Foundries

Overview

- EU foundry industry facts
- The foundry process
  A. Melting
  B. Moulding
  C. Casting

EU foundry industry facts

- 3rd largest in the world for ferrous casting and 2nd largest for non-ferrous.
- In 2005, 11,7 million tonnes of ferrous.
- Germany, France and Italy: top producers.
- Predominantly still an SME industry, 80% of companies employing <250 people.
- Serves automotive (50%), general engineering (30%) and construction (10%) sectors.

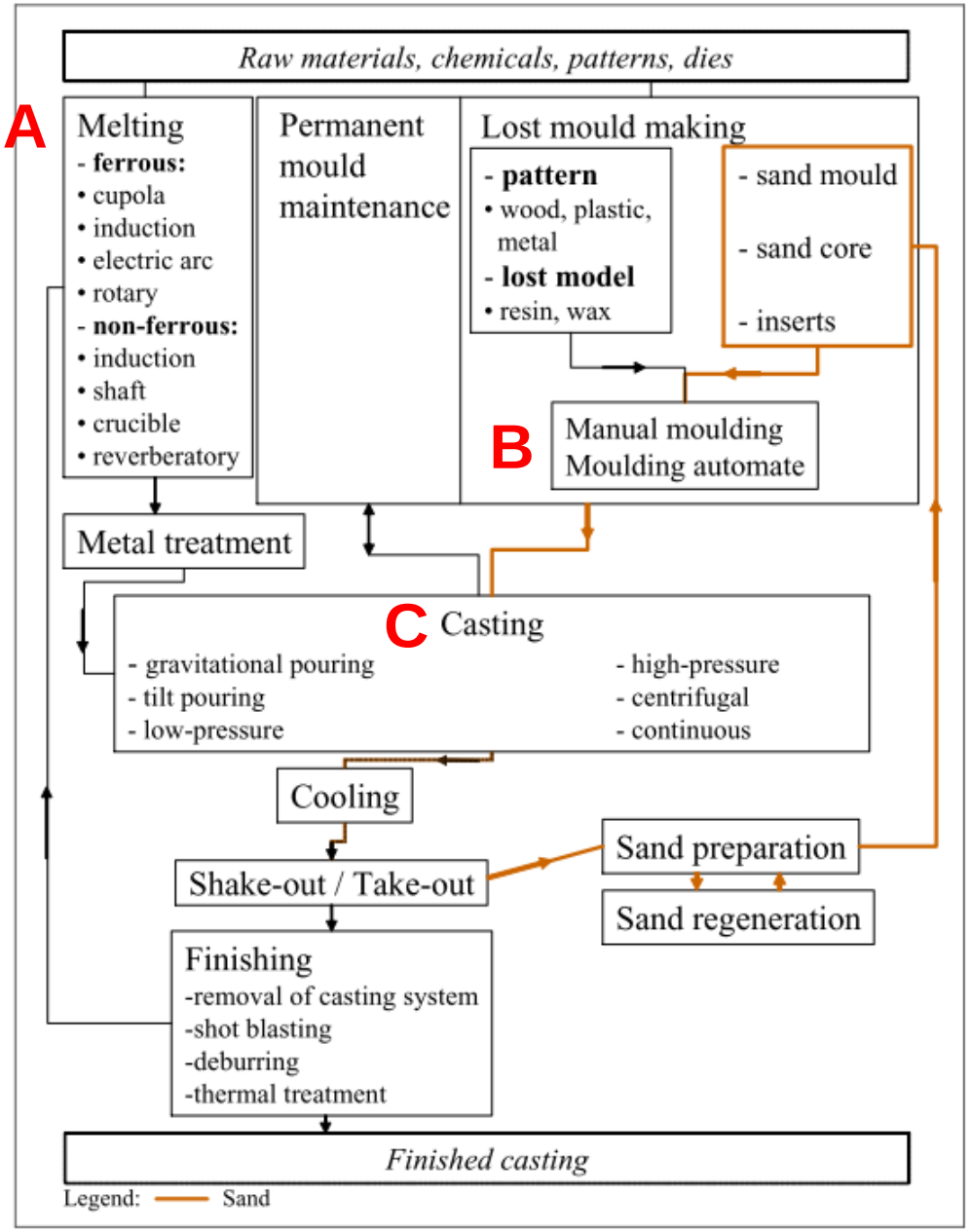
Source: European Commission, 2005, Reference document on Best Available Techniques in the Smitheries and Foundries Industry, p.ii

