Casting Defects

What are the origin of casting defects

- Defects caused by patterns and molding box equipments
- Defects due to improper molding and core making materials
- Defects due to improper sand mixing & distribution
- Defects caused by molding, core making, gating
- Defects due to improper mold drying and core baking.
- Defects accurring while closing & pouring the molds.
- Defects caused by molten metal.
- Defects due to faulty heat treatment
- Defects due to cast metal. etc

Casting Defects

The following are the major defects, which are likely to occur in sand castings

- Gas defects
- Shrinkage cavities
- Molding material defects
- Pouring metal defects
- Mold shift

Casting Defects: Gas Defects

- A defect in a casting caused by the trapping of gas in the molten metal or by mold gases evolved during the pouring of the casting.

The defects in this category can be classified into

- Blow holes and
- Pin hole porosity.

- Blowholes are spherical or elongated cavities present in the casting on the surface or inside the casting.
- Pinhole porosity occurs due to the dissolution of hydrogen gas, which gets entrapped during heating of molten metal.

Casting Defects:

Causes for Gas Defects

The lower gas-passing tendency of the mold, which may be due to

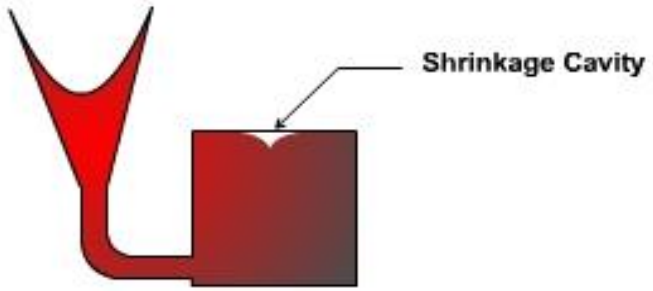
- lower venting,
- lower permeability of the mold or
- improper design of the casting.

- The lower permeability is caused by finer grain size of the sand, high percentage of clay in mold mixture, and excessive moisture present in the mold.
- Metal contains gas
- Mold is too hot
- Poor mold burnout

Casting Defects:

Shrinkage Cavities

- These are caused by liquid shrinkage occurring during the solidification of the casting.
- To compensate for this, proper feeding of liquid metal is required.
- For this reason risers are placed at the appropriate places in the mold.
- Sprues may be too thin, too long or not attached in the proper location, causing shrinkage cavities.
- It is recommended to use thick sprues to avoid shrinkage cavities.



Shrinkage Cavity

Casting Defects:

Molding Material Defects

The defects in this category are cuts and washes, metal penetration, fusion, and swell.

Cut and washes

- These appear as rough spots and areas of excess metal, and are caused by erosion of molding sand by the flowing metal.
- This is caused by the molding sand not having enough strength and the molten metal flowing at high velocity.
- The washes can be taken care by the proper choice of molding sand and the cuts can be overcome by the proper design of gating system.

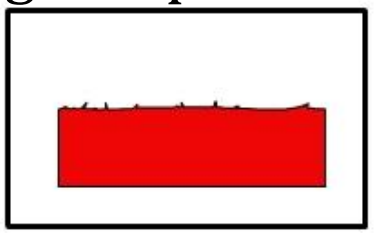
Casting Defects: Molding Material Defects

Metal penetration

- When molten metal enters into the gaps between sand grains, the result is a rough casting surface.
- This occurs because the sand is coarse or no mold coating was applied on the surface of the mold.
- The coarser the sand grains more the metal penetration.

Fusion

- This is caused by the fusion of the sand grains with the molten metal, giving a brittle, glassy appearance on the casting surface.
- The main reason for this is that the clay or the sand particles are of lower refractoriness or that the pouring temperature is too high.



Metal Peneration

Casting Defects: Molding Material Defects

Swell

- Under the influence of metallostatic forces, the mold wall may move back causing a swell in the dimension of the casting.
- A proper ramming of the mold will correct this defect.

Inclusions

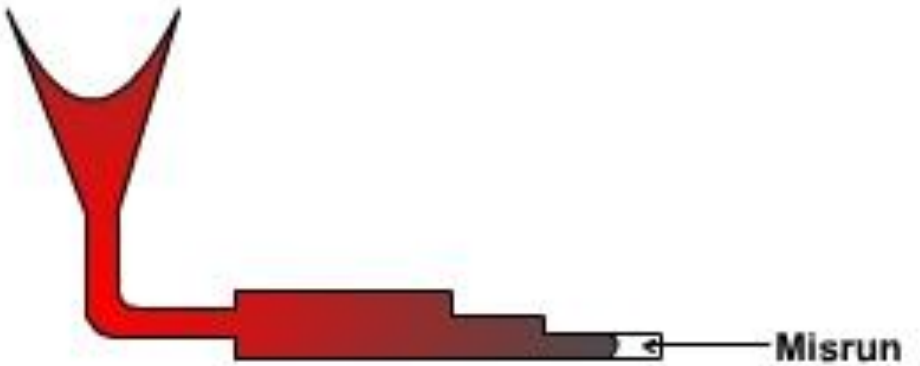
- Particles of slag, refractory materials, sand or de-oxidation products are trapped in the casting during pouring and solidification.
- The provision of choke in the gating system and the pouring basin at the top of the mold can prevent this defect.

