B.E.

Fourth Semester Examination, May-2009

Manufacturing Technology (ME-202-E)

Note : Attempt any five questions. All questions carry equal marks.

Q. 1. (a) What are the common allowance provided on patterns and why?

Ans. Finish/Machining Allowance : The finish and accuracy achieved in sand casting are generally poor and therefore when the casting is functionally required to be of good surface finish or dimensionally accurate, it is generally achieved by subsequent machining. Also, ferrous materials would have states on the skin which are to be removed by cleaning. Hence extra material is to be provided which is to be subsequently removed by machining/cleaning processes.

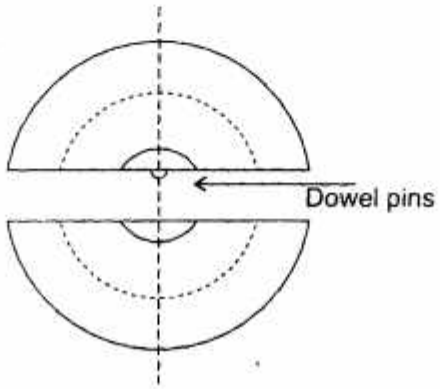
Shake Allowance : Before withdrawl from the sand mould, the pattern is rapped all around the verticle faces to enlarge the mould cavity slightly which facilitates its removal. Since it enlarges the final casting made, it is desirable that the original pattern dimensions should be reduced to account for this increase. There is no sine way of qualifying this allowance, since the highly dependent at the foundry personnel and practices involved.

Distortion Allowance : A metal when it has just solidified is very weak and therefore is likely to be distortion prove. This is particularly so far weaker sections such as song flat portions. U, V sections or in a complicated casting which may have thin and long sections which are connected to thick sections.

Q. 1. (b) What are the split and multi piece patterns? What are the advantages of making them in two or more pieces? Give examples.

Ans. Split or 2 piece pattern is the most widely used type of pattern for intricate castings. When the contour of the castings makes its withdrawl from the mould difficult, or when the depth of the casting is too high, then the pattern is split into 2 parts so that one part is in the drag and the other in the cope.

The split surface of the pattern is same as the pasting plane of the mould. The 2 halves of the pattern should be aligned properly by making use of dowel pins which are fitted to the cope half. These dower pins match with the precisely made holes in the drag half of the pattern and thus align the 2 halves properly as shown in figure.



Q. 2. (a) What are the main constituents of moulding sands? How are the binders classified? Name a few binders of each type.

Ans. The main ingredients of any moulding sand are :

(i) The silica grains (SiO_2)

(ii) The clay binder, and

Moisture to activate the clay and provide plasticity.

Clays are the most generally used binding agents mixed with the moulding sands to provide the strength, because of their low cost and widely utility. The most popular clay types used are

(i) Kaolinite/fire clay ($Al_2O_3.2SiO_2.2H_2O$) &

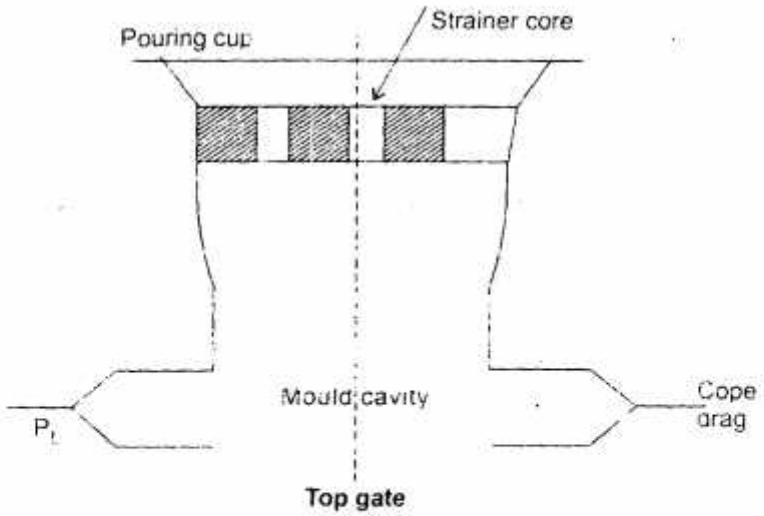
(ii) Bentonite ($Al_2O_3.4SiO_2.H_2O.4H_2O$)

Kaolinite has a melting point of 1750 to 1787 C and Bentonite has a melting temperature range of 1250 to 1300 C of the 2, bentonite can absorb more water which increases its bonding power. The clays besides basic constituents, may also contain some mixtures of lime, alkaline and other then refractoriness.

Q. 2. (b) What are the different types of gates you know? Explain them with the help of suitable sketches stating their relative merits and demerits.

Ans. Gates :

(i) Top Gate : This is the type of gating through which the molten metal-enters the mould cavity from the top. Since the first metal entering the gate reaches the bottom and heater metal is at the top, a favourable temperature, gradient towards the gate is achieved.



