Thapar Institute of Engineering & Technology – Patiala

Manufacturing Processes
UTA026

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CASTING DEFECTS

Introduction

- **Casting Defects:** It is an unwanted irregularities that appear in the casting during metal casting process
- It may sometimes be tolerated, sometimes eliminated with proper moulding practice or repaired using methods such as welding, metallization etc.
- The following are the major defects, which are likely to occur in sand castings
  1. Gas defects: blow holes, open holes, pinholes.
  2. Shrinkage defects: Shrinkage cavity
  3. Molding material defects: Cut and washes, fusion
  4. Pouring metal defects: Cold shut, Mis-run, slag inclusion
  5. Metallurgical defects: Hot tears, Hot spot.

1. Gas Defects

- A condition existing in a casting caused by the *trapping of gas* in the molten metal or by mold gases *evolved during the pouring of the casting*
- All *gas defects* are caused to the greater extent:
  - Lower *gas passing tendency of mold*, which may be due to *lower venting*
  - *Lower permeability* of the mold
  - *Improper design* of casting
- The defects in this category can be classified into *blowholes and pinhole porosity*

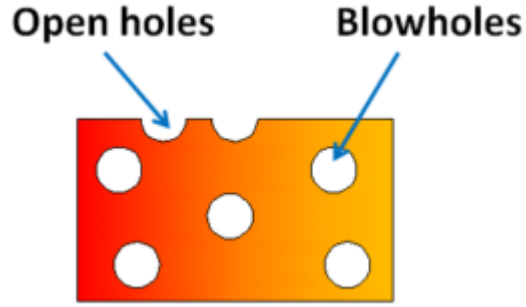
1. a. Blow holes and Open blows

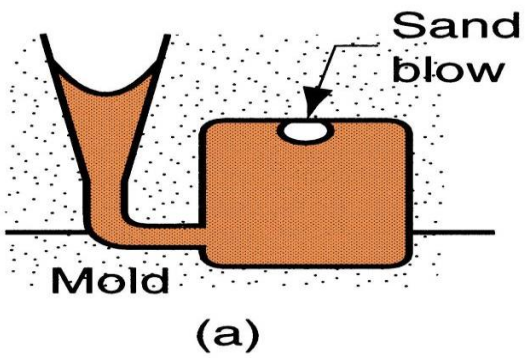
- *It occurs at or below the casting surface near the top of the casting*.
- Part of which when *entrapped into the casting end up* as blow holes or end up as *open blow when it reaches the surface.*

CAUSES:

- *Low sand permeability,*
- *poor venting, and*
- *high moisture content* of the sand mold

are the usual causes.

