# 18 CASTING DEFECTS, CLEANING AND INSPECTION

*18.1 Introduction, 18.2 Casting defects, 18.3 Blow holes, 18.4 Porosity, 18.5 Shrinkage, 18.6 Misruns and cold shuts, 18.7 Inclusions, 18.8 Hot tears, 18.9 Cuts and washes, 18.10 Metal penetration, 18.11 Drop, 18.12 Fusion, 18.13 Shot metal, 18.14 Shift, 18.15 Rat tails or buckles, 18.16 Swells, 18.17 Hard spots, 18.18 Run outs, 18.19 Crushes, 18.20 Warpage, 18.21 Cleaning of castings (fettling), 18.22 Inspection of castings.*

## 18.1 INTRODUCTION

Casting defects are usually not accidents, they occur because some steps in the manufacturing cycle do not get properly controlled and somewhere goes wrong. So close control and standardization of all aspects of manufacturing technique offers the best defense against the occurrence of defects in casting.

## 18.2 CASTING DEFECTS

The factors, which are normally responsible for the production of these defects are :

- ❖ Design of casting.
- ❖ Design of pattern equipment.
- ❖ Moulding and core making equipments.
- ❖ Mould and core material.
- ❖ Gating and risering.
- ❖ Melting and pouring.
- ❖ Melting and core making techniques.
- ❖ Metal composition.
- ❖ Various casting defects are described below :

## 18.3 BLOW HOLES

- ❖ They appear as cavities (holes) in a casting.

- Blow holes visible on the surface of a casting are called open blows whereas those occur below the surface of castings and not visible from outside are termed as blow holes.

**Causes :**

- Excessive moisture in the moulding sand.
- Low permeability and excessive fine grain sands.
- Cores, neither properly baked not adequately vented.
- Extra hard rammed sand.
- Rusted and damp chills, chaplets and inserts.
- Excessive use of organic binders.

**Remedies :**

- Control moisture content.
- Use clean and rust free chills, chaplets and metal insert.
- Bake cores properly.
- Proper use of organic binders.
- Cores and moulds should be properly vented.
- Moulds should not be rammed excessively hard.

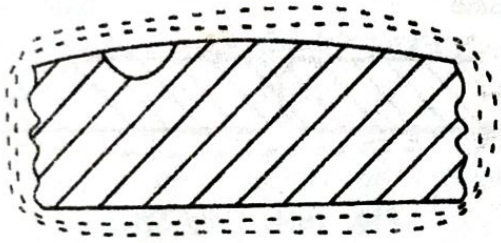

**Fig. 18.1.** *Blow Holes.*

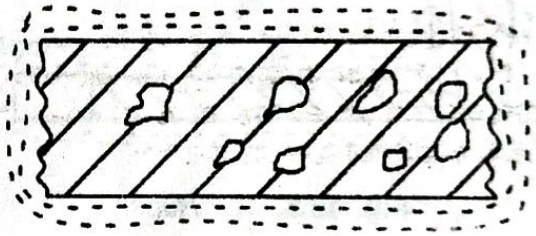

**Fig. 18.2.** *Porosity.*

## 18.4 POROSITY

This defect occurs in the casting in the form of pin hole porosity or gas porosity. Hydrogen is responsible for pin hole porosity. Gases will be absorbed by the liquid metal. When the metal solidifies, the solubility decreases and gases will be released and create small voids throughout the casting called porosity.

**Causes :**

- High pouring temperature.
- Gas dissolved in metal charge.
- Less flux used.
- High moisture and low permeability in mould.

**Remedies :**

- Increase flux proportions.
- Ensure effective degassing.
- Reduce moisture and increase permeability.

## 18.5 SHRINKAGE

During solidification of metal, there is a volumetric shrinkage. To compensate this, proper feeding of liquid metal is required.

**Causes :**

- ❖ Faulty gating and risering.
- ❖ Improper chilling.

**Remedies :**

- ❖ Ensure proper directional solidification by modifying gating, risering and chilling.

## 18.6 MISRUNS AND COLD SHUTS

When the metal is unable to fill the mould cavity completely and thus leaving unfilled portion called Misruns. A cold shut is called when two metal streams don't fuse together properly.

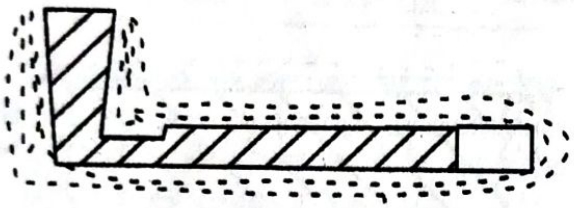

**Fig. 18.3.** *Mis Runs.*

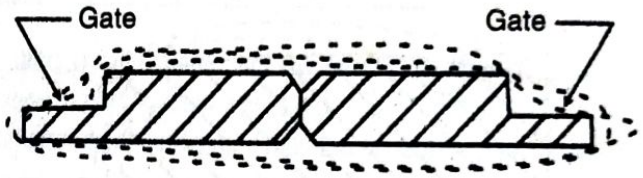


**Fig. 18.4.** *Cold Shut.*

**Causes :**

- ❖ Lack of fluidity in molten metal
- ❖ Faulty design.
- ❖ Fauly gating.

