SECOND SEMESTER DIPLOMA EXAMINATION IN MECHANICAL

ENGINEERING- MARCH, 2015

MANUFACTURING PROCESS

PART-A

1. Define hardness.

It is the ability of a material to resist indentation or surface abrasion

2. What is the use of Vernier height gauge?

It is used to measure the height of a component to an accuracy of 0.02 mm. It can also used to mark at specified height by inserting scriber in the lower face of the jaw.

3. What is the purpose of a comparator?

Comparators are measuring instruments which give only dimensional difference in relation to a basic dimension. Used to check components in mass production, to set working or inspection gauge, etc.

4. What do you mean by seasoning of wood?

Seasoning is the controlled process of reducing the moisture content of the timber so that it is suitable for the environment and intended use.

5. Write the ingredient of core sand.

Silicon sand mixed with organic compound such as linseed oil, resins and other binding materials.

PART-B

1. Define the following physical properties of metals.

(1) Density (2) Viscosity (3) Specific gravity.

(1) Density: It is the ratio between mass of substance to volume.

(2) Viscosity: It is the resistance offered by the fluid layers to flow.

(3) Specific gravity: It is the ratio of density of a substance to the density of a standard substance.

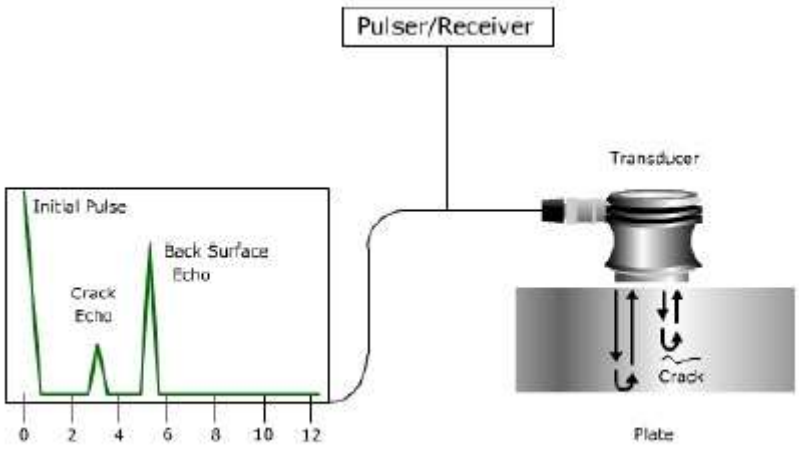
2. Explain ultrasonic testing of materials.

Ultrasonic Testing (UT) uses high frequency sound waves (typically in the range between 0.5 and 15 MHz) to conduct examinations and make measurements. Besides its wide use in engineering applications (such as flaw detection/evaluation, dimensional measurements, material characterization), etc.

UT inspection system consists of several functional units, such as the pulser/receiver, transducer, and a display device. A pulser/receiver is an electronic device that can produce high voltage electrical pulses. Driven by the pulser, the transducer generates high frequency ultrasonic energy.

The sound energy is introduced and propagates through the materials in the form of waves. When there is a discontinuity (such as a crack) in the wave path, part of the energy will be reflected back from the flaw surface. The reflected wave signal is transformed into an electrical

signal by the transducer and is displayed on a screen. Knowing the velocity of the waves, travel time can be directly related to the distance that the signal traveled. From the signal, information about the reflector location, size, orientation and other features can sometimes be gained.



3. Write the difference between comparator and gauge.

Comparator: Comparators are one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions. It will not show the actual dimension of the work piece. It gives only dimensional differences in relation to a basic dimension. A comparator has to compare the unknown dimensions of a part with some standard (Basic Size). These are commonly used for linear measurement in mass production.
Comparators of all types incorporate some kind of magnifying device. The magnifying device magnifies how much dimension deviates, plus or minus from the standard size.

