

Cost Analysis of casting

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Similarly, secondary processing may involve more than one process such as machining, heat treating, welding, painting, and plating. In addition, processes such as machining might involve several different operations (e.g., drilling, milling, grinding, etc.).

The per unit cost of secondary processing is therefore calculated as

$$C_s = \sum_{i=1}^{n_s} \left(C_T'' + \frac{C_0'' t_{cycle}''}{Y_S''} \right)_i$$

where:

n_s = number of secondary processes

C_T'' = secondary process tooling cost (Rs/unit)

C_0'' = secondary process equipment and labor cost (Rs/hr)

t_{cycle}'' = secondary process cycle time (hr)

Y_S'' = secondary process yield (useable castings/N)

Cost Analysis of casting

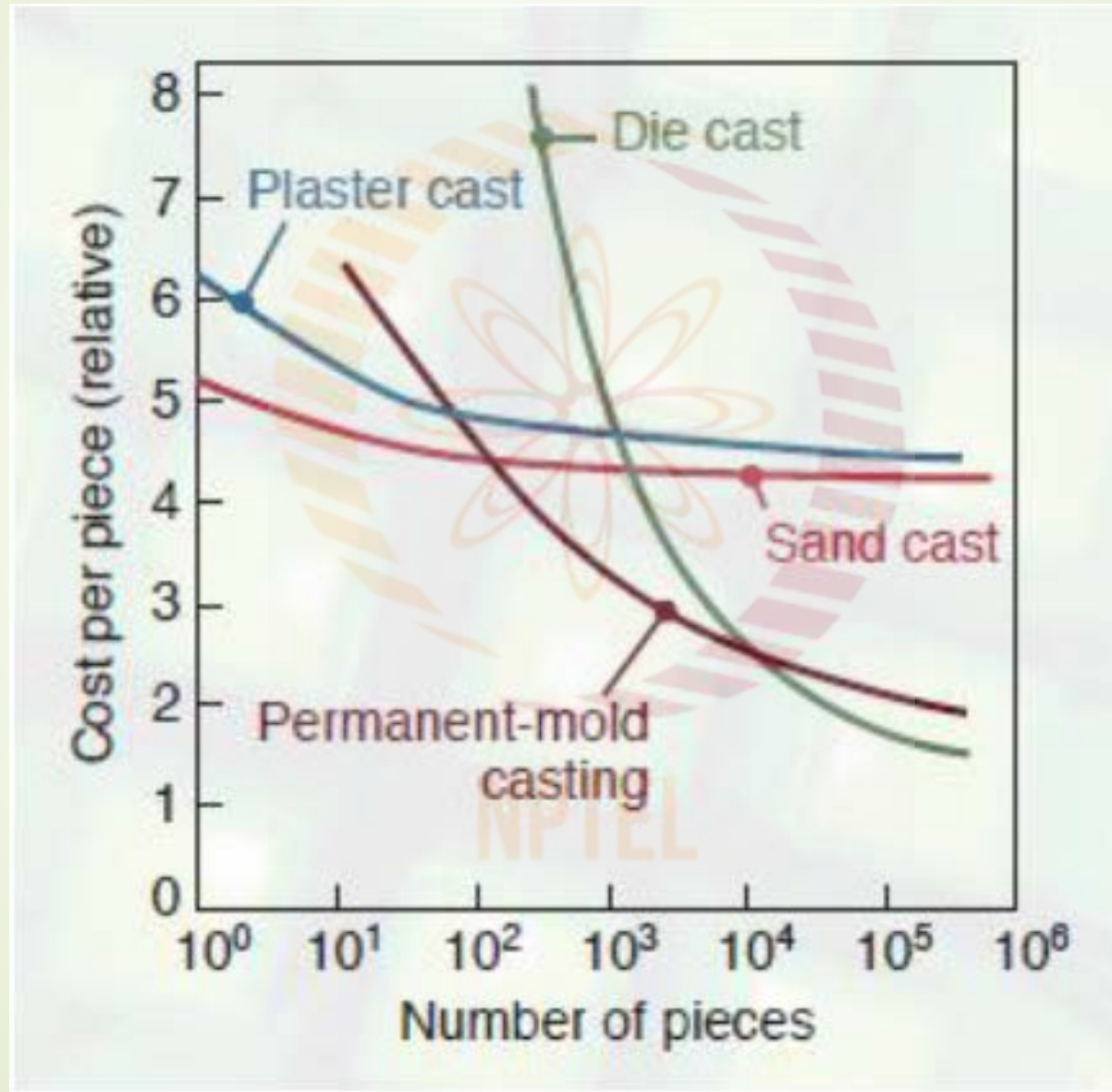
Those Equations indicate that the following measures are to be taken to reduce the per unit production and design cost:

- Design to minimize tooling cost
- Design to minimize material cost
- Design to minimize process cycle time
- Design to maximize yield
- Minimize the number of cores and secondary processes

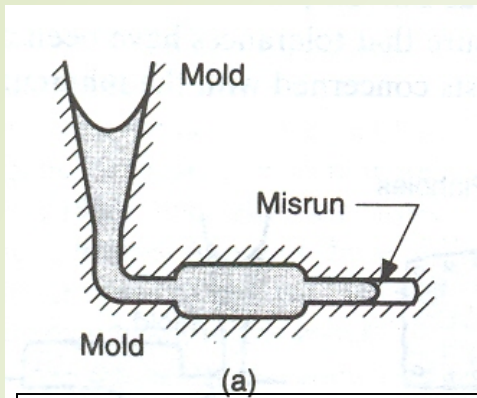
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Economics of casting

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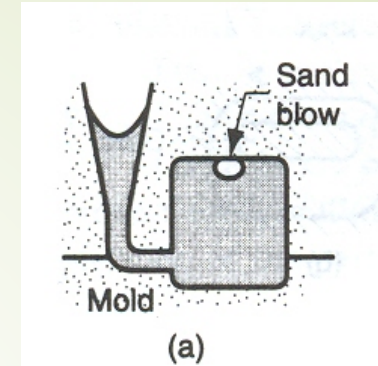
Casting Defects



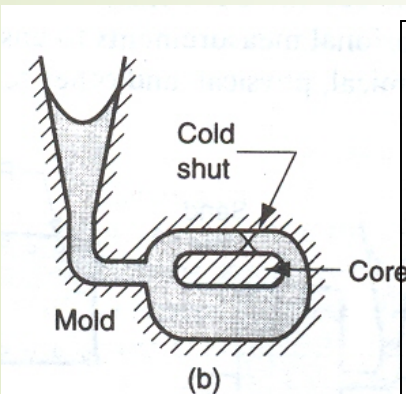
Misrun is caused when a casting solidifies before completely filling the mould cavity.

Causes of Misrun:

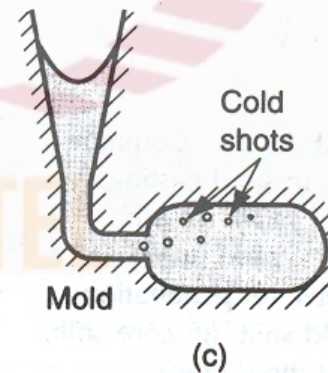
- Fluidity of the molten metal is insufficient
- Low pouring temperature
- Slow pouring
- Thin cross section of the mould cavity



Sand blow is caused by release of mould gases during pouring

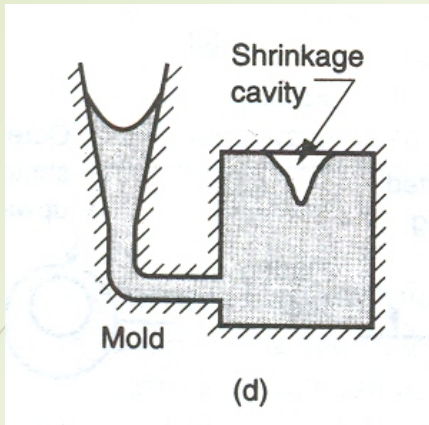


Cold Shut occurs when two portions of the metal flow together but there is a lack of fusion between them due to premature freezing.