**Remedies :**

- ❖ Adjust proper pouring temperature.
- ❖ Modify design.
- ❖ Modify gating system.

## 18.7 INCLUSIONS

During the melting process, flux is added to remove the undesirable oxides and impurities present on the metal. At the time of tapping, the slag should be properly removed. If it mixes with the molten metal, defect is called inclusion (slag).

**Causes :**

- ❖ Faulty gating and faulty pouring.
- ❖ Inferior moulding or core sand.

- Soft ramming.
- Improper flux.

**Remedies :**

- Improve or modify gating and pouring.
- Use a superior sand.
- Provide harder ramming.
- Use proper flux.

## 18.8 HOT TEARS

Since metal has low strength at higher temperatures, any unwanted cooling stress may cause the rupture (tear) of the casting called hot tears.

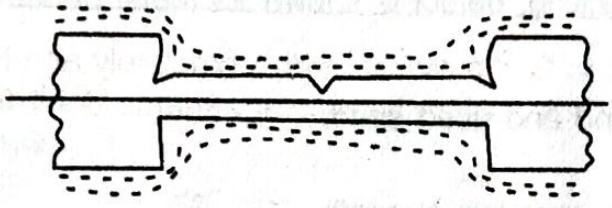

**Fig. 18.5.** *Hot Tears.*

**Causes :**

- Lack of collapsibility of core and mould.
- Faulty design.
- Hard ramming.

**Remedies :**

- Improve collapsibility.
- Modify design.
- Provide soft ramming.

## 18.9 CUTS AND WASHES

These defects occur due to the erosion of sand from the mould or core surface by the molten metal.

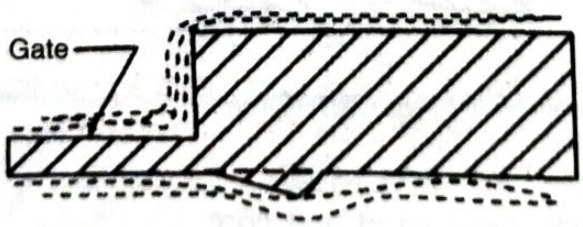


**Fig. 18.6.** *Washes.*

**Causes :**

- Low strength of mould and core.
- Lack of binders in facing and core sand.
- Faulty gating.

**Remedies :**

- Improve collapsibility.
- Modify design.
- Provide soft ramming.

## 18.10 METAL PENETRATION

If the molten metal enters into the spaces between the sand grains and holds some of the sand tightly with it even after fettling, defect is known as metal penetration.

**Causes :**

- Large grain size of sand and used sand.
- Soft ramming.
- Moulding sand or core have low strength.
- Pouring temperature of metal two high.

**Remedies :**

- Use sand having finer grain size.
- Provide harder ramming.
- Increase the strength of sand.
- Adjust the proper pouring temperature.

## 18.11 DROP

If a portion of the sand breaks away from the mould and drops in the molten metal, that is called drop defect.

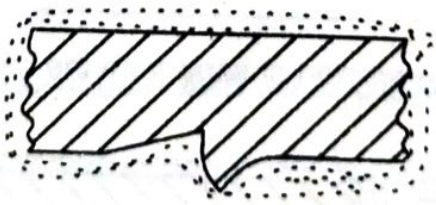

**Fig. 18.7.** *Drop.*

**Causes :**

- Low green strength in moulding sand and core.
- Too soft ramming.
- Inadequate reinforcement of sand projections and core.

**Remedies :**

- Modify sand composition to increase the strength.
- Provide harder ramming.
- Provide adequate reinforcement to sand projection.

## 18.12 FUSION

This is caused by the fusion of sand grains with the molten metal, giving a brittle, glassy appearance on the casting surface.

**Causes :**

- Low refractoriness.
- Faulty gating.
- Too high pouring temperature.
- Poor facing sand.

**Remedies :**

- Improve refractoriness.
- Modify gating system.
- Use lower pouring temperature.
- Improve quality of facing sand.

## 18.13 SHOT METAL

If the molten metal is poured into the mould when its temperature is relatively lower or there is not proper fusing between the main stream and small particles, shot metal defect occurs.

**Causes :**

- Too low pouring temperature.
- Excess sulphur content in the metal.
- Faulty gating.

**Remedies :**

- Use higher pouring temperature.
- Reduce sulphur content.
- Modify gating system.

## 18.14 SHIFT

A shift is a misalignment between two mating surfaces. This defect may occur at the parting surface between the two parts of the mould called mould shift or between the core and core seat called core shift.

