

Introduction to Crucible Casting

Safety, Setup and Process

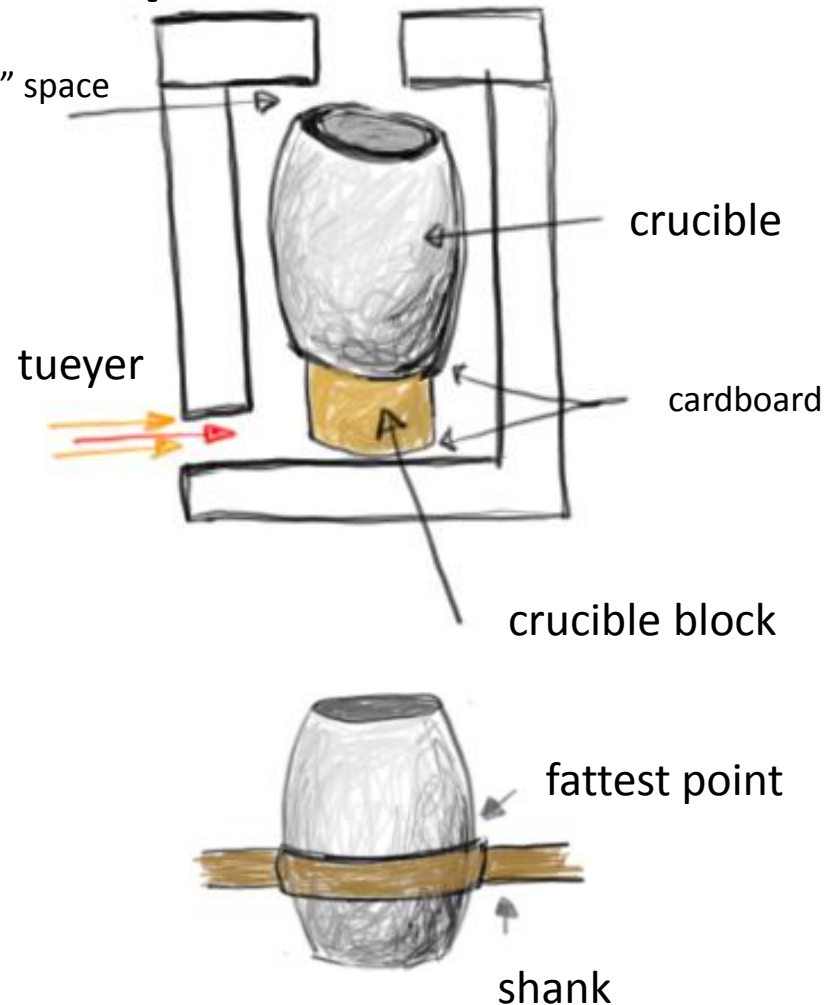
On the pour day proper clothing and safety gear is worn.



- All natural fiber clothing and leather boots should be worn to class that day by the pour crew.
- Leather or Kevlar jacket, apron, spats and gloves are worn.
- Safety glasses and a hard hat with a metal screen is also worn by the crew.

Furnace Prep

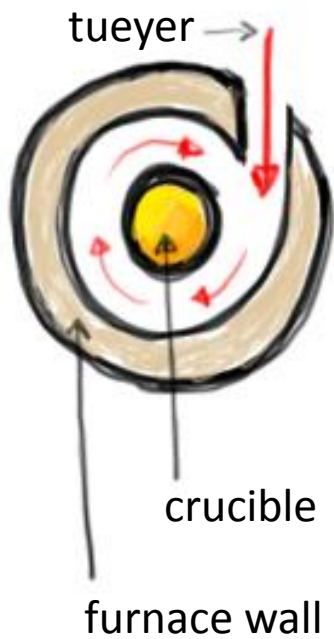
- The furnace is thoroughly cleaned and all metal drops are removed from the bottom and sides of the furnace (chisel, hammer, vacuum)
- The crucible is cleaned – sides and lip are gently scraped with rebar. Inspect for flaws.
- Check the fit of the crucible in your shank and tongs. The tongs should grab the crucible evenly without shifting. The shank should fit just below the hip of the crucible.
- A layer of cardboard is placed on the bottom of the furnace. The crucible block is centered in the bottom. A second layer of cardboard is added.
- If the crucible comes within $1\frac{1}{2}$ - 2" of the lid, the crucible is centered on top of the crucible block and layers of cardboard. If the crucible block is not high enough, a second block and corresponding layers of cardboard are added.





