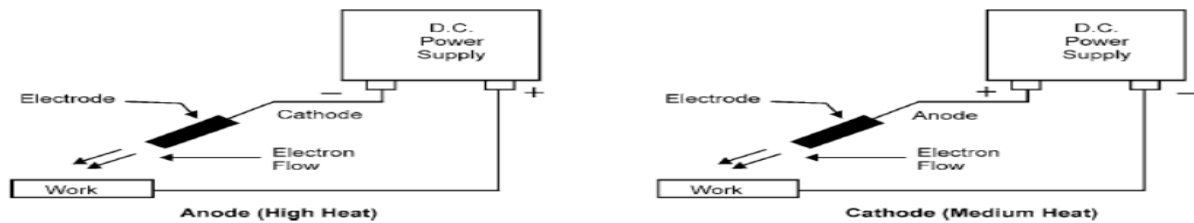


Figure: Straight Polarity Welding and Reverse Polarity Welding

In reverse polarity system the work is made cathode and the electrode is made anode. This welding is done specially for thin section. AC welding has the advantage of being cheap. Equipment used is simpler than DC welding. A transformer is used to increase the current output at the electrode. The current varies from 150 to 1000 amperes depending upon the type of work.

Effect of Arc Length

Arc length is the distance from the tip of the electrode to the bottom of the arc. It should vary from 3 to 4 mm. In short arc length, the time of contact will be shorter and will make a wide and shallow bead. The penetration is low as compared to long arc lengths.

Welding Positions

In horizontal position it is very easy to weld. But many times it is impossible to weld the job in horizontal position. Other positions are classified as under:
 (a) Flat Position, (b) Horizontal Position, (c) Vertical Position, (d) Overhead Position

Flat Position:

In flat positions the work piece is kept in nearly horizontal position. The surface to be worked is kept on upper side. The welding is done as illustrated in the Figure

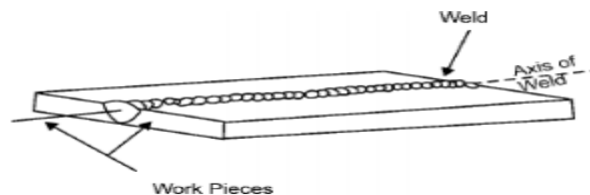


Figure :Flat Position

Horizontal Position:

In this position, the work piece is kept as in the fig. Two surfaces rest one over the other with their flat faces in vertical plane. Welding is done from right side to left side. The axis of the weld is in a horizontal plane and its face in vertical plane.

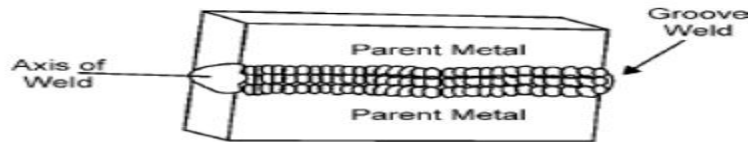


Figure :Horizontal Position

Vertical

Position:

In this position, the axis of the weld remains in approximate vertical plane. The welding is started at the bottom and proceeds towards top. Welding process is illustrated in Figure



Figure: Vertical Position

Overhead Position:

As shown in the figure, the work piece remains over the head of the welder. The work piece and the axis of the weld remain approximate in horizontal plane. It is the most difficult position of welding.

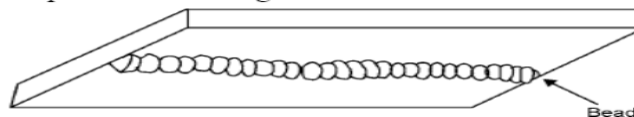


Figure: Overhead Position

Types of Electrodes

Electrodes are of two types

1. **Coated electrodes:** Coated electrodes are generally applied in arc welding processes. A metallic core is coated with some suitable material. The material used for core is mild steel, nickel steel, chromium molybdenum steel, etc. One end of the coated core is kept bare for holding.

2. **Bare electrodes:** Bare electrodes produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.

Electrode Size

Electrodes are commonly made in lengths 250 mm, 300 mm, 350 mm, 450 mm, and the diameters are 1.6 mm, 2 mm, 2.5 mm, 3.2 mm, 4 mm, 7 mm, 8 mm and 9 mm.

Functions of Coatings:

The coating on an electrode serves the following functions:

1. To prevent oxidation.
2. Forms slogs with metal impurities.
3. It stabilizes the arc.
4. Increases deposition of molten metal.
5. Controls depth of penetration.
6. Controls the cooling rate.
7. Adds alloy elements to the joint. Specifications of electrodes.

Electrode Classification and Coding

According to ISI coding system, an electrode is specified by six digits with profile letter M. For example IS: 815-1956 These six digits & M indicate the following matter:

M: It indicates that it is suitable for metal arc welding.

First Digit: First digit may be from 1 to 8, which indicate the type of coating on the electrode.

Second Digit: It denotes the welding position for which electrode is manufactured. It varies from 1 to 6.

Third Digit: It denotes the current to be used for an electrode. It is taken from 0 to 7.

Fourth Digit: Fourth digit is from 1 to 8. Each digit represents the tensile strength of welded joint.

Fifth Digit: It carries any number from 1 to 5. This digit denotes a specific elongation in percentage of the metal deposited.

Sixth Digit: It carries any number from 1 to 5 and denotes impact strength of the joint.

TYPES OF JOINTS

Basic types of welding joints are classified as under:

Butt Joint

In this type of joint, the edges are welded in the same plane with each other. V or U shape is given to the edges to make the joints strong. Some examples of butt joints are shown in the figure.

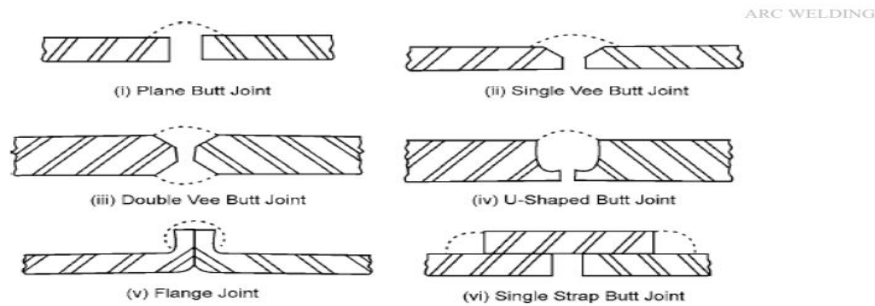


Figure: Different Types of Butt Joints

Lap Joint

This type of joint is used in joining two overlapping plates so that the corner of each plate is joined with the surface of other plate. Common types of lap joints are single lap, double lap or offset lap joint. Single welded lap joint does not develop full strength as compared to double welded lap

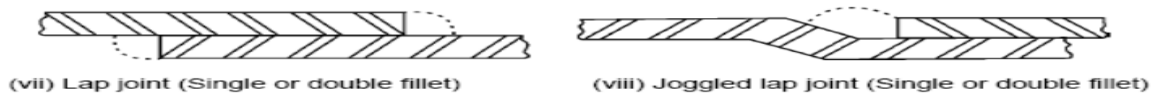


Figure: Lap joints and joggled joint

T-Joint

When two surfaces are to be welded at right angles, the joint is called T-Joint. The angle between the surfaces is kept 90°.

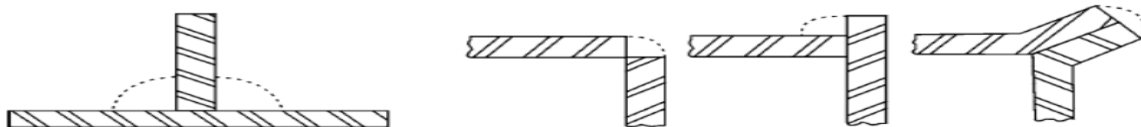


Figure: T-joint and corner Joints

Corner Joint

In this joint, the edges of two sheets are joined and their surfaces are kept at right angle to each other. Such joints are made in frames, steel boxes, etc.

Edge Joint

In this joint two parallel plates are welded edge to edge.



Figure 3.10: Edge joint and rivet butt Joints

Figure: Edge joint and rivet butt Joints

Plug Joint

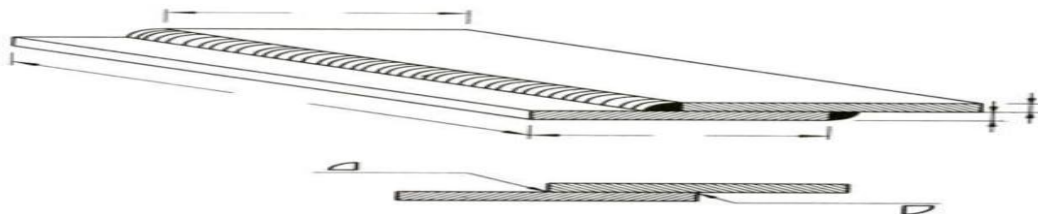
Plug joints are used in holes instead of rivets and bolts.

Procedure:

1. Mild steel flat is taken and it is filed using flat rough file.
2. After filing the right angles arc checked by using try square.
3. The above two steps are repeated on another work piece also.
4. The two pieces are kept one above the other in lap position.
5. Tags are made on either side of the work pieces, so that their positions are disturbed during welding.
6. Welding is carried out, first on one side of the work pieces, allowing sufficient amount of metal to fill the weld puddle by slowly moving the electrode in wavy fashion.
7. After the welding is over, the slag which is formed on the top of the weld head is removed by using chipping hammer.
8. The work pieces are reversed by holding them with tongs, and above two steps are repeated.
9. The joint thus obtained is a lap joint.

Precautions:

1. Check the right angles of the work pieces properly using try square.
2. Tags should be made so that work pieces are not disturbed from their position
3. Arc is struck by touching the work piece with the electrode and quick removing the electrode away from the work piece. The electrode should be kept at a distance of equal to electrode diameters for maintaining the arc.



Result:

Lap joint has been produced by arc welding



ARC WELDING SINGLE V-BUTT JOINT

Aim:

To prepare a single V butt joint.

Materials Required:

Mild steel flat 100 mm X 50 mm X 5 mm.

Equipment Required:

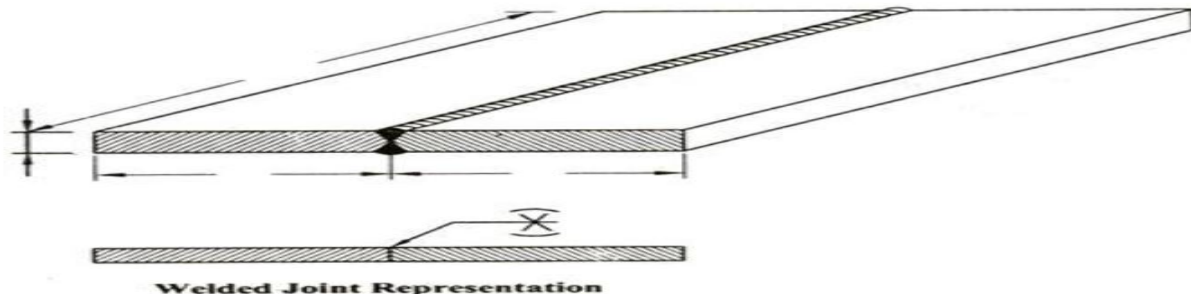
Flat rough file, try square, step down transformer, electric lugs, shield, goggles, gloves, electrode holder, electrode, chipping hammer, wire brush.

Procedure:

1. Filing is done on four sides of the mild steel flat and right angles are checked by using try square.
2. With a root face of 2 mm, 30° taper is made along the longer length of the work piece.
3. Repeat the above two steps for the other work piece.
4. Two pieces are kept such that the width will form for a V-groove.
5. Tags are made at both the end of the work piece.
6. Welding is carried out along the length of the V-groove by slowly moving the electrode in a weavy fashion, so that sufficient amount of metal is filled in the groove.
7. After welding is over, the slag is removed using chipping hammer, cleaning is done by using wire brush.
8. The joint thus obtained is a V-butt joint.

Precautions:

1. Check the right angles of the work pieces properly using try square.
2. Tags should be made so that work pieces are not disturbed from their positions.
3. Arc is struck by touching the work piece, with the electrode away from the work piece. The electrode should be kept -at a distance of equal to electrode diameter for maintaining the arc.
4. Electrode should be moved slowly so that required amount metal is filled in the weld puddle.
5. Never see the arc directly with naked eye, It is advisable to wash the eyes three to four times after welding.



