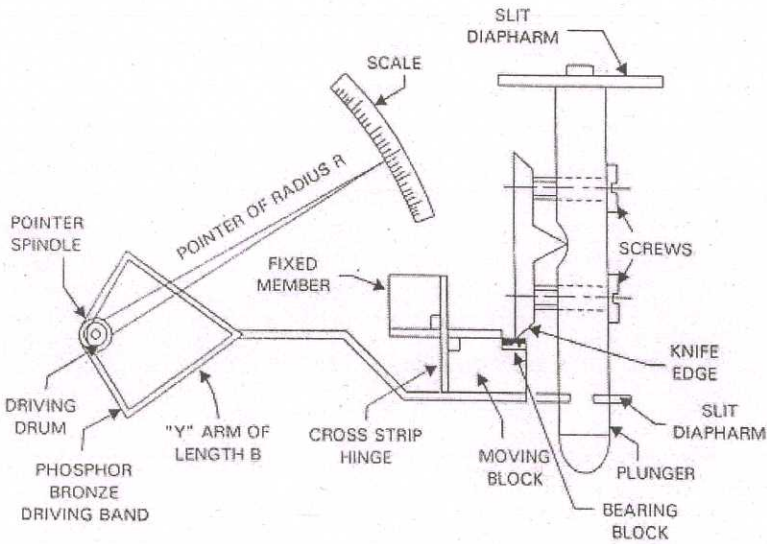



SCHEME OF VALUATION
(Scoring Indicators)


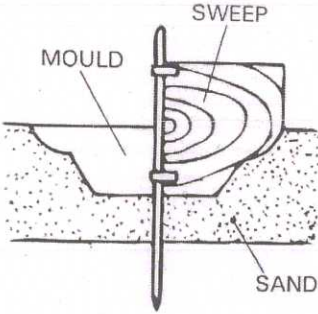
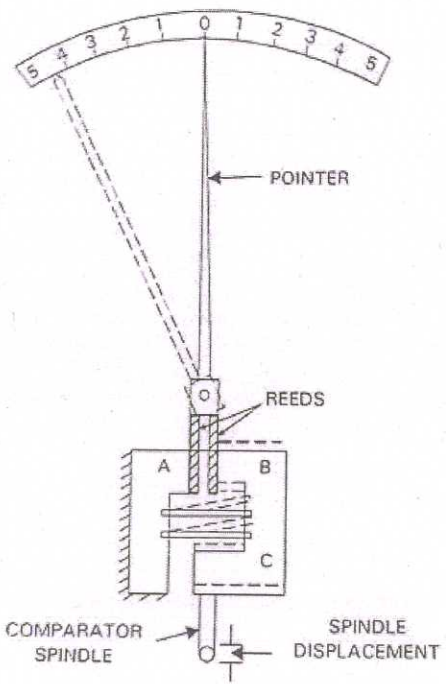
Revision: 2015

Course Code : 3023

Course Title : MANUFACTURING PROCESS

Qst. No.	Scoring Indicator	Split up score	Sub Total	Total
PART – A				
I.1	<ul style="list-style-type: none"> - Combination set, - Bevel protractor, - Sine bar. <p style="text-align: right;"><i>(any two)</i></p>	1*2	2	10
I.2	Welding is a process of making a permanent joint by establishing inter-atomic bonds between two or more pieces of metal by using heat or heat and pressure.	2	2	
I.3	Strain hardening is the process of making a metal harder and stronger through plastic deformation.	2	2	
I.4	<u>Pattern allowances.</u> <ul style="list-style-type: none"> - Shrinkage allowance - Machining or finishing allowances - Taper or draft allowances - Distortion allowances - Shake or rapping allowance <p style="text-align: right;"><i>(any four)</i></p>	½*4	2	
I.5	<u>Function of runner:</u> Runner receives molten metal from sprue base, and distributes to the ingates, which carries metal to the mould. <u>Function of riser:</u> A riser is a vertical passage or opening through the cope. Its main function is to feed the molten metal into the casting to compensate for its shrinkage.	1*2	2	
PART – B				
II.1	<u>Sigma Comparator:</u> 	6	6	6