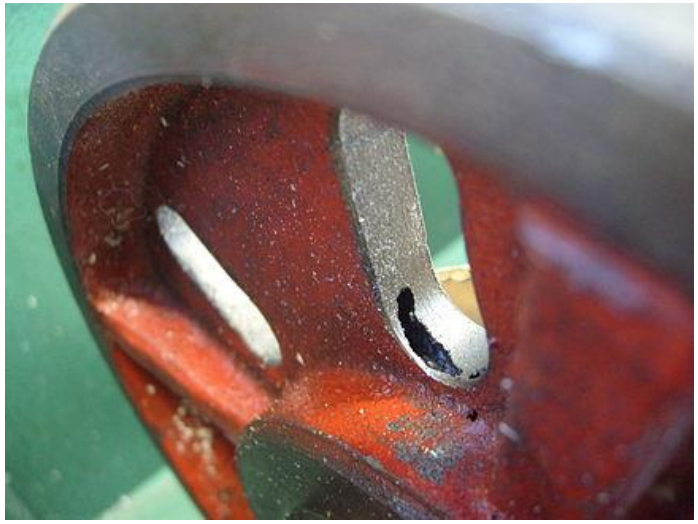




1. a. Blow holes and Open blows

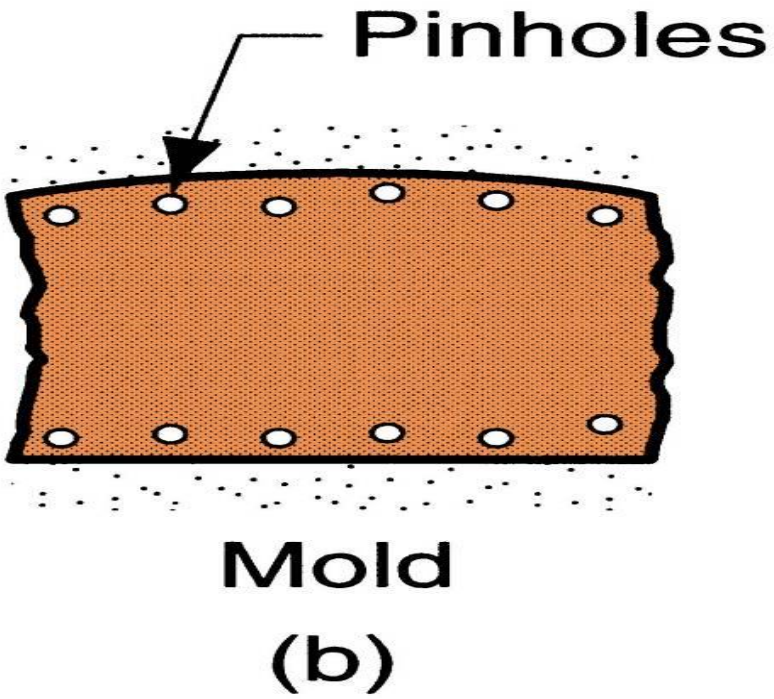
Remedies :

- Control of moisture content in moulding sand.
- Use of rust free chills, chaplets & inserts.
- Provide adequate venting in mould and cores.



1. b. Pin holes

- Pin holes are *tiny blow holes* appearing just below the casting surface.



1. b. Pin holes

- ***Causes:***

  -sand with high moisture content.

  -absorption of hydrogen gas in the metal.

  -alloy not being properly degassed.

  -sand containing gas producing ingredients.

- ***Remedies:***

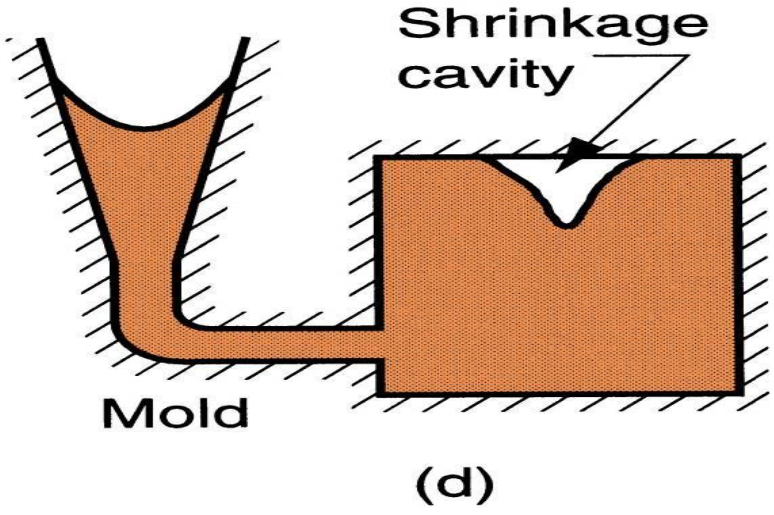
  -reducing the moisture content of molding sand.

  -increasing its permeability.

  -employing good melting and fluxing practices.

2. Shrinkage Cavities

- Shrinkage cavity is a *depression in the surface* or an internal void in the casting.
- Shrinkage cavity occur when *feed metal is not available* to compensate for shrinkage as the metal solidifies.
- It often occurs *near the top of the casting*.
- The problem can often be solved by *proper riser design and using chills.*



(d)

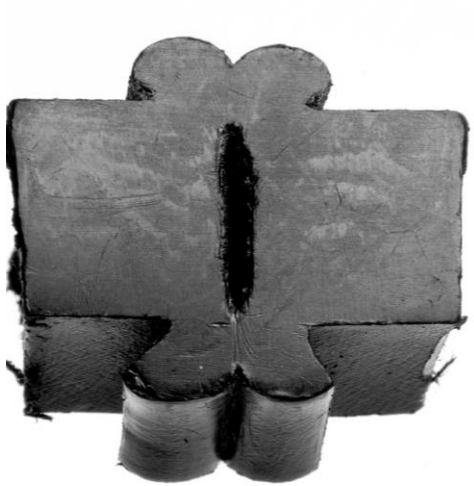
Cavities

Causes :

- Inadequate and improper gating & risering system.
- Too much high pouring temperature.
- Improper chilling.

Remedies :

- Ensure proper directional solidification by modifying gating, risering & chilling system.