Result:

V- Butt joint has been produced by using arc welding.



SPOT WELDING (SINGLE STRAP BUTT JOINT)

Aim:

To prepare a Single Strap Butt Joint on the given work pieces using spot welding

Material Required:

GI Sheet of 50 x 50 mm--- 1 No's

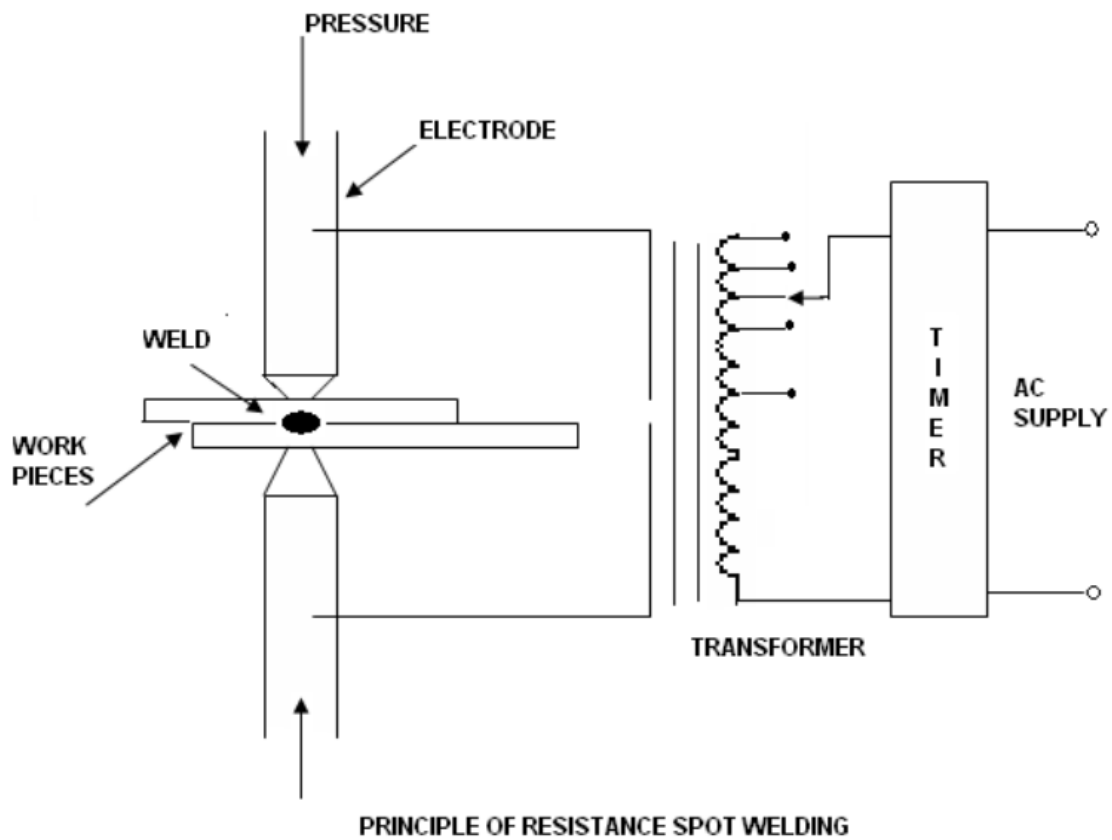
GI Sheet of 50 x 50 mm---- 1 No.

Apparatus Required:

Spot Welding Equipment, Snips and Gloves

Theory:

Spot welding is a resistance welding process in which overlapping sheets are joined by local fusion at one or more spots by the heat generated by resistance to the flow of electric current through work pieces that are held together under force by two electrodes, one above and the other below the two overlapping sheets as shown in fig.



In resistance welding (RW) a low voltage (typically IV) and very high current (typically 15,000 A) is passed through the joint for a very short time (typically 0.25 s). This high amperage heats the joint, due to the contact resistance of the joint and melts it. The pressure on the joint is continuously maintained and the metal fuses together under this pressure. The heat generated in resistance welding can be expressed as

$$H = k I^2 R t$$

Where H = the total heat generated in the work, J

I = electric current, A

t = time for which the electric current is passing through the joint, s

r = the resistance of the joint, ohms

and k = a constant to account for the heat losses from the welded joint.

The resistance of the joint, R is a complex factor to know because it is composed of

1. The resistance of the electrodes,
2. The contact resistance between the electrode and the work piece,
3. The contact resistance between the two work piece plates,
4. The resistance of the work piece plates.

The amount of heat released is directly proportional to the resistance. It is likely to be released at all of the above-mentioned points, but the only place where a large amount of heat is to be generated to have an effective fusion is at the interface between the two work piece plates. Therefore, the rest of the component resistances should be made as small as possible, since the heat released at those places would not aid in the welding. Because of the squaring in the above, equation, the current, i needs to be precisely controlled for any proper joint. The main requirement of the process is the low voltage and high current power supply. This is obtained by means of a step down transformer with a provision to have different tappings on the primary side, as required for different materials. The secondary windings are connected to the electrodes which are made of copper to reduce their electrical resistance. The time of the electric supply needs to be closely controlled so that the heat released is just enough to melt the joint and the subsequent fusion takes place due to the force (forge welding) on the joint. The force required can be provided either mechanically, hydraulically or pneumatically. To precisely control the time, sophisticated electronic timers are available. The critical variable in a resistance welding process is the contact resistance between the two work piece plates and their resistances themselves. The contact resistance is affected by the surface finish on the plates, since the rougher surfaces have higher contact resistance. The contact resistance also will be affected by the cleanliness of the surface. Oxides or other contaminants if present should be removed before attempting resistance welding

Steps Involved In Spot Welding:

The job is clean, i.e. free from grease, dirt, scale, oxide etc. Electrode tip surface is clean, since it has to conduct the current into the work with as little loss as possible. Very fine emery cloth may

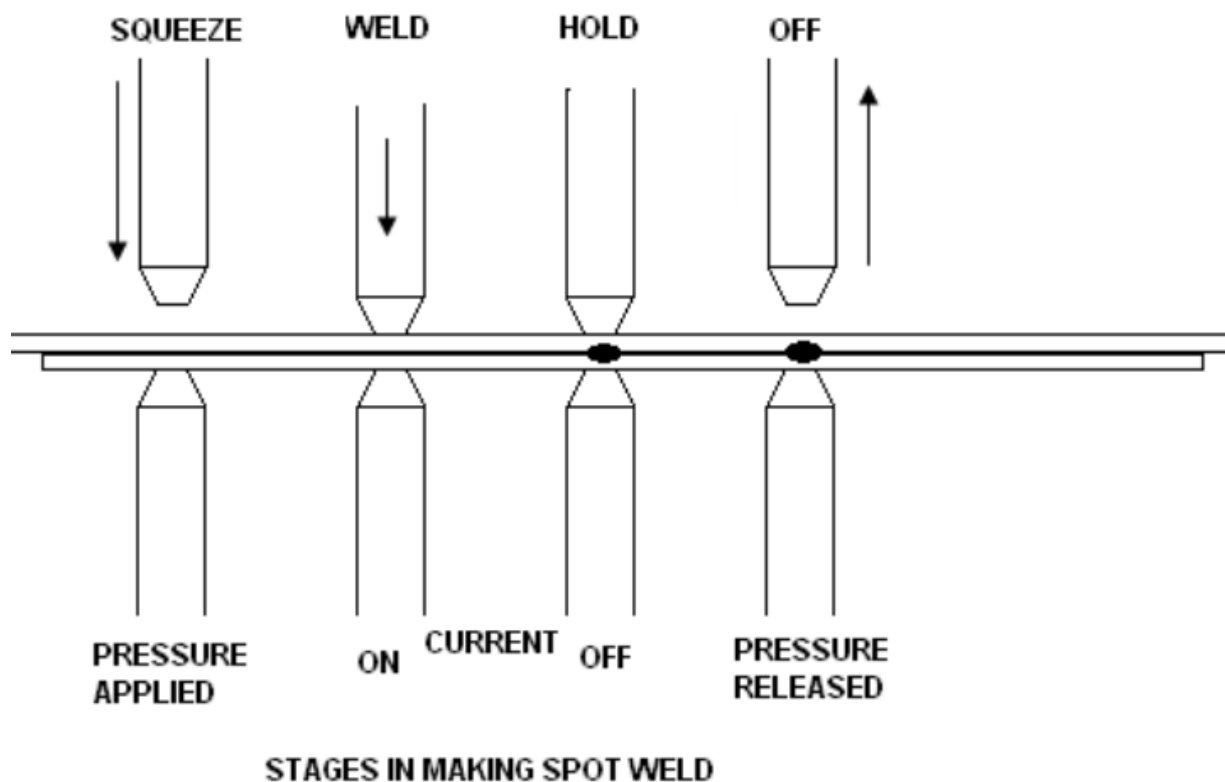
be used for routine cleaning. Proper welding current has been set on the current selector switch. Proper time has been set on the weld-timer.

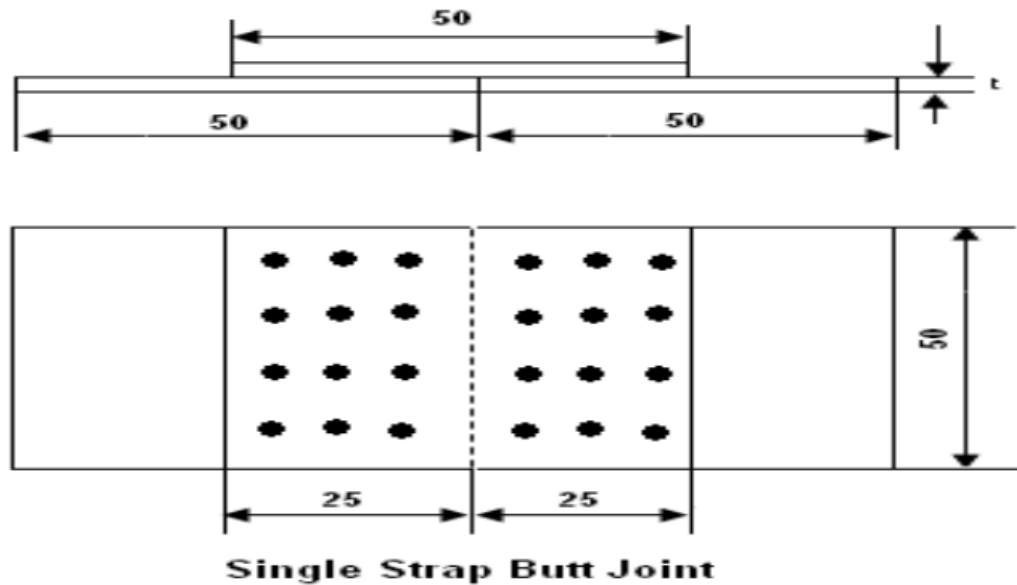
Step I: Electrodes are brought together against the overlapping work pieces and pressure applied so that the surfaces of the two work pieces under the electrodes come in physical contact after breaking any unwanted film existing on the work pieces.

Step II: welding current is switched on for a definite period of time. The current may be of the order of 3000 to 100,000 A for a fraction of seconds depending upon the nature of material and its thickness. As the current passes through one electrode and the work pieces to the other electrode, a small area where the work pieces are in contact is heated. The temperature of this weld zone is approximately 8150C to 9300C. To achieve a satisfactory spot weld the nugget of coalesced metal should form with no meeting of the material between the faying surfaces.

Step III: at this stage, the welding current is cut off. Extra electrode force is then applied or the original force is prolonged. This electrode force forges the weld and holds it together while the metal cools down and gains strength.

Step IV: The electrode force is released to remove the spot welded work pieces.





Procedure:

1. The two pieces to be joined by spot welding are placed between the two electrodes in the required position.
2. Set the timer for which the current flows through the electrodes with reference to the thickness of the plates
3. Press the foot lever, so that the movable electrode moves towards the fixed electrode.
4. This causes to develop a pressure of about 200-1000 Kg / cm² on the sheets.
5. A low voltage and very high current is passed through the joint for a very short time. The duration of the current flow is for about 2 sec (This high amperage heats the joint, due to contact resistance at the joint and melts it).
6. Then the metal under electrodes pressure is squeezed and welded
7. The pressure is then released and the process is repeated until the job is completed.

