



Jan Willem van der Wal Bowen Island BC

Bronze; Lost Wax Method (cire perdue)

The “lost wax” (cire perdue) method is also known as “investment casting”.

In this process, a sculpture is first made out of wax and then cast in a mold made with a slurry of grog, old mass, and plaster. The wax sculpture is then de-waxed in a kiln at about 1292 F (700 C). The heating in the kiln results in the original wax structure burned off and evaporated and the mold cast now holds a hollow negative of the sculpture.

Into this mold, the hot molten bronze is poured and cast. After cooling down, the mold itself is smashed and demolished to reveal the sculpture in bronze.

The bronze has to be cleaned from all kinds of abnormalities which result from the firing of the mold and the casting of the bronze. (air bubbles, small cracks turn in bronze too)

In addition, the casting cup, sprue, support posts and vents installed prior to the sculpture being cast in the mold must be removed.

After, cleaning the sculpture, color can be added using a variety of chemicals that are applied with a brush and then heated with a torch.

A finishing touch can be made by polishing some aspects on the sculpture.

Creating a bronze sculpture, step by step:

Phase I

Creative

Using all kinds of materials which can burn, but mainly wax, you create the wanted sculpture.

As wax is a weak substance (there are different kinds of firmness) you often need to reinforce the wax model using a variety of substances including: wood (branches), plastic, cloth, cardboard, etc. All of these materials burn and will vanish during the firing process of the mold / investment in the kiln.



Wax and other materials for the sculpture



The sculpture in wax

Phase II Creating the correct flow for bronze

This is a most important step in the process of creating a sculpture as it is critical to the poring of the molten bronze.

In order to enable a proper flow of the liquid bronze into the mold, you must strive to prevent airlocks and passages that are too narrow. Accordingly, vents need to be created to allow air to be released. In addition, great differences in thickness of the wax model can cause failures in the final product due to uneven shrinking or cooling down speed. Also, sometimes bypasses are necessary on the original structure to allow for successful bronze casting.

Finally, the wax structure needs to be connected to a casting cup / sprue gate and air vents, risers to enable the bronze to flow properly through the hollow chambers as can be seen below.



Casting cup/ sprue gate, vents and supports mounted (casting cup shown upside down)

Phase III

Mold making

To encase the wax structure in a mix of plaster and grog, a form to contain the sculpture and grog must be made. We typically use a metal sheet for this purpose as it is very good for creating a flexible form.

Once we have made the form, the grog, made of Ludo (old mass, refractory material) and plaster (1:1:1) is mixed with clean water until it reaches the consistency of yogurt.



Plaster and grog (coarse)

This slurry mix sets up quickly, so it needs to be immediately poured into the container which holds the wax structure.

About 30 minutes later, the metal form can be removed, and the mold is ready for firing in a kiln.



The wax model in the metal form



The form filled with grog, plaster, Ludo mass

Phase IV

Burning out the wax (de-waxing)

In this phase, the mold is placed into a kiln and burned out for about 24 hours at a temperature up to 800 degrees Celsius. (1500 F)

After cooling down, a negative of the sculpture is all that remains in the mold.

Small particles still found in the hollow part of the form can be removed by using a combination of vacuuming and compressed air.



Molds in the kiln



The kiln with a torch



After firing the mold for about 24 hours, the mold is ready to cast the bronze

Phase V

Pouring bronze

In order to melt solid bronze, our smelting furnace must reach a temperature between 1100 and 1200 degrees Celsius (2000-2200 F).

We use a crucible to melt the bronze down into its molten form. Amazingly, once the bronze has liquified, it is essentially the consistency of water.

The crucible is then carefully removed, and the bronze is poured into the mold and cast until the vents in the mold fill entirely with bronze.



Smelting furnace with crucible



Bronze is an alloy of copper, tin and zinc (90% Co, 5% Sn, and 5% Zn)



Pouring the bronze



Bronze has cooled. Pouring cup and vents filled with bronze

Phase VI

Cleaning the sculpture

Now, the mold can be broken to reveal the bronze structure and then it must be thoroughly cleaned using also a pressure washer.



Once washed, the casting cup / sprue gate, vents and other casting bypasses are removed using a saw, angled grinder, Dremel and chisels. In its raw form, you can now see your bronze sculpture.



Sculpture after cleaning



Sculpture after removing the sprue system

A considerable amount of time and effort is required to completely work the sculpture into its finished form.

An array of tools is needed for this phase and safety precautions are important. We always use eye and ear protection and wear masks to avoid inhaling small particles of bronze.

Small bronze cracks and bronze bullets can be removed using a chisel and a steel brush attached to an angled grinder can be used as well.



Various tools to finish the sculpture

Phase VII

The finishing touch

After cleaning, the sculpture is now revealed in its bronze form.

We often use a variety of chemicals such as liver of sulphur, aluminum sulphate and copper nitrate to colour the bronze sculptures. Chemicals are applied to the sculpture and a torch is used to fuse the chemical to the bronze. Some chemicals react slowly in humid air and show their patina after some weeks.

To deepen the effect of color, shoe polish can be applied and some spots brightened by buffing with a polishing machine.



Clockwise top: copper carbonate, copper nitrate, liver of sulphur, copper acetate & coppersulfate.





The result: **Take Off**

Jan Willem van der Wal

Bowen Island July 2019.

Bronze facts

- Bronze was created about 4000 BC in Persia. Called Brontpsion means alloy.
- It is an alloy with copper and arsenic, later tin, approx 5%.
- Melting point of copper is 1.085 C ; 1985 F
- The alloy bronze with app. 8% tin 1.000 C ; 1832 F
- Hardness of copper is 30 HB (Brinell hardness)
- Copper with 5% tin creates 203 HB!
- Forging the bronze the hardness will even be 230 HB.
- Iron does have a hardness of 70 – 80 HB, with 0,6 % carbon 246 HB.



Amazon



Mistake



Walking together



Growing



The box



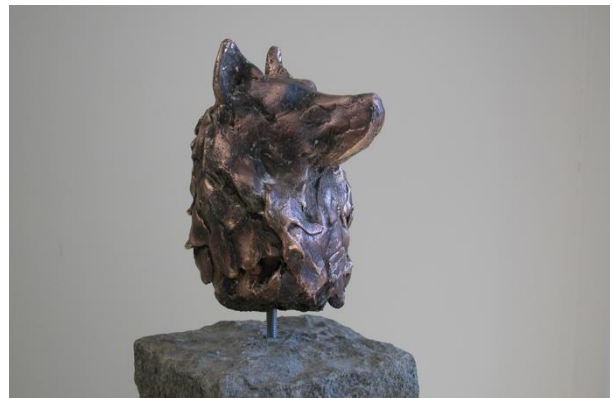
Movement



Uranus



Joep



Kahn



Take off



Happy landing



Seagull



Eyecatcher