3. Molding Material Defects

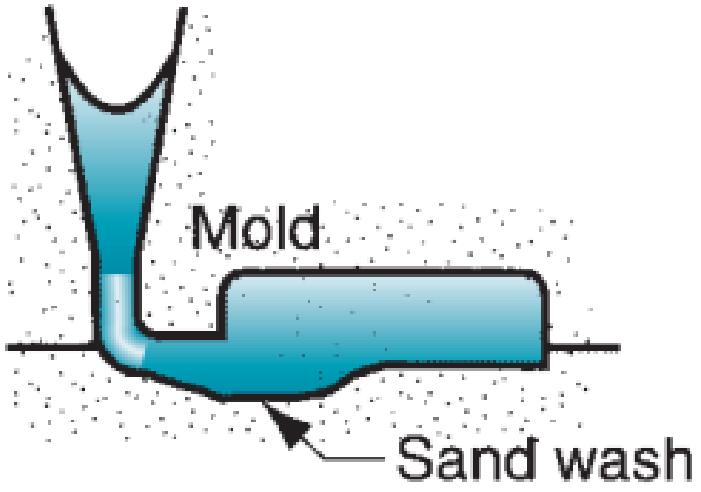
- Under these category are those defects which are caused by ***the characteristic of molding material***. The defects can be put into this category are:

a. Cut and washes

b. Fusion

3. a. Cut and Washes

- Sand wash, which is an *irregularity in the surface* of the casting *that results from erosion of the sand mold during pouring*, and the *contour of the erosion* is formed in the *surface* of the final cast part.



3. a. Cut and Washes

- ***Causes:***
  - Weak strength of the molding sand
  - Molten metal flowing at a high velocity

- ***Remedies:***
  - Selecting proper molding sand
  - Using appropriate molding method
  - Increasing size of gates or using multiples ingates to reduce the turbulence in the metal.

3. b. Fusion

- Fusion of sand grains with molten metal, giving a brittle, glassy appearance on the cast surface.
- ***Causes:***
  - Clay in the molding material has low *refractoriness* or pouring temp is very high.
- ***Remedies:***
  - Choice of appropriate types and bentonite clay would cure this effect

4. Pouring Metal Defects

- The likely defects in this category are
  a. Slag inclusion
  b. Mis-runs
  c. Cold shuts

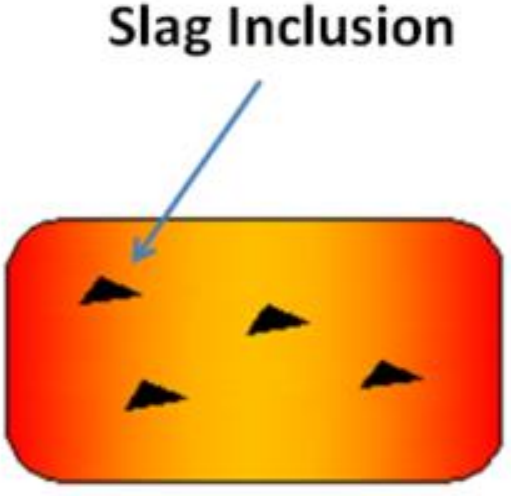
4. a. Slag Inclusion

- There are a number of chemical reactions that can occur between molten metal and its surroundings.
- These reactions and their products can often lead to defects in the final casting.
- For example, oxygen and molten metal can react to produce metal oxides which can then be carried with the molten metal during the pouring and filling of the mold.
- Known as dross or slag , this material

can become trapped in the casting

and poor surface finish, machinability,

and mechanical properties.



