SYLLABUS

KARPAGAM ACADEMY OF HIGHER EDUCATION

COIMBATORE – 21

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

16BEME303 MANUFACTURING TECHNOLOGY I 3 0 0 3 100

OBJECTIVE

To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES **9**

Introduction to Sand casting – Sand moulds – Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Types – CO_2 process - Moulding machines – Types of moulding machines – Types of melting furnaces (cupola, induction) – Working principle of Special casting processes – Shell moulding, Investment casting, Pressure die casting, Centrifugal casting – Casting defects – Inspection methods.

UNIT II JOINING PROCESSES **9**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials and properties – Arc welding equipments – Electrodes – Coating and specifications – Principles of Resistance welding – Gas metal arc welding – Submerged arc welding – TIG, MIG welding – Friction Stir Welding – Weld defects – Brazing and soldering process.

UNIT III BULK DEFORMATION PROCESSES **9**

Hot working and cold working of metals – Ingots – Forging processes – Open, impression and closed die forging – Types of Forging Machines – Rolling of metals – Types of Rolling mills – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing –– Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion –– Equipments used.

UNIT IV SHEET METAL PROCESSES **9**

Sheet metal characteristics – Press – Types of press – Principle of punching, blanking, coining, piercing, notching, embossing – Typical shearing operations, bending, drawing and deep drawing operations – Metal spinning, Stretch forming operations – Formability of sheet metal – Test methods.

UNIT V MANUFACTURING OF PLASTIC COMPONENTS **9**

Types of plastics – Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of – Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding – Typical industrial applications – Introduction to Blow moulding Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL **45**

TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Serope Kalpajian, Steven R.Schmid	Manufacturing Engineering and Technology (Second Indian Reprint)	Pearson Education, Inc., New Delhi	2013
2	S.Gowri, P.Hariharan, and A.Suresh Babu	Manufacturing Technology 1	Pearson Education, Inc., New Delhi	2008

REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	P.N. Rao	Manufacturing Technology Second Edition	Tata McGraw–Hill Publishing Limited, New Delhi	2013
2	P.C. Sharma	A text book of production technology Fourth Edition	S. Chand and Company, New Delhi	2007
3	Begman	Manufacturing Process Eighth Edition	John Wilely and Sons	2005

WEB REFERENCES
www.themetalcasting.com
www.industrialmetalcastings.com
www.purolator–lp.com
www.manufacturercompanies.com/manufacturers

KARPAGAM ACADEMY OF HIGHER EDUCATION

COIMBATORE – 21

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE PLAN

Subject Name : **MANUFACTURING TECHNOLOGY I**
Subject Code : **16BEME303** **(Credits - 3)**
Name of the Faculty : **P. M. GOPAL**
Designation : **ASSISTANT PROFESSOR**
Year/Semester/Section : **II/ III 'A'**
Branch : **MECHANICAL**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – I : METAL CASTING PROCESSES			
1.	1	Introduction to Sand casting , Sand moulds	**T(1), R(1)**
2.	1	Type of patterns ,Pattern materials, Pattern allowances	**T(1), R(1)**
3.	1	Types of Moulding sand, Properties,	**T(1), R(1)**
4.	1	Core Making ,CO2 process	**T(1), R(1)**
5.	1	Moulding machines – Types of moulding	**T(1), R(1)**
6.	1	Melting furnaces (cupola, induction)	**T(1), R(1)**
7.	1	principle of Special casting processes Shell investment casting	**T(1), R(1)**
8.	1	Pressure die casting, Centrifugal casting , CO_2 process	**T(1), R(1)**
9.	1	Sand Casting defects and Inspection methods	**T(1), R(1)**
10.	1	**Discussion on Competitive Examination related Questions / University previous year questions**	**Question Bank**
Total No. of Hours Planned for Unit - I			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – II : JOINING PROCESSES			
11	1	Introduction to Fusion welding processes	**T(1), R(1)**
12	1	Types of Gas welding, welding Equipments	**T(1), R(1)**
13	1	Flame characteristics – Filler and Flux materials and properties	**T(1), R(1)**
14	1	Arc welding equipments	**T(1), R(1)**
15	1	Electrodes ,Coating and specifications	**T(1), R(1)**
16	1	Principles of Resistance welding – Gas metal arc welding	**T(1), R(1)**
17	1	Submerged arc welding, TIG, MIG welding	**T(1), R(1)**
18	1	Friction Stir Welding – Weld defects	**T(1), R(1)**
19	1	Brazing and soldering process.	**T(1), R(1)**
20	1	**Discussion on Competitive Examination related Questions / University previous year questions**	**Question Bank**

Total No. of Hours Planned for Unit - II	10

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – III : BULK DEFORMATION PROCESSES			
21	1	Introduction to Hot working and cold working of metals	**T(1), R(1)**
22	1	Ingots Forging processes ,Open impression and closed die	**T(1), R(1)**
23	1	forging ,Types of Forging Machines	**T(1), R(1)**
24	1	Rolling of metals , Types of Rolling mills	**T(1), R(1)**
25	1	Defects in rolled parts ,Principle of rod	**T(1), R(1)**
26	1	wire drawing, Tube drawing	**T(1), R(1)**
27	1	Principles of Extrusion ,	**T(1), R(1)**
28	1	Types of Extrusion	**T(1), R(1)**
29	1	Hot and Cold extrusion ,Equipments used	**T(1), R(1)**
30	1	**Discussion on Competitive Examination related Questions / University previous year questions**	**Question Bank**
Total No. of Hours Planned for Unit - III			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – IV : SHEET METAL PROCESSES			
31	1	Introduction to Sheet metal characteristics	**T(1), R(1)**
32	1	Press Types of press	**T(1), R(1)**
33	1	Principle of punching, blanking	**T(1), R(1)**
34	1	Principle of coining, piercing	**T(1), R(1)**
35	1	notching, embossing, Typical shearing operations	**T(1), R(1)**
36	1	bending, drawing, deep drawing operations	**T(1), R(1)**
37	1	Metal spinning, Stretch	**T(1), R(1)**
38	1	forming operations	**T(1), R(1)**
39	1	Formability of sheet metal, Test methods	**T(1), R(1)**
40	1	**Discussion on Competitive Examination related Questions / University previous year questions**	**Question Bank**
Total No. of Hours Planned for Unit - IV			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – V : MANUFACTURING OF PLASTIC COMPONENTS			
41	1	Introduction to Types of plastics	**T(1), R(1)**
42	1	Characteristics of the forming and shaping processes	**T(1), R(1)**
43	1	Moulding of Thermoplastics	**T(1), R(1)**

44	1	Working principles and typical applications	**T(1), R(1)**
45	1	Injection moulding , Plunger and screw machines	**T(1), R(1)**
46	1	Compression moulding, Transfer moulding, Typical industrial applications	**T(1), R(1)**
47	1	Introduction to Blow moulding	**T(1), R(1)**
48	1	Rotational moulding ,Film blowing	**T(1), R(1)**
49	1	Extrusion Thermoforming, Bonding of Thermoplastics	**T(1), R(1)**
50	1	**Discussion on Competitive Examination related Questions / University previous year questions**	**Question Bank**
Total No. of Hours Planned for Unit - V			**10**

TOTAL PERIODS : 50

TEXT BOOKS

T [1] – Serope Kalpajian, Steven R.Schmid Manufacturing Engineering and Technology (Second Indian Reprint) Pearson Education, Inc., New Delhi 2002

T [2] – S.Gowri, P.Hariharan, and A.Suresh Babu Manufacturing Technology 1 Pearson Education, Inc., New Delhi 2008

REFERENCES

R [1] - P.N. Rao Manufacturing Technology Second Edition Tata McGraw–Hill Publishing Limited, New Delhi 2013

R [2] - P.C. Sharma A text book of production technology Fourth Edition S. Chand and Company, New Delhi 2007

R [3] - Begman Manufacturing Process Eighth Edition John Wilely and Sons 2005

WEBSITES

W [1] - www.themetalcasting.com

W [2] - www.industrialmetalcastings.com

W [3] - www.purolator–lp.com

JOURNALS

J [1] - http://www.tandfonline.com/doi/abs/10.1179/136404605225022865

J [2] –http://www.sciencedirect.com/science/article/pii/S007964250800039X

J [3] –http://www.sciencedirect.com/science/article/pii/S0924013606002755

J [4] –http://www.sciencedirect.com/science/article/pii/S0924013617300109

J [5] –http://www.sciencedirect.com/science/article/pii/S0928493117317186

UNIT	Total No. of Periods Planned	Lecture Periods	Tutorial Periods
I	10	10	-
II	10	10	-
III	10	10	-
IV	10	10	-
V	10	10	-
TOTAL	50	50	-

I. CONTINUOUS INTERNAL ASSESSMENT : 40 Marks
(Internal Assessment Tests: 30, Attendance: 5, Assignment/Seminar: 5)

II. END SEMESTER EXAMINATION : 60 Marks

TOTAL : 100 Marks

FACULTY **HOD / MECH** **DEAN / FOE**

MANUFACTURING TECHNOLOGY-1
UNIT –I
METAL CASTING PROCESS

PREREQUISTE DISCUSSION

1.Manufacturing

Manufacturing in its broadest sense is the process of converting raw materials into useful products.

- IT Includes

i) Design of the product
ii) Selection of raw materials and
iii) The sequence of processes through which the product will be manufactured. Casting.

Any Product in the engineering industry will be manufactured in the below methods

1. By totally deforming the metal to the required shape. (Casting /Forming)
1. By joining two metals. (Welding)
2. By removing the excess material from the raw stock.(Machining)

1.1.1Moulding .

It is the process of preparing the cavity required for casting using the pattern (Physical Model), Moulding sand, Moulding boxes,(Cope, Drag, cheek) and other tools.

1.1.2Casting.

Casting is the process of producing metal parts by pouring molten metal into the mould cavity of the required shape and allowing the metal to solidify. The solidified metal piece is called as "casting".

1.1.3Foundry

It is the place where both moulding and casting is done.

1.2. Sand Casting /Sand Moulding.

Sand Casting 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.

1.3 Types of sand

a) Green-sand - mixture of sand, clay, and water,Binders (Molases, Linseed oil); "Green" means mold contains moisture at time of pouring.
b) Dry-sand - organic binders rather than clay and mold is baked to improve strength
c) Skin-dried - drying mold cavity surface of a green-sand
- mold to a depth of upto 25 mm, using torches or heating

d)Core Sand
e)Baking sand
f)Loam Sand
g)Parting sand, Etc.,

1.4Patterns

Patterns are the replica or physical models of the final required shape of the casting, made by wood (teak,magony,pine), plastics, Metals, Plaster of paris etc.,

1.4.1 Types of patterns.

1. Solid pattern
2. Split piece pattern
3. Three piece pattern
4. Loose piece pattern
5. Match plate pattern
6. Segmental pattern
7. Sweep patten
8. skeleton Pattern
9. shell Pattern.

1.4.2 Pattern Allowance.

Allowance are the extra dimensional compensation give to the pattern in order to attain the correct shape and size of the final solidified metal casting.Five types of allowances were taken into consideration for various reasons. They are

1.4.2.1.hrinkage 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%)

1.4.2.2.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.

1.4.2.3. **Finish allowance**

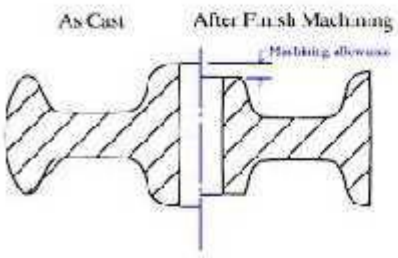
It is otherwise called as machining allowance .The pattern is made slightly 5mm -10mm large in dimension than the required final part dimension. After casting the extra material is removed from the solidified material by machining.

1.4.2.4.hake or Rapping allowance.

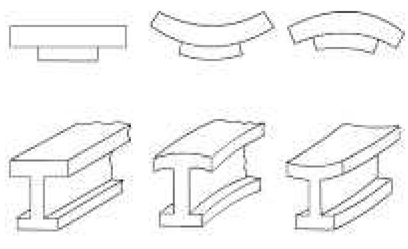
Before withdrawing the pattern it is rapped and thereby the size of the mould cavity increases. Actually by rapping , the external sections move outwards increasing the size and internal sections move inwards decreasing the size. This allowance is kept negative and hence the pattern is made slightly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

1.4.2.5.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.



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

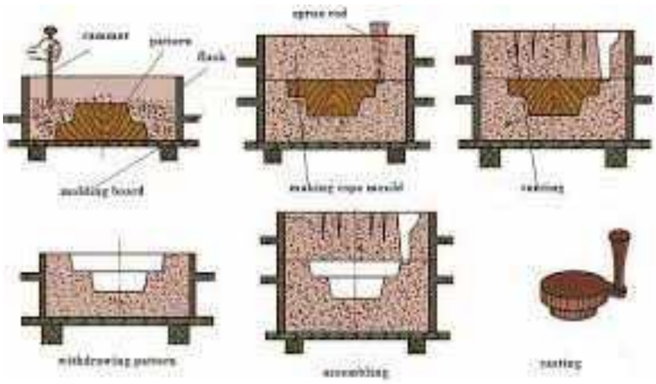


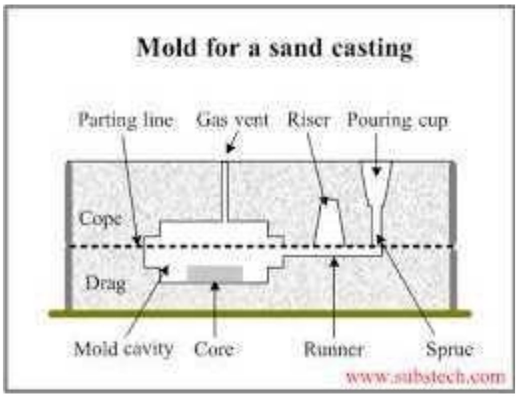
1.5 Steps in Sand Casting

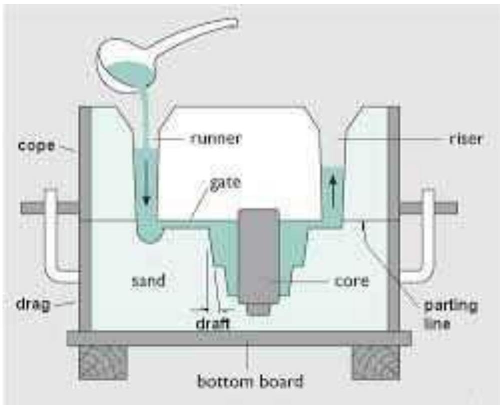
The cavity in the sand mold is formed by packing sand around a pattern, separating themold into two halves

- 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.