Top gate

Bottom Gate : When molten metal enters the mould cavity slowly, it would not cause any mould erosion. Bottom gate is generally used for very deep moulds. It takes somewhat higher time for filling of the moulds and also generates a very unfavourable temp. gradient. The preparation of the gating also requires special sprue as shown in figure.

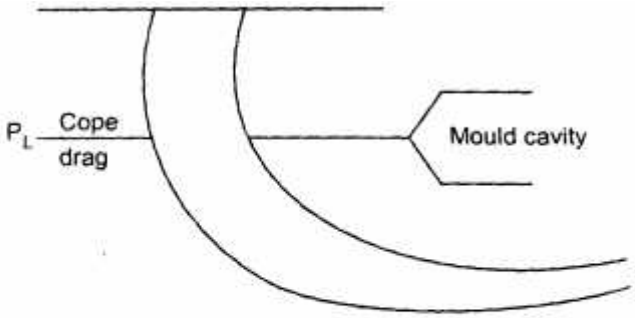


Fig. Bottom gate

Q. 3. Compute the composition of the mixture to be used for producing grey iron castings of the following analysis, with the help of the data given below :

Constituents	Analysis of material in Hand					Analysis of Required cast metal %
	Pig iron No1	Pig iron No2	Foundry Returns	Purchased Scrap	Ferrous Silicon	
Carbon	3.5	3.25	3.2	3.5	—	3.0 to 3.5
Silicon	3.0	1.6	1.2	1.5	50.0	2.25 to 2.5
Manganese	0.4	0.8	0.6	0.5	—	0.4 to 0.65
Phosphorus	0.6	0.4	0.5	0.5	—	0.5 to 0.6
Sulphur	0.02	0.02	0.08	0.1	—	0.08

Assume a carbon pick-up of 0.15%, loss of silicon 10.0%, loss of manganese 15% and an increase of sulphur 0.05% during melting.

Ans.

Usual description	British Designation	German Designation
Mild Steel	C20	C22
	C35	C35
	C45	CK45
	C55	C55
	C60	C60
	C75	C75
High carbon steel	C100	—
Low alloy	40 Cr 90 MO 15	42Cr MO4
Steel	13 Ni3 Cr 80	14 NiCr 14

Carbon	0.30 to 0.40%
Chromium	4.75 to 5.25%
Molybdenum	1.20 to 1.60%
Vanadium	0.20 to 0.40%
Manganese	0.25 to 0.50%
Silicon	0.80 to 1.20%

Q. 4. (a) What are the advantages and disadvantages of true centrifugal casting?

Ans. Advantages : (i) The mechanical properties of centrifugally cast jobs are better compared to other processes, because the inclusions such as slag and oxides get segregated towards the centre and can be easily removed by machining. Also, the pressure acting on the metal throughout the solidification, causes the porosity to be eliminated giving rise to dense metal.

(ii) Upto a certain thickness of objects, proper directional solidification can be obtained starting from the mould surface to the centre.

(iii) No cores are required for making concentric holes in the case of true centrifugal casting.

(iv) There is no need for gates and runners, which increases the casting yield, reaching almost 100%.

Limitations/Disadvantages :

(i) Only certain shapes which are axisymmetric and having concentric holes are suitable for true centrifugal casting.

(ii) The equipment is expensive and thus is suitable only for large quantity production.

Q. 4. (b) What fuels are generally used in forging furnaces? What specific characteristics a fuel used in forging work should possess?

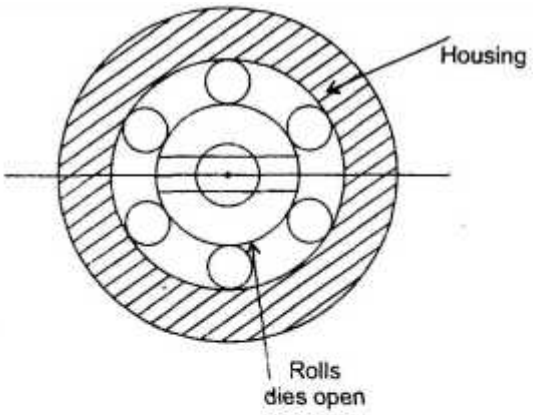
Ans. Smaller foundries generally prefer the crucible furnace. The crucible is generally heated by electric resistance or gas flame. In these the metal is placed in a crucible of refractory metal and the heating is done to the crucible thus there is no direct contract between the flame and metal charge. This type of melting is very flexible since it suits a variety of casting alloys. Degassing and clay metal treatment can be completed in the crucible before it is removed for pouring. Melt quality and temperature can also be controlled reasonably well.

Q. 5. (a) What is cold forging and swaging? What for cold heading is used? Explain the process of rotary swaging with the help of neat sketch.