II.2	<p><u>Plug gauge:</u> Plug gauge is used for checking diameter of a hole. Standard type is used to check one size only.</p> <div style="text-align: center;">  </div> <p>'Go-No go' variety is shown in figure. It is used to test limits of size of a hole. 'Go' end will enter the hole if it is not made less than lower limit. 'No go' end will not enter the hole, when the hole is made up to the highest limit. The plug gauge used to check the cylindrical holes is called plain plug gauge.</p>	3	6	6				
II.3	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;"><u>Pressure Welding</u></th> <th style="width: 50%;"><u>Fusion Welding</u></th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> - Requires heat and pressure - Joint area is heated to plastic state - Requires lower temperature - Composition and structure is not much affected - Does not requires filler metal </td> <td> <ul style="list-style-type: none"> Requires only heat Joint area is heated to fusion state Requires higher temperature Composition and structure is affected Generally requires filler metal </td> </tr> </tbody> </table>	<u>Pressure Welding</u>	<u>Fusion Welding</u>	<ul style="list-style-type: none"> - Requires heat and pressure - Joint area is heated to plastic state - Requires lower temperature - Composition and structure is not much affected - Does not requires filler metal 	<ul style="list-style-type: none"> Requires only heat Joint area is heated to fusion state Requires higher temperature Composition and structure is affected Generally requires filler metal 	6	6	6
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II.4	<p><u>Differences between Welding, Brazing and Soldering</u></p> <ul style="list-style-type: none"> ▪ Welding, soldering and brazing are permanent fastenings. ▪ The essential differences between these operations are presented below <ol style="list-style-type: none"> 1. Welding joint is carried out directly between the parts being joined by the application of heat with or without pressure while soldering and brazing joints are done by inserting metal between two surfaces being joined, the inserting metal having a lower melting point than that of material being joined. 2. In welding, two materials being joined are fused together whereas in soldering, solder (alloy of lead and tin) and in brazing, spelter (copper base or silver base alloy) melts and forms the bond between two surfaces being joined. 3. Welding gives much stronger joint than brazing and soldering, brazing gives stronger joint than soldering. 4. Welding requires very high temperature than brazing and soldering. Brazing involves temperature above 450°C, but below the melting point of the material being joined. Soldering requires temperature below 450°C. 	6	6	6				
II.5	<p><u>Advantages of forging</u></p> <ul style="list-style-type: none"> - More uniform structure with directional characteristics - Minimum cavities and blow holes - High mechanical strength and toughness - Smooth surface, closer dimensions permitting less machining - Economy in mass production <p><u>Limitations of forging</u></p> <ul style="list-style-type: none"> - Size is limited - Not suitable for complicated shapes - High tool and equipment cost - Process is not economical for small quantities <p style="text-align: right;"><i>(any six)</i></p>	6	6	6				

<p>II.6</p>	<p><u>Fullers</u></p>  <p>Fullers are used in pairs for necking or grooving operations. These are made in various shapes and sizes. The bottom fuller has square shank to fit in the hole and top one is provided with handle. Fullers are generally used to spread metal in one direction only.</p>	<p>3</p>	<p>6</p>	<p>6</p>
<p>II.7</p>	<p><u>Sweep pattern</u></p>  <p>It is not a true pattern, but a template made of wood or metal revolving around a fixed axis in the mould shapes the sand to the desired contour. It is suitable for producing simple symmetrical castings. Moulding with sweep pattern is shown in figure. In this case no importance is given to accuracy and smoothness of the casting.</p>	<p>3</p>	<p>6</p>	<p>6</p>
<p>PART - C</p>				
<p>III.a</p>	<p><u>Reed type mechanical comparator</u></p> <p>In reed type mechanical comparator, the gauging head is usually a sensitive, high quality dial indicator mounted on a base supported by a sturdy column.</p> 	<p>3</p>	<p>8</p>	