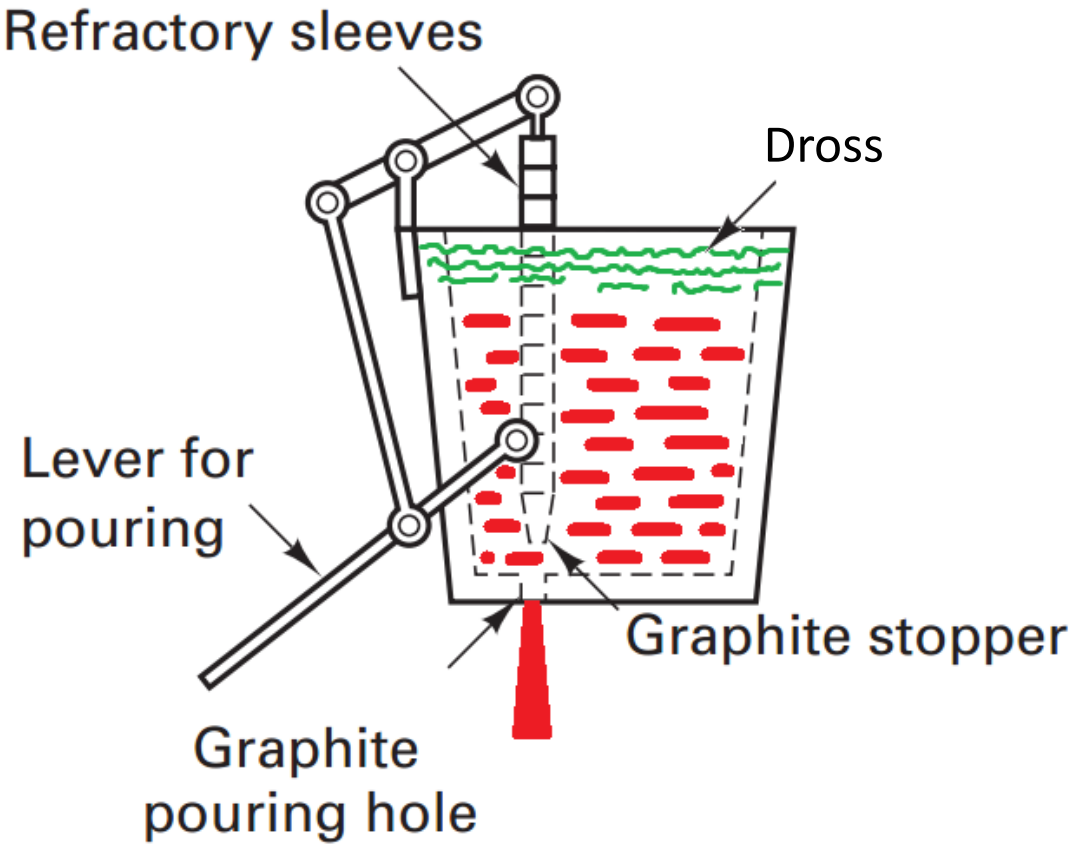
4. a. Slag Inclusion- Prevention

- *Lower pouring temperatures* slows the rate of dross-forming reactions.
- *Fluxes can be used to cover and protect* molten metal during melting.
- The melting and pouring can be performed *under a vacuum or protective* atmosphere.

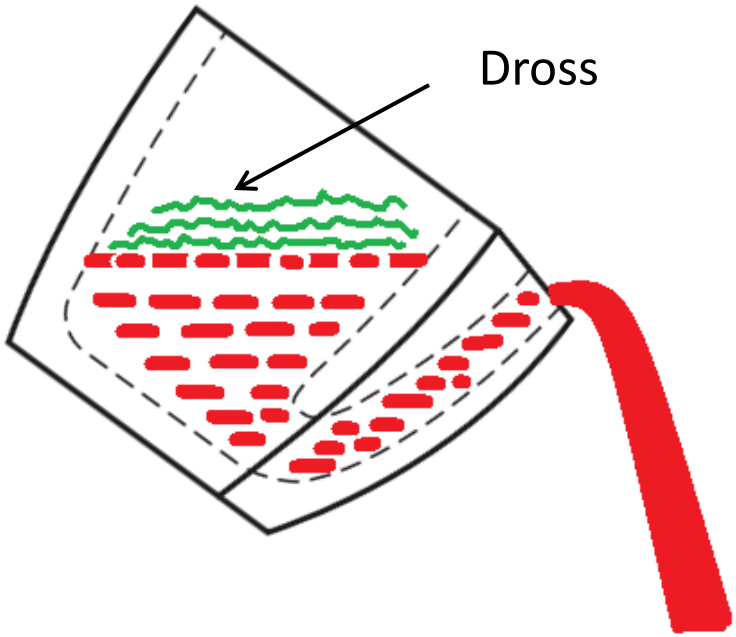
4. a. Slag Inclusion - Prevention

- Measures can be taken to cause the dross to float to the surface of the metal, where it can be skimmed off prior to pouring.
- Special ladles can be used that extract metal from beneath the surface thereby avoiding the dross to enter the mould.
- In Addition ceramic filter can be inserted to feeder channel of the mold.

