Casting

Metal casting process

- **Primary manufacturing process (used to convert a raw material to a primary shaped and sized product).**
- **Raw material is liquefied in a furnace.**
- **Liquefied metal is poured in a mould cavity.**
- **Liquid metal is solidified in the mould cavity.**
- **Product is taken out from the mould cavity.**

Steps of product manufacturing by casting:

1. **Pattern and mould preparation**
2. **Melting and pouring**
3. **Solidification and further cooling to room temperature**
4. **Inspection for defects**

Metal casting process

Advantages of casting:

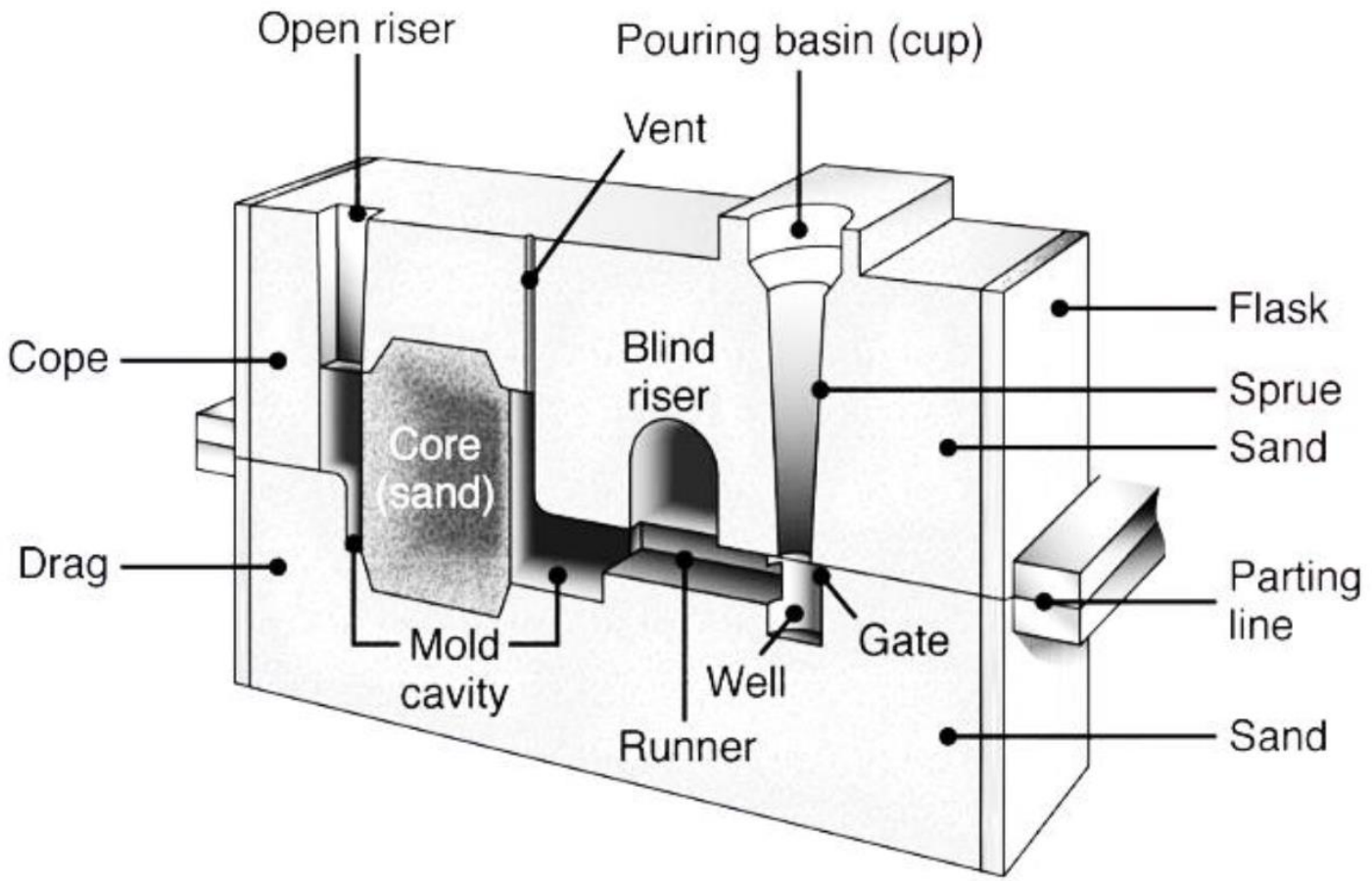
1. Intricate shapes can be manufactured
2. Vast types of materials can be cast
3. Tools are simple and cheap
4. Uniform properties in all directions
5. Size range of products is large

Disadvantages of casting:

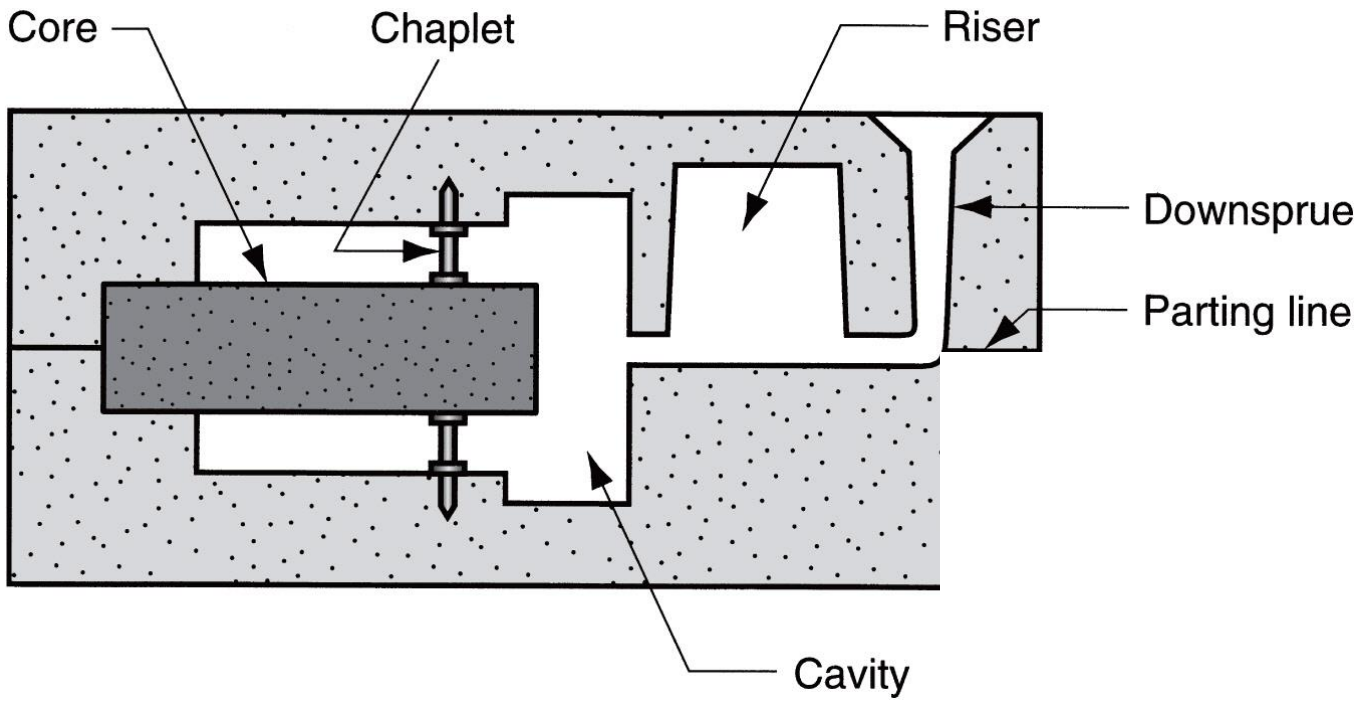
1. Poor dimensional accuracy and surface finish
2. Labour intensive process
3. Some casting defects are unavoidable

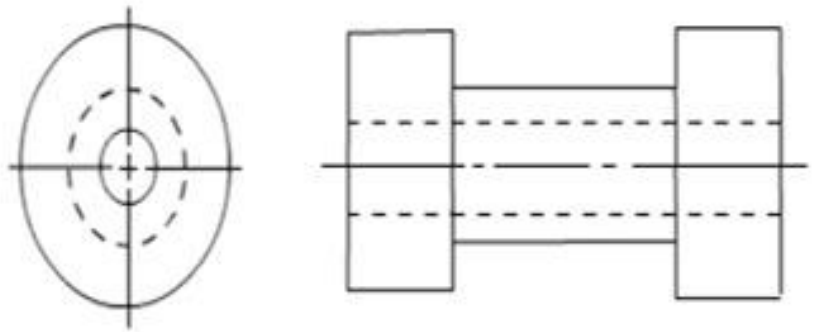
Metal casting process

Sand casting mould:

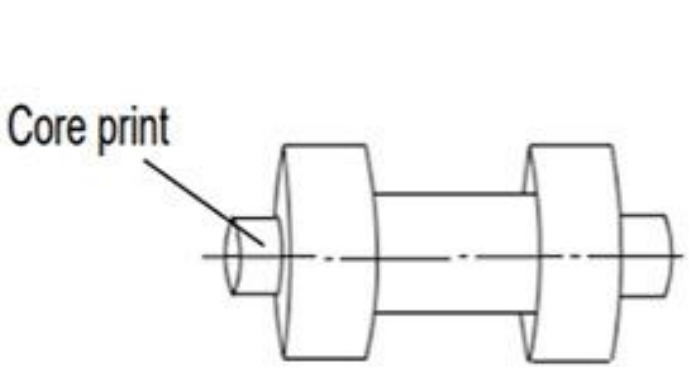


1. Moulding flask
2. Pattern
3. Parting line
4. Bottom board
5. Facing sand
6. Moulding sand
7. Backing sand
8. Core
9. Core Print
10. Pouring Basin
11. Sprue
12. Runner
13. Gate
14. Riser
15. Chill
16. Chaplet

