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* Explain Defects in Casting :

- Casting defects are imperfections or irregularities that compromise the quality specifications of a component. There are various reasons and sources for casting imperfections, ranging from material failure to casting equipment or non-optimized procedure.
- While some of these defects may be tolerated or neglected, some casting surface defects result in weak casting, odd shapes and poor functionality. Therefore, they must be removed or prevented to ensure better functioning of the end product.

There are various types of casting defects, by they are generally grouped into four categories namely :

- Metallurgical defects
- Pouring metal defects
- Mold material defects
- Casting shape defects

• Pouring Metal Defects :

- Cold shut
- Cold shut
- Misrun

• Metallurgical Defects

- Hot Tears
- Hot Spots
- Slag inclusion

• Casting Shape Defects

- Mismatches
- flash

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• Mold Material Defects :-

- Cuts and washes
- Swells
- Metal penetration
- Run out
- fusion

• Gas Porosity

- Pin holes
- Blow holes
- open Holes

• Shrinkage Defects

- open
- closed
- warping

The various Casting defects that appears in Casting process are :

i) Shift or Mismatch :

The defect Caused due to misalignment of upper and lower part of the Casting and misplacement of the Core at parting line.

Cause :

i) Improper alignment of upper and lower part during mold preparation.

ii) Misalignment of flask (a flask is type of tool which is used to Contain a mold in metal casting. It may be Square, round, rectangular or of any Convenient shape :)

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Remedies :

- i) Proper alignment of the pattern or die part, molding boxes.
- ii) Correct mountings of pattern on pattern plates.
- iii) check the alignment of flask.

2. Swell : It is the largement of the mold cavity because of the molten metal pressure, which results in localized or overall enlargement of the Casting.

Causes : i) Defective or improper ramming of the mold.

Remedies : i) The Sand should be rammed properly and evenly.

3. Blow holes : • When gases entrapped on the Surface of the Casting due to Solidifying metal, a rounded or oval Cavity is formed called as blowholes.
 - These defects are always present in the Cope part of the mold.

Causes :

- i) Excessive moisture in the Sand.
- ii) low permeability of the Sand
- iii) Sand grains are too fine.
- iv) Too hard rammed Sand.
- v) Insufficient venting is provided.

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Remedies : i) The moisture Content in the Sand must be controlled and kept at desired level.

- ii) High permeability Sand should be used.
- iii) Sand of appropriate grain size should be used.
- iv) Sufficient ramming should be done.
- v) Adequate venting facility should be provided.

4. Drop : Drop defects occurs when there is Cracking on the upper surface of the Sand and Sand pieces fall into the molten metal.

Causes : (i) Soft ramming and low strength of Sand.

- (ii) Insufficient fluxing of molten metal. fluxing means addition of a substance in the molten metal to remove impurities. After fluxing the impurities from the molten metal can be easily removed.
- (iii) Insufficient reinforcement of sand projections in the cope.

Remedies :

- i) Sand of high strength should be used with proper ramming (neither too hard nor soft).
- (ii) There should be proper fluxing of molten metal so the impurities present in molten ^{metal} is removed easily before pouring it into the mold.
- (iii) Sufficient reinforcement of the sand projection in the Cope.

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5. **Metal Penetration** : These Casting defects appear as an uneven and rough surface of the casting. When the size of sand grains is large, the molten metal fuses into the sand and solidifies giving us metal penetration defect.

Causes : ① It is caused due to low strength, large grain size, high permeability and soft ramming of sand. Because of this the molten metal penetrates in the molding sand and we get rough or uneven casting surface.

Remedies : ① This defect can be eliminated by using high strength, small grain size, low permeability and soft ramming of sand.

6. **Pin holes** : • They are very small holes of about 2mm in size which appear on the surface of the casting.

- This defect happens because of the dissolution of the hydrogen gases in the molten metal.
- When the molten metal is poured in the mold cavity and as it starts to solidify, the solubility of the hydrogen gas decreases and it starts escaping out the molten metal leaves behind - small no. of holes called as pinholes.

Causes : i) use of high moisture content sand.

- ii) Absorption of hydrogen or carbon monoxide gas by molten metal.
- iii) pouring of steel from wet ladles or not sufficiently gasified.

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Remedies: i) By reducing the moisture content of the moulding sand.

ii) Good fluxing and melting practices should be used.

iii) Increasing permeability of the sand.

iv) By along rapid rate of solidification.

7. Shrinkage Cavity: The formation of cavity in the casting due to volumetric contraction is called as shrinkage.

- The metal alloys shrink as they solidify in the mold cavity of the pouring step. The molten metal is less dense.

- Two types of shrinkage casting defects are close shrinkage defects and open shrinkage defects.

- The open shrinkage defects can be detected in the casting surface by eyes, whereas, the closed shrinkage (shrinkage porosity defects) are inside the castings.

Causes: i) uneven or uncontrolled solidification of molten metal.

ii) pouring temperature is too high.

Remedies: i) This defect can be removed by applying principle of directional solidification in mold design.

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8. Cold Shut : • It is a type of Surface defects and a line on the Surface Can be Seen -
- when the molten metal enters into the mold from two gates and when these two streams of molten metal meet at a junction with low temperature than they do not fuse with each other and Solidifies Creating a Cold Shut (appear as line on the Casting)
 - It looks like a Crack with round edge.

