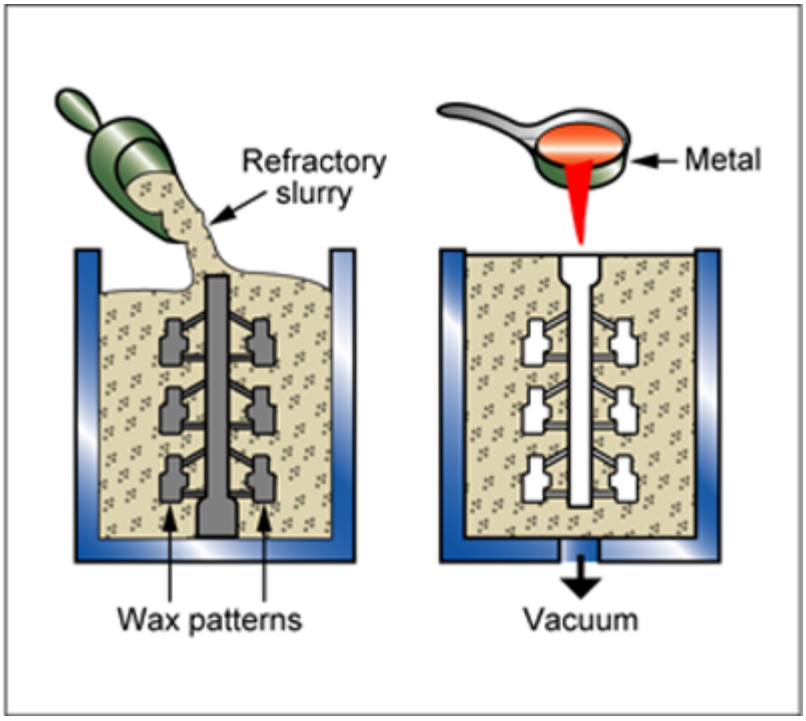
Description

Process schematic



The process

If you have gold fillings (or more elaborate metal work) in your mouth, be thankful for this process - it was used to make them. The lost wax process - the old name for INVESTMENT CASTING - has been practiced for at least three thousand years; sophisticated jewelry, ornaments and icon were being made in Egypt and Greece well before 1500BC. In investment casting, wax patterns are made and assembled (if small) into a tree with feeding and gating systems. The assembled pattern is dipped into refractory slurry, then covered in refractory stucco and allowed to dry. The procedure is repeated a number of times until about 8 layers have built up, creating a ceramic investment shell. The wax is then melted out and the ceramic shell fired before the molten metal is cast. Gravity die casting is adequate for simple shapes, but air pressure, vacuum or centrifugal pressure is needed to give complete filling of the mold when complex, thin sections are involved. The mold is broken up to remove the castings. The process is suitable for most metals of melting temperatures below 2200 C. Because the wax pattern is melted out, the shape can be very complex, with contours, undercuts, bosses, and recesses. For making hollow shapes, this process is very sophisticated: all large bronze statues are hollow, and they are made by an elaboration of this process.

Tradenames

Lost wax casting

Material compatibility

Metals - ferrous	✓
Metals - non-ferrous	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Solid 3-D	✓

Hollow 3-D	✓			

Economic compatibility

Relative tooling cost	low			
Relative equipment cost	medium			
Labor intensity	high			
Economic batch size (units)	1	-	1e4	

Physical and quality attributes

Mass range	0.022	-	44.1	lb
Range of section thickness	39.4	-	2.95e3	mil
Tolerance	1.97	-	9.84	mil
Roughness	0.0197	-	0.126	mil
Surface roughness (A=v. smooth)	A			

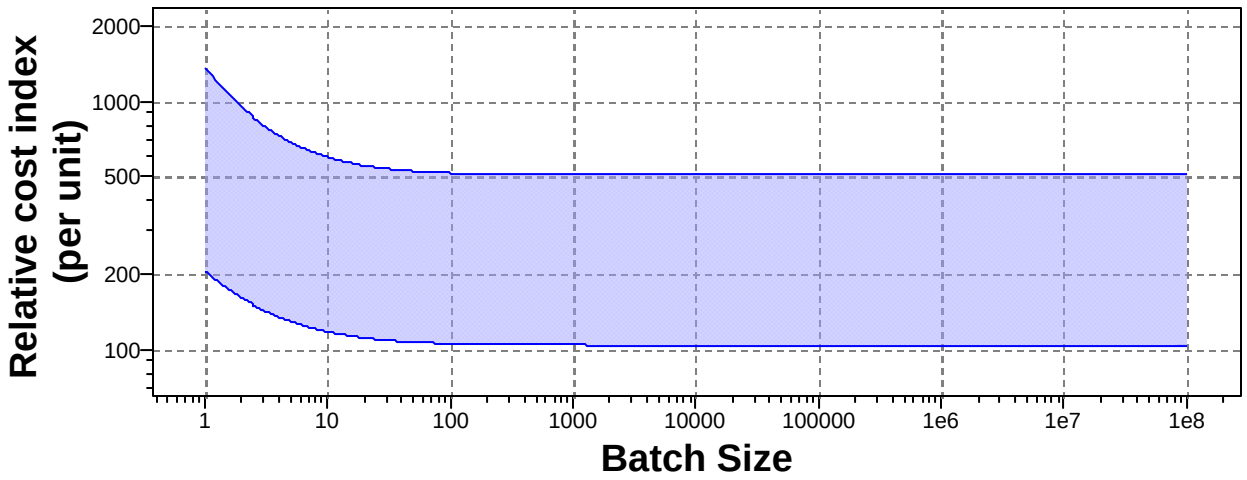
Process characteristics

Primary shaping processes	✓			
Discrete	✓			
Prototyping	✓			

Cost model and defaults

Relative cost index (per unit)	* 104	-	505	

Parameters: Material Cost = 3.63USD/lb, Component Mass = 2.2lb, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Material Cost=3.63USD/lb, Component Mass=2.2lb, Overhead Rate=150USD/hr, Capital Write-off Time=5yrs, Load Factor=0.5, Discount Rate=5%

Capital cost	* 328	-	1.64e3	USD
Material utilization fraction	* 0.8	-	0.85	
Production rate (units)	* 1	-	200	/hr

Tooling cost	* 82	-	820	USD
Tool life (units)	* 1	-	5	

Supporting information

Design guidelines

The process is extremely versatile, allowing great freedom of form. It offers excellent reproduction of detail in small 3D components.

Technical notes

Investment