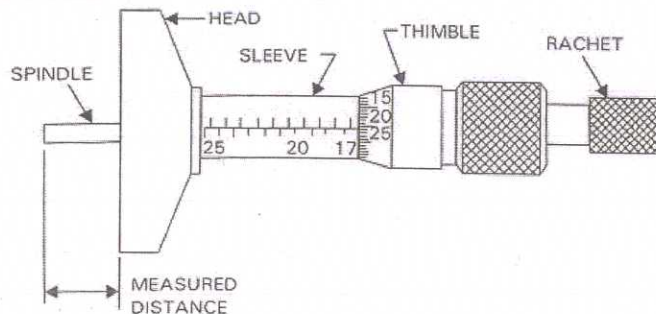
The reed mechanism is frictionless device for magnifying small motions of spindle. It consists of a fixed block A which is rigidly fastened to the gauge head case, and floating block B, which carries the gauging spindle and is connected horizontally to the fixed block by reeds C. A vertical reed is attached to each block with upper ends joined together. These vertical reeds are shown in figure by letter D.

Beyond this joint extends a pointer or target. A linear motion of the spindle moves the free block vertically causing the vertical reed on the floating block to slide past the vertical reed on the fixed block. However as these vertical reeds are joined at the upper end, instead of slipping, the movement causes both reeds swing through an arc and as the target is merely an extension of the vertical reeds, it swings through a much wider arc. The amount of target swing is proportional to the distance the floating block has moved but of course very much magnified. The scale may be calibrated by means of gauge block (slip gauges) to indicate any deviation from an initial setting. Comparators using this type of linkage have sensitivities of the order of 0.25 micron per scale division. The mechanical amplification is usually less than 100, but it is multiplied by the optical lens system.

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III.b Depth Micrometer



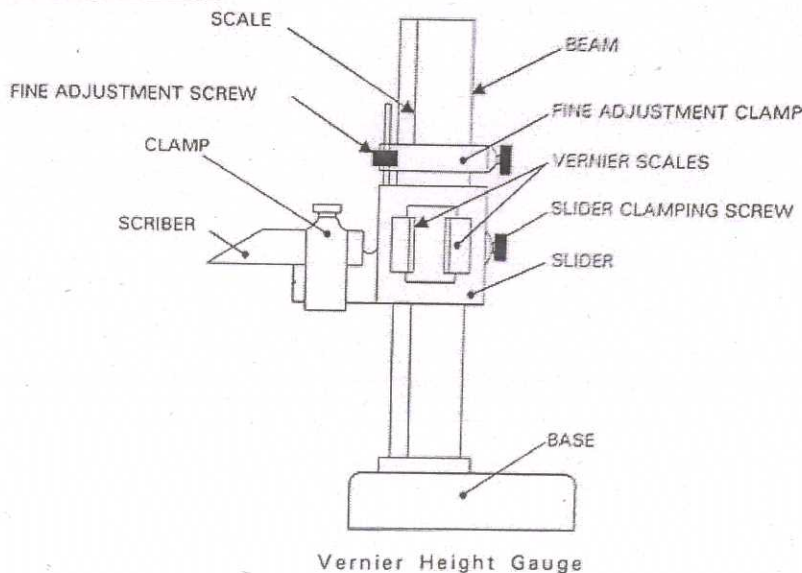
It is used to measure the depth of blind holes up to an accuracy of 0.01 mm. It consists of a micrometer head attached to a sleeve. The screwed spindle moves and does the actual measurement. In principle, it is similar to an outside (external) micrometer, but depth increases as the spindle extends from the face. Therefore, the sleeve graduations are numbered in opposite direction as in figure. Each micrometer is provided with three inter changeable spindles in steps of 25 mm to give a wide measuring range.

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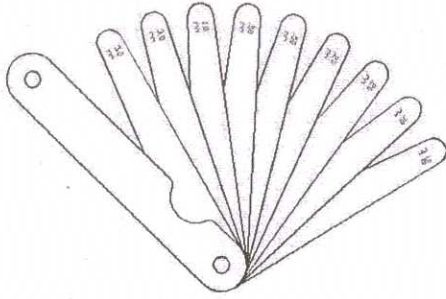
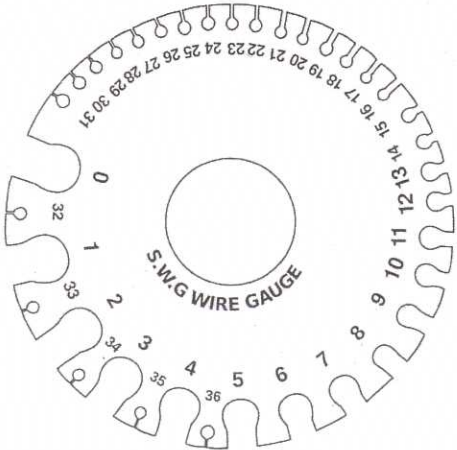
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IV.a Vernier Height Gauge