1.6. FURNACES USED FOR MELTING METALS FOR CASTING.

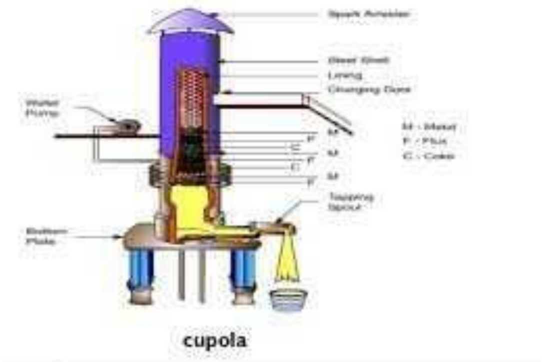
1.6.1 Types of furnace used in a casting industry.

–Crucible Furnace
– Electric-arc Furnace
– Induction Furnace
--Reverbratory furnace
Blast Furnace
- Cupola Furnace.

1.6.1.1.Cupola Furnace

- A continuous flow of iron emerges from the bottom of the furnace.
- Depending on the size of the furnace, the flow rate can be as high as 100 tones per hour.

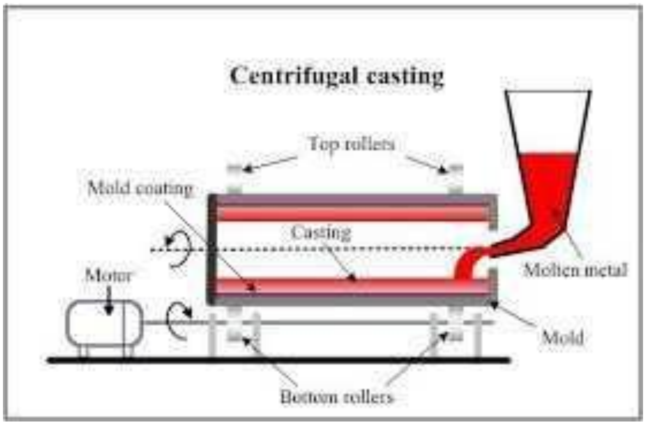
.At the metal melts it is refined to some extent, which removes contaminants. This makes this process more suitable than electric furnaces for dirty charges.



1.7. SPECIAL CASTING PROCESS.

1.7.1.Centrifugal casting

Centrifugal casting uses a permanent mold that is rotated about its axis at a speed between300 to 3000 rpm as the molten metal is poured.Centrifugal forces cause the metal to be pushed out towards the mold walls, where it solidifies after cooling.Centrifugal casting has greater reliability than static castings. They are relatively free from gas and shrinkage porosity. Surface treatments such as case carburizing, flame hardening and have to be used when a wear resistant surface must be combined with a hard tough exterior surface.One such application is bimetallic pipe consisting of two separate concentric layers ofdifferent alloys/metals bonded together.



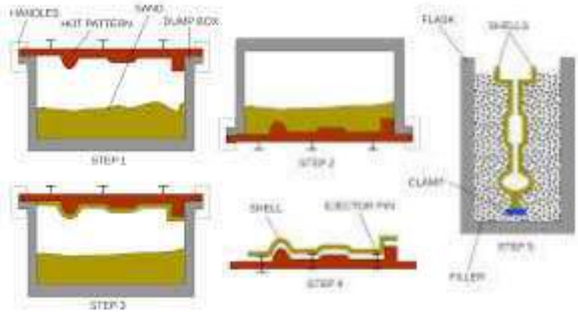
1.7.2. CARBON DI OXIDE PROCESS MOULDING.

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.

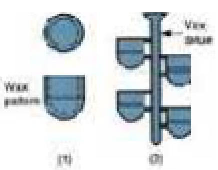
1.7.3.Investment Casting

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.

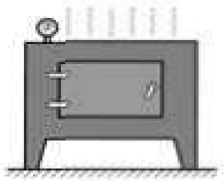


Advantages
– Parts of great complexity and intricacy can be cast
– Close dimensional control and good surface finish
– Wax can usually be recovered for reuse
– Additional machining is not normally required - this is a net shape process

Disadvantages
– Many processing steps are required
– Relatively expensive process

1.7.4.Shell-molding
Shell-mold casting yields better surface quality and tolerances.
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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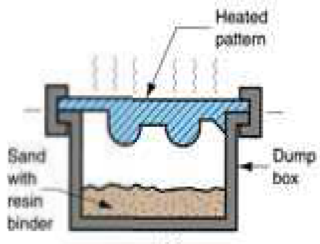
Disadvantages of shell moulding.
More expensive metal pattern
Difficult to justify for small quantities



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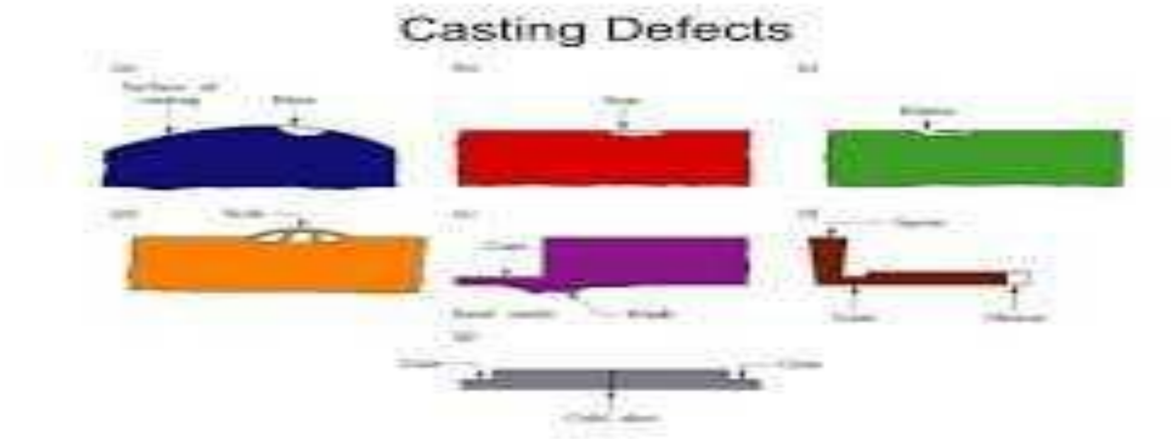
1.8..Casting Defects.



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

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.

1.9 Non-destructive methods used for finding casting Defects.

The various casting defects may be on the surface, under the surface of the solidified casting. These defects are found out by the below mentioned non-Destructive Inspection methods.

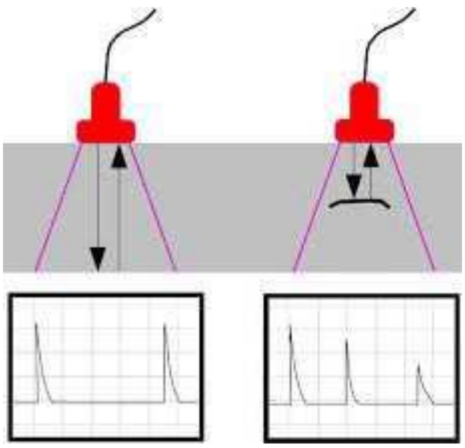
1. Ultra Sonic Inspection
2. Liquid Penetrant Inspection
3. Magnetic Particle Inspection

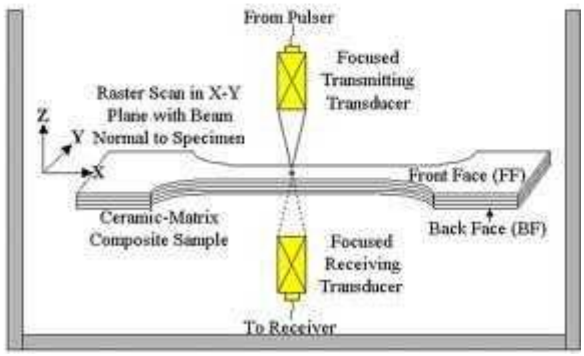
1.9.1.Ultra sonic Inspection.

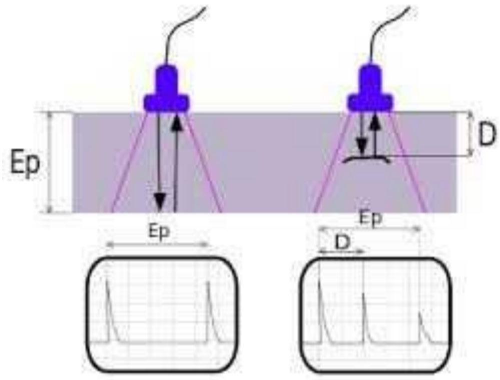
Ultrasonic sound waves are in the frequency decibel which cannot be heared by a human ear. The bats use this kind of sound waves in-order to find the obstacles while flying. These waves will be reflected back to the source when obstructed. Similarly, in ultrasonic testing there is a probe which sends the ultrasonic sound waves into the metal part that is to be inspected. The sound waves will be reflected back after hitting the other end of the metal.

If there is a crack in the middle of the metal part, then the sound waves will be reflected before in advance.

This process is shown in the monitor as a graph. Thus the crack is identified and decided wheather to rectify the crack or reject the metal part.







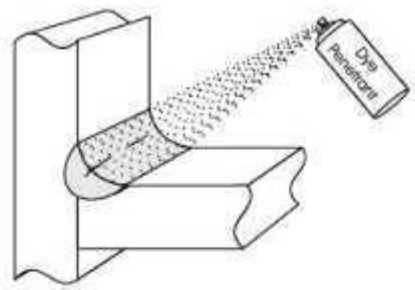
1.9.2. LPT (Liquid Penetrant Testing)

Chemicals Used.

1. Cleaner
2. Potassium Permanganate solution
3. Developer.

Initially the Casted Metal Part to be inspected is cleaned using Cleaner. Dust, oil, Grease etc are removed. Then potassium permanganate solution is sprayed over the surface of the metal part and allowed to remain for 5 – 7 mins. Then the potassium permanganate solution is cleaned.

Now developer is applied over the surface. Due to capillary action the rose/pink colour potassium permanganate liquid will reach the surface of the crack. And now the crack will be visible in pink/rose color.Thus the surface cracks are inspected on the casting.



ADVANTAGES & LIMITATIONS OF LPT

Cost of the chemicals is low when compared to UT & MPT.

Huge / Large size components can be inspected, only on the particular area, where it is required.

Time taken is less.

1.9.3.MPT Magnetic Particle testing.

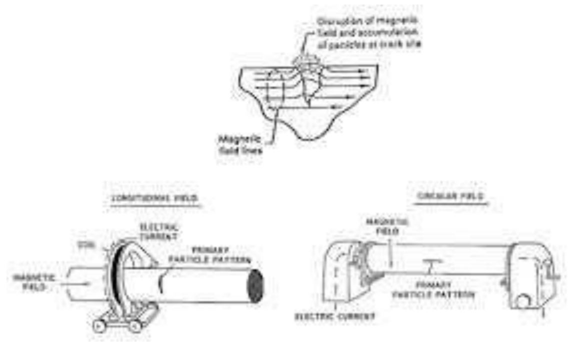
This method of inspection is used on magnetic ferrous castings for detecting invisible surface or slightly subsurface defects. Deeper subsurface defects are not satisfactorily detected because the influence of the distorted lines of magnetic flux (owing to a Discontinuity) on the magnetic particles spread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

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



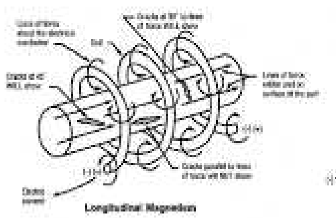


Figure 10.22—Longitudinal Magnetism

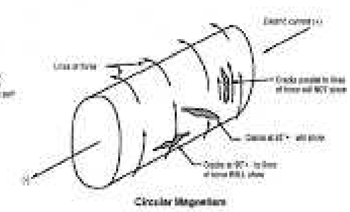


Figure 10.23—Circular Magnetism

MCQ

Questions	**opt1**	**opt2**	**opt3**	**opt4**	**answer**
Sand castings are being produced in a _____________	Foundry	Press shop	Heat treatment shop	Machine shop	Foundry
Sand casting is also known as ___________	Centrifugal casting	Sand moulded casting	Die casting	Investment casting	Sand moulded casting
Prime factor to decide the Pattern type being _________	Size and Complexity	Profit margin	Number of castings	Individual's decision	Size and Complexity
Metal running system is mounted in --------------- type of pattern	Single piece pattern	Sweep pattern	Gated pattern	Skeleton pattern	Gated Pattern
------------- Type of pattern does not have Cope and Drag system	Split piece pattern	Loose piece pattern	Shell pattern	Sweap pattern	Sweap pattern
Pattern mounting is mandatory in ---------------- type of pattern	Follow board pattern	Single piece pattern	Sweap pattern	Match plated pattern	Match plated pattern
Wood is not suitable for making -------------- type of pattern	Split piece pattern	Single piece pattern	Shell pattern	Gated pattern	Shell pattern
Pattern is subjected to heating in ------------ type of pattern	Single piece pattern	Shell pattern	Gated pattern	Split piece pattern	Shell pattern
Pit moulding is normally chosen for -------- type of pattern	Shell pattern	Gated pattern	Split piece pattern	Skeleton pattern	Skeleton pattern
External details of castings are revealed in -----------------	Core	Mould	Match plate	Mould box	Mould
External details of castings are revealed in -----------------	Core box	Pattern	Match plate	Mould box	Pattern
Internal details of castings are revealed in -----------------	Core	Mould	Match plate	Mould box	Core
Internal details of castings are revealed in -----------------	Core box	Pattern	Match plate	Mould box	Core box