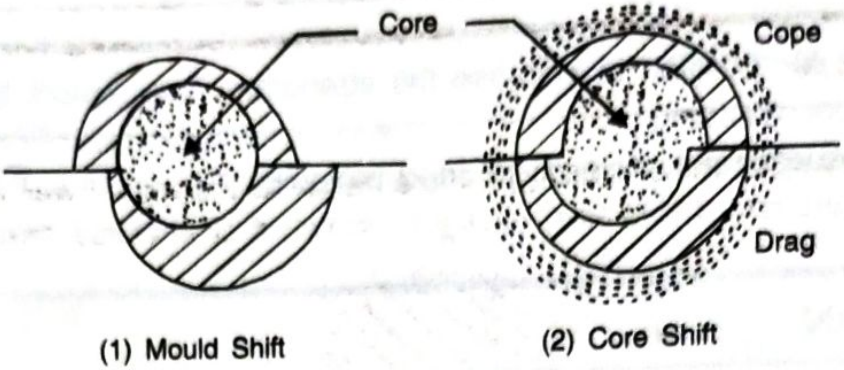


**Fig. 18.8.** *Shift.*

**Causes :**

- ❖ Misalignment.
- ❖ Worn out clamping pins.
- ❖ Improper support and location of core.
- ❖ Faulty core boxes.

**Remedies :**

- ❖ Repair or replace the pins.
- ❖ Provide adequate support to cores.
- ❖ Locate the core properly.
- ❖ Repair or replace the core boxes.

## 18.15 RAT TAILS OR BUCKLES

Under the influence of the heat, the sand expands, thereby moving the mould wall backwards. Due to this there is an irregular line on the surface of the casting called rat tails. If there are a number of criss-crossing small lines and there are severe rat tails, that is called buckles.

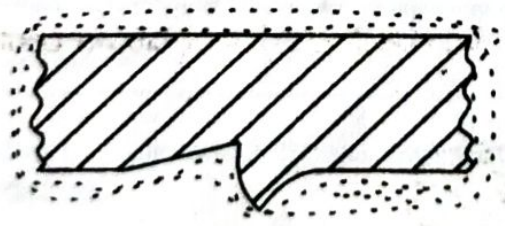

**Fig. 18.9.** *Rat Tails*

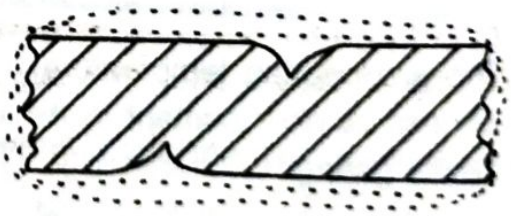

**Fig. 18.10.** *Buckles.*

**Causes :**

- ❖ Excessive mould hardness.
- ❖ Large flat surface of casting.

**Remedies :**

- ❖ Reduce mould hardness.
- ❖ Break continuity of large flat surface by grooving or depressions.

## 18.16 SWELLS

If there is an enlargement of casting surface because the mould wall moves backward due to liquid metal pressure and the size of cavity increases that is called swells.

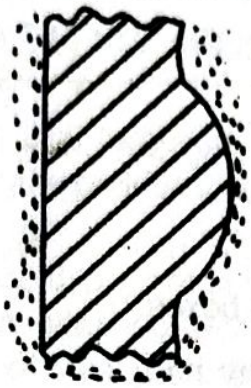

**Fig. 18.11.** *Swells.*

**Causes :**

- Soft ramming of mould.
- Low strength of mould core.
- Mould not properly supported.

**Remedies :**

- Provide harder ramming.
- Increase strength of mould and core.
- Provide adequate support to mould.

## 18.17 HARD SPOTS

Hard spots on surfaces are generally developed on iron castings rich in silicon content due to local chilling of those spots by moulding sand.

**Fig. 18.12.** *Hard Spot.*

**Causes :**

- Faulty metal composition.
- Faulty casting design.

**Remedies :**

- Suitable change in the metal composition.
- Modify the casting design.

## 18.18 RUN OUTS

A run out occurs when the molten metal leaks out of the mould during pouring, resulting in an incomplete casting.

**Causes :**

- ❖ Faulty moulding.
- ❖ Defective moulding boxes.

**Remedies :**

- ❖ Improve moulding technique.
- ❖ Change the defective moulding boxes.

## 18.19 CRUSHES

A crush is a deformation of mould surface due to pressing or scrapping of the sand during setting of core or assembly of the mould boxes.

**Causes :**

- ❖ Careless assembly of cores in the mould.
- ❖ Worn out core prints on patterns.
- ❖ Defective core boxes.

**Remedies :**

- ❖ Repair or replace core boxes.
- ❖ Repair or replace core prints.
- ❖ Proper setting of cores.

## 18.20 WARPAGE

If the deformation takes place due to internal stresses developed in the casting or due to differential solidification in different sections, it causes warpage.

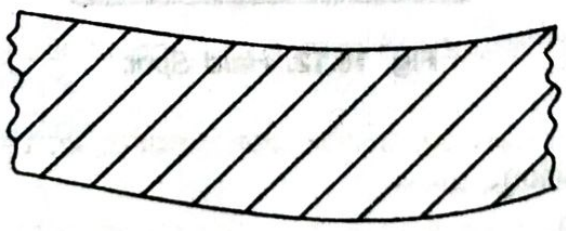

**Fig. 18.13.** *Warpage.*

**Causes :**

- ❖ Not proper directional solidification.
- ❖ Continuous large flat surfaces.

**Remedies :**

- Facilitate proper directional solidification.
- Modify the casting design to break continuity.