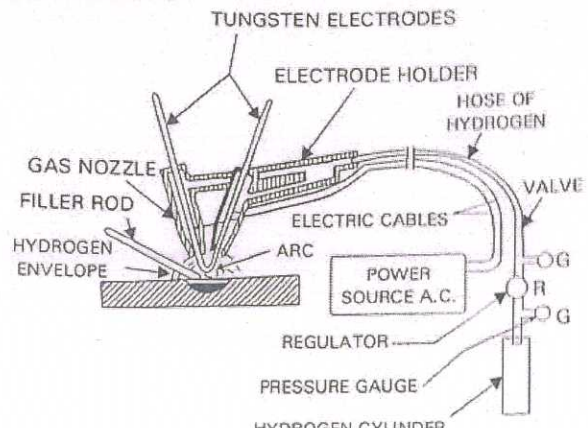


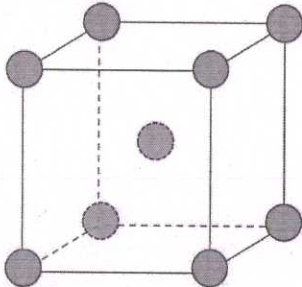
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	<p><u>Principle.</u> The vernier height gauge is a precision tool used to measure the height of an object up to an accuracy of 0.02 mm. It consists of a stationary beam with main scale graduations. It is integrated with fixed measuring jaw. The other part is a sliding unit incorporating movable jaw, vernier scale with lock nuts and the fine adjustment nut. The vernier slide is moved along the beam until both jaws contact the work being measured, the lock nut over the fine adjustment nut is tightened. The adjustment nut is turned until the jaws engage the work firmly to precise the reading. After locking the nut over the vernier plate, the object is removed to measure the size.</p> <ul style="list-style-type: none"> ▪ The main scale is accurately graduated in steps of 1 mm while the vernier scale has 50 graduations equally spaced over a length of 49 mm. ▪ Therefore, each division on vernier scale is $49/50 = 0.98$. ▪ The difference between 1 M.S.D. and 1 V.S.D. is $1 - 0.98 = 0.02\text{mm}$. ▪ This difference is called the least count. <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Note the full graduations on the main scale that coincident with 'zero' on the vernier scale. 2. Find the line on the vernier scale which coincides with a line on main scale. Multiply this number by 0.02. 3. The sum of the main scale reading and vernier scale reading give the size of the component. 	2		15
IV.b	<p>(i) <u>Feeler gauges:</u></p>  <p>Feeler gauges are thin steel blades hardened and ground to various sizes. These are used for checking the clearance between two mating parts. The blades are pivoted in a holder as in figure. Each blade is marked with its thickness which varies from 0.03 mm to 1 mm and the length of the blades is about 100 mm.</p> <p>(ii) <u>Standard wire gauge:</u></p> 	2	1	7