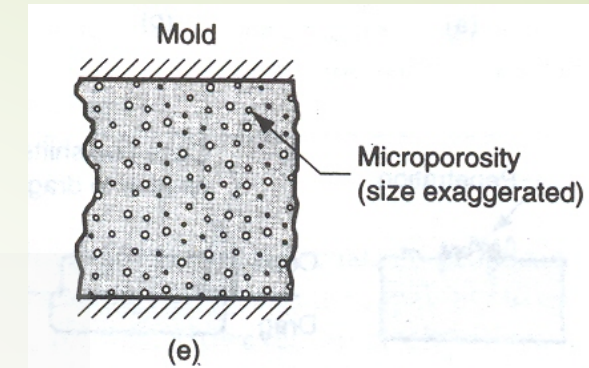


Due to splattering, solid globules of metal are formed that become entrapped in the casting known as cold shots.

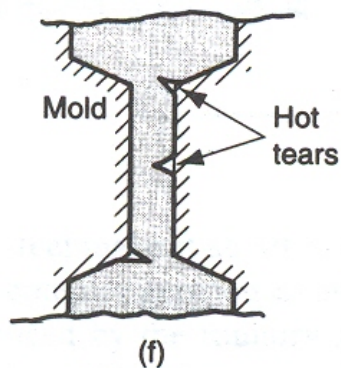
Casting Defects



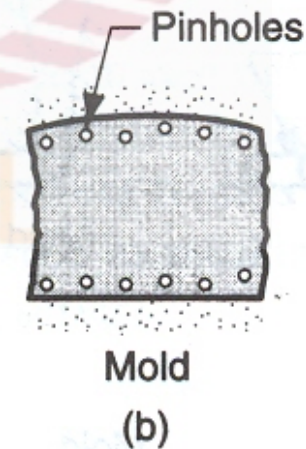
Shrinkage cavity is an internal void in the casting caused by solidification shrinkage that restricts the amount of molten metal available in the last region to freeze.



Small voids distributed throughout the casting caused by localised solidification shrinkage are known as microporosity. Usually happens in alloys.



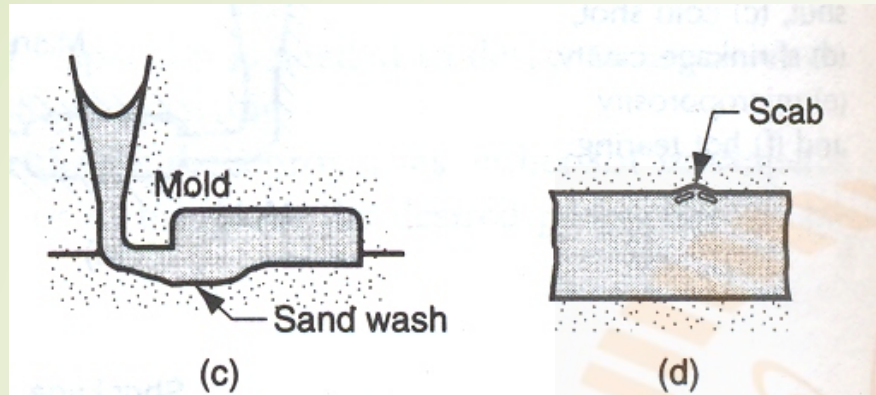
Hot tears happen when the casting is restrained from contraction by an unyielding mould.



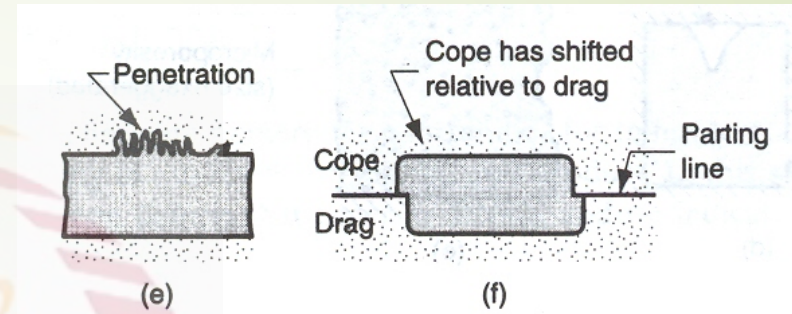
Pinholes are similar to sand blow involving the formation of many small gas cavities.