Ans. Cold forging is the operation where the metal is heated and then a force is applied to manipulate the metal in such a way that the required final shape is obtained. This is the eldest of the metal working processes known to mankind since the copper age. Forging is generally a hot working operation though cold forging is used sometimes.

Swaging is a mechanical deformation technique of reducing or shaping the cross-section of rods or tubes by means or repeated impacts or blows. The swaging process consists of dies which are given the requisite external shape.

Rotary swaging is the operation where the 2 dies which are free to move radially are held in a spindle which rotates continuously. On the internal side of the die is the shape to be obtained. Whereas the outside is simply cylindrical.



The dies are free to move radially and held in position with the spindle by means of a retainer plate fixed to the housing. In between the housing and the spindle is a cage similar to the bell bearing cage, which houses the rolls.

Q. 5. (b) How direct extrusion differs from indirect extrusion? Discuss their relative merits and demerits.

Ans. Extrusion is the process of confining the metal in a closed cavity and then allowing it to flow from only one opening so that the metal will take the shape of opening. The operation is identical to the squeezing of toothpaste tube.

The forward cold extrusion is similar to that of forward hot extrusion process except for the fact that the extrusion ratios possible are lower and extrusion pressures higuer, than that of hot extrusion. It is normally used for simple shapes requiring better surface finish and to improve mechanical properties. The backward cold extrusion is much more common particularly with softer materials such as aluminium and its alloys. In backward cold extrusion called the impact extrusion, the set-up consist of a die and a punch. The slug for making the component, is kept on the die and the punch strikes the slug against the die.

Q. 6. (a) What is the main difference between the blow pipes used for high pressure and low pressure gas welding? Explain with the help of sketches.

Ans. To light the flame, the acetylene valve on the torch is opened slightly and lighted with the help of a friction spark lighter. The flame draws the oxygen from the atmospheric air and thus results in a reducing flame. Then the acetylene valve is opened to get the required flow of acetylene. The oxygen valve is then slowly opened till the intermediate flame feather of the reducing flame receds into the inner white cone. The actual adjustment of the flame depends on the type of material to be pined provides the details of flames generally used for welding.

When the welding rod is used to provide filter material, it is necessary to hold it at a distance of 10 mm from the flame and 1.5 to 3.0 mm from the surface of the puddle. This way of the rod gets preheated and when dipped into the puddle would readily get melted. So as and when filler metal is required. The welder dips the preheated welding rod into the puddle. The welding rod should be swiftly withdrawn after enough filler metal is added.

The preheating of the welding rod should be maintained by keeping it at a proper distance from the flame. Too little a distance makes the tip melt with the result that the molten metal would be blown away by the flame causing uneven bead and poor penetration.

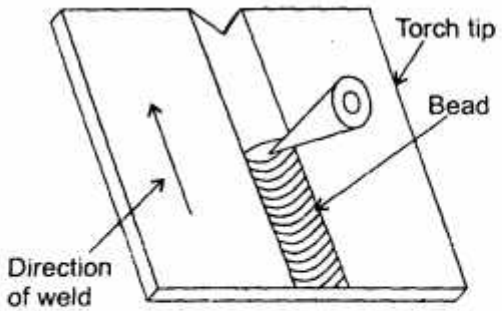


Fig. (a) Forehead welding

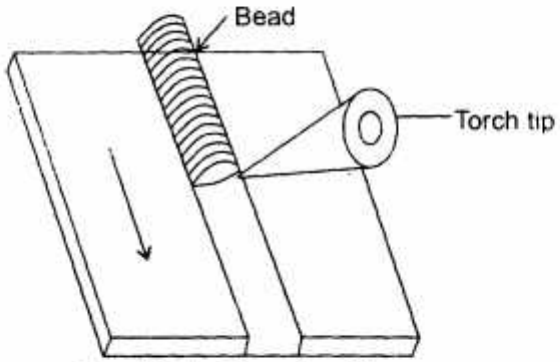
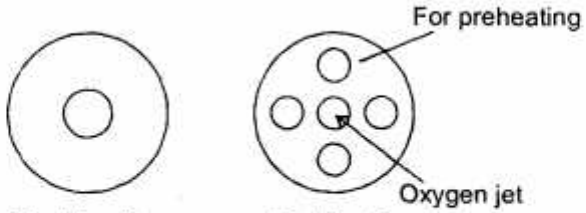


Fig. (b) Backhand welding

Q. 6. (b) Describe how flame cutting is done stating its principle. Describe fully the method of oxygen cutting. State the difference in oxygen and arc cutting? Which one is preferred and why?

Ans. For cutting metallic plates, the general purpose shears as explained are used. These are useful for only straight line cuts and also upto a thickness of 40mm. For thicker plates and when the cut is to be made along specified contour, shearing cannot be used. To this end, oxy fuel gas cutting OFe is useful. With the oxy fuel gas cutting, plates upto a thickness as high as 2m can be cut with special precautions or methods.

