

Pattern (Figure 2)

The pattern is the principal tool during the casting process. It is the replica of the object to be made by the casting process, with some modifications. The main modifications are the addition of pattern allowances, and the provision of core prints. If the casting is to be hollow, additional patterns called cores are used to create these cavities in the finished product. The quality of the casting produced depends upon the material of the pattern, its design, and construction.

The costs of the pattern and the related equipment are reflected in the cost of the casting. The use of an expensive pattern is justified when the quantity of castings required is substantial.

Functions of the Pattern

1. A pattern prepares a mold cavity for the purpose of making a casting.
2. A pattern may contain projections known as core prints if the casting requires a core and need to be made hollow.
3. Runner, gates, and risers used for feeding molten metal in the mold cavity may form a part of the pattern.
4. Patterns properly made and having finished and smooth surfaces reduce casting defects.
5. A properly constructed pattern minimizes the overall cost of the castings.

Pattern Material

Patterns may be constructed from the following materials. Each material has its own advantages, limitations, and field of application. Some materials used for making patterns are: wood, metals and alloys, plastic, plaster of Paris, plastic and rubbers, wax, and resins. To be suitable for use, the pattern material should be:

1. Easily worked, shaped and joined
2. Light in weight
3. Strong, hard and durable
4. Resistant to wear and abrasion
5. Resistant to corrosion, and to chemical reactions
6. Dimensionally stable and unaffected by variations in temperature and humidity
7. Available at low cost

The usual pattern materials are wood, metal, and plastics. The most commonly used pattern material is wood, since it is readily available and of low weight. Also, it can be easily shaped and is relatively cheap. The main disadvantage of wood is its absorption of moisture, which can cause distortion and dimensional changes. Hence, proper seasoning and upkeep of wood is almost a pre-requisite for large-scale use of wood as a pattern material.

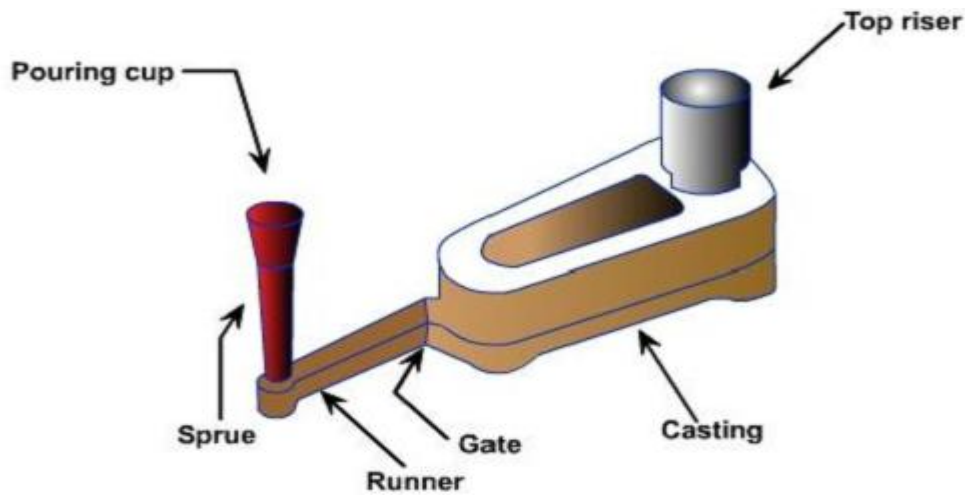


Figure 2: A typical pattern attached with gating and risering system

Pattern Allowances

Pattern allowance is a vital feature as it affects the dimensional characteristics of the casting. Thus, when the pattern is produced, certain allowances must be given on the sizes specified in the finished component drawing so that a casting with the particular specification can be made. The selection of correct allowances greatly helps to reduce machining costs and avoid rejections. The allowances usually considered on patterns and core boxes are as follows:

1. Shrinkage or contraction allowance
2. Draft or taper allowance
3. Machining or finish allowance
4. Distortion or camber allowance
5. Rapping allowance

Shrinkage or Contraction Allowance (**Table 1** view various rate of contraction of various materials)

All most all cast metals shrink or contract volumetrically on cooling. The metal shrinkage is of two types:

- i. **Liquid Shrinkage:** it refers to the reduction in volume when the metal changes from liquid state to solid state at the solidus temperature. To account for this shrinkage; riser, which feed the liquid metal to the casting, are provided in the mold.
- ii. **Solid Shrinkage:** it refers to the reduction in volume caused when metal loses temperature in solid state. To account for this, shrinkage allowance is provided on the patterns.

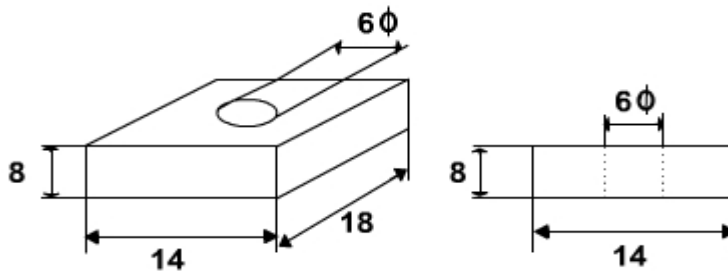
The rate of contraction with temperature is dependent on the material. For example steel contracts to a higher degree compared to aluminum. To compensate the solid shrinkage, a shrink rule must be used in laying out the measurements for the pattern. A shrink rule for cast iron is $\frac{1}{8}$ inch longer per foot than a standard rule. If a gear blank of 4 inch in diameter was planned to produce out of cast iron, the shrink rule in measuring it 4 inch would actually measure $4 - \frac{1}{24}$ inch, thus compensating for the shrinkage. The various rate of contraction of various materials are given in **Table 1**.

Table 1 : Rate of Contraction of Various Metals

Material	Dimension	Shrinkage allowance (inch/ft)
Grey Cast Iron	Up to 2 feet	0.125
	2 feet to 4 feet	0.105
	over 4 feet	0.083
Cast Steel	Up to 2 feet	0.251
	2 feet to 6 feet	0.191
	over 6 feet	0.155
Aluminum	Up to 4 feet	0.155
	4 feet to 6 feet	0.143
	over 6 feet	0.125
Magnesium	Up to 4 feet	0.173
	Over 4 feet	0.155

Exercise 1

The casting shown is to be made in cast iron using a wooden pattern. Assuming only shrinkage allowance, calculate the dimension of the pattern. All Dimensions are in Inches



Solution 1

The shrinkage allowance for cast iron for size up to 2 feet is 0.125 inch per foot (as per Table 1)

For dimension 18 inch, allowance = $18 \times 0.125 / 12 = 0.1875$ inch » 0.2 inch

For dimension 14 inch, allowance = $14 \times 0.125 / 12 = 0.146$ inch » 0.15 inch

For dimension 8 inch, allowance = $8 \times 0.125 / 12 = 0.0833$ inch » 0.09 inch

For dimension 6 inch, allowance = $6 \times 0.125 / 12 = 0.0625$ inch » 0.07 inch

The pattern drawing with required dimension is shown below:

