UNIT I

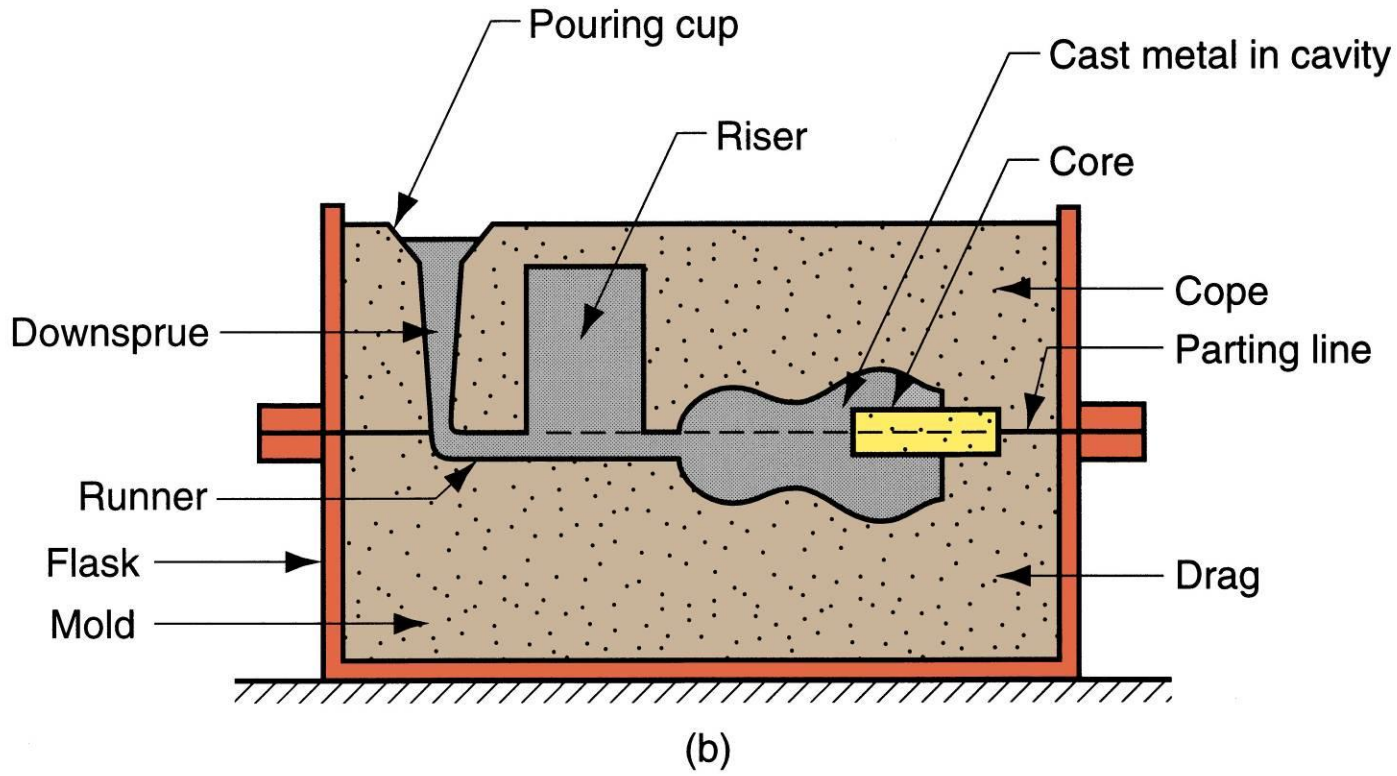
Metal Casting Processes

Metal Casting Processes

Two Categories of Casting Processes

1. **Expendable mold processes** – uses an expendable mold which must be destroyed to remove casting
   - **Mold materials**: sand, plaster, and similar materials, plus binders
2. **Permanent mold processes** – uses a permanent mold which can be used over and over to produce many castings
   - Made of metal (or, less commonly, a ceramic refractory material)