The oxy acetylene gas cutting outfit is similar to that of oxy acetylene welding except for the torch tip. Here the torch tip has a provision for preheating the plate as well as providing the oxygen jet.



Welding tip **Cutting tip**

After the steel is heated to its kindling temperature which is about 870 ° C, it gets readily combined with oxygen, giving iron oxide as :

$$3Fe + 2O_2 \longrightarrow Fe_2O_3 + 6.67 \text{ MJ/kg of iron}$$

The other reactions are

$$2Fe + O_2 \longrightarrow 2FeO + 3.18 \text{ MJ/kg of iron}$$

$$4Fe + 3O_2 \longrightarrow 2Fe_2O_3 + 4.9 \text{ MJ/kg of iron.}$$

Q. 7. What are principles of operation of resistance welding? Describe UPSET-Butt, Flash-Butt, Spot, Projection, Percussion welding giving their merits and limitations.

Ans. Principle : In resistance welding, (RW) a low voltage typically N and very high current (15,000A) is passed through the point for a veyr short time (0.25 sec). The high amperage heats the joint, due to the contact resistance at the joint and melts it

$$H = KI^2 Rt$$

The amount of heat released is proportional to the resistance.

UPSET Butt Welding : In UW, the pieces to be joined are brought together to mate with each other in butt joint compared to the lap joint. The 2 pieces are held tightly together and current is applied, so that the heat is generated through the contact area between the 2 plates. Because of the joint being under pressure, the ends of 2 pieces gets slightly upset and hence its name. This is useful for joining 2 ends of rods or similar pieces.

Flash Butt Welding : FW is similar to upset welding except that the heat required for melting is obtained by means of an arc rather than the simple resistance welding. The welding equipment consists of essentially two plates to which the 2 pieces to be joined are clamped.

It is generally a faster operation compared to that of upset welding and would be automatically controlled by a corn arrangement.

Projection Welding : (RPW) is another variation of spot welding, where one of the sheets to be joined is provided with a number of projections to help localise the current at a predetermined spot.

Advantages :

(i) It is possible to used more than 1 spot at a given time.

(ii) The welds may be placed closer than in spot welding.

(iii) Life is much longer than spot welding.

(iv) More better uniformity and appearance of weld.

Spot Welding : This process die is most common of all. This is essentially done to join 2 sheet metal jobs in lap joint forming a small nugget at the interface of 2 plates. A resistance welding schedule is the sequence of events that normally take place in each of the welds.

The events are :

(i) The squeeze time is time required for the electrodes to align and clamp 2 workpieces together under them and provide the necessary electrical contact.

Q. 8. Write short notes on :

(i) Brazing

(ii) Electron beam welding

(iii) Diffusion welding

(iv) Drop forging

(v) Press forging

Ans. (i) Brazing : Brazing is the coalescence of a joint with the help of a filler metal whose liquidus temperature is above 450° C and is below the solidus temperature of the base metal. The filler metal is drawn into the joint by means of capillary action.

Brazing is a much widely used joining process in various industries because of its many advantages.

(ii) Electron Beam Welding : The heat source in electron beam welding (EBW) for melting the joint, is a focussed beam of high velocity electrons. The electron beam upon impringing the workpiece, releases the necessary heat by connecting its kinetic energy. The electron beam is focussed by means of an electromagnetic lens so that the energy is released in a small area. When all the high velocity e beam strikes the workpiece. all the KE is converted to heat.

(iii) Diffusion Welding : DW is also called diffusion bonding, is the process of joining 2 parts purely by diffusion. The diffusion can be achieved by keeping the 2 pieces in intimate contact under pressure. The pressures used are in the range 35 to 70 mPa, because of large contact area used. The diffusion being a rate process, can be accelerated by the use of heat though this is not essential.

(iv) Drop Forging : This is the operation in which the metal gets elongated with a reduction in the cross-sectional area. For this purpose, the force is to be applied in a direction, perpendicular to the length axis. Forging is the operations, where the metal is heated and than a force is applied to manipulate the metal in such a way that the required final shape is obtained. This is the oldest of the metal cooking process known to mankind since the copper age.

(v) Press Forging : Press forging dies are similar to drop forging dies as also the process. In press forging, the metal is shaped not by means of a series of blows as in drop forging, but by means of a single continuous squeezing action. This squeezing is obtained by means of hydraulic press. Because of the continuous action of the hydraulic press, the material gets uniformly deformed throughout its entire depth. More hammer force is likely to be transmitted to the machine frame in drop forging. Whereas in press forging, it is abosrbed fully by the stock. The impressions obtained in press forging are clean compared to that of the likely jarred impressions which are likely in the drop forged components.