Metal is mandatory in -------------- pattern	Skeleton pattern	Shell pattern	Sweep pattern	Gated pattern	Shell pattern
Bentonite is used in -------------- moulding	Nobake	Shell	CO2	Green sand	Green sand
Sodium Silicate is used in ------------- moulding	Nobake	Shell	CO2	Green sand	CO2
Baking of mould is done to drive out ----------	Impurities	Moisture	Sand fines	Binder	Moisture
Acid Demand Value refers to	Sand property	Pattern property	Corebox property	Binder property	Sand property
Sand that we get from river banks are ----------------	Chromite sand	Zircon sand	Olivine sand	Silica sand	Silica sand
Superior thermal properties are in ------------ sand	Chromite sand	Zircon sand	Olivine sand	Silica sand	Chromite sand
Refractoriness of a mould / core refers to ------------ resisting property	Thermal	Metal flow	Gas entrapment	Hardness	Thermal
Permeability of a mould / core refers to ------------ resisting property	Thermal	Metal flow	Gas entrapment	Hardness	Gas entrapment
Collapsibility is essential in case of --------------	Mould	Pattern	Core	Corebox	Core
Sodium Hydroxide is used in ------------type of sand testing	Moisture content	Clay content	Compression strength	Grain Fineness	Clay content
Sieves are used in ---------- type of sand testing	Moisture content	Clay content	Compression strength	Grain Fineness	Grain Fineness
In GFN tester coarsest sand is retained in --------------	Bottom most pan	2nd pan from bottom	Top most pan	2nd pan from top	Top most pan
In GFN tester finest sand is retained in --------------	Bottom most pan	2nd pan from bottom	Top most pan	2nd pan from top	Bottom most pan
AFS number refers to --------------	Grain Fineness Number	Permeability Number	Hot tensile strength	Hardness	Grain Fineness Number

Resistance offered by mould / core against indentation is ----------	Permeability Number	Hot tensile strength	Hardness	Grain Fineness Number	Hardness
Specimen size of hardness test is -----------	Dia. 2" x Ht. 2"	Dia. 40 mm x Ht. 40 mm	Dia. 50 mm x Ht. 50 mm	Dia. 30 mm x Ht. 30 mm	Dia. 2" x Ht. 2"
Holding power or bonding strength of Mould / Core is ---------	Permeability Number	Compression strength	Hardness	Grain Fineness Number	Compression strength
Specimen size of Compressive test is -----------	Dia. 2" x Ht. 2"	Dia. 40 mm x Ht. 40 mm	Dia. 50 mm x Ht. 50 mm	Dia. 30 mm x Ht. 30 mm	Dia. 2" x Ht. 2"
Specimen size of Shear strength test is -----------	Dia. 50 mm x Ht. 50 mm	Dia. 40 mm x Ht. 40 mm	Dia. 2" x Ht. 2"	Dia. 30 mm x Ht. 30 mm	Dia. 2" x Ht. 2"
Jolting is one operation in --------------	Core making	Metal pouring	Moulding	Fettling	Moulding
Squeezing is one operation in --------------	Moulding	Fettling	Core making	Metal pouring	Moulding
Compaction is one operation in --------------	Metal pouring	Core making	Fettling	Moulding	Moulding
----------------- operation of moulding is noisy	Jolting	Sand filling	Pattern stripping	Applying releasing agent	Jolting
Jolting operation enables ramming on ---------------- surface	Vertical	Horizontal	Overall	Not at all	Horizontal
In Squeezing operation ramming will be good near -----------	Pattern profile	Top surface of Flask	Bottom surface of Flask	Overall Uniform	Top surface of Flask
Furnace is used for ---------	Metal testing	Melting	Ramming mould	Core shooting	Melting
Low grade Cast iron casting is generally produced by ------------	Arc Furnace	Cupola	Pit Furnace	Induction	Cupola
Steel casting is generally produced by ------------	Open hearth Furnace	Induction	Cupola	Arc Furnace	Open hearth Furnace
Non ferrous casting is generally produced by ------------	Cruicible	Open hearth Furnace	Induction	Cupola	Cruicible

In Cupola furnace, Cylindrical shell thickness is ------ mm	2	10	250	500	10 mm
In Cupola furnace, Charging door is situated near -------------	Slag hole	Spark arrestor	Metal tap hole	Wind box	Spark arrestor
In Cupola furnace ----------- is located at bottom of the sand bed	Spark arrestor	Metal tap hole	Wind box	Slag hole	Metal tap hole
In Cupola furnace ----------- is located at top of the sand bed	Metal tap hole	Wind box	Slag hole	Spark arrestor	Slag hole
In Cupola furnace, Clay plug is used for closing -----------	Tuyers	Metal tap hole	Wind box	Charging door	Metal tap hole
In Cupola furnace, --------------- is used for supplying fuel	Metal tap hole	Wind box	Charging door	Tuyers	Tuyers
In Cupola furnace, ratio of Pig iron to Lime stone is ------	25:1	20:1	15:1	10:1	25:1
In Cupola furnace, ratio of Pig iron to Coke is ------	20:1	15:1	10:1	25:1	10:1
In Cupola furnace, purpose of adding Lime stone is to ------------------	Increase Hardness	Improve Microstructure	Remove impurities	Improve Tensile strength	Remove impurities
Composition homogenity of metal is achieved in ---------- furnace	Pit	Cupola	Arc	Induction	Induction
Most common cause for the Crack defect is ------------	Metal feeding system	Improper fillet Radii	Low temp. of Pouring	Low carbon equivalent	Improper fillet Radii
Most common cause for the shrinkage defect is ------------	Improper fillet Radii	Low temp. of Pouring	Rapid cooling of casting	Metal feeding system	Metal feeding system
Most common cause for the Hard spot defect is ------------	Low temp. of Pouring	Rapid cooling of casting	Metal feeding system	Improper fillet Radii	Rapid cooling of casting

2 MARKS

1.Name any four types of commonly used

patterns

2.What is the merit of CO_2 process?

3.State the essential properties of mounding sand

4. Give any two merits and demerits of investment casting process

5. Mention any two merits and demerits of die casting

7. List out any four defects in casting

8. What is meant by split pattern

9. Define the term mould

10. What are the defects caused by low pouring temperature?

11. What is meant by match plate pattern making?

12. How will you calculate grain fineness number?

13. How patterns differ from casting?

14. What are the tests carried out to determine the quality of casting?

15. What are the functions of riser?

16. What are core prints?

17. What are the functions of gating and risering?

18. What is the composition of moulding sand?

19. What is the function of core?

20. Which process is called “Lost wax process”?Why?

CHAPTER 114 MARKS

1. i. Discuss the properties of moulding sand

ii. What are the various moulding methods, explain them

2. i. Explain the working principle of investment casting

   ii. Discuss the casting defects and their inspection methods

3. i. What are the pattern making allowances and briefly explain them

   ii. Describe centrifugal casting process

4. i. Describe the shell moulding process

   ii. Explain the ceramic moulding process and state its merits and demerits

5. i. What are the factors which govern the selection of a proper material for pattern making?

   ii. What are the specific advantages of match plate patterns? Explain how they are used for making mould

6. .i. Classify the types of patterns and sketch any three of them

   ii. What is core and explain how to make a core?

7. i. Explain the construction and operation of Cupola furnace with diagram

   ii. Write a short note on "Chills"

8 .i. Describe various materials used for making patterns. What are its merits and demerits

   ii. What are the basic requirements of core sand? How does it differ from the moulding sand?

9.i. What are the different types of furnace used in foundry? Describe in detail with neat sketches any one of them

   ii. Describe the steps involved in the preparation of green sand mould with cope and drag pattern

10. i. Briefly explain cold-chamber die casting process with a neat sketch

   ii. What are the advantages of centrifugal casting?

UNIT - II

METAL JOINING PROCESS

PREREQUISTE DISCUSSION

2.1.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.

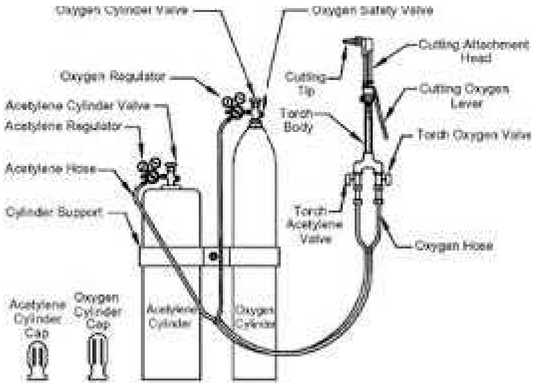
2.2. Types of welding

GAS Welding
ARC Welding

2.3 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.

2.3.1GAS WELDING EQUIPMENT

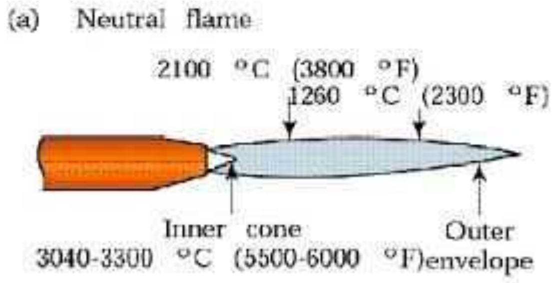


1. Gas Cylinders
Pressure
Oxygen – 125 kg/cm2
Acetylene – 16 kg/cm2
2. Regulators
Working pressure of oxygen 1 kg/cm2
Working pressure of acetylene 0.15 kg/cm2
Working pressure varies depends upon the thickness of the work pieces welded.
3. Pressure Gauges
4. Hoses
5. Welding torch
6. Check valve
7.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

2.3.2FLAMES PRODUCED DURING GAS WELDING

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

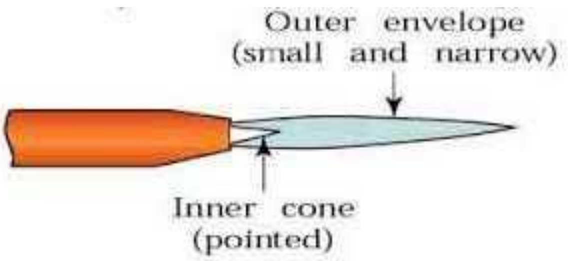
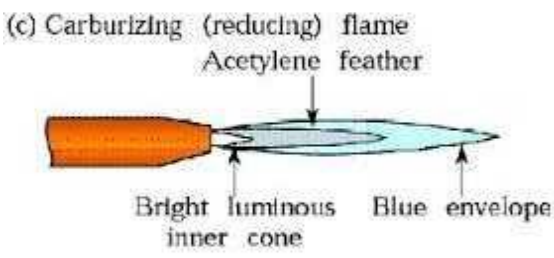


Figure3: Oxidizing Flame

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.

2.3.3. Difference between Gas Welding and Arc Welding.

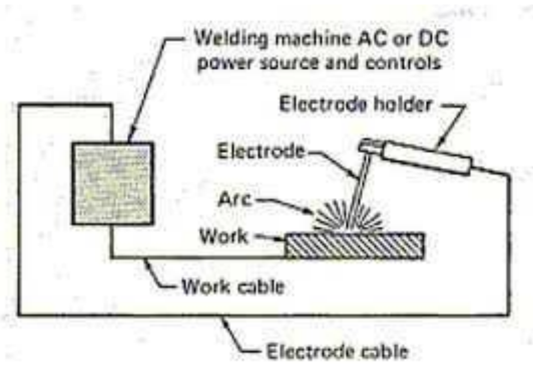
Sr No	GAS WELDING	ARC WELDING
1.	Heat is produced by the Gas Flame	Heat is produced by Electric Arc
2.	The flame temperature is about 3200^{o}C	The temperature of Arc is about 4000^{o}C
3.	Separate Filler rod introduced	Arc Producing as well as filler rod material is the electrode.
4.	Suggested for thin 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.

2.4. 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

2.4.1.Arc welding Equipments

- A welding generator (D.C.) or Transformer (A.C.)
- Two cables- one for work and one for electrode
- Electrode holder
- Electrode
- Protective shield
- Gloves
- Wire brush
- Chipping hammer
- Goggles



2.4.2.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

2.4.3.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

2.4.4.STEPS FOLOWED IN ARC WELDING :

- 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
- 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.

2.5. SPECIAL WELDING PROCESS

2.5.1.bmerged 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

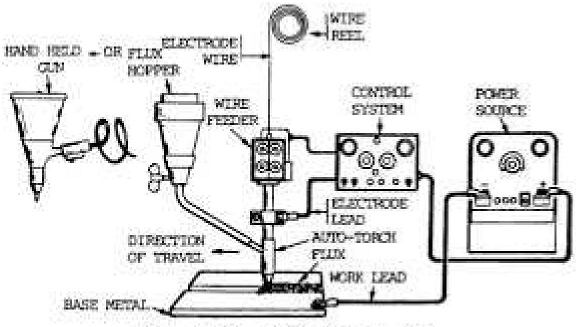


Figure 10-59. Block diagram - SAW.

2.5.2.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
- 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.

