

Metal Casting Basics 2

**Your Basic Guide
to Metal Casting
Volume 2**

MetalCastingZone.com

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What is Casting?

Casting can be defined as a process of manufacturing, which implies pouring of a 'liquid' material into 'A Mold' containing a desired shaped hollow cavity, and then made to solidify. The ejection or breaking out of the casting then takes place to get the process completed. The use of casting is 'forming hot liquid metals' or numerous metals that are cooled after having the components like clay, plaster, concrete, and epoxies mixed. Complex shapes are normally made by casting, as other methods are not feasible. Casting came into being around 6000 years ago. 'Copper Frog' is the most ancient casting existing till date since 3200 BC. The process of casting has two distinct subdivisions: non-expendable and expendable mold casting.

'Non-expendable' mold casting: This technique is inclusive of at least 4 distinct methods: continuous, centrifugal, die, and permanent casting.

Continuous casting: Continuous casting can be defined as a refined process of casting for high-volume, continuous production of 'metal sections' with constant cross-section. The pouring of molten metal into a water-cooled, open-ended copper mold takes place. This allows a 'layer' of 'solid metal' to be formed above the 'still-liquid' center. Continuous casting is widely accepted due to its cost-effectiveness. The metals continuously cast are aluminum, copper, and steel.

Centrifugal casting: Centrifugal casting is independent of both-pressure and gravity. This is because its own 'force feed' is created by the way of using a 'temporary sand mold' in 'spinning chamber' at 900 N. Lead time is variant with respect to application. True- and semi-centrifugal processing allow 30 to 50 pieces/hr. The batch processing has an upper limit of around 9000 Kg (practically). This method used to be applied for 'Casting of Railway Wheels'. It was developed by the company called 'Krupp'. It had a German origin. Jewelry is normally cast by this method.

Die-casting: Die casting can be defined as a process of 'forcing molten metal' into cavities of mold under high pressure. These castings comprise of nonferrous metals, especially-alloys of aluminum, copper, and zinc. It is even possible to make die castings of metal. The method of die casting is used where finer parts are needed.

'Permanent Mold Casting': This casting is made up of non-ferrous metals. It requires some time to set up (some weeks), after which the production rate of about 5 to 50 pieces/hour-mold is achieved. The coating of 'acetylene soot' is applied to steel cavities. This helps in removing the work piece easily and promoting longer life (of tools). Permanent molds possess a limited life span. For worn molds, replacement or refinishing is required.

Expendable mold casting: 'Expendable Mold casting' can be referred to as a standard classification inclusive of the following:

Sand casting: It is amongst the simplest and most popular casting types used since ages. It involves very small size operations. The bonding of sand takes place by use of clays (as in 'green sand') or 'polymerized oils', or 'chemical binders'. Recycling is easily possible.

Plaster casting (for metals): There is no difference between plaster casting and sand casting, except the fact that plaster is used in place of sand. Similarly, there are also plastic and concrete castings.

Learn The Casting Process

There are various casting processes being implemented now days. The oldest amongst them is sand casting. Spin casting is also widely used. They can be described as follows:

Sand Casting: Sand casting involves formation of mold from a mixture of sand and to pour a casting liquid, most probably, a molten metal into mold. The metal is then allowed to solidify and the removal of mold, takes place. Sand molding consists of two types: green sand method and air set method. The first one consists of mixture of clay, moisture, silica, and many other additives. The second one consists of mixture of dry sand and other materials, not moist clay. They are mixed with the help of a quick curing adhesive. The collective use of these materials is called 'air set'.

At times, there is temporary plug placed to pour the fluid which is to be molded. Air-set molds usually form molds consisting of two parts-the bottom and the top. The mixture of sand gets tamped down after its addition. It does not generate any by-product. After the solidification and cooling of metal, the mold gets usually destroyed. This is because its removal involves a lot of breaking and cracking. The casting accuracy depends a great deal on the sand and the process of molding used. Castings composed of green sand result into formation of rough texture on casting surface, and this characteristic makes them easily recognizable. Air-set molds produce smoother castings.

Many a times, the casting process results in losing of components of sand mixture. It is possible to reuse green sand by the way of adjusting the composition to get the lost additives and moisture replenished. The entire pattern itself is eligible to be reused for producing novel sand molds. The method of reuse can be continued for an indefinite period. In 1950, casting process got automated partially. They have been in great demand for developing production lines since then.

Spin Casting: Spin Casting is better known as Centrifugal Rubber Mold Casting (CRMC). It implies utilization of centrifugal force for producing castings out of rubber mold. As a customary practice, a mold having shape of a disc gets spun through its 'central axis' at a pre-decided speed. The material used for casting is usually thermoset plastic in the liquid form or a molten metal. It gets poured into the mold through the opening at its centre. Corresponding to the solidification of metal, or the setting of thermoset plastic, the spinning of the filled mold takes place.

Normally, organic rubber or vulcanized silicone is used as a mold-making substrate in spin casting. Vulcanization takes place in the middle of process of mold-making. After the successful completion of vulcanization process, venting and gating must be undergone by the mold. This implies carving of channels for ensuring proper material flow and air during the course of casting. A scalpel or knife is used to carry out the above two processes. The mold complexity is directly proportional to the time required in implementation of venting and gating.

Casting Furnace Types

There are several types of casting furnaces which include Electric Arc furnaces, Blast furnaces, Cornwall Iron Furnace, etc. Here's a quick review of some of them.

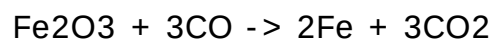
Electric Arc Furnace: This furnace can be described as a furnace heating charged materials by the way of an electric arc. These furnaces exist in all the sizes-right, from the smallest one having a capacity of around 1 ton to the largest one having a capacity of 400 tons. The former one is used in foundries to produce cast iron products, whereas the latter one is used for secondary steel making. The ones used by dentists and in research laboratories might be having capacity of a few grams only. The electric arc furnace can have temperatures risen up to 1800 Celsius. The first electric furnaces came into being in 1907, at the hands of Paul Heroult of French origin. The commercial part of these furnaces was established in the United States of America. In the beginning, the specialty product used in the making of spring steel and machine tools was electric steel. Calcium Carbide was also prepared in these arc furnaces. It (calcium carbide) was used in carbide lamps.

This furnace comprises of a refractory-lined vessel, normally water-cooled in huge sizes, having a covering of a retractable roof, through which the entry of graphite electrodes takes place. They might be one or many in number. The furnace is divided into 3 sections: the shell, consisting of lower steel bowl and sidewalls, the hearth, consisting of refractory lining the lower bowl, and the roof, that can be water-cooled or refractory-lined, and can easily be

shaped into a spherical section or conical section (frustum). A refractory delta is also supported by the roof at its center, by the way of which graphite electrodes make an entry.

The process of operation starts with delivery of scrap metal to scrap bay which is located adjoining melt shop. After that, the loading of scrap into huge buckets or baskets takes place. The next step is to carry this basket to the melt shop. The charging takes place here. After the completion of charging, let the electrodes be allowed to enter and placed onto scrap. This causes the arc to be struck. Lower voltage is preferred for this part (of operation) to provide protection to the walls and roof against arc damage and excessive heat. After having the electrodes reached the heavy melt, shielding of arcs by scrap takes place. This enables a rapid formation of molten pool, thereby decreasing tap-to-tap times. Oxygen is also allowed to enter.