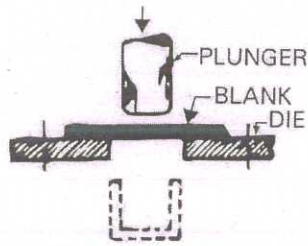
	<p>Standard Wire Gauge (plate gauge) is used to measure thickness of sheets. It is a circular metal plate having slots of different thickness along its periphery. Each slot is represented by a number (SWG number); as the number increases the size (thickness) decreases. It is shown in figure. The most common gauge used in sheet metal has 21 slots with gauge numbers ranging from 4 to 24.</p>	2		
V.a	<p><u>Types of Oxy-Acetylene Flame</u></p> <p>The type of flame to be used is adjusted according to the work materials. This can be achieved by regulating the supply of acetylene and oxygen. Depending on the relative amounts of oxygen acetylene, the gas flame can be classified into three types:</p> <ol style="list-style-type: none"> <u>Oxidising flame:</u> <div data-bbox="542 548 973 660" data-label="Image"> </div> <p>(A very short pointed cone and the smaller flame)</p> <p>Oxidizing flame</p> <p>The oxidising flame has an excess of oxygen over the acetylene. Its inner cone is shorter and less luminous and outer flame acquires light bluish colour. It is used for welding brass, bronze and brazing of ferrous metals. A slightly oxidising is helpful in welding manganese steel and cast iron. Oxidising flame assures complete combustion and highest temperature but has a tendency to oxidise metals being welded.</p> <ol style="list-style-type: none"> <u>Neutral flame:</u> <div data-bbox="510 1041 1029 1176" data-label="Image"> </div> <p>(Clear round cone and lengthy flame)</p> <p>Neutral flame</p> <p>The neutral flame has equal quantities of oxygen and acetylene. It is most common flame used in welding processes. It has an inner luminous cone and outer flame with bluish colour as shown in figure. It is used for welding low-carbon steel, stainless steel, cast iron, aluminium, magnesium, copper and bronze. It has no tendency to react with material being welded.</p> <ol style="list-style-type: none"> <u>Reducing (carburising) flame:</u> <div data-bbox="542 1523 1053 1668" data-label="Image"> </div> <p>(Excess acetylene flame surrounding the cone and more lengthy flame)</p> <p>Carburizing flame</p> <p>The carburising flame has an excess of acetylene over the oxygen. It has a longer inner cone, an intermediate cone of whitish colour (intermediate feather) and bluish outer flame. It is used for welding high carbon steel and hard facing of HSS with satellites and cemented carbides. The flame has carburising effect on steel, causing hard, brittle and weak weld. The general outline of welding flames is shown in figure.</p>	3	3	8
		2	8	15

V.b	<p><u>Advantages</u> (any seven)</p> <ul style="list-style-type: none"> - A welded joint is as strong as the base metal. - Welding equipment is not very costly and is portable. - Welding permits considerable freedom in design. - A large number of metals and alloys can be welded, and is suitable for both similar and dissimilar metals. - Welding products are lighter and stronger. - Joints are easier to inspect. <p><u>Disadvantages</u></p> <ul style="list-style-type: none"> - Welding requires skilled operator. - Welding results in residual stresses and distortion of workpiece. Therefore, it needs heat treatment to relieve internal stresses. - Welding requires edge preparation and use of jigs and fixtures. - Welding gives out harmful radiation and fumes. - The structure of welded joint is not same as the base metal. 	1*7	7	
VI.a	<p><u>Safety devices used in welding:</u> The use of various safety devices by a welder is most essential during arc welding operation. The following protective devices are most common.</p> <ul style="list-style-type: none"> - Face shield - Hand gloves - Apron - Safety goggle - Skull cap - Safety boots and spats <p><u>Face shields</u> are made of fire proof materials and fitted with a special dark glass which is protected by clear glass. No metal fittings should be incorporated because of risk of electric shocks. They protect the eyes of the welder from the radiation of electric arc. Face shields are available as hand-shield (welder holds it with his left hand) or head shield (helmet).</p> <p><u>Hand gloves</u> are generally made of leather. Its function is to protect the hands of the welder from sparks during the welding.</p> <p><u>Apron</u> is made of leather. Its function is to protect the body and clothes of welder from the sparks during the welding.</p> <p><u>Safety goggles</u> are to protect the eyes during the chipping.</p> <p><u>Skull caps</u> are made from leather and designed to protect the top of the head during overhead welding.</p> <p><u>Safety boots and spats:</u> Safety boots are provided to protect the feet of the welder from hot slag. Spats are usually made with leather and designed to protect the top of the foot by ensuring that hot metal does not enter the boot.</p>	2*4	8	
VI.b	<p><u>Atomic-Hydrogen Welding</u> (any four)</p> 	3	7	15

