

### PATTERNS

- A pattern is a replica of the object to be made by the casting process, with some modifications. The main modifications are:
  - (a) The addition of pattern allowances,
  - (b) The provision of core prints, and
  - (c) Elimination of fine details which cannot be obtained by casting and hence are to be obtained by further processing.

### Pattern Materials

The primary materials for sand casting patterns are wood, metal, and plastics, including 3D-printed polymers. The ideal material depends on production volume, dimensional accuracy requirements, cost, and the complexity of the final part.

### Pattern Materials

#### Wood patterns

Wood is a popular choice for low-volume production or creating prototypes due to its low cost and easy workability.

- Best for: Simple, small runs where the pattern will not be used frequently.
- Examples: Pine, mahogany, and teak are common woods used for patterns.
- Advantages:
  - Lightweight, easy to handle, and readily available.
  - Easy to shape, glue, and repair.
  - Lower cost compared to metal patterns.
- Disadvantages:
  - Susceptible to moisture, which can cause warping or dimensional changes.
  - Less durable than metal and wears down more quickly from sand abrasion.
  - Requires a protective coating like varnish or shellac to prolong its life.

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### Pattern Materials

#### **Metal patterns**

Metal patterns are used for high-volume production because of their durability and ability to produce highly accurate castings.

- Best for: Large-scale manufacturing and parts with high dimensional tolerance requirements.
- Examples:
  - Aluminum and its alloys: A common choice for machine molding and automated processes. Aluminum is lightweight, easy to machine, and resistant to corrosion.
  - Steel and cast iron: Often used for high-pressure molding and shell molding processes, especially in the automotive industry.
  - Brass and white metal: Used for small, intricate patterns where a smooth surface is needed.

### Pattern Materials

#### **Metal patterns**

- Advantages:
  - i. Extremely durable with high resistance to abrasion.
  - ii. Dimensionally stable and unaffected by moisture.
  - iii. Capable of producing high-precision castings.
- Disadvantages:
  - i. Higher cost and heavier than wood or plastic patterns.
  - ii. Can be difficult and expensive to repair or modify.

### Pattern Allowances

- The dimensions of the pattern are different from the final dimensions of the casting required. The following types of allowances are usually provided –

**1) Shrinkage allowance**

**2) Finish or Machining allowance**

**3) Draft allowance**

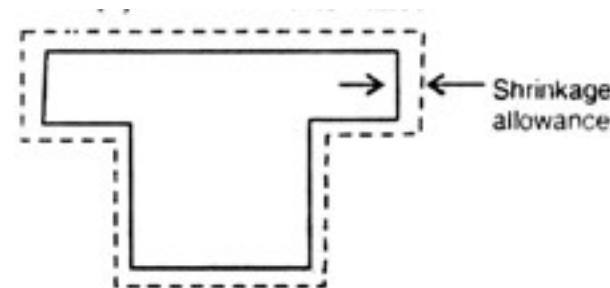
**4) Shake allowance**

**5) Distortion allowance**

### PATTERNS

#### Shrinkage Allowance

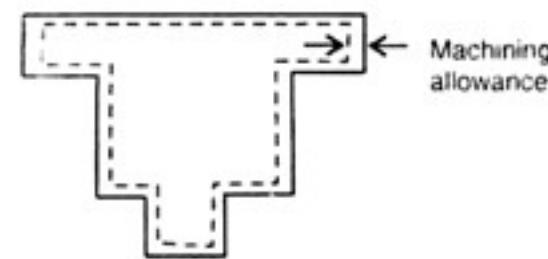
- All the metals shrink when cooling except perhaps bismuth. This is because of inter- atomic vibrations which are amplified by an increase in temperature. However, there is a distinction to be made between **liquid shrinkage and solid shrinkage**.
- Liquid shrinkage refers to the reduction in volume when the metal changes from liquid to solid state at the solidus temperature. To account for this, risers are provided in the moulds.
- Solid shrinkage is the reduction in volume caused when metal loses temperature in solid state. The shrinkage allowance is provided to take care of this reduction.
- The rate of contraction with temperature is dependent on the material. The pattern maker's experience and a little bit of trial are to be used in arriving at the final shrinkages provided on the pattern.