Precautions:

1. Proper pressure should be applied on the electrodes.
2. Correct electrode diameter needs to be chosen depending on the material thickness to be joined.
3. Proper weld time should be selected for welding.
4. Use Gloves while doing operation.

Result:



Spot welding machine

TUNGSTEN INERT GAS (TIG) WELDING

Aim:

To prepare a Lap Joint Using TIG Welding.

Material And Apparatus Required:

MS flat 100 x 50 X 5 mm³ ---2 No's Tong, Chipping Hammer, goggles Tungsten Electrode, Ceramic Nozzle and Filler rod.

Equipment Required:

Transformer, Rectifier and Argon gas cylinder.

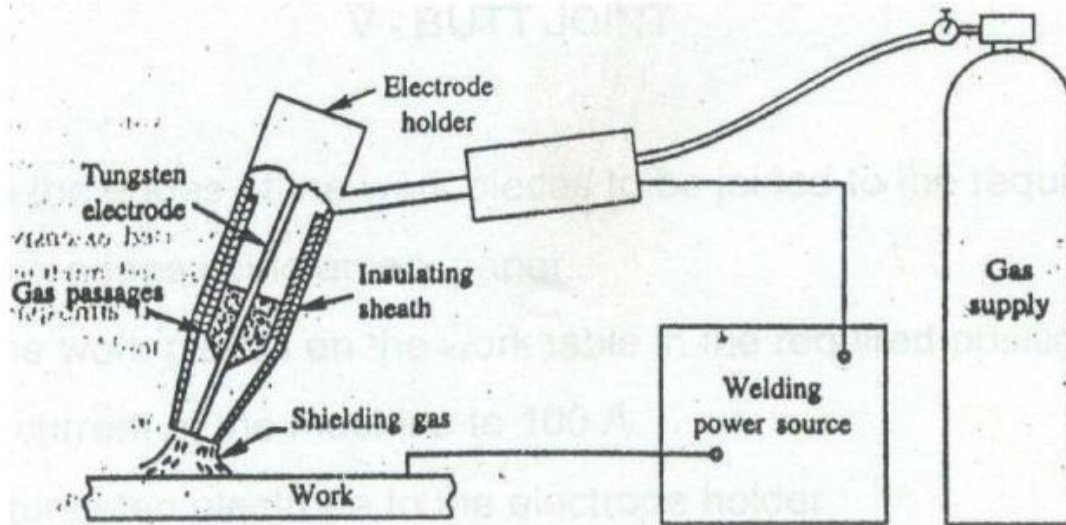
Theory:

The Endeavour of welder is always to obtain a joint which is as strong as the base metal and at the same time, the joint is as homogeneous as possible. To this end, the complete exclusion of oxygen and other gases which interfere with the weld pool to the detriment of weld quality is very essential. In manual metal arc welding, the use of stick electrodes does this job to some extent but not fully. In inert gas shielded arc welding processes, a high pressure inert gas flowing around the electrode while welding would physically displace all the atmospheric gases around the weld metal to fully protect it. The shielding gases most commonly used are argon, helium, carbon dioxide and mixtures of them. Argon and helium are completely inert and therefore they provide completely inert atmosphere around the puddle, when used at sufficient pressure. Any contaminations in these gases would decrease the weld quality. Argon is normally preferred over helium because of a number of specific advantages. It requires a lower arc voltage, allows for easier arc starting and provides a smooth arc action. A longer arc can be maintained with argon, since arc voltage does not vary appreciably with arc length. It is more economical in operation. Argon is particularly useful for welding thin sheets and for out of position welding. The main advantage of Helium is that it can with stands the higher arc voltages. As a result it is used in the welding where higher heat input is required, such as for thick sheets or for higher thermal conductivity materials such as copper or aluminum. Carbon dioxide is the most economical of all the shielding gases. Both argon and helium can be used with AC as well as DC welding power sources. However, carbon dioxide is normally used with only DC with electrode positive.

Tungsten Inert Gas (Tig) Welding:

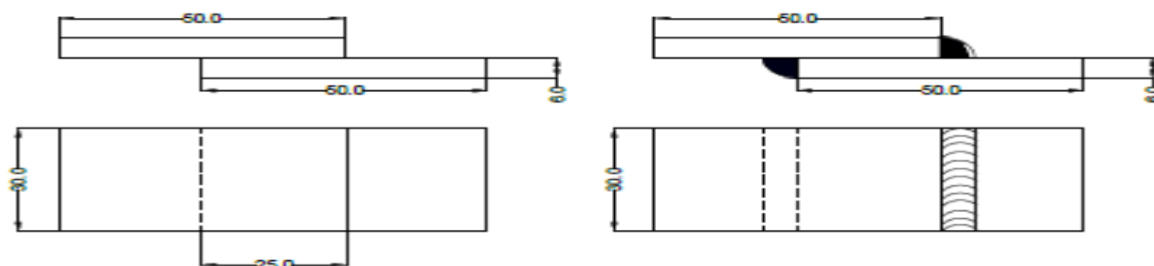
Tungsten inert gas (TIG) welding is as inert gas shielded arc welding process using non consumable electrode. The electrode may also contain 1 to 2% thoria mixed along with core tungsten or tungsten with 0.15 to 0.4% zirconia. The pure tungsten electrodes are less expensive but will carry less current. The thoriated tungsten electrodes carry high currents and are more desirable because they can strike and maintain stable arc with relative ease. The zirconia added

tungsten electrodes are better than pure tungsten but inferior to thoriated tungsten electrodes. A typical TIG welding setup is shown in fig.



It consists of a welding torch at the centre of which is the tungsten electrode. The inert gas is supplied to the welding zone through the annular path surrounding the tungsten electrode to effectively displace the atmosphere around the weld puddle. The TIG welding process can be used for the joining of a number of materials though the most common ones are aluminium, magnesium and stainless steel. The power sources used are always the constant current type. Both DC and AC power supplies can be used for TIG welding. When DC is used, the electrode can be negative (DCEN) or positive (DCEP). With DCEP is normally used for welding thin metals where as for deeper penetration welds DCEN is used. An AC arc welding is likely to give rise to a higher penetration than that of DCEP.

Procedure:



BEFORE WELDING

AFTER WELDING

All dimensions are in 'mm'.

Prepare the edges of the work pieces to be joined to the required position.

- Finish the edges using emery paper.
- Place the work pieces on the work table in the required position.
- Set the current of the machine to 100 A.
- Fix the tungsten electrode to the electrode holder.
- Required size of the nozzle is selected and it is fixed to the torch. Adjust the inert gas flow rate to the required rate.
- Select the filler rod (same as base metals) of required diameter.
- Touch the electrode to the work, so that current flow will be established and then separated by a small distance and the arc will be generated.
- First tack weld is done on the work pieces.
- Move the electrode slowly along the length of the joint with the filler rod, so that the filler metal will be deposited in the joint.
- Repeat the operation for the second pass, so that required amount of filler metal will be deposited on the work pieces.

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. Select the parameters of the machine properly based on the metals to be welded.
5. Set these parameters properly before performing the operation.
6. Inflammable and combustible materials are removed from the vicinity of welding operations.

Result:



TIG Welding Machine

BRAZING

Aim:

To join the given two work pieces as required type of joint by brazing.

Material Used:

Mild steel plate

Tools Used:

Filler rod, Flux, Safety goggles, gloves, brazing torch

Theory:

Brazing is coalescence of a joint with the help of a filler metal whose melting temperature is 450°C and is below solidify temperature of the base metal. The filler metal is drawn into the joint by means of capillary action. Brazing is a metal-joining process whereby a filler metal is heated above melting point and distributed between two or more close-fitting parts by capillary action. The filler metal is brought slightly above its melting (liquidus) temperature while protected by a suitable atmosphere, usually a flux. It then flows over the base metal (known as wetting) and is then cooled to join the workpieces together. It is similar to soldering, except the temperatures used to melt the filler metal are higher.

Procedure:

1. The given work piece are thoroughly cleaned, i.e., rust, scales are removed.
2. The joining work pieces are positioned properly.
3. A flux is applied to all surfaces where the filler material is flow.
4. After that the joint is heated to the proper brazing temperature.
5. Solid filler metal may be replaced on the metal pieces and thus melted as the metal pieces are heated.
6. Only small amount of filler metal is needed to fill the joint completely

Result: Thus the required welding is obtained by brazing process



Figure: Brazing process



GAS WELDING

Aim:

To make the butt joint by using gas welding equipment

Equipment Required:

Oxy-acetylene gas welding outfit

Tools Required:

Wire brush, Hand gloves, chipping hammer, Spark lighter

Material Required:

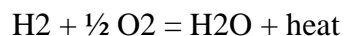
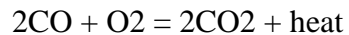
MS Sheets 100*50*5mm (2no.)

Theory:

Gas Welding or Oxy-fuel gas welding is a general term used to describe any welding process that uses a fuel gas combined with oxygen to produce a flame. The most commonly used fuel is acetylene (C₂H₂) gas. The heat source is the flame obtained by combustion of oxygen and acetylene. When mixed together in correct proportions within a hand-held torch or blowpipe, a relatively hot flame is produced with a temperature of about 3300°C (6000°F). The chemical action of the oxyacetylene flame can be adjusted by changing the ratio of the volume of oxygen to acetylene. The combustion of oxygen and acetylene (C₂H₂) is a two-stage reaction. Chemical reactions are as follows: -

Stage 1: In the first stage, the supplied oxygen and acetylene react to produce Carbon Monoxide and Hydrogen. Approximately one-third of the total welding heat is generated in this stage.
$$\text{C}_2\text{H}_2 + \text{O}_2 = 2\text{CO} + \text{H}_2 + \text{heat}$$

Stage 2: The second stage of the reaction involves the combustion of the CO and H₂. The remaining two-third of the heat is generated in Stage 2. The specific reactions of the second stage are:



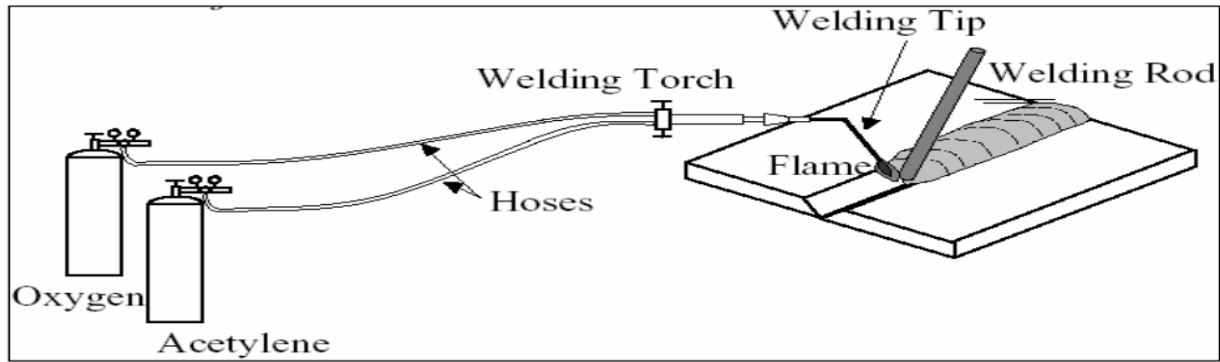


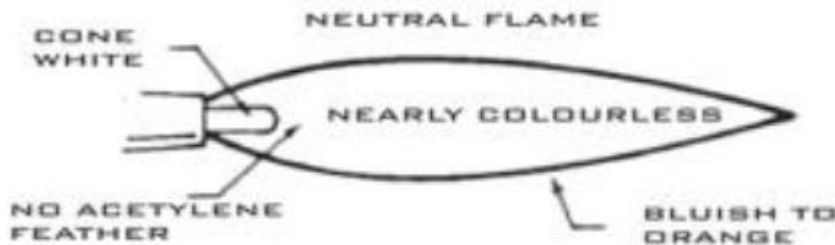
Figure: Gas Welding (Oxygen–fuel gas) process

Types of flames:

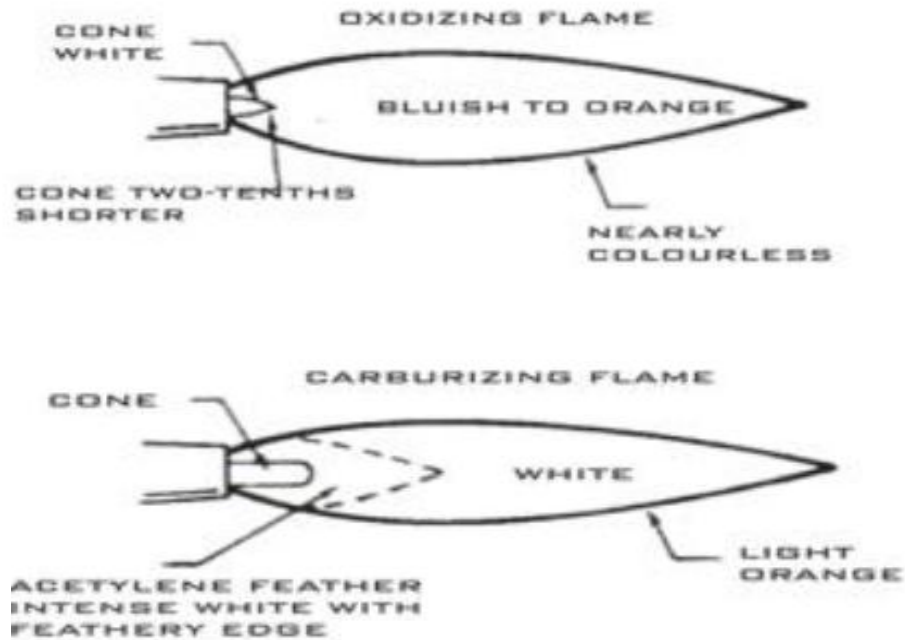
Three different types of flames can be obtained by varying the oxygen–acetylene (or oxygen–fuel gas) ratio.