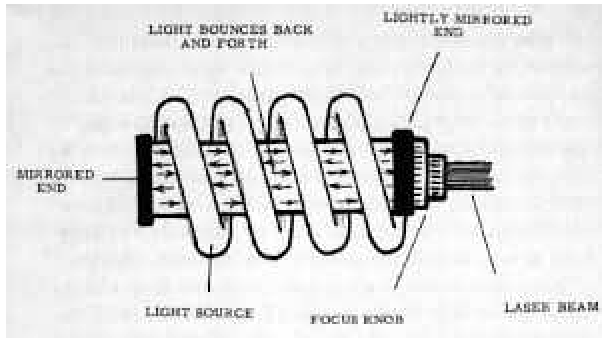
The output laser beam is highly directional and strong, coherent and unicromatic with a wavelength of 6934^{o}A. It goes through a focusing device where it is pinpointed on the work piece, fusion takes place and the weld is accomplished due to concentrated heat produced. Laser beam welding process is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

2.5.3.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

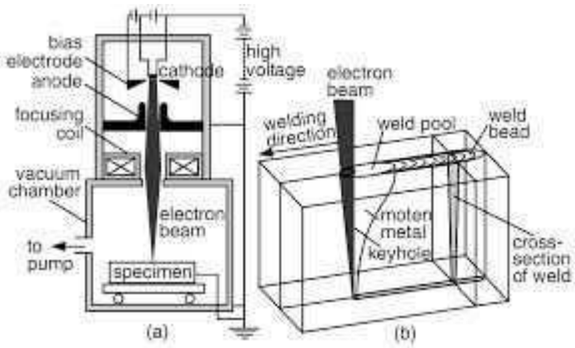
Disadvantages

- High equipment cost
- Precise joint preparation & alignment required
- Vacuum chamber required
- Safety concern: EBW generates x-rays

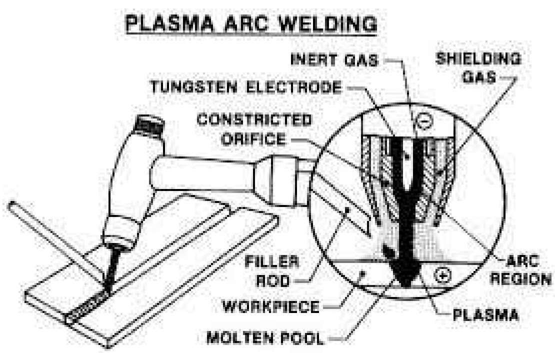
Comparison: LBW vs. EBW

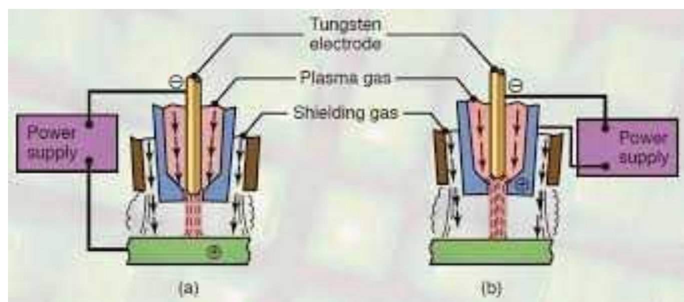
- No vacuum chamber required for LBW
- No x-rays emitted in LBW
- Laser beams can be focused and directed by optical lenses and mirrors
- LBW not capable of the deep welds and high depth-to-width ratios of EBW

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



2.5.4.PLASMA ARC WELDING





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

(A) Transferred Arc
(B)Non- Transferred Arc.

(a)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.

(b)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.

2.5.5. THERMIT WELDING.

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

- Thermite = mixture of Al and Fe_3O_4 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

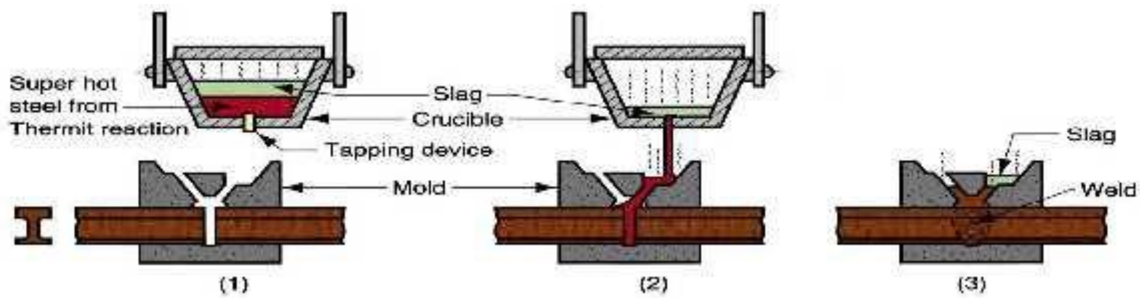
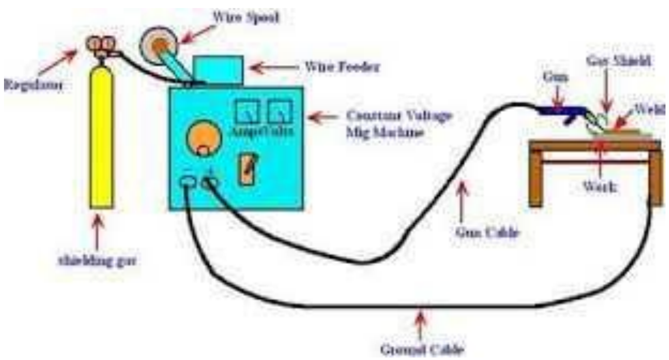


Fig: Thermit welding: (1) Thermit ignited; (2) crucible tapped, superheated metal flows into mold; (3) metal solidifies to produce weld joint.

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

2.5.6.TIG& MIG WELDING



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)

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

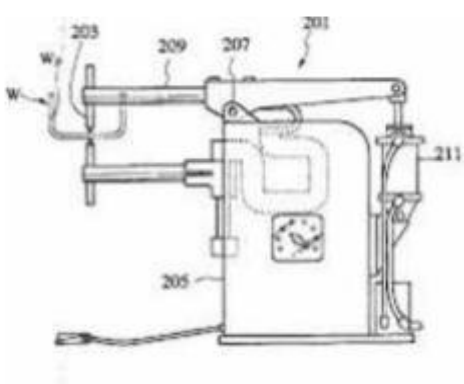
2.5.7. RESISTANCE WELDING.

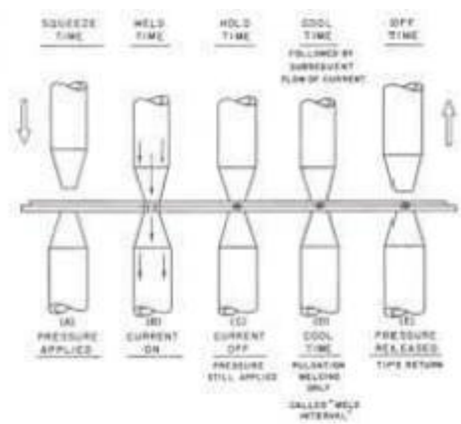
Resistance Welding (RW)

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 time duration

Advantages

- 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.

MCQ

Questions	opt1	opt2	opt3	opt4	answer
External pressure is not required for ------------------ welding process	Resistance welding	Fusion welding	Thermit welding	Seam welding	Fusion welding
External pressure is required for ------------------ welding process	Oxy Acetylene gas welding	Thermit welding	Arc welding	TIG welding	Thermit welding
Prime purpose of filler rod is to supply additional -------------	Heat	Weld metal	Pressure	Electrical energy	Weld metal
Diameter of the filler rod depends upon ---------- weld material	Length	Thickness	Density	Width	Thickness
-------------- is one type of Fusion welding	Thermit welding	Oxy - Acetylene welding	TIG welding	MIG welding	Oxy - Acetylene welding
Prime purpose of flux is to remove -------------	Extra weld metal	Impurities	Heat	Applied pressure	Impurities
Purpose of flux is also to -------------	Add weld metal	Prevent Oxidation	Add heat	Add pressure	Prevent Oxidation
In Oxy - Acetylene gas welding, temp. at the hottest zone will be around --------	125 degree centigrade	625 degree centigrade	3200 degree centigrade	1250 degree centigrade	3200 degree centigrade
This welding process is employed for joining high temperature metals	Air - Acetylene	Oxy - Acetylene	Oxy - Hydrogen	Thermit	Oxy - Acetylene
This welding process is employed for joining low temperature metals	Arc	Air - Acetylene	Plasma Arc	Oxy - Acetylene	Air - Acetylene
Colour identification for Oxygen cylinder is ---------	White	Black	Maroon	Green	Black
Colour identification for Acetylene cylinder is ---------	Black	Maroon	Green	White	Maroon
In Gas welding process, Hose is made up of ------ that transmits gases from Cylinder to welding torch	Steel	Rubber	Aluminium	Copper	Rubber
Gas Oxygen is stored inside the Cylinder at ------------- Pressure	125 - 140 bars	10 - 16 bars	250 - 280 bars	50 - 80 bars	125 - 140 bars
Gas Acetylene is stored inside the Cylinder at -------------	10 - 16 bars	250 - 280	50 - 80 bars	125 - 140	10 - 16 bars

Pressure		bars		bars	
Working pressure of Oxygen in Gas welding is --------	0.7 - 2.8 bars	0.07 - 1.03 bars	15.07 - 20.18 bars	50 - 80 bars	0.7 - 2.8 bars
Working pressure of Acetylene in Gas welding is -------------	0.07 - 1.03 bars	15.07 - 20.18 bars	50 - 80 bars	0.7 - 2.8 bars	0.07 - 1.03 bars
-------------- Cylinder is fitted with Fusible plug for safety purpose	Helium	Hyrogen	Acetylene	Oxygen	Acetylene
Tip of the Flame torch is made up of ----------- material	Stainless Steel	Mild Steel	Copper	Aluminium	Copper
Purpose of regulator is to control --------------	Temperatute	Gas pressure	Current	Voltage	Gas pressure
To clean the debris before and after welding, ------------ wire brush is used	Cotton	Fibre	Steel	Coir	Steel
Personal protective equipment , Goggle is to protect ------- from UV rays	Hands	Ears	Eyes	Head	Eyes
Personal protective equipment , Gloves is to protect ------- from heat and metal splashes	Ears	Eyes	Head	Hand	Hand
Personal protective equipment , Apron is to protect ------- from hot metal splashes	Head	Body	Ears	Eyes	Body
In Oxy - Acetylene gas welding, ---- ratio of Oxygen and Acetylene gives Carburising flame	1: 1	0.9 : 1	1 : 2	1.25:1	0.9 : 1
In Oxy - Acetylene gas welding, ---- ratio of Oxygen and Acetylene gives Neutral flame	0.9 : 1	1 : 2	1.25 : 1	1: 1	1: 1
In Oxy - Acetylene gas welding, ---- ratio of Oxygen and Acetylene gives Oxidising Flame	1 : 2	1.25 : 1	1: 1	0.9 : 1	1.25 : 1
In Oxy - Acetylene gas welding, --------- flame is also known as reducing flame	Neutral	Oxidising	Carburising	Mixed	Carburising
In Oxy - Acetylene gas welding, outer cone of the Neutral flame is having -------- colour	Blue	White	Sharp bright	Dark red	Blue
In Oxy - Acetylene gas welding, inner cone of the Neutral flame is having -------- colour	White	Sharp bright	Dark red	Blue	Sharp bright
In Oxy - Acetylene gas welding, intermediate cone of the Carburising flame is having -------- colour	Sharp bright	Dark red	Blue	White	White

In Arc welding, vertical distance between electrode tip to bottom of weld pool is -------------	Crater	Arc length	Depth of fusion	Vortex	Arc length
In Arc welding, vertical distance between job surface to bottom of weld pool is -------------	Vortex	Crater	Arc length	Depth of fusion	Depth of fusion
In Arc welding, angle between electrode axis to job surface plane is -------------	Depth of fusion	Vortex	Crater	Arc length	Crater
In Arc welding, Arc is generating heat in the range of ---------------- degree centigrade	100 - 200	5000 - 6000	500 - 600	1500 - 2500	5000 - 6000
In Arc welding, to have better depth of fusion, Crater angle should be ------- degrees	10	45	70	90	70
In Arc welding, welding generator efficiency is in the ------ range	40%	60%	85%	55%	60%
In Arc welding, AC Transformer efficiency is in the ------ range	55%	40%	60%	85%	85%
In Arc welding, welding generator power factor is in the ------ range	0.7	0.5	0.4	0.8	0.7
In Arc welding, AC Transformer power factor is in the ------ range	0.5	0.4	0.8	0.7	0.4
In Arc welding, Energy consumption per Kg of metal deposit while using DC generator is -----------	8 kwh	12 kwh	4 kwh	22kwh	8 kwh
In Arc welding, Energy consumption per Kg of metal deposit while using AC Transformer is -----------	12 kwh	4 kwh	22kwh	8 kwh	4 kwh
In Arc welding, Terminal current while using DC Generator is -----------	120 - 500 A	40 - 50 A	80 - 90 A	140 - 160 A	120 - 500 A
In Arc welding, Terminal current while using AC Transformer is -----------	40 - 50 A	80 - 90 A	140 - 160 A	120 - 500 A	40 - 50 A
In Arc welding, Bare electrodes are coated with ------- mm thickness of flux	No coating	1.0 - 3.0	0.1 - 0.6	6.0 - 8.0	No coating
In Arc welding, Lightly coated electrodes are coated with -------mm thickness of flux	6.0 - 8.0	No coating	1.0 - 3.0	0.1 - 0.6	0.1 - 0.6
In Arc welding, Heavily coated electrodes are coated with -------mm thickness of flux	0.1 - 0.6	6.0 - 8.0	No coating	1.0 - 3.0	1.0 - 3.0
In Arc welding, flux is coated with -------- % of	1-5 %	30 - 40%	15 - 30 %	8 - 10 %	15 - 30 %

electrode weight in heavily coated electrodes					
Which one among these electrodes is a non consuming electrode	Cast iron rod	Copper rod	low carbon steel rod	Tungsten rod	Tungsten rod
In resistance welding, square of ------ is directly proportional to the quantity of heat generated	Resistance R	Current I	Voltage V	Time T	Current I
In MIG welding, ----------- gas is used for shielding purpose	Oxygen	Acetylene	Helium	CO2	Helium
Which one among these process is meant for welding Similar metals	Diffusion welding	Laser Beam welding	TIG welding	Electric Arc welding	Electric Arc welding
In welding, Low range of current will lead to -------- defect	Undercut	Porosity	Cracks	Incomplete fusion	Incomplete fusion
In welding, fast solidification will lead to -------- defect	Incomplete fusion	Undercut	Porosity	Cracks	Cracks
In welding, more arc length will lead to -------- defect	Cracks	Incomplete fusion	Undercut	Porosity	Undercut
In welding, defective coating of electrode will lead to -------- defect	Porosity	Cracks	Incomplete fusion	Undercut	Porosity
In welding, high density of coating material will lead to -------- defect	Cracks	Incomplete fusion	Undercut	Slag inclusion	Slag inclusion
Brazing is a Joining process using a filler metal having temperature ----- degree centigrade	Above 450	100 - 200	600 - 800	below 450	Above 450
Soldering is a Joining process using a filler metal having temperature ----- degree centigrade	below 450	100 - 200	600 - 800	Above 450	below 450
Preferred joining process for metals of small but complex shape is --------------	Brazing	Gas welding	Soldering	Arc welding	Brazing

2 MARKS

1. What is the principle of resistance welding?
2. What is the role of fluxes in welding? Or function of flux in welding?
3. List out any four arc welding equipment.
4. What is the principle of Thermit welding?
5. What are the different types of gas flames? How are they formed?
6. Differentiate soldering and brazing .
7. What is the chemical reaction occurs in thermit welding?
8. What are the advantages of carbon arc welding?
9. Differentiate between oxy-acetylene and air-acetylene welding
10. What are the advantages of a.c. arc welding?
11. What is the principle cause of cracks in weld metals?
12. How do you specify an electrode?
13. What is the function of shielding gas in welding?
14. Why laser welding is used only for micro-welding applications?
15. Define resistance welding
16. What is flux? Why is it essential to use it in some welding situations?
17. What are the defects that are generally found in welding?
18. List any four applications of TIG Welding process.
19. Is flux necessary in Brazing process? If yes why?
20. How slag inclusions in welding be avoided?