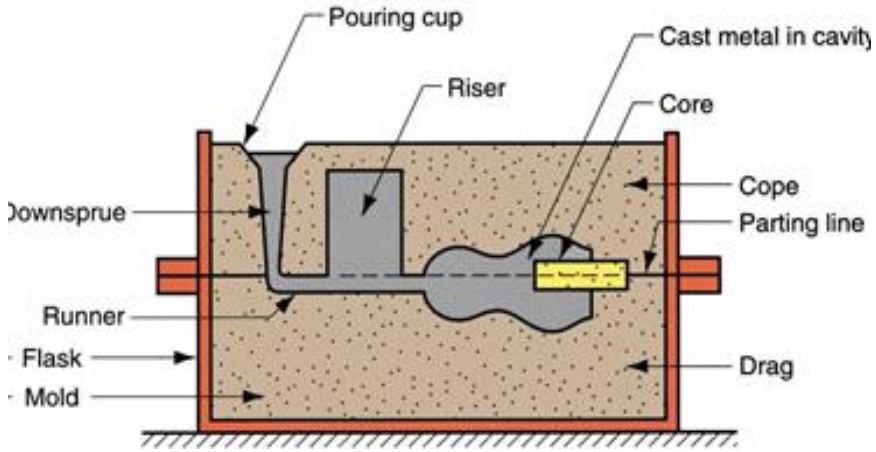
Sand Casting Mold



Sand casting mold.

Sand Casting Mold Terms

- Mold consists of two halves:
  - ***Cope*** = upper half of mold
  - ***Drag*** = bottom half
- Mold halves are contained in a box, called a ***flask***
- The two halves separate at the ***parting line***



Forming the Mold Cavity

- ***Cavity*** *is inverse of final shape with shrinkage allowance*

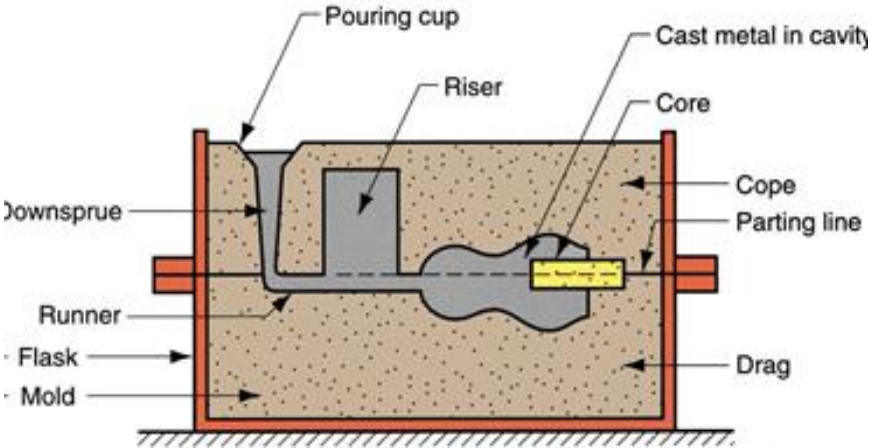
  Pattern *is model of final shape with shrinkage allowance*

  Wet sand *is made by adding binder in the sand*

  – Mold cavity is formed by packing sand around a ***pattern***

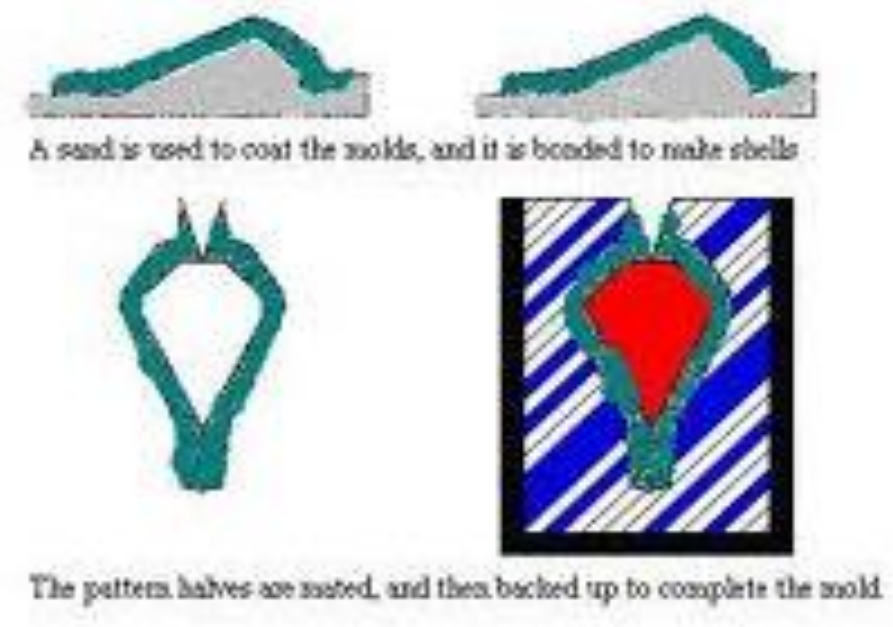
  When the ***pattern*** is removed, the remaining cavity of the packed sand has desired shape of cast part

  – The pattern is usually oversized to allow for shrinkage of metal during solidification and cooling