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#### Finish or Machining Allowance

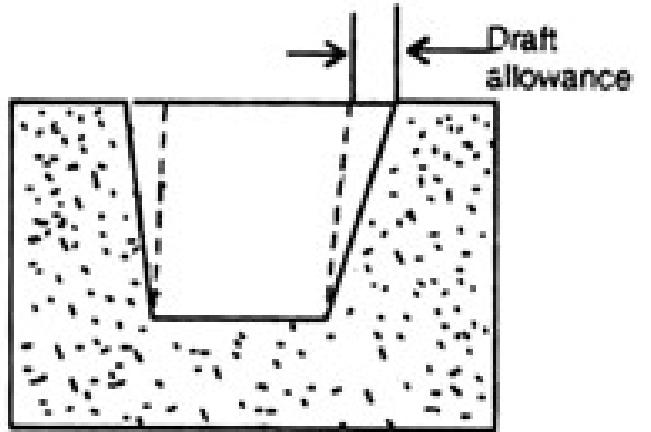
- The finish and accuracy achieved in sand casting are generally poor and therefore when the casting is functionally required to be of good surface finish or dimensionally accurate, it is generally achieved by subsequent machining.
- Also ferrous materials would have scales on the skin which are to be removed by cleaning.
- Hence, extra material is to be provided which is to be subsequently removed by machining or cleaning process.
- This depends on dimensions, the type of casting material and the finish required.



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#### Draft Allowance

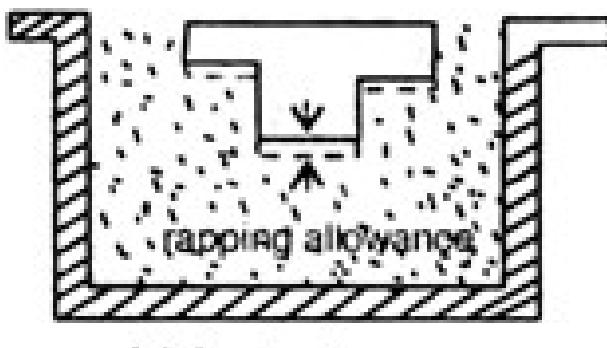
- At the time of withdrawing the pattern from the sand mould, the vertical faces of the pattern are in continual contact with the sand which may damage the mould cavity.
  
- To reduce its chances, the vertical faces of the pattern are always tapered from the parting line. This provision is called draft allowance.



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#### Shake Allowance

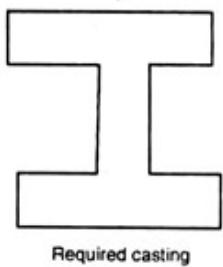
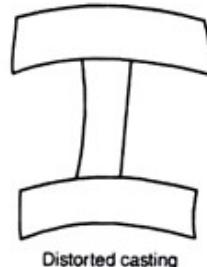
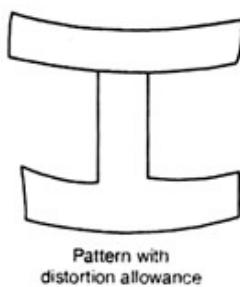
- Before withdrawal from the sand mould, the pattern is rapped all around the vertical faces to enlarge the mould cavity slightly which facilitates its removal.
  
- Since it enlarges the final casting made, it is desirable that the original pattern dimensions should be reduced to account for this increase. There is no sure way of quantifying this allowance since it is highly dependent on the foundry personnel and practices involved.



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#### Distortion Allowance

- A metal when has just solidified is very weak and therefore is likely to be distortion prone. This is particularly so for weaker sections such as long flat portions, V, U sections or in a complicated casting which may have thin and long sections connected to thick sections.
- The foundry practice should be to make extra material provision for reducing the distortion. Alternatively, the shape of pattern itself should be given a distortion of equal amount in the opposite direction of the likely distortion direction.
- This can be done by trial and error basis to get the distortion amount.