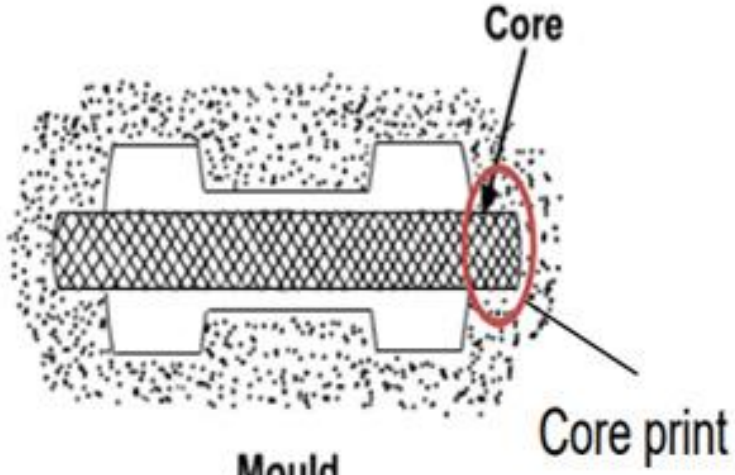




JOB



Pattern



Mould

Patterns

Pattern is the replica of the product with certain modifications.

Main modifications to the product for the development of pattern:

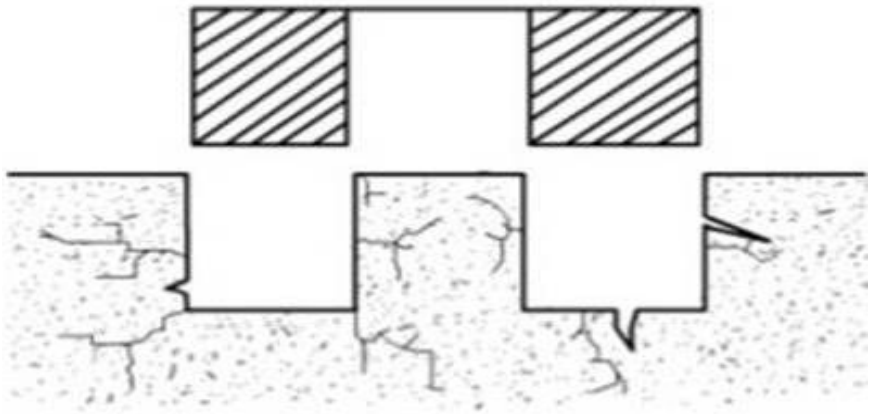
1. Addition of pattern allowances
2. Provision of core prints
3. Elimination of fine details

Pattern Allowances

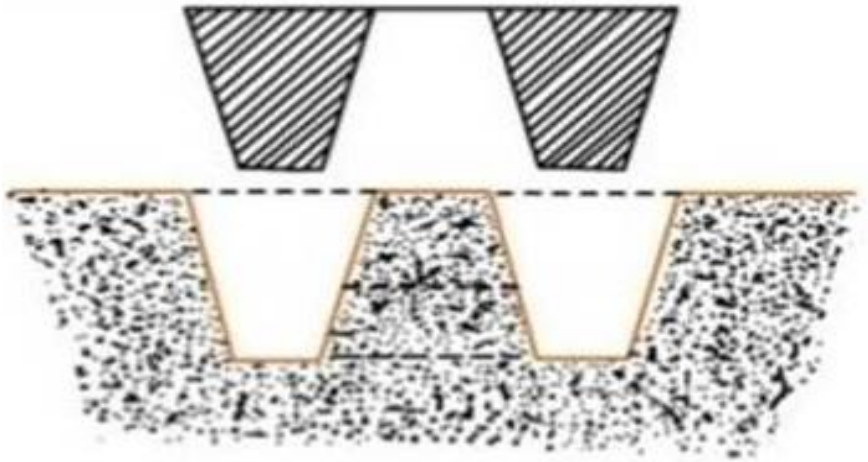
1. Shrinkage allowance
2. Finish/machining allowance
3. Draft allowance
4. Shake allowance
5. Distortion allowance