	<p>In atomic-hydrogen welding, an arc is struck between two tungsten-electrodes (non-consumable electrodes), and a stream of hydrogen passes through an arc region. The molecules of hydrogen dissociated into hydrogen atoms by the high heat of arc in the electrodes gap.</p> <p>The stream of atomic hydrogen strikes the workpiece at high velocity and is again converted into molecular hydrogen, releasing a large quantity of heat; the temperature attained on the metal is in the range of 3400 to 4000 °C. This heat is used to melt base metal and filler rod in making fusion weld. The atomic-hydrogen welding employs A.C. supply. The current, rating is in the range of 15 to 50 amps for electrodes of diameter 1 mm to 2.5 mm. The voltage range is 50-75 Volts.</p>	4		
VII.a	<p><u>Merits of cold working in comparison with hot working</u></p> <ul style="list-style-type: none"> - No heating is required - Better surface finish is obtained - Better dimensional control is achieved, therefore no secondary machining is generally required - Products possess better reproducibility and interchangeability - Better strength, fatigue, and wear properties of material - Directional properties can be imparted - Contamination problems are almost negligible <p><u>Demerits of cold working in comparison with hot working</u></p> <ul style="list-style-type: none"> - Higher forces are required for deformation - Heavier and more powerful equipment is required - Less ductility is available - Metal surfaces must be clean and scale-free - Strain hardening occurs (may require intermediate annealing) - Undesirable residual stresses may be produced 	4	8	
VII.b	<p><u>Body-centered cubic (BCC) structure</u></p>  <p>It is a type of crystal structure in metals. This structure can be seen as a gathering of cubes with atoms at the edges and an atom in the center of every cube. The corner or edge atoms are shared among eight unit cells. The metals which have a bcc structure are:</p> <ul style="list-style-type: none"> - Alpha iron - Tungsten - Chromium - Beta titanium <p>The elements which crystallize in the bcc structure show properties of metallic conductors. They have the eight-fold coordination in the nearest neighbor shell which does not permit saturated bonds.</p>	3	7	15

VIII.a

(i) Hot Drawing

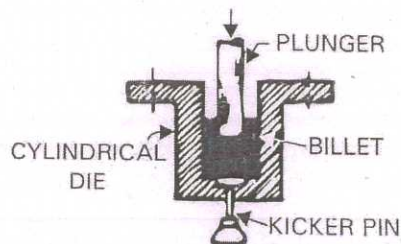


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Hot drawing is a process of making a cup shaped components from a circular plate of definite thickness. The process consists of heating and placing a plate over a cylindrical die as in figure. The plunger forces the plate through the die to form a cup-shaped component. Hot drawing or cupping is employed for making oxygen and acetylene cylinders. Also, the cylinders with closed bottoms are produced by this process.

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(ii) Hot Piercing



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Hot piercing of metal consists of placing heated billet in a cylindrical die, which is positioned beneath and in line with the plunger of hydraulically operated ram. During the downward stroke of plunger, the metal displaced around the space between the plunger and die as in figure. After completing the downward stroke, plunger withdraws from blank and the work is then ejected by a kicker pin.

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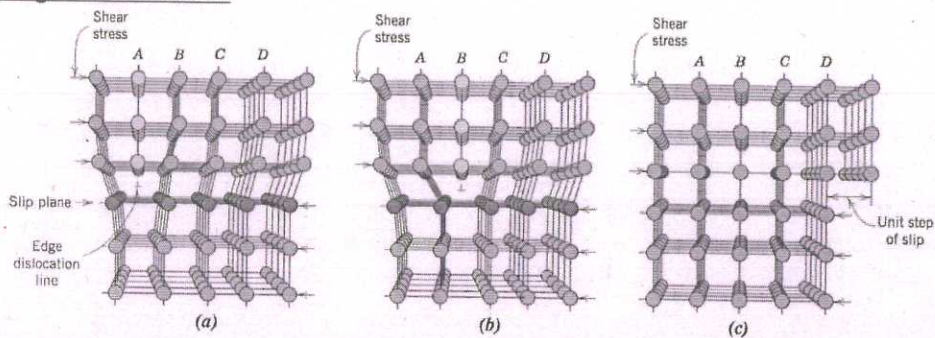
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VIII.b