14 MARKS

1. i. Distinguish between gas and arc welding

   ii. What are the advantages of welding?

   iii. Explain percussion welding

2. i. Describe Electro slag welding

   ii. Distinguish between soldering and

brazing 3..i. Explain spot welding

   ii. Explain submerged are welding

4. i. Explain the electron beam welding process with a neat sketch

   ii. Write a brief note on “Welding defects”

5. i. Sketch the three types of Oxy-acetylene flames and state their characteristics and applications.

   ii. Describe the electro-slag welding process with a neat sketch.

6. i. What is the principle of resistance welding and explain the seam welding?

   ii. Describe plasma arc welding

7. i. What are the different types of electrode? What are the functions of flux coating?

   ii. What is the principle of friction welding?

8. i. Describe metal inert Gas arc welding process with a neat sketch.

   ii. Briefly explain on butt welding process

9.i. Give a brief account of classification of welding processes?

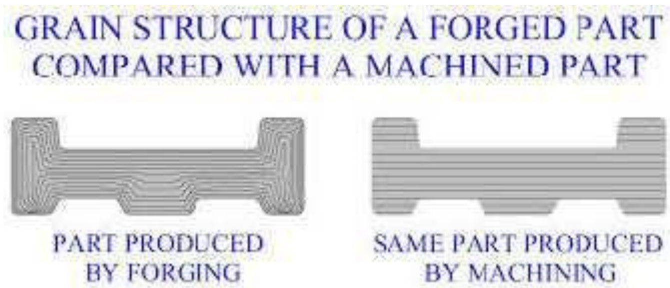
   ii. Explain TIG welding process variables and enumerate its advantages

10. i. Describe shielded metal arc welding process with suitable diagram. What are its applications?

   ii. What is the difference between welding, brazing and soldering process?

UNIT III

METAL FORMING PROCESS



3.PREREQUISTE DISCUSSION

The Materails to be used in places where the component is subjected to very high Impact load, Shock Load, intermittant load and in Power transmission lines, Need to be produced with dense grain structure. This requirement can be acheived by manufacturing process such as Forging, Rolling,Extrusion and Drawing.

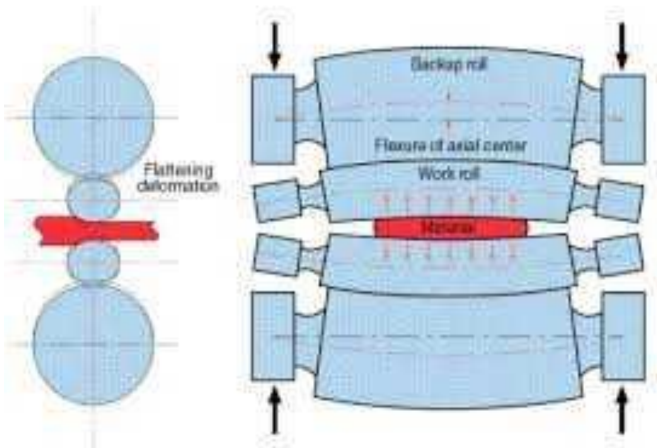
3.1.COMPARISION BETWEEN HOT WORKING AND COLD WORKING

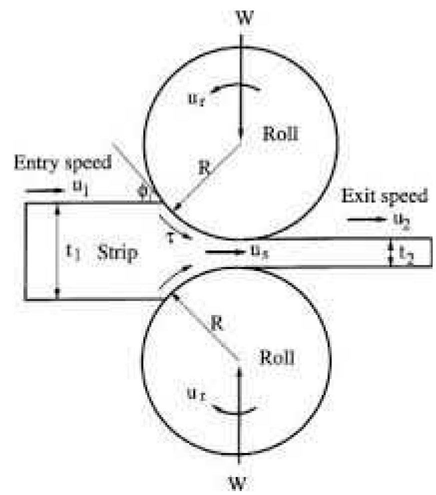
SR NO	HOT WORKING	COLD WORKING
1.	Hot working is done above recrystallisation temperature	Cold working isdone below recrystallisation temperature.
2.	Refinement of grains takes place	Grain structure is distorted.
3.	Impurities and porosity are removed from metals after hot working.	Impurities and porosities 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.

3.2.ROLLING

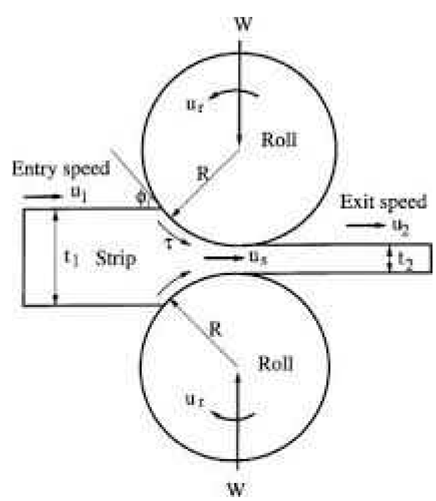
Rolling is the most rapid method of forming metals into desired shapes by plastic deformation in between rolls.

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





3.2.1.Classification of Rolling mill based on number of rolls.



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.

3.2.2. DEFECTS IN ROLLED PARTS

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

(a) SURFACE DEFECTS
(b) INTERNAL SURFACE DETECTS.

(a) **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.,

(b).INTERNAL SURFACE DEFECTS

i. 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.

ii. 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.

iii. **FOLDS**

Folds occur if the reduction per pass is very less.

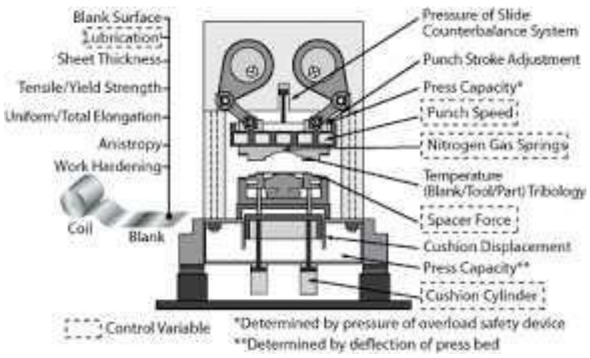
iv. **Alligatoring**.

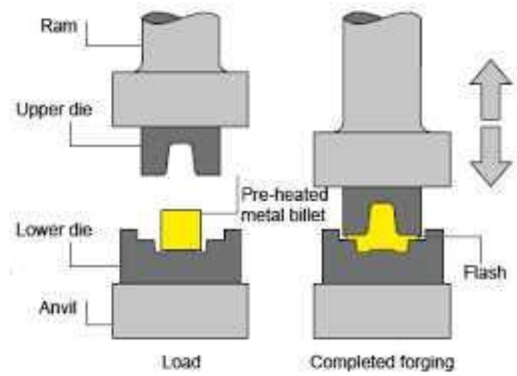
It is the splitting of work piece along the horizontal plane on exit, with top and bottom part following the rotation of their respective rolls.

v. Lamination.

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

3.3.FORGING





3.3.1. COMPARISON BETWEEN PRESS FORGING AND 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.

3.3.2. Forging operations

Forging is a process in which the work piece 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 impression dies - closed die forging. This results in favorable grain flow for strong parts

3.3.3. 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

3.3.3.1Open-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 equipment, aircraft, railroad and mining equipment, general mechanical industry, and energy-related engineering production.

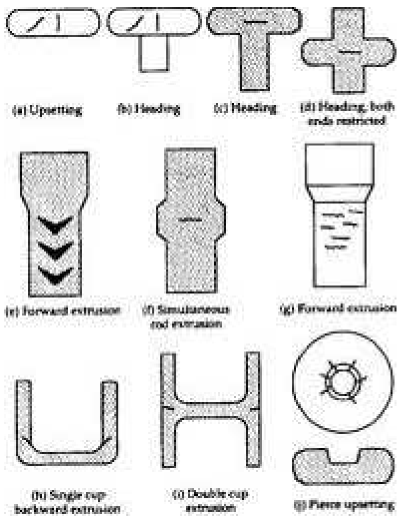
3.3.4. DEFECTS IN FORGED PARTS

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?

7.Laps.

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

MCQ

Questions	opt1	opt2	opt3	opt4	answer
Hot working is a process that is being done ----------- temperature	Above Recrystallisation	Below Recrystallisation	Above boiling	Below boiling	Above Recrystallisation
Recrystallisation temperature is a minimum temperature at which the --------- recrystallisation of cold worked metal occurs in a specified time	Complete	25 percentage	50 percentage	75 percentage	Complete
Recrystallisation temperature depends on the material and the extent of --------- already done	Hot working	Cold working	Heat treatment	Pre machining	Cold working
Recrystallisation temperature is ------------ percentage of melting temperature	10 - 15 percentage	15 - 30 percentage	30 - 40 percentage	40 - 50 percentage	30 - 40 percentage
Hot working temperature is around --------------- percentage of Melting temperature	20 - 40 percentage	40 - 60 percentage	70 - 90 percentage	10 - 20 percentage	70 - 90 percentage
Atoms of workpiece reach a certain higher energy level due to ------------ when it is hot worked	Heat and Force	Pressure and Density	Hardness and Temperature	Ductility	Heat and Force
When temperature of the hot metal increases -------	Hardness	Strength	Density	Ductility	Strength

--- decreases hence it can be worked more easily					
When hot working is properly carriedout, no change in -----------------	Density	Hardness	Ductility	Compression strength	Hardness
Controlled hot working improves --------- of the material	Density	Hardness	Ductility	Toughness	Toughness
Metals become stronger due to closing of pores by --------------	Expansion	Squeezing	Vibration	Impact	Squeezing
Less ----------- is sufficient for hot working process	Displacement	Force	Energy	Temperature	Energy
Metals can be worked to achieve extreme shapes without any ---------------	Rupture	Deformation	Collision	Evaporation	Rupture
High temperature working requires ------- heat resistant tools	Reasonably cheap	Cheap	Costlier	Very Costlier	Costlier
Results in oxidation and scaling which gives poor --------------------	Asthetics	Tensile strength	Yield strength	Hardness	Asthetics
By hot working, --------------- tolerances cannot be achieved	Very high narrow	Narrow	Very wide	Wide	Narrow
Hot working may lead to ---------- defect due to high temperature working	Blow holes	Shrinkage	Crack	Void	Crack
Cold working is a process that is being done ----------------	Above recrystallisation	Below recrystallisation	Above boiling	Below boiling	Below recrystallisation

temperature					
Cold working is alos done with the application of --------------	Tensile force	Pressure	Shear force	Impact force	Pressure
By cold working, --------------- tolerances can be achieved	Very high narrow	Narrow	Very wide	Wide	Narrow
Cold working process lead to ------------------	Annealing	Work hardening	Tempering	Nitriding	Work hardening
Cold working process lead to ------------------ of metal	Deformation	Collision	Rupture	Evaporation	Deformation
Cold working process leads to improvement in ---------------	Density	Microstructure	Tensile strength	Compression strength	Tensile strength
During cold working, further deformation is not possible, when the job reaches	Breaking point	Boiling point	Yield point	Melting point	Breaking point
Cold working requires ------------ process and equipments	Smaller and Heavier	Larger and Heavier	Smaller and Lighter	Larger and Lighter	Larger and Heavier
Helve hammer is a type of --------- hammer in Forging machines	Mechanical	Air	Steam	Pneumatic	Mechanical
Steam hammer is a type of --------- hammer in Forging machines	Mechanical	Air and Steam	Helve	Trip	Air and steam
Helve hammer has got a maximum capacity of ------- kgs	50	100	150	200	200
Lever spring hammer has got a maximum capacity	50	100	150	250	250

of ------- kgs					
Steam hammer has got a maximum capacity of ------- kgs	300	500	800	1200	800
Trip hammer has got a minimum capacity of ------- kgs	5	10	15	20	5
Steam hammer has got a minimum capacity of ------- kgs	100	200	300	400	400
Lever spring hammer has got a minimum capacity of ------- kgs	10	20	30	40	30
In single acting hammer air pressure is used to -------	Lift the Ram	Lift ram and Impact work piece	Impact workpiece only	Lift ram, impact and eject workpiece	Lift the Ram
In Double acting hammer air pressure is used to -------	Lift the Ram	Lift ram and Impact work piece	Impact workpiece only	Lift ram, impact and eject workpiece	Lift ram and Impact work piece
Pivoted end is applied in ------------- hammer	Helve	Trip	Lever spring	Pneumatic	Helve
Toggle is applied in ------------- hammer	Helve	Trip	Lever spring	Pneumatic	Trip
Ram is being operated by an elastic rod in ------------- hammer	Helve	Trip	Lever spring	Pneumatic	Lever spring
Hot heading is the process of ------- Forging operation	Upsetting	Drawing down	Punching	Bending	Upsetting
In ------------- forging operation length decreases and Cross section increases	Upsetting	Drawing down	Punching	Bending	Upsetting