Gauge: These are inspection tools used in production work to control the size and shape of the component. Gauges generally do not indicate actual dimension, but they check whether the part has been made within the specified limits of size. Gauges are two types, standard gauges and limit gauges. Standard gauges are made to nominal size of the part to be tested. Limit gauges are made to limit of the dimensions of the part to be tested.

4. Explain the following forging operations

(1) Upsetting (2) Drawing down (3) Setting down

(1) Upsetting: It is the process of increasing cross-sectional area at the expense of its length. It is achieved by heating the bar and striking the end with bar. Upsetting also known as 'jumping up'.

(2) Drawing down: It is the process of decreasing the cross-sectional area with a corresponding increase in length of object. It is opposite to upsetting.

(3) Setting down: It is the process of decreasing the thickness rather than a general reduction in area. Setting down is initiated with fullers and finished with flatters.

5. Write the principle of arc welding.

Principle of arc welding is that in this process, in which an electric arc between an electrode and a workpiece or between two electrodes is utilized to weld base metals, is called an arc welding process. The basic principle of arc welding is shown in Fig. Most of these processes use some shielding gas while others employ coatings or fluxes to prevent the weld pool from the surrounding atmosphere. When the weld metal solidifies, the slag gets deposited on its surface as it is lighter than metal and weld metal is allowed to cool gradually and slowly. After cooling, a sound metal is joint is formed. The slag is removed by chipping hammer.

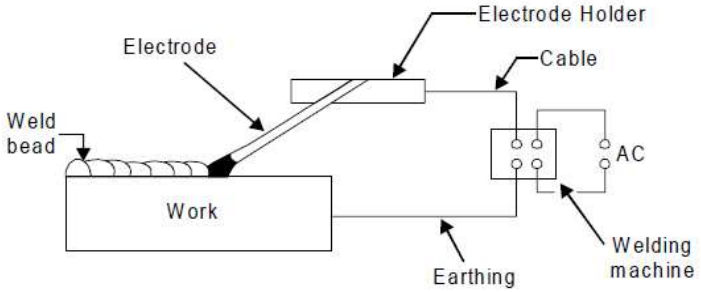
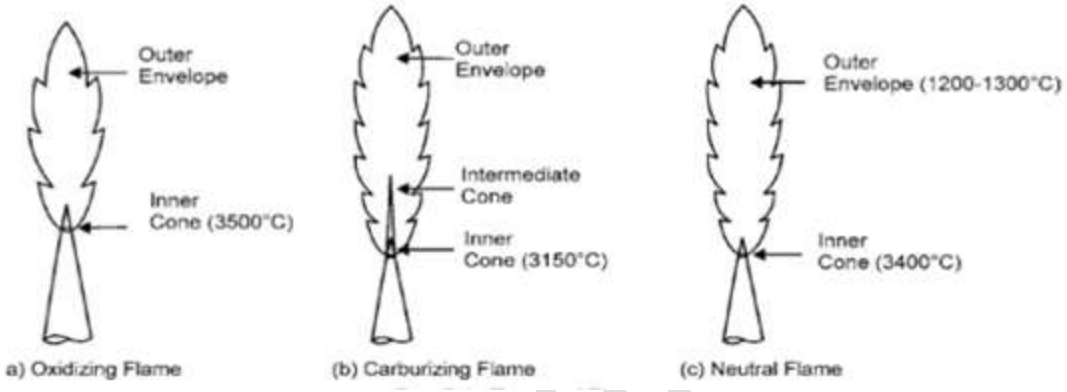


Fig. Principle of arc welding

6. Explain different type of flames used in gas welding.

Oxidizing flame: It has an excess of oxygen over the acetylene. Its inner cone is shorter. It is used for welding brass and bronze and brazing of ferrous metals. It assures complete combustion and highest temperature, but has a tendency to oxidize metals being welded.



Neutral flame: It has equal quantities of oxygen and acetylene. It is most common flame used in welding processes. It has no tendency to react with material being welded.