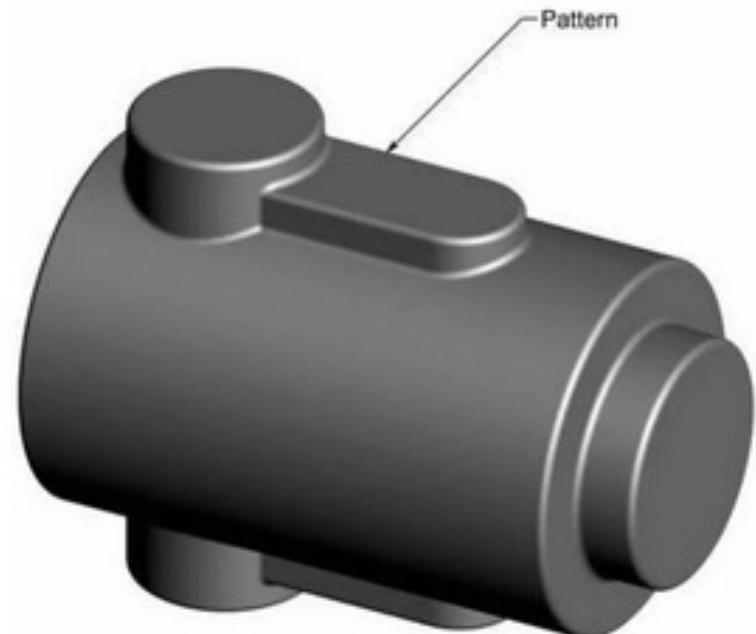


### PATTERNS

#### Types of Patterns

##### Solid or Single Piece Pattern

- As the name indicates, they are made of a single piece.
- This type of pattern is used only in cases where the job is very simple and does not create any withdrawal problems. It is also used for applications in very small-scale production or in prototype development.
- This pattern is expected to be entirely in the drag.
- One of the surfaces is expected to be flat which is used as the parting plane.

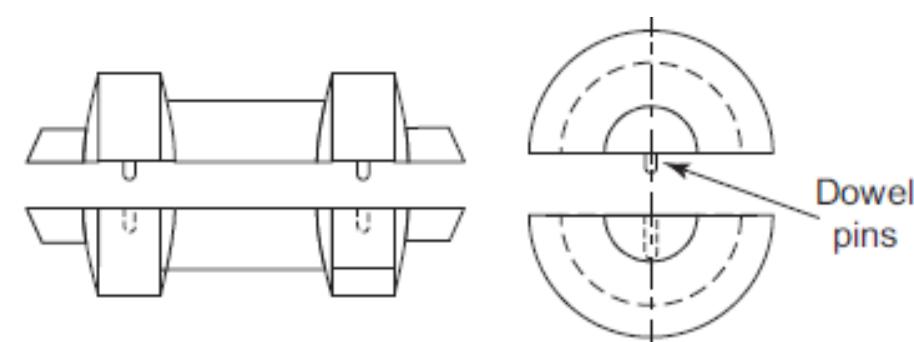
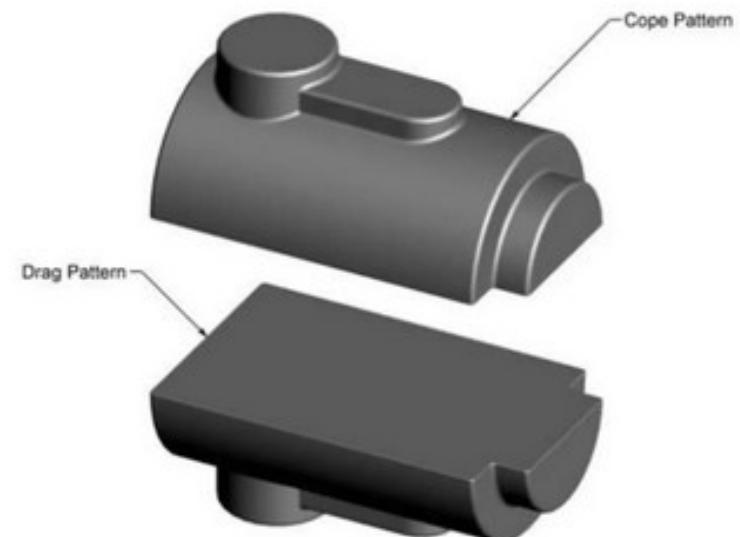


### PATTERNS

#### Types of Patterns

##### Split Pattern

- When the contour of the casting makes its withdrawal from the mould difficult or when the depth of the casting is too high, then the pattern is split into two parts so that one part is in the drag and the other in the cope.
- The split surface of the pattern is same as the parting plane of the mould.
- The two halves of the pattern should be aligned properly by making use of the dowel pins which are fitted to the cope half. These dowel pins match with the precisely made holes in the drag half of the pattern and thus align the two halves properly.

