

Work Shop Practices (ME110)
L-T-P (0-0-3)

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Presentation Layout

- Introduction of Foundry
- Foundry Terminologies
- Foundry Tools
- Types of sand in Sand Casting.
- Basics of mold making

What will you learn in this section?

- Type of jobs carried out in a foundry shop.
- What is casting process and basics of sand casting.
- Different foundry tools and how to use them for mold making.
- A working knowledge of metal sand casting using wooden pattern.

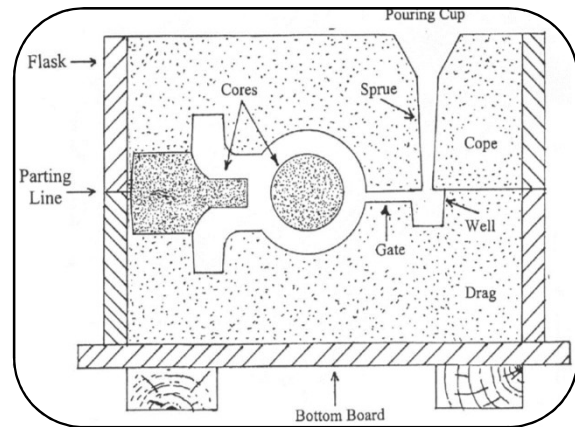
Introduction to Foundry

The place where jobs are prepared by melting and pouring the molten metal into the molds is known as foundry. A term casting refers to the process of liquefying metals and pouring it into the mold, which upon solidifying gives the final part. Foundry is a place where the principle activity is that of casting. Casting is one of the oldest manufacturing process. It is the first step in making most of the products. Casting follows a sequence of steps listed below

- Making a mold cavity .
- Material is then liquefied by properly heating it in a suitable furnace.
- Liquid is then poured into the prepared mold cavity.
- Allow the liquid material to solidify.
- Product is then taken out of the mold cavity, trimmed to shape.

Foundry Terminology

- **Pattern:** An approximate replica of the part to be cast.
- **Flask:** A rigid frame that holds the molding aggregate.
- **Cope:** The upper part of the flask.
- **Drag:** The lower part of the flask.
- **Core:** Sand or metal shape that is inserted into the mold to create internal features.
- **Pouring Basin/Cup:** Pouring basin acts as a storage element, through which the molten metal passes into the mold cavity.



Layout of a casting process

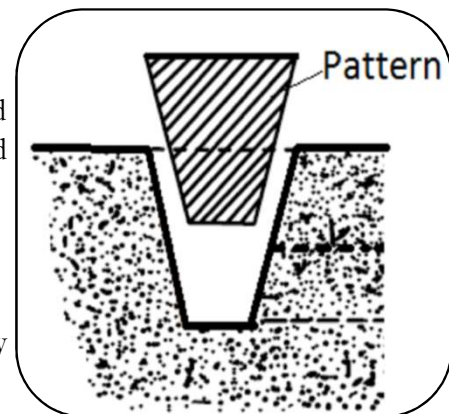
Foundry Terminology (...Cont.)

Mold: A cavity left after removal of the pattern.

Riser: A column of molten metal placed in the mold to feed the castings as it shrinks and solidifies. Also known as “feed head”.

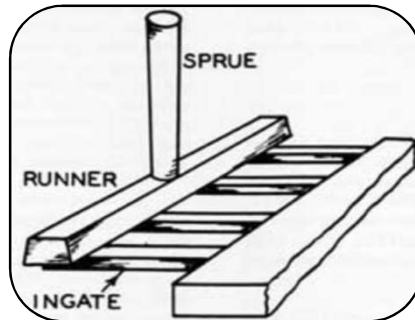
Parting line: Separates the cope and drag.

Draft: An angle or taper on a pattern that allows for easy removal of the casting from the mold.

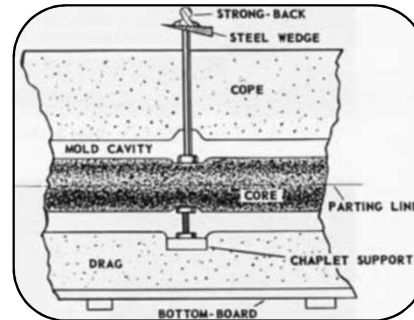


Draft in pattern

Foundry Terminology (...Cont.)



Use of runners in casting



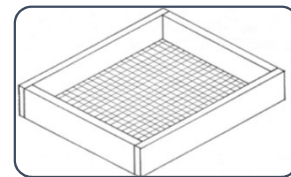
Use of chaplets in casting

- **Sprue:** The vertical passage, connecting a pouring basin to a runner or gate is called as the sprue
- **Runner:** Trapezoidal shaped piece that runs horizontally to the mold cavity and connects the sprue base to the gate(s).
- **Chaplets:** Chaplets are used to support the cores inside the mold cavity to take care of its own weight and overcome the metallostatic force.

Foundry Tools

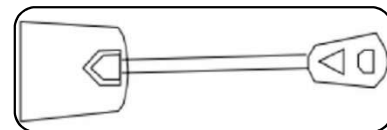
Hand Riddles

Hand riddles consists of a screen of a circular wire mesh, equipped with a wooden frame. It is generally used for cleaning sand to remove foreign material. Manual and powered riddles are also available.



Shovel

Shovel consists of a steel pan, fitted with a long wooden handle. It is used in mixing tempering and conditioning the foundry sand by hand



Rammer

Rammer are required for molding sand mass in the molding box to pack or compact it uniformly all around the pattern.



Foundry Tools (...Cont.)

Sprue Pin

Sprue pin, shown on the right, is a tapered rod of wood or metal, which is placed in mold cavity, while the molding sand in the cope is rammed. Later its withdrawal from the cope produces a vertical hole, called a sprue, through which molten metal is poured.



Strike-off Bar

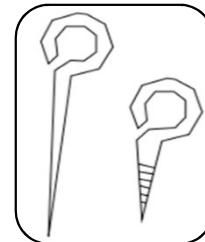
Strike off bar is a flat and long piece of wood or iron. It is used to remove excess sand from the top of a molding box. after completion of ramming.



Foundry Tools (...Cont.)

Draw Spike

Draw spike is a tapered steel rod having a loop or a ring at its one end. It also has screw threads (in some cases) to engage a metal or a wooden pattern. It is used to remove embedded pattern from the mold.



Vent Rod

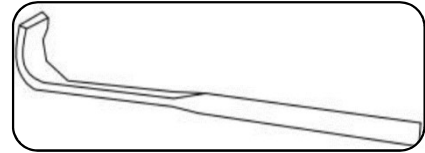
Vent rod is thin spiked steel rod or a wire. After ramming and striking off the excess sand, it is utilized to make number of small holes in the molding sand in the cope. This series of small holes are called as vent holes, which allow the escape of steam and gases during molten metal pouring and solidification.



Foundry Tools (...Cont.)

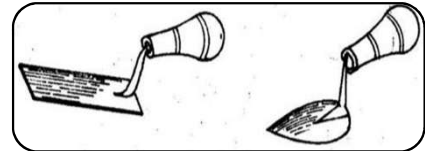
Lifter

Lifters are made of thin sections of steel with one bent edge. They are used for cleaning, repairing and finishing the mold cavities.



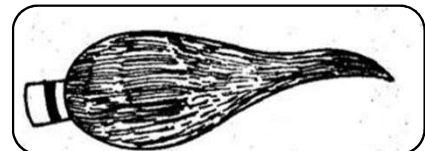
Trowels

Trowels are utilized for finishing flat surfaces, joints, and parting lines of the mold. They consist of metal blades with wooden handles. They may also be used for cutting gates and repair mold surfaces.



Swab

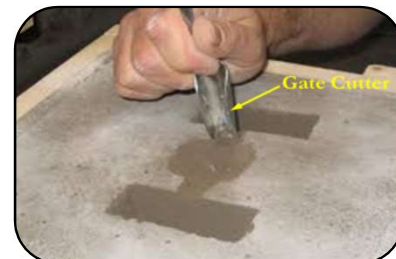
A swab is used for moistening the sand around the edge before the pattern is withdrawn. It consists of soft hair brush to hold water at one end, and a rubber bulb at the other end.



Foundry Tools (...Cont.)

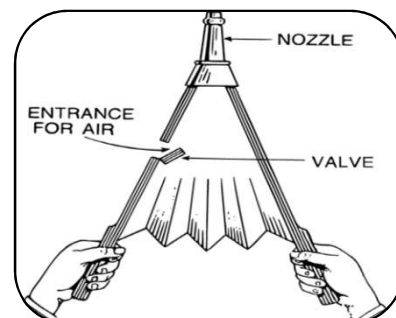
Gate Cutter

A gate cutter is used for cutting the gate in the mold which acts as a passage for the hot metal. It is U-shaped piece of thin sheet metal.

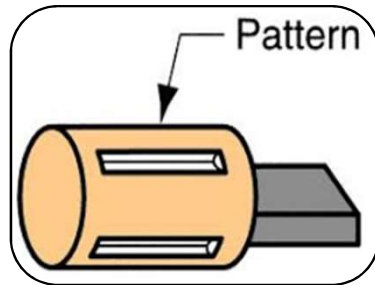


Bellow

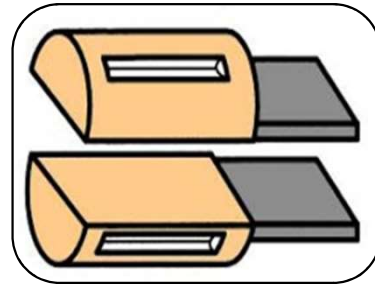
A bellow is used to blow loose particles of sand from the cavity and surface of the mold. Sometimes, a compress jet of air is used for this purpose.



