Foundry furnaces

Melting or fusion: is a physical process that results in the phase transition of a substance from a solid to a liquid.

Foundry: is a factory that produces metal casting. Metals are cast into shapes by melting them into a liquid , pouring the metal into a mould, and removing the mould material after the metal has solidified as it cools

Furnace: is a device used to heat and melt metal ore to remove impurities.

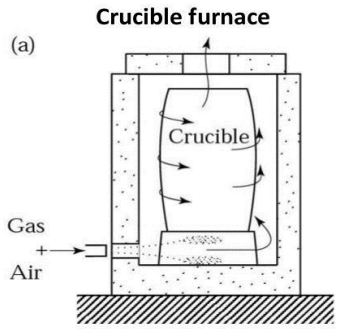
The selection of the melting unit is one of the most important decisions foundries must make with due consideration to several important factors including;

1. The temperature required to melt the alloy.
2. The melting rate and quantity of molten metal required.
3. The economy of installation and operation.
4. Environmental and waste disposal requirements.

Types of furnaces: To give a better idea of all the different types of foundry furnaces out there, here are the most common three furnaces in use at a manufacturing foundry:

1.Crucible Furnaces: (operated by liquid and gas fuels)

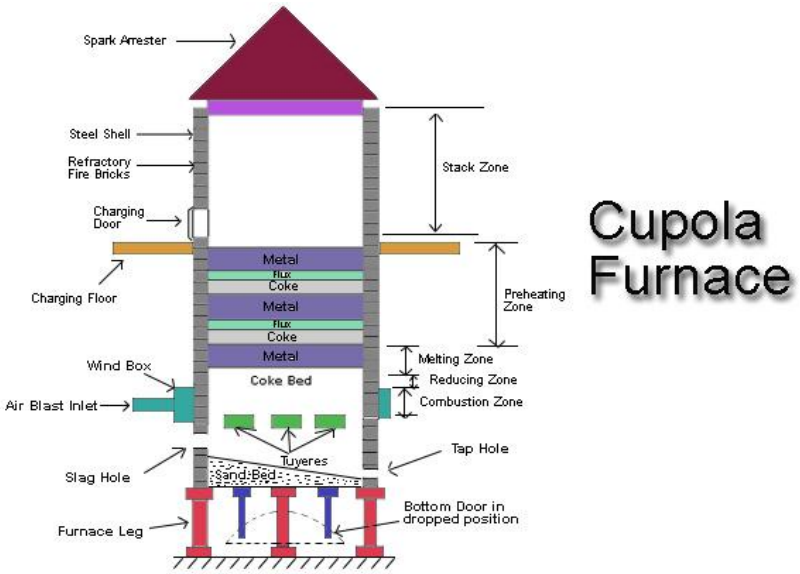
Crucible furnaces are very simple furnaces. They are often made of refractory materials such as ceramic so they can handle high temperatures. The crucible is placed into the source of heat and filled with metal and additives. They can range in size from a very small cup to large kiln-like furnace. Crucible furnaces are often used by jewellery makers and hobbyists. It is used to melt non-ferrous materials.



Crucible furnace

1.Cupola Furnaces: (operated by solid fuels)

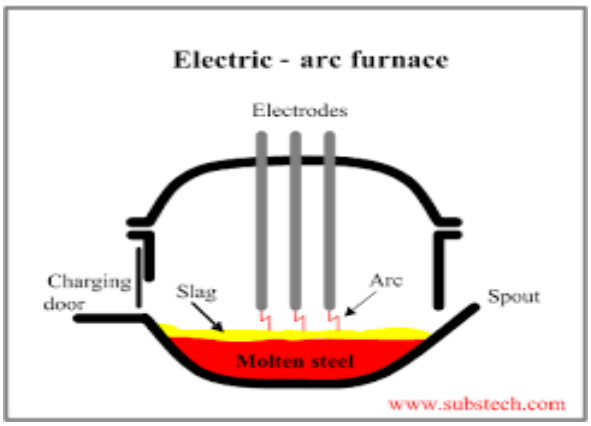
Cupola furnace is a melting device used in foundries that can be used to melt cast iron, Ni-resist iron and some bronzes. The cupola can be made almost any practical size. The size of cupola is expressed in diameters and range from 1.5 to 13 feet(0.5 to 4m). cupola furnaces are long, chimney-like furnaces that are filled with coal-coke and additives and lit. metal is then added directly to the furnace.



Cupola furnace

3.Electric arc Furnaces: (operated by electric)

Electric arc furnaces use electrodes to run an electrical current through the metal inside the furnace. Foundries usually use these types of furnaces of large slabs and beams and shredded scrap. When the tank of the furnace is filled with metal, electrodes are placed into the metal and an arc of electricity passes between them to melt it. Oxygen might be added to the process. It is used to melt alloy steel.



Electric arc furnace

Casting Defects

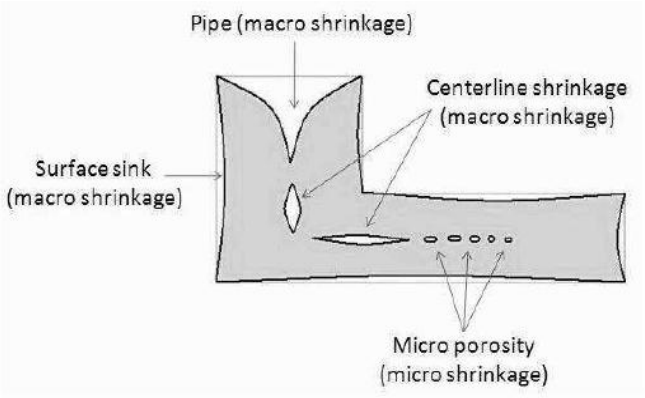
Casting defects are roughly broken down into five main categories;

-Gas defects -Moulding material defects -Pouring metal defects -Metallurgical defects. All of these categories include various types of defects which are shown below:

1.Shrinkage cavity;

Shrinkage cavity is a void on the surface of the casting caused mainly due to uncontrolled and haphazard solidification of the metal. Shrinkage defects can be split into two different types: 1) external shrinkage 2) closed shrinkage defects.

This defect can be eliminated by the use of feeders and chills at proper locations to promote directional solidification.



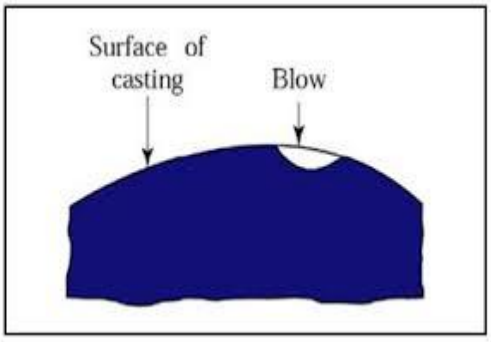
Shrinkage defects

2.Gas cavities:

a. Blow holes;

Balloon shaped gas cavities caused by release of mould gases during pouring are known as blow holes.

To prevent these defects should be increase the level of ventilation and increase the permeability of the sand and reduce the pouring temperature if possible.

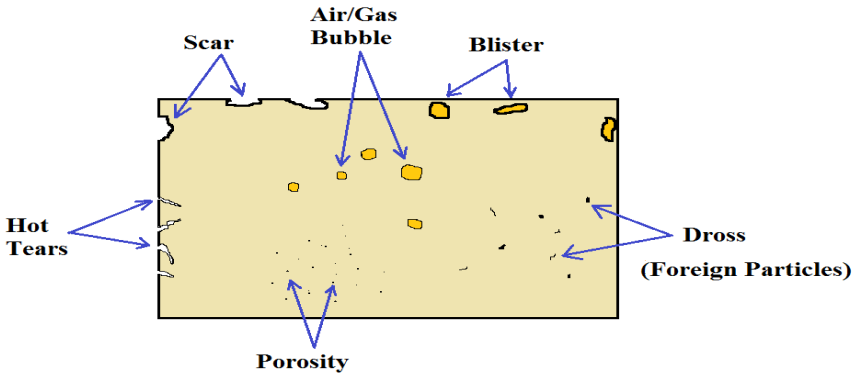


Blow holes defects

b. Gas Porosity:

Porosity is in the form of cavities causes due to gas entrapment during solidification.

To prevent porosity the material may be melted in a vacuum, in an environment of low -solubility gases, such as argon or carbon dioxide or under a flux that prevents contact with the air.

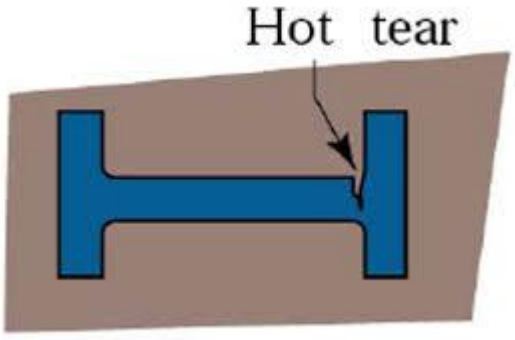


Porosity defect

3.Hot tears or hot cracking:

Hot tears are ragged irregular internal or external cracks occurring immediately after the metal have solidified.

In order to eliminate this defect, abrupt changes in section should be avoided. The pouring temperature should be correct and there should be even rate of cooling.



4.Cold shuts:

When two metal streams meeting in the mould cavity, do not fuse together properly, causing discontinuity or weak spot inside casting, it is called as cold shuts.

In order to eliminate these defects, the casting should be designed in principle of gating and rising and the molten metal should be poured at the correct temperature.

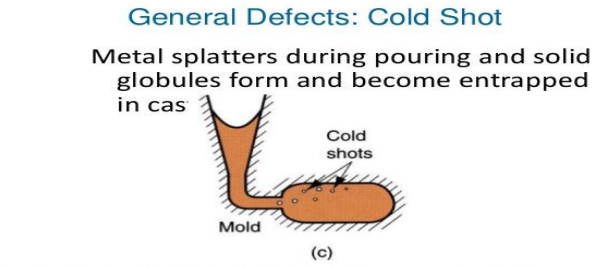


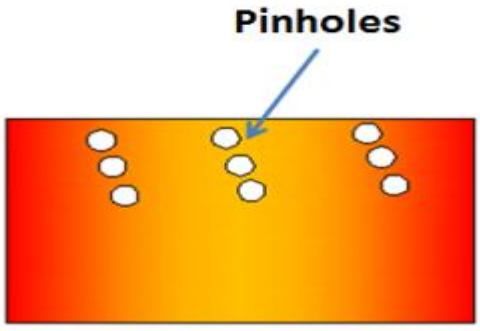
Figure 11.22 Some common defects in castings: (c) cold shot

Cold shot defects

5.Pin holes:

Formation of many small gas cavities at or slightly below surface of casting is called as pin holes.

To prevent these defects should be use charge components with low nitrogen contact and use materials free of impurities adhering to sand and helping with feeder.



Pin holes defect

Inspection of casting defects

The inspection methods may be divided into destructive or non-destructive categories depending upon the magnitude of damage done to the casting during inspection.

Non-destructive testing:

1.Visual inspection:

It consists of inspecting the surface of the casting with naked eye or sometimes with a magnifying glass or microscope. It can only indicate surface defects such as blow holes, fusion, swells, external cracks, and mismatch. Almost all castings are subjected to certain degree of visual inspection.

2.Penetrates testing:

This method also is used for detecting very small surface cracks and it can be used for any material. The parts to be tested are either dipped into or covered with a penetrant testing liquid which has very good wetting and penetrating ability. The liquid is drawn into the cracks or voids by capillary action. After the penetrant has been applied to the surface to be tested, a developer applied to it. This developer helps in drawing out the penetrant so that it becomes visible on the surface.

3.Magnetic particle testing:

This test is used for detecting cracks in metals like cast iron and steel which can be magnetized. For carrying out the test the casting is magnetized and then fine particles of iron or steel are spread on its surface. Presence of a crack or void in the casting results in interruption of the magnetic field and leakage of magnetic flux at the place of the crack.

Destructive inspection

1.Ultrasonic testing:

Ultrasonic testing is used to detect defects like cracks, voids or porosity within the interior of the casting. The method uses reflection and transmission of high frequency sound waves. Ultrasonic sound waves much higher than the audible range are produced and made to pass through the casting.

2.X-Ray test:

This method is used to inspect the internal defects of castings such as gas porosity, cold shut, cracks, shrinkage and gas holes.

In this method, a casting is exposed to radiation from an x-ray tube. Dense material withstands the radiation penetration, so the film is exposed to a lesser degree in those areas, giving the film a lighter appearance. Less dense materials allow more penetration and correlates to darker areas on the film. any hole, crack or inclusion that is less dense than the casting alloy is revealed as a dark area.