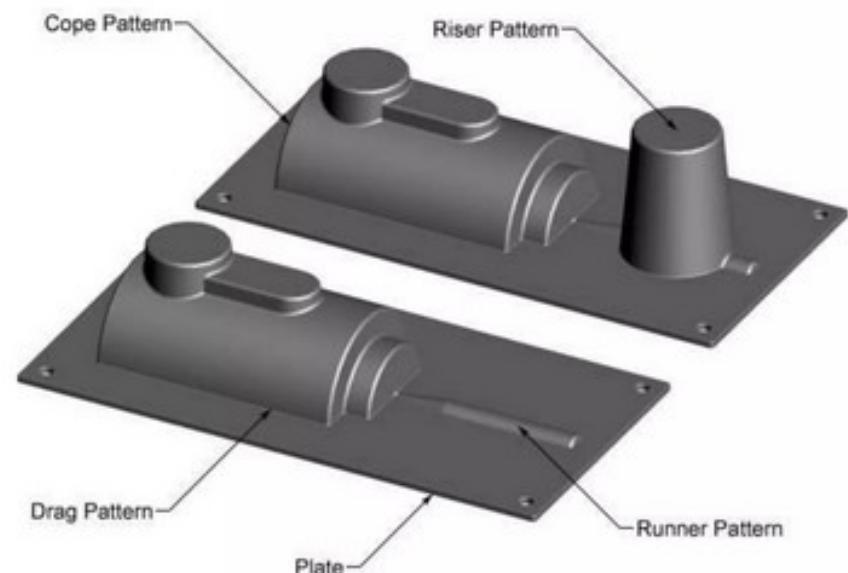


### PATTERNS

#### Types of Patterns

#### Cope and Drag Pattern

- These are similar to split patterns. In addition to splitting the pattern, the cope and drag halves of the pattern along with the gating and risering systems are attached separately to the metal or wooden plates along with the alignment pins. They are called the cope and drag patterns.
- The cope and drag moulds may be produced using these patterns separately by two moulders but they can be assembled to form a complete mould.
- These types of patterns are used for castings which are heavy and inconvenient for handling as also for continuous production.

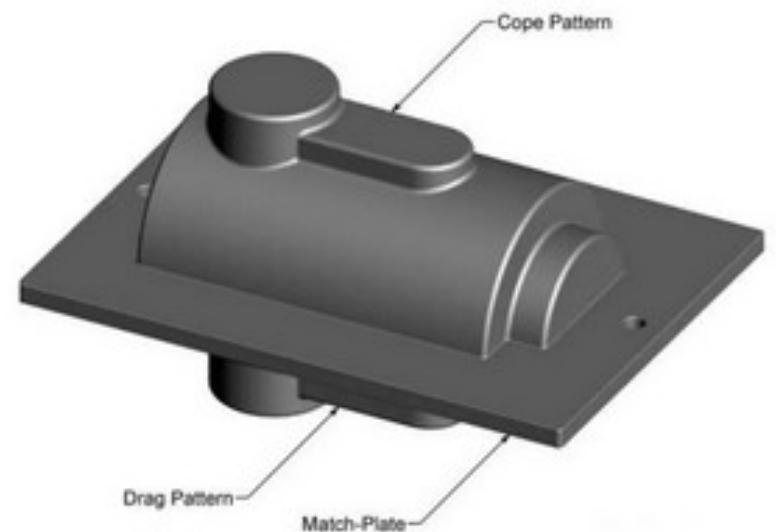


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#### Types of Patterns

#### Match Plate Pattern

- Here the cope and drag patterns along with the gating and the risering are mounted on a single matching metal or wooden plate on either side.
- On one side of the match plate the cope flask is prepared and on the other, the drag flask.
- After moulding when the match plate is removed, a complete mould with gating is obtained by joining the cope and the drag together.
- These are generally used for small castings with higher dimensional accuracy and large production.

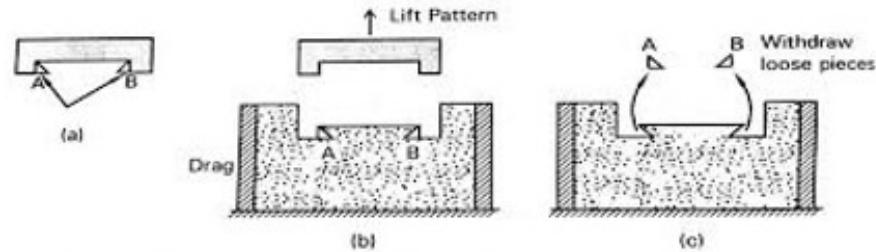


### PATTERNS

#### Types of Patterns

##### Loose Piece Pattern

- This type of pattern is used when the contour of the part is such that withdrawing the pattern from the mould is not possible.
- Hence during moulding the obstructing part of the contour is held as a loose piece by a wire.
- After moulding is over, first the main pattern is removed and then the loose pieces are recovered through the gap generated by the main pattern.
- Moulding with loose pieces is a highly skilled job and is generally expensive and therefore, should be avoided where possible.



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#### Types of Patterns

#### Sweep Pattern

- It is used to sweep the complete casting by means of a plane sweep. These are used for generating large shapes which are axi-symmetrical or prismatic in nature such as bell shaped or cylindrical.
- This greatly reduces the cost of a three dimensional pattern. This type of pattern is particularly suitable for very large castings such as bells for ornamental purposes used, which are generally cast in pit moulds.