Casting Defects

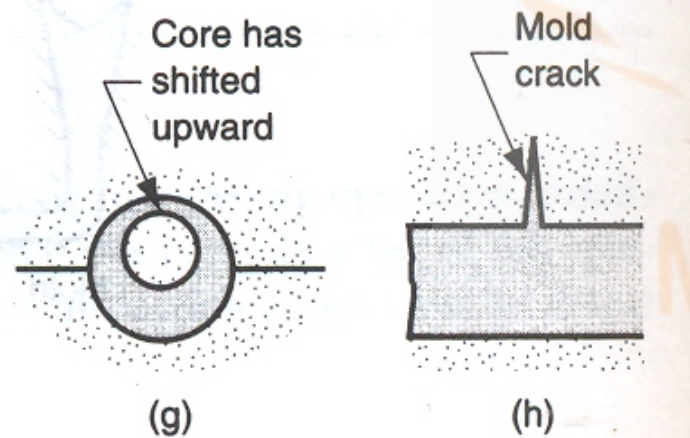
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Sand wash is the result of erosion of the sand mould during pouring. **Scab** is caused by portions of the mould surface flaking off during solidification and getting embedded in the casting surface.



Liquid Metal with high fluidity penetrates into the sand mould and after freezing the surface of the casting consists of a mixture of sand grains and metal known as **penetration**.



Mould with insufficient strength may **crack**, into which liquid metal can seep to form a fin.

Product Design Considerations in Casting

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- **Geometric simplicity:** Although casting is a process that can be used to produce complex part geometries, simplifying the part design will improve its castability. Avoiding unnecessary complexities simplifies mold making, reduces the need for cores, and improves the strength of the casting.
- **Corners:** Sharp corners and angles should be avoided, because they are sources of stress concentrations and may cause hot tearing and cracks in the casting. Generous fillets should be designed on inside corners, and sharp edges should be blended.

Product Design Considerations in Casting

- ➡ **Draft:** Part sections that project into the mold should have a draft or taper. In expendable-mold casting, the purpose of this draft is to facilitate removal of the pattern from the mold. In permanent-mold casting, its purpose is to aid in removal of the part from the mold. Similar tapers should be allowed if solid cores are used in the casting process. The required draft need only be about 1° for sand casting and 2° to 3° for permanent-mold processes.

Product Design Considerations in Casting

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- **Section thicknesses:** Section thicknesses should be uniform in order to avoid shrinkage cavities. Thicker sections create hot spots in the casting, because greater volume requires more time for solidification and cooling. These are likely locations of shrinkage cavities.

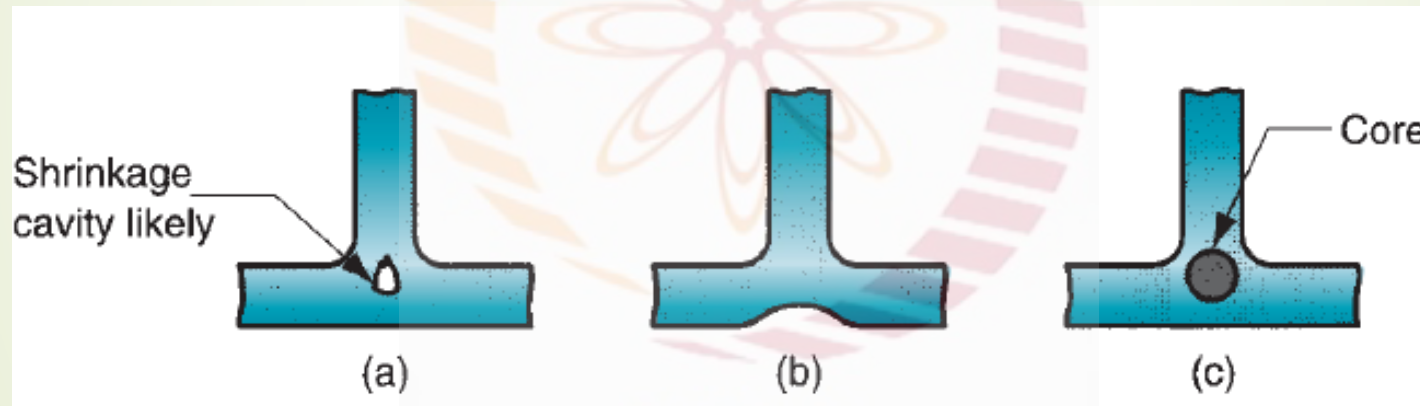


FIGURE (a) Thick section at intersection can result in a shrinkage cavity. Remedies include (b) redesign to reduce thickness and (c) use of a core.