Neutral Flame: When the ratio of oxygen-acetylene (or oxygen–fuel gas) is between 1:1 and 1.15:1, all reactions are carried to completion and a neutral flame is produced. As the supply of oxygen to the blowpipe is increased, the flame contracts and the white cone become clearly defined, assuming a definite rounded shape. This type of flame is the one most extensively used by the welder, who should make himself thoroughly familiar with its appearance and characteristics.



Oxidizing flame: A higher ratio of oxygen-acetylene (or oxygen–fuel gas), such as 1.5:1, produces an oxidizing flame, which is hotter than the neutral flame (about 3600°C or 6000°F). With the increase in oxygen supply, the inner cone will become shorter and sharper, the flame will turn a deeper purple color and emit a characteristic slight "hiss". An oxidizing flame is only used for special applications.



Carburizing flame: Excess fuel compared to oxygen produces a carburizing flame. The excess fuel decomposes to carbon and hydrogen, and the flame temperature is not as great (about 3050°C or 5500°F). This type of flame is mainly used for hard surfacing and should not be employed for welding steel as unconsumed carbon may be introduced into the weld and produce a hard, brittle, deposit.



Figure: welding torch

Filler Metals & Flux

Filler metals are used to supply additional material to the weld zone during welding. These consumable filler metals may be bare or flux coated. The purpose of flux is to retard oxidation of the surfaces of the parts being welded, by generating a gaseous shield around the weld zone.

Gas Welding/Cutting Equipment

The apparatus used in gas welding consists basically of an oxygen source and a fuel gas source, regulators, hoses, non-return valve, check valve and torches.

Regulator:

The regulator is used to control pressure from the tanks by regulating pressure and flow rate of gas. It releases the gas at a constant rate from the cylinder despite the pressure in the cylinder becoming less as the gas in the cylinder is used.

Hoses:

The hose is usually a double-hose design i.e. there are two hose joined together. The oxygen hose is green and the fuel hose is red.

Non-return valve:

Between the regulator and hose and ideally between hose and torch on both oxygen and fuel lines, a non-return valve and/or flashback arrestor should be installed to prevent flame/oxygen-fuel mixture being pushed back into either cylinder and damaging the equipment.

Check valve:

A check valve lets gas flow in one direction only. Not to be confused with flashback arrestor, a check valve is not designed to block a shockwave. A check valve is usually a chamber containing ball that is pressed against on end by a spring. Gas flow in a particular direction pushes the ball out of the way while no flow or flow on the other way lets the spring push the ball into the inlet thus blocking it.

Torches:

The torch is the part that the welder holds and manipulates to make the weld. It has a connection and valve for Oxygen and also a connection and valve for Fuel, a handle for grasp, a mixing chamber for mixing of the fuel and oxygen, a tip where the flame forms. A **welding torch** head is used to weld metals and can be identified by having only two pipes running to the nozzle and no oxygen blast trigger. A **cutting torch** head is used to cut metals and can be identified by having three pipes that go to an around 900 nozzle and also by oxygen-blast trigger that provides oxygen to blast away material while cutting

Procedure:

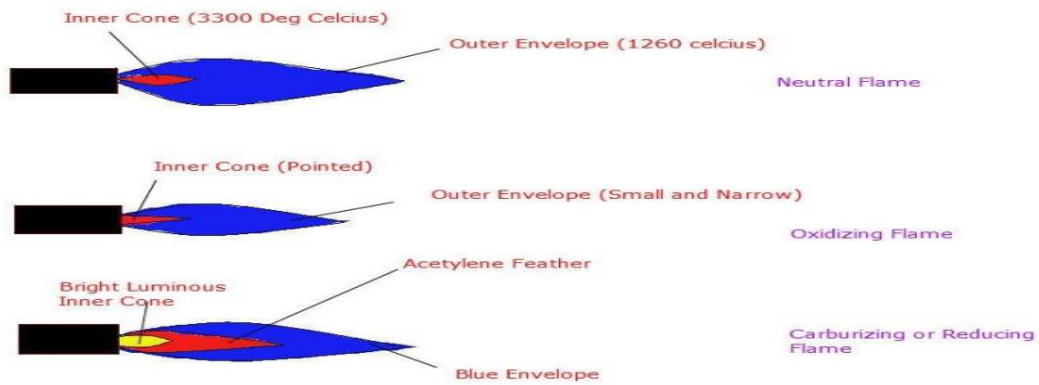
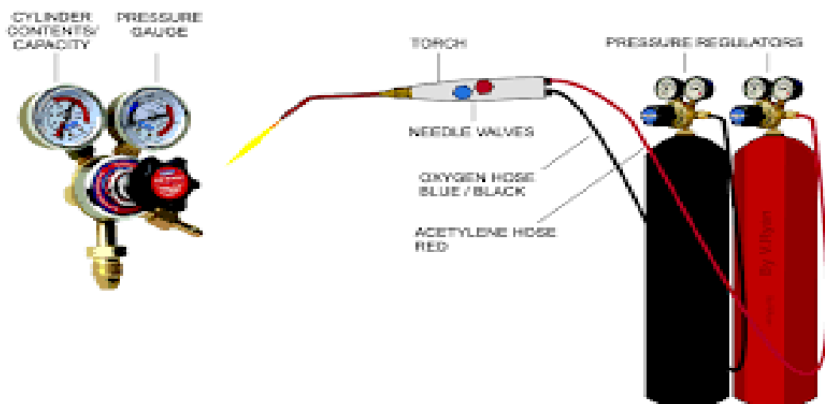
1. Acetylene valve on the torch is opened slightly and lightened with the help of spark lighter.
2. Now acetylene valve is opened to get the required flow of acetylene.

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.

Precautions:

1. The use of safety equipment such as goggles with shaded with lenses, Face shields, gloves 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.





PLASMA ARC WELDING

Aim:

To join two given work pieces using plasma arc welding and Brazing and cut the given plate into two parts using plasma cutting.

Apparatus required:

Plasma Arc Welding System

Material Required:

MS flat 100x50x5 mm –2 Nos

Theory:

Procedure:

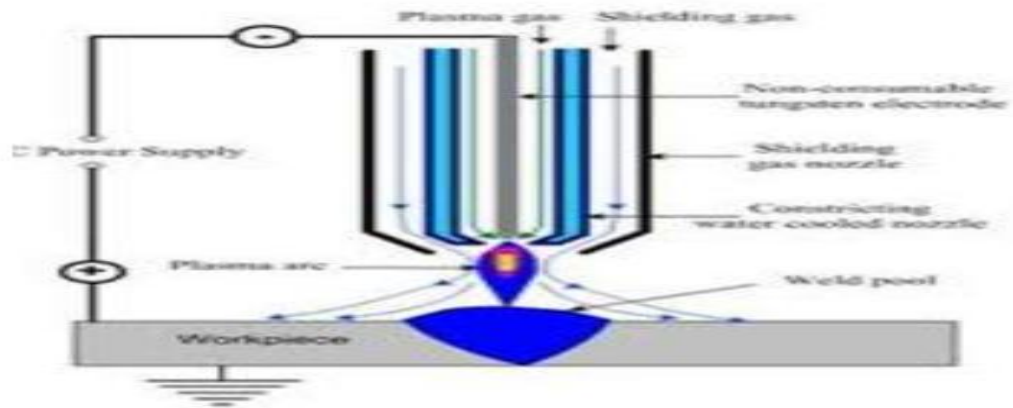
1. The edge of the given material is prepared to the required V-shape using grinding machine
2. The machine is set to the required parameters (For Welding).
3. Place the two work pieces on the table with required position as shown in figure.
4. The work pieces are kept in the required position and tack welding is performed on the work pieces.
5. First run of welding is done to fill the gap and penetration of the weldment by holding the electrode at about 700 and filler rod at 300 and move the electrode to another end uniformly.
6. Second run of welding is done with proper weaving and uniform movement so that a uniform weld bead will be obtained.
7. The scale formed is chipped with chipping hammer.
8. Filing is done to remove any spatter around the weld.
9. The machine is set to the required parameters(For Cutting)

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.

Result:

The required butt joint is prepared by Plasma Arc Welding.



Plasma Welding



PLASMA CUTTING

Aim:

To cut a given specimen using plasma cutting equipment.

Equipment And Material Required:

plasma cutting equipment, MS Sheets 100x50x5mm

Tools Required:

Wire brush, hand gloves, and chipping hammer, spark lighter. Plasma cutting Plasma Welding

Theory:

Procedure:

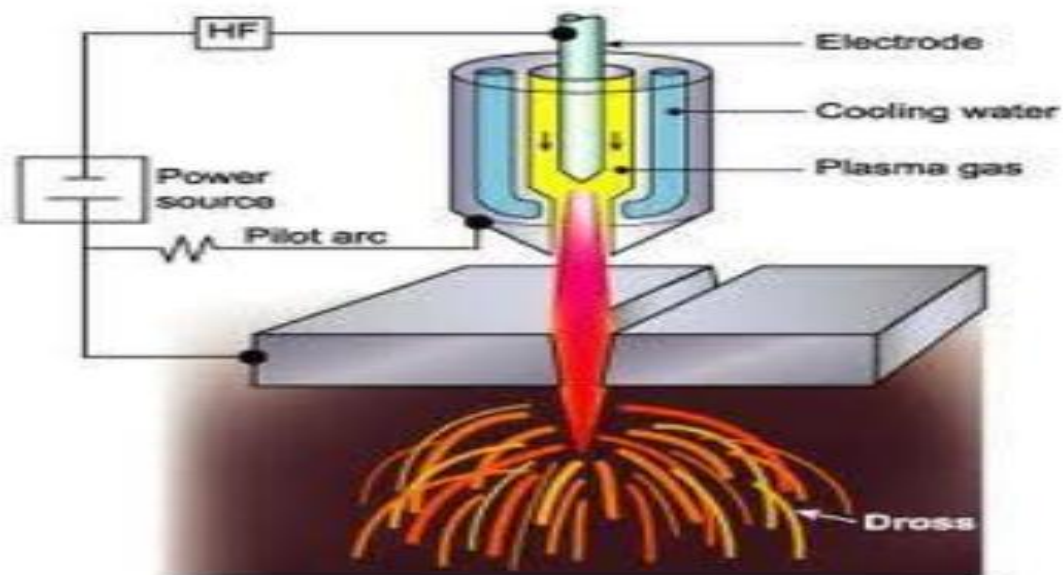
1. Gas (helium or hydrogen) valve on the torch is opened slightly and lightened with the help of a spark lighter.
2. Now ionized gas are forced through the arc and nozzle (at a flow rate of 1.5 to 15 litres per min) with the result that these get ionized and become plasma
3. The torch tip is to be positioned above the plates so that white cone is at a distance of 1.5mm to 3mm from the plate.
4. Torch is to be held almost vertical to the base metal surface for cutting,
5. Torch is to be held almost vertical to the base metal surface and filler metal wire fed at angle for Welding
6. 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.
7. As the backward welding allows better penetration, backward welding is to be used
8. After the completion of welding, slag is to be removed by means of chipping hammer, wirebrush.