Pattern Allowances

Draft allowance

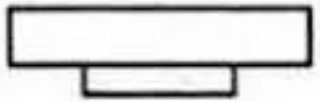


Distorted Casting



Taper Casting

Distortion allowance



Required shape

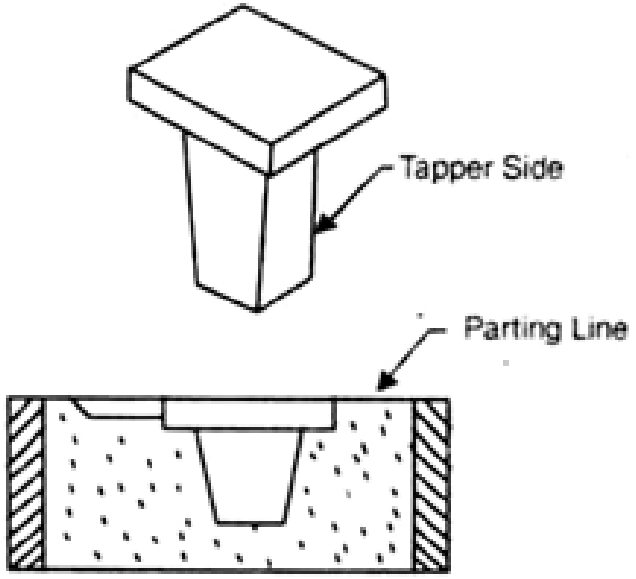
Distorted shape

Cambered pattern

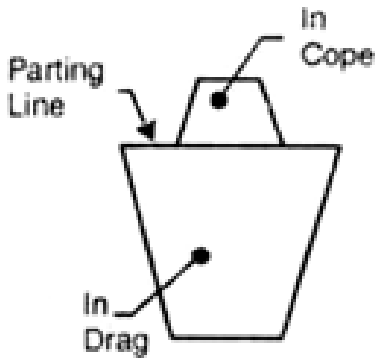
Types of Pattern

1. Single piece pattern
2. Split pattern
3. Gated pattern
4. Cope and drag pattern
5. Match plate pattern
6. Loose piece pattern
7. Follow board pattern
8. Sweep pattern
9. Skeleton pattern

Single piece/Solid pattern



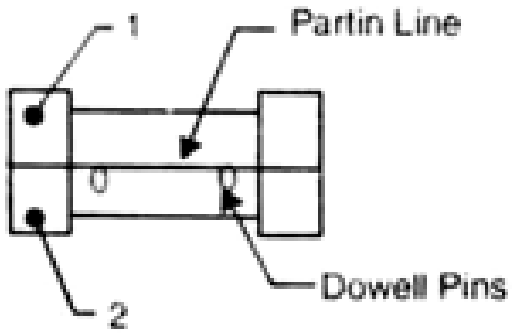
(a) Solid piece pattern.



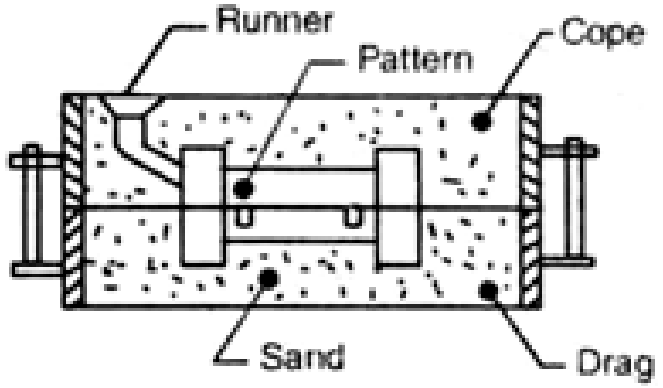
(b) Solid pattern in cope and drag.

1. Simplest pattern, made of a single piece.
2. Used for very simple jobs with no withdrawal problem.
3. In most of the cases, the pattern remains in drag.

Split/ Two piece pattern



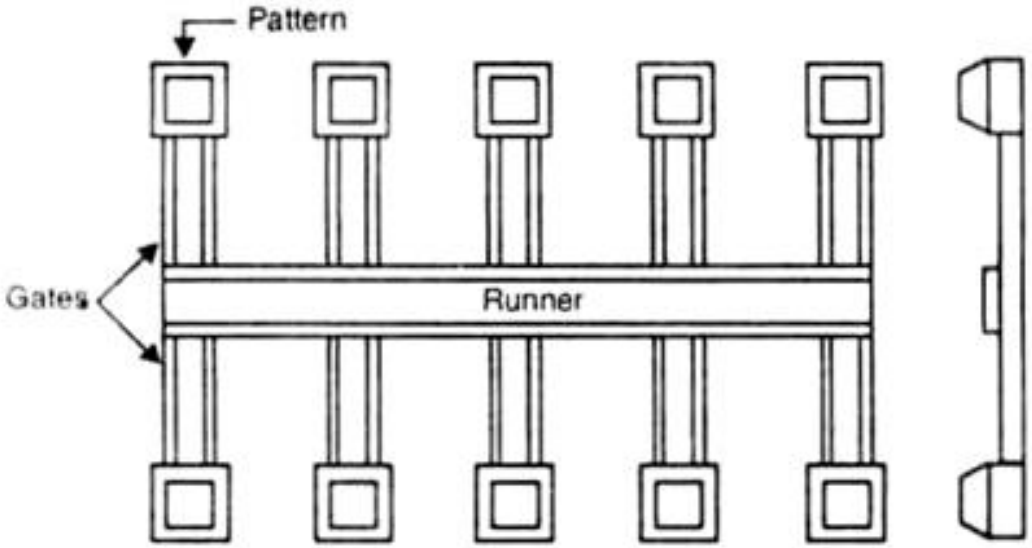
(*a*) Split pattern.



