1.6 Pattern Allowance

A pattern is always made larger than the final catting, because it carries certain allowance due to metallurgical and mechanical reasons. The following allowances are provided on the pattern:

(a) Shrinkage or contraction allowance

(b) Machining allowance

(c) Draft or taper allowance

(d) Distortion allowance

(e) Rapping or shake allowance

(a) Shrinkage or constriction allowance

Almost all the metals used in the casting work shrink or contract during cooling from pouring temperature to room temperature.

This contraction takes place in three forms i.e.

- Liquid contraction
- Solidifying contraction
- Solid contraction

To compensate liquid and solidifying contraction, gates and risers are provided in the mould, whereas for solid contraction adequate allowance are provided on the pattern. The different metals shrink at different rates because shrinkage is the metal property, hence corresponding allowances are also different. The shrinkage of metal depends on the following factors:

The metal to be cast

Pouring temperature of the molten metal

Dimensions of the casting

Method of moulding

Shrinkage allowance for different cast metals is given in the following Table 1.1

Table 1.1 Typical Shrinkage Allowances

Materials	Shrinkage Allowance
Cast Iron	10.4 mm/m
Aluminium	17 mm/m
Brass	15.3 mm/m
Steel	20.8 mm/m
Zinc, Lead	25 mm/m

(b) Machining allowance

Machining allowance or finish allowance is the amount of dimension on a casting which is made oversized to provide stock for machining. A casting may require machining all over or on certain specified portions. Such portions or surfaces on the pattern are given adequate allowance in addition to the shrinkage allowance.

The amount of machining allowance depends upon following factors:

- Metal of casting
- Machining method used
- Casting method used
- Shape and size of the casting
- Amount of finish required on the machined portion

Ferrous metal needs more allowance than the non-ferrous metals and similarly, large castings need more allowance than small castings. Machining allowance varies from 1.5mm to 16mm, but 3 mm allowance is more common for small and medium castings.

(c) Draft allowance

Draft allowance or taper allowance is given to all vertical faces of a pattern for their easy removal from sand without damaging the mould. This slight taper inward or outward on the vertical faces is known as draft. It can be expressed either in degrees or in mm/meter. Generally, it is more on internal surfaces as compared to external surfaces.

The amount of draft allowance depends on following factors:

i) Shape and size (height) of the pattern

ii) Method of moulding

iii) Material of moulding

This allowance varies from 10mm to 25 mm per meter on external surfaces and 40mm to 65mm per meter on internal surfaces. Fig. 1.2 shows two patterns i.e. one without taper allowance and other with taper allowance. It can be seen that, it is easy to withdraw the pattern having taper allowance out of the mould without damaging the mould cavity.

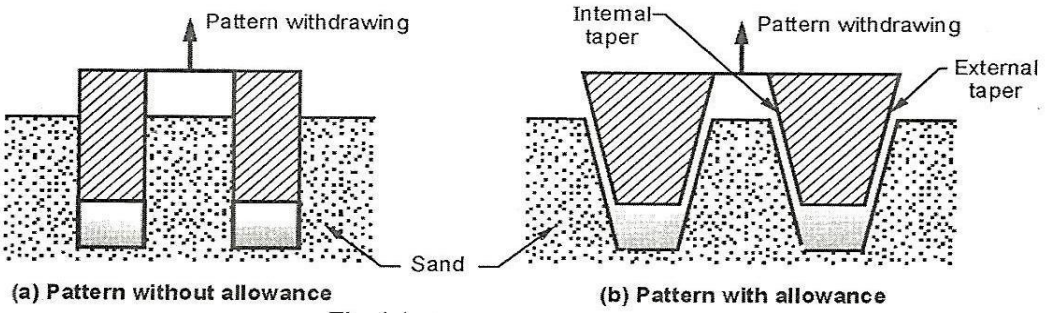


Figure 1.2: Taper or Draft Allowance

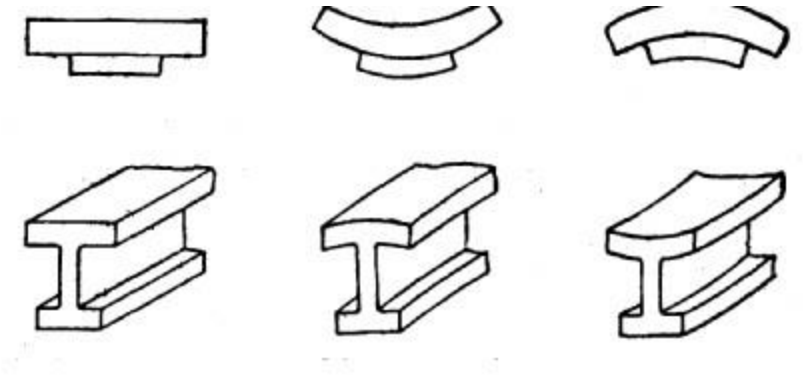
(d) Distortion allowance (Camber allowance)

The tendency of distortion is not common in all the castings.