Casting Defects: Pouring Metal Defects

The likely defects in this category are

- ❑ Mis-runs and
- ❑ Cold shuts.

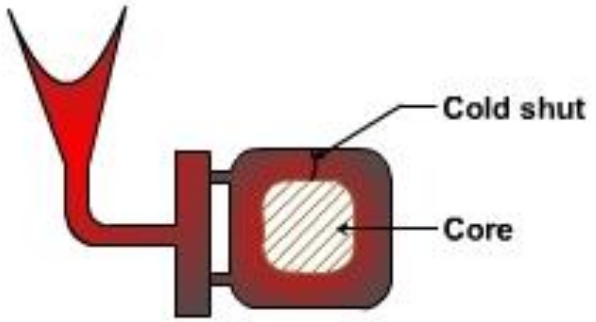
- ➢ A mis-run is caused when the metal is unable to fill the mold cavity completely and thus leaves unfilled cavities.
- ➢ A mis-run results when the metal is too cold to flow to the extremities of the mold cavity before freezing.
- ➢ Long, thin sections are subject to this defect and should be avoided in casting design.



Misruns

Casting Defects: Pouring Metal Defects

- A cold shut is caused when two streams while meeting in the mold cavity, do not fuse together properly thus forming a discontinuity in the casting.
- When the molten metal is poured into the mold cavity through more-than-one gate, multiple liquid fronts will have to flow together and become one solid.
- If the flowing metal fronts are too cool, they may not flow together, but will leave a seam in the part.
- Such a seam is called a ***cold shut***, and can be prevented by assuring sufficient superheat in the poured metal and thick enough walls in the casting design.



Cold shut

Casting Defects: Micro-porosity

- This refers to a network of a small voids distributed throughout the casting caused by localized solidification shrinkage of the final molten metal in the dendritic structure.
- The defect is usually associated with alloys, because of the protracted manner in which freezing occurs in these metals.

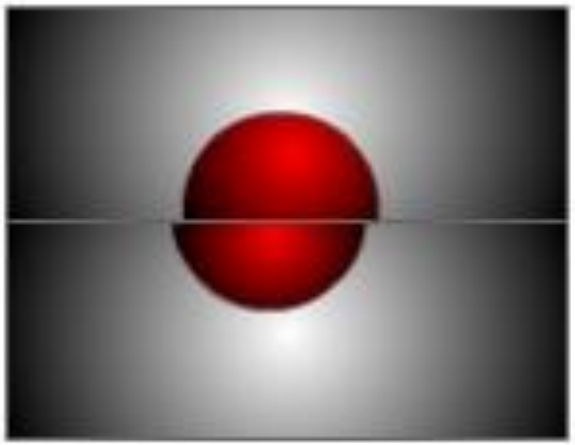
Microporosity

Casting Defects: Pouring Metal Defects

- The mis-run and cold shut defects are caused either by a lower fluidity of the mold or when the section thickness of the casting is very small.
- Fluidity can be improved by changing the composition of the metal and by increasing the pouring temperature of the metal.

Casting Defects: Mold Shift

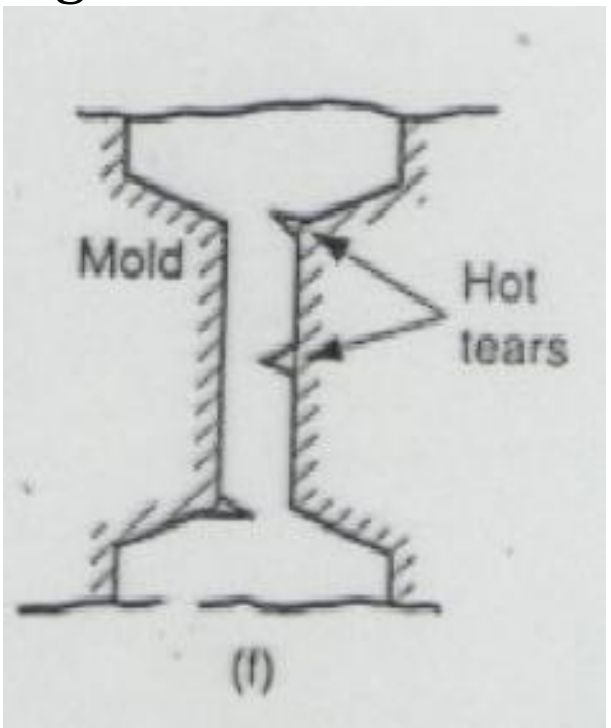
- The mold shift defect occurs when cope and drag or molding boxes have not been properly aligned.



