

## FOUNDRY

### PATTERN

A pattern is a model or the replica of the object (to be casted). It is embedded in molding sand and suitable ramming of molding sand around the pattern is made. The pattern is then withdrawn for generating cavity (known as mold) in molding sand.

### COMMON PATTERN MATERIALS

The common materials used for making patterns are wood, metal, plastic, plaster, wax or Mercury.

### TYPES OF PATTERN

The types of the pattern and the description of each are given as under.

1. One piece or solid pattern 2. Two piece or split pattern 3. Cope and drag pattern 4. Three-piece or multi- piece pattern 5. Loose piece pattern 6. Match plate pattern 7. Follow board pattern 8. Gated pattern 9. Sweep pattern 10. Skeleton pattern 11. Segmental or part pattern

**1. Single-piece or solid pattern:** Solid pattern is made of single piece without joints, parting lines or loose pieces. It is the simplest form of the pattern. Typical single piece pattern is shown in Fig. 10.1.

**2. Two-piece or split pattern:** When solid pattern is difficult for withdrawal from the mold cavity, then solid pattern is split in two parts. Split pattern is made in two pieces which are joined at the parting line by means of dowel pins. The splitting at the parting line is done to facilitate the withdrawal of the pattern. A typical example is shown in Fig. 10.2

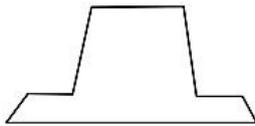


Fig. Single Piece Pattern

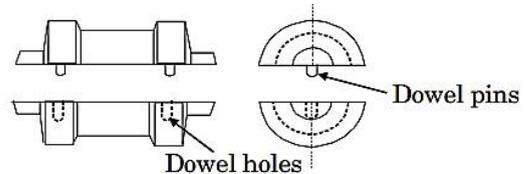


Fig. Two Piece Pattern

### MOLDING SAND

The general sources of receiving molding sands are the beds of sea, rivers, lakes, granular elements of rocks, and deserts.

Molding sands may be of two types namely natural or synthetic. Natural molding sands contain sufficient binder. Whereas synthetic molding sands are prepared artificially using basic sand molding constituents (silica sand in 88-92%, binder 6-12%, water or moisture content 3-6%) and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipments.

### Binder

In general, the binders can be either inorganic or organic substance. The inorganic group includes clay sodium silicate and port land cement etc. In foundry shop, the clay acts as binder which may be Kaolonite, Ball Clay, Fire Clay, Limonite, Fuller's earth and Bentonite. Binders included in the organic group are dextrin, molasses, cereal binders, linseed oil and resins like phenol formaldehyde, urea formaldehyde etc. Organic binders are mostly used for core making.

Among all the above binders, the bentonite variety of clay is the most common. However, this clay alone cannot develop bonds among sand grains without the presence of moisture in molding sand and core sand.

### Additives

Additives are the materials generally added to the molding and core sand mixture to develop some special property in the sand. Some common used additives for enhancing the properties of molding and core sands are discussed as under.

1. **Coal dust:** Coal dust is added mainly for producing a reducing atmosphere during casting.
2. **Corn flour:** It belongs to the starch family of carbohydrates and is used to increase the collapsibility of the molding and core sand
3. **Dextrin:** Dextrin belongs to starch family of carbohydrates that behaves also in a manner similar to that of the corn flour. It increases dry strength of the molds.
4. **Sea coal:** Sea coal is the fine powdered bituminous coal which positions its place among the pores of the silica sand grains in molding sand and core sand
5. **Wood flour:** This is a fibrous material mixed with a granular material like sand; its relatively long thin fibers prevent the sand grains from making contact with one another.
6. **Silica flour:** It is called as pulverized silica and it can be easily added up to 3% which increases the hot strength and finish on the surfaces of the molds and cores

### **KINDS OF MOULDING SAND**

Molding sands can also be classified according to their use into number of varieties which are described below.

1. **Green sand:** Green sand is also known as tempered or natural sand which is a just prepared mixture of silica sand with 18 to 30 percent clay, having moisture content from 6 to 8%. The clay and water furnish the bond for green sand. It is fine, soft, light, and porous.
2. **Dry sand:** Green sand that has been dried or baked in suitable oven after the making mold and cores, is called dry sand. It possesses more strength, rigidity and thermal stability.
3. **Loam sand:** Loam is mixture of sand and clay with water to a thin plastic paste. Loam sand possesses high clay as much as 30-50% and 18% water.
4. **Facing sand:** Facing sand is just prepared and forms the face of the mould. It is directly next to the surface of the pattern and it comes into contact molten metal when the mould is poured. Initial coating around the pattern and hence for mold surface is given by this sand. This sand is subjected severest conditions and must possess, therefore, high strength refractoriness.
5. **Backing sand:** Backing sand or floor sand is used to back up the facing sand and is used to fill the whole volume of the molding flask.
6. **Parting sand:** Parting sand without binder and moisture is used to keep the green sand not to stick to the pattern and also to allow the sand on the parting surface the cope and drag to separate without clinging
7. **Core sand:** Core sand is used for making cores and it is sometimes also known as oil sand. This is highly rich silica sand mixed with oil binders such as core oil which composed of linseed oil, resin, light mineral oil and other bind materials.

### **PROPERTIES OF MOULDING SAND**

The basic properties required in molding sand and core sand are described as under.