(*b*) Pattern in moulding sand.

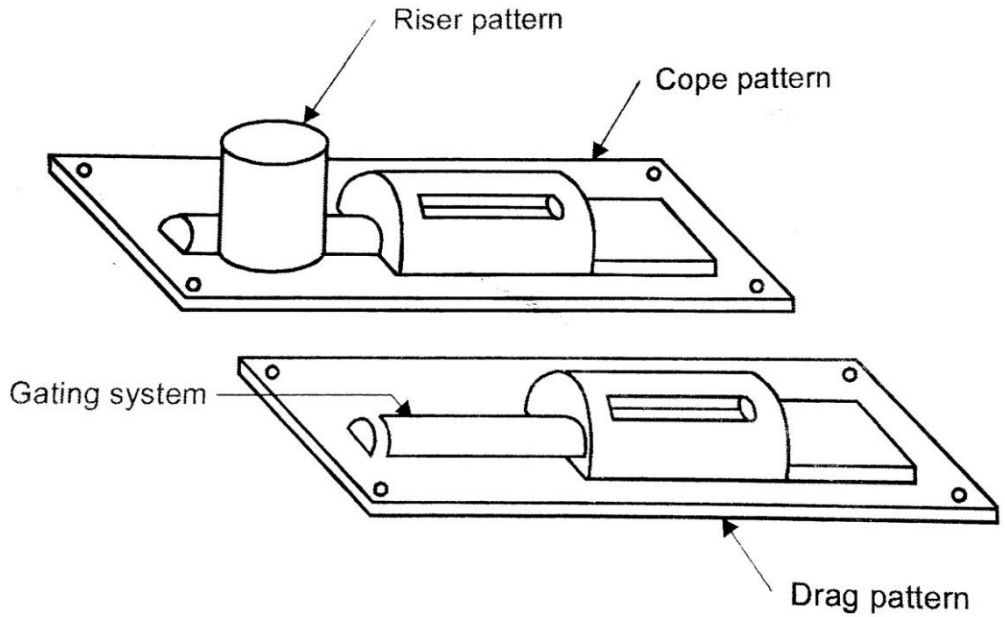
1. Most widely used pattern for intricate casting.
2. Used for patterns with withdrawal problem.
3. Pattern is split in cope and drag with proper alignment, split surface on parting plane.

Gated pattern



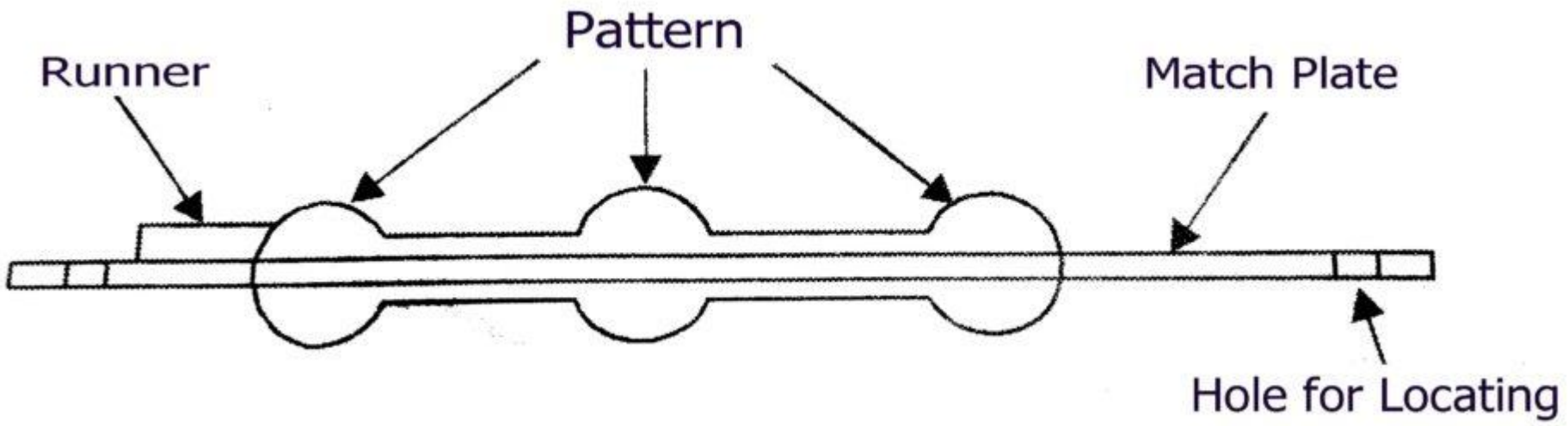
1. Gating and runner system are integral with the pattern.
2. Time needed for manual preparation of gate and runner is eliminated.
3. Used in mass-production of small size castings.

