

# Investment Casting



Investment casting, also called "lost-wax casting" is an industrial process, and one of the oldest known metal forming techniques known to man. Investment castings allow the production of components with accuracy, repeatability, versatility and integrity in a variety of metals and high-performance alloys.

The investment casting process is generally used for small castings, but has been used to produce items of much larger size and dimension. The process is generally more expensive per unit than die casting or sand casting, but with lower equipment cost. Investment casting can produce complicated shapes that would be extremely difficult to impossible with die casting. Yet like the die casting process, investment casting requires little surface finishing and only minor machining.

The are nine basic steps in the investment casting process:

1. *Produce a master pattern:* An original pattern is created from wax, clay, wood, plastic, steel or another material.
2. *Mouldmaking:* A mould, known as the master die, is made of the master pattern. The master pattern may be made from low-melting-point metal, steel or wood.
3. *Produce the wax patterns:* Although called a wax pattern, materials also include plastic and frozen mercury. Wax patterns may be produced in one of two ways. In one process the wax is poured into the mold and swished around to achieve an even coating covers the inner surface of the mould. This process is repeated until the desired thickness is achieved. The second method is to fill the entire mould with molten wax, and let it cool until a desired thickness has set on the surface of the mould. Then the balance of the wax is poured out, the mould is turned upside down and the wax layer is left to cool and harden
4. *Assemble wax pattern:* The wax pattern is then removed from the mould. Depending on the application, multiple wax patterns may be created so that they can all be cast at once. The multiple patterns are attached to a sprue, with the result known as a "tree."
5. *Investment:* the ceramic mould, known as the investment, is produced by three repeating steps: coating, stuccoing, and hardening.
  - Step one entails dipping the wax pattern assembly (tree) in a slurry and draining it evenly
  - Step two is to cover the tree in ceramic grain
  - Step three is to allow the slurry-ceramic material to thoroughly dry These steps re repeated until the investment is the required thickness.
6. *Dewax:* The investment is then allowed to completely dry, which can take from 16 to 48 hours. The drying process can be enhanced by applying a vacuum or minimizing the environment humidity. The investment is then turned upside-down and placed in a furnace or autoclave to melt out and/or vaporize the wax.
7. *Burnout & preheating:* The mold is then subjected to a burnout, which heats the mold between ?F & ?F to remove any moisture and residual wax, and to sinter the mold. Sometimes this heating is also the preheat, but other times the mold is allowed to cool so that it can be tested. If any cracks are found, they can be repaired with ceramic slurry or special cements. The mold is preheated to allow the metal to stay liquid longer to fill any details and to increase dimensional accuracy, because the mold and casting cool together.
8. *Pouring:* the investment mold is then placed cup-upwards into a tub filled with sand. The metal may be gravity poured, but if there are thin sections in the mold, it may be filled by applying positive air pressure, vacuum cast, tilt cast, pressure assisted pouring, or centrifuge cast.
9. *Removal:* The shell is hammered, media blasted, vibrated, waterjetted, or chemically dissolved to release the casting. The casting may be cleaned up to remove signs of the casting process, usually by grinding.

Investment casting is used with almost any castable metal, however aluminum alloys, copper alloys, and steel are the most common. The advantages of investment casting are:

- Excellent surface finish
- High dimensional accuracy
- Extremely intricate parts are castable
- Almost any metal can be cast
- No flash or parting lines