There are two basic types of linear defects (dislocations) are:

- Edge dislocations
- Screw dislocations

Edge Dislocations



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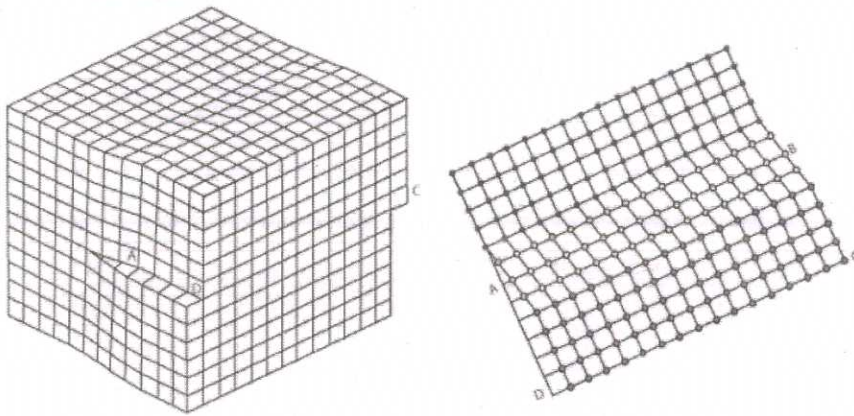
The edge defect can be easily visualized as an extra half plane of atoms in a lattice. The dislocation is called a line defect because the locus of defective points produced in the lattice by the dislocation lie along a line. This line runs along the top of the extra half-plane. The inter-atomic bonds are significantly distorted only in the immediate vicinity of the dislocation line.

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Screw Dislocations

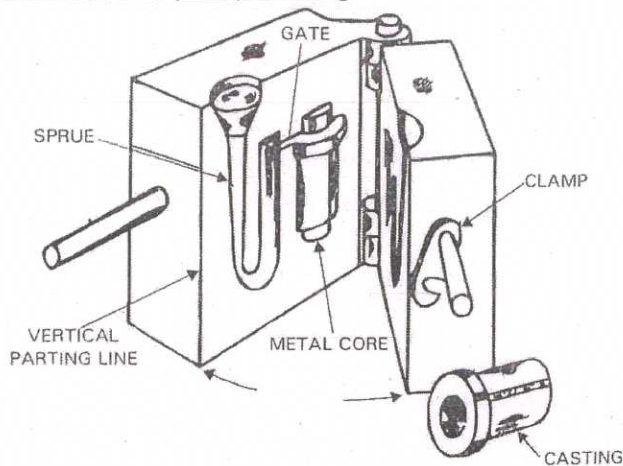


There is a second basic type of dislocation, called screw dislocation. The screw dislocation is slightly more difficult to visualize. The motion of a screw dislocation is also a result of shear stress, but the defect line movement is perpendicular to direction of the stress and the atom displacement, rather than parallel. To visualize a screw dislocation, imagine a block of metal with a shear stress applied across one end so that the metal begins to rip. This is shown in the left image. The dislocations move along the densest planes of atoms in a material, because the stress needed to move the dislocation increases with the spacing between the planes. FCC and BCC metals have many dense planes, so dislocations move relatively easy and these materials have high ductility. Metals are strengthened by making it more difficult for dislocations to move.

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IX.a Permanent Mould (Gravity die) Casting



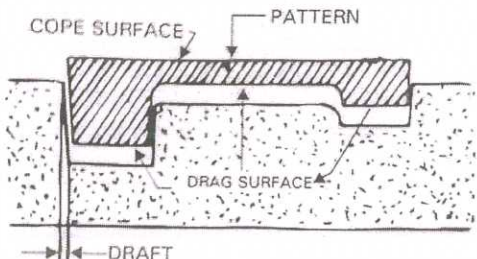
Permanent mould casting refers to the process in which molten metal is transferred into the cavity by gravity. Therefore, it is known as gravity die casting. Permanent moulds (made of cast iron or other metal) are made in two halves. The moulds are coated with refractory materials and are closed. The molten metal is poured into the dies and after solidification of casting the dies are opened. The casting is removed from the dies with the help of ejectors.