Foundries

Foundries melt ferrous and non-ferrous metals and alloys and reshape them into products at or near their finished shape through the pouring and solidification of the molten metal or alloy into a mould.

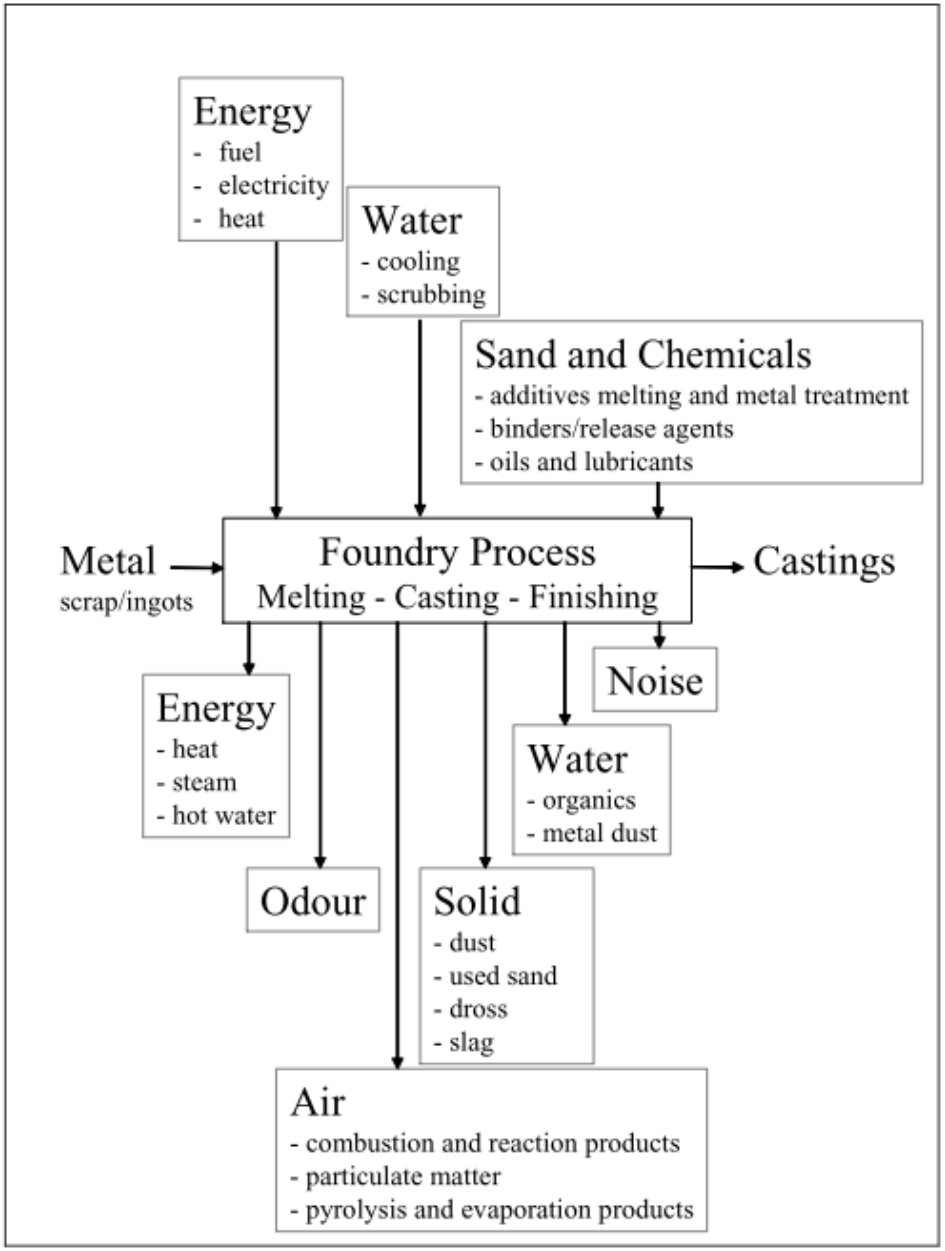
Source: *Ivi*, ii

The foundry process



Source: *Ivi*, p. 13

Mass stream overview of the foundry process



Source: *Ivi*, p. 97

A) Melting and metal treatment

- Different melting and metal treatment for each material
- For instance, for steel:

	Cupola	Electric arc	Channel induction	Coreless induction	Rotary	Hearth type	Shaft	Crucible/ Ladle
Iron	m	m*	h	m, h	m*	m		h
Steel		m		m				h
Aluminium			m, h	m, h	m	m	m	m, h