Reducing flame: It has an excess of acetylene over the oxygen. It has a longer inner cone, an intermediate feather and bluish outer flame. It is used for welding high carbon steel. The flame has carburizing effect on steel, causing hard, brittle and weak weld.

7. List different type of patterns used in foundry.

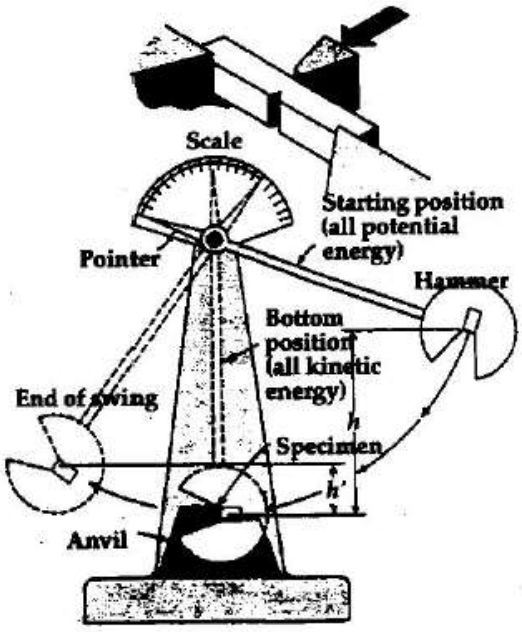
Single piece pattern, split pattern, match plate pattern, Gated pattern, Sweep pattern, Cope and Drag pattern, loose piece pattern, Skelton pattern, Segmental pattern, shell pattern, follow board pattern, etc..

PART-C

UNIT-I

(a) Explain impact test

When metal is subjected to suddenly applied load or stress, it may fail. In order to assess the capacity of metal to stand sudden impacts, the impact test is employed. The impact test measures the energy necessary to fracture a standard notched bar by an impulse load and As such is an indication of the notch toughness of the material under shock loading.



IMPACT TESTER

Izod test and the Charpy test are commonly performed for determining impact strength of materials. These methods employ same machine and yield a quantitative value of the energy required to fracture a special V notch shape metal. The most common kinds of impact test use notched specimens loaded as beams. The beams may be simply loaded (Charpy test) or loaded as cantilevers (Izod test). The function of the V notch in metal is to ensure that the specimen will break as a result of the impact load to which it is subjected.

It is therefore important to observe that the blow in Charpy test is delivered at a point directly behind the notch and in the Izod test the blow is struck on the same side of the notch towards the end of the cantilever. The energy input in this case is a function of the height of fall and the weight of the pendulum used in the test setup.

The energy remaining after fracture is determined from the height of rise of the pendulum due to inertia and its weight. The difference between the energy input and the energy remaining represents the energy absorbed by the standard metal specimen. Advance testing setups of carrying out such experiments are generally equipped with scales and pendulum actuated pointers, which provide direct readings of energy absorption.

(b) Explain the following mechanical properties of metals:

(1) Creep (2) Fatigue

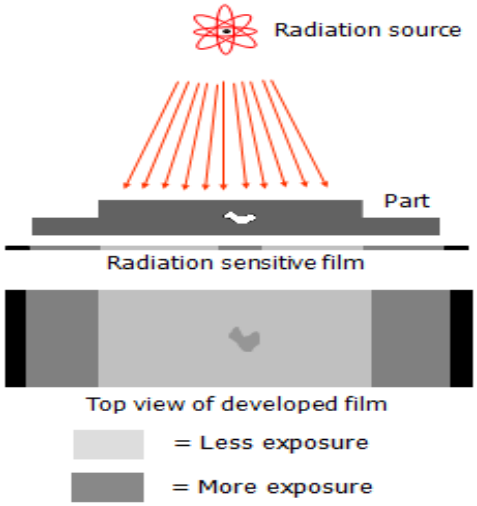
(1) Creep: The slow and continuous deformation of a material under steady load with time. In other words, the slow and continuous deformation of a material with time at constant stress and high temperature below elastic limit.