The casting will distort or warp if:

- It is of irregular shape.
- It is of U or V-shape.
- The arms having unequal thickness.
- One portion of the casting cools at a faster rate than the other.

To eliminate this defect, an opposite distortion is provided on the pattern, so that the effect is balanced and correct shape of the casting is produced. The amount of distortion allowance varies from 2mm to 20mm as per the size, shape and casting material. Refer Fig.1.3.



Required Shape of Casting Distorted Casting Cambered Pattern

Figure. 1.3. Distortion or Camber Allowance

(e) Rapping or Shake allowance

When a pattern is to be taken out from the mould, it is first rapped or shaken by striking it with a wooden piece from side to side. This is done so that the pattern surface becomes free from adjoining sand of the mould. Due to this, there is little increase in the size of the mould cavity. For this purpose, a negative allowance is provided on the pattern i.e. the dimensions are kept smaller. It is normally provided only to the large castings and negligible for small and medium sized castings.

1.7 Types of Patterns

The type of pattern to be used for a particular casting will depend on following factors:

Quantity of casting to be produced

Size and shape of the casting

Type of moulding method

Design of casting

The various types of patterns which are commonly used are as follows:

1. Single piece or solid pattern
2. Two piece or split pattern
3. Loose piece pattern
4. Cope and drag pattern
5. Gated pattern
6. Match plate pattern
7. Sweep pattern
8. Skeleton pattern
9. Segemental pattern
10. Shell Pattern

1. Single piece or solid pattern

It is the simplest of all the patterns and it is made in one-piece and does not carry loose pieces or joints. Refer Fig. 1.4.

It is generally used for making large sized simple casting.

It is less expensive as compared to other types of pattern.

Depending upon the quantity of the casting to be produced, it is usually made up of wood or metal.

For making the mould, single piece pattern is used either in the cope or in the drag.

Stuffing box of steam engine can be cast by using single piece pattern.

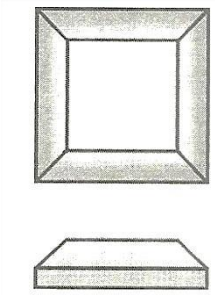


Figure: 1.4 Single piece or solid pattern

2. Two piece or split pattern

Patterns of complicated shape castings cannot be made in one-piece because of the difficulties associated with the moulding operations.

Such patterns are made in two pieces, called as split pattern or two piece pattern. Refer Fig. 1.5 (a)

Its upper and lower parts are accommodated in the cope and drag portions of the mould, respectively.

For keeping the alignment between the two parts of the pattern, dowel pins are used.

Patterns of more complicated casting are made in more than two pieces for their easy removal and they have three piece flasks for the moulding purpose. Refer Fig. 1.5 (b).

Casting of taps and water stop cocks are produced by using split patterns.