Magnesium								m, h
Copper			h	m, h		m		m, h
Lead				m, h				m, h
Zinc				m, h				m, h
* Less common								

Applicability of furnace types, for melting (m) and holding (h)

Source: *Ivi*, p. 28

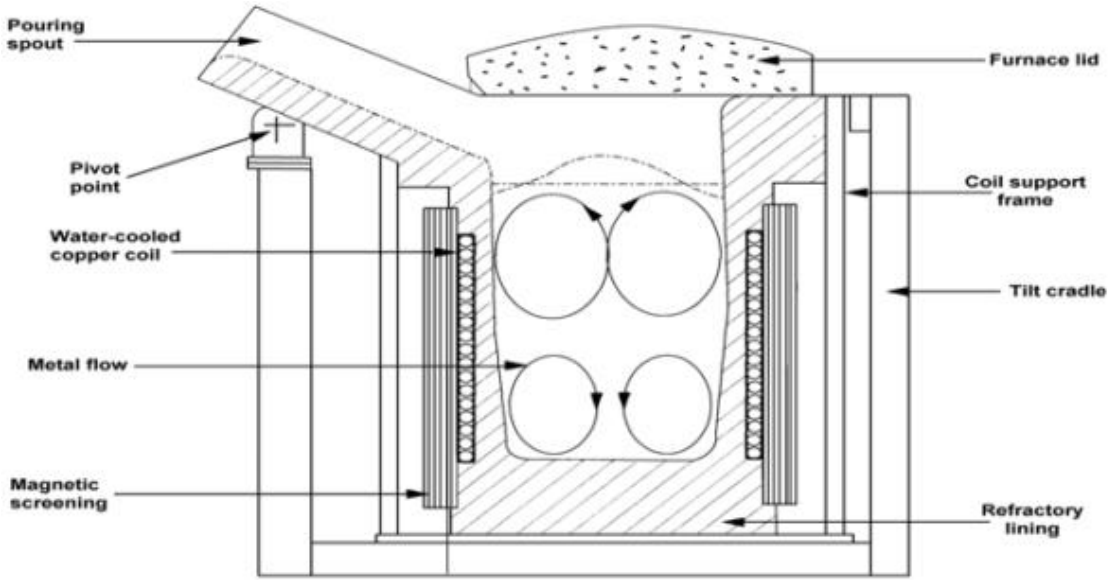
Electric arc furnace (EAF)

- It is a batch-melting furnace consisiting of a large bowl-shaped refractory lined body with a dish-shaped hearth.
- It is covered by a refractory roof, which has ports for three graphite electrodes.
- Typically the shell diameter is 2 to 4 m.
- Most furnaces use roof charging.
- Capacities from 2 to 50 tonnes.
- Low refining abilities if acidic lined EAF, high if basic lined.