Blast Furnace: It can be referred to as a kind of metallurgical furnace, through which the process of smelting takes place. This produces metals, normally iron. These furnaces trace their origin to China (around 500 BC). They were also found in Belgium and England later. They do not have any special mode of operation. The metals get melted by heating only. Generally, iron is melted in these furnaces. The chemical reaction can be explained as follows:



DIY Casting Furnaces

DIY casting furnaces are nothing but Do It Yourself casting furnaces. One can make variety of furnaces. The procedure of some of them can be described as follows:

DIY Induction Furnace: Theoretically, only three things are required for implementing induction heating: High frequency Electrical Power Source, work coil for generating an alternating magnetic field, and a workpiece-electrically conductive. However, the practical approach is very complicated. For instance, the work coil and High Frequency source' should have a matching network in between, to obtain better power transfer. Use of water cooling systems is very common in induction heaters of high power. This facilitates removal of waste heat from the matching circuit of the work coil and the coil itself. This process involves application of control electronics as well. Control Electronics, as the name suggests, controls the heating action's intensity, thereby ensuring consistent results. It also provides protection against unpleasant operating conditions.

Usually, the incorporation of work coil takes place into a resonant tank circuit. There are innumerable advantages of this. The first advantage is that any one of the parameters, i.e. voltage or current is made sinusoidal. This causes fewer losses to inverter by the way of allowing it getting benefited from either zero-current-switching or zero-voltage-switching corresponding to the arrangement chosen. The visibility of sinusoidal waveform at work coil gives the proof of purity of signal. There also occurs less interference of

radio frequency with the equipment in its vicinity. It's up to the designer to choose one amongst several resonant schemes.

DIY Bronze Furnace: The making of DIY Bronze furnace involves taking silica bricks of 9 inches X 4 ½ inches X 2 ½ inches in the first place. After that, one is supposed to put a steel plate having dimensions 18 inches X 24 inches at the place where he intends building the furnace. In other words, the steel plate should be used as a base. The construction of furnace should start thereafter. It is advisable to keep the circumference of the furnace as 14 inches. A small hole of diameter 3 inches should be made at a height of 5.5 inches above the floor. Let the height of the cylindrical furnace be 11 ½ inches (including floor). This hole is to be used for inserting the burner.

The cutting of the burner port should be done in such a way that it acts as a perfect tangent to furnace. This should be done in order to make the flames whirl around crucible, thereby hitting it indirectly. The peculiarity of bronze casting is emission of toxic fumes. Therefore, it is always advised to perform the casting task in the area which has ample ventilation. Wearing of safety clothing is recommended. After the completion of furnace (including the cutting of hole to get the fitting of one's biggest crucible enabled), it should be permitted to dry. At that time, trawling of water, vermiculite, and kaolin clay on the exterior is recommended. The immediate use should be strictly avoided, as it may develop cracks. After drying, let the furnace be heated slowly to reduce 'kaolin paste' cracking.

Casting Torches - Furnace Torches

Oxy-fuel cutting and oxy-fuel welding can be described as the processes of using oxygen and fuel gases to either cut or weld metals. There are some striking differences between these two processes. In the first process, a cutting torch is made use of for heating ferrous metal to a temperature of around 980 degree Celsius. An oxygen stream is being trained on a hot metal that combines with iron chemically which later flows from the kerfs, or cut in the form of slag of iron oxide. In the second process, a 'welding torch' is made use of for welding metals.

Torches that burn the inside fuel with air (atmosphere) cannot be termed as oxy-fuel torches. They stand out owing to the use of single tank. This is because oxy-fuel cutting/welding requires oxygen, fuel, and two tanks. It's not possible to melt some of the metals with single-tank torches. Hence, these torches can be used for brazing and soldering, but not for welding. A metal-cutting torch is better known as hot blue spanner, blue wrench, hot wrench, smoke wrench, and gas-axe.

Types of Torches: The torch can be defined as the part held and manipulated by the welder to get the weld made. It possesses a valve and connection for oxygen and the same things for fuel gas, a handle to obtain the grip, an integrating chamber (angularly set) where there occurs a mixing of oxygen and fuel gas, with a tip where formation of flame takes place. The fuel gases used along with oxygen include propylene, propane, hydrogen gas, MAPP gas, Liquefied Petroleum Gas (LPG), and the most widely used is acetylene.

Injector Torch: It can be defined as an archetypal oxy-fuel torch, also known as an equal-pressure torch. It carries out the mixing of mere two gases. The injector torch operates in such a way that high pressure oxygen comes out of the tiny nozzle present in the torch head, and the fuel gas gets dragged towards it via the venturi effect.

Rose-bud Torch: The use of this torch is to carry out the heating of metals for straightening, bending, etc. It is generally used where a huge area requires heating. It produces a rose-bud shaped flame at the end, hence the name. This torch can carry out the function of heating small areas like rusted bolts and nuts as well. However, here, filler rod won't be used with torch.

Cutting Torch: The head of the cutting torch is used for cutting metal. Its identification details are as follows: The inside of the torch consists of a combination of oxygen and acetylene. It helps in producing flame of a high temperature. It consists of 3 pipes going to a nozzle at 90 degree. It also contains an oxygen-blast trigger which blasts away the material during its cutting by the way of providing oxygen.

Welding Torch: The welding torch consists of either 1 or 2 pipes running towards the nozzle without oxygen-blast trigger. As the name suggests, it performs the function of welding.

Casting Jewelry

Casting is a process in which liquid material made from heating metals, is poured in a module, to give the liquid a desired shape. Then the liquid is cooled and a solid object in the desired shape and size is obtained. Casting Jewelry is the latest “in-thing” in the fashion markets. This jewelry is made from different materials like silver, aluminum, gold, bronze, alloy metals and even plated casting jewelry is available.

Casting Jewelry is very attractive and delicate. They are made using machines, but very finely crafted and hand made jewelry is also available in the market. This type of jewelry can be available at a very low, as well as high costs, depending on the design and material and design that you choose. Casting Jewelry is very fragile and should be handled with out most care as it can break easily. With the advent of casting jewelry, the fashion world has benefited a great deal. Today, free flowing designs, multicolored jewelry and even a special made to order jewelry is available in the market.

Before this, it was difficult to cast a metal in a desired shape but today it is as simple as it gets, all you need is a creative mind to create new designs and a group of well qualified workers and good machinery to make your own casting jewelry. This also gives you an option to make your own series of new designs. Casting jewelry is being widely used across the globe. With the prices of gold increasing day by day and with the entry of new metal jewelry like platinum, casting jewelry slowly but surely is making a mark in the fashion world. With the cost silver plated casting jewelry, the dream of wearing a new necklace or a new ear-ring everyday is a reality. You can

actually afford new set of jewelry everyday. There are also costly models made of pure gold and delicate designs and with embedded diamonds that are available.

Casting Jewelry is not only about fashion, it has also opened a new avenue for small scale businesses. With proper knowledge and machinery, you can start your own company and make casting jewelry. It does not need any expensive material nor does it need a big capital. A small store room in your house will also be sufficient to set up your casting jewelry work-shop. You can then design your own range or hire a professional jewelry designer to create your range of jewelry.

Casting Jewelry has also helped the educational branch of “jewelry designing” grow considerably. Today it is considered in par with “fashion designing”. Many young students are nowadays looking at jewelry designing as a full time career.

The only draw-back of plated casting jewelry is that is they are used on daily basis, then they might lose their shine and the coated silver or gold respectively. If they come in contact with water regularly, then they can turn black. You can get them re-plated and use them. As casting jewelry is very fragile and delicate, even a slight mishap can change its shape or even break it.