On pour day the patched mold are placed back in the kiln for pre-heating.

It is important to not pour into cold ceramic or plaster based molds – the moisture in the mold will cause the metal to pop and spit back out at minimum. At maximum, it can cause an impressive and dangerous display.
(sand molds are not pre-heated)

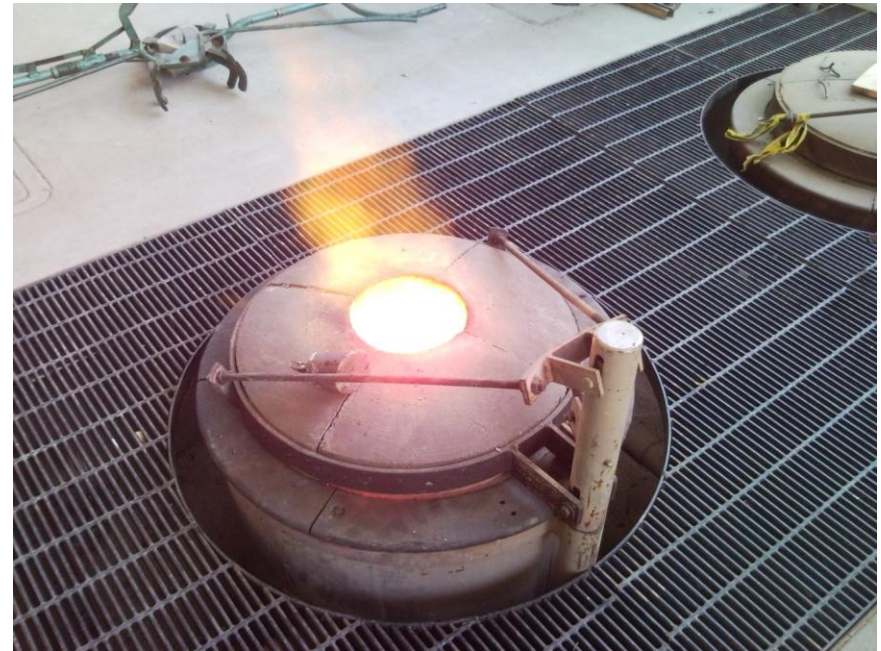


A crucible with metal in it is placed in the furnace.

- The crucible is a silicon carbide “cup” that holds the molten metal.
- The crucible is centered in the furnace on the block(s) and then packed loosely with metal.
- The furnace is then lit with the lid open. The furnace is left open until the flame stabilizes.
- The flame is left at a low but stable level in a neutral or reducing flame, until the furnace “gains color” or the walls and crucible begin glowing red.

The furnace lid is then closed and the metal melts inside.

- After the furnace gains color the burner is adjusted to the highest blast that a slightly reducing flame can be maintained.
- As the metal “drops” or begins melting, more metal is added to the crucible. **IT IS EXTREMELY IMPORTANT TO PRE-HEAT THE METAL AND PUSH OFF ALL MOISTURE BEFORE ADDING IT TO A HOT FURNACE!!! WATER EXPANDS INSIDE MOLTEN METAL AND WILL CAUSE AN EXPLOSION!** You should pre-heat all metal on the lid of the furnace.
- The crucible should be kept as full as possible during all phases of the melt until the desired amount of metal is in the crucible. Basically you want to melt the metal as fast as possible and expose it the least amount to air.



When to pour metal

- You should use a pyrometer to temp the metal and keep it close to the pouring temperature of the specific alloy. Do not over heat the metal – it will expose it to gas and it will also burn off the trace metals that are added to the alloy.
- As you gain experience with your particular furnace and location (altitude and moisture levels) you will be able to judge the temperature by looking.
- If the metal reaches a rolling boil, back the gas/air down until you can get the molds ready (try not to do this – timing is everything).
- We pour bronze when it reaches between 2050 and 2150 degrees – the temperature that I actually choose will depend upon the molds (thick vs thin patterns and type of mold), experience level of the crew and layout of the foundry.
- Aluminum is poured between 1150-1250 degrees F. Often it must be degassed before pouring with a chlorine tablet.





When the metal is ready the molds are removed from the kiln and placed in pouring rings.

- The shells are very hot and fragile at this point. Smaller ones are usually carried with tongs and then gently steadied by someone wearing two sets of gloves.
- Sand is packed around the molds to insulate them and protect them from leaks. It is best to use a formula of green sand or zircon.
- Be careful not to get sand inside the mold during positioning and packing.