4. a. Bottom – pour ladle

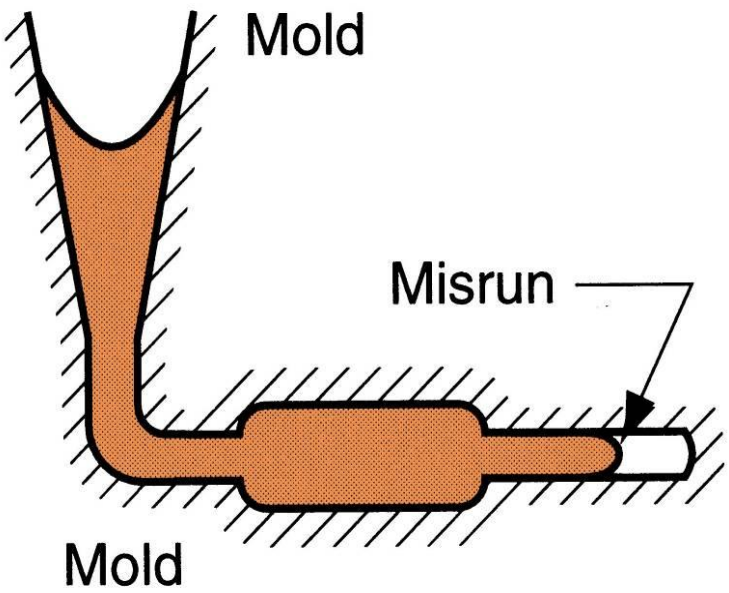


Tea pot ladle



4. b. Misrun

- When the *molten metal fails to fill the entire mould cavity before the metal starts solidifying*, resulting in an incomplete casting, the defect is known as Misrun. *The edge of defect is round and smooth.*



4. b. Mis-runs

Causes:

–Low pouring temperature of molten metal, reduce fluidity

–Too thin casting sections

–Slow and intermitted pouring

–Improper alloy composition

–Improper gating system

–Casting with large surface area to volume ratio

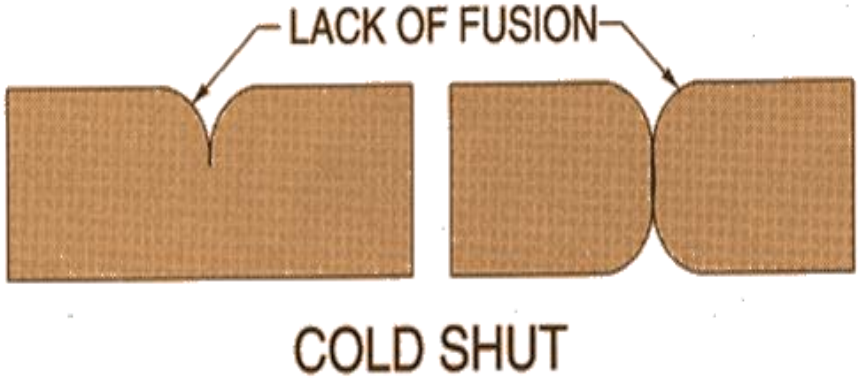
–Back pressure due to gases in the mold which is not properly vented

4. b. Mis-runs

- ***Remedies:***
  - Increase the fluidity of metal by increasing the pouring temperature or changing chemical composition.
  - Smooth pouring
  - Improve mold design

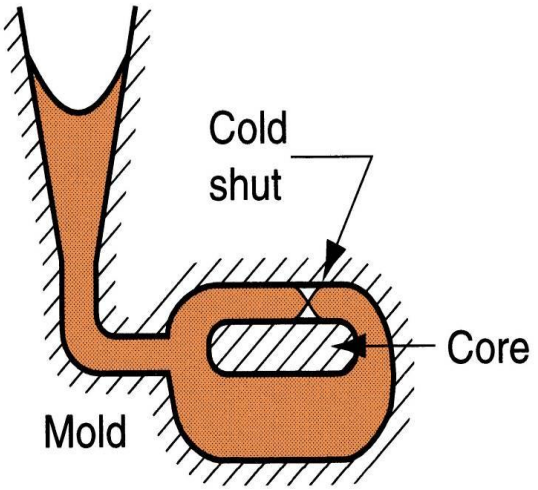
4. c. Cold Shuts

- When two streams of molten metal approach each other in the mould cavity from opposite directions but fail to fuse properly, with the result of discontinuity between them, it is called a cold shut.



Cold Shuts

- ***Causes:***
  - Low temperature of molten metal
  - Slow and intermitted pouring
  - Improper alloy composition
  - Use of damaged pattern



- ***Remedies:***

-Smooth pouring

-Properly transport mould during pouring.