Gravity Casting

Research and development in gravity casting has taken an important step in making metal products a part of our day to day lives. The products used in homes, aircrafts, artifacts, automobiles have become more durable and less expensive. Cast alloy parts are formed by melting the alloy and then pouring it in a mold under heavy pressure or vacuum. Gravity casting is also known as vacuum casting. It is a technique in which large diameter filaments are used with adequate separation. This ensures that no clusters are formed and also good metal wetting of the fiber is guaranteed. This technique was first used in 1970. The gravity casting method has advantages like cost effective, good quality, and process control over other casting techniques.

Gravity casting is done in ceramic molds, sand, permanent casting and also in investment or lost wax casting. The gravity casting process was started with common steel after successful implementation it was further tried on heat resistance super alloys. With recent development and with more refined methods today even titanium alloys are being cast using the gravity casting method and using ceramic crucibles. The use of desired mold designs and also specially made unique designs enable a reduction in the metal cast to yield the given part. This also helps in reducing the amount of energy that is used in making such casting articles.

With new developments, today even computerized control of the vacuum pressure and rate is possible. This enables the user to control the filling rate. This makes casting of high quality metals like and viscous metals like metal matrix and composites of aluminum casting possible. This gravity casting

method is used to produce casting worth of more than \$200 million. The industry is expected to grow rapidly in the coming years due to the increase in production of automotive exhaust manifolds in stainless steel.

The first ever commercial use of this computerized technology, was made by Howmet Industries of Whitehall, Michigan. They used this technology to precisely cast and design turbine blades used in aircrafts. This technology is also being used by Ford Motors to develop and improve the casting process of light truck and automobile engine blocks.

Today, metal parts fabricated using gravity casting method is being used in 90 per – cent of all durable goods. Goods like stoves, washing machine, automobiles, refrigerators, lawn mowers, cars and even boats. Many other articles like badminton rackets, tennis rackets, and even football studs are made by using light weight metals which are gravity casting method. This gravity casting method has been used to develop metal alloy parts, which are used for the auto and airline industries, which is said to make vehicles lighter though much stronger and extremely efficient.

Alloys like ferric cast metals, casting grade iron and steel are typical metals that are used for gravity casting. Also die cast grade zinc can be cast using gravity casting method. Also other raw materials like sand, spin or plaster are used. Aluminum is also used, but it is very difficult to gravity cast aluminum a lot of care needs to be taken and proper pressure should be applied to obtain the desired shape and effect.

Die Casting

Die casting is the method used for forcing molten metal into mold cavities under high pressure. Die casting is very versatile and hence, is the widest used method for casting a metal. Die casting is same as permanent mold casting the only difference is that the metal is injected into the mould at very high pressure of 10-210 Mpa. This results in a more uniform part, usually good dimensional accuracy and also good surface finish.

The different metals and alloys that can be used in die casting are zinc, aluminum, copper, magnesium, tin and lead. Ferrous metals can also be used for die casting, die casting method is generally used for applications in which a large quantity is medium or small sized parts are required with detail, good dimension and fine surface finish.

There are namely two equipments used for die casting cold chamber and hot chamber process.

Cold Chamber process: In the cold chamber category of die casting, a cold chamber of each module is filled with molten metal. The time exposure provided for the molten metal to plunge the walls of the mold is less. This cold chamber process method is very useful for metals like aluminum, copper and metals that easily alloy with iron at high temperatures.

Hot Chamber process: In the hot chamber process method of die casting, the pressure that is connected to the die cavity is forever and permanently in molten metal. As the plunger moves towards the open position that is towards the non - pressurized area, the inlet port connected to the pressurizing cylinder is uncovered.

The die casting molds which are used in this method are expensive and take usually take long production time. These die casting modules are also called as “dies’

Advantages of Die Casting: The method of die casting gives excellent dimensional accuracy. The dimensional accuracy is as good as 0.1mm for the first 2.5cms and 0.005 for the first inch. Die casting also provides with smooth cast surfaces. Small and thin walls and can be made using the method of die casting walls as tiny as 0.75mm approximately can be casted. Inserts like thread insert, high strength bearing surfaces and heating elements can also be inserted using the Die Casting method. Die casting also helps in reducing or even completely eliminating the use of secondary machining operations. The use of Die Casting method also helps to reduce the production time and a huge number of articles can be produced in a very short time. Die casting method also helps to retain as well as increase the tensile strength of the metal. It offers tensile strength as high as 415 MPa that is 60ksi.

Disadvantages of Die Casting: The casting weight is very less hardly between 30 grams and 10 kgs. Also the size of the material that needs to be casted using the Die Casting method needs to small say around 600mm. the

process of Die Casting requires high budget and can pile up high initial cost. Die Casting method makes the metal porous up to some extent. In the Die Casting method the thickest section needs to be less than 13mm or 0.5 inches.

Lost Wax Casting

Lost Wax Casting is known as Cire Perdue in French. It is a process in which an artist's sculpture is used to cast bronze. The Lost Wax Casting method is also known as Investment Casting in the modern industrial world. This is a very ancient method used for casting small bronze sculptures, but today it is used to make many different artifacts and the process varies from foundry to foundry. Today this developed method of Lost Wax Casting is used to make articles like fine jewelery, show pieces, dental restoration, a few specific industrial parts and also some machine tools.

Rough Sculptor making: A creative artist makes an original sculptor or mold or an artwork by using raw material like wax, plaster of Paris or clay. A mixture of oil based clay and wax is preferred as these materials retain their softness.

Final Mold Making: A mold is then made as per the original sculptor. The mold is made up of two pieces and a key with shim is placed between the two pieces during construction so the mold can be put accurately back together. Molds are generally made using plaster or fiberglass or any other material that may be suitable. An inner mold of latex or vinyl or silicone is put to preserve the details of the original art work. Generally, the original art work made of plaster mold cracks and breaks during the initial phase of deconstruction. Many a times, numerable molds are required to get the exact replica of the original art work.

Filling up the mold: Once the latex and plaster mold is complete and finished, molten wax is poured into the mold till it gets an even coating all around the mold. The thickness of the wax coating is around 1/8 inch. This process is then repeated until the desired thickness is achieved.

Removal of wax replica: The hollow wax replica of the original art work is then removed from the mold. The original mold can be used for making more wax replicas, but due to the wear and tear of the original mold the reuse of the mold is limited.

Softening: Each wax mold is then chased or softened using heated metal tools. The metal tools are rubbed around portions that show cracks or the joining line of the mold, where the pieces have come together. Separately molded wax pieces are then heated and attached. The finished mold is then dressed in order to hide any imperfections. The final piece then looks like a bronze sculpture.

Making paths for molten bronze: It is also known as “spuring”, in short the wax copy is then branched with treelike wax, so that the molten bronze reaches the right parts and also it helps the air to escape. The critical and careful spuring begins from the top of the wax copy. The top of the copy is attached to by wax cylinders to different points on the wax copy.

Slurry, burnout, testing, pouring, release, metal-chasing, and painting are the final steps in the process of Lost Wax Casting.

Lost Foam Casting

Lost Foam Casting is a sub type of Investment Casting. This type of casting method uses foam pattern as the investment. This method benefits from the advantages of the foam properties helpful to make simple and cheap castings. These types of simple castings are impossible using the regular cope and drag method.

Foam Shaping: The original foam pattern of the Polystyrene is generally molded or carved.

Carving Polystyrene: The formed foam or polystyrene is then carved using traditional carving tools or the new-age hot-wire cutting tools. It can also be sanded easily.

