

Pattern

A pattern is the replica of final casting.

* Pattern is a mirror image of the casting, when it is used with suitable moulding material it form a cavity called a mould. When the cavity is filled by molten metal and after solidification we get the desired casting.

Pattern Material

- ① Wood [economical, easily available]
- ② Plaster of paris
- ③ Metals and Alloys
 - Cast Iron
 - Brass
 - Aluminium
- ④ Plastics
- ⑤ Wax.

Pattern Allowance

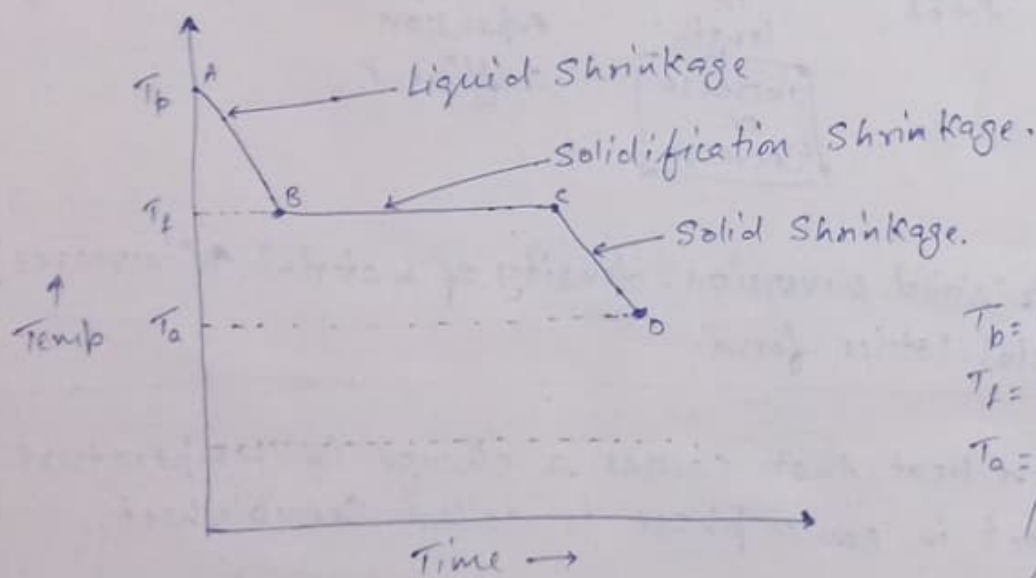
Master pattern is used for making moulds for castings. Pattern having both the shrinkage allowance and the machining allowance etc.

Types of Allowances

- (1) Shrinkage or Contraction allowance
- (2) Machining or finish allowance.
- (3) Draft or Taper.
- (4) Shake or Rapping.
- (5) Distortion or Camber.

(1) Shrinkage or Contraction Allowance.

When the liquid metal is allowed to solidify in the cavity, there is a possibility of shrinkage or contraction of the material.



T_p = Pouring temp.

T_f = freezing temp.

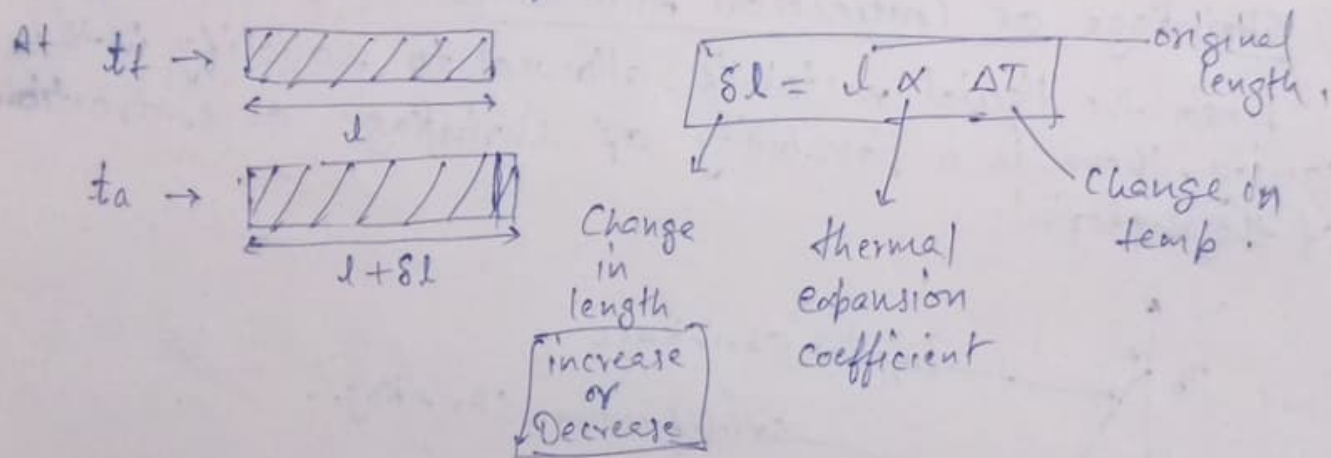
T_a = Ambient temp./
Atmospheric temp./
Normal room temp.

State	Heat transfer	Type of Shrinkage	Compensated
A-B	Sensible heat	Liquid Shrinkage	Riser
B-C	Latent heat	Solidification	Riser
C-D	Sensible heat	Solid Shrinkage	Shrinkage allowances on the pattern.

- When the liquid metal is cooled from pouring to temp. shrinkage is liquid shrinkage.
- During the phase transformation, shrinkage of the material is solidification shrinkage.
- When the solid casting is cooled from freezing to ambient temp., the shrinkage is solid shrinkage.