(2) Fatigue: It is the ability of a material to withstand repeated or cyclic load without fracture. The fatigue strength of a material is the maximum stress at which failure may occur after a certain number of applications.

(a) Explain radiographic test.

In radiographic testing, the part to be inspected is placed between the radiation source and a piece of radiation sensitive film. The radiation source can either be an X-ray machine or a radioactive source (Ir-192, Co-60, or in rare cases Cs-137). The part will stop some of the radiation where thicker and denser areas will stop more of the radiation. The radiation that passes through the part will expose the film and forms a shadowgraph of the part. The film darkness (density) will vary with the amount of radiation reaching the film through the test object where darker areas indicate more exposure (higher radiation intensity) and liter areas indicate less exposure (higher radiation intensity).

This variation in the image darkness can be used to determine thickness or composition of material and would also reveal the presence of any flaws or discontinuities inside the material.



Advantages and Disadvantages

The primary advantages and disadvantages in comparison to other NDT methods are:

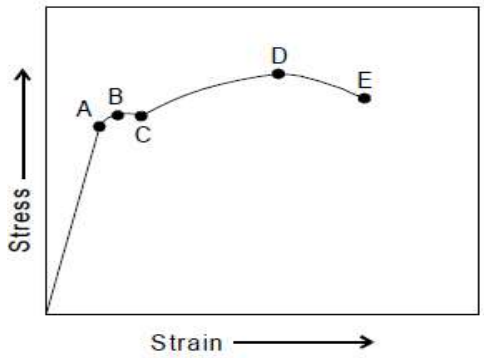
Advantages

- ✓ Both surface and internal discontinuities can be detected.
- ✓ Significant variations in composition can be detected.
- ✓ It has a very few material limitations.
- ✓ Can be used for inspecting hidden areas (*direct access to surface is not required*)
- ✓ Very minimal or no part preparation is required.
- ✓ Permanent test record is obtained.
- ✓ Good portability especially for gamma-ray sources.

Disadvantages

- Hazardous to operators and other nearby personnel.
- High degree of skill and experience is required for exposure and interpretation.
- The equipment is relatively expensive (*especially for x-ray sources*).
- The process is generally slow.
- Highly directional (*sensitive to flaw orientation*).
- Depth of discontinuity is not indicated.
- It requires a two-sided access to the component.

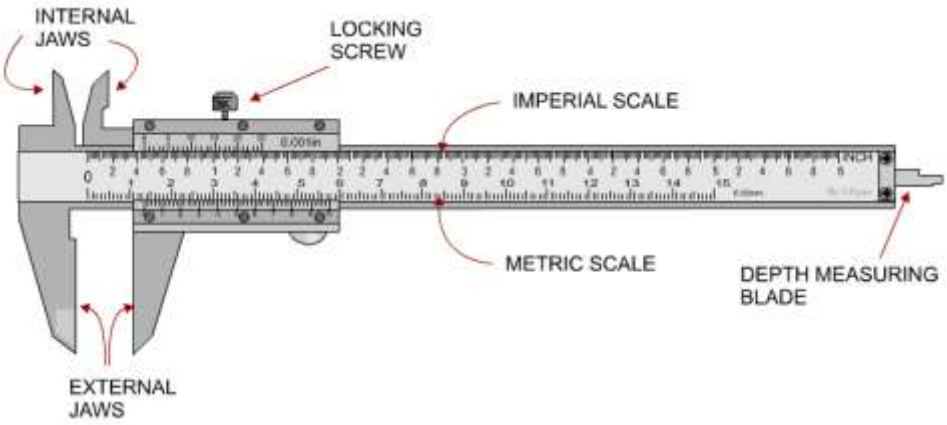
(b) Draw a typical stress-strain diagram for ductile material.