Injecting Polystyrene in a Mold: Polystyrene contains pentane as a blowing agent and is commonly used for beads. The beads are pre-extended, stabilized and then blown into the mold to form pattern sections. A steam cycle forces the beads to expand fully, after this the fuse together and then it undergoes an in-mold cooling cycle. The final shape is very complex, then it is molded in sections. A cluster is formed by aging and gluing together the shaped foam sections.

Preparing Final Mold (Investment) for Casting: Gates and Raisers are generally attached to the pattern, they are also the part of the casting as

this helps reduce the shrinkage. Pouring, dipping or spraying are the different methods used for coating the foam cluster with ceramic investment. The reason for this coating is that it forms a barrier and helps to prevent the molten metal to penetrate or cause sand erosion while pouring. Structural integrity of the casting is protected thanks to the coating. The cluster when dried is backed up with un-bonded sand and is placed in a flask. Proper and uniform compaction is then achieved by performing mold compaction using a vibrating table. After all this process and after proper compaction, the mold is ready to be poured.

Automatic pouring is the preferred method in Lost Foam Casting. This is the most critical process and also a bit difficult than the traditional foundry practice. As there are no parting lines or fins to remove the cleaning is easier and requires far more less time and operations in the Lost Foam Casting process.

Advantages of Lost Foam Casting: Due to its unique properties, foam is easy to carve glue and manipulate. It also provides accurate dimensions as Lost Foam Casting is more accurate and effective than sand casting. There are no fins or parting lines the finishing process is easy and less time consuming. The elimination of cores makes complex casting designs easy. Lost Foam Casting also allows us to control the wall thickness and thus no core prints are required thus eliminating shifts or fins and also saves the trouble of sand mixing and core defects. As there are no drafts multiple levels of casting is possible. Precise gate and riser replacements are achieved. Unconventional forms of casting that are difficult or impossible to achieve in traditional cope and drag method are easily achieved in Lost Foam

Costing. Due to simpler process and easy finishing work, the process is very cost effective and lowers the overall price of the final product.

Bronze Casting

Bronze has been the most sought-after metal for cast metal sculptures in the bygone years. Bronze alloys have a desirable and unusual property to expand slightly prior to their setting. This helps a great deal in filling every corner of the mold. Their ductility and strength causes them to be molded into any form. However, bronze has a basic disadvantage of not being durable. Hence, there are hardly any traces of ancient bronze statues found. Bronze casting generally takes place by a process called lost-wax casting. Though, centrifugal and sand castings are also employed, around 90% of bronze casting takes place through lost-wax casting.

Lost-wax method: Lost-wax casting, in the industry, is better known as investment casting. It is costlier than die and sand casting, but outshines them in terms of accuracy. It is easily possible to make complicated structures through 'lost-wax casting'. The process can be described as follows:

Sculpting: First, the original artwork is created by the artist from clay, wax, or some other material. Mostly, clay (oil-based) and wax are used due to their property of retention of softness.

Mold making: Majority of molds consist of 2 pieces, along with a shim placed between 2 halves at the time of construction in order to put back the mold accurately. Keys are kept in the shim. The small sculpture molds generally consist of plaster. Fiberglass can also be used. To have the minute

details preserved on the surface of original artwork, there exists a mold inside. It is made up of vinyl, silicone, or latex supported by plaster part of mold. Generally, the destruction of original artwork takes place during making. This is due to the solid nature of the originals. The other reason is the rigidity of the originals at the time of removal of plaster mold. That's why; the original is cut off into thin, long pieces and separately molded. At times, a number of molds are required for recreating the original structure.

Wax: After the completion of latex-and-plaster mold, the pouring of molten wax takes place. Then, swishing is carried out till a uniform coating is obtained. The thickness of the coating is 1/8 inches. The mold's inner surface gets covered by it. This process is repeatedly executed till the preferred thickness is attained.

Wax removal: Artwork's 'hallow wax copy' is detached from mold. This mold may be reused by the artist for making more copies of wax, but its use gets restricted due to frequent 'wear & tear'. Around 25 copies can be made for tiny bronze artworks.

Chasing: The chasing of each copy starts. Rubbing of the marks is done by a hot metal tool. The marks showing 'flashing' or 'parting line' are rubbed out.

Spruing: The spruing of copy generates paths to flow (for molten bronze) and causes air to move out.

Slurry: The dipping of sprued copy into a liquid silica slurry, and then into sand-like 'stucco' takes place. This process is repeatedly carried out till the coating attains thickness of at least ½ inch.

After these steps, the out-and-out processes like burnout, testing, pouring, releasing, metal chasing, and patinating are carried out.

Brass Casting

Brass casting, as the name suggests, involves the use of brass as the molten metal. Brass casting can be carried out by the way of sand casting only. Sand casting can be defined as a 'cast part' produced by formation of a mold from a mixture of sand and pouring the casting liquid (mostly molten metal) into mold. Then the air-cooling of the mold takes place. After the solidification of metal, the removal of mold takes place. The metal used here is brass. It is a known fact that brass is an alloy of copper and zinc. Hence, to be precise, the molten metal consists of two elements.

Sand molding consists of two types- 'Green sand' molding and 'air set' molding. The first one consists of a blend of moisture, clay, silica sand and other additives. The second one makes use of dry sand bonded to all the above materials except moist clay, by the way of using an adhesive, which is fast curing.

At times, there is a placing of a temporary plug (in the mold cavity) to enable the formation of a channel to pour the fluid which is to be molded. The molds of the second type, i.e. the air-set molds result in the formation of a 2-part mold. The two parts are bottom and top. The tamping-down of the sand mixture takes place as it gets added. Many a times, the final assembly of the mold is vibrated to get the sand compacted and get the unwanted voids filled. Then the molten alloy (brass) gets poured into mold. After the solidification and cooling of brass, the separation of casting from sand mold takes place. Normally, such molds are one-time usable.

Patterns: A designer or an engineer provides the design of the object to be produced. On the basis of this design, a pattern is built by an efficient pattern maker by the use of plastic, metal, or wood. Polystyrene can also be used. The casting brass would get contracted during solidification. Non-uniformity can also result out of this. Therefore, the size of the pattern should be a bit larger as compared to the final product. 'Contraction Allowance' is the name given to this difference. Brass enters the mold cavity through a runner system including sprue and other feeders.

Molding box: A molding box having multiple parts (also known as casting flask whose bottom and top halves are called drag and cope respectively) is constructed for receiving the pattern. There may be an addition of sand to nullify the defects introduced due to the pattern getting removed.

Chills: To have a proper control over metallurgical structure and solidification of brass, plates of brass, or any other metal can be placed in mold. A hard structure may get formed at these places. Chills can be used for promoting directional solidification as well.

Design Requirements: The thing in making and the pattern corresponding to it should be designed in such a way that every stage of process can get accommodated. One should be able to take away the pattern without causing any disturbance to molding sand.

Aluminum Casting

Aluminum is amongst those metals which can be 'cast' by every process used in metal casting. These processes, in descending order of quantity of aluminum casting are: die casting, permanent mold casting, sand casting, plaster casting, investment casting, and continuous casting. The casting process is selected on the basis of factors such as cost, feasibility, quality, etc.

Feasibility is not a problem, as all the above methods are quite practicable. However, the most suitable casting method can be decided according to the design features or dimensions. For instance-Large products are made using sand casting. The quality factor is also important in selecting the casting process. Quality refers to both, mechanical properties (ductility and strength) and soundness (surface imperfections, cracking, and porosity freedom).