Use of a Core in the Mold Cavity

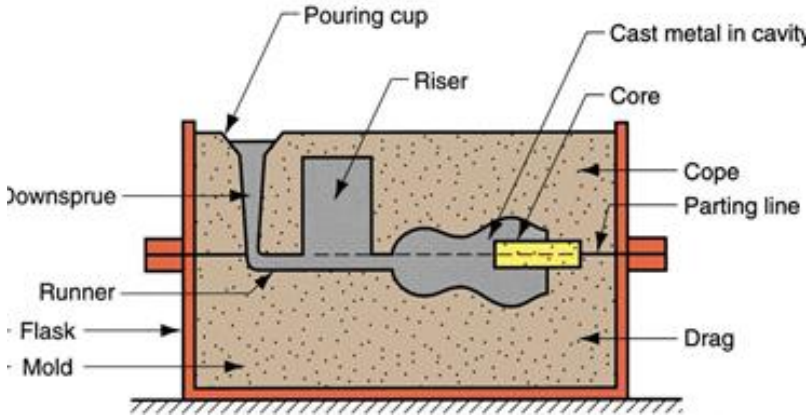
- **Cavity** provides the *external features* of the cast part
- ***Core* provides *internal features* of the part.** ***It is*** placed inside the mold cavity with some support.
- In sand casting, cores are generally *made of sand*

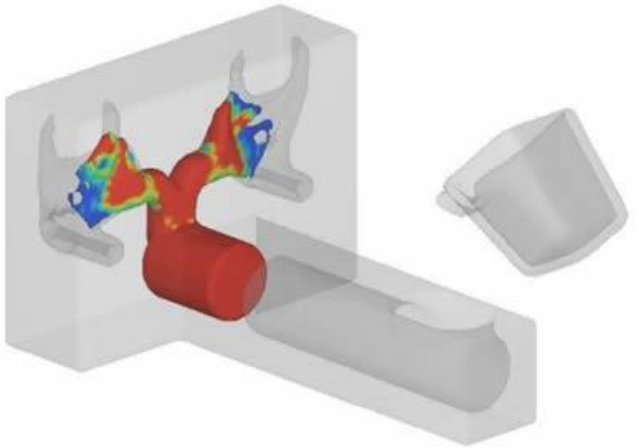


Gating System

It is channel through which molten metal flows into cavity from outside of mold

- Consists of a ***down-sprue***, through which metal enters a ***runner*** leading to the main cavity
- At the top of down-sprue, a ***pouring cup*** is often used to minimize splash and turbulence as the metal flows into down-sprue

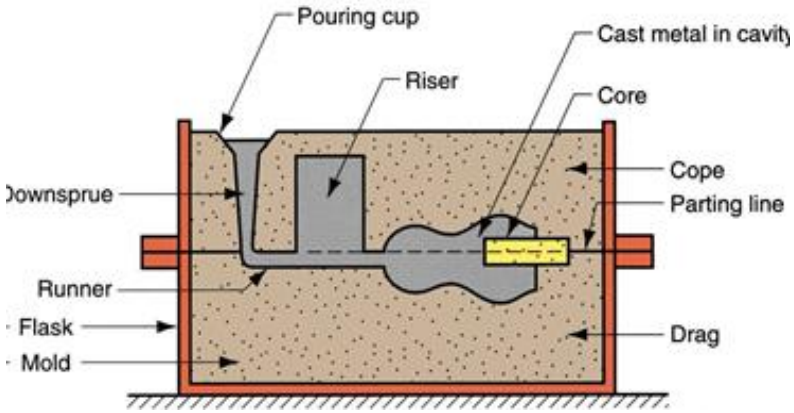




Riser

It is a reservoir in the mold which is a source of liquid metal to compensate for shrinkage of the part during solidification

Most metals are less dense as a liquid than as a solid so castings shrink upon cooling, which can leave a void at the last point to solidify. Risers prevent this by providing molten metal to the casting as it solidifies, so that the cavity forms in the riser and not in the casting