A – Limit of proportionality
B – Elastic limit
C – Yield point
D – Maximum stress point
E – Breaking of fracture point

UNIT-II

(a) Sketch the figure of Vernier caliper and label its parts.



(b) Explain the following gauges:

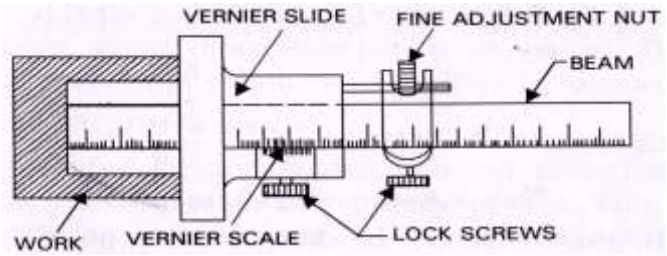
(1) Plug gauge (b) Screw pitch gauge.

Plug gauge: Used for checking inside diameter of an object. Standard type plug gauge is used to check one size only. GO-NO GO type is used to test limits of size of a hole.

Screw pitch gauge: It is used to check the pitch of the screw. A set of gauges are provided in a holder, and one of which is in mesh with screw to be tested. The pitch of the screw is read directly on the gauges.

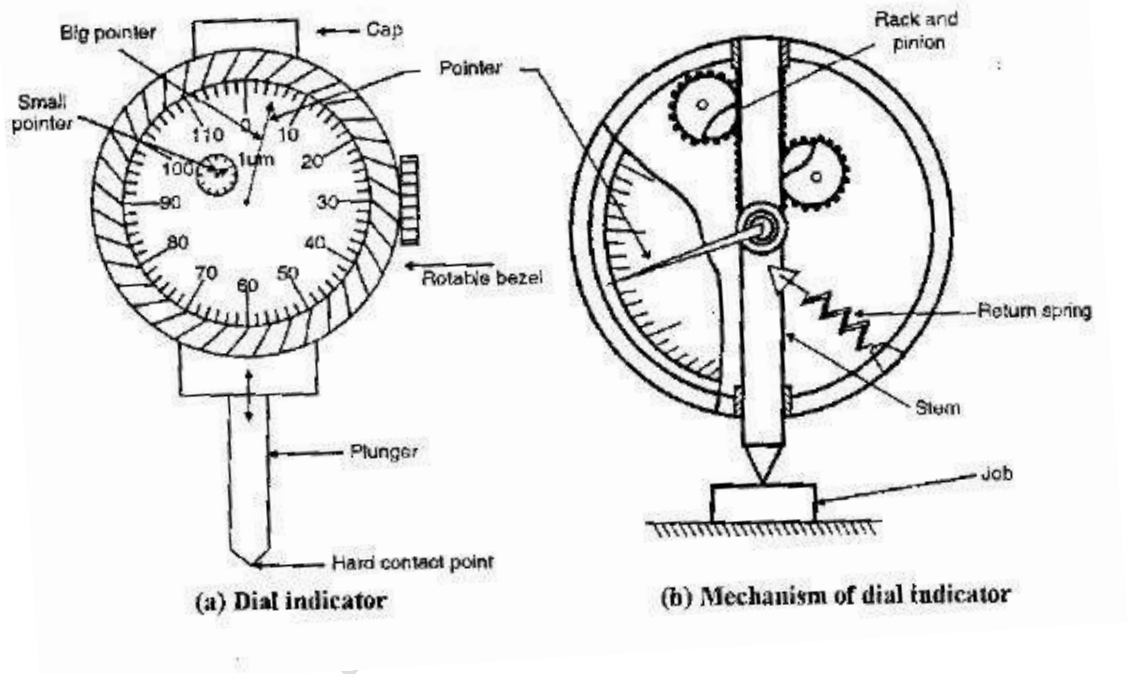
(a) With a neat sketch explain Vernier depth gauge.