The methods most commonly used can be described as follows:

Die Casting: As per the statistics, around \$2.5m worth of die-castings of aluminum alloys are produced in the US alone every year. The process of die casting utilizes almost two times the tonnage of aluminum alloys as the combination of other casting processes. Die casting is best suited for large quantity production of relatively tiny parts. Aluminum die castings upto 50 Kg of weight can be produced if casting-machine costs and high tooling are justified.

Some common applications of die cast aluminum alloys are inclusive of alloy 380.0 for Lawnmower housings, Alloy A380.0 for streetlamps housings, dental equipment, typewriter frames, Alloy 360.0 for frying skillets, instrument cases, cover plates, parts needing corrosion resistance, Alloy 413.0 for outboard parts of motor like connecting rods, pistons, housing, and Alloy 518.1 for conveyor components, escalator parts, aircraft, marine hardware.

Die castings cannot be easily heated or welded due to entrapped gases. Efforts are being on the war footing to overcome this obstacle. The die castings of aluminum alloys are generally produced using aluminum -silicon-copper alloys. This alloy family gives an excellent combination of corrosion resistance, strength, and cost, along with respite from 'hot shortness' and high fluidity which are mandatory for easy casting. If one desires a better resistance to corrosion, he should make use of alloys having a lower copper content.

'Permanent Mold' casting: 'Permanent mold' casting is best suited for high-volume production. Their size is larger than 'die castings'. These castings have a very low pouring rate. They are gravity-fed. Outstanding mechanical properties are exhibited by 'permanent mold' castings. There is a lot of scope for further improvement if they are given heat treatment.

Some of the most common alloys of 'aluminum permanent mold casting' include Alloy 366.0 for automotive pistons, Alloys 355.0, A357.0, C355.0 for

impellers, timing gears, compressors, missile and aircraft components, Alloys A356.0, 356.0 for aircraft wheels, parts of machine tools, pump parts, valve bodies, marine hardware, and 296.0, 333.0, 319.0.

Sand casting: This type of casting involves formation of casting mold (with sand). It is inclusive of conservative sand casting & lost-foam casting. The first one involves forming a pattern of sand, pouring the molten metal into it and breaking it once the product is formed. Lost-foam pattern involves putting a dispensable pattern of polystyrene in the mold. The rest of the procedure is the same as conservative sand casting.

Iron Casting

Iron castings can be referred to as products made out of melted iron molecules. These molecules are, first, poured into mold and allowed to cool. They are then extracted. The casting properties depend a great deal on the foundry practice. They also depend on the cooling rate. Iron contains huge carbon concentrations. This content facilitates melting, simplicity of casting, and machining. Iron casting designs have a great variation owing to the property of iron to resist shrinkage during the process of cooling. The end product attains a great reputation for its strength and durability. Tensile strength ranges between 20,000 psi and over 60,000 psi. The values of hardness (without heat treatment) range between 100 and 300 BHN.

Some factors need to be considered while buying iron castings. The first thing on the agenda should be, checking the quality of foundry used in products and procedures. This should be done because foundry practices determine the casting properties. The consumer might have a tough time in finding the apt one. Secondly, the concentration of carbon should be looked into. The percentage of carbon commonly ranges between 2.5 and 4%. An addition of even 0.1% would cause the tensile strength to decrease by around 2700 psi. Casting procedures differ from foundry to foundry.

Green sand molding is the most commonly used type of casting. Normally, small and medium sized products are produced using this type of casting. Shell molding is preferred for bigger applications. Shell molding facilitates cooling of the mold containing heated metal. This process gives a better finishing to the final product as compared to all the other processes.

Centrifugal casting is used for producing big cylinders and pipes. Both, producer and consumer would get highly satisfied if a proper blend of correct casting process and reputed foundry is made.

Iron castings are utilized extensively in machinery, automotive, and agricultural industry. Parts such as turbine and pump housings, dynamometer bases, compressors are made out of iron castings. Majority of manufacturers have the caliber to go for high and low production outputs. They are also entitled to go for short order runs. There are standard prototypes ensuring customer satisfaction and accuracy. Some manufacturers provide finishing services like galvanizing, painting, and machining as well. In general, iron castings include alloy casting, ductile castings, and malleable castings. There are some terms relating to iron castings. They need to be known in order to get a fair idea of iron.

Brinell Hardness Number (BHN): It can be defined as the method used for measuring the hardness of iron. For iron castings, a metal ball of 3000Kg is put on a flat iron piece. After the removal of ball, indentation observed is recorded. This measurement indicates the value of hardness.

Tensile Strength: Tensile strength can be defined as the quantity of bending and stretching undergone by a material before tearing or breaking. Here the metal is iron.

Modulus of Elasticity: It can be defined as the ratio of stress to strain. This value determines the elasticity as well as the stiffness of the concerned material.

Casting Supplies

Some of the casting supplies are described below:

Cast cutters and blades: There are two varieties of cast cutter blade for plaster casts – 2 inches and 2.5 inches. This comprises of one blade and in most of the cutters, stainless steel blades fit in. This has a maintenance free operation and is comfortable to use. There is a high torque motor and an ON / OFF switch. The Cast cutter blade for synthetic casts is also available in two sizes – 2 inches and 2.5 inches. This has the same features as mentioned above. The Hercules Plaster Shears 7.5 inches is a Hercules heavy duty bandage and plaster shears 7.5 inches (19.1 cm) and has a serrated blade. The Cast cutter heavy duty with metal housing consists of one 2 inches fiberglass blade. In most of the cutters, a stainless steel blade can be fitted. The length is 12.5 inches and weight is 3 lbs 13 oz. This is specially lubricated for greater service and more comfort. The heavy duty can be used in both clinical use and fabrication setting.

Cast padding: The specialist casting padding 3 inches X 4 yards is made up of micro pleated cotton fabric that stretches more than 50 percent. There is no need to tear and tuck for a smooth and comfortable fit. This is also available in sizes of 4 inches X 4 yards as well as 2 inches X 4 yards. The Sof Rol padding 3 inches X 4 yards is made of 100 percent surgical grade rayon. This is also available in sizes of 2 inches and 4 inches X 4 yards.

Cast splinting materials: The orthoplast II splint material plain is available in size of 18 inches X 24 inches X 1/8 inch. The setting time is 3 to 4

minutes. The finished splints can be butt bonded, hinged, bonded, strapped and riveted. There is a wax coated surface. This is self adhering when heated. This is majorly designed for upper extremities. It is perfect for hand splints. It moulds as per the contours of the body without any wrinkling. The orthoplast splinting material plain is available in sizes of 18 inches X 24 inches X 1/8 inch. This is made of a low heat thermo plastic material and is highly comfortable. After this material is heated, it can be molded or cut to any shape and adheres to itself. This material can be butt bonded, hinged, bonded, strapped and riveted. This can also be used in cylindrical casting procedures.

Splinting pans: The forma splint 14 inches X 10 inches is an extremely compact and lightweight design. So, it is perfect for small splinting needs or for varying spots. This has a stainless steel working tank of dimensions 13 inches X 9.5 inches X 1.25 inches. This has a lexan cover. Water is maintained at controlled temperatures by a variable temperature thermostat between 150 degrees Fahrenheit and 190 degrees Fahrenheit. There is a high heat safety switch and grounded hospital grade plug. The empty weight of this device is 5.5 lbs. It heats to the required temperature in only 15 minutes.

Casting Tools

There are various types of casting tools. Provided below are details of some of the casting tools.

Esmarch plaster scissors: These are German stainless steel cast scissors of high quality. The entire length is 20 centimeters or 8 inches. There is a 6 centimeters slanted blade for safety of the patient. The handle for leverage is of 15 centimeters. This is perfect to cut the inner layers of synthetic cast materials or plaster.