1. **Refractoriness:** Refractoriness is defined as the ability of molding sand to withstand high temperatures without breaking down or fusing thus facilitating to get sound casting. It is a highly important characteristic of molding sands. Refractoriness can only be increased to a limited extent
2. **Permeability:** It is also termed as porosity of the molding sand in order to allow the escape of any air, gases or moisture present or generated in the mould when the molten metal is poured into it. All these gaseous generated during pouring and solidification process must escape otherwise the casting becomes defective
3. **Cohesiveness:** It is property of molding sand by virtue which the sand grain particles interact and attract each other within the molding sand

4. **Green strength:** The green sand after water has been mixed into it, must have sufficient strength and toughness to permit the making and handling of the mould. For this, the sand grains must be adhesive, i.e. they must be capable of attaching themselves to another body
5. **Dry strength:** As soon as the molten metal is poured into the mould, the moisture in the sand layer adjacent to the hot metal gets evaporated and this dry sand layer must have sufficient strength to its shape in order to avoid erosion of mould wall during the flow of molten metal
6. **Flowability or plasticity:** It is the ability of the sand to get compacted and behave like a fluid. It will flow uniformly to all portions of pattern when rammed and distribute the ramming pressure evenly all around in all directions
7. **Adhesiveness:** It is property of molding sand to get stick or adhere with foreign material such sticking of molding sand with inner wall of molding box
8. **Collapsibility:** After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs and this would naturally avoid the tearing or cracking of the contracting metal.

### HAND TOOLS USED IN FOUNDRY SHOP

**Hand riddle:** It consists of a screen of standard circular wire mesh equipped with circular wooden frame. It is generally used for cleaning the sand for removing foreign material such as nails, shot metal, splinters of wood etc. from it. Even power operated riddles are available for riddling large volume of sand.

**Shovel:** It consists of a steel pan fitted with a long wooden handle. It is used in mixing, tempering and conditioning the foundry sand by hand. It is also used for moving and transforming the molding sand to the container and molding box or flask.

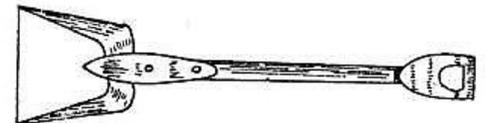
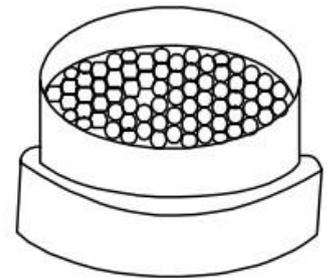


Fig. Shovel  
Shovel

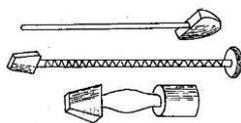


Fig. Rammers

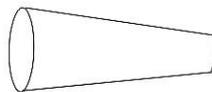
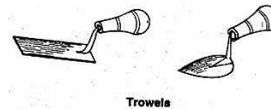


Fig. Sprue Pin



Trowels

**Rammers:** Rammers are shown in Fig. These are required for striking the molding sand mass in the molding box to pack or compact it uniformly all around the pattern.

**Sprue pin:** It is a tapered rod of wood or iron which is placed or pushed in cope to join mold cavity while the molding sand in the cope is being rammed.

**Trowels:** These are used for finishing flat surfaces and corners inside a mould. Common shapes of trowels are shown as under. They are made of iron with a wooden handle.

**Lifter:** A lifter is a finishing tool used for repairing the mould and finishing the mould sand. Lifter is also used for removing loose sand from mould.

**Strike off bar:** It is a flat bar, made of wood or iron to strike off the excess sand from the top of a box after ramming. It's one edge made beveled and the surface perfectly smooth and plane.

**Vent wire:** It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is used to make small

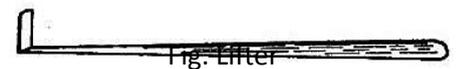


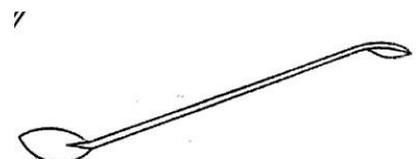
Fig. Lifter



Fig. Strike off bar



Fig. Vent Wire



holes, called vents, in the sand mould to allow the exit of gases and steam during casting.

**Slicks:** They are also recognized as small double ended mold finishing tool which are generally used for repairing and finishing the mold surfaces and their edges after withdrawal of the pattern

Fig. Slicks

**Swab:** Swab is shown in Fig. 11.1(u). It is a small hemp fiber brush used for moistening the edges of sand mould, which are in contact with the pattern surface before withdrawing the pattern. It is used for sweeping away the molding sand from the mold surface and pattern.

Fig. Swab

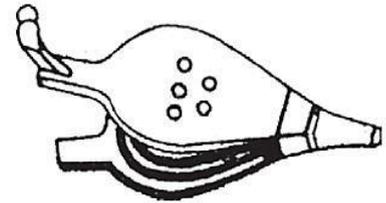
**Gate cutter:** Gate cutter (Fig. 11.1(v)) is a small shaped piece of sheet metal commonly used to cut runners and feeding gates for connecting sprue hole with the mold cavity.



Fig. Gate Cutter

**Bellows:** Bellows gun is shown in Fig. 11.1(w). It is hand operated leather made device equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose or unwanted sand from the surfaces of mold cavities.

**Draw spike:** Draw spike is shown Fig. 11.1(f). It is a tapered steel rod having a loop or ring at its one end and a sharp point at the other. It may have screw threads on the end to engage metal pattern for its withdrawal from the mold.



**Sprue Pin:** It is a tapered wooden pin, used to make a hole in the cope through which the molten metal is poured into the mould.

**MOULDING BOX:**

Moulding box is also called moulding flask. It is frame or box of wood or metal. It is made of two parts cope and drag as shown in figure.