If necessary, cores may be inserted in the mould and the gating system is built in the mould halves itself. Figure illustrates the principle of permanent mould casting for casting Aluminium bearing.

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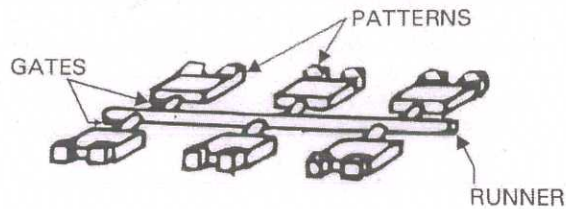
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IX.b	<p><u>Draft allowance</u></p>  <p>When a pattern is removed, the tendency to tear away the edges of the mould is greatly reduced if the vertical surfaces of the pattern are tapered inwards. The provision of taper on vertical faces of the pattern is called draft. The amount of draft recommended on external surfaces varies from 10 to 20 per metre, and that of internal surfaces is approximately 60 mm per metre. It important to note that the draft is always provided as an extra metal over and above the original casting dimensions. Draft may be expressed in mm per metre on a side, or in degrees.</p>	3	7	
X.a	<p><u>Properties of moulding sand</u> (any five)</p> <p>A moulding sand should possess the following properties.</p> <ul style="list-style-type: none"> - Porosity - Plasticity - Flowability - Collapsibility - Adhesiveness - Cohesiveness - Refractoriness <ol style="list-style-type: none"> 1. <u>Porosity</u>: Moulding sand must be sufficiently porous to provide a passage for steam (formed due to evaporation of moisture) and gases (evolved during solidification). Otherwise, the gas penetrates into metal which leads to the formation of gas cavities (blow holes). The ability of sand to allow the gas to pass through it is called permeability. 2. <u>Plasticity</u>: Sand should have plasticity. It is the ability of a sand to acquire shape from the pattern that is moulded and retain it during casting. The plasticity of a moulding sand depends on properties of ingredients and binders. 3. <u>Flowability</u>: Flowability of a moulding sand refers to its ability to flow, under externally applied forces (ramming), into deeper sections of the pattern and uniformly fill the flask. 4. <u>Collapsibility</u>: Collapsibility is the property of sand that permits it to collapse (break) easily during its knockout from the castings. This property depends on amount of the sand and clay and type of binder used. 5. <u>Adhesiveness</u>: Adhesiveness is the ability of a moulding sand to adhere (stick on) to the surfaces of moulding boxes. This enables the mould to retain in a box during handling. 6. <u>Cohesiveness</u>: Cohesiveness is the ability of sand particles to stick to each other. It refer to the strength of moulding sand to hold the grains together. The strength depends of grain size (decreased with grain size) and clay content (increases with clay) of sand. 7. <u>Refractoriness</u>: Refractoriness is the ability of a moulding sand to withstand the heat of molten metal without softening or fusion. This property depends on the ingredients. The higher the contents of impurities in the sand mixture the lower the refractoriness of moulding sand. 	4	8	15

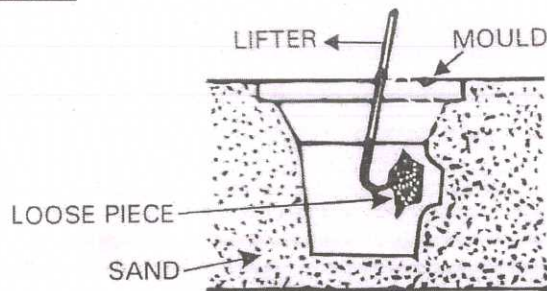
X.b

Gated pattern



Pattern those include gates and riser for producing casting are called gated patterns. The use of gated pattern eliminates the time required to cut the gating system by hand. Thus the moulding time is greatly reduced. These are suitable for small quantity production.

Loose piece patterns



Loose piece pattern is used to produce the castings having projections in the sides. Such design makes impossible to draw the pattern from the mould. It is therefore necessary to make such projection in loose piece and fastened to main pattern by means of anchor pin. During the moulding, anchor pin is removed keeping loose piece in place. After completing mould, the main pattern is drawn, the loose piece remains in the mould; but it is later removed with the help of pointed lifter.

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