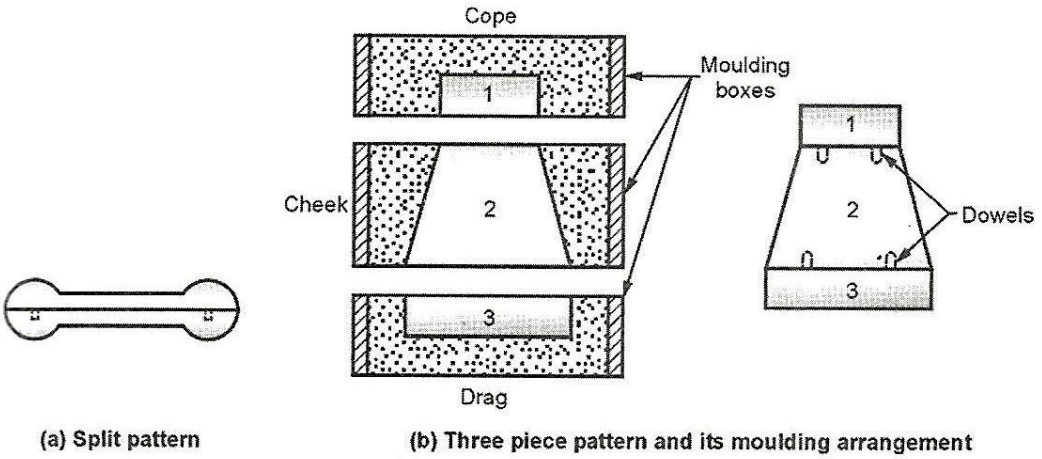


Figure: 1.5 split pattern

3. Loose piece pattern

Some patterns embedded in the moulding sand cannot be withdrawn, hence such patterns are made with one or more loose pieces for their easy removal from the moulding box.

These patterns are known as loose piece patterns. Refer Fig. 1.6.

Loose pieces like A and B as shown in Fig. 1.6. remain attached with the main body by using dowel pins.

These pattern consume more time for moulding operation and require more labour work.

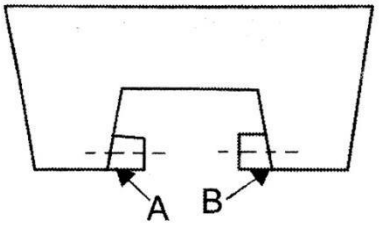


Figure: 1.6 Loose piece pattern

4. Cope and drag pattern

It is another form of split pattern.

The pattern is split about a suitable surface or line.

Each half of the pattern is fixed to a separate plate and besides the pattern it has provision for moulding runner and gates.

Each half of the pattern is moulded separately in a separate moulding box and then assembled for pouring.

These patterns are used for producing large casting.

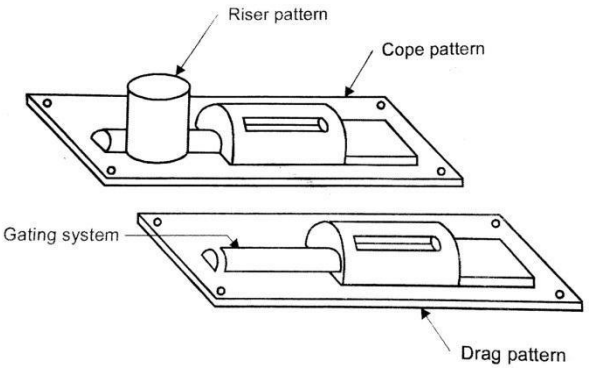


Figure: 1.7. Cope and drag pattern

5. Gated pattern

To increase the strength and reduce the tendency to warp, gated patterns are generally made of metals.

By using gated patterns number of casting can be made at a time, hence they are used in mass production system.

The sections connecting various patterns serve as a runner and gates. Refer Figure1.8.

This facilitates filling of the mould with molten metal in better manner and reduces the required time and labour work.

These pattern are used for producing small castings.

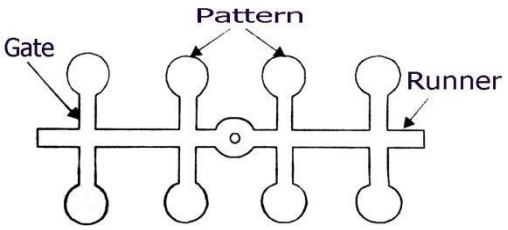


Figure: 1.8 Gated pattern

6. Match plate pattern

These patterns are made in two pieces i.e. one piece mounted on one side and the other on the other side of the plate, called as match plate.

The plate may carry one pattern or group of patterns mounted in the same way on its two sides. Refer Figure1.9.

The plate can be of wood, aluminum, magnesium or steel.

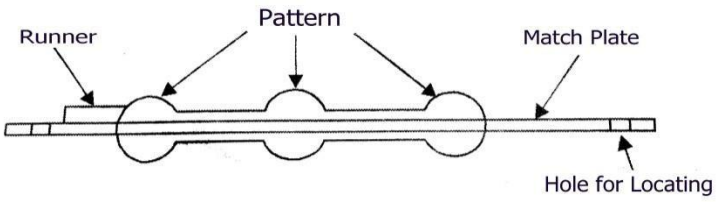


Figure: 1.9 Match plate pattern

The match plate has runner and gates attached with it.

Match plate patterns are generally used in machine moulding because they produce accurate casting at faster rates.