Source: *Ivi*, p.34; HUT, 2003

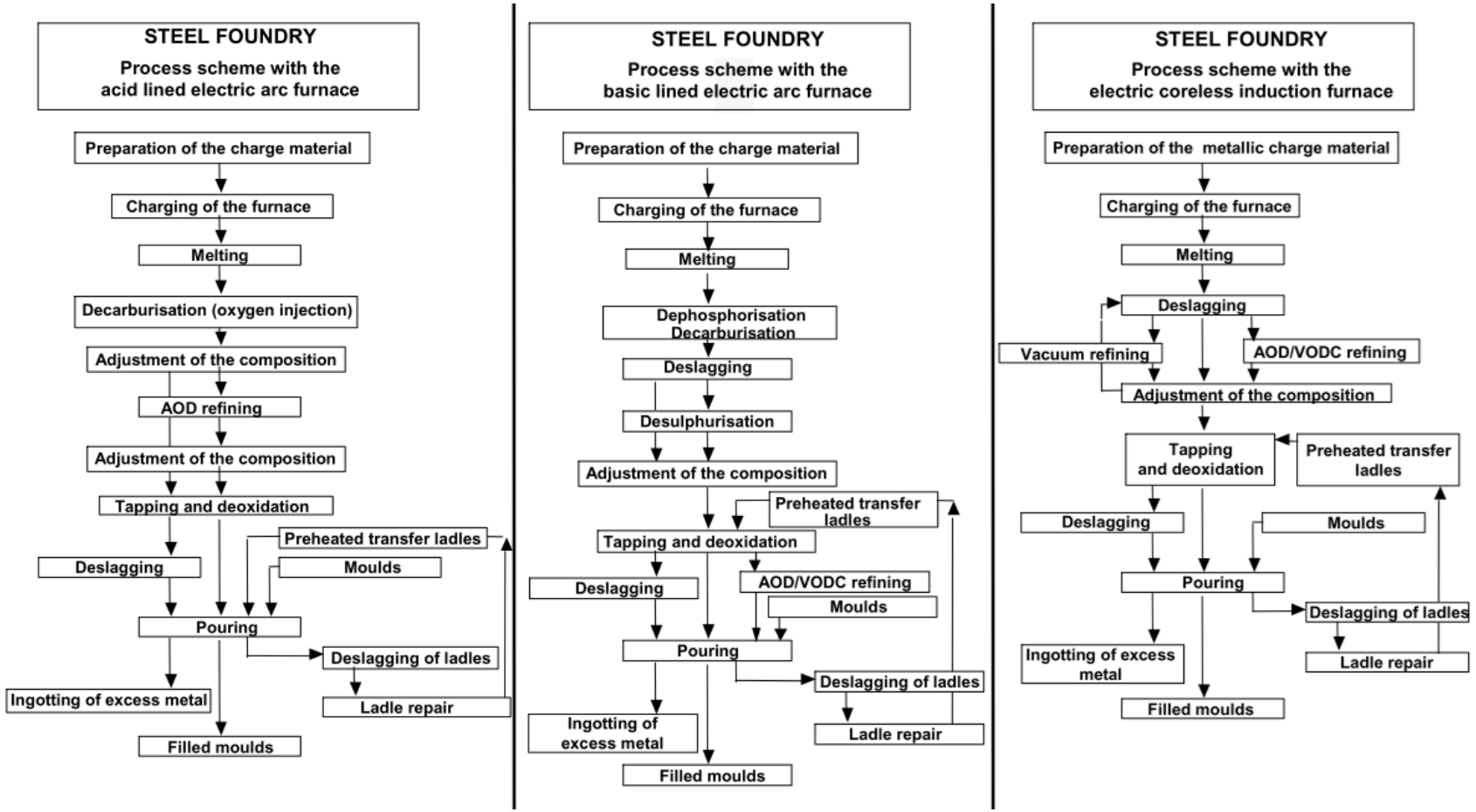
Coreless induction furnace

- It is a batch-melting furnace containing a water-cooled copper coil, the inside of which is internally refractory lined.
- It is charged by a lifting magnet, bucket skips, a vibrating conveyor or manually.
- Furnace capacities range from 10 kg up to 30 tonnes.