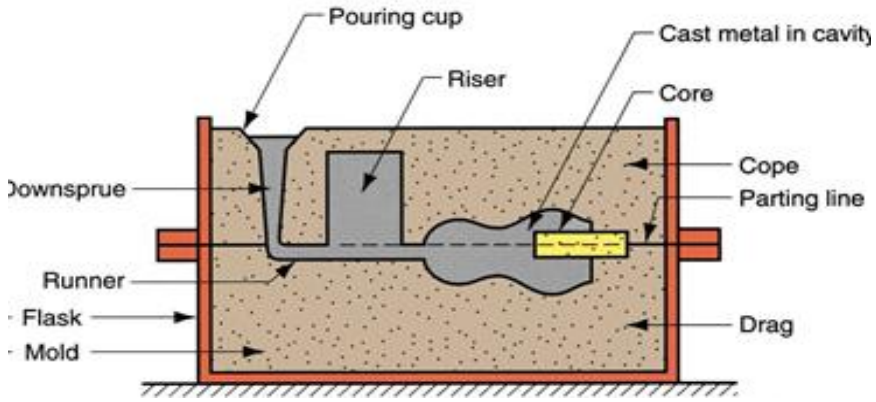


Heating the Metal

- Heating furnaces are used to heat the metal to molten temperature sufficient for casting
- The heat required is the sum of:
  1. Heat to raise temperature to melting point
  2. Heat to raise molten metal to desired temperature for pouring

Pouring the Molten Metal

- For this step to be successful, metal must flow into all regions of the mold, most importantly the main cavity, before solidifying
- Factors that determine success
  - Pouring temperature
  - Pouring rate
  - Turbulence
- **Pouring temperature** should be sufficiently high in order to prevent the molten metal to start solidifying on its way to the cavity



Pouring the Molten Metal

Pouring rate should neither be high (may stuck the runner – should match viscosity of the metal) nor very low that may start solidifying on its way to the cavity

Turbulence should be kept to a minimum in order to ensure smooth flow and to avoid mold damage and entrapment of foreign materials. Also, turbulence causes oxidation at the inner surface of cavity. This results in cavity damage and poor surface quality of casting.

Fluidity

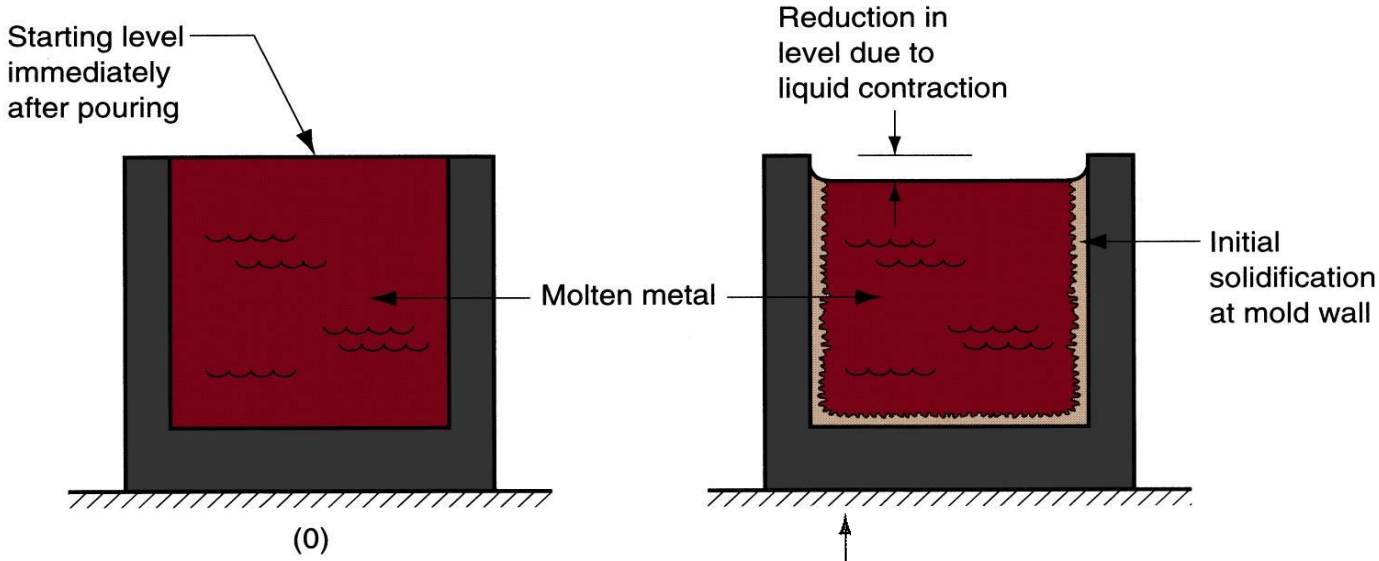
A measure of the capability of the metal to flow into and fill the mold before freezing.