In ------------- forging operation length increases and Cross section decreases	Upsetting	Drawing down	Punching	Bending	Drawing down
Shapes like Ovals, Angles and Circles are done in ------- Forging operation	Upsetting	Drawing down	Punching	Bending	Bending
Making a hole of given diameter is done in -------------- Forging operation	Swaging	Cutting	Punching	Bending	Punching
Removal of excess metal from work is done in --------------- forging operation	Swaging	Cutting	Punching	Bending	Cutting
Making blind hole with the application of Punch is done in --------------- Forging operation	Piercing	Cutting	Punching	Bending	Piercing
Reducing the stock and increasing the length of workpiece in Forging operation is -----------	Swaging	Cutting	Fullering	Piercing	Fullering
Deforming the metal into semi finished or finished condition by passing the metal in between two rollers is called ----------------------- process	Swaging	Rolling	Fullering	Piercing	Rolling
The concept of Billet rolling is adopted in ---------------- roll mill	Two high	Three high	Four high	Universal	Three high
Large diameter backup	Two high	Three high	Four high	Universal	Four high

rolls are installed to effect reversing mills in ----------- roll mill					
Almost Extrusion process ie strips having thickness in terms of Microns are being produced in ---------------- roll mills	Two high	Three high	Four high	Universal	Universal
Rolling defect of ------------- occurs due to edges are restrained from expanding freely	Wavy edges	Zipper cracks	Folds	Alligatoring	Wavy edges
Rolling defect of ------------- occurs due to poor material ductility at the rolling temperature	Wavy edges	Zipper cracks	Folds	Alligatoring	Zipper cracks
Rolling defect of ------------- occurs due to very small reduction is given per pass	Wavy edges	Zipper cracks	Folds	Alligatoring	Folds
Rolling defect of ------------- occurs due to incomplete welding of pipe and blow holes	Wavy edges	Zipper cracks	Laminations	Alligatoring	Laminations
It is most suitable to do Extrusion of --------------- in hot process at high temperature	Steel	Aluminium	Tin	Lead	Steel
Heated metal is compressed and forced through a suitable shaped Die is known as ----------	Rolling	Extrusion	Welding	Casting	Extrusion

process					
Application of ----------- load is given for the Cold Extrusion process	Gradual	Tensile strength	Impact	Compressive	Impact
Electrical wires are made by the ------------- process	Drawing	Extrusion	Rolling	Welding	Drawing down
Bull block machine is employed for -------------- -process	Extrusion	Wire drawing	Rolling	Welding	Wire drawing
In doing Die design calculation for Forging operation, Draft angle for outside faces are taken as -------	1 - 3 degrees	3 - 5 degrees	5 - 7 degrees	7 - 9 degrees	5 - 7 degrees
Increased width in ------- ---- operation is called as Spreading	Flat Strip Rolling	Fullering	Upsetting	Swaging	Flat Strip Rolling

2 MARKS

1. List out the types of forging machines
2. What are the types of rolling mills?
3. What are the four major draw backs of hot working?
4. Classify the types of extrusion
5. State any two effects produced by Cold-working
6. What are the two basic types of forging process?
7. What do you understand by forging? What are the advantages?
8. List out the forging defects
9. Classify the types of forging machines
10. State the defects in rolled parts.
11. What are the advantages of cold forming?
12. What is the purpose of piercing operation?
13. Name any four limitations of hot forging
14. Write the limitations of hot working process
15. What is the difference between stretch forming and bending?
16. What do you understand by recrystallisation and recrystallisation temperature?
17. What are the general advantages of forging as a manufacturing process?
18. List the functions of Back-up rollers in rolling operation?
19. Discuss in brief open die and closed die forging
20. What is the principle of impact forging?

14 MARKS

1.Classify the types of forging machines and explain any

one 2.Explain the forward and back extrusion process

3. i. Classify the types of rolling mills and sketch them

   ii. List out various forging defects

4. i. Describe hydrostatic extrusion process.

   ii. Compare press forging and hammer forging

5. i. Explain the tube piercing process

   ii. Distinguish hot and cold extrusion process and briefly explain one in each.

6. i. Describe the principle of rolling. Write the various kinds of rolling mills along with their applications

   ii. What are the types of power hammers available and explain the pneumatic hammer with a neat sketch

7. i. Describe the difference between a bloom, a slab and a billet. Explain the features of different types of rolling process.

   ii. Discuss the effects of temperature, strain rate and friction on metal forming process

8. i. Explain with a sketch, what is meant by flat strip rolling.

   ii. Explain the procedure for making the head of Bolt by forging operation

9. i. Name the hand forging operation and explain briefly about them.

   ii. Explain with a neat sketch of roll forging process.

10. Describe the following processes

    a. Roll die forging   b. Skew rolling   c. Ring rolling

UNIT IV

SHEET METAL PROCESS

PREREQUISITE DISCUSSION

Now a day the automobile component, aircraft and ship building involves the usage of thin sheets of various metals. If the thickness of the metal is less than six ‘mm’ then it is called as sheet. Hence the knowledge about the sheet metal processing is necessary. This unit deals how the sheet metals are processed for meeting the requirement & 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. The surface finish of the sheet metals processed by this methods are good when compared to other process like welding, machining etc., 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.

4. The Major operations of sheet Metal are;

(A) Shearing,
(B) Bending,
(C) Drawing and
(D) Squeezing

4.1. 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

Classifications of Shearing Processes

Blanking
Punching
Piercing
Trimming
Slitting
Notching
Nibbling
Shaving
Dinking
Perforating
Lancing
Cutoff
Spring Back

Blanking.

Cutting a piece from the sheet metal by leaving enough scrap around the opening to assure that the punch has enough metal to cut along its entire edge, during which a metal work piece is removed from the primary metal strip or sheet when it is punched.

Punching.

It is the operation to produce circular holes on a sheet metal by a punch and a die. Here the pierced metal is the final product then the operation is called as punching.

Piercing.

It is an operation to produce holes of any desired shape. Piercing produces a raised hole rather than a cut hole. Piercing refers to punching a hole.

Trimming.

It is the operation of cutting and removing unwanted excess metal from the periphery of a previously formed /forged/cast component.

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. Shearing operations can be carried by means of a pair of circular blades.

Notching

Same as piercing- edge of the strip or black forms part of the punch-out perimeter. In this process the metal is removed from the side (OR) EDGE of a sheet to get the desired shape.

Nibbling

Produces a series of overlapping slits/notches. A machine called nibbler moves a small straight punch up and down rapidly into a die.

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. The rough edges of a blanked part are removed by cutting thin strip of metal along the edge on the periphery.

Dinking

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

Perforating.

Process of making multiple holes which are small in diameter and closed together.

Lancing.

Lancing refers to leaving a tab without removing any material. It is an operationof cutting on one side and bending on the other side to form a sort of tab (or) Louver. No metal is removed in this operation.
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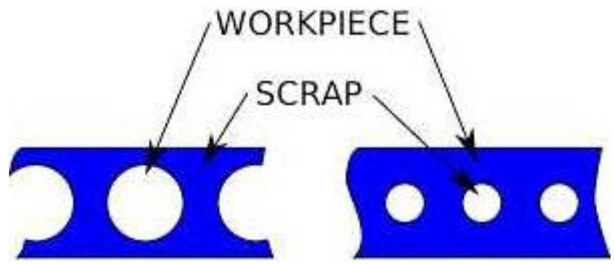
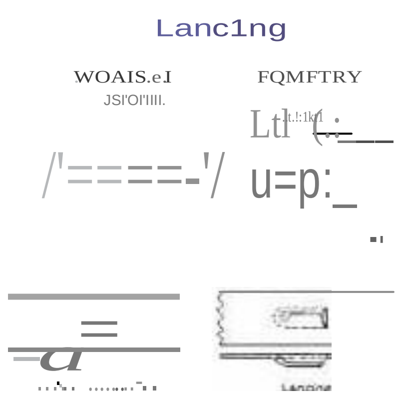
Cutting Off.

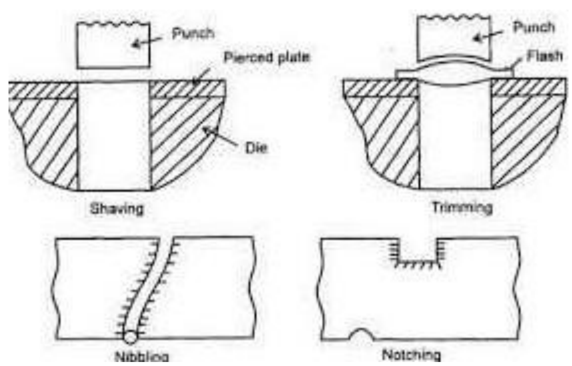
In this operation a piece is removed from a strip by cutting along a single line.Parting The sheet is sheared into two (Or) more pieces.

Spring back

The elastic recovery of the material after unloading of the tools.







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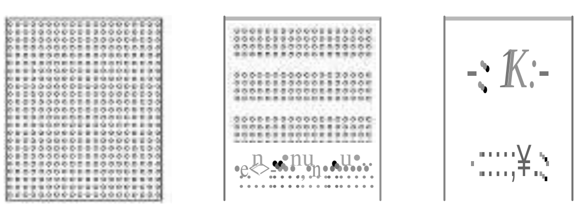
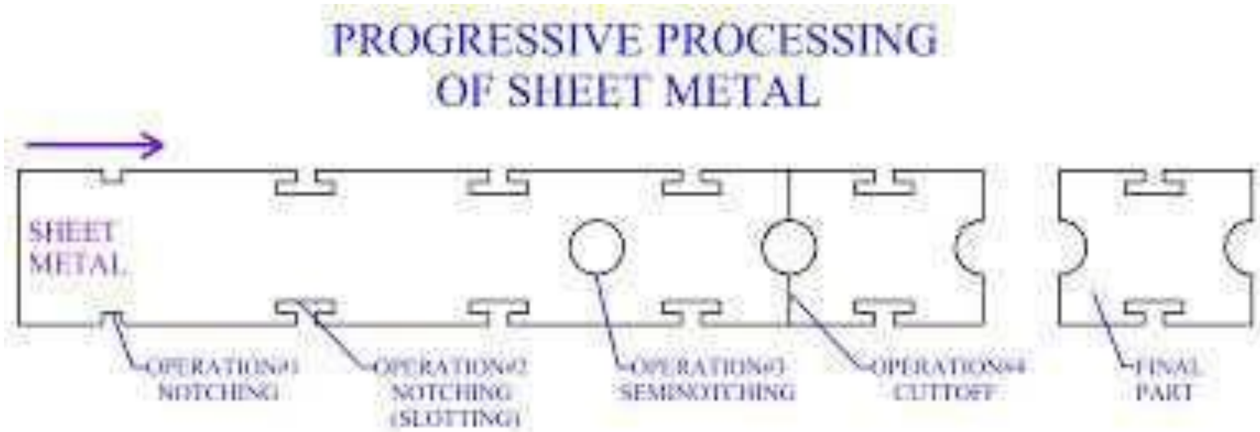


METAL SI-11£ETS
WITH HOLES

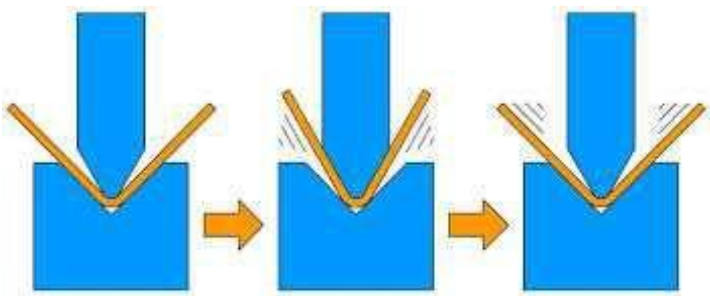
Embossing

- Certaio designs are embossed on the :..;hcct rnc.:tal.
- Punch and die are of l.he ame COJJlOur bol in oppoite dil'ectiof).

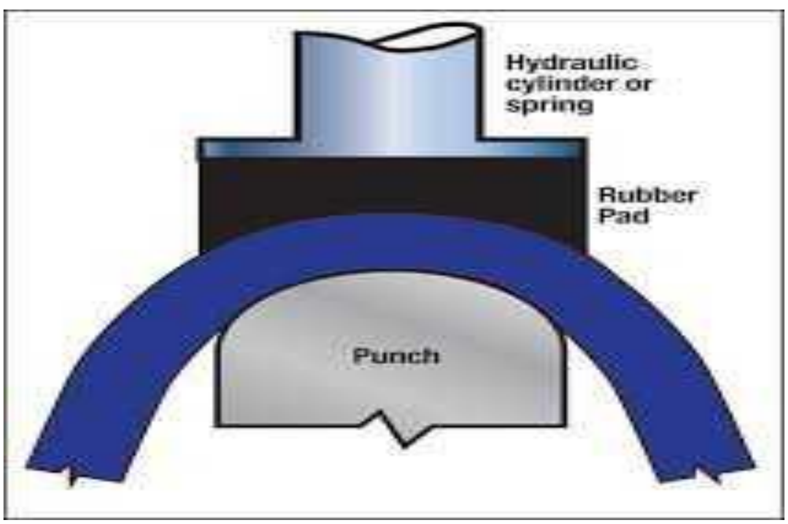


4.2. Bending

The plastic deformation of metals about a linear axis with little or no change in the surface area. The purpose of bending is to form sheet metal along a straight line



4.3. STRETCH FORMING OPERATIONS



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

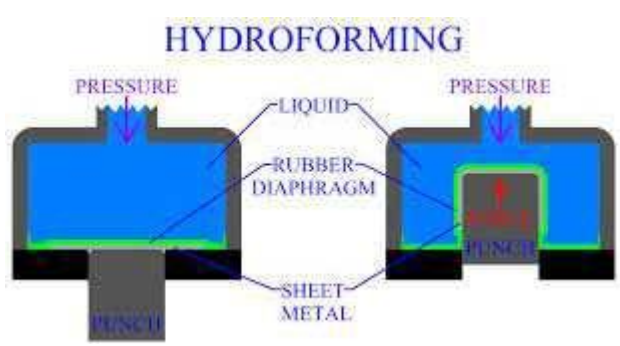
1. In a single operation, blanks can be stretched.
2. Heat treatment before and after stretching process is not required.
3. Spring back effect is minimized.
4. Tooling cost is low.
5. Direct bending is not introduced, and plastic deformation is due to pure tension.
6. It is suitable for low volume production.

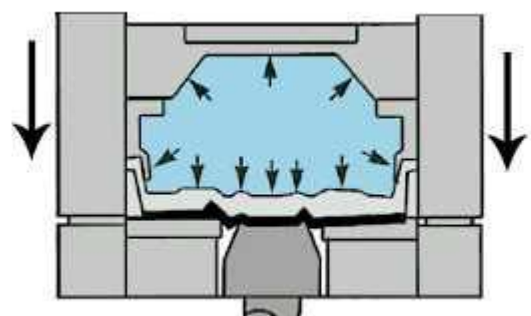
Disadvantages.

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

4.4. SPECIAL FORMING PROCESS.

4.4.1.HYDRO FORMING PROCESS





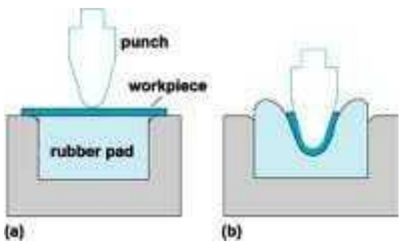
STEP 2
Top of press lowered and fluid chamber pressurized.

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.

4.4.2.RUBBER PAD FORMING



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.

Advantages of rubber pad forming.

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

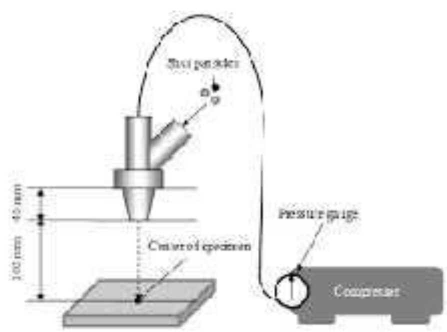
1.Rapid wearing of rubber Pads is a problem in this process.
2.Accurate sharp corners cannot be made by this process.
3.Loss of pressure between hydraulic fluid and rubber pad which is a major problem

Aplications.

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

4.4.3.PEEN FORMING PROCESS.

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.

MCQ

Questions	opt1	opt2	opt3	opt4	answer
Fly press is operated by ------- means	Mechanical	Hydraullic	Electrical	Manual	Manual
Straight side press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Design of Frame
Hydraullic press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Source of power
Vertical press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Position of Frame
Rack and Pinion press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Mechanism used for applying power to Ram
Horning press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Design of Frame
Horizontal press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Position of Frame
Crank press is classified according to -----------------	Source of power	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Mechanism used for applying power to Ram
Single action press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Actions

Cam press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Mechanism used for applying power to Ram
Single drive press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Number of gear drives
Fly wheel press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Mechanism used for applying power to Ram
Triple action press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Actions
Screw press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Number of gear drives
Quadruple press is classified according to -----------------	Actions	Number of gear drives	Method of Transmission of power from Motor to Crankshaft	Mechanism used for applying power to Ram	Method of Transmission of power from Motor to Crankshaft
Multiple geared press is classified according to ---------	Actions	Number of gear drives	Method of Transmission of power from	Mechanism used for applying power to Ram	Mechanism used for applying power to Ram

--------			Motor to Crankshaft		
Gap frame press is classified according to -----------------	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Number of Crankshafts used	Design of Frame
Eccentric press is classified according to -----------------	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Number of Crankshafts used	Mechanism used for applying power to Ram
Open end press is classified according to -----------------	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Number of Crankshafts used	Design of Frame
Double crank press is classified according to -----------------	Design of Frame	Position of Frame	Mechanism used for applying power to Ram	Number of Crankshafts used	Number of Crankshafts used
Cutout portion is the required part in ------------- operation	Blanking	Piercing	Shearing	Notching	Blanking
Cutout portion is the waste part in ------------- operation	Blanking	Piercing	Shearing	Notching	Piercing
Aluminium punch has ------ kg per square mm maximum Ultimate strength	35	40	60	70	40
Plain carbon steel punch has ------ kg per square mm	35	40	60	70	70

maximum Ultimate strength					
Brass punch has ------ kg per square mm maximum Ultimate strength	35	40	60	70	60
Copper punch has ------ kg per square mm maximum Ultimate strength	35	40	60	70	35
Cutting action is done in ----------------sheet metal operation	Blanking	Piercing	Shearing	Notching	Shearing
It is a straight line cutting action in --------- sheet metal operation	Blanking	Piercing	Shearing	Notching	Shearing
It is a circular line cutting action in --------- sheet metal operation	Blanking	Piercing	Shearing	Notching	Piercing
It is an edge cutting action in --------- sheet metal operation	Blanking	Piercing	Shearing	Notching	Notching
It is a two parallel lines / contours cutting action in --------- sheet metal operation	Blanking	Parting	Shearing	Notching	Parting

It is removing excess metal, irregular outlines and waved edges action in ------------ sheet metal operation	Blanking	Trimming	Shearing	Notching	Trimming
It is removing 10 percentage thickness of blank action in ------------sheet metal operation	Shaving	Trimming	Shearing	Notching	Shaving
It is doing chain multiple holes in straight line action in ------- sheet metal operation	Shaving	Trimming	Perforating	Notching	Perforating
------------- is the operation of cutting sheetmetal through a small length and bending this small cut portion downwards	Shaving	Trimming	Perforating	Lancing	Lancing
One of the process in cutting operation is --------------	Drawing	Squeezing	Shaving	Bending	Shaving
One of the process in Forming operation is --------------	Parting	Squeezing	Lancing	Trimming	Squeezing
One of the process in cutting operation	Drawing	Bending	Blanking	Embossing	Blanking

is --------------					
One of the process in Forming operation is --------------	Nibbling	Punching	Notching	Perforating	Nibbling
One of the process in cutting operation is --------------	Slitting	Nibbling	Embossing	Bending	Slitting
One of the process in Forming operation is --------------	Blanking	Embossing	Lancing	Shaving	Embossing
It is the process of ----------------- operation where sheet metal flows plastically to form cylindrical / box shape	Drawing	Squeezing	Shaving	Bending	Drawing
Spring back property is existing in ----------- Forming operation	Drawing	Squeezing	Nibbling	Bending	Bending
Tracer or Template is used in --------------- Forming operation	Drawing	Squeezing	Nibbling	Bending	Nibbling
It is the process of ----------------- operation where stressing the work blank beyond its elastic limit by	Stretch forming	Squeezing	Nibbling	Bending	Stretch forming

moving a form blank towards the blank or sheetmetal					
Generally sheet metal is specified in terms of ---------------	Density	Length unit	Weight	Gauge	Gauge
Behaviour is altered in actual working condition for the ------------- material	Castings	Sheetmetal	Fuel	Forgings	Sheet metal
Law of Geometrical similitude is applicable for --------------- material	Castings	Sheetmetal	Fuel	Forgings	Sheet metal
Formability test for Bulk deformation is done for --------------- material	Castings	Sheetmetal	Fuel	Forgings	Sheet metal
Formability test for Elastic plastic deformation is done for --------------- material	Castings	Sheetmetal	Fuel	Forgings	Sheet metal
Ratio between elastic deformation and plastic deformation is found to test ------------ of sheet metal	Bulk deformation	Elastic plastic deformation	Tensile	Simlative	Bulk deformation

Full scale forming test is being done to perform formability tests for	Bulk deformation	Elastic plastic deformation	Tensile	Simulative	Elastic plastic deformation
Important property of work hardening is predicted in ----------- test	Bulk deformation	Elastic plastic deformation	Tensile	Simulative	Tensile
------------- test is conducted in various cup forming operations like Erichson	Bulk deformation	Elastic plastic deformation	Tensile	Simulative	Simulative
Specimen is clamped in a Die having 27 mm diameter opening in ------------ test	Erichson	Olsen	Surift	Fukui	Erichson
Specimen is clamped in a Die having 50 mm diameter opening in ------------ test	Erichson	Olsen	Surift	Fukui	Olsen
Both Stretchability and Drawability can be assesed in ------------- test	Erichson	Olsen	Surift	Fukui	Fukui
Edge wrinkling disadvantage is faced in --------------------test	Erichson	Olsen	Surift	Fukui	Surift

To form seamless metal parts from a circular sheet, ---------------- Forming process is adopted	Electro Hydraulic	Rubber pad	Hydro	Metal Spinning	Metal Spinning
More complex shaped parts require segmental chuck in -------------- forming process	Electro Hydraulic	Rubber pad	Hydro	Metal Spinning	Metal Spinning

2 MARKS

1. What is blanking?
2. What is punching operation?
3. What are the different types of metals used in sheet metal work?
4. Mention any four products produced by spinning process?
5. In which member the clearance should be given for blanking and piercing?
6. What is the difference between stretch forming and bending?
7. List various operations generally performed in a sheet metal shop
8. Show the details of punching process with the help of a simple sketch
9. Give the difference between punching and blanking
10. List the various sheet metal that can be formed in press working
11. Define the term spring back
12. What are the advantages of stretch forming operation?
13. What are the types of special forming processes?
14. What are the advantages of hydro forming process?
15. State the limitations and applications of rubber pad forming process
16. What is metal spinning process?
17. State the advantages and applications of explosive forming process
18. What is peen forming process?
19. What are the advantages and disadvantages of peen forming process
20. What are the applications of super plastic forming process?

14 MARKS

1. i. Explain any one stretch forming operation

   ii. Define formability and how it is tested?

   iii. What is drawing operation?

2. i. Explain the metal spinning operation

   ii. Describe the magnetic pulse forming process

3. What is deep drawing operation? Explain with a neat sketch.

4. i. Explain rubber pad forming process

   ii. Describe the electro hydraulic forming process

5. i. Describe the explosive forming process

   ii. How are aluminium kitchen utensils produced?

6. i. Describe the process of hydro forming

   ii. Describe the various methods of rubber forming. Where are these processes used?

7. i. What is super plastic forming?

   ii. Describe the hydro forming process with the help of neat diagram

8. i. Explain the characteristic features of sheet metal used in forming process

   ii. Explain peen forming process

9. i. Find the total pressure, dimensions of tools to produce a washer 5cm outside dia with a 2.4 cm diameter hole, from a material 4 mm thick, having a shear strength of 360 N/mm^2

   ii. Determine a) blank diameter b) Least no. drawing operations c) force and energy for the first draw with 40% reduction to produce a cup of 5 cm in diameter and 7.5cm deep to be drawn from 1.5mm thick drawing steel with a tensile strength of 315 N/mm^2

10.i. Estimate the blanking force to cut a blank 30mm and 35 mm long from a 1.5 mm thick metal strip,if the ultimate shear stress of the material is 450 N/mm$^{2.}$ Also determine the work done if the percentage penetration is 25% of material thickness

ii. A blank has a perimeter of 31.75cm. The metal is 1mm thick cold worked 0.15% carbon steel with a shear strength of 420 N/mm^2 and percent penetration of 25%. Two holes of 1.25cm diameter each are to be pierced during the same stroke when the piece is blanked. What are the forces required for blanking and for piercing?What is the maximum force the press must exert at any one time without shear?

iii. Estimate the blanking force to cut a blank 30 mm wide and 35 mm long from a 1.8mm strip if the ultimate shear stress of the material is 450 N/mm^2.Also determine the workdone if the percentage penetration is 25% of material thickness.

UNIT -V

MANUFACTURING OF PLASTIC COMPONENTS

PREREQUISITE DISCUSSION

Plastics are the best alternatives used in the areas where the component size is very small and weight reduction is required in order to minimize the cost of material. Hence knowledge about various types of plastics, its properties, production method etc is very important.

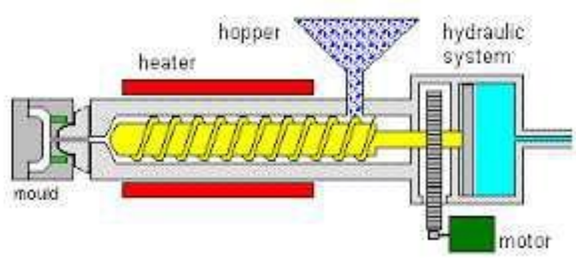
5.1.TYPES OF PLASTICS

Plastics are of two types
1.Thermo plastics
2.Thermosetting Plastics

Common plastics USED in molding are

- 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)

5.2.INJECTION MOULDING.



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.

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.

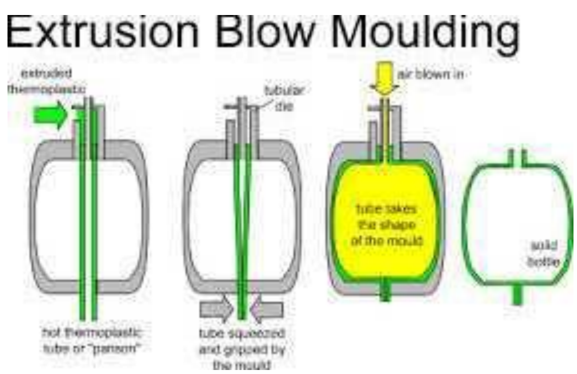
1. Plunger type injection moulding.
2. Screw type injection moulding.

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.

5.3. BLOW MOULDING



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

The parison can be formed by

A)Extrusion process
B)Injection molding process

(A)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

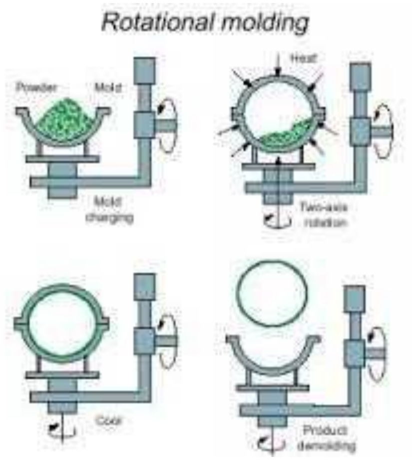
- The mold is closed
- Resin is then injected to form a cylindrical part
- The mold is opened and perform is ejected

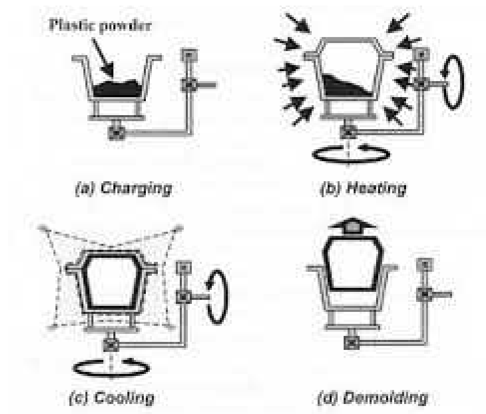
The perform can be stored until the finished blow molded is needed.
The flexibility of separating the two cycles has proven useful in manufacture of soda pop bottle.

Comparison of extrusion and injection blow molding

Sr no	(a)Extrusion blow molding	(b)Injection blow molding
1.	– It is best suited for bottle over 200g in weight, shorter runs and quick tool changeover	• Best suited for long runs and smaller bottles • No trim scrap
	– Machine costs are comparable to injection blow molding	• Higher accuracy in final part
	Tooling costs are 50% to 75% less than injection machine It requires sprue and head trimming	Better transparencies with injection blow molding, because crystallization can be better controlled
	Total cycle is shorter than injection (since the parison and blowing can be done u sing the same machine)	• Can lead to improve mechanical properties from improved parison design.
	Wider choice of resin	• Uniform wall thickness

5.4.ROTATIONAL MOULDING.





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. The steps followed in rotational moulding are.

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

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.

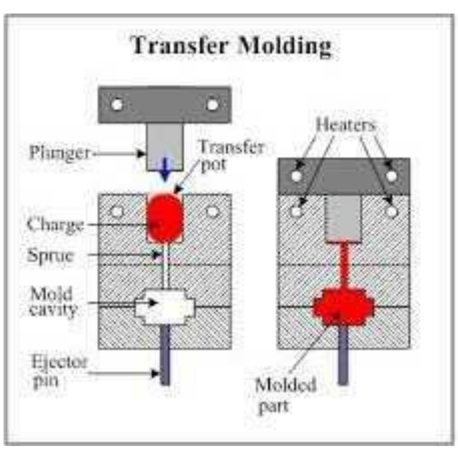
Limitations of rotational moulding.

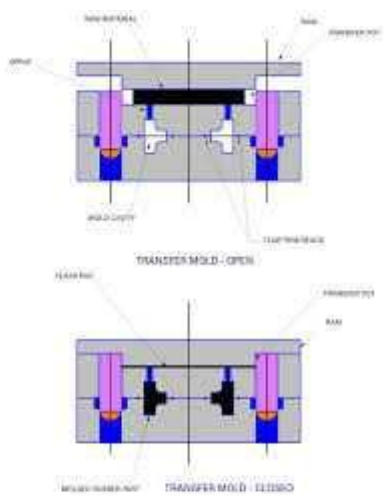
1.Moulding Cycles are long 10-20 mins

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

3.Cannot make parts with tight tolerance.

5.5.TRANSFER MOULDING.





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

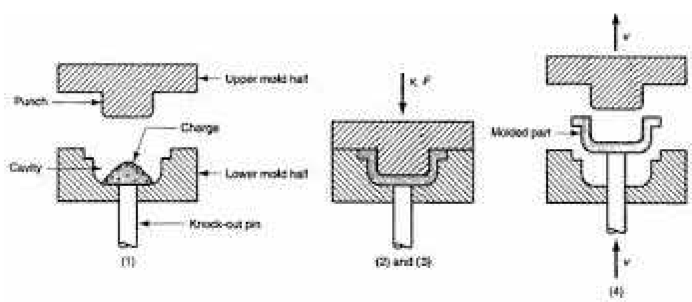
Advantages

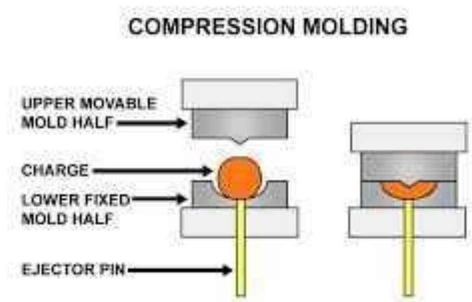
- Little waste (no gates, sprues, or runners in many molds)
- Lower tooling cost than injection molding
- Good surface finish
- Less damage to fibers
- Process may be automated or hand-operated
- Material flow is short, less

Disadvantages

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

5. 6.COMPRESSION MOULDING.





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

MCQ

Questions	opt1	opt2	opt3	opt4	answer
The term ------------- refers to a group of synthetic organic materials that can be formed to a desired shape	Casting	Welding	Plastics	Press work	Plastics
Organic materials are directly obtained from ---------	Aluminium	Carbon	Hydrogen	Prottasium	Carbon
The term ------------- stands to represent a substance built up of several repeating units	Monomer	Polymer	Die	Binder	Polymer
A Polymer is made up of thousands of ----------------	Plastics	Monomer	Binder	Die	Monomer
are in the form of liquids with high --------------- point	Flash point	Firing point	Boiling point	Melting point	Boiling point
The liquid form of plastics is termed as --------------	Polymer	Monomer	Binder	Resin	Resin
Which one among this group belongs to Natural Organics	Ceramic	Fiber	Glass	Petroleum	Petroleum
Which one among this group belongs to Polymer	Petroleum	Coal	Ceramic	natural rubber	Ceramic
This is an example for thermosetting plastics	Epoxy resin	Cellulose Nitrate	Cellulose Acetate	Cellulose propionate	Epoxy resin
One among these is the example of Thermoplastics	Ethyl Cellulose	Epoxy resin	Silicones	Alkyd	Ethyl Cellulose
In Thermosetting plastic, structure is made of ------------------ chain molecules	Cross	Linear	Curvilinear	Straight	Cross
In Thermo plastic, structure is made of ----------------- chain molecules	Cross	Linear	Curvilinear	Straight	Linear
Thermosetting plastics is formed by ---------------------- polymerisation process	Addition	Condensation	Evaporation	Deletion	Condensation
Thermo plastics is formed by ---------------------- polymerisation process	Addition	Condensation	Evaporation	Deletion	Addition
Thermosetting plastics can	Not be reproduce	Be reproduced	Be reproduced by heating	Be produced by heat	Not be reproduced

	d			treatement	
Thermo plastics can	Not be reproduce d	Be reproduced	Be reproduced by heating and cooling	Be produced by heat treatement	Be reproduced by heating and cooling
Thermosetting plastics are	Softer	Softer and less strong	Harder	Harder and strong	Harder and strong
Thermo plastics are	Softer	Softer and less strong	Harder	Harder and strong	Softer and less strong
The process which is used to achieve high speed moulding of Thermoplastics is	Transfer moulding	Injection moulding	Rotational moulding	Vacuum forming	Injection moulding
This is a close mould process	Blow moulding	Injection moulding	Compression moulding	Film moulding	Injection moulding
This is an open mould process	Injection moulding	Compressio n moulding	Rotational moulding	Transfer moulding	Compression moulding
In Transfer moulding process, pressure applied is 50 to 100 times higher than that of -------- process	Injection moulding	Compressio n moulding	Rotational moulding	Blow moulding	Compression moulding
In Transfer moulding process, moulding cycle time is shorter than that of -------- process	Injection moulding	Compressio n moulding	Rotational moulding	Blow moulding	Compression moulding
In Transfer moulding process, reinforcing fillers are used to improve ------------ of the polymer	Density	Toughness	Hardness	Microstructure	Toughness
In ------------- moulding process, helical screw is employed for achieving plastisizing action	Blow moulding	Injection moulding	Compression moulding	Film moulding	Injection moulding
Transfer moulding is the modification of ------------- process	Blow moulding	Injection moulding	Compression moulding	Film moulding	Compression moulding
In transfer moulding process, purpose of orifice is to ------------------	Develop Temperat ure	Improve pressure	Reduce time	Improve flowability	Develop temperature
Polymers are preheated by radio frequency option in ---------------- moulding process	Blow moulding	Injection moulding	Compression moulding	Transfer moulding	Transfer moulding
In Transfer moulding process, ----------- of flow material reduces	Temperat ure	Viscosity	Density	Pressure	Viscosity
Hot extruded tube known as Parison is uded in ----------------- moulding process	Blow moulding	Injection moulding	Compression moulding	Transfer moulding	Blow moulding

Multilayer type moulding is one type of ----------------- process	Blow moulding	Injection moulding	Compression moulding	Transfer moulding	Blow moulding
Sintering activity is polymers getting fused without melting occuring in ------- moulding process	Blow moulding	Injection moulding	Rotational moulding	Transfer moulding	Rotational moulding
Mould is rotated in ---------- axes in Rotational moulding process	Two perpendicular	Two Parallel	Three Parallel	Three Perpendicular	Two Perpendicular
In Rotational Moulding process, ------------------ is a key quality factor	Temperature Vs Time	Temperature Vs Pressure	Pressure Vs Time	Time Vs Speed	Temperature Vs Time
The most preferred process for making fuel tanks of Motor cars is ----------- moulding process	Injection moulding	Compression moulding	Rotational moulding	Blow moulding	Rotational moulding
In Thermo forming process, --------- medium in between die and sheet place a vital role	Air	Water	Paraffin	Resin	Air
------------- process is utilising the concept of evacuating air for drawing sheet to the shape of Die	Injection moulding	Compression moulding	Rotational moulding	Thermo forming	Thermo forming
This process is also called as Vacuum forming	Thermo forming	Compression moulding	Rotational moulding	Injection moulding	Thermo forming
In this process, belt conveyor is employed to eject the product out of the machine	Thermo forming	Compression moulding	Rotational moulding	Extrusion	Extrusion
Raw material can be in the form of Granuels, Pellets and Powder in this ---------- moulding process	Thermo forming	Compression moulding	Rotational moulding	Extrusion	Extrusion
Modular dies may be applied in this ------------- moulding process	Thermo forming	Compression moulding	Rotational moulding	Extrusion	Extrusion
In reinforced plastics, polymer is strengthened with -------------	Fabric	Particulates	Paper	Fibermat	Particulates
In reinforced plastics ------------------ is improved	Hardness	Density	Stiffness	Flexibility	Stiffness
In laminated plastics, Fibermat is impregnated with -------------	Mineral oil	Linseed oil	Synthetic resin	Petroleum gel	Synthetic resin
In Fabric laminated plastics --------- is serving as	Epoxy	Polyesters	Cotton	Wood	Cotton

fillers	resin				
In laminated plastics -------------is used as bonding agent	Phenol formaldehyde	Paper	Epoxy resin	Fibermat	Phenol formaldehyde
In this -------- process, mould is preheated	Injection moulding	Compression moulding	Rotational moulding	Transfer moulding	Compression moulding
In this process, ----------- is the key quality parameter	Pressure and Time	Pressure and Temperature	Temperature and Speed	Speed and Time	Pressure and Temperature
Flash type moulding is in the classification of ----------------- moulding process	Injection moulding	Compression moulding	Rotational moulding	Transfer moulding	Compression moulding
Melt Casting Technology is applied in ------------------- moulding process	Film Blowing	Compression moulding	Rotational moulding	Transfer moulding	Film Blowing
Thin films are formed in ---------------------- moulding process	Compression moulding	Rotational moulding	Transfer moulding	Film Blowing	Film Blowing
Crystalline powders of sharp melting polymers are initially heated in ----------- moulding process	Rotational moulding	Transfer moulding	Film Blowing	Compression moulding	Film Blowing
End product is wound on the reeling wheel in -------------- moulding process	Transfer moulding	Film Blowing	Compression moulding	Rotational moulding	Film Blowing
Heated and extruded product is stretched by rollers to reduce the thickness in ----- moulding process	Film Blowing	Compression moulding	Rotational moulding	Transfer moulding	Film Blowing
This ---------------------process is having high production rates	Injection moulding	Rotational moulding	Thermo forming	Casting	Injection moulding
This ---------------------- process is having low production rates	Injection moulding	Rotational moulding	Transfer moulding	Blow moulding	Rotational moulding
This ---------------------- process is having medium production rates	Injection moulding	Rotational moulding	Blow moulding	Thermo forming	Thermo forming
This ---------------------- process is most suitable for producing hollow thin walled parts	Injection moulding	Rotational moulding	Blow moulding	Extrusion	Blow moulding

This ----------------------- process is most suitable for producing shallow deep parts	Injection moulding	Thermo forming	Blow moulding	Extrusion	Thermo forming
This --------- process is most suitable for producing large hollow shapes of simple parts	Injection moulding	Rotational moulding	Blow moulding	Extrusion	Rotational moulding

2 MARKS

1. What are the applications of laminated plastics?
2. Enumerate the advantages of Electro-hydraulic forming process
3. Write any two limitations of Electro-magnetic forming process
4. What are the characteristics of thermosetting plastics?
5. Classify thermoplastics
6. What is meant by high energy rate forming?
7. Name any four thermosetting plastics, used in industries.
8. Give four examples of thermo plastics
9. Give two examples of thermoplastics and thermosetting plastics
10. What is blow moulding process?
11. Which type of plastic is used for manufacturing electrical switches? Why?
12. What is meant by rotational moulding?
13. List the advantages and disadvantages of rotational moulding
14. Define thermoforming
15. What is meant by transfer moulding?
16. Which type of moulding is used for making bottles?
17. What are the types of compression moulding?
18. What is bonding of thermoplastics?
19. List the advantages and disadvantages of transfer moulding
20. What is meant by film blowing?

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14 MARKS

1. Explain the principle of injection moulding process

2 .i. Describe any method of bonding thermoplastics

ii. What is laminating? Explain the low pressure method of laminating

3. i.Explain the transfer moulding process

ii. Why screw injection moulding machine is better than a ram type injection moulding machine?

4. i.Describe the compression moulding process

ii. Describe briefly any two thermoplastics and thermosetting plastics

5. What are the process used for processing of thermoplastic. Explain any one process with suitable sketches

6. What is thermoforming process. Explain with a neat sketch

7. Describe film blowing operation

8. Explain Rotational moulding

9. i. Explain blow moulding process with its salient features

ii. What are the additives to be mixed in processing plastics and explain the purpose of each.

10.i. Describe different types of plastics with applications of each type

ii How do thermoplastics differ from thermosetting plastics?