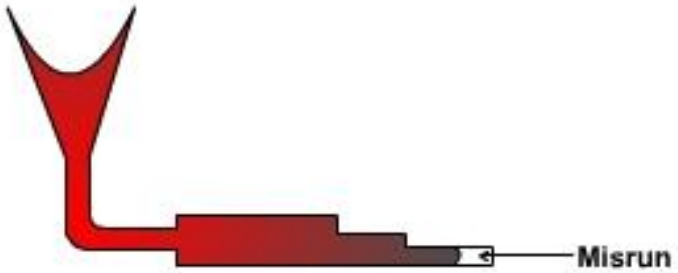
Mismatch

Casting Defects: Hot Tearing

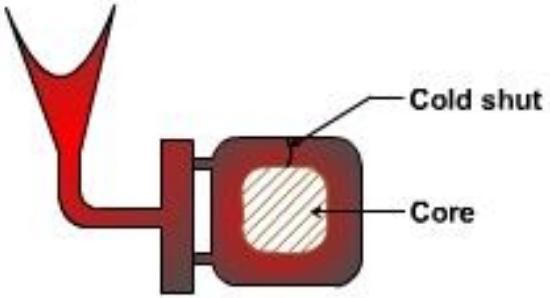
- This defect, also called ***hot cracking***, occurs when the casting is restrained or early stages of cooling after solidification.
- The defect is manifested as a separation of the metal (hence the terms tearing or cracking) at a point of high tensile stress caused by metal's inability to shrink naturally.
- In permanent mold processes, removing the part from the mold immediately after freezing reduces hot tearing.