The Vernier depth gauge is designed for measuring the depth of blind holes, slots, grooves and the height of projections. It consists of hardened steel equipped with a Vernier scale. A narrow, graduated steel rule slides through the head for making measurement. The reading is taken in the same way as in a Vernier caliper.



(b) Explain the working of a dial indicator.

The dial indicators are also known as dial gauges and are shown in Fig. They are generally used for testing flatness of surfaces and parallelism of bars and rods. They are also used for testing the machine tools. They are available in both metric as well as in inches units. Inches dial indicator of 0.001" measuring accuracy is in commonly used. The commonly used metric dial indicator has an accuracy of 0.01 mm. Those having 0.001 mm accuracy are also available, however they are used in highly precision measurement work.



UNIT-III

(a) Explain flat die forging and closed die forging.

Flat die forging:

The dies are usually flat in shape, but some have a specially shaped surface for specialized operations. In flat die forging, a hammer strikes and deforms the workpiece, which is placed on a stationary anvil. Open-die forging gets its name from the fact that the dies (the surfaces that are in contact with the workpiece) do not enclose the workpiece, allowing it to flow except where contacted by the dies. In some cases, open-die forging may be employed to rough-shape ingots to prepare them for subsequent operations. Open-die forging may also orient the grain to increase strength in the required direction.

Closed die forging:

In closed-die forging, the metal is placed in a die resembling a mold, which is attached to the anvil. Usually, the hammer die is shaped as well. The hammer is then dropped on the workpiece, causing the metal to flow and fill the die cavities. The hammer is generally in contact with the workpiece on the scale of milliseconds. Depending on the size and complexity of the part, the hammer may be dropped multiple times in quick succession. Excess metal is squeezed out of the die cavities,forming that is referred to as *flash*. The flash cools more rapidly than the rest of the material; this cool metal is stronger than the metal in the die, so it helps prevent more flash from forming. This also forces the metal to completely fill the die cavity. After forging, the flash is removed.

(b) Explain the advantages and limitations of welding.

Advantages:

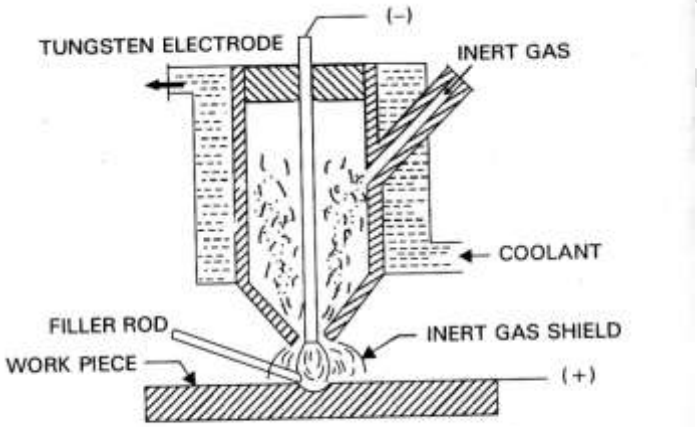
- ✓ Welding equipment is not very costly and is portable.
- ✓ Welding permits considerable freedom in design.
- ✓ A welded joint is strong as base metal.
- ✓ Welding joints are easier to inspect.
- ✓ Welding products are lighter and stronger**.**

Limitations:

- Welding requires skilled operator.
- Welding gives out harmful radiations and fumes.
- Welding require edge preparations, and use of jigs and fixtures.
- Welding results in residual stresses and distortions of work piece.
- The structure of the welded joint is not same as the base metal.

(a) Explain TIG welding.

In this process the heat necessary to melt the metal is provided by a very intense electric arc which is formed between a non-consumable tungsten electrode and metal work piece. In this process a non-consumable tungsten electrode is used with an envelope of inert shielding gas around it.