The crucible is removed from the furnace and placed into the pouring shank.

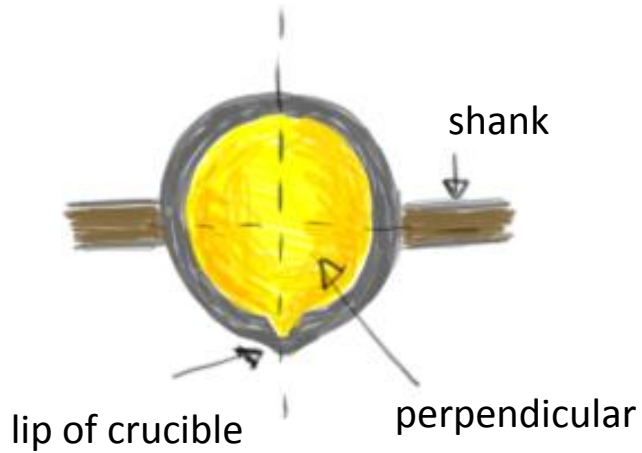


- Make certain that you use fire bricks or a crucible block to place the hot crucible on top of. **DO NOT EVER PLACE A HOT CRUCIBLE ON A COLD CONCRETE FLOOR – THE MOISTURE CAN CAUSE IT TO CRACK!**
- The lifting tongs are counter intuitive as to open most tongs you must push downwards. Make certain that you are level with your pouring partner at all times. If the live end pushes down, the dead end must correspond in a identical manner.
- Make sure you do not drop the tongs on the lip of the furnace or get the edges caught inside of the crucible.



The slag is then skimmed off the surface of the crucible.

- Impurities in the metal float to the top for easy removal. Generally this is a combination of metal oxides and silicon (glass).
- Experienced metal casters will often skim inside the furnace before removing the crucible. This is not something that I recommend for the beginning metal caster. Do not skim too early, as the slag will act as a barrier between the metal and the air.
- Be conscious of where you put your slag – do not just drop it on the ground. Whatever container you chose to drop your slag into, should be lined with sand.



The crucible is then lifted with the shank.

There is a spring loaded clamp which holds the crucible in place on the dead end of the shank (following side).

Make certain when you lift the shank, that it is level before closing the tongs and that the lip of the crucible is centered in the ring.



The crucible is then carried over to the shells for pouring.

The two handed end of the shank is called the live end. This is the steering/leading end of the pour team.



It is important for the dead end to follow the live end.

The dead end must keep the shank level with the live end. The live end should have the lip of the crucible as close to the cup as possible (this keeps the metal from cooling and reduces the amount of gas it picks up). The skimmer guides the team. The whole crew must work as if they were one person.

Any remaining slag is pushed back with the skimmer.

- The skimmers job is to “captain” the pour and help guide the team through the process.
- This person will line up the team, tell them when the cup is full, watch for leaks and tell them which mold is next in the line up. In deciding which mold is next, they must gauge the metal temperature vs. pattern thickness and pour each mold at the appropriate time as well as gauge the amount of metal left in the crucible vs. the size of the mold.
- In addition to this, they must not allow any remaining slag to pour into the mold, by pushing it back with the skimmer. They also must not leave the skimmer in the pot of molten metal, as it will melt and contaminate the alloy.
- Lastly, they must watch their feet – if metal is going to end up on the floor, it will also end up in their path.





After all molds are poured the remaining metal is poured into pre-heated ingot molds (right image) and then the crucible is scraped with the skimmer to clean the excess metal from the sides before returning to the furnace (*note it is better to do this into the pit and not on damp cement*).



The crucible is then returned to the furnace.

The process can be repeated if all of the molds are not poured in one melt. If it is the last melt, the excess bronze is poured into ingot molds and then the crucible is returned to the furnace to cool slowly. A layer of wet cardboard is placed on the crucible block, the crucible is placed inside and the lid is closed. If the furnace has cooled significantly, the furnace is relit and the temperature brought up to 2000 degree F before shutting off. The vent hole in the furnace lid is covered with refractory.



The hot molds are then allowed to cool.

Once the molds cool, the shell mold is chipped away and then the cup, gates and vents are removed and chased.

Next you will need to remove the mold after the casting cools





The gates and vents are removed and any casting flaws are chased away with both hand and power tools. Larger sections are welded together with a tig welder.



The final step is to apply a patina and seal the bronze with wax or an acrylic spray.