Lister bandage scissors: These are stainless steel bandage scissors of high quality. The size of the blade is 5.5 centimeters. It resists rust and corrosion. This scissors are perfect to remove QuickCast splints and casts.

Cast scissors for serial finger casts: These are manufactured from German stainless steel of highest quality. The total length is 9 centimeters. There is a 1.3 centimeters slant design on the cutting surface. During cast removal, there is good patient safety and the scissors offer excellent force.

Cast spreader: This has a stainless steel construction. There is a spring loaded handle to facilitate use.

Cast breaker: The length of the cast breaker is seven inches. This is an O.R. quality German instrument. This is used for lightweight cast breaking and trimming. This has deep serrated tips and is free of latex. The cast breaker is available in sizes of 9.5 inches also.

Plaster and Utility shears: The length of this instrument is 8 inches. This is a German instrument of O.R. quality. There is a spring loaded handle design that decreases the hand fatigue. This is very efficient in case of cotton or cloth wadding. It is free of latex.

Wire suture scissors: This is a stainless steel scissors of high quality. This is a perfect device to remove finger serial casts and to make tight corner cuts.

Fiskars all purpose snips: This instrument has a positive safety latch, a stainless steel spring and a comfort grip. The design is such that there is maximum power and handling ease. The stainless steel blades of high quality are used to cut a wide range of materials. Low temperature thermoplastics can be cut at room temperature by this device.

Aviation snips: These snips are of industry quality. Non-heated splinting material can be cut with efficiency. It can be used to cut straight lines as well as wide curves. The handles are coated with plastic to increase the comfort. This device can be used in the left hand as well as right hand.

Softouch spring action scissors: Those who have weak hands can also operate these by employing half the effort. There is a gray cushion grip. This is used to provide relief to the finger and thumb discomfort. It also absorbs squeezing pressure. The handle can be easily gripped and used in the left hand or right hand. There is a gentle spring action to open blades at the end of each cut. This offers relief to the hand and joints. There is a large slide lock for single handed operation. This also maintains the blades closed for portability and safe storage. It is free of latex.

Cast stand: The height can be adjusted. This comprises of a drip bucket. While the limb is being casted, it provides support to the arm or leg of the patient.

Crucibles

A pot in which metal is held, while melting in a furnace is called as a “Crucible.” It is made of silicon carbide and clay graphite.

Shapes of crucibles: A bilge shaped crucible has the shape of a barrel. The part of the crucible in the middle region is called as a bilge. This is the widest part of the crucible and has the maximum diameter. The top of the crucible has lesser diameter than the bilge. The base of the crucible has lesser diameter than the top. As per a thumb rule, the # of a bilge crucible is the number of pounds of aluminum that it would hold. For bronze and brass, thrice the # can be held. For instance, a #5 bilge crucible can hold almost 5 pounds of aluminum and 15 pounds of brass. This thumb rule is applicable for bilge shape only.

An “A” shaped crucible has a narrow bottom and a wider top. There are straight sides that are bent outwards. The diameter continuously increases from the base to the top. As it is simpler to manufacture this shape than the bilge one, the A shaped crucible has a lesser cost. When compared with the equivalent bilge style, the capacity of the A shaped crucible is lesser.

Both the above mentioned shapes can be manufactured in Clay graphite and silicon carbide.

Properties of crucibles: A crucible must be able to bear the extremely high temperatures of the molten metal. For this, the melting point of the material used to create the crucible must be more than the melting point of the metal that is placed in the crucible. Also, the crucible material must have excellent strength even in the white hot state.

For melting metals like aluminum and zinc, a steel crucible made at home can be used. The reason is that the melting point of aluminum and steel is lesser than steel. In this case, the interior surface of the steel crucible undergoes flaking or scaling. Due to this scale, the molten metal is polluted. The thickness of the crucible walls decreases fast. Hence, a coating of marcote-7 is applied to the inner surface of the steel crucible. The use of steel crucibles is okay if the contamination due to the scales is not regarded serious.

Materials used: To construct a crucible, the usual refractory materials (i.e. carbon bonded silicon carbide and clay graphite) can survive the extremely high temperatures of work of a foundry. In addition, silicon carbide is a very durable material.

Some of the clay graphite crucibles can be used up to 2750 degrees Fahrenheit. Some A shaped crucibles are used up to 2000 degrees Fahrenheit. These crucibles can be used to handle gold, silver, bronze, brass, aluminum and zinc alloys.

The A shaped crucibles have a rough surface finish and there are dents along the rims. However, this roughness does not interfere with the performance by any means.

While handling crucibles, correctly fitting tongs must be used. In correct tongs can lead to damage or total failure of the crucible. In between the base of the furnace and the crucible there must be a disk of cardboard or a coating of Plumbago.

Casting Sand and Green Sand

Green Sand: Green sand is also called as foundry sand or molding sand. This is utilized for sand casting. When this sand is oiled or moistened, it has a tendency to pack well and retain the shape. Green sand is a mix of pulverized coal, water, bentonite clay and sand. Out of these four components, the biggest part is that of the sand. There are several proportions of these four components. The different ratios are used to adjust the surface finish, moldability and capacity of the hot molten metal to degas. The prime use of this sand is in the metal casting. The coal is usually called as sea coal in foundries. The amount of sea coal is less than 5 percent. It undergoes partial combustion when there is molten metal present and this causes offgassing of organic vapors.

Green sand is stored in flasks (as the casters call the container). These are boxes that do not have a bottom or lid. This box is divided into two half parts and these are connected together. These halves are called as the top or cope and bottom or drag flask.

As per its name, green sand is not green in color. The word “green” is used as it is used in the wet state.

Casting Sand: Some casting sands are oil bonded and foundry mix sand. This is a mixing of oil, resin and sharp fine silica sand. Such a mix can be utilized in sand casting of all varieties of metals. Some casting sands consist of 20 percent more oil and resin as compared to other brands. The objective

is to ascertain the best mix for maximum green power and the best finish for the surface, that is possible.

The oil bonded sand is a substitute for water bonded green sands to be used for casting sand. The advantage over traditional, older sands is that as water is absent, the sand does not steam like the traditional sands. This sand is more secure to use than green sand. The reason is that potentially explosive quantities of steam are not generated. Due to this dearth of steam generation and the smooth texture of the sand, the oil bonded sand results in a smoother surface finish. The novice can use these sands and get professional results.

Use of casting sand: The same techniques, patterns and tools that are used for water bonded sands can be used for oil bonded casting sands. As the sand has better adhesive properties, there are fewer hassles with loose sand in the impression. The difference is that water cannot be used to manage loose sections. However, as the self adhesion is better, there are fewer problems of crumbling.

When the oil comes in contact with molten metal, it does not burn. When the castings are being shaken out, it is advisable to take off the sand that is burned. This sand that is burned can then be mixed again in the pile of fresh sand. It reabsorbs oil and works very well. After repeated use of this sand, the oil gets depleted. In this case, around 30W of non-detergent motor oil can be used to reload the sand with oil.

Casting Associations and Groups

Metal Casting is one of the most widely used processes that is used in the production and process industry. In the metal industry the process of Casting is the basic and the most essential step in the process of production. At the dawn of the industrial revolution, casting was a very crude process that had not undergone development.

Need for associations and institutes: Though the process of casting is an important step in production, it remained underdeveloped for a very long period of time. The basic need for the formation of metal casting related associations was to develop the process of casting. The many associations that are working for the development of metal casting are continuously working for the development of the process. Associations and the groups that have been formed by the companies are constantly experimenting with the proposed reforms in the casting process. Many of them have also come up with sound technical rectifications and an amazing number of proposals.