Source: European Commission, 2005, Reference document on Best Available Techniques in the Smitheries and Foundries Industry, p.37

Process Flow diagrams for the melting and metal treatment of steel



Source: *Ivi*, p. 18

B) Moulding techniques

- The process of making a mould in which the molten metal will be poured.
- Special cares include:
  - Get dimensional precision
  - Get a smooth skin
  - Avoid casting defects, e.g. cracks, pinholes, etc.
- Types of moulds: lost and permanent, i.e. single and multi use.

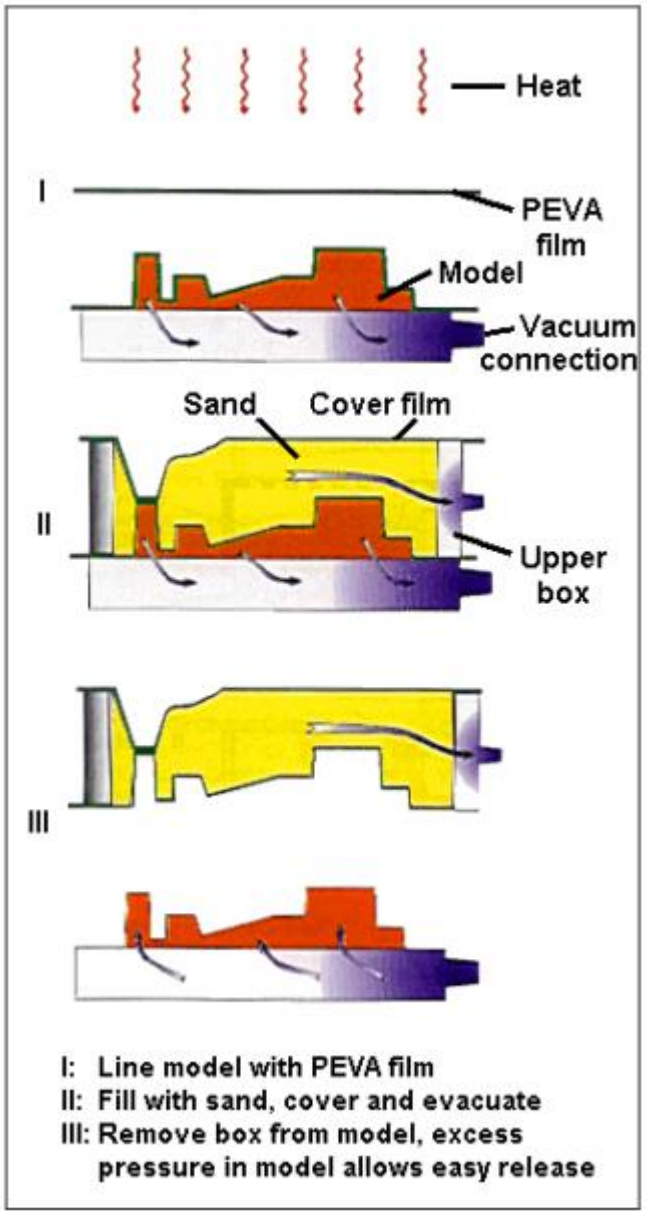
Source: *Ivi*, p. 61

Lost moulds vs Permanent m.

- Single use, i.e. destroyed after pouring.
- Generally made out of sand (different types), which can be chemically bonded, clay-bonded or unbonded.
- Multiple uses.
- Typically metallic.
- Used for gravity and low-pressure casting, pressure die-casting and centrifugal casting

Example: Vacuum moulding (sand)

- Sand moulding involves the use of large sand volumes, with sand-to-liquid-metal weight ratios generally ranging from 1:1 up to **20:1**.



Source: Hoppenstedt, 2002; European Commission, 2005, Reference document on Best Available Techniques in the Smitheries and Foundries Industry, p.ii, 64

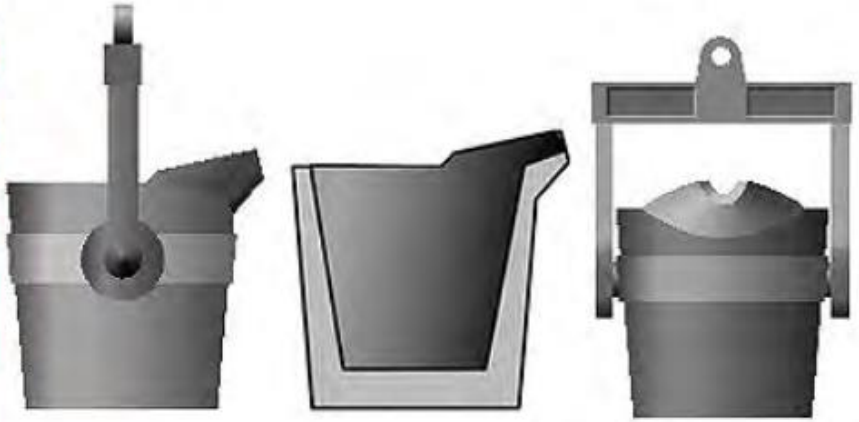
C) Casting

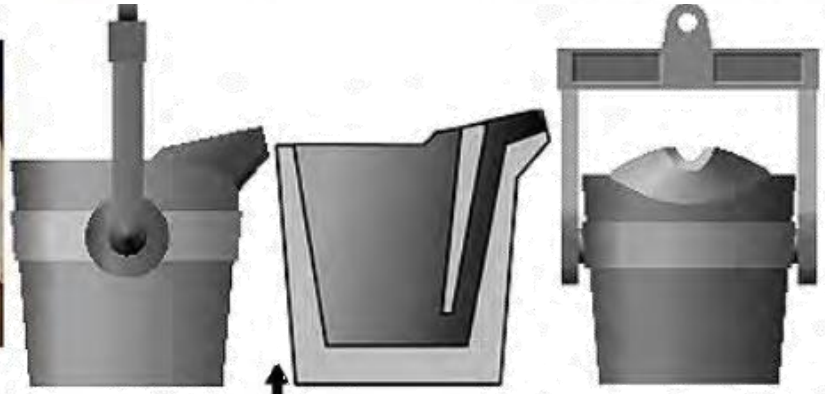
- **Pouring** is the central activity in casting production.
- The finished mould is filled with the liquid metal under the effects of gravitational or centrifugal forces or pressure.
- After pouring the casting is **cooled** to allow solidification and is then removed from the mould for further cooling and treatment.

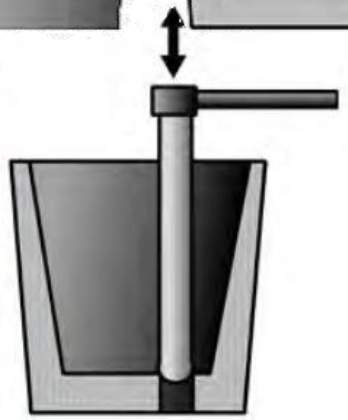
Source: European Commission, 2005, Reference document on Best Available Techniques in the Smitheries and Foundries Industry, p.79

Pouring

- Lip pour ladle for molten metal pouring.
- Teapot ladle for molten metal pouring.
- Bottom pour ladle for molten metal pouring.