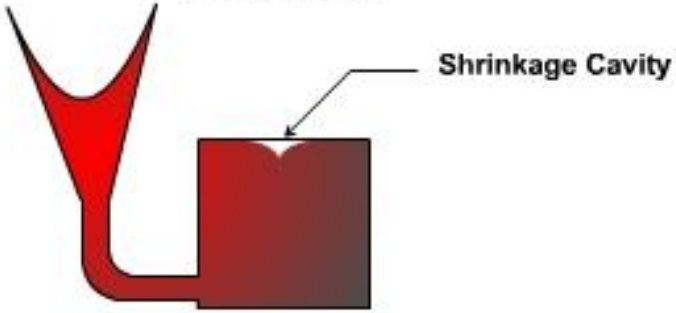
Casting Defects



Misruns

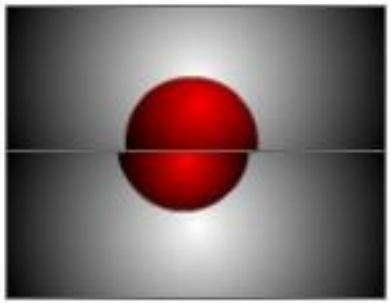


Cold shut

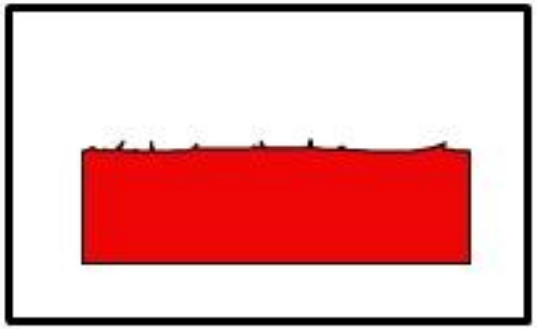


Shrinkage Cavity

Microporosity

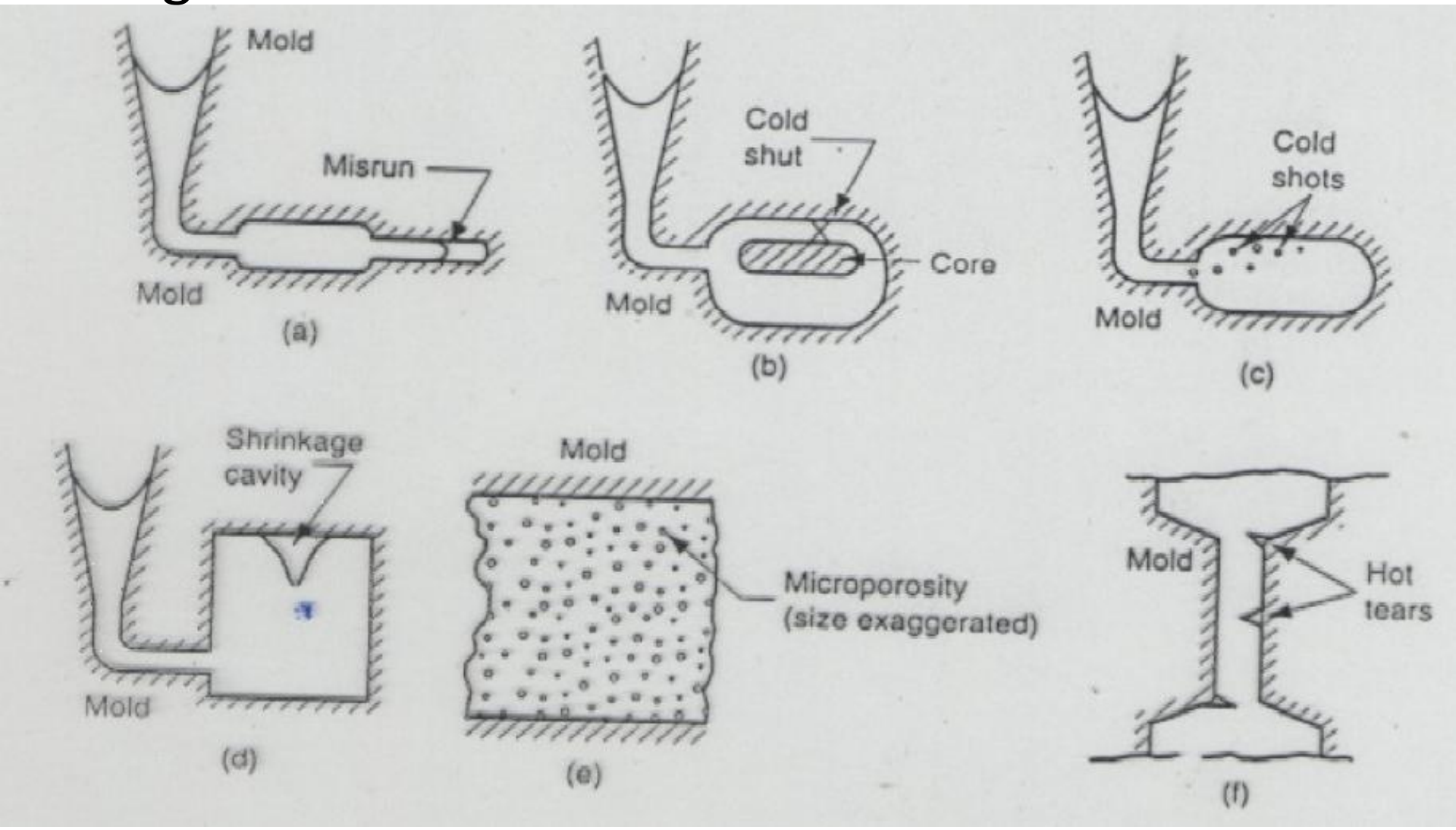


Mismatch



Metal Peneration

Casting Defects



Some common defects in castings:

a) Misruns b) Cold Shut c) Cold Shot d) Shrinkage Cavity e) Microporosity f) Hot Tearing

Casting Defects

a) **Sand Blow:** This defect consists of a balloon-shaped gas cavity caused by release of mold gases during pouring. It occurs at or below the casting surface near the top of the casting. Low permeability, poor venting and high moisture content of the sand mold are the usual causes.

b) **Pinholes:** A defect similar to a sand blow involves the formation of many small gas cavities at or slightly below the surface of the casting.

c) **Sand Wash:** A wash is an irregularity in the surface of the casting that results from erosion of the sand mold during pouring. The contour of the erosion is imprinted into surface of the final cast part.

d) **Scabs:** This is a rough area of the casting due to coatings of sand and metal. It is caused by portions of the mold surface flaking off during solidification and becoming embedded in the casting surface.

Casting Defects

e) **Penetration:** When the fluidity of the liquid metal is high, it may penetrate into the sand mold or sand core after freezing, the surface of the casting consists of a mixture of sand grins and metal. Harder packing of the sand molds helps to alleviate this condition.

f) **Mold Shift:** This is manifested as a step in the cast product at the parting line caused by sidewise displacement of the cope with respect to the drag.

g) **Core Shift:** A similar movement can happen with the core but the displacement is usually vertical. Core shift and mold shift are caused by buoyancy of the molten metal.

h) **Mold Crack:** If mold strength is insufficient a crack may develop into which liquid metal can seep to form a fin on the final casting.

Casting Defects