- Fluidity is the inverse of viscosity (resistance to flow)

Factors affecting fluidity are:

- Pouring temperature relative to melting point
- Metal composition
- Viscosity of the liquid metal
- Heat transfer to surrounding

Shrinkage in Solidification and Cooling



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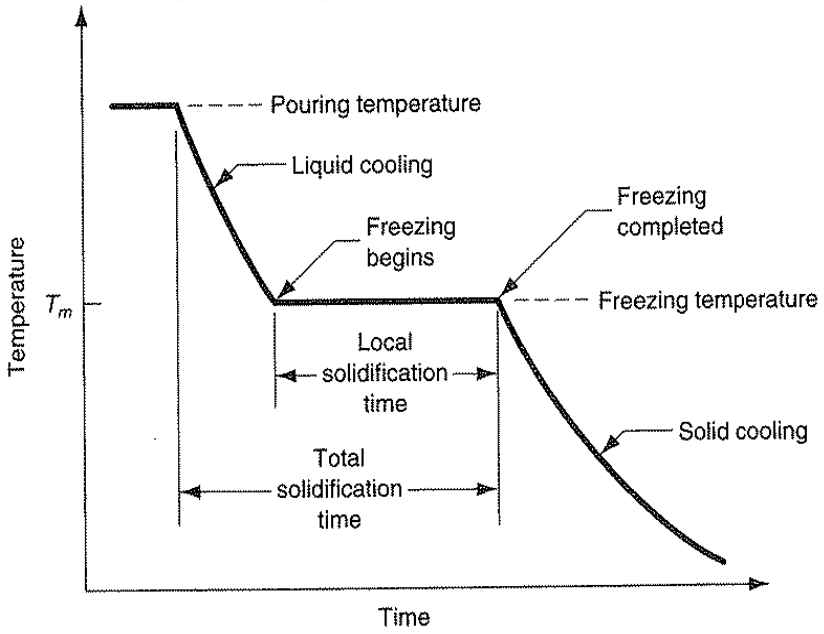
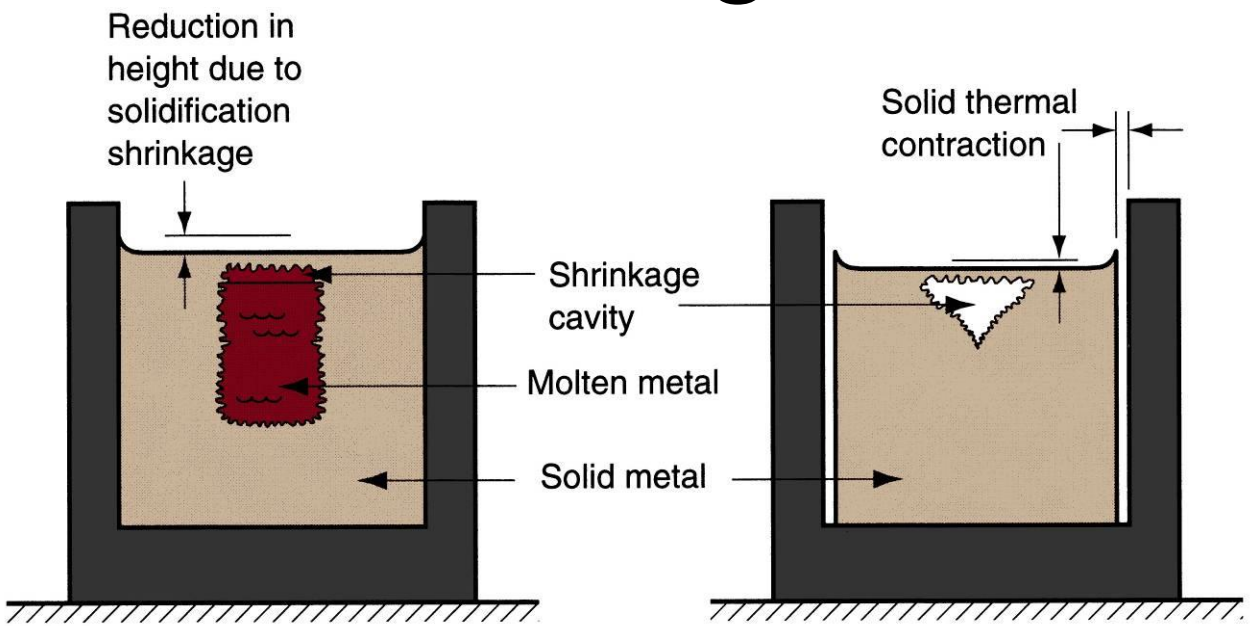
wh... form (liquid contraction); **b.** during phase transformation from liquid to solid (solidification shrinkage); **c.** while solidified metal is cooled down to room temperature (solid thermal contraction).



Shrinkage in Solidification and Cooling



(2) red (2) (3) sed by solidification shrinkage; (3) further reduction in height and diameter due to thermal contraction during cooling of solid metal (dimensional reductions are exaggerated for clarity).

References

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Thank you