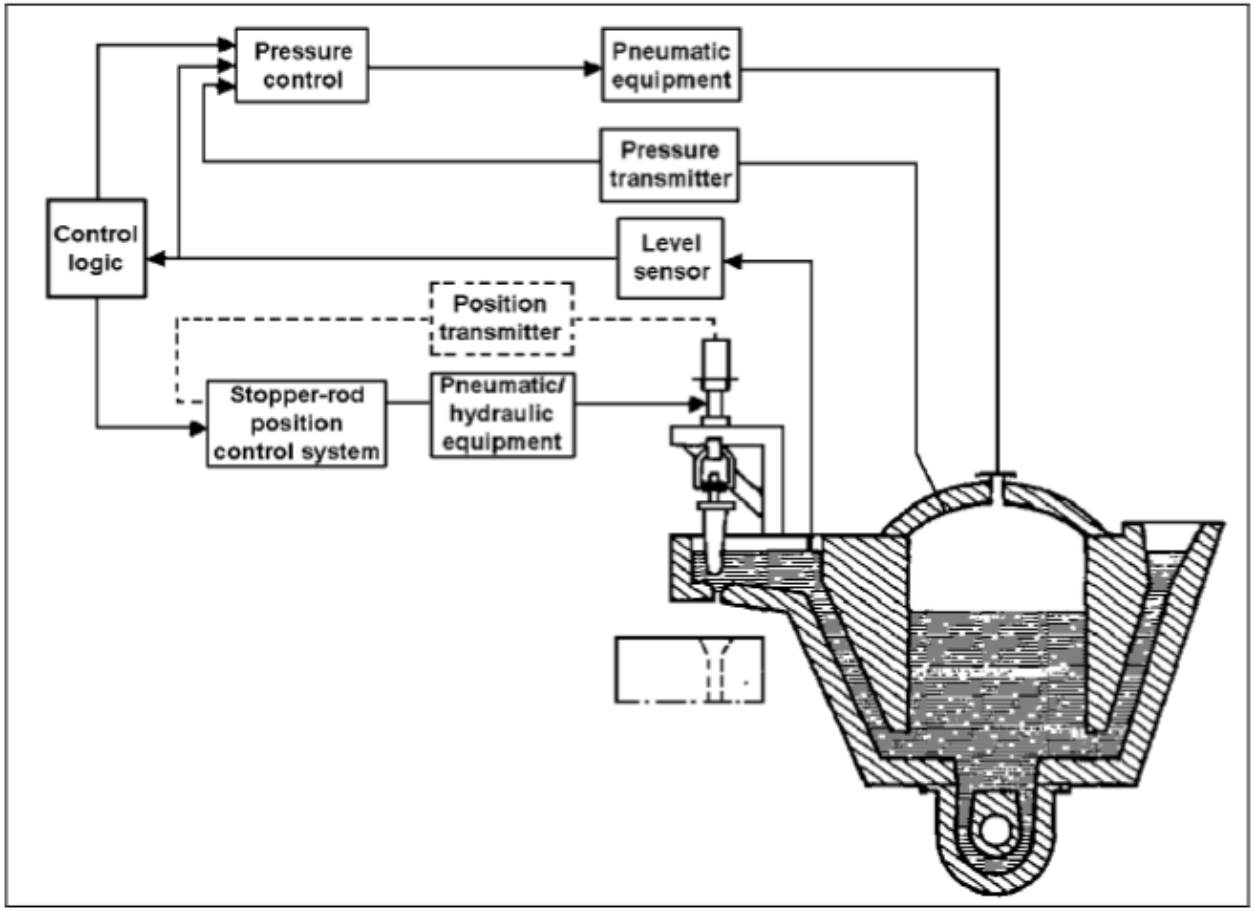




Source: HUT, 2003

Pouring

- Automatic casting lines are often equipped with a pouring furnace.
- Metal is poured during a fixed period by elevating a stopper



Solidification (1st cooling)

- The length of the cooling line determines the final temperature of the casting at the point of shake-out.
- This temperature must be low enough to provide the casting with sufficient strength during shake-out and further manipulation.
- Big moulds are not moved during cooling. The cooling time can be up to several days

Source: European Commission, 2005, Reference document on Best Available Techniques in the Smitheries and Foundries Industry, p.81