Liquid and solid shrinkage can be compensated by providing the riser. These values are expressed as " % of shrinkage volume of the material."

Solid Shrinkage can be compensated by providing shrinkage allowance on the pattern. These values are expressed in terms of "linear dimensions."



When liquid to solid conversion, density of material \uparrow (increases),
Perfect crystal Lattice form.

* Sensible heat \rightarrow Heat that causes a change in temperature in an object in some phase is called Sensible heat.

* Latent heat \rightarrow Heat that causes phase changes / bond formation, where temperature remain constant.

* Ambient temp \rightarrow 68 to 77 degrees Fahrenheit.

Batch Time: _____

Roll Number: _____

Date: _____

Name of Candidate: _____

Shrinkage values for different Materials

- ① Bismuth, Invar (Metal) [Nickel alloy] → Negligible or 0 mm/m.
- ② White metal [Tin based alloy] → 5 mm/m.
- ③ Cast Iron → 10 mm/m
- ④ Aluminium → 13 mm/m. [13 mm/m to 17 mm/m]
- ⑤ Copper → 16 mm/m [16 mm/m to 18 mm/m]
- ⑥ Steel → 20 mm/m
- ⑦ Brass → 23 mm/m.
- ⑧ Lead, Zinc → 24-25 mm/m.

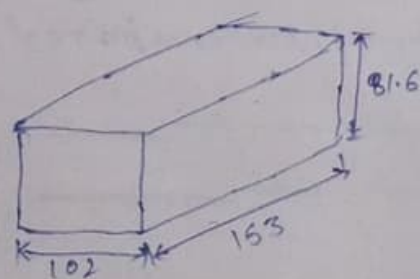
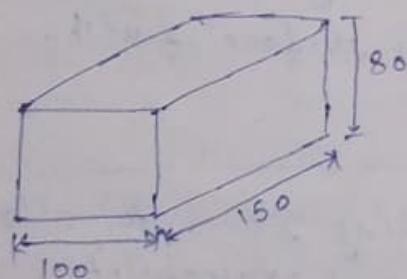
* Maximum Solid Shrinkage } lead or Zinc.
Biggest pattern

* Maximum Liquid + Solidification Shrinkage → Aluminium (Al)
It requires large sized risers to compensate shrink volume

* Maximum total Shrinkage → Steel.

Example

Design a pattern for a casting by considering shrinkage allowances if it is produced by steel.



Steel

Shrinkage Allowances → 20 mm/m

means

1000 → 20 mm.

Length 150 → 3

breadth 100 → 2

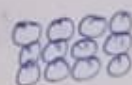
Depth 80 → 1.6

In case of Grey Cast Iron, due to conversion of Carbon into graphite flakes, there is a possibility of expansion of the material. So, there is no need of riser in case of C.I.

In solid state there is a possibility of contraction of material. To overcome this size of the pattern can be increased by providing Shrinkage allowance.

② Machining or Finishing Allowance :

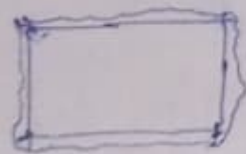
Casting objects are not having smooth surface finish. To get better surface finish, machining is required. Due to machining, size of the casting will be decreased. To overcome this size of pattern can be increased by providing machining allowances.



Uniform grain structure

↓
More permeability

↓
Rough Surface finish.



Non-uniform grain structure

↓
Less permeability

↓
Better surface finish..

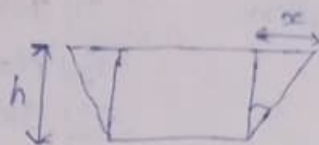
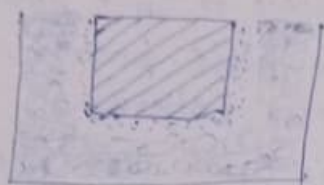
* Permeability : Ability of the moulding sand to allow the gases to escape, is known as permeability.

Uniform grains have more permeability when compared to non-uniform grains.

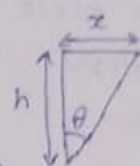
Draft or Taper Allowances:

Provided For easy removal of the pattern from the mould.

or
to minimize the continuous contact b/w pattern & mould surface for the vertical surface of the pattern,



$$\left[\theta \approx \frac{1}{2} - 2^\circ \right]$$

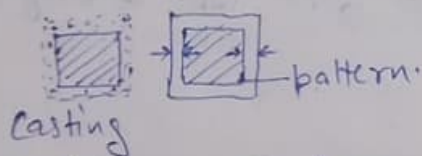


$$\tan \theta = \frac{x}{h}$$

$$x = h \tan \theta$$

(4) Shake allowance:

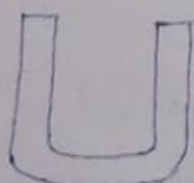
Moulding sand will stick to the pattern surface during ramming. For easy removal of the pattern, some clearance is required b/w pattern & mould surface. This can be produced by shake of the pattern. Due to shaking, size of the cavity will be increased. To overcome this, size of the pattern can be reduced by providing shake allowance. It is negative allowance provided on the pattern.



(5) Distortion or Camber allowances:

If the shape of the casting changes that is called distortion of the casting. A casting will distort or warp, if irregular shape. All parts do not shrink uniformly.

Distortion can be practically eliminated by providing cam allowances and constructing the pattern initially distorted.



Required Shape of Casting.



Distorted Casting without allowances



Cambered pattern [allowance provided]