Cope and Drag pattern



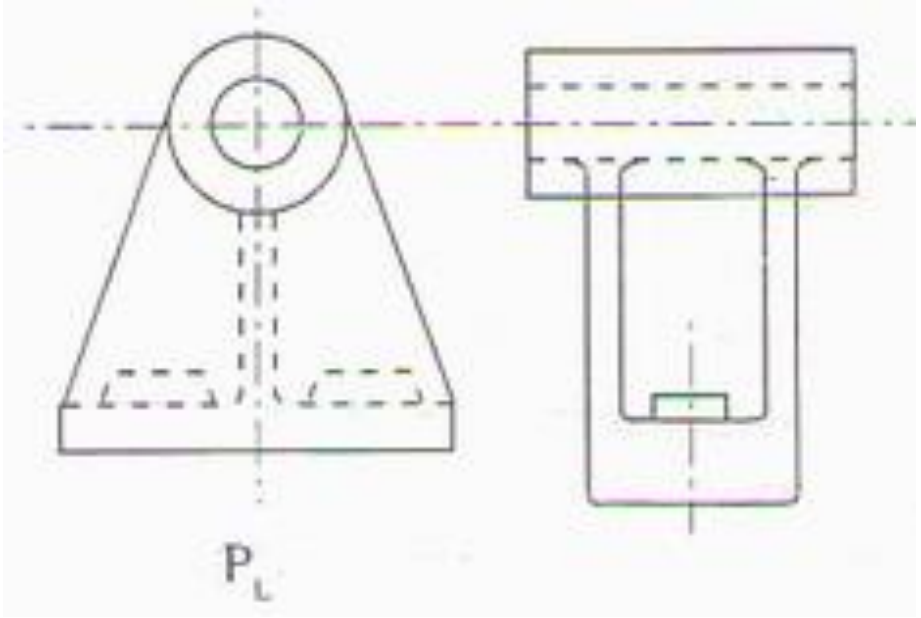
1. Cope and drag halves of the pattern along with the gating and risering systems are attached separately to metal/wooden plates with alignment pins.
2. Cope and drag moulds are prepared separately by two workers simultaneously.
3. Cope and drag moulds are assembled to get the final mould.
4. Used for heavy castings.

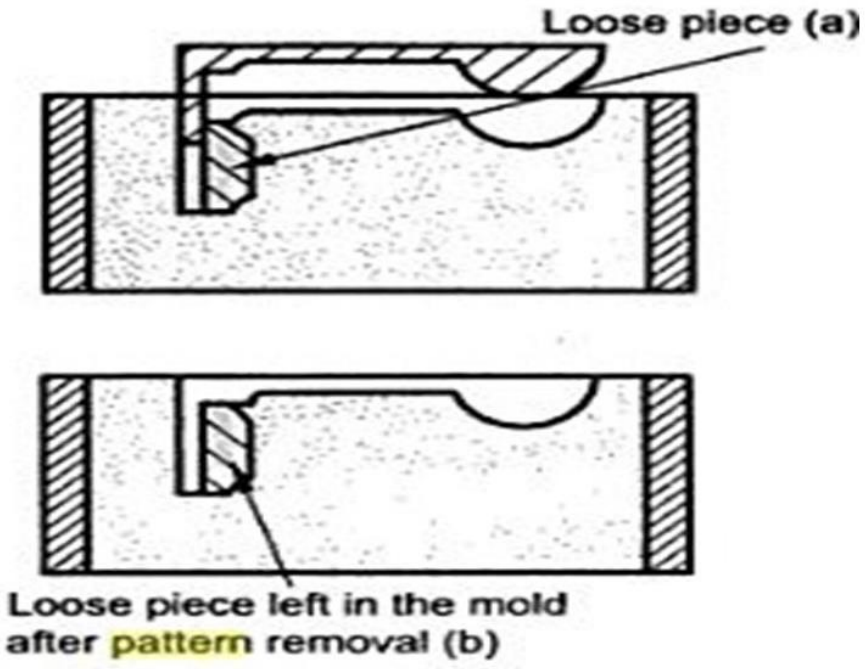
Match plate pattern



1. Cope and drag halves of the pattern along with the gating and risering systems are mounted on a single wooden/metal (mostly aluminium) plate on either sides.
2. After moulding, when the match plate is removed, a complete mould with gating is obtained.
3. Used for small castings in large quantity with high dimensional accuracy.

