Casting Defects

There are numerous opportunities for things to go wrong in a casting operation, resulting in quality defects in the product. The defects can be classified as follows:

– Defects common to all casting processes
– Defects related to sand casting processes

**Defects common to all casting processes:**

a) **Misruns**:

A Misrun is a casting that has solidified before completely filling the mold cavity. Typical causes include:

1) Fluidity of the molten metal is insufficient,
2) Pouring Temperature is too low,
3) Pouring is done too slowly and/or
4) Cross section of the mold cavity is too thin.

Some common defects in castings: (a) misrun

b) **Cold Shut**: A cold shut occurs when two portions of the metal flow together, but there is lack of fusion between them due to premature freezing. Its causes are similar to those of a Misrun.

Some common defects in castings: (b) cold shut
Some common defects in castings: (b) cold shut

c) Cold Shots:
When splattering occurs during pouring, solid globules of the metal are formed that become entrapped in the casting. Poring procedures and gating system designs that avoid splattering can prevent these defects.

![Diagram of Cold Shots](c)

Some common defects in castings: (c) cold shot

d) Shrinkage Cavity:
This defect is a depression in the surface or an internal void in the casting caused by solidification shrinkage that restricts the amount of the molten metal available in the last region to freeze. It often occurs near the top of the casting in which case it is referred to as a pipe. The problem can often be solved by proper riser design.

![Diagram of Shrinkage Cavity](d)

Some common defects in castings: (d) shrinkage cavity
e) Microporosity:
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.

f) 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 sand casting and other expandable mold processes, compounding the mold to be collapsible prevents it. In permanent mold processes, removing the part from the mold immediately after freezing reduces hot tearing.

Defects related to sand casting process:
Some defects are related to the use of sand molds and therefore they occur only in sand castings as following :

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 encrustations of sand and metal. It is caused by portions of the mold surface flaking off during solidification and becoming embedded in the casting surface.

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.

**Inspection Methods:**

Foundry inspection procedures include;

a. Visual Inspection to detect obvious defects, such as Misruns, cold shut and severe surface flaws;

b. Dimensional measurements to ensure that tolerances have been met;

c. Metallurgical, chemical, physical and other tests concerned with the inherent quality of the cast metal. Tests in category 3 include
   1) Pressure testing to locate leaks in the casting
   2) Radiographic methods, magnetic particle tests, the use of fluorescent penetrate and supersonic testing to detect either surface or internal defects in the casting;
   3) Mechanical testing to determine properties such as tensile strength and hardness. If defects are discovered but are not too serious, it is often possible to save the casting by welding, grinding or other salvage methods to which the customer has agreed.