Patterns for Casting



Single Piece Pattern

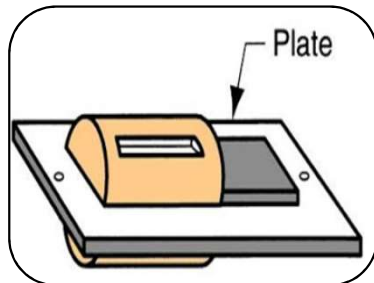


Split Pattern

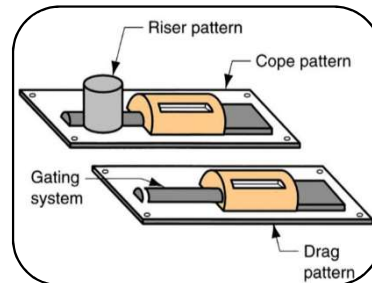
Single Piece Pattern: This is the simplest type of pattern, exactly like the desired casting. For making a mold, the pattern is accommodated either in cope or drag.

Split Pattern: These patterns are split along the parting plane (which may be flat or irregular surface) to facilitate the extraction of the pattern out of the mold before the pouring operation. For a more complex casting, the pattern may be split in more than two parts.

Patterns for Casting (...Cont.)



Match Plate Pattern



Cope and Drag Pattern

Match Plate Pattern: A match plate pattern is a split pattern having the cope and drag portions mounted on opposite sides of a plate (usually metallic), called the "match plate" that conforms to the contour of the parting surface.

Cope and Drag Pattern: A cope and drag pattern is a split pattern having the cope and drag portions each mounted on separate match plates. These patterns are used when in the production of large castings; the complete molds are too heavy and unwieldy to be handled by a single worker.

Sand for Foundry

Green Sand: The green sand is the natural sand containing sufficient moisture in it. It is mixture of silica and 15 to 30% clay with about 8% water. Clay and water act as a bonding material to give strength. Molds made from this sand are known as green sand mold.

Facing Sand: A sand used for facing of the mold is known as facing sand. It is used directly next to the surface of the pattern. Facing sand comes in direct contact with the hot molten metal; therefore it must have high refractoriness and strength.

Parting Sand: A pure silica sand employed on the faces of the pattern before molding is known as parting sand. When the pattern is withdrawn from the mold, the molding sand sticks to it. To avoid sticking, parting sand is sprinkled on the pattern before it is embedded in the molding sand. Parting sand is also sprinkled on the contact surface of cope and drag

Molasses Sand: A sand which carries molasses as a binder is known as molasses sand. It is used for core making and small castings of intricate shapes.

Basic Steps of Mold Making

- The drag flask is placed on the board. The dry facing sand is sprinkled over the board.
- Drag half of the pattern is located on the mold board. The dry facing sand will provide a non-sticky layer.
- Molding sand is then poured in to cover the pattern.
- Sand is then tightly packed in the drag by means of hand rammers.
- The ramming must be proper i.e. it must neither be too hard or soft. Too soft ramming will generate weak mold and imprint of the pattern will not be good. Too hard ramming will not allow gases/air to escape and hence bubbles are created in casting resulting in defects called 'blows'. Moreover, the making of runners and gates will be difficult.
- After the ramming is finished, the excess sand is leveled/removed with a straight bar known as strike off bar.
- Vent holes are made in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during pouring and solidification. It is done by vent rod.

Basic Steps of Mold Making (...Cont.)

- The finished drag flask is now made upside down exposing the pattern.
- Cope half of the pattern is then placed on the drag pattern using locating pins. The cope flask is also located with the help of pins. The dry parting sand is sprinkled all over the drag surface and on the pattern.
- A sprue pin for making the sprue passage is located at some distance from the pattern edge. Riser pin is placed at an appropriate place.
- Filling, ramming and venting of the cope is done in the same manner.
- The sprue and riser are removed and a pouring basin is made at the top to pour the liquid metal.
- Pattern from the cope and drag is removed.
- Runners and gates are made by cutting the parting surface with a gate cutter.
- The core for making a central hole is now placed into the mold cavity in the drag.
- Mold is now assembled and ready for pouring.



Sand miller

Sand milling machine is used to mixing sand with binder (*i.e.* clay) and moisture (Water)

References

References:

- [1] S. K. H. Choudhury, A. K. H. Choudhury and N. Roy, Elements of Workshop Technology, Volume I: Manufacturing Processes, Media Promoters, 2008
- [2] Steve Chastain , Metal Casting: A Sand Casting Manual for the Small Foundry Volume I:Stephen Chastain, 2004.
- [3] Peter Beeley, Foundry Technology (Second Edition),Butterworth-Heinemann, 2001

Thank you