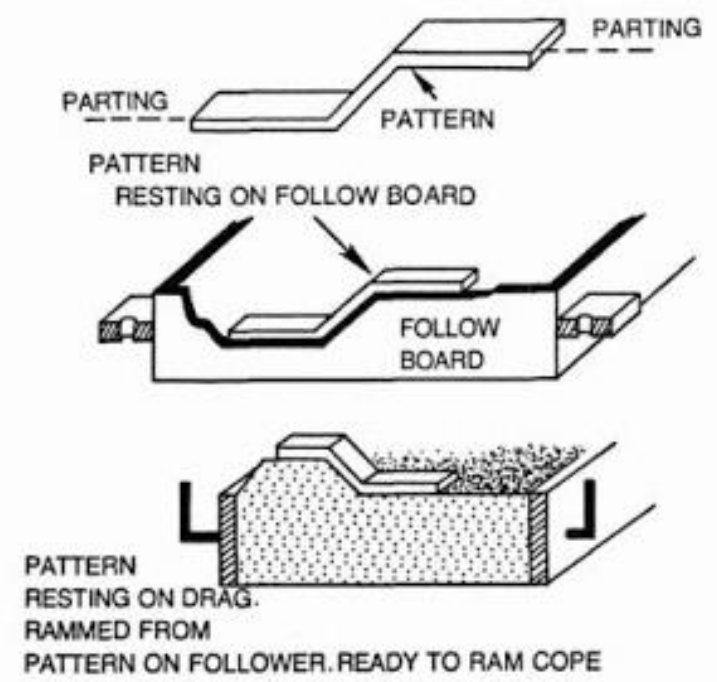
Loose piece pattern

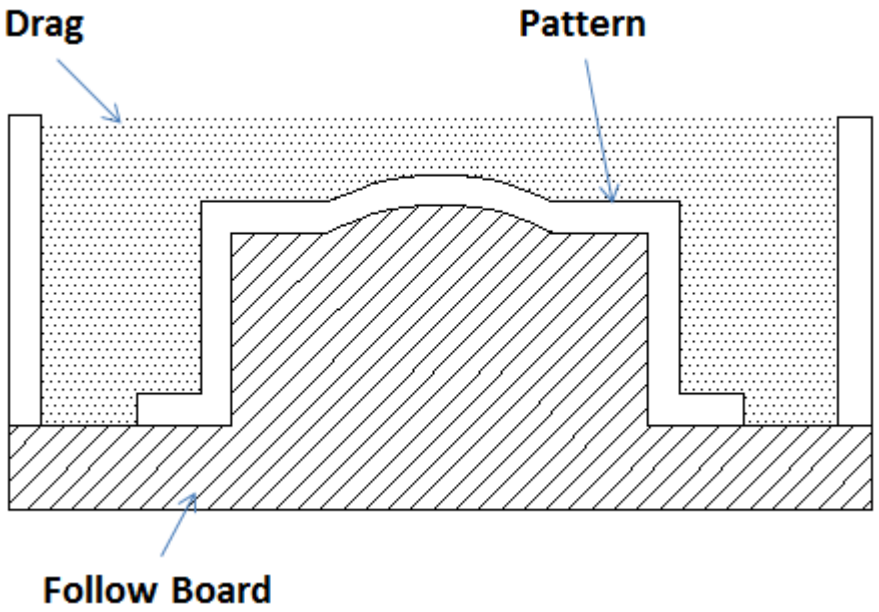




1. Used when withdrawal of the pattern from mould is impossible due to complicated contour.
2. Obstructing portion is held as a loose piece by a wire.
3. After moulding, the main part is first withdrawn, then the loose piece.
4. Requires highly skilled worker.