Piston rings of an I.C. engines are made by using these patterns.

7. Sweep pattern

Sweep pattern is just a form made on a wooden board which sweeps the casing shape into the sand all around the circumference.

The equipment consists of a base, placed in the sand, vertical spindle and a wooden template called as sweep.

The sweep is rotated about the spindle or post, to form the cavity as shown in Figure1.10.

Once the mould is ready, sweep pattern and post can be removed.

It saves lot of time and labour work as compared to making a full pattern.

Sweep patterns are used for making large casting of circular sections and symmetrical shape; for example, large kettles of cast iron.

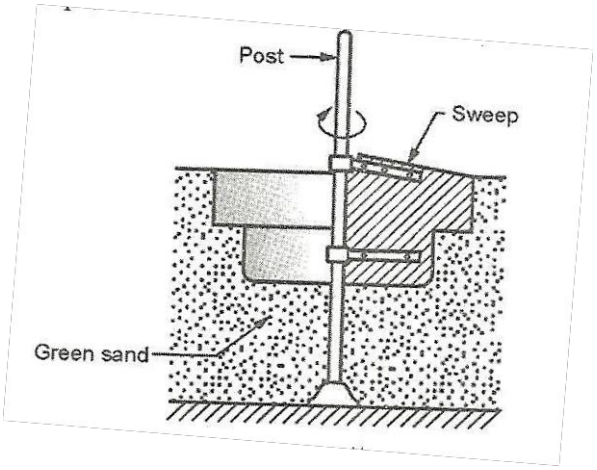


Figure: 1.10 Sweep pattern

8. Skeleton pattern

When the casting size is very large, but easy to shape and few are to be made, then it is not economical to make a large solid pattern of that size.

In such cases, a pattern consisting of a wooden frame and strips is made which is called as skeleton pattern.

It is filled with loam sand and rammed.

A strickle is used for giving the desired shape to the sand and for removing the extra sand.

Figure shows the skeleton pattern for a hollow pipe. Skeleton patterns are used for producing large casting like turbine casting, water pipes, L-bends, etc.

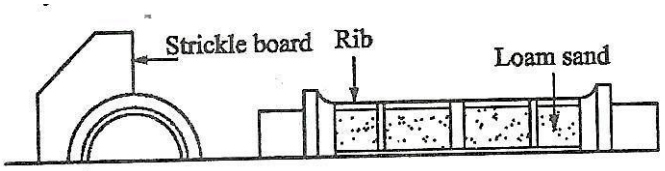


Figure: 1.11 Skeleton pattern

9. Segmental pattern

The working principle of segmental pattern is similar to sweep pattern.

The main difference between them is that, a sweep is given a continuous revolving motion to generate the required shape, whereas a segmental pattern is a portion of the solid pattern itself and the mould is prepared in parts by it.

It is mounted on a central pivot and it completes one portion of the mould and them moves to the next portion. Refer Figure1.12.

These patterns are used for producing large circular casting like big gears, wheel rims, etc.

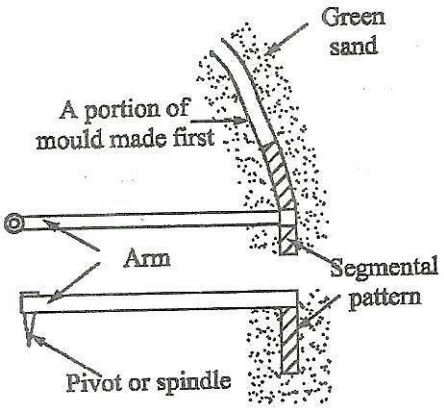


Figure: 1.12 Segmental pattern

10. **Shell Pattern**

It shell pattern is used to molding of hollow shape product with curved or straight.

It means of pipe work done it process.

Pattern usually made of metal.

That pattern parted along with the center line and both halves are doweled.

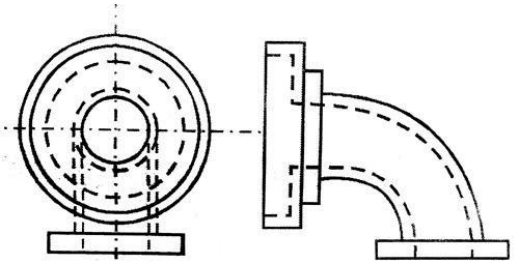


Figure: 1.13 Shell Pattern