Aims and Objective of Casting Associations and groups: The basic objective of all the Metal casting Groups and associations that have been working for a few decades remains unchanged. The associations strive to develop the process of casting to the pinnacle. The global market has become demanding and competitive than ever. The associations help the member companies in maximizing their quality standards. These associations also work for the spread of appropriate technology. Many innovations and inventions are proposed and executed for the technological benefit of the member companies. This kind of technical support helps the

company to cut the cost of production. It also helps the companies to increase the quality and also ht performance of their production units.

Work against pollution: Metal Casting companies are often pressurized and also accused of polluting the environment. Many of the associations provide technical knowledge to the companies about the disposal of pollutants. Many a times the companies who have operational centers close to each other set up a common plant to dispose off the harmful waste materials. Many of the associations have set up their own norms for the member companies.

Man power safety: Some of the associations also keep a tab on the safety of the workers. A metal casting industry is a very dangerous place to work in. the associations hence have prescribed many safety norms to the member companies.

The norms regarding safety of the environment and the safety of the workers if not followed always invite trouble from the government. If the safety norms of the associations are followed then the intervention of the government reduces considerably.

Spread of Knowledge: To make the people in the industry aware of the ongoing commercial development and technical research the associations arrange international expos and also many exhibitions. The associations also represent their member companies in many seminars organized on the international level.

Commercial Aspects: The metal casting associations work as exchange houses for commercial meetings. Many associations give sound financial information and also explain the market conditions to the member companies.

Resin Casting

Resin Casting is a system of technical installation that is used in the process of casting resin. The process of Resin Casting is a complex process that is used in a variety of fields. The resin casting gives a high quality and precision to the product that is casted.

Need for Resin Casting: Resin casting is used to obtain a high level of quality and also precision in the dimensions of the product. Resin casting is basically used in the process of miniaturization i.e. the process of making things small. The process of Resin Casting is also used extensively in the field of electronics. The electronics industries today resort to the resin castings to achieve the norms of total quality management.

The process of resin metal casting earned success and also gained popularity in the field of electronics because it facilitated the acute miniaturization process and also at the same time maintained a high level of quality. The electronics industry is a very demanding field in terms of quality and cost. Experts recommend that the process of resin casting is an ideal way to achieve the required quality and it also helps cut down the cost of production. The process is also highly productive and also reliable with respect to speed.

Industrial Applications of Resin Casting: The process of resin casting is basically used in the electronics industry. Resin Casting is used in the

production of transformers, Liquid Crystals Displays more commonly known as the LCD's. It also used in the manufacture of heavy electronic systems.

Important steps in Resin Casting: The process of resin casting is completed in basically five important steps. The first step is to condition the resin, and then the material is transported. After the transportation of the material the three most important steps are executed. First the material is metered, then the material is mixed and then finally it is dispensed.

Conditioning process: The process of conditioning in the resin casting evenly distributes the fillers in the mixture. The conditioning also eliminates the moisture and air. It also makes the mixture constant, and also elevates the temperature of the mixture. The process of conditioning also maintains a low viscosity in the mixture. This process is very important for complex combinations as it intensifies the quality of the product.

Process of Material Transportation: In the process of transportation of the materials, the piston pumps, screw pumps, and the gear pumps are used. For the highly viscous substances, instead of gear pumps, follower plate pumps are used.

Mixing process: The process of mixing is extremely important as it obtains an equal and stabilized reaction through all the materials. The most commonly used methods in the mixing are the static mixing tube, the dynamic blender, and the dynamic static mixing tube.

Dispensing process: The process of dispensing is the most important process in the Resin Casting. In the dispensing process the dispensing unit and the movement of the part are relative to each other.

Resin is casted through various dispensing processes like the metering systems, or sometimes the dispensing is done in a vacuum. In the industrial to cut costs and also time multiple dispensing units are used.

Cupola Casting

A Cupola is a type of furnace that is very much alike to blast furnace. The Cupola furnace is refractory lined, stack of steel that is around 20 to 35 feet high. It rests on a base plate that is made of cast iron and has four legs. The casting that is obtained from the cupola furnace is known as a cupola casting.

Cupola Furnace: The Cupola furnace is one of the oldest forms of furnace that have been used by the iron and metal foundries. The Cupola furnace is the crudest and the simplest furnace that has been used by the industries. However, the cupola's use is declining and the furnace is fast being extinct.

Merits of the Cupola Furnace: Though the electric or the blast furnace has started replacing the Cupola Furnace, it has some special benefits of its own. The Cupola furnace can always remain continuously in action. The furnace also offers a very high melting rate. The most important merit of the furnace is that it has relatively very low melting cost. The furnace has also permits a lot of ease of operation.

However, due to the invention and development of the electric furnace, the use of Cupola furnaces has substantially declined. The electric furnace melts a much larger amount of metal. The operation cost of the electric furnace is also very low. The electric furnace also emits a much smaller level of smoke heat and also pollutants.

Construction of the Cupola furnace: The Cupola furnace is constructed in a crude and simple manner. The Cupola furnace is a vertical structure like a steel shell. The steel is lined with refractory bricks from the inside. The furnace has an opening half way in the vertical shaft. The charge is introduced through the opening. The charge is divided into different layers. It contains the metal that is to be melted. The metal is mixed with coke, fuel, and lime stone flux. The fuel is burnt directly into the air and is introduced in to the furnace through the tuyeres which are positioned above the hearth. The hot gases that have been produced ascend and pre heat the charge.

The cupolas in majority of the cases have drop down doors. The bottoms can be dropped down to facilitate the cleaning and the repairs. At bottom in front of the furnace is a tap hole. The molten metal is removed from the tap hole. At the rear there is also another slag hole. The top of the stag is covered with a spark or fume arrester.

Usually the cupola has a diameter of 405 to 2000 mm. It is operated on varying fuels for different metal ratios. The molten metal that can be produced in the copula of this size at a speed of 1 to 30 tones per hour.

Continuity of process: After the process of melting has ended, the charging is halted. However, the blast of hot air is always maintained till all the metal has been melted and has been taken out from the tap hole. When

the air cools down, the doors at the bottom are opened and the residue that has been left behind is removed.

DIY Casting Movement

People who like to make their own artifacts and are enchanted with the idea of building new and useful things from scratch are sure to enjoy 'do it yourself casting' that can be done at home using simple methods and techniques. Many amazing things can be produced and created using your homemade metal foundry. A good understanding of some basic foundry knowledge and few simple tools can help you make metal casting at home possible. Many people find it difficult to get special parts for their cars or bikes or even find it very costly to modify their cars, house or even bikes. If you develop your hobby of metal casting, then you can easily make special parts for your cars and bikes and also will find it easy and save a lot of money. Casting can be used to make many things like, simple ornaments knobs and even handles. Hand wheels and small machinery or tools can also be made. Small articles like brass name plates, statues, vintage motorcycle and car parts, etc can also be made at home.

Furnace Designs that can be made at home:

Coffee Can Furnace: This is very easy to build and even a large coffee-can will serve the purpose. This can be used to build a simple gas fired furnace.

The "2 bucks" furnace: Is not as the name suggests, the furnace can't be built in two bucks. It refers to the design based on two buckets. It is very useful and a good experienced person can build it with a budget that is below 10 bucks. It effectively burns propane.

Flowerpot crucible furnace: This furnace can also be built very easily and most importantly, it can be built using the waste material from your back yard. All you need is an old flower pot and a few metal cans. Melt the metal cans and coat the inside of the flower pot with the melted metal and you furnace is ready.