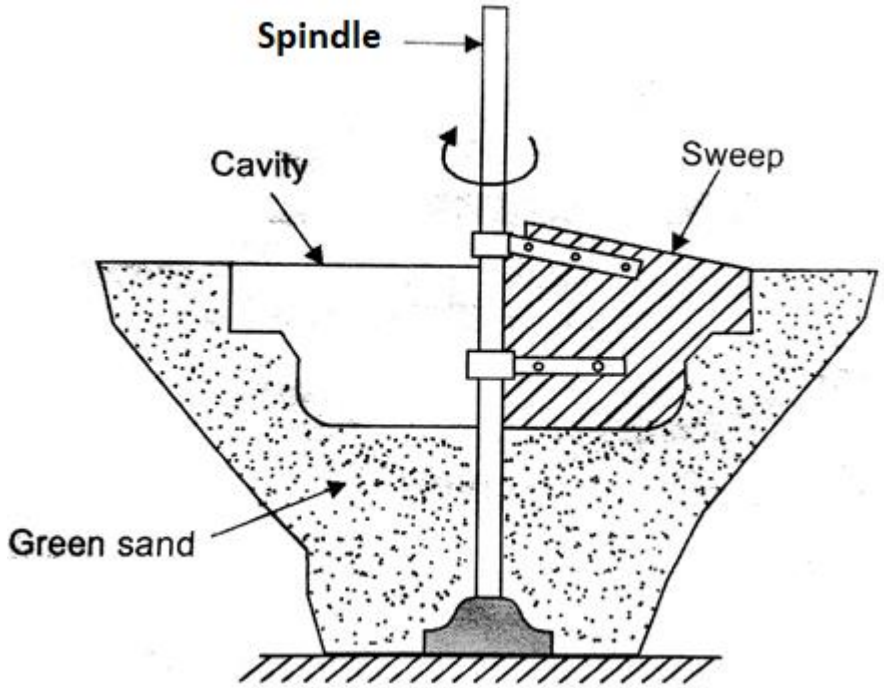
Follow board pattern





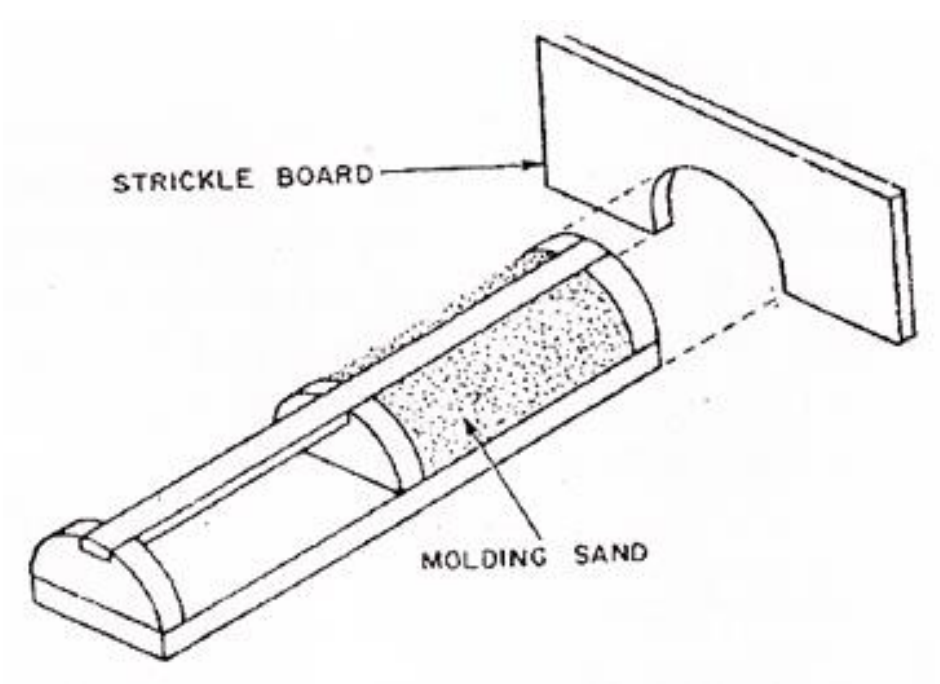
1. Used for castings with weak sections or irregular shape.
2. The bottom board is modified to closely fit the weak section or the odd contour.
3. Supports the pattern during ramming of the drag.

Sweep pattern



1. Used for moulding of large axisymmetric shapes.
2. The pattern is a plane with the desired contour.
3. Cost of pattern making is greatly reduced by using sweep pattern.

Skeleton pattern



1. It is a hollow form of pattern, consisting of a wooden frame and ribs.
2. The hollow portion is filled with loam sand or clayed sand.
3. A stickle board is used to scrap the surplus sand.
4. Used for very large castings required in small quantities.

Pattern materials

Wood

1. Most widely used
2. Easily available
3. Low weight
4. Problem of moisture absorption causing dimensional inaccuracy over time
5. Low durability due to wear
6. Pine, mahogany, teak, walnut, deodar trees are commonly used

Metal

1. Durable, dimensionally accurate, better surface finish
2. Extensively used for large production quantity
3. Aluminium and white metal are mostly used due to low weight, easily workable, corrosion resistance.
4. Low shrinkage allowance is needed for metal patterns.

Plastic

1. Low weight, easy formability, durability, smooth surface finish
2. Dimensionally stable
3. Corrosion resistant, does not absorb moisture like wood
4. Epoxy resins are commonly used