Precautions:

1. Ensure that torch movement is uniform.
2. See that the joints are extremely clean.

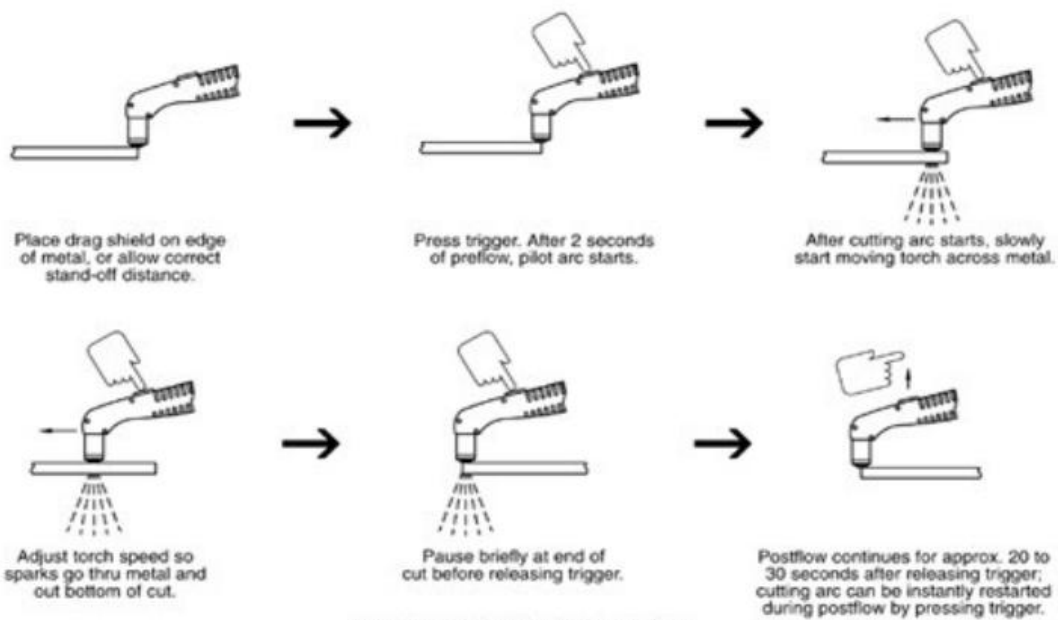
Result:

A butt joint is prepared using plasma welding and a given piece is cut by plasma cutting



Plasma cutting

EXAMPLE of Cutting Operation



Plasma Cutting Sequence



STUDY OF PROGRESSIVE DIE (Blanking and Piercing)

Aim:

To study a progressive tool and perform blanking and piercing

Operations:

To determine the punching force and blanking force theoretically and compare the same with obtained readings.

Tools And Material Required:

Progressive tool, Clamps and Blank.

Equipment Required:

Hydraulic Press

Specifications:

Capacity: 25 tons

Distance between columns: 865x300 mm² Distance between ram to bed: minimum 180mm
: Maximum 915mm, Travel of ram: 180mm

Theory:

Sheet Metal Working (Or) Press Working Of Sheet Metal

Press working may be defined as a chip less manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The main features of a press are: A frame which supports a ram or a slide and a bed, a source of mechanism for operating the ram in line with and normal to the bed. The ram is equipped with suitable punch and a die block is attached to the bed. A stamping is produced by the down ward stroke of the ram when the punch moves towards and into the die block. The punch and die block assembly is generally termed as a "die set" or simply as a "die". Press working operations are usually done at room temperature. In this process, the wall thickness of the parts remains almost constant and differs only slightly from the thickness of the initial sheet metal. The initial material in cold press working is: low carbon steels, ductile alloy steels, copper and its alloys, aluminium and its alloys, as well as other ductile materials from 10th of a mm to about 6 or 8 mm thick.

Elastic recovery or spring back. In metal working processes, the total deformation imparted to a work piece will be the sum of elastic deformation and plastic deformation. We also know the elastic deformation is recoverable where as plastic deformation is permanent. So, at the end of a metal working operation, when the pressure of metal is released, there is an elastic recovery by the material and the total deformation gets reduced a little. This phenomenon is called as "spring

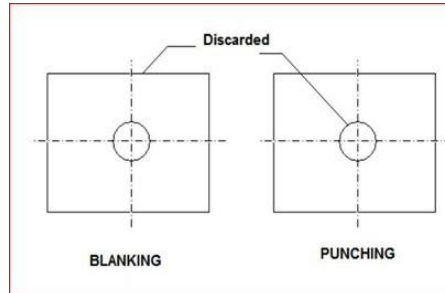
back". This phenomenon is of more importance in cold working operations, especially in forming operations such as bending etc

.Spring back depends upon the yield point strength of a metal. The higher the yield point strength of a metal, the greater the spring back. The amount of spring back for a forming operation is difficult to predict and cut- and try methods are most satisfactory to account for it. To compensate for spring back, the cold deformation must always be carried beyond the desired limit by an amount equal to the spring back.

Press operation: The sheet metal operations done on a press may be grouped into two categories, cutting operations and forming operations.

In **cutting** operations, the work piece is stressed beyond its ultimate strength. The stresses caused in the metal by the applied forces will be shearing stresses. In **forming** operations, the stresses are below the ultimate strength of the metal. In this operation, there is no cutting of the metal but only the contour of the work piece is changed to get the desired product. The cutting operations include: blanking, punching, notching, perforating, trimming, shaving, slitting and lancing etc. The forming operations include: bending, drawing, redrawing and squeezing. The stresses induced in the metal during bending and drawing operations are tensile and compressive and during the squeezing operations these are compressive.

Blanking: Blanking is the operation of cutting a flat plate from sheet metal. The article punched out is called the „blank“ and is the required product of the operation. The hole and metal left behind is discarded as waste. It is usually the first step of series of operations.



Punching:

It is a cutting operation by which various shaped holes are made in sheet metal. Punching is similar to blanking except that in punching, the hole is the desired product, the material punched out to form the hole being waste.

Perforating:

This is a process by which multiple holes which are very small and close together are cut in flat work material.

Trimming:

This operation consists of cutting unwanted excess material from the periphery of a previously

formed component.

Shaving:

The edges of a blanked part are generally rough, uneven and un square. Accurate dimensions of the part are obtained by removing a thin strip of metal along the edges.

Slitting:

It refers to the operation of making incomplete holes in a work piece. Lancing: This is a cutting operation in which a hole is partially cut and then one side is bent down to form a sort of tab or louver. Since no metal is actually removed, there will be no scrap.

Bending:

In this operation, the material in the form of flat sheet or strip is uniformly strained around a linear axis which lies in the neutral plane and perpendicular to the lengthwise direction of the sheet metal.

Drawing:

This is a process of forming a flat work piece into a hollow shape by means of a punch which causes the blank to flow into a die cavity.

TYPES OF DIES:

The dies may be classified according to the type of press operation and according to the method of operation.

Types of press operation:

According to this criterion, the dies may be classified as: cutting dies and forming dies.

Cutting dies:

The dies are used to cut the metal. They utilize the cutting or shearing action. The common cutting dies are: blanking dies, piercing dies, perforating dies, notching, trimming, shaving dies etc.

Forming dies:

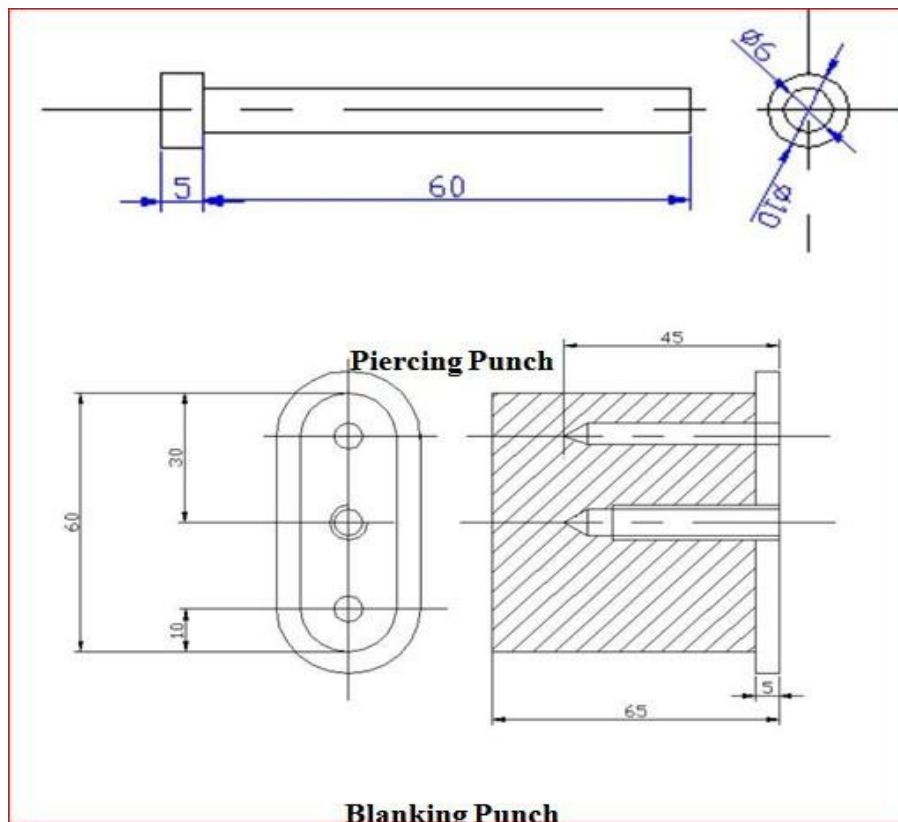
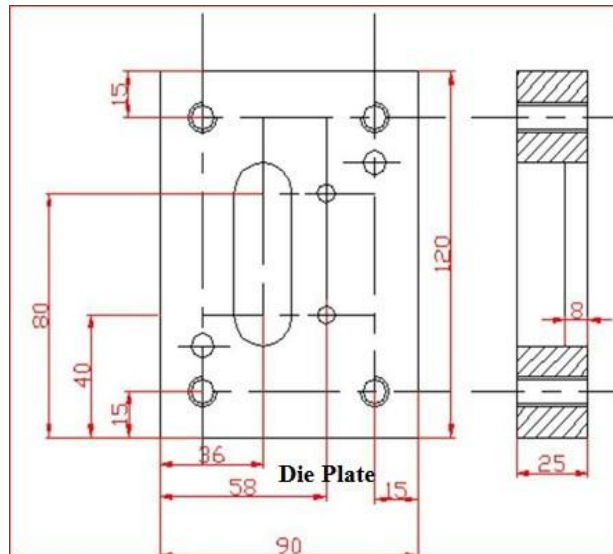
These dies change the appearance of the blank without removing any stock. These dies include bending dies, drawing dies, squeezing dies etc..

Method of operation:

According to this criterion, the dies may be classified as: single operation dies or simple dies,

compound dies, combination dies, transfer dies, progressive dies and multiple dies.

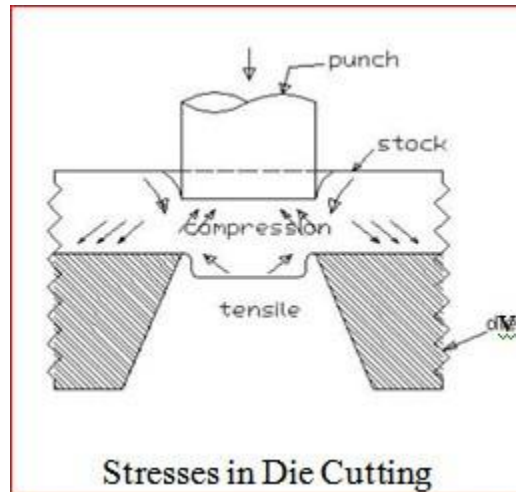
1. STUDY OF PROGRESSIVE DIE:



A progressive or follow on die has a series of stations. At each station an operation is performed on the work piece during a stroke of the press. Between strokes the piece in the metal strip is transferred to the next station. A finished work piece is made at each stroke of the press. A progressive die is shown in fig. while the piercing punch blanks out a portion of the metal in

which two holes had been pierced at a previous station. Thus after the stroke two holes will be punched. Each stroke of the press produces a required finished component.