Product Design Considerations in Casting

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- **Use of cores:** Minor changes in part design can reduce the need for coring

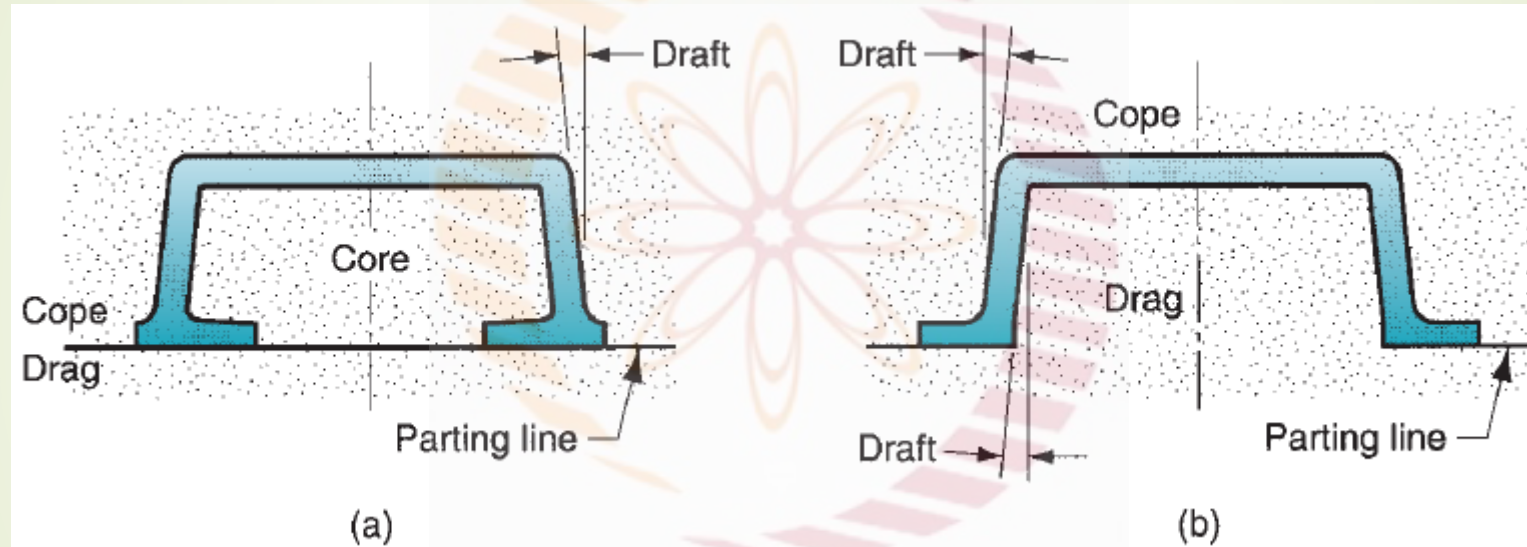


FIGURE Design change to eliminate the need for using a core: (a) original design and (b) redesign.

Product Design Considerations in Casting

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- **Dimensional Tolerances:** There are significant differences in the dimensional accuracies that can be achieved in castings, depending on which process is used. Table 11.2 provides a compilation of typical part tolerances for various casting processes and metals.
- **Surface Finish:** Typical surface roughness achieved in sand casting is around $6\text{ }\mu\text{m}$. Similarly, poor finishes are obtained in shell molding, while plaster-mold and investment casting produce much better roughness values: $0.75\text{ }\mu\text{m}$. Among the permanent-mold processes, die casting is noted for good surface finishes at around $1\text{ }\mu\text{m}$.

Product Design Considerations in Casting

- **Machining allowances:** Tolerances achievable in many casting processes are insufficient to meet functional needs in many applications. Sand casting is the most prominent example of this deficiency. In these cases, portions of the casting must be machined to the required dimensions. Almost all sand castings must be machined to some extent in order for the part to be made functional. Therefore, additional material, called the machining allowance, is left on the casting for machining those surfaces where necessary. Typical machining allowances for sand castings range between 1.5 mm and 3 mm

**Thank you for your
attention**