Cause : i) Poor gating System
 ii) low melting temperature
 iii) lack of fluidity.

Remedies : i) Improved gating System.
 ii) proper pouring temperature.

9. Misrun : when the molten metal Solidifies before Completely filling the mold Cavity and leaves a Space in the mold called as misrun.

Causes : i) low fluidity of molten metal.
 ii) low temperature of the molten metal which decreases its fluidity.
 iii) Too thin section and improper gating System.

- Remedies : i) Increasing the pouring temperature of the molten metal increases the fluidity.
 (ii) Proper gating System.
 (iii) Too thin section is avoided.

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10. **Slag Inclusion** : This defect is caused when the molten metal containing slag particles is poured in the mold cavity and it gets solidified.

Causes : i) Presence of slag in the molten metal.

Remedies : i) Remove slag particles from the molten metal between pouring it into the mold cavity.

11. **Hot Tears or Hot Cracks** : When the metal is hot it is weak and the molten metal cools down, the residual stress (tensile) in the material cause the casting fails.

• The failure of casting in this case is looks like cracks and called as hot tears or hot cracking.

Cause

(i) Improper mold design.

Remedies :

(i) Proper mold design can easily eliminate these types of casting defects.

(ii) Elimination of residual stress from the material of the casting.

12. **Hot Spot or Hard Spot** :

• Hot spot defects occurs when an area on the casting cools more rapidly than the surrounding materials.

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- It is also called as hard spot.

Cause :

The rapid cooling an area of the casting than the surrounding materials causes this defect.

Remedies :

- (i) This defect can be avoided by using proper cooling practice.
- (ii) By changing the chemical composition of the metal.

13. Sand holes : It is the holes created on the external surface or inside the casting. It occurs when loose sand washes into the mold cavity and fuses into the interior of the casting or rapid pouring of the molten metal.

Causes : (i) loose ramming of the sand.

(ii) Rapid pouring of the molten metal.

(iii) Improper cleaning of the mold cavity.

Remedies : (i) proper ramming of the sand.

(ii) Molten metal should be poured carefully in the mold.

(iii) Proper cleaning of the molten cavity eliminates sand holes.

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14. Dirt : The embedding of particles of dust and Sand in the Casting Surface, results in dirt defect.

Causes : Presence of slag particles in the molten metal.

Remedies : Sufficient fluxing should be done to remove slag impurities from molten metal.

15. Honey Combing or Sponginess :

It is an external defect in which there is a no. of small cavities in close proximity present in the metal casting.

Causes : (i) It is caused due to dirt and Scum held mechanically in the Suspension of the molten metal.

(ii) Due to imperfect Skimming in the ladle.

Remedies : (i) Prevent the entry of dirt and Scum in the molten metal.

(ii) Prevent Sand wash.

(iii) Remove slag materials from the molten metal by proper skimming in the ladle.

16. Warpage : It is an accidental and unwanted deformation in the Casting that happens during or after solidification. Due to this defect, the dimension of the final product changes.

Causes : (i) Due to different rates of solidification of different sections. This induces stresses in adjoining walls and result in warpage.

Remedies : (i) Proper Casting designs can reduce these defects more efficiently.

17. **fin** : A thin projection of metal, not considered as a part of casting is called as fin or fin. It usually occurs at the parting of the mold or core section.

Causes : (i) Incorrect assembling of mold and cores.
(ii) Insufficient weight of the mold or improper clamping of the flask may produce the fins.

Remedies : (i) Correct assembly of the mold and cores.
(ii) There should be sufficient weight on the top part of the mold so that the two parts fits together tightly.

Inspection of Casting :

Inspection of Casting is a critical process to ensure the quality, safety and performance of Cast Components. The inspection process involves visual examination, dimensional checks and non-destructive testing (NDT) to detect any defects or irregularities. It involves the following steps:

- 1) Visual Inspection : Detects Surface defects like cracks, porosity and misrun and roughness.
- 2) Dimensional Inspection : Check the Casting dimension against the Specifications using tools like Calipers and CMM.
- 3) Non-Destructive Testing (NDT) : Detects and identify internal defects such as porosity, cracks, inclusions and roughness by using method like x-ray, ultrasonic testing, and magnetic particle inspection.
- 4) Mechanical Testing / Destructive Testing : Assesses strength, hardness and toughness through tensile, hardness and impact tests.
- 5) Chemical Analysis : Verify materials composition using Spectroscopy.

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- 6) Pressure / Leak Testing: Ensures the Casting is free if leaks under pressure.
- 7) Microstructural Examination: Analysis grain structure and material integrity.
- # Determination of production Cost of a given material considering Raw material, process Cost, overheads and other expenses.
- Manufacturing Cost: Manufacturing Cost may be defined as the total Cost imposed by a manufacture in manufacturing a particular product.

Manufacturing Cost = Material Cost + process cost + overhead and other Cost.



$$\therefore \text{Inner diameter} = \text{Outer} - \text{thickness} = 10 - (1 + 1) = 8\text{mm}$$

Step 1 :- Calculation of material Cost

for Calculating Material Cost; firstly

- we should know about material name.
- we should know about material Cost / kg in market.
- " " " " " Density to find out the weight.
- " " " " " Scrap Cost in market.