Other types of furnaces that can be built at home are dirt and brick furnace, chimney pipe furnace and breaking metal in barbecue.

Tools and material needed:

Homemade Aluminum pulleys: Pulleys of different size and shapes can be made by bending aluminum rods or plates. They are very simple to make and once you get the hang of it, you'll enjoy making them.

Building steel crucibles: Steel crucibles are a bit difficult to make. You need to cut the steel and weld it using a welder, so it is a bit risky job and can cause injuries. It needs to be done with utmost care and precaution.

Home made ladle: A ladle can be made at home using a small portion of a steel water pipe; you can select the water pipe according to your needs and then cut it in the desired dimensions to create your home made ladle.

After doing all this basic work and gathering all the required information, you can now start your own metal casting and make desired articles. You also

need to make the molds of your desired shape and size and you are ready to go. All types of metals and alloys can be used and melted for home casting, only their degree of heat required varies.

Art Casting

Art casting is one form of excellence, put with diverse craft skills. It should be perfect and graceful at the same time. One should have unique craft skills which can produce a perfect art casting. There are several websites which can provide a person with information on art casting technique, their sculptors and the craft skills which are required to be a sculptor.

The websites that showcases the Art founders combines to provide advanced foundry techniques and similar superb craft skills. One can thus understand the sculptor's needs and vision after viewing the art form. Previously, such sculptors were used in museums, galleries and exhibitions. Even today, at large the sculptors are used in public places, galleries and such art casting are made out of modern equipments and casting techniques.

Types of art casting: There are many types and kinds of art casting. Wax art casting, sand art casting, lost wax casting and many more. These websites that offer a client the art casting images and its services, offers concept design, Marquette works and enlargement of certain sculptors. The creative department has created new work for their clients and have provided enlargement of the miniature sculptures.

Typically, an assignment would begin with the concept stage and wherein the creative department makes drawings for approval. After this, a Marquette is done and the scaling procedure is done to work up the required size and alignment of the sculpture. Such work undertaken is done under

one roof with involvement of clients who accompany in decision making of the design, creating stage and also throughout the casting and finishing of the sculpture. These websites provide their clients with full installation service and with delivery of the sculpture to other countries.

Lost Wax process: Most of the art casting of lost wax is processed by use of lost wax ceramic method of casting. This can make it a possibility of reproduction of maximum detail from original concept. Such facilities can make the sculptors to keep the original core in mold and allow the production of the largest wax in the country. A perfect cast is very much demanded by the clients. Smaller works like the abstract works, animal figures and many more are designed on such department. These wax shops are bright with daylight bulb.

Sand casting art form: The art casting shops which focus on making sand sculptures use sand pieces and they make sure that there are deep undercuts on the making process. The team which undertakes the process are experienced and they strive to create some of the magnificent works that ranges from life size horses to full sized boats and such letter signs. A lot of the works with right to sand casting provide great dimensional stability and less reduction of metal.

Strengths of the art casting work shops: One of the key strength of the casting shop is the depth of skill set and experience in the department. The Bronze one's are collected and finished by master craftsmen. The final touch to the sculpture is of coloring it and patination of the work which is important part of the whole art casting process. These workshops provide

lots of patinas and colors which a client may require right from traditional browns and green to blue, white, black and red color.

Casting Molds

Casting is basically the manufacturing process through which a liquid material is emptied into a mold that includes a hollow opening of the desired art or shape and is then allowed to harden. This hardened casting is then removed and broken out in order to complete the process. Apart from using sand as the main mold material there is a metal that is used as the mold. Normally, a cast meehanite or an iron is used as the material for mold and the objects are made from the sand or metal. The cavity surface is basically covered with a thin layer of material that is heat resistant which can be either sodium silicate or clay.

Casting Molds: The casting molds are actually pre heated to nearly 392 degree Fahrenheit before the metal is poured in the cavity. The design of cavity for these casting molds does not chase the same principle for shrinkage like in the sand casting molds. This is because of the fact that the metal casting molds heat up and enlarge during the pouring process and so the cavity does not need to be expanded like in the sand castings. Nevertheless, care should be taken in order to ensure a correct thermal balance as you can use external water source for cooling or you can also opt for suitable radiation techniques.

Permanent Casting Molds: Although these permanent casting molds are not as flexible as the sand castings which allow to be used in different metal patterns or designs but these lower the cost of producing the part. When there is a production run of more than 1000 parts the permanent casting molds would produce much lower piece of cost part. Apart from this, the

breakeven point also depends on the density of the part. There are more complex parts that are favored when you use these permanent casting molds. The typical part size would be around 50g to 70 kg and the basic materials used are medium and small parts that are made from magnesium, aluminum and brass and also their alloys.

Slush Casting Molds: The slush casting molds are actually a special type of permanent casting molds in which the molted metal is not allowed to solidify completely. After gaining the desired wall thickness the still not solidified molted metal is then poured out. This is basically used in order to make void ornamental objects like lamps, candlesticks and statues.

Corthias Casting Molds: This type casting molds is yet another variant of the permanent casting molds in which basically a plunger is used to pack the molted metal through the spure hole. This type of process allows thinner walls and to produce greater details.

Vacuum Permanent Casting Molds: This is also another type of permanent casting molds which is also similar to low pressure permanent casting molds. In this type vacuum is used rather than a pressure. You can make thin wall casting through this type of casting molds like in the other low pressure casting molds. Apart from this the results are high as there are no risers used.

Casting Patterns

A casting pattern is basically a shaped form of either metal or wood where sand is packed around it in the mold. When this pattern is removed, the resulting cavity would be exactly the shape of the pattern object that was to be cast. The casting pattern should however be designed in order to be easily removed without any damage done to the mold. The pattern should be also be perfectly dimensioned and should be very durable for the intended use. The patterns that are used in sand casting can be made of plastic, metal, wood or any other material. The casting patterns are made to the right standards of construction this is basically because they can last for a reasonable time. The durability of the pattern would however depend according to the quality of grade in the casting pattern. If the pattern is made of right quality then they would be constantly providing dimensionally perfect casting patterns.

The process: The process of making casting patterns is actually called as pattern making which is in fact a skilled trade which is related to the trades of die and tool making and mold making. However this also sometimes incorporates the elements of fine wood making. The makers of casting patterns basically learn their pattern making skills through trade schools and apprenticeships over a number of years of experience. There is also an engineer who a few times helps in making the casting patterns but in fact it is the pattern maker who carries out the design.

Design: The casting patterns incorporate proper allowances for the shrinkage and this process is called as contraction allowance. Their accurate

values however depend on the alloys that are being used and the accurate sand casting methods that is used. There are a few alloys that have the overall linear shrinkage of nearly 2.5 percent as other alloys might actually experience 0 percent shrinkage or even a light positive shrinkage or it might also increase the size in the casting process. The amount of the shrinkage is also dependant on the sand casting process that is employed for instance chemical bonded sands, clay bonded sands or other bonding materials.

The casting patterns should also include proper allowance for the draft. This means that the sides would be tapered so that when it would be taken out from the sand it will not tend to drag out sand of place along with it. This process is also called as taper that is normally done in the range of one to three degrees. The foundry engineers or the pattern maker of the casting patterns actually decide where the gating systems, risers and the sprues are places in terms of casting patterns. In this pattern a hole is desired in the casting pattern that uses a core which defines the location and volume of in the casting where the metal would not flow into. Chills are also used sometimes located on the casting patterns surface and these are then formed into sand molds. These casting patterns however continue to be a vital requirement for sand casting of metal.