-Providing appropriate pouring temperature

5. Metallurgical Defects

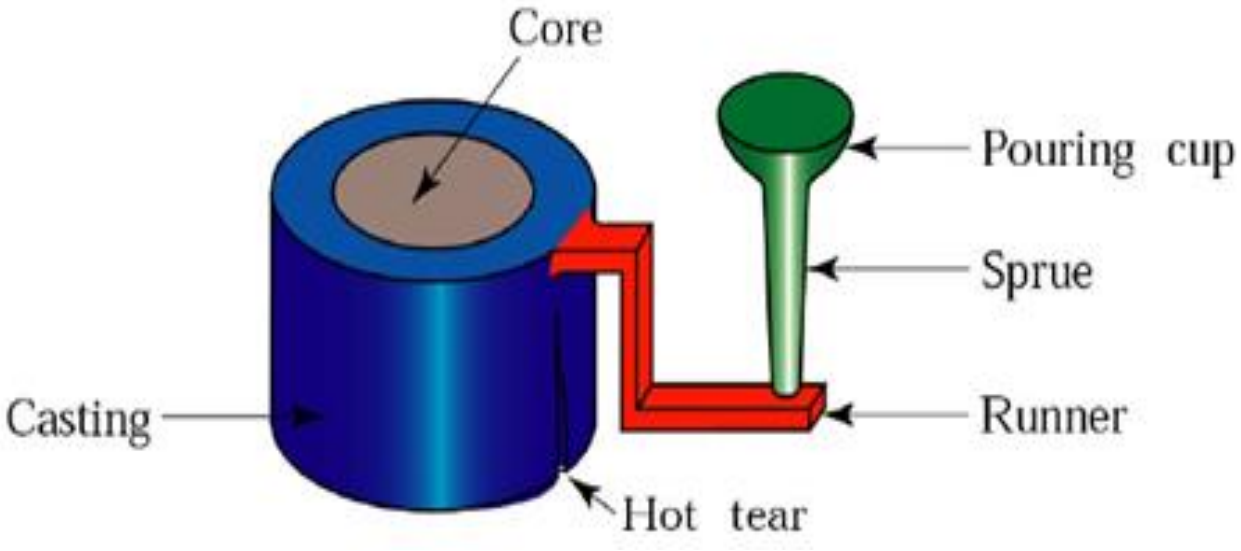
- These are defects are caused by the properties of the casting products.

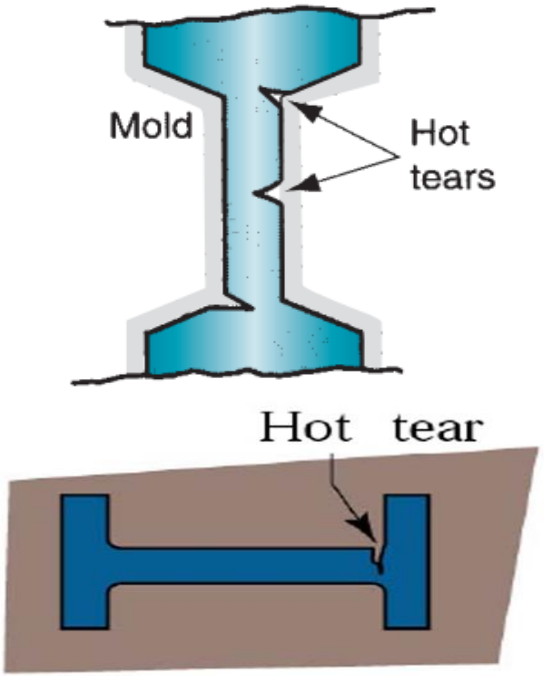
a. Hot tears/cracking

b. Hot Spot

5. a. Hot Tears/Cracking

- When the *metal is hot, it is weak and the residual stress (tensile) in the material cause the casting fails* as the molten metal cools down.
- The failure of casting in this case is looks like cracks and called as hot tears or hot cracking.





5. a. Hot Tears/Cracking

Causes

- Improper mold design.

Remedies

- Proper mold design can easily eliminate these types of casting defects.
- Elimination of *residual stress* from the material of the casting.

5. b. Hot Spots

- Hot spot defects occur when *an area on the casting cools more rapidly* than the surrounding materials
- Hot spot are *areas on the casting which is harder* than the surrounding area

Causes & Remedies

Causes:

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

Remedies:

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

References:

- M. P. Groover, Fundamentals Of Modern Manufacturing: Materials, Processes, and Systems, Wiley (2016), 5th edition.
- Degarmo, E. P., Kohser, Ronald A. and Black, J. T., Materials and Processes in Manufacturing, Prentice Hall of India (2008) 8th ed.
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