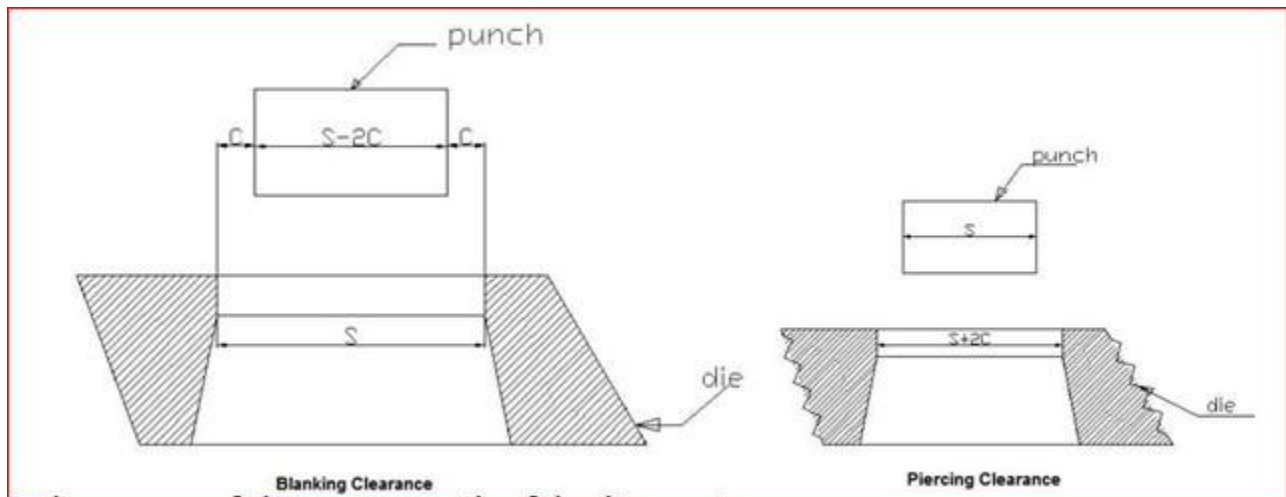
2. Principle of metal cutting:



The cutting of sheet metal in the press work is a shearing process. The punch is of the same shape as of the die opening except that it is smaller on each side by an amount known as „clearance“. As the punch touches the material and travels downward, it pushes the material into the die opening. The material is subjected to both tensile and compressive stresses as shown in fig (a).

Stresses will be highest at the edges of punch and die and the material will start cracking there. The various steps in the rupture or fracture of material can be written as stressing the material beyond the elastic limits; plastic deformation reduction in area fracturing starts in the reduced area and becomes complete. If the clearance between punch and die is correct, the cracks starting from the punch and die edges will meet and the rupture is complete as shown in fig (b). If the clearance is too large or too small the cracks do not meet and ragged edge results due to the material being dragged and torn through the die.

Clearance: The die opening must be sufficiently larger than the punch to permit a clean fracture of the metal. This difference in dimensions between the mating members of a die set is called „clearance“. This clearance is applied in the following manner:



„c“ is the amount of clearance per side of the die opening.

When the hole has to be held to size, i.e. the hole in sheet metal is to be accurate, and slug is to be discarded the punch is made to the size of hole and the die opening size is obtained by adding clearance to the punch size shown in fig (a).

In blanking operation where the slug or blank is desired part and has to be held to size the die opening size equals the blank size and the punch size is obtained by subtracting the clearance from the die opening size shown in fig (b).

The clearance is a function of the kind, thickness and temper of the work material harder materials requiring clearance than soft materials, the exception being aluminium. The usual clearances per side of the die, for various materials, are given below in terms of the stock thickness, t:

For brass & soft steel,	$c=5\%$ of t
For mild steel,	$c=6\%$ of t
For hard steel,	$c=7\%$ of t
For Aluminium	$c=10\%$ of t

The total clearance between punch and die size will be twice these figs these clearances are for blanking and piercing operations.

The clearance may also be determined with the help of the following equation: $c=0.0032t \times \zeta s$
Where ζs is the shear strength of the material in N/mm².

Cutting forces:

In cutting operation as the punch in its downward movement enters the material it need not penetrate the thickness of the stock in order to affect complete rupture of the part. The distance which the punch enters in to the work material to cause rupture to take place is called “penetration” and is usually given as percentage of the stock thickness. The % penetration depends on the material being cut and also on the stock thickness. When a hard and strong material is being cut very little penetration of the punch is necessary to cause fracture. With softer the penetration will be greater. The percentage penetration is also depends upon the stock

thickness, being smaller for thinner sheets.

The max force F_{max} in newtons needed to cut a material is equal to :

For a circular blank of diameter D mm and of thickness t mm the maximum cutting force will be given as:

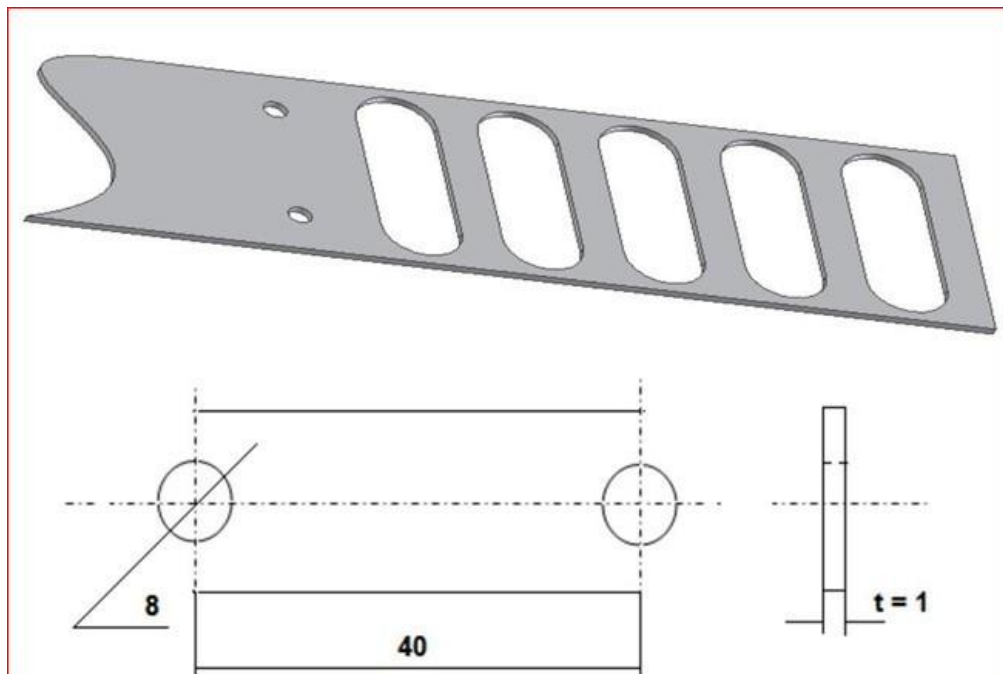
$$F_{max} = \pi D t \zeta_s = P t \zeta_s.$$

Where P is the perimeter of the section to be blanked For rectangular blanks the length L and width b it is

$$F_{max} = 2(L+b) t \zeta_s.$$

Procedure:

Component to be produced:



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.
3. Place the blank of required size between the die and punch.
4. Apply pressure hydraulically on the blank through the punch so that piercing will takes place at the first station.
5. Note down the reading of the pressure gauge which directly gives the force required to perform the piercing operation.
6. Move the blank in forward direction until it touches the stopper on the die.
7. Again apply pressure hydraulically on the blank so that piercing punch blanks out a portion of the metal in which already two holes had been pierced. At the same time piercing operation takes place at the first station.
8. Note down the reading of the pressure gauge which directly gives the force required to perform the piercing and blanking operations.

9. Difference of the two readings gives the force required to perform blanking operation.
10. Compare the values with the theoretically obtained values.
11. The process may be repeated to produce the components in mass production.

Observations & Calculations:

Piercing Force (F_p) =
 Blanking & Piercing Force (F_{bp}) =
 Blanking Force (F_b = F_p - F_{bp}) =
 Maximum force needed to cut material is F_{max} =
 P. t. ζ_s Where P is the Perimeter of the blank
 t is the thickness of the blank
 ζ_s is the shear strength of the material.

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 blank.
4. The ram should be fed slowly towards the die and make sure that it is properly in line with the die.

Result:





MECHANICAL
PRESS

SIMPLE DIE
COMPOUND DIE
PROGRESSIVE
DIE

STUDY OF COMPOUND DIE

Aim:

To study a Compound tool and perform blanking and piercing operations.

To determine the punching force and blanking force theoretically and compare the same with obtained readings.

Tools And Material Required:

Compound die, Clamps and Blank.

Equipment Required:

Hydraulic Press

Specifications:

Capacity: 25 tons

Distance between columns: 865x300 mm²

Distance between ram to bed: minimum 180mm and maximum 915mm

Travel of ram: 180mm

Theory:

Press working may be defined as a chip less manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The process has got the following advantages:

Small weight of fabricated parts.

1. High productivity of labour.
2. High efficiency of technique as regards the fabrication of items of diversified shapes, both simple and complex, such as washers, bushings, retainers, of ball bearings, tanks and car bodies etc.
3. The parts obtained by cold sheet metal working are distinguished for their size accuracy. In many cases, they require no subsequent machining and are delivered to the assembly shop.

Presses:

These are classified in various ways:

1. Source of power.
2. Method of actuation of the rams
3. Number of slides
4. Type of frame

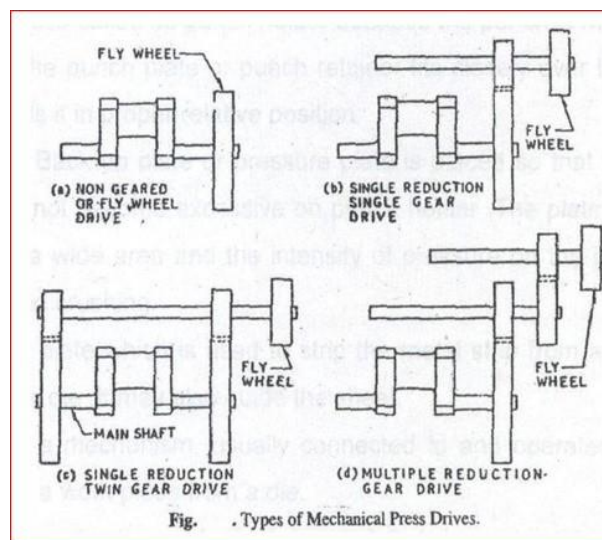
The type of work for which the press has been designed.

Source of power:

Two kinds of sources of power for applying force to the ram are mechanical and hydraulic.

In **Mechanical Presses**, the energy of flywheel is utilized which is transmitted to the work piece by gears, cranks, eccentrics or levers. The flywheel rotates freely on the crankshaft and is driven from an electric motor through gears or V belts. The motor runs continuously and stores energy in the fly wheel. When the operator presses a foot treadle or actuates a button, the clutch gets engaged and the fly wheel is connected to the crank shaft. The crankshaft starts rotating and the stored up energy in the flywheel is transmitted to its ram on its downward stroke .The clutch to engage and disengage the flywheel to the driveshaft can be

: a jaw clutch, an air operated clutch or an electromagnetic clutch. In manually operated mechanical presses, the clutch is engaged after each cycle. But in automatic presses in which the metal strip is fed to the die automatically, there is no need of single stroke clutch disengaging mechanism and the ram moves up and down continuously.



These presses can be classified as plain and geared . In the first design, the flywheel is mounted directly on the driveshaft .On a geared press, the flywheel is carried on an auxiliary shaft which is connected to the main shaft through one or more gear reductions, depending upon size and energy needed. In this arrangement, the flywheel stores considerably more energy than the plain drive as its speed is higher than main drive shaft.

In **hydraulic press**, the ram is actuated by oil pressure on a piston in a cylinder. Mechanical presses have following advantages over the hydraulic press:

1. Run faster
2. Lower maintenance cost
3. Lower capital cost. Advantages of Hydraulic presses are:
4. More versatile and more easy to operate.
5. Tonnage adjustable from zero to maximum.
6. Constant pressure is maintained throughout the stroke.
7. Force and speed can be adjusted throughout the stroke.
8. More powerful than Mechanical presses.
9. Safe as it will stop at pressure setting.

The main disadvantage of Hydraulic press is that it is slower than a Mechanical press.

A press is rated in tones of force, it is able to apply without undue strain. To keep the deflections small, it is a usual practice to choose a press rated 50 to 100% higher than the force required for an operation.

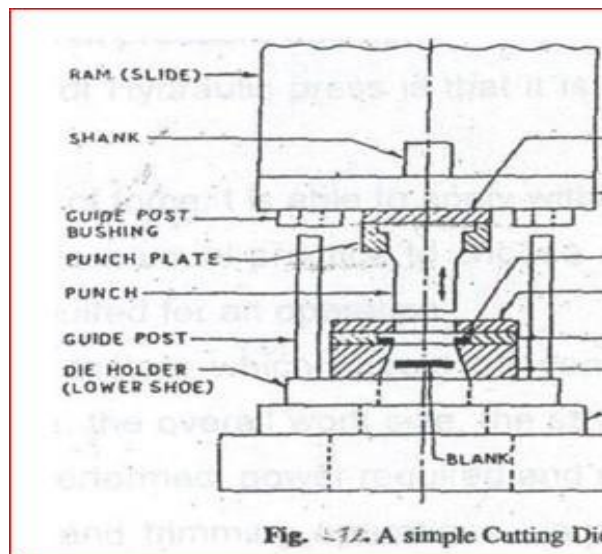
Press selection:

The factors which should be considered while selecting a press for a given job are: the overall work size, the stock thickness and material, kind of operation to be performed, power required and speed of operation.

For punching, blanking and trimming operations, usually the crank or eccentric type mechanical press is used. This is due to their small working strokes and high production rates. In these operations, there is sudden release of load at the end of cutting stroke. This sudden release of load is not advisable in Hydraulic presses. So, Hydraulic presses are not preferred for these operations. If however these are inevitable, and then some damping devices are incorporated in press design. For coining and other squeezing operations, which require very large forces, knuckle joint mechanical press is ideally suited. Hydraulic presses, which are slower and more powerful, can also be used for these operations. Hydraulic presses are also better adapted to pressing, forming and operations, which are basically slower processes.

Press Working Terminology:

A simple cutting die used for punching and blanking operations is shown in fig. the following are the main components of die and press.



Bed: The bed is the lower part of a press frame that serves as a table to which a bolster plate is mounted.

Bolster Plate: This is a thick plate secured to the press bed, which is used for locating and supporting the die assembly. It is usually 5 to 12.5 cm thick.

Die set: It is unit assembly which incorporates a lower and upper shoe, two or more guide posts

and guide post bushings.

Die: The die may be defined as the female part of a complete tool for producing work in a press. It is also referred to a complete tool consisting of a pair of mating members for producing work in a press.

Die Block: It is a block or a plate which contains a die cavity.

Lower Shoe: The lower shoe of a die set is generally mounted on the bolster plate of a press. The die block is mounted on the lower shoe. Also, the guide posts are mounted in it. It is also called as die holder.

Punch: This is the male component of the die assembly, which is directly or indirectly moved by and fastened to the press ram or slide.

Upper shoe: This is the upper part of the die set which contains guide post bushings. It is also called as punch holder because the punch is mounted on it. **Punch plate:** The punch plate or punch retainer fits closely over the body of the punch and holds it in proper relative position.

Back up plate: Back up plate or pressure plate is placed so that the intensity of pressure does not become excessive on punch holder. The plate distributes the pressure over a wide area and the intensity of pressure on the punch holder is reduced to avoid crushing.

Stripper: It is a plate which is used to strip the metal strip from a cutting or non cutting punch or die. It may also guide the sheet.

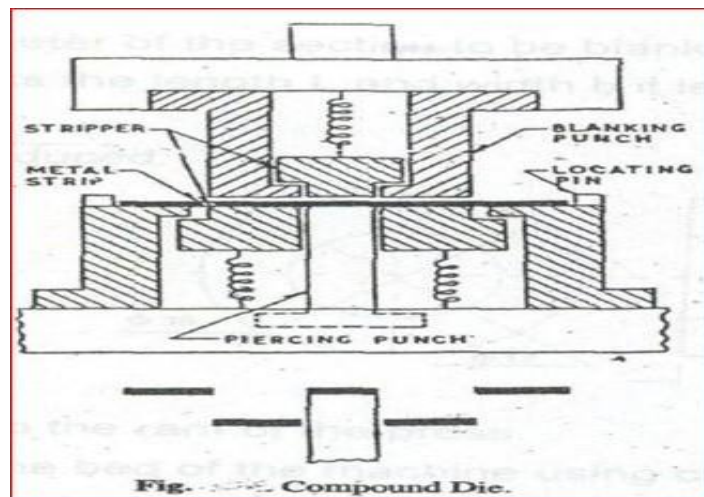
Knockout: It is a mechanism, usually connected to and operated by the press ram, for freeing a work piece from a die.

Pitman: It is a connecting rod which is used to transmit motion from the main drive shaft to the press slide.

Shut height: It is the distance from top of the bed to the bottom of the slide, with its stroke down and adjustment up.

Stroke: The stroke of a press is the distance of ram movement from its up position to its down position. It is equal to twice the crankshaft throw or eccentric drives but is variable on the hydraulic press.

Study of Compound Die:



In these dies two or more operations may be performed at one station. Such dies are considered as cutting tools since only cutting operations are carried out. Compound dies are more accurate and economical in mass production as compared to single operation dies.

Cutting forces: In cutting operation as the punch in its downward movement enters the material it need not penetrate the thickness of the stock in order to affect complete rupture of the part. The distance which the punch enters in to the work material to cause rupture to take place is called “penetration” and is usually given as percentage of the stock thickness. The % penetration depends on the material being cut and also on the stock thickness. When a hard and strong material is being cut very little penetration of the punch is necessary to cause fracture. With softer the penetration will be greater. The percentage penetration is also depends upon the stock thickness, being smaller for thinner sheets.

The max force F_{max} in newtons needed to cut a material is equal to the area to be sheared times the shearing strength, T_s in N/mm^2 for the material.

For a circular blank of diameter D mm and of thickness t mm the cutting force will be given as:

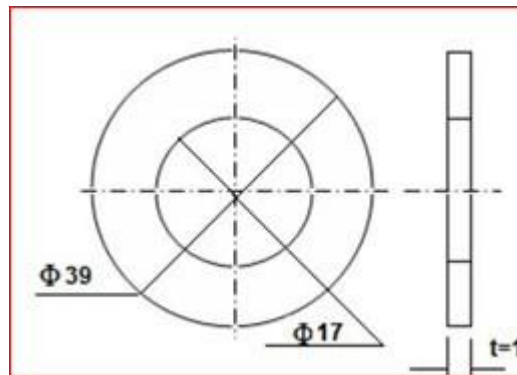
$$F_{max} = \pi D t \zeta_s = P t \zeta_s.$$

Where P is the perimeter of the section to be blanked

For rectangular blanks the length L and width b it is $F_{max} = 2(L+b) t \zeta_s$.

Procedure:

Component to be produced:



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
3. Place the blank of required size between the die and punch.
4. Apply pressure hydraulically on the blank through the punch so that blanking and piercing will takes place at one station.
5. Note down the reading of the pressure gauge which directly gives the force required to perform both blanking and piercing operations.
6. Compare the value with the theoretically obtained value.
7. The process may be repeated to produce the components in mass production.

Observations & Calculations:

Force required to perform blanking and piercing operations = Maximum force needed to cut material is $F_{max} = P. t. \zeta_s$ Where P is the Perimeter of the blank t is the thickness of the blank ζ_s is the shear strength of the material.

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 blank.
4. The ram should be fed slowly towards the die and make sure that it is properly in line with the die.

Result:



HYDRAULIC PRESS (DEEP DRAWING)

Aim:

1. To Determine the Blank Size, Drawing Force and Blank Holding Force for Producing a symmetrical cup of circular cross section using a Draw Tool and Perform Drawing Operation.

Material Required:

GI sheet of required size and MS round bar of 25mm diameter. EQUIPMENT AND TOOLS

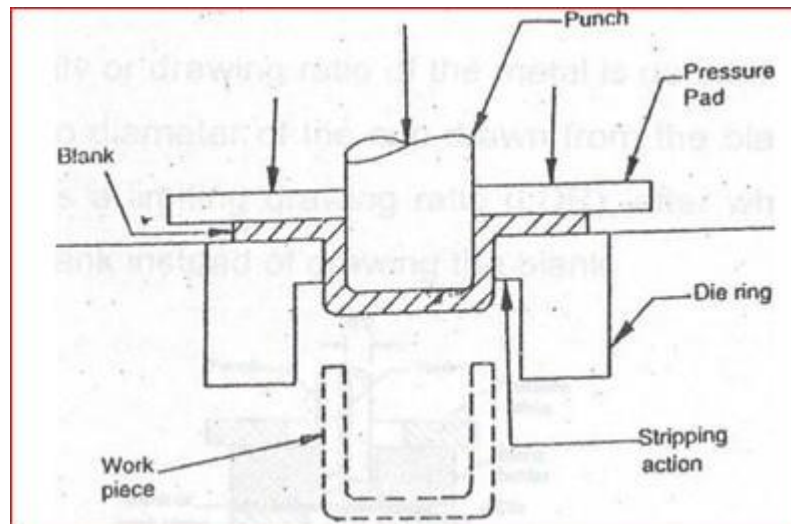
Required:

Hydraulic Press, Draw tool and Inclinator.

Theory:

Drawing:

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.



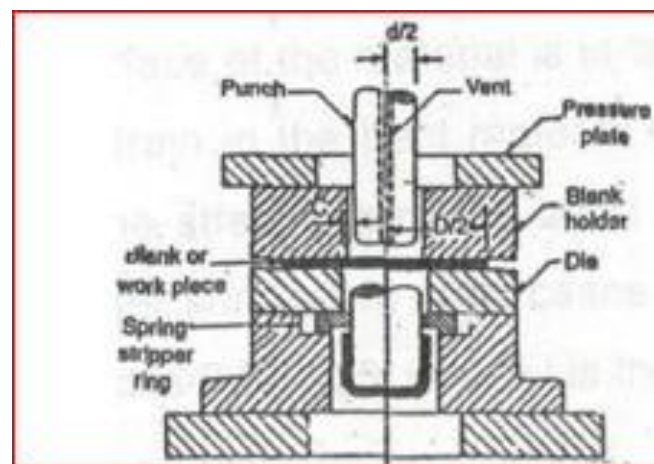
Deep drawing operation

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 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 and die is not enough to accommodate increased thickness of the work piece. This ironing is useful if uniform thickness of the product is desired after the drawing operation.

Deep Drawability:

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 passages. Venting serves double purpose it eliminates suction which would hold 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:

$$\% \text{ reduction} = \frac{D-d}{D} \times 100$$

Now $D/d = 6$ to 2.3 , $d/D = 0.435$ to $0.625 = 0.5$ (average) The average reduction in deep drawing = $[1 - d/D] \times 100 = 50\%$

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.

$D = \sqrt{d^2 + 4dh}$	When $d \geq 20r$
$D = \sqrt{d^2 + 4dh + \frac{4d^2r}{d}}$	When $15r \leq d \leq 20r$
$D = \sqrt{d^2 + 4dh + \frac{4d^2r}{d}}$	When $10r \leq d \leq 15r$
$D = \sqrt{(d - 2r)^2 + 4d(h + r) + (d - 0.7r)^2}$	When $d < 10r$

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.

$$P = \frac{\pi D}{4} \left(\frac{D}{d} - C \right) t$$

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

Drawing Operation:

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.
3. Calculate the required blank size and place the same between the punch and die block.
4. 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.
5. 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.
6. Observe the reading of the pressure gauge which directly gives the force required to perform the operation.
7. Calculate the drawing force required, to perform the operation using above relations.
8. Compare the two readings
9. Then move the punch in the return direction so that the cup will be stripped by counter bored portion.

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.

Result:



BENDING OPERATION

Aim:

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

Material Required:

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

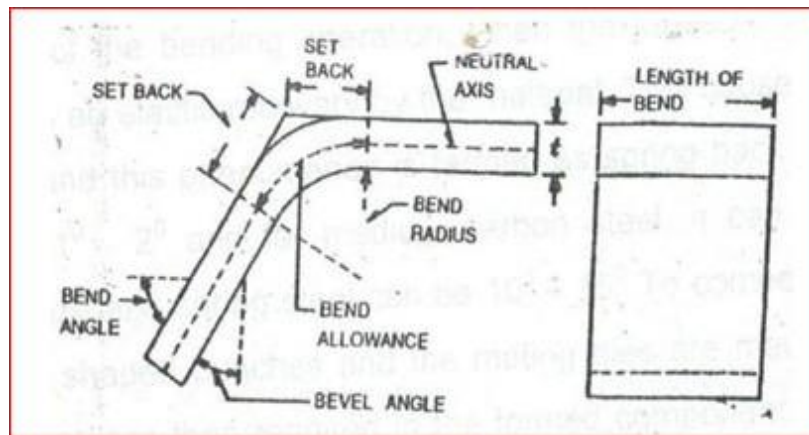
Equipment And Tools Required:

Hydraulic Press.

Theory:

Bending:

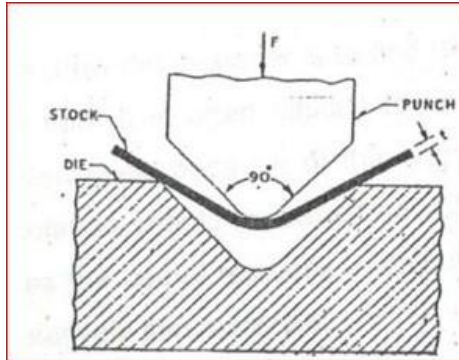
Bending is the metal working process by which a straight length is transformed into the curved length. It is a very common forming process for changing sheet and plate into channels, drums, tanks etc. During the bending operation, the outer surface of the material is in tension and the inside surface is in compression. The strain in the bent material increases with decrease in the radius of curvature. The stretching of the bend causes the neutral axis of the section towards the inner surface. In most cases the distance of the neutral axis to the inside of the bend is $0.3t - 0.5t$ where t is the thickness of the part.



Bending Methods:

The two bending methods commonly used are v-bending and edge bending.

1. V- Bending:



In V bending, a wedge shaped punch forces a metal sheet or strip in to a wedge shaped die cavity. The bend angle may be acute, 90° or obtuse. As the punch descends the contact forces at the die corner produces a sufficiently large bending moment at punch corner to cause the necessary deformation.

To maintain the deformation to be plane - strain, the side creep of the part during its bending is prevented or reduced by incorporating a spring loaded knurled pin in the die. The friction between pin and the part will achieve this. Plane strain conditions will also be established in the center of the sheet if its width is more than 10 times its thickness.

2. Edge Bending:

In edge bending, a flat punch forces the stock against the vertical force of the die. The bend axis is parallel to the edge of the die and the stock, is subjected.

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.

Result:



ARC WELDING TEE JOINT

Aim:

To prepare a tee joint.

Materials Required:

Mild Steel Flat of 100 mm X 50 mm X 5 mm size.

Equipment Required:

Flat rough file, try square, step down transformer, electric lugs, shield, goggles, gloves, electrode holder, electrode, chipping hammer, wire brush.

Procedure:

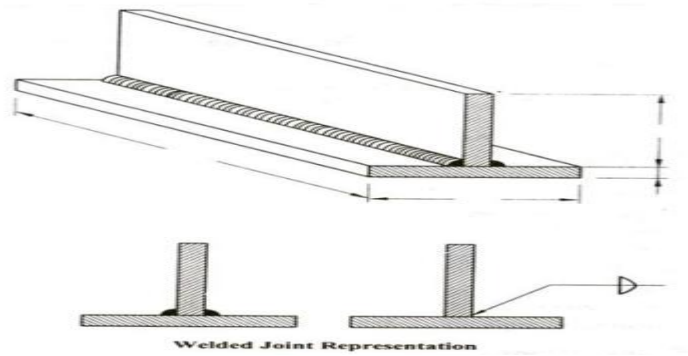
1. Filing is done on four sides of the mild steel flat and right angles are checked by using try square.
2. Repeat the same procedure for second flat also.
3. One work piece is kept horizontally on the work table, and another vertically above the first work piece, and in the middle, so that a 'Tee' is formed.
4. Tags are made at the ends of plates where two plates meet on either side.
5. Welding is carried out first on one side of the work pieces allowing sufficient amount of metal to full the weld puddle by slowly moving the electrode in weavy fashion.
6. After welding is over the slag is removed by using chipping hammer.
7. The above two steps are repeated on the other side of the work piece also.
8. The joint thus obtained is a 'tee' joint.

Precautions:

1. Tags should be made so that work pieces are not disturbed from their positions.
2. The plates should be flat, so check the right angles using the try square
3. Never see the arc directly with naked eye.
4. Work pieces should be handled only with the tongs during and after welding.
5. Electrode should be moved slowly so that required amount of metal is in the weld puddle.

Result:

T joint has been produced by using arc welding



All dimensions are in 'mm



INJECTION MOULDING

Aim:

To Prepare a Plastic product using Injection Molding machine

Equipment:

Injection molding machine Setup.

Material Required:

High grade poly ethylene

Theory:

Plastics:

Polymers can be divided into three broad divisions: plastics, fibers and elastomers (polymers of high elasticity, for example, rubber). Synthetic resins are usually referred to as plastics. Plastics derive their name from the fact that in a certain phase of their manufacture they are present in a plastic stage (that is acquire plasticity), which makes it possible to impart any desired shape to the product. Plastics fall into a category known chemically as high polymers. Thus Plastics is a term applied to compositions consisting of a mixture of high molecular compounds (synthetic polymers) and fillers, plasticizers, stains and pigments, lubricating and other substances. Some of the plastics contain nothing but resin (for instance, polyethylene, polystyrene).

Types of Plastics:

Plastics are classified on the broad basis of whether heat causes them to set(thermosetting) or causes them to soften and melt(thermoplastic).

Thermosetting Plastics: These plastics undergo a number of chemical changes on heating and cure to infusible and practically insoluble articles. The chemical change is not reversible. Thermosetting plastics do not soften on reheating and cannot be reworked. They rather become harder due to completion of any leftover polymerization reaction. Eventually at high temperatures, the useful properties of the plastics get destroyed. This is called degradation. The **commonest thermosetting plastics are:** alkyds, epoxides, melamines, polyesters, phenolics and ureas.

Thermoplastic Plastics: These plastics soften under heat, harden on cooling, and can be resoftened under heat. Thus they retain their fusibility, solubility and capability of being repeatedly shaped. The mechanical properties of these plastics are rather sensitive to temperature and to sunlight and exposure to temperature may cause thermal degradation. Common **thermoplastics are:** acrylics, polytetra fluoro ethylene (PTFE), polyvinyl chlorides (PVC), nylons, polyethylene, polypropylene etc.

Processing of Thermoplastic Plastics:

The common forms of raw materials for processing plastics into products are: Pellets, Powders, Sheet, Plate, and Tubing. Liquid plastics are used especially in the fabrication of reinforced plastic parts. Thermoplastics can be processed to their final shape by moulding and extrusion processes. However, extruding is often used as an intermediate process to be followed by other processes for example vacuum forming or machining. An important industrial method of producing articles of thermoplastics is Injection Moulding.

Procedure:

- Pour the raw material in the hopper.
- Place the die in such a way that its hole coincides with the central axis of the cylinder.
- Heat the cylinder by pouring plastic pellets in it.
- When the metal is heated at 80°C to 100°C it is converted into molten metal.
- The die is placed exactly below the nozzle of the container.
- Press the lever so that the softened plastic will enter into the die and gets the desired shape of the mould and it is allowed to solidify say for about one minute.
- Allow it to cool for some time.
- Then retract the lever arm slightly and open the mould.
- Then eject the mould piece of the required shape from the die

Precautions:

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

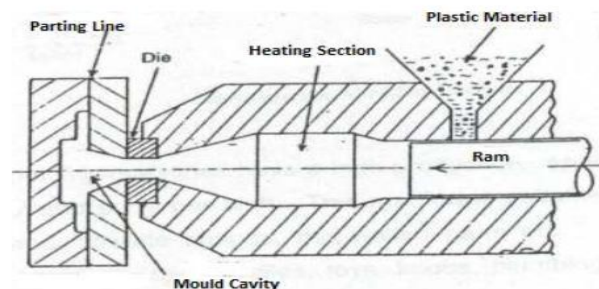


Fig.. Injection Moulding Setup



BLOW MOULDING PROCESS

Aim:

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

Equipment:

Blow moulding machine

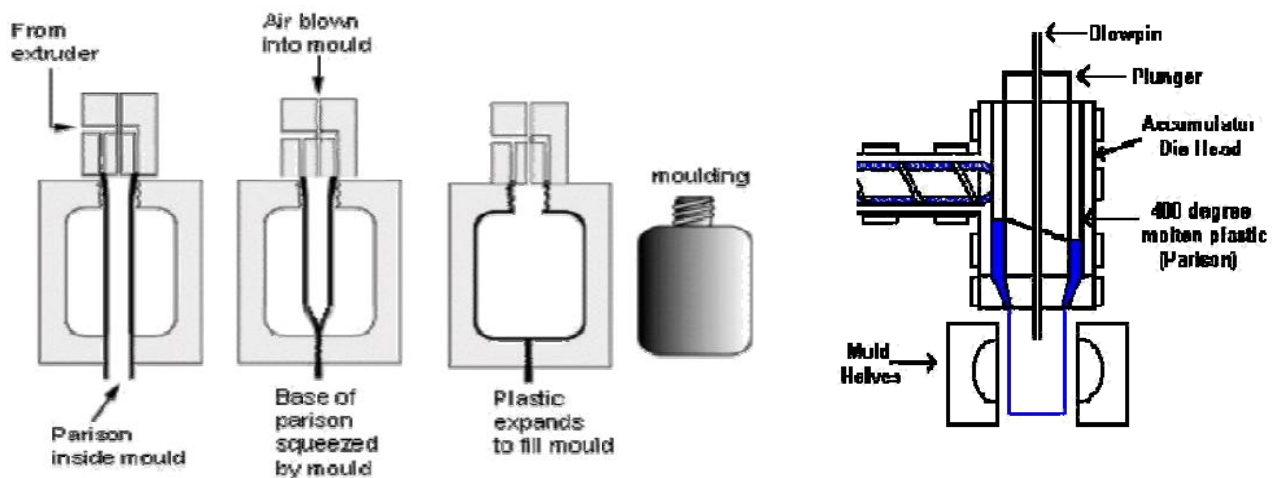
Material Required:

Low grade poly ethylene

Working Principle:

The process is applied to only thermo plastics, which are used for producing hollow objects such as bottle, and flow table objects by applying air pressure to the sheet material when it is in heated and in soft pliable condition. Blow moulding can be accomplished in two manners; one is direct blow moulding and other indirect blow moulding. In the former case, a measured amount of material in the form of tube is either injected or extruded in a split cavity die. The split mould is closed around the tube, sealing off the lower end. The air under pressure is blown into the tube, which causes the tube to expand to the walls of cavity. In the latter case, a uniformly softened sheet material by heat is clamped at the edges between the die and cover, which causes the sheet to attain a hemispherical shape or the configuration of mould whatever it may be parts obtained by indirect blow moulding have excellent appearance but they are more costly as only 10 percent of the sheet stock is utilized and also there is a tendency for excessive thinning of sheet at the deepest point.

Experimental Diagram:



Sample figure:

Operating Instructions:

1. Install the machine on leveled strong flooring near the compressor (within 2 meters). For letter rigidity foundation bolt is recommended & anti vibration rubber mounting can be used.
2. The machine must be placed in a position where all parts are accessible readily.
3. Check for loose any loose electrical connection with the help of certified electrician and with the electrical circuit enclosed.
4. Fill the lubricator with SAE 20 grade oil to the level indicated. The lubrication has been set to allow one drop of oil for every 5 strokes of air cylinder (oil) drop is factory set, no need to adjust)
5. Connect the air filter to the compressor by rubber/nylon hose (Min inside dia 10mm), pressure with standing capacity 20kg/cm².
6. Set the pressure switch in the compressor as per the compressor manual to switch on 7 kg/cm² pressure & switch off at 10kg/cm² (NOTE: The air pressure should not exceed 10cm²)
7. Set the air pressure in machine by adjusting the injection & release regulator (18).
8. Set release pressure 2kg/cm² by adjusting release regulator.
9. Operate the hand lever valve (13) and check for smooth functioning of plunger.
10. Set the blow pressure in regulator (15) and operate the hand lever valve (14) to check flow of air throw blow nozzle.
11. Electrical connection should be given as indicated on the main plug phase, neutral and earth.
12. Proper earthing should be done.
13. Check the incoming voltage (230VAC, 50Hz) Now the machine is ready for operation.

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.

Result:

Required product is made using blow molding process.

