

The Lost-Wax Casting Process—Down To Basics

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Lost-wax casting is a ancient technique that is used today in essentially the same manner as it was first used more than 5,000 years ago. As they say, there's no messing with success. Today, of course, technology has vastly expanded the technique and produced powerful equipment that makes the process faster, easier and more productive than ever, but the basic steps remain the same. The steps below represent a simple overview and are intended to provide a beginning understanding of the casting process.

Concept

This is obviously where the design is initially conceived, discussed, evolved, and captured on paper—or on computer; CAD (computer aided design) software is increasingly popular among designers. You create the design you envision using the computer tool and the software creates a file that can be uploaded into a CNC mill or 3D printer.

Model

Build a model, either by hand-carving, guided by the paper rendering, or by uploading the CAD file into a computer controlled milling machine or a 3D printing machine. Models are made using carving wax, resin or similar material. This process can also be done in metal by a goldsmith or silversmith.

Note: If a 3D printer or other rapid prototyping equipment is used, it is possible to skip the molding and wax-injection steps by using one of the resins that are specially made to go directly to the treeing process.

Molding

Create a mold from your master model, placing it in one of a variety of rubber or silicone materials, curing the material, then removing the model from the finished mold. Typically, a sprue (usually a 3mm or 1/8" rod) is attached to the model, creating a channel through one side of the mold material, preparing it for the injection step. There are many different types of molding materials and the curing action is different for each different compound.



Wax Injection

Inject the mold with hot, molten wax pumped, under pressure, from a heated wax pot. The liquid wax replicates all the textures and details left by the model on the interior surface of the mold cavity and solidifies into a wax pattern (complete with the sprue channel through which the wax entered the mold). Once removed from the mold, the pattern is ready to be attached to your casting tree. Thousands of patterns can be produced by one mold, if it is used correctly. With metal molds, the injection is done using a plastic material rather than a wax.

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Treeing

Attach the slender sprue on each of your wax patterns (created in the molding process) onto a long, tapering wax rod; this becomes the 'trunk' of the tree, supporting many pattern 'branches.' The tree is rooted in the center of a rubber base that keeps the tree upright and steady as it is built. Patterns are attached using a sticky wax or a hot-wax pen.

Investing

Set a steel flask (essentially, a metal cylinder) into place over the tree, seating it firmly into the rim of the rubber base. Then mix the investment and pour it over and around the tree and patterns. Casting investment is a smooth, fine slurry similar to plaster of paris; when it cures—just as in the molding process—it will replicate every detail on the surface of the pattern. Curing usually takes about 2 hours, after which the rubber base is removed by lifting it off the flask and away from the wax tree.

Removing the Wax

Sometimes, the flask is de-waxed with steam; however, this step can be skipped and the wax will be eliminated—literally melted out and burned away—during burnout, a step that heats the flasks to the appropriate temperature for casting.

To steam de-wax, place the flask with the visible sprue end down in a steam de-waxing unit. The hot steam melts the wax, which drains out through the opening in the investment. After a couple of hours, nearly all of the wax will have been evacuated from the investment and may be seen puddled in the water at the bottom of the de-waxing unit.

Burnout

Place the flask, sprue end down, in a kiln or oven programmed for the necessary ramp and hold stages to ultimately bring the flask to casting temperature. The makeup of the patterns (casting with stones in place, using direct-to-tree resins, etc.), will determine the specific burnout schedule for that tree. The burnout stage serves a few purposes. It completes the curing of the investment, removes all traces of wax, and brings the investment in the flask to a temperature that will help keep the molten metal liquid as it fills the pattern cavities. A flask that is cooler than the metal draws heat away from the metal, causing it to solidify too quickly, before the patterns have been properly and completely filled.

Casting

The metal to be cast may be melted using electrical resistance-heated or induction-heated machines, fuel gas/oxygen torch systems or blast furnaces. Remove the flask from the oven and pour in the molten metal. Pouring the metal can involve a variety of processes, methodologies and techniques: centrifugal, vacuum, pressure differential and sand are the most common today. Neutec® casting machines use vacuum or pressure-differential methods and use only induction and resistance methods to melt the metal.



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Quenching

With most metals, once the button (the metal visible in the hole where the metal was poured) loses the red glow. This usually takes 10–20 minutes, though each metal type and alloy will have its own optimal hold time before quenching. Quenching involves submerging the flask in water; the thermal shock of the water against the hot flask fractures the investment, which cannot accommodate such a rapid change in temperature. The broken pieces of investment fall away from the now-metal tree, leaving it nearly free of investment.



De-vesting

Using water at high pressure or a slurry mix of water and sand or glass beads, clear all remaining investment from the metal tree; if desired, use an ultrasonic cleaner to help remove the last traces. It is important to remove all the investment from the metal before any finishing.

Pickling/Acid-Dipping

Use any of a variety of available acid solutions as a dip to pickle the tree; pickling cleans and removes any surface oxidation from the cast pieces. Rinse thoroughly with water after pickling.

The casting process is complete and the cast pieces are ready to be clipped from the tree and started along the finishing path. The steps above represent a simple overview; it is intended only to provide a beginning understanding of the casting process.