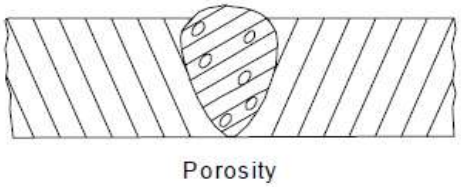
Principle of TIG Welding

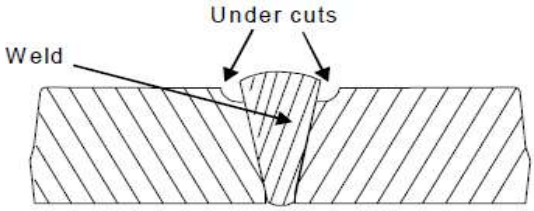
The shielding gas protects the tungsten electrode and the molten metal weld pool from the atmospheric contamination. The shielding gases generally used are argon, helium or their mixtures. TIG welding is specially used for aluminums and its alloys.

(b) Explain the following welding defects:

(1) Porosity (2) Undercut.

(1) Porosity: It is the holes in the weld metal caused by the entrapment of gas. It caused due to dampness in the flux coating electrode or on the surface of the metal and wrong type of electrode.


Porosity



(2) Undercut: Groove formed along the edges of the welding bead, thereby reducing the thickness of base metal. It caused due to excessive current, excessive speed and wrong electrode position.

UNIT-IV

(a) What are the desirable properties of moulding sand?

Porosity: Moulding sand must be sufficiently porous to provide a passage for steam or gases that escaping from the molten metal.

Plasticity: Moulding sands ability to acquire shape from the pattern that is moulded and retain it during casting**.**

Flowability: It refers to its ability to flow, under externally applied forces into deeper section.

Collapsibility: This property permits to it to collapse easily during its knockout from the castings.

Adhesiveness: Ability of a moulding sand to adhere to the surfaces of moulding boxes.

Cohesiveness: Ability of a moulding sand to stick to each other. It refers to the strength of moulding sand to hold the grains together.

Refractoriness: Ability of a moulding sand to withstand the heat of molten metal without softening or fusion.

(b) List different marking and measuring tools used in fitting.

Marking tools: Scriber, Divider, Punch, Surface plate, Angle plate, Try square, V-block

Measuring tools: Steel rule, calipers, Vernier, micrometer, bevel protractor, combination set, gauge block

(a) Write short notes on the following pattern making allowances:

(1)Shrinkage allowances **(2) Machining allowances**

(3) Draft allowances **(4) Rapping allowances**

Shrinkage allowance:

The pattern must be made oversize to compensate for contraction of liquid metal on cooling. This addition to the dimension of the pattern is known as shrinkage allowances.

Machining or finishing allowance:

The excess in the dimension of the casting (i,e. in the dimension of pattern) over the finished casting is called machining or finishing allowance.

(b) Explain the sweep moulding process.

Sweep patterns are used for forming large circular moulds of symmetric kind by revolving a sweep attached to a spindle. Actually a sweep is a template of wood or metal and is attached to the spindle at one edge and the other edge has a contour depending upon the desired shape of the mould. The pivot end is attached to a stake of metal in the center of the mould. In this case, no importance is given to accuracy and smoothness of the casting.

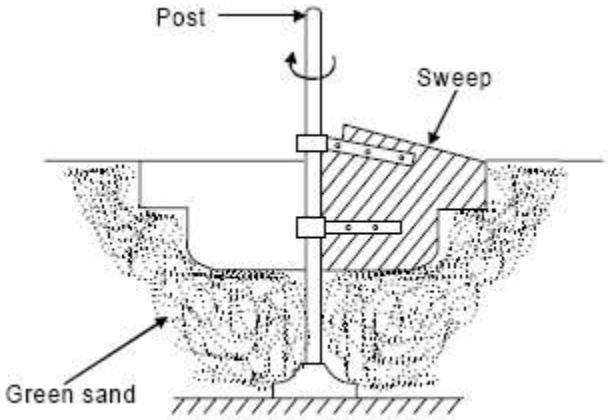


Fig. Sweep pattern