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ME3393 - MANUFACTURING PROCESSES - BY STUCOR APP

MANUFACTURING PROCESSES

UNIVERSIT QUESTION BANK WITH ANSWERS
UNIT –I
METAL CASTING PROCESS

PART –A (2 Marks)

1 **State any four types of patterns. (May 2006)**

Ans: The various types of patterns which are commonly used areas follows:

1) Single piece or solid pattern
2) Two piece or split pattern
3) Loose piece pattern
4) Cope and drag pattern
5) Gated pattern

2 **Mention any two advantages and disadvantages of die casting. (May=2006)**

Ans: Advantages:

- It is a very fast process.
- Moulds have longer life.
- Better surface can be obtained.

Limitations:

- Moulds are much costlier.
- This method is not suitable for small quantity production.
- Shape and weight of the casting is limited.

3 **Write the requirements of good pattern. (May 2007)**

Ans: Simple in design

- Cheap and readily available
- Light in mass
- Surface id smooth
- Have high strength

4.What is core venting? (May 2007)

Ans: While pouring the mould with molten metal mould walls and cores heat up rapidly and releases large amount of gases. In order to prevent casting defects these gases must be vented out. For this purpose core venting are used. Core venting are incorporated in the core box itself.

5.What function of core ? (May 2008)

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– Ans: Functions of core are:

- Core provides a means of forming the main internal cavity for hollow casting.
- Core provides external undercut feature.
- Cores can be inserted to obtain deep recesses in the casting.
- Cores can be used to increase the strength of the mould.

6. Which process is called lost waxing method? Why? (May 2008)

Ans: Investment casting process is also known as Lost-wax process. The term investment refers to a clock or special covering apparel. In investment casting, the clock is a refractory mould which surrounds the precoated wax pattern.

7. What is the function of core prints? (Dec. 2008)

Ans:

1. Core prints are basically extra projections provided on the pattern.
2. They form core seats in the mould when pattern is embedded in the sand for mould making.
3. Core seats are provided to support all the types of cores.
4. Though the core prints are the part of pattern, they do not appear on the cast part.

8. What are the advantages and applications of ceramic moulds? (Dec. 2008)

Ans: Advantages:

- It is less expensive
- Intricate objects can be casted.
- Castings of thin sections and which do not require machining can be produced.

Applications:

- It is mainly used for all material using better ingredient in slurry.

9. What are the pattern materials? (Dec. 2008)

Ans:1) Wood 2) Metal 3) Plastic
4) Plaster 5) Wax

10. Explain the term fettling. (Dec. 2009)

Ans: Fettling is the name given to cover all those operations which help the casting to give a good appearance. It includes the removal of cores, sand, gates, risers, runners and other Unwanted projections from the casting.

11. What are the applications of casting?

Ans: Transportation vehicles (in automobile engine and tractors)

- Machine tool structures
- Turbine vanes and power generators
- Mill housing
- pump filter and valve

12. Mention the specific advantages of Co2 moulding Process.

1.Gives strength and hardness to core.
2.Process cost is less.
3.It saves time on heating.

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4.It can be stored for long use.

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13. Define AFS grain- fineness number.

It is defined as the ratio between the total products and total percentage of sand retained on pan and each sieve.AFS grain fineness number =sum of products /total sum of the % of sand retained on pan and each sieve.

14. Classify moulding Machines.

1.Squeezer Machine.
2.Jolt machine.
3.Jolt – squeezer Machine.
4.Slinging Machines.
5.Patten draw Machines.

15.what are the different types of furnaces used for casting.

1.Cupola Furnace.
2.Open Hearth furnace
3.Crucible Furnace.
4.Pot Furnace.
5.Electric Furnace.

16.State the main functions of tuyeres in cupola furnace.

The tuyers are used to supply air to the coke bed for complete burning.

Part-B (16 Marks)

1. **What are the pattern allowances? Explain briefly each.** (Nov/Dec- 2013) (16)

Five types of allowances were taken into consideration for various reasons. They are

1.Shrinkage allowance

Any metal when heated to liquid stage and solidified will undergo change in dimension. Mostly the dimension of the product will be reduced, then the actual size of the pattern. Hence the patterns are made slightly in larger dimensions.(3%-5%)

2.Draft allowance

It will be difficult to remove the pattern from the mould cavity (without disturbing the mould) after ramming of sand. Hence the pattern (wooden or metal pattern) is slightly given 2 ^{o}– 3 ^{o} TAPER in the z - axis or vertical direction.

3. **Finish allowance**

It is otherwise called as machining allowance .The pattern is made slightly 5mm -10mm large in dimension than the required final part dimension. After casting the extra material is removed from the solidified material by machining.

4.Shake or Rapping allowance.

Before withdrawing the pattern it is rapped and thereby the size of the mould cavity increases. Actually by rapping , the external sections move outwards increasing the size and internal sections move inwards decreasing the size. This allowance is kept negative and hence the pattern is made slightly smaller in dimensions 05.1.0 mm.

5.Distortion allowance.

Some material might tend to bend or distort from the actual size or dimensions. Hence the pattern is give counter balance degree or angle of recess so that the material will be in the required dimension when solidified in the mould cavity.

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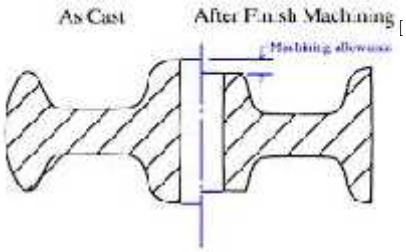
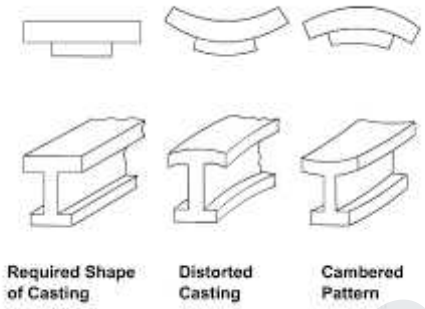


Example of machining or "cleanup' allowance on hub face of a wheel casting



2. Explain the CO2 process of core making state its advantages and applications. (16)

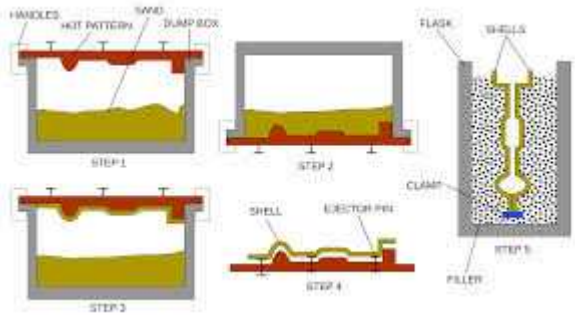
Working Principle

The highly flowable mixture of pure dry silica sand and sodium silicate binder is rammed or blown into the mould or core box. Carbon –dioxide gas at a pressure of about 1.5 bar is diffused through the mixture (of sand and sodium silicate) to initiate the hardening reaction which takes from a few seconds to a few minutes depending upon the size of core or mould.Passage of carbon-dioxide through the sand containing sodium silicate produces carbonic acid in the aqueous solution, this causes a rise in the SiO_2- Na_2O ratio and the formation of a colloidal silica gel which hardens and forms a bond between the sand grains. The reaction is represented by the following equation.

$NaSiO_3 + CO2$ ---------→ $NaCO_3 + SiO_2$
(Sodium Silicate) (Silica Gel)

Carbon Dioxide Moulding Operation

This sand is mixed with 3 to 5 % sodium silicate liquid base binder in Muller for 3 to 4 minutes. Additives such as coal powder, wood flour sea coal, and dextrin may be added to b improve its properties. Aluminium oxide Kaolin clay may also added to the sand. Patterns used in this method may be coated with Zinc of 0.05 mm to 0.13 mm and then spraying a layer of aluminium or brass of about 0.25 mm thickness for good surface finish and good results.



Advantages

- Operation is speedy since we can use the mould and cores immediately after processing.
- Heavy and rush orders
- Floor space requirement is less
- Semi skilled labor may be used.

Disadvantages

Difficult in reusing the moulding sand.

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3. Write a short note on 'Green sand mould' and shell Moulding.

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Sand Casting (Green sand mould) is simply melting the metal and pouring it into a preformed cavity, called mold, allowing (the metal to solidify and then breaking up the mold to remove casting. In sand casting expandable molds are used. So for each casting operation you have to form a new mold.

- Sand with a mixture of water and bonding clay
- Typical mix: 90% sand, 3% water, and 7% clay
- to enhance strength and/or permeability

Sand – Refractory for high temperature.

TYPES OF SAND

a) Green-sand molds - mixture of sand, clay, and water; "Green" means mold contains moisture at time of pouring.

b) Dry-sand mold - organic binders rather than clay and mold is baked to improve strength

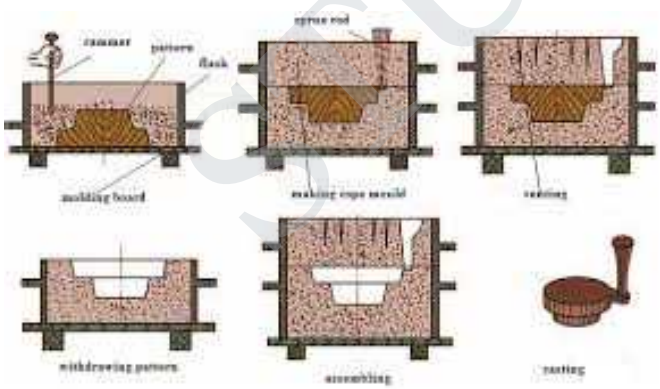
c) Skin-dried mold - drying mold cavity surface of a green-sand

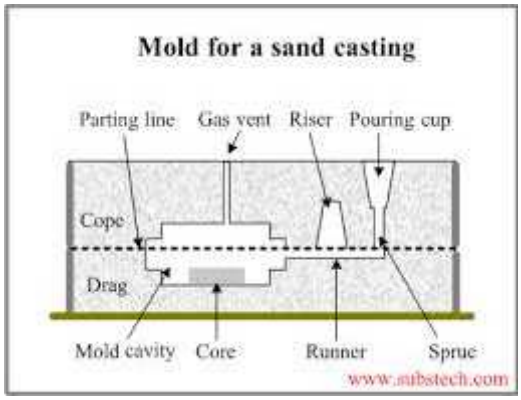
- mold to a depth of 10 to 25 mm, using torches or heating

Steps in Sand Casting

The cavity in the sand mold is formed by packing sand around a pattern, separating the mould into two halves.The mold must also contain gating and riser system For internal cavity, a core must be included in mold A new sand mold must be made for each part

1. Pour molten metal into sand mold
2. Allow metal to solidify
3. Break up the mold to remove casting
4. Clean and inspect casting
5. Heat treatment of casting is sometimes required to improve metallurgical properties





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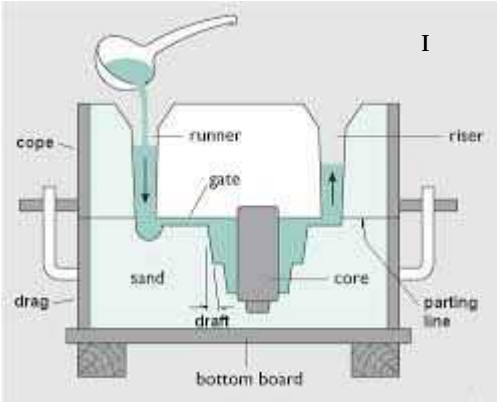
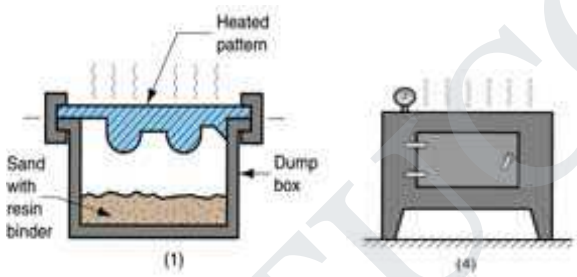


Steps in shell-molding

Shell-mold casting yields better surface quality and tolerances.

The process is described as follows:

The 2-piece pattern is made of metal (e.g. aluminum or steel), it is heated to between 175°C-370°C, and coated with a lubricant, e.g. silicone spray. Each heated half-pattern is covered with a mixture of sand and a thermoset resin/epoxy binder. The binder glues a layer of sand to the pattern, forming a shell. The process may be repeated to get a thicker shell.The assembly is baked to cure it.The patterns are removed, and the two half-shells joined together to form the mold; metal is poured into the mold. When the metal solidifies, the shell is broken to get the part.



Advantages of shell moulding

- Smoother cavity surface permits easier flow of molten metal and better surface finish on casting

  Good dimensional accuracy

  Machining often not required

  Mold collapsibility usually avoids cracks in casting

  Can be mechanized for mass production

Disadvantages of shell moulding.

More expensive metal pattern

Difficult to justify for small quantities

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4. Briefly explain about Investment casting.

Investment Casting

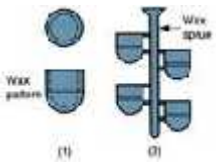
Investment casting produces very high surface quality and dimensional accuracy. Investment casting is commonly used for precision equipment such as surgical equipment, for complex geometries and for precious metals.

This process is commonly used by artisans to produce highly detailed artwork.

The first step is to produce a pattern or replica of the finished mould. Wax is most commonly used to form the pattern, although plastic is also used.

- Patterns are typically mass-produced by injecting liquid or semi-liquid wax into a permanent die.
- Prototypes, small production runs and specialty projects can also be undertaken by carving wax models.
- Cores are typically unnecessary but can be used for complex internal structures. Rapid prototyping techniques have been developed to produce expendable patterns.
- Several replicas are often attached to a gating system constructed of the same material to form a tree assembly. In this way multiple castings can be produced in a single pouring.

Casting with expendable mould: Investment Casting



advantages

– Parts of great complexity and intricacy can be cast
– Close dimensional control and good surface finish
– Wax can usually be recovered for reuse
– Additional machining is not normally required - this is a net shape process

Disadvantages

– Many processing steps are required
– Relatively expensive process

5.Explain about MPT Magnetic Particle testing in detail.

This method of inspection is used on magnetic ferrous castings for detecting invisible surface or slightly subsurface defects. Deeper subsurface defects are not satisfactorily detected because the influence of the distorted lines of magnetic flux (owing to a Discontinuity) on the magnetic particles spread over the casting.

The defects commonly revealed by magnetic particle inspection are quenching cracks, overlaps, thermal cracks, seams , laps, grinding cracks, fatigue cracks, hot tears Etc,

Working Principle.

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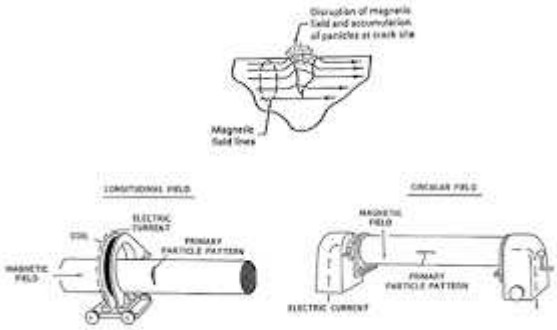
When a piece of metal is place in a magnetic field and the lines of magnetic flux get intersected by a discontinuity such as a crack or slag inclusion in a casting, magnetic poles are induced on either side of the discontinuity. The discontinuity causes an abrupt change in the path of magnetic flux flowing through the casting normal to the discontinuity, resulting in a local flux leakage field and interference with the magnetic lines of force. This local flux disturbance can be detected by its effect upon magnetic particles which are attracted to the region of discontinuity and pile up and bridge over the discontinuity.

A surface crack is indicated (under favorable conditions) by a line of fine particles following the crack outline and a subsurface defect by a fuzzy collection of the magnetic particles on the surface near the discontinuity. Maximum sensitivity of indication is obtained when the discontinuity lies in a direction normal to the applied magnetic field and when the strength of magnetic field is just enough to saturate the section being inspected.



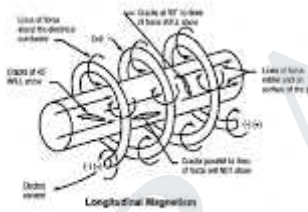


Figure 10.22—Longitudinal Magnetism

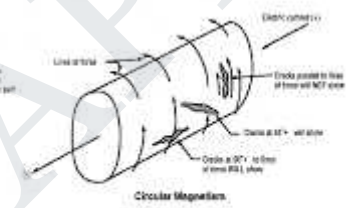
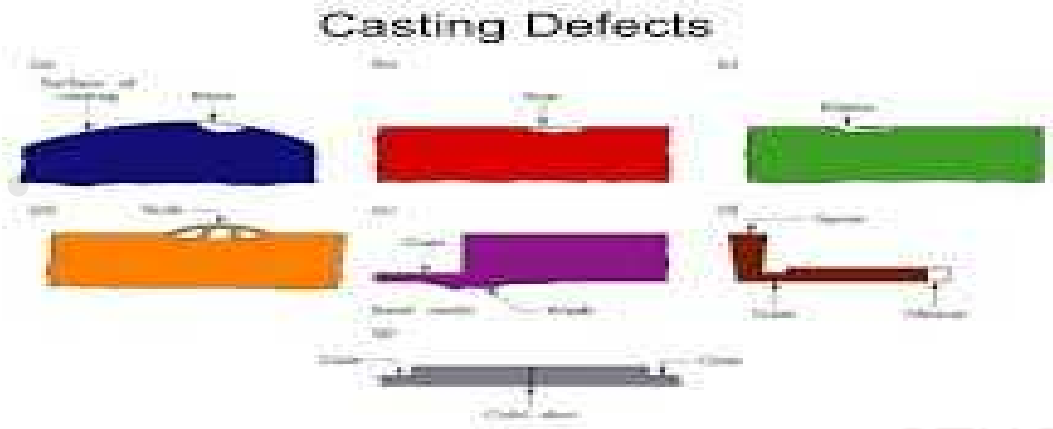


Figure 10.23—Circular Magnetism

11. What are the defects occur in products made by casting process. Explain with neat sketch. (NOV/DEC 2013) (16)



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Casting defects

Defects may occur due to one or more of the following reasons:

- Fault in design of casting pattern
- Fault in design on mold and core
- Fault in design of gating system and riser
- Improper choice of moulding sand
- Improper metal composition
- Inadequate melting temperature and rate of pouring

Some common defects in castings:

a) Misruns b) Cold Shut c) Cold Shot d) Shrinkage Cavity e) Microporosity f) Hot Tearing

Misruns:

a)Misruns

It is a casting that has solidified before completely filling the mold cavity.

Typical causes include

1) Fluidity of the molten metal is insufficient,
2) Pouring Temperature is too low,
3) Pouring is done too slowly and/or
4) Cross section of the mold cavity is too thin.

b) Cold Shut

A cold shut occurs when two portion of the metal flow together, but there is lack of fusion between them due to premature freezing, Its causes are similar to those of a Misruns.

c) Cold Shots

When splattering occurs during pouring, solid globules of the metal are formed that become entrapped in the casting. Poring procedures and gating system designs that avoid splattering can prevent these defects.

d) Shrinkage Cavity

This defects is a depression in the surface or an internal void in the casting caused by solidification shrinkage that restricts the amount of the molten metal available in the last region to freeze.

e) Microporosity

This refers to a network of a small voids distributed throughout the casting caused by localized solidification shrinkage of the final molten metal in the dendritic structure.

f) Hot Tearing

This defect, also called hot cracking, occurs when the casting is restrained or early stages of cooling after solidification.

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UNIT – II

METAL JOINING PROCESS

1 List out any four arc welding equipment. (May 2006)

Ans: The most commonly used equipments for arc welding are as follows:

(a) A.C or D.C. machine
(b) Wire brush
(c) Cables and connectors
(d) Ear thing clamps
(e) Chipping hammer

2 What are the special features of friction welding? (May 2007)

Ans:

- Friction welding is a solid state welding process where coalescence is produced by the heat obtained from mechanically induced sliding motion between rubbing surfaces.
- The work parts are held together under pressure.
- Its operating is simple.
- Power required for the operation is low.
- It is used for joining steels, super alloys, non-ferrous metals and combinations of metals.

3.Define resistance welding process. (May 2006, May 2007)

Ans: Resistance welding is a process where coalescence is produced by the heat obtained from resistance offered by the workpiece to the flow of electric current in a circuit of which the workpiece is a part and by the application of pressure.

4.What is the purpose of flux? (May 2008)

Ans: 1) It acts as shield to weld.
2) To prevent atmospheric reaction of molten metal with atmosphere.

5. How can slag inclusions in welding be avoided? (May 2008)

Ans: Avoid multi layer welding

- Reduce arc length
- Increase electrode angle
- Avoid using large electrode

6 **How does brazing differ from braze welding? (Dec. 2008)**

Ans:

Brazing	**Braze Welding**
The filler alloy is fed to one or more points in the assembly and it is drawn into the rest of the joint by capillary action.	The filler alloy is deposited directly at the point where it is desired.

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7 **Why flux is coated on filler rods? (Dec. 2008)**

Ans: The coating improves penetration and surface finish.

- Suitable coating will improve metal deposition rates.

8 **What is the application of carburizing flame? (Dec. 2009) Ans:**

- Carburizing flame is generally used for: o Welding of low alloy steel rods
  - o Non-ferrous metals
  - o High carbon steel

9 What are the diameter and length of the electrodes available in the market? (Dec. 2009)

Ans: Standard length of electrodes are 250 mm, 300 mm and 450 mm.

- Standard diameters of electrodes are 1.6,2 ,2.5, 3.2, 4,5,6,7,8, and 9 mm.

10. Classify various ARC welding processes

(i) **Arc welding**

- Carbon arc
- Metal arc
- Metal inert gas
- Tungsten inert gas
- Plasma arc
- Submerged arc
- Electro-slag

11. Classify various GAS welding processes

(ii) **Gas Welding**

- Oxy-acetylene
- Air-acetylene
- Oxy-hydrogen

12. Name the various methods of Resistance Welding

B UTT
Spot
Seam
Projection & Percussion.

13. What is 'Brazing'

It is defined as the t3echnique of joining two dissimilar or similar materials by addition of special filler material. Brazing gives a much stronger joint than soldering but requires greater heat which cannot be obtained from copper in soft soldering.

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14.Mention the applications of frictiɒn welding.

Used in refrigeration.
Used in super alloys.
Making simple forging.
Production of taper and reamer drills
Production of axle shafts , valves and gears.

15.Name the chemicals used in flux Manufacure.

1.Chlorides
2.Borax and boric acid.
3.Borates
4.Fluorides.

Part-B (16Marks)

1. **Define welding, mention its types, Explain Arc welding with a neat sketch and Mention its advantages and limitations. (16) (NOV/DEC 2010)**

Welding

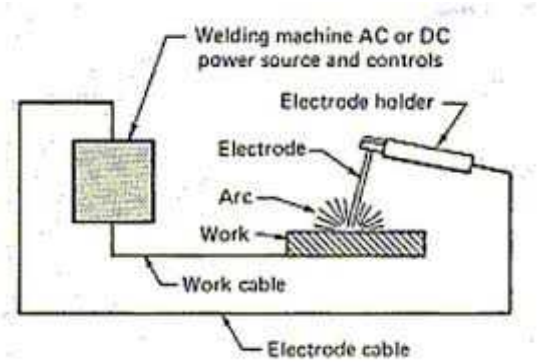
Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the pplication of pressure or by the application of pressure alone, and with or without the use of filler material. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

Types of welding

ARC Welding
Gas Welding

Arc welding

Uses an electric arc to coalesce metals
Arc welding is the most common method of welding metals
Electricity travels from electrode to base metal to ground



Arc welding Equipments

- A welding generator (D.C.) or Transformer (A.C.)
- Two cables- one for work and one for electrode
- Electrode holder

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- Electrode
- Protective shield
- Gloves
- Wire brush
- Chipping hammer
- Goggles

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Electrode

Electrode is a thin rod made up of same as that of parent material. Flux is coated over the electrode to avoid oxidation. It is mostly connected to the negative polarity.

Two Basic Types of AW Electrodes

Consumable – consumed during welding process
Source of filler metal in arc welding
Nonconsumable – not consumed during welding process
Filler metal must be added separately

Consumable Electrodes

Forms of consumable electrodes

- Welding rods (a.k.a. sticks) are 9 to 18 inches and 3/8 inch or less in diameter and must be changed frequently
- Weld wire can be continuously fed from spools with long lengths of wire, avoiding frequent interruptions

In both rod and wire forms, electrode is consumed by arc and added to weld joint as filler metal.

Nonconsumable Electrodes

Made of tungsten which resists melting
Gradually depleted during welding (vaporization is principal mechanism)
Any filler metal must be supplied by a separate wire fed into weld pool

Flux

A substance that prevents formation of oxides and other contaminants in welding, or dissolves them and facilitates removal

Provides protective atmosphere for welding
Stabilizes arc
Reduces spattering

Welding practice & equipment

STEPS :

- Prepare the edges to be joined and maintain the proper position
- Open the acetylene valve and ignite the gas at tip of the torch
- Hold the torch at about 45deg to the work piece plane

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- Inner flame near the work piece and filler rod at about 30 – 40 deg
- Touch filler rod at the joint and control the movement according to the flow of the material

Advantages

Most efficient way to join metals
Lowest-cost joining method
Affords lighter weight through better utilization of materials
Joins all commercial metals
Provides design flexibility

Disadvantages

- Manually applied, therefore high labor cost.
- Need high energy causing danger
- Not convenient for disassembly.
- Defects are hard to detect at joints.

2. Define welding, mention its types, Explain Gas welding with a neat sketch and Mention the equipments used , types of flames produced and give its advantages and limitations. (16) APR /MAY -2010

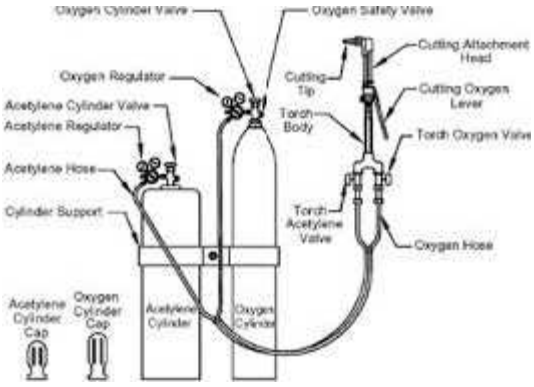
Welding

Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

Types of welding

ARC Welding
Gas Welding

GAS WELDING



Sound weld is obtained by selecting proper size of flame, filler material and method of moving torch

The temperature generated during the process is 33000c.

When the metal is fused, oxygen from the atmosphere and the torch combines with molten metal and forms oxides, results defective weld

Fluxes are added to the welded metal to remove oxides

Common fluxes used are made of sodium, potassium. Lithium and borax.
Flux can be applied as paste, powder, liquid. solid coating or gas.

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GAS WELDING EQUIPMENT

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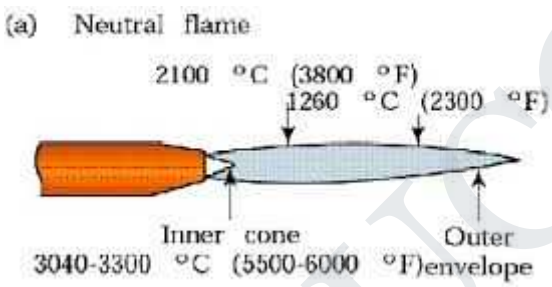
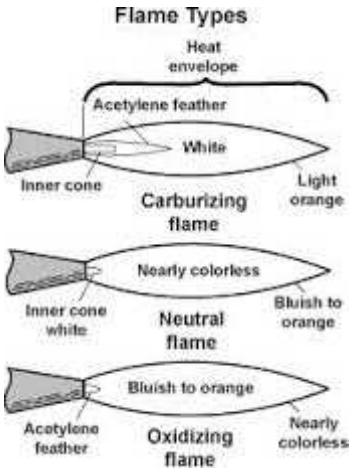
1.Gas Cylinders
Pressure
Oxygen – 125 kg/cm2
Acetylene – 16 kg/cm2
2. Regulators
Working pressure of oxygen 1 kg/cm2
Working pressure of acetylene 0.15 kg/cm2
Working pressure varies depends upon the thickness of the work pieces welded.
3. Pressure Gauges
4. Hoses
5. Welding torch
6. Check valve
7. Non return valve

Three basic types of oxyacetylene flames used in oxyfuel-gas welding and cutting operations:
(a) neutral flame; (b) oxidizing flame; (c) carburizing, or reducing flame.





Addition of more oxygen give a bright whitish cone surrounded by the transparent blue envelope is called **Neutral flame** (It has a balance of fuel gas and oxygen) (32000c)

- Used for welding steels, aluminium, copper and cast iron

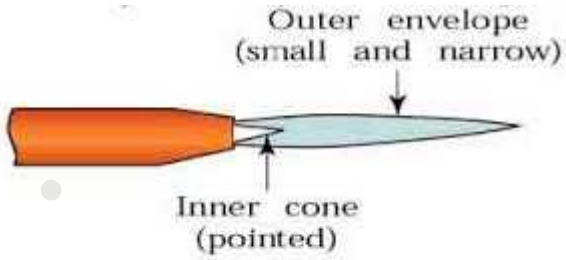


Figure3: Oxidizing Flame

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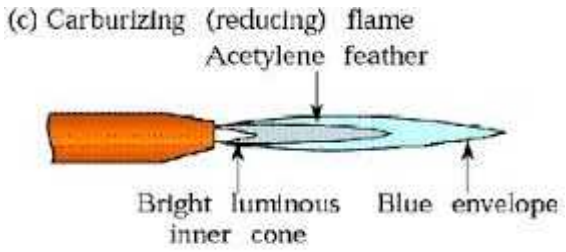
oxygen give a bright whitish cone surrounded by the transparent blue envelope is called **Neutral flame** (It has a balance of fuel gas and oxygen) (32000c)

- Used for welding steels, aluminium, copper and cast iron



Oxygen is turned on, flame immediately changes into a long white inner area (Feather) surrounded by a transparent blue envelope is called **Carburizing flame** (30000c)

Advantages of Gas welding.

1.Simple Equipment
2.Portable
3.Inexpensive
4.Easy for maintenance and repair

Disadvantages Of Gas welding

1.Limited power Density
2.Very low welding speed.
3.High total heat input per unit length
4.Large Heat affected Zone
5.Severe Distortion
6.Not recommended for welding reactive metals such as titanium and Zirconium.

3. Give the Difference between Gas Welding and Arc Welding.

Sr No	GAS WELDING	ARC WELDING
1.	Heat is produced by the Gas Flame	Heat is produced by Electric Arc
2.	The flame temperature is about 3200°C	The temperature of Arc is about 4000°C

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3.	Separate Filler rod introduced I	Arc Producing as well as filler rod material is the electrode.
4.	Suggested for thin materials	Suggested for medium and thick materials
5.	Gas welded parts do not have much strength	Arc welded parts have very high strength
6.	Filler metal may not be the same parent metal	Filler metal must be same or an alloy of the parent metal
7.	Brazing and soldering are done using gas	Brazing and soldering can't be carried out by electric arc.

4. **Explain Submerged arc welding with a neat sketch. State its advantages and disadvantages**. (NOV/DEC-2011).

Submerged arc welding

- Weld arc is shielded by a granular flux , consisting of silica, lime, manganese oxide, calcium fluoride and other compounds.
- Flux is fed into the weld zone by gravity flow through nozzle

Thick layer of flux covers molten metal

- Flux acts as a thermal insulator ,promoting deep penetration of heat into the work piece
- Consumable electrode is a coil of bare round wire fed automatically through a tube
- Power is supplied by 3-phase or 2-phase power lines

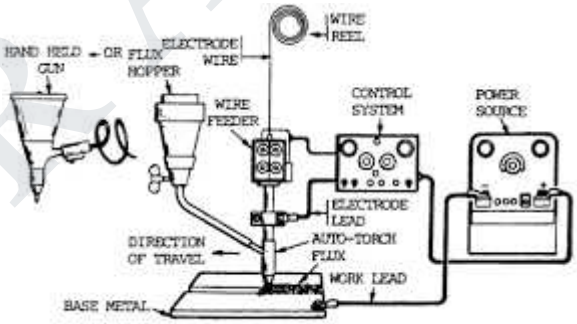
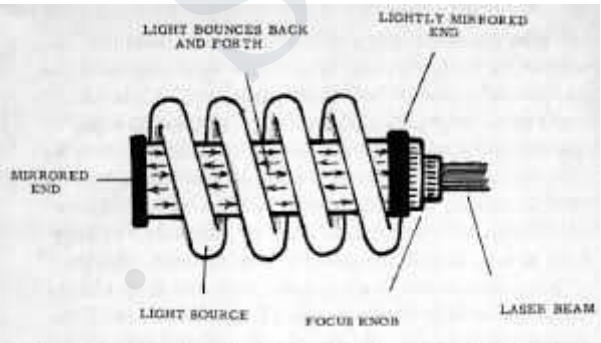


Figure 10-59. Block diagram - SAW.

5. **Explain the method of laser beam welding and give their applications (APR/MAY 2014) (16)**



Laser Beam Welding (LBW)

Fusion welding process in which coalescence is achieved by energy of a highly concentrated, coherent light beam focused on joint

Laser = "light amplification by stimulated emission of radiation"

LBW normally performed with shielding gases to prevent oxidation

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Filler metal not usually added
High power density in small area, so LBW often used for small parts

Working

The laser WELDING system consists of a power source, a flash lamp filled with Xenon, lasing material, focusing lens mechanism and worktable. The flash tube flashes at a rate of thousands per second. As a result of multiple reflections, Beam power is built up to enormous level.

The output laser beam is highly directional and strong, coherent and unicromatic with a wavelength of 6934°A. It goes through a focusing device where it is pinpointed on the work piece, fusion takes place and the weld is accomplished due to concentrated heat produced. Laser beam welding process is shown in the figure.

Advantages.

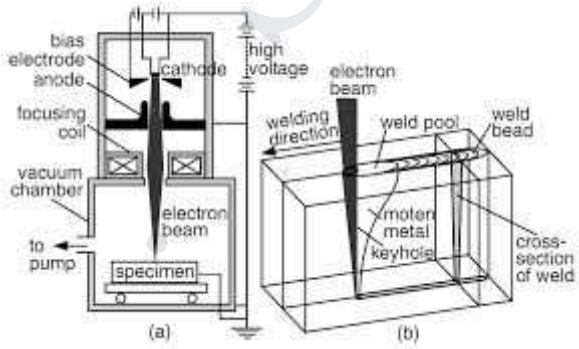
1.Wide variety of metals can be welded.
2.Thermal damage is minimum.
3.Weld metal is purified.
4.Good ductility and mechanical properties.
5.Welds are vaccum tight.
6.filler metal is not used.
7.No effect on heat treated components.

Limitations.
1.Low welding Speed.
2.Limited to thickness of 1.5mm.
3.Materials like Mg cannot be welded.

APPLICATIONS

Radio Engineering and Microelectronics.

6. Explain the method of electron beam welding and given their applications (16)



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Electron Beam Welding (EBW)

Fusion welding process in which heat for welding is provided by a highly-focused, high-intensity stream of electrons striking work surface

Electron beam gun operates at:

High voltage (e.g., 10 to 150 kV typical) to accelerate electrons

Beam currents are low (measured in milliamps)

Power in EBW not exceptional, but power density is

Working

The Kinetic energy of the electrons is converted into intense heat energy when the electrons are absorbed by the metal piece over a small area of the weld, producing deep penetration weld with a depth/width ratio as high as 15. This results in a narrow, almost parallel weld with very little distortion and a small width of the heat affected zone. There is no possibility of contamination by atmospheric gases because process is carried out in vaccum.

Advantages

High-quality welds, deep and narrow profiles

Limited heat affected zone, low thermal distortion

High welding speeds

No flux or shielding gases needed

Disadvantages

High equipment cost

Precise joint preparation & alignment required

Vacuum chamber required

Safety concern: EBW generates x-rays

Comparison: LBW vs. EBW

No vacuum chamber required for LBW

No x-rays emitted in LBW

Laser beams can be focused and directed by optical lenses and mirrors

LBW not capable of the deep welds and high depth-to-width ratios of EBW

Maximum LBW depth = ~ 19 mm (3/4 in), whereas EBW depths = 50 mm (2 in)

7. Describe plasma Arc welding and give their applications (NOV/DEC 2011) (16)

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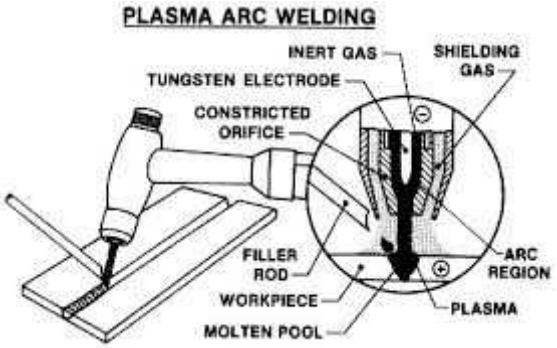

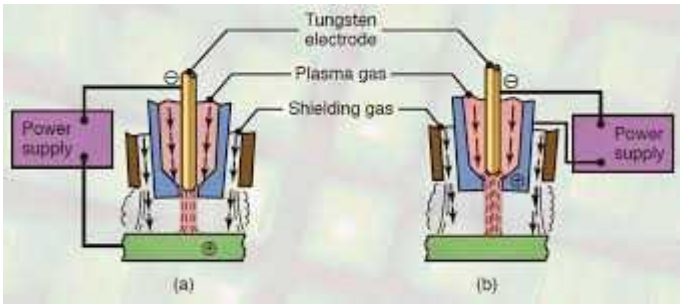

Principle:

Plasma Arc welding is a constricted arc process. The arc is constrained with the help of a water cooled small diameter nozzle which squeezes the arc, increases its pressure, temperature and heat intensely and thus improves stability, arc shape and heat transfer, characteristics

There are two methods of Plasma Arc Welding

1.Transferred Arc
2.Non- Transferred Arc.

1.Transfered Arc

Here the electrical circuit is between the tungsten electode and the work piece. Work piece acts as anode and the tungsten electrode as cathode. The arc is transferred from the electrode to the work piece and hence the term transferred. Here the arc force is directed away from the plasma torch and into the work piece, hence capable of heating the work piece to a higher temperature.

2.NON-Transferred Arc.

In Non-transferreed type, power is directly connected with the electrode and the torch of nozzle. The electrode carries the same current. Thus ,ionizing a high velocity gas that is strewing towards the workpiece. The main advantage of this type is that the spot moves inside the wall and heat the incoming gas and outer layer remains cool. This type of plasma has low thermal efficiency.

Advantages

1.Ensures arc stability.
2.Produces less thermal distortion
3.The process is readily automated.

Disadvantages.

1.Excessive noise is produced.
2.Equipment is complicated and expensive.
3.Large amount of ultraviolet and infrared rays are emitted.

8. Explain Thermit welding and given their applications (16)

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FW process in which heat for coalescence is produced by superheated molten metal from the chemical reaction of thermite

Thermite = mixture of Al and Fe3O4 fine powders that produce an exothermic reaction when ignited

Also used for incendiary bombs

Filler metal obtained from liquid metal

Process used for joining, but has more in common with casting than welding

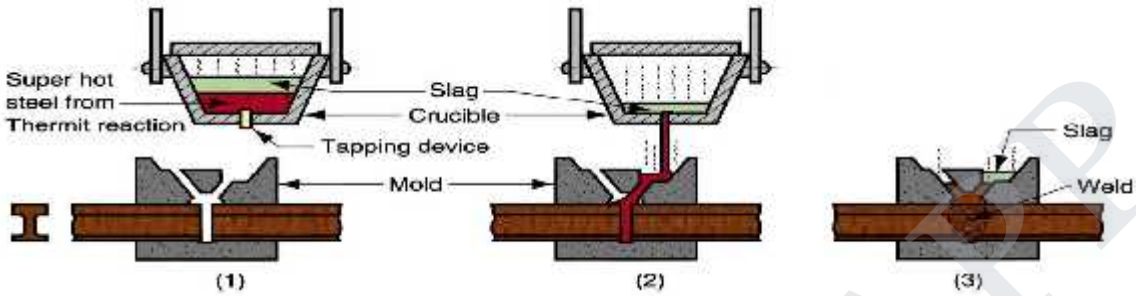


Fig: Thermit welding: (1) Thermit ignited; (2) crucible tapped, superheated metal flows into mold; (3) metal solidifies to produce weld joint.

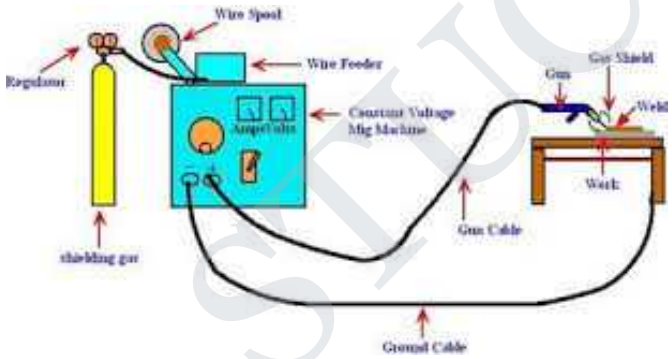
Applications

joining of railroad rails

Repair of cracks in large steel castings and forgings

Weld surface is often smooth enough that no finishing is required

9. Explain TIG and MIG welding in detail.



Inert Gas Welding

For materials such as Al or Ti which quickly form oxide layers, a method to place an inert atmosphere around the weld puddle had to be developed

Metal Inert Gas (MIG)

- Uses a consumable electrode (filler wire made of the base metal)
- Inert gas is typically Argon

Gas Tungsten Arc Welding (GTAW)

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Uses a non-consumable tungsten electrode and an inert gas for arc shielding

Melting point of tungsten = 3410 C (6170 F)

A.k.a. Tungsten Inert Gas (TIG) welding

In Europe, called "WIG welding"

Used with or without a filler metal

When filler metal used, it is added to weld pool from separate rod or wire

Applications: aluminum and stainless steel most common

Advantages

High quality welds for suitable applications

No spatter because no filler metal through arc

Little or no post-weld cleaning because no flux

Disadvantages

Generally slower and more costly than consumable electrode AW processes

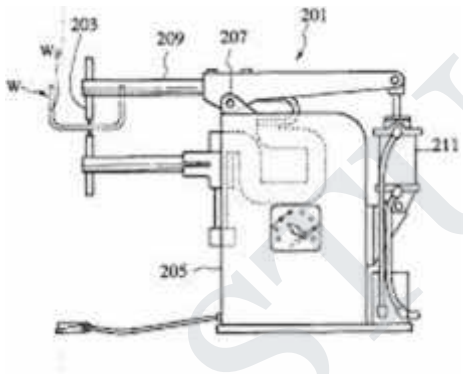
10. What is resistance welding; Mention the various types of Resistance welding. Explain in details about spot welding.

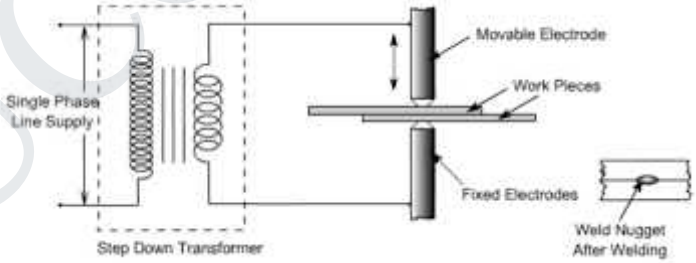
Resistance Welding (RW)

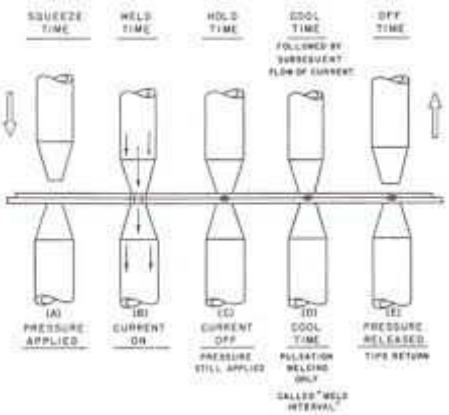
A group of fusion welding processes that use a combination of heat and pressure to accomplish coalescence

Heat generated by electrical resistance to current flow at junction to be welded

Principal RW process is resistance spot welding (RSW







Components in Resistance Spot Welding

Parts to be welded (usually sheet metal)

Two opposing electrodes

Means of applying pressure to squeeze parts between electrodes

Power supply from which a controlled current can be applied for a specified

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time duration

Advantages I

No filler metal required
High production rates possible
Lends itself to mechanization and automation
Lower operator skill level than for arc welding
Good repeatability and reliability

UNIT III

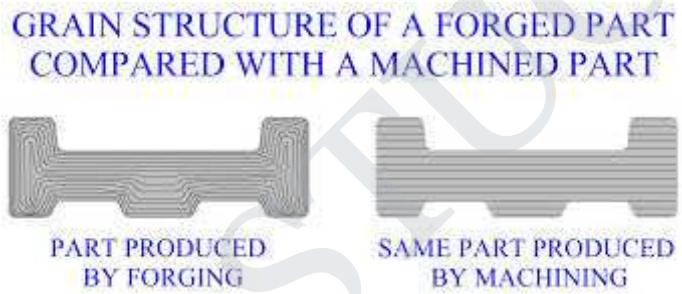
METAL FORMING PROCESS

1 **What are the four major drawbacks of hot working? (May 2006)**

Ans:

- As hot working is carried out at high temperatures, a rapid oxidation orscale formation takes place on the metal surface which leads to poor surface finish and loss of metal.
- Due to the loss of carbon from the surface of the steel piece being worked, the surface layer loses its strength.
- This weakening of the surface layer may give rise to fatigue crack which results in failure of the part.
- Close tolerance cannot be obtained.
- Hot working involves excessive expenditure on account of high tooling cost.

2. **Explain why parts produced by Forging is preffered when compared to other machining and welding process.**



2 **Classify the types of extrusion. (May 2006)**

Ans: Extrusion

1. Hot Extrusion
2. Cold Extrusion
3. Hot extrusion

(A)Direct extrusion,(B) Indirect extrusion,(C)Tube extrusion

3 **What is the difference between a bloom and a billet? (May 2007)**

Ans: A bloom has a square cross section with minimum size of 150x150 mm and a billetis smaller than bloom and it may have any square section from 38 mm upto the size of a bloom.

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4 **What is impact extrusion ? (May 2007)**

Ans: The raw material is in slug form which have been turned from a bar or punched from a strip. By using punch and dies, the operation is performed. The slug is placed in the die and struck from top by the punch opareting at high pressure and speed.

5 **Why are a number of passes required to roll a steel bar? (May 2008)**

Ans: To reduce the thickness and to increase the width of the bar number of passesare required.

6 **How are seamless tubes produced? (May 2008)**

Ans: Seamless tubing is a popular and economical raw stock for machining because it saves drilling and boring of parts. The piercing machine consists of two rapered rolls, called as piercing rolls.

7 **What is Sejournet process? (Dec. 2008)**

Ans: That extrusion process which is based both on the use of a lubricantin a viscous condition at extrusion temperature and on a separation between the lubrication of the chamber wall and die is called Sejournet process.

8 **What is skew rolling ?(Dec. 2008)**

Ans: The rolls are powered and the workpiece is in due to frictional force between metal and surface. The torque on the rolls is being zero.

9 **Explain the term Extrusion process. (Dec.2009)**

Ans: The extrusion process consists of compressing a metal inside achamber to force itout through a small opening which is called as die. Any plastic material can be successfully extruded. A large number of extruded shapes which are commonly used are tubes, rods, structural shapes and lead covered cables. During the process, a heated cylindrical billet is placed in the container and forced out through a steel die with the help of aramor plunger.

10 **What are the disadvantages of forging processes? (Dec. 2009)**

Ans:

- Complicated shapes cannot be produced.
- Generally used for large parts.
- Because of cost of dies, process is costly.

11.Define Impact extrusion.

Ans. It is a cold working process of making required shape by striking slugs of metal by high impact. It is used for making tooth paste ,shaving cream and collapsible medicine tubes.

12.What is meant by cold spinning. It is the operation of shaping very thin metals by pressing against a form while it is rotating , It is carried out at room temperature.

13.Define Hot Spinning.

It is the process of making circular cross section or a dish or head from circular , heavy plates by spinning sheet metal.

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14.What is wire drawing.

Drawing of metal through a small aperture die and wounding in the form of coil is called wire drawing. The aperture is generally below 16mm diameter.

15.What is meant by deep Drawing.

It is the process of making cup shaped parts from sheet metal blanks, where the depth of the cup is greater than that of the diameter of the cup.

Part-B (16 Marks)

1. **Compare HOT working and Cold Working.**

SR NO	HOT WORKING	COLD WORKING
1.	Hot working is done above recrystallisation temperature	Cold working isdone below recrystallisation temperature.
2.	Refinement of grains takes place	Grain structure is distorted.
3.	Impurities and porosity are removed from metals after hot working.	Impurities and porosities exist in metal after cold working.
4.	Residual stresses are eliminated.	Residual stresses are not eliminated.
5.	Rapid oxidation or scaling of surfaces occurs which results in poor surface finish.	No oxidation and hence good surface finish is obtained.
6.	Close dimensional tolerances cannot be maintained.	Close dimensional tolerances can be obtained.
7	Toolling and handling costs are more.	Tooling and handling costs are less
8.	Mecanical properties such as Toughness,ductility,elongation are improved.	Cold w2orking decreases elongation,reduction in area , hardness, tensile strength. Fatigue strength are improved.

2. **Define rolling and discuss according to the classification. (APR/MAY-2010) (16)**

Rolling is the most rapid method of forming metals into desired shapes by plastic deformation in between rolls.

The forming of bars, plates , sheets, rails and other steel sections are produced by rolling.

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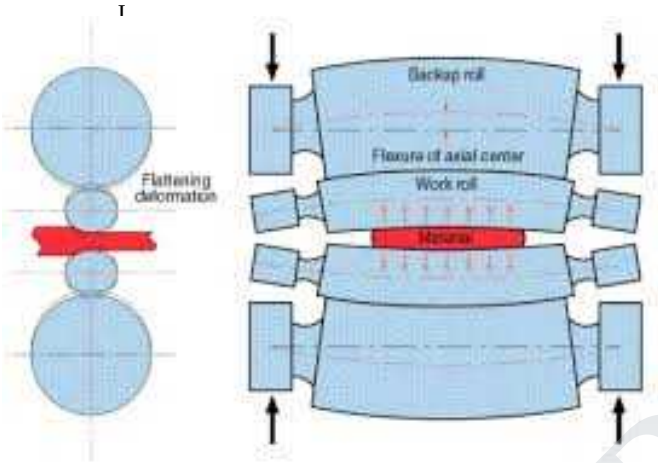
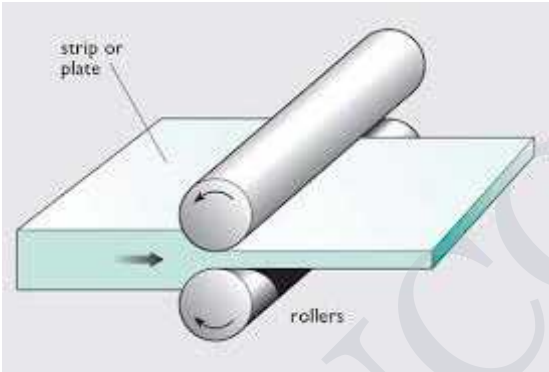
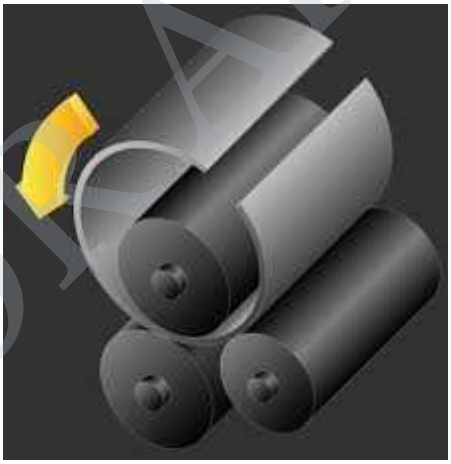






Classification of Rolling mill based on number of rolling mills.

1.Two High Rolling Mill.

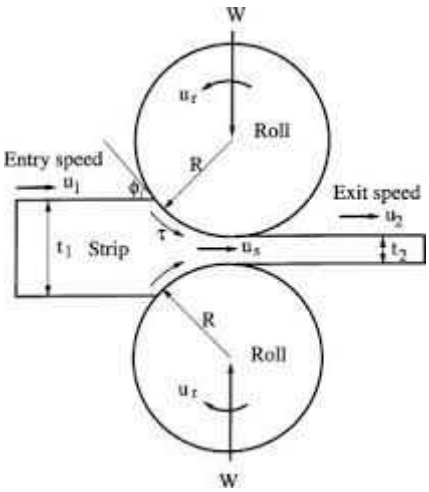
2.Three high Rolling Mill

3.Four high Rolling Mill

4. Multi Rolling Mill.

5.Universal Rolling Mill

6.Planetary Rolling Mill.



1.Two High Rolling Mill.

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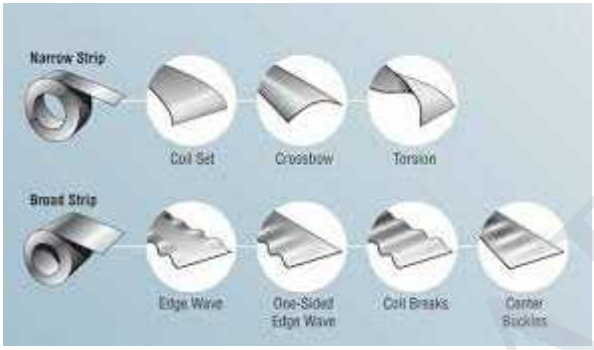
This Mill has two rolls. Both the rolls rotate in a constant direction about the horizontal axis. The principle operation of this process is reduction of cross sectional area of stock and increasing the length. This method is used for both cold and hot rolling operation.

3. What are the defects in rolled parts?



There are two types of major defects on the rolled products.

1. SURFACE DEFECTS
2. INTERNAL SURFACE DETECTS.

1.SURFACE DEFECTS

Major surface defects on rolled products are scales, rust, scratches,cracks, and pits.

These defects occurs on the rolled products due to the impurities and inclusions present in the original cast materials.,

II.Internal surface defects

1.waviness or wavy edges.

It occurs due to the bending of rolls. The rolls acts as a straight beam. If the material flow is continuous and to maintain this continuity, strains with in the material should adjust with itself. There are compressive strain on the edges and tensile strain at the centre. The edges are restrained from expanding freely in the longitudinal direction because of which wavy edges on the sheet will be produced.

2.Zipper Cracks

It occurs due to poor material ductility, at the rolling temperatureCamber is provided to avoid this defect., Camber is providing slightly large diameter at the center of rolls than that at the edges.

3. **FOLDS**

Folds occur if the reduction per pass is very less.

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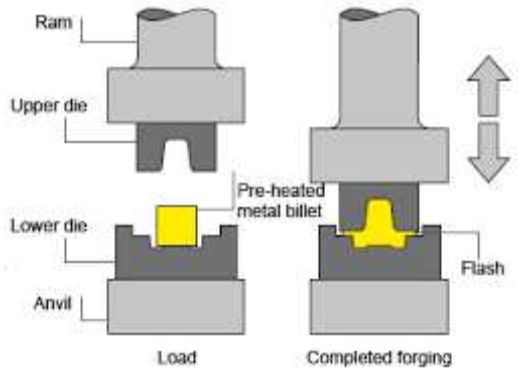
4. **Alligatoring**.

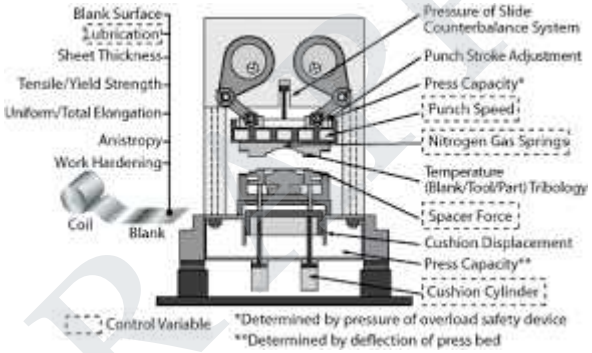
It is the splitting of work piece along the horizontal plane on exit, with top and bottom part following the rotation of their respective rolls.

5.lamination.

These are small cracks which may develop when reduction in thickness is excessive.

4..Give the advantage of press forging over drop forging





SR NO	Press forging	Drop Forging
1.	It is a Faster process	Slow Process
2.	Die alignment is easier	Die alignment is difficult
3.	Operation is quite	Noisy operation
4.	Quality of product is good	Quality of product is fair.
5.	Stroke and ram speed is high	It is low.
6.	It is one stroke operation	Multiple stroke operation.
7.	Range is 20 tons to 1500 tons.	Range upto 10 tons
8.	Shapes formed are dense and homogeneous in structure.	Coarse and not homogenous in structure.

5. Define Forging, Mention its types , differentiate between open die forging and closed die forging.

Forging operations

Forging is a process in which the workpiece is shaped by compressive forces applied through various dies and tools. It is one of the oldest metalworking operations. Most forgings require a set of dies and a press or a forging hammer.

A Forged metal can result in the following: -

Decrease in height, increase in section - open die forging

Increase length, decrease cross-section, called drawing out.

Decrease length, increase in cross-section on a portion of the length - upsetting

Change length, change cross-section, by squeezing in closed .

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impression dies - closed die forging. This results in favorable grain flow for strong parts

Types of forging

Closed/impression die forging
Electro-upsetting
Forward extrusion
Backward extrusion
Radial forging
Hobbing
Isothermal forging
Open-die forgig
Upsetting
Nosing
Coining

Commonly used materials include

- Ferrous materials: low carbon steels
- Nonferrous materials: copper, aluminum and their alloys

Open-Die Forging

Open-die forging is a hot forging process in which metal is shaped by hammering or pressing between flat or simple contoured dies.

Equipment. Hydraulic presses, hammers.

Materials. Carbon and alloy steels, aluminum alloys, copper alloys, titanium alloys, all forgeable materials.

Process Variations. Slab forging, shaft forging, mandrel forging, ring forging, upsetting between flat or curved dies, drawing out.

Application. Forging ingots, large and bulky forgings, preforms for finished forgings.

Closed Die Forging

In this process, a billet is formed (hot) in dies (usually with two halves) such that the flow of metal from the die cavity is restricted. The excess material is extruded through a restrictive narrow gap and appears as flash around the forging at the die parting line.
Equipment. Anvil and counterblow hammers, hydraulic, mechanical, and screw presses.
Materials. Carbon and alloy steels, aluminum alloys, copper alloys, magnesium alloys, beryllium, stainless steels, nickel alloys, titanium and titanium alloys, iron and nickel and cobalt super alloys.

Process Variations. Closed-die forging with lateral flash, closed-die forging with longitudinal flash, closed-die forging without flash.

Application. Production of forgings for automobiles, trucks, tractors, off-highway

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equipment, aircraft, railroad and mining equipment, general mechanical industry, and energy-related engineering production.

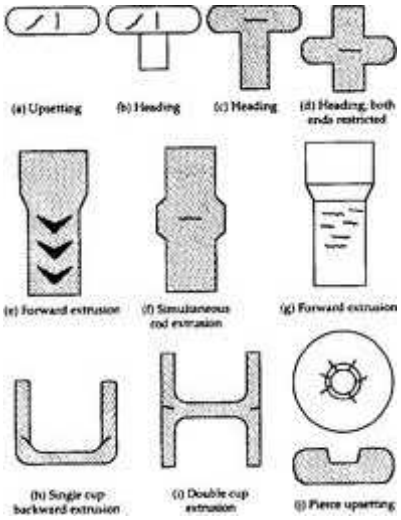
6.What are the defects in forgings? Explain it with neat sketches, (Apr/May-2011) (16)

1.**Unfilled Sections**.

In this some of the die cavity are not completely filled by the flowing metal.

2.**Cold Shuts.**

This appears as small cracks at the corners of the forging. Caused due to improper design of die.



3.Scale Pits.

This is seen as irregular depositions on the surface of forging. This is primarily caused because of improper cleaning of the stock used for forging.

The oxides and scales gets embedded into the finish forging surface.

When the forging is cleaned by pickling, these are seen as deputations on the forging surfaces.

4.Die Shifts.

This is caused by the mis-alignment of the half dies, making the two halves of te forging to be of improper shape. It is also called as mismatch.

5..Flakes.

These are basically ruptures caused by the improper cooling of the large forging. Rapid cooling causes the exterior to cool quickly causing internal fractures.

6.Improper Grain Flow.

Due to improper design of the die, which makes the flow of the metal to be not in the final intended direction.

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7.Laps.

Laps are formed by webbucklin g during forging. To avoid laps web thickness should be increased and properly edesigned.

UNIT - IV

SHEET METAL PROCESS

1 **What is punching operation ?**

Ans : It is the cutting operation with the help of which various shaped holes are produced in the sheet metal. It is similar to blanking; only the main difference is that, the hole is the desired product and the material punched out to form a hole is considered as a waste.

2 **What is super plastic forming operation ?**

Ans: Superplastic forming is a metalworking process for forming sheet metal. It works upon the theory of superplasticity, which means that a material can elongate beyond 100% of its original size.

3 **What is press brake?**

Ans: Press brake (bending brake) is an open frame press used for bending, cutting and forming. Generally, it handless long workpieces in the form of strips. Usually press brake have long dies and suitable and suitable for making long straight line bends.

4 **Define hydro forming process.**

Ans : Hydro forming is a process which can be carried out in two ways:

1) Hydro - mechanical forming

2) Electro - hydraulic forming Hydro - mechanical forming: In this method , the blank is placed over the punch whose shape is similar to inner of the find workpiece.

Electro - hydraulic forming : This method involves the conversion of electrical energy into mechanical energy in a liquid medium. Electric spark in a liquid produces shock waves and pressures which can be used for metal forming.

5 **Give the difference between punching and blanking.**

Ans:

Blanking : It is the cutting operation of a flat metal sheet. The article punched out is known as blank. Blank is the required product of the operation and the metal left behind is considered as a waste.

Punching: It is similliar to blanking; only the main difference is that, the hole is the desired product and the material punched out to form a hole is considered as a waste.

6 **How is hydro forming is similar to rubber forming ?**

Ans : In both the sheet metal working processes sheet metal is pressed between a die and rubber block.

Under pressure, the rubber and sheet metal are driven into the die and confirm to its shape by forming the part.

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7 **What do you mean by minimum bend radius?**

Ans: It is the radius of curvature on inside surface of the bend. If the bend radius is too small, then cracking of a material on the outer tensile surface takes place. To prevent any damage to punch and die, the bend radius should not be less than 0.8mm.

8 **Define limiting drawing ratio.**

Ans : It is the ratio of finished shell diameter (d) to the radius of bottom corner(r).

9 **Define Embossing.**

Ans : With the help of this operation, specific shapes or figures are produced on the sheet metal.

It is used for decorative purpose or giving details like names, trade marks, specifications, etc. On the sheet metal.

10. What are the factors affecting shearing operation?

Shape and material of punch
Die,speedof punching,lubrication
Clearance between punch & die.

11. Define Blanking.

A finite shape of sheet metal is removed and blocked by shearing the entire contour using a die and a punch. The portion removed, which is the required part is called as blank and the operation is called as blanking.

12.What is meant by Dimpling.

irst hole is punched and then it is expanded into a flange. flange may be produced by piercing with a sharp punch when ther bend angle is less than90^0, as n fittings with conical ends.this process is also called as **FLAIRING.**

13.Define Notching.

It refers to the removing pieces from the edge. In this process, the metal is removed from the side (or) edge of a sheet to get the desired shape.

14.define Stretch forming.

The sheet metal is placed under a tensile load over a forming block and stretching it beyond its elastic limit and to the plastic range, thus cause permanent set to take place.this process is useful in making prototype models of aircraft and automotive parts.

15.Define Wrinkling

It is caused by compressive stresses in the plane of the sheet . It can be objectionable or can be useful in imparting stiffness to parts. It can be controlled by proper tool and die design.

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PART-B (16-marks)

1. **Describe shearing operations in a sheet metal work with a neat sketch (16)**

Sheet Metal Forming

Involves methods in which sheet metal is cut into required dimensions and shape; and/or forming by stamping, drawing, or pressing to the final shape

A special class of metal forming where the thickness of the piece of material is small compared to the other dimensions

Cutting into shape involve shear forces

Forming Processes involve tensile stresses

The Major operations of sheet Metal are;

1) Shearing,
2) Bending,
3) Drawing and
4) Squeezing

Shearing

The mechanical cutting of materials without the information of chips or the use of burning or melting for straight cutting blades: shearing for curved blades: blanking, piercing, notching, trimming,Lancing.

Slitting

shearing process used to cut rolls of sheet metal into several rolls of narrower width

used to cut a wide coil of metal into a number of narrower coils as the main coil is moved through the slitter.

Blanking

during which a metal workpiece is removed from the primary metal strip or sheet when it is punched.

Notching

same as piercing

- edge of the strip or black forms part of the punch-out perimeter

Nibbling

Produces a series of overlapping slits/notches

Shaving

finishing operation in which a small amount of metal is sheared away from the edge of an already blanked part

- can be used to produce a smoother edge

Dinking

Used to blank shapes from low-strength materials such as rubber, fiber and cloth

Springback

The elastic recovery of the material after unloading of the tools

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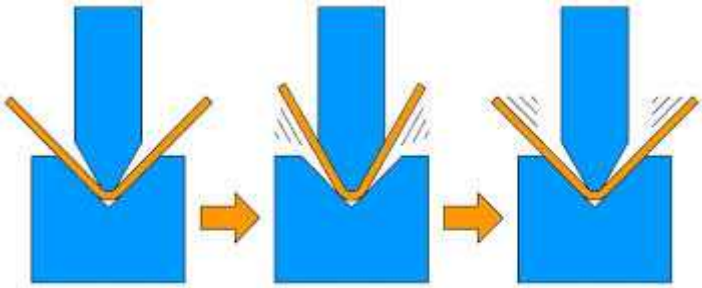
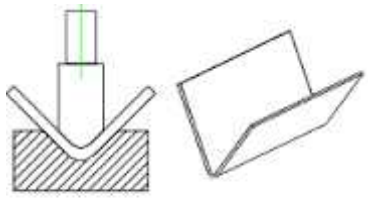
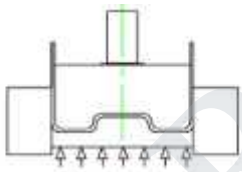
2.Describe the various sheet metal making operations with neat sketch.



1.Bending is the process by which a straight line is transformed into a curved length.



Bending



Bottom Forming

2.**Shearing.** (refer previous question)

3.**Drawing**

It is the process of producing hollow objects (ex.utencils) by using an semicircular punch and Die.

4.Deep Drawing.

If the depth of the hole is greater than that of the diameter then the drawing operation is called deep drawing.

5.**Forming**.

Changing the shape of the sheet metals without cutting, shearing or drawing.

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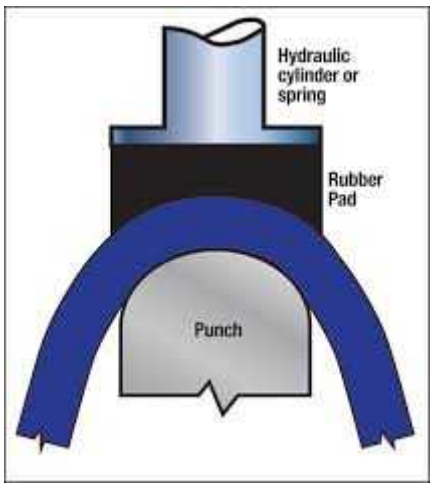
3. Explain any one method of stretch forming operation with a neat sketch (16)



In this process, the sheet metal is clamped along the edges and then stretched over a die (OR) FORM BLOCK, which moves upward, downward (or) side ways, depending on the particular machine.

It is used to make aircraft wing-skin panels, automobile door panels and window frames.

The desirable qualities in the metal for maximum strechability are as follows.

1.Fine grain structure.
2.toughness.
3.LARGE SPREAD between the tensile yield and ultimate strength.

Working.

It consists of placing the sheet –metal under a tensile load over a forming block and stretching it beyond its elastic limit and to te plastic range, thus cause a permanent set to take place.

Two Basic Forms of Stretch forming are,

1.Stretch forming,
2.Stretch – Wrap forming.

ADVANTAGES.

7. In a single operation, blanks can be stretched.
8. Heat treatment before and after stretching process is not required.
9. Spring back effect is minimized.
10. Tooling cost is low.

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11. Direct bending is not introduced, and plastic deformation is due to pure tension.
12. It is suitable for low volume production.

DISADVANTAGES

1.uneven thickness of blank cannot be stretched.
2.The maintanence cost of the hydraulic cylinders is high.

4. Explain hydro forming process with its neat sketches. State their advantage and applications

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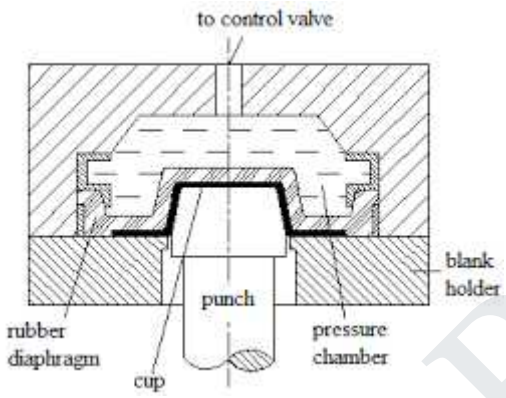

In this process te pressure over the rubber membraneis controlled throughout the forming cycle, with maximum pressure upto- 100 Mpa.This procedure allows close control of the part during forming, to prevent wrinkling (or) tearing. This process is called hydroform or fluif – Forming Process.

Hydro forming is a Drawing process.

Advantages of Hydro-formimg Process.

1.It is used for Mass production.

2.Tools can be quickly changed.

3.Complicted shapes , sharp corners can be made by this method.

4.Spring back, Thining off metals are removed.

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5.Explain about Rubber Pad Forming.

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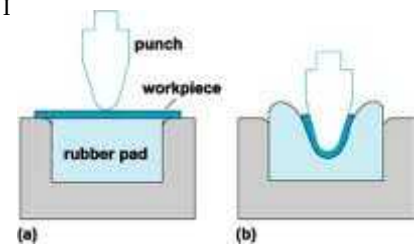

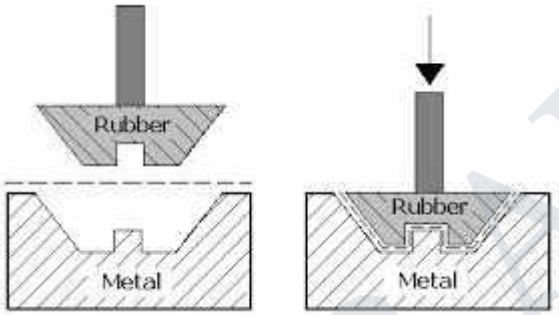

One of the die material is made up of a flexible material (ex. Rubber) Or (poly-urethane material. In bending and embossing of sheet metal , the female die is replaced with a rubber pad.Pressure in the rubber pad forming is usually in the order of10Mpa.

The blank is placed under the punch called male die.Then the ram (femal part) is moved so that punch touches the top surface of the work. Then the force is appled and gradually increased on the blank through the rubber pad.

The blank holder ring is used to distribute uniform pressure throughout the blank.

Thus the required shape is formed on the sheet metal between male and female parts.

ADVANATAGES OF RUBBER PAD FORMIMNG.

1.Number of shapes can be formed on one rubber pad.
2.Thining in metal balank does not take place.\
3.setting time of the tool is less.
4.Wrinkle – free , shrink flanges can be produced.

DISADVANTAGES

1.Rapid wearing of rubber Pads is a problem in this process.

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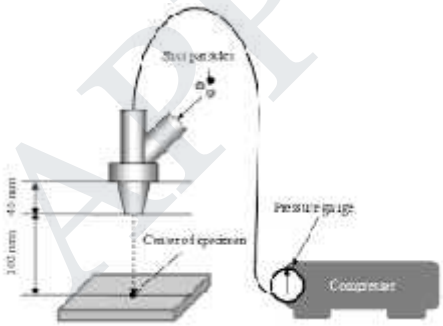
2.Accurate sharp corners cannot be made by this process.
3.Loss of pressure between hydraulic fluid and rubber pad which is a major problem

APPLICATIONS.

Flanged Cylinders.
Rectangular cups,
Spherical Domes.
Unsymmetrical shaped components can be made.

6. **Explain peen forming process with a neat sketch (Nov/Dec -2010) (16)**



This process is used to produce curvature on thin sheet metals by shot peening on surface of the sheet.

A stream of metal shots is blasted against the surface of the blank.

This process is also called as peen forming technique.
Peening is done with cast- iron (or) Steel shot discharged either from a rotating wheel by an air blast made from a nozzle.

ADVANTAGES OF PEEN FORMING

Complex shapes can be easily produced .
Die and Punch is not used.
Peening is used as a salvage operations for distorted parts (OR) correcting part.

DISADVANTAGES OF PEEN FORMING

This process requires longer time for forming the required shape.
Requires additional devices for forcing out metal shots.

APPLICATIONS.

Specific portions on crankshafts , connecting rods, gears
Honey comb panels like aircraft wings and large tubular shapes can be produced.

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UNIT -V

MANUFACTURING OF PLASTIC COMPONENTS

PART-A (2 Marks)

1 **What are the characteristic of thermoplastics ? (May 2006)**

ANS: Themoplastics polymers soften when heated and harden, when cooled.These types of polymers are soft and ductile. They have low melting temperature and can be repeatedly moulded and remoulded to the required shapes.

2 **List out the material for processing of plastics?**

ANS: The following metioned are the various polymer additives used in practice:

(1) Filler material (2) Plasticizers (3)Stabilizers
(4) colorants (5)Flame retardants (6) Reinforcements
(7)Lubricants.

3 **List the advantage of cold forming of plastics? (MAY 2007)**

ANS:

ADVANTAGES:

- Cold forming can be carried out at room temperature
- It is used to produce filament and fibres
- It is a simple process.

4 **What is film blowing? (May 2007)**

Ans: In this process a heated doughy paste of plastic compound is passed through a series of hot rollers, where it is squeezed into the from of thin sheet of uniform thickness. It is used for making plastic sheets and films.

5 **What are the types of plastics ? (May 2008)**

Ans: Polymers are classified in two major categoies:

o Thermoplastic polymers (Soften when heated and harden when cooled) o Thermosetting polymers (Soften when heated and permanently hardened when cooled).

6 **What is compression moulding? (May 2008)**

Ans: The main objective is to melt the material due to compression.

7 **Name the parts made by rotational moulding. (Dec. 2008)**

Ans: Rotational moulding process is mostly used for the production of toys in P.V.C like horse, boats, etc. Larger containers upto 20 m^3 capacity, fuel tanks of automobile are made from polythene and nylon. This process is also used for production of large drums, boat hulls, buckets, housings and carrying cases.

8 **What is parison ? (Dec.2008)**

Ans: Blow moulding consists of extrusion of the heated tubular plastic piece called as parison which is transferred to the two piece mold.

9 **Define degree of polyenerization. (Dec. 2009)**

Ans: It is the number of repetitive units present inone molecule of a polymer.

$$\text{Degree of polymerisation} = \frac{\text{Molecular weight of a polymer}}{\text{Molecular weight of a single monomer}}$$

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10 **What is rotational mouldig of plastics? (Dec. 2009)**

Ans:

- Rotataional moulding also called as roto-moulding.
- A measured amount of polyemer power is placed in a thin walled metal mould and the mould is closed.
- Then the mould is rotated about two mutually perpendicular axes as it is heated.

11.What are the two types of polymerization.

1.addition polymerization

2.Condensation polymerization

12. Rubber is a _____ Polymer

Rubber is a **Organic** Polymer.

13.Write the two types of Injection Moulding.

1.Ram Or plunger type injection moulding
2.Screw type Injection Moulding

14.Define Polymer

Polymers are long chain molecules and are formed by polymerization process,linking and cross linking a particular building block called monomer, a unit cell.

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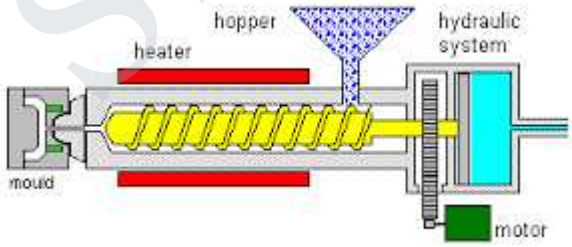
15.Define Plastics.

Plastic is defined as the organic polymer which can be moulded into any required shape with the help of heat and pressure.

Part-B (16 Marks)

1. **Explain the working principles and application of Injection Moulding. (NOV/DEC-2012)(16)**



Injection Molding

Most widely used process. Suitable for high production of thermoplastics. Charge fed from a hopper is heated in a barrel and forced under high pressure into a mold cavity. Several types. Variety of parts can be made.

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Basic components:

mold pieces (define the geometry of the part), and sprue, gates, runners, vents, ejection pins, cooling system

There are two types of injection moulding.

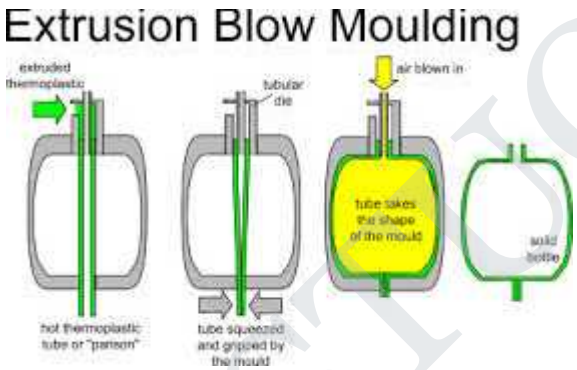
3. Plunger type injection moulding.
4. Screw type injection moulding.

In screw type injection moulding machine the plunger is replaced by a screw.A receiprocating screw now forces the material into the mould.since the screw action generally helps to pack the materials better , a given plunger travel will push more material into the cavity. Finally the action of the screw , as it rotates and mixes, adds energy to the melt.

Band heaters are still needed to fully heat the melt. All of this results in a much better and more consistent part.

Virtually all industrial presses are screw type presses.

2.Explain the working principles and application of Blow Moulding. Mention Its types .



Blow Molding

used to make thermoplastic bottles and hollow sections. Starting material is a round heated solid-bottom hollow tube – perform.

Perform inserted into two die halves and air is blown inside to complete the process

General steps

- Melting the resin- done in extruder
- Form the molten resin into a cylinder or tube (this tube is called parison)
- The parison is placed inside a mold, and inflated so that the plastic is pushed outward against the cavity wall
- The part is allowed to cool in the mold and is then ejected
- The part is trimmed

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The parison can be formed by

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A)Extrusion process
B)Injection molding process

Extrusion blow molding

– Parison is formed from by forcing the plastic through an extrusion die.

Material enters the die, flow around the mandrel so that extrudate would be cylindrical
– The die would have a hole at the center so that air could be blown into the cylinder
– In some blow molding operations, the air is introduced from the bottom through an inlet

This process can be;

continuous extrusion blow molding

- During the process, the extrusion runs continuously, thus making a continuous parison. using multiple mold to match the mold cycle to the extrusion speed

Intermittent extrusion blow molding

- During the process, the extruder is stopped during the time that the molding occur- use either reciprocating screw or an accumulator system
- In this system, the output of the extruder is matched by having multiple molds which seal and blow the parison and then move away from extruder to cool and eject
- In practical case, the mold cycle is longer than time required to extrude a new parison
- If the mold cycle is twice than time needed for creating a parison, a two mold system can be used
- The method is sometimes called rising mold system - system of which two or more molds are used to mold parts from one extruder during continuous process

b) Injection Blow Molding

- The parison is formed by the injection of molten resin into a mold cavity and around a core pin
- The parison is not a finished product, but it is subjected to subsequent step to form the final shape
- Second step, blowing of the intermediate part in a second mold
- Because of distinct separation of the two steps, the parison made by injection molding is called a perform

Process

- The mold is closed
- Resin is then injected to form a cylindrical part
- The mold is opened and perform is ejected

The perform can be stored until the finished blow molded is needed.
The flexibility of separating the two cycles has proven useful in manufacture of soda pop bottle.

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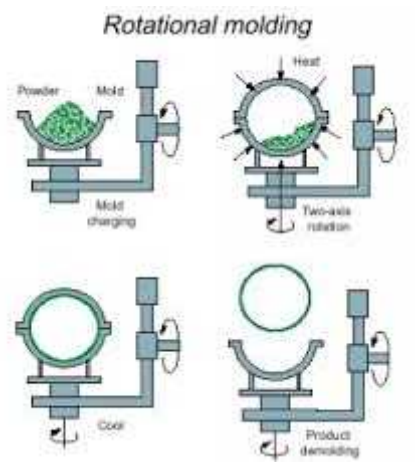
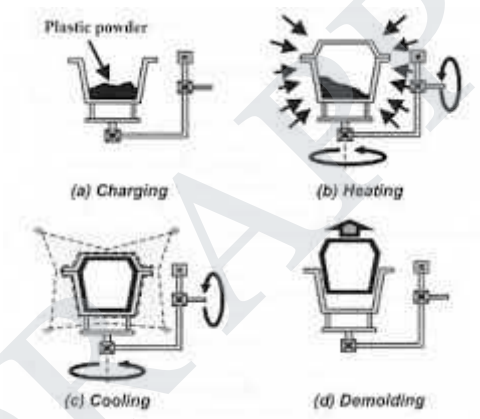
Common plastics for blow molding

- HDPE (stiff bottle, toys, cases, drum)
- LDPE (flexible bottle)
- PP (higher temperature bottle)
- PVC (clear bottle, oil resistant containers)
- PET (soda pop bottle)
- Nylon (automotive coolant bottle, power steering reservoir)

3. **Explain the working principles and application of Rotational Moulding.**

5.





It is also known as Rotomoulding, rotocasting or spin casting.

The thin walled metal mould is a split female mould made of two pieces and is designed to be rotated about two perpendicular axes.

STEP-1

A predetermined amount of plastic , powder or liquid form , is deposited in one half of a mould.

STEP – 2

The mould is closed.

STEP -3

The mould is rotated biaxially inside an oven. The hollow part should be rotated through two or more axes, rotating at different speeds, in order to avoid the accumulatiuon of polymer powder.

STEP – 4

The plastic melts and forms a coating over the inside surface of the mould.

STEP -5

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The mould is removed from the oven and cooled usually by fan. The polymer must be cooled so that it solidifies and can be handled safely by the operator.The part will shrink on cooling, coming away from the mould and facilitating easy removal of the part.

STEP-6

The part is removed from the mould.

Advantages of rotational moulding

1. Moulds are relatively inexpensive.

2. Different parts can be moulded at same time.

3.Very large hollow parts can be made.

4.Parts are stress free.

5.Very little scrap is produced.

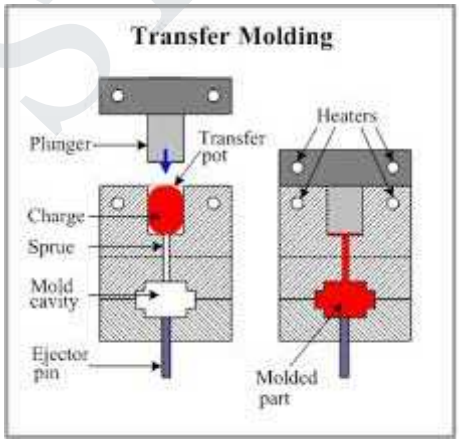
Limitations of rotational moulding.

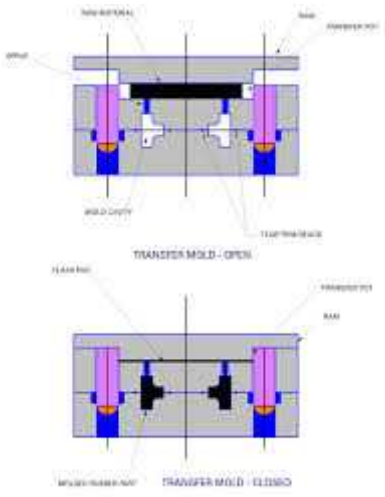
1.Moulding Cycles are long 10-20 mins

2.It is not possible to make some sharp threads.

3.Cannot make parts with tight tolerance.

6. Explain the working principles and application of Transfer Moulding.





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Transfer Molding

A process of forming articles by fusing a plastic material in a chamber then forcing the whole mass into a hot mold to solidify.

Used to make products such as electrical wall receptacles and circuit breakers

Similar to compression molding except thermosetting charge is forced into a heated mold cavity using a ram or plunger.

Examples: electrical switchgear, structural parts

Process Variables

- Amount of charge
- Molding pressure
- Closing speed
- Mold temperature
- Charge temperature
- Cycle time

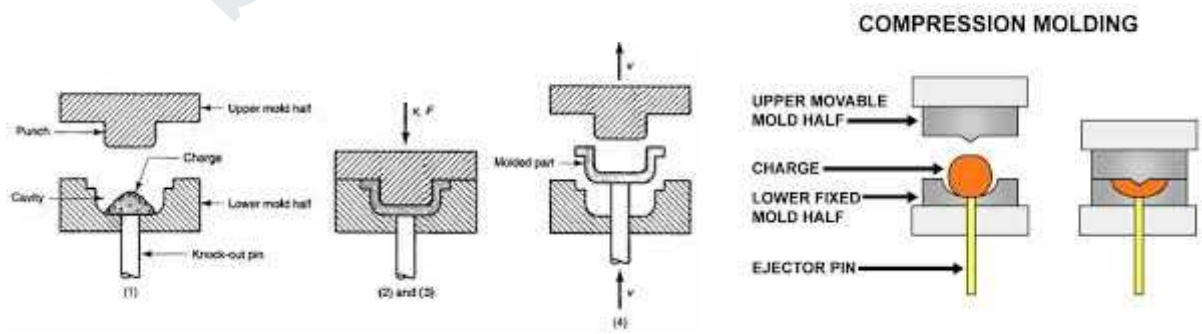
Advantages

- Little waste (no gates, sprues, or runners in many molds)
- Lower tooling cost than injection molding
- Good surface finish
- Less damage to fibers
- Process may be automated or hand-operated
- Material flow is short, less chance of disturbing inserts, causing product stress, and/or eroding molds.

Disadvantages

- High initial capital investment
- Labor intensive
- Secondary operations maybe required
- Long molding cycles may be needed.

6.Explain the working principles and application of compression Moulding.



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Compression Molding

- The process of molding a material in a confined shape by applying pressure and usually heat.
- Almost exclusively for thermoset materials
- Used to produce mainly electrical products

Thermoset granules are "compressed" in a heated mold to shape required.

Examples: plugs, pot handles, dishware

Applications of compression moulding.

1.Dishes , Handles , container caps, fittings, electrical and electronic components.

2.Scoops, spoilers, hoods, fenders.

3.Polyester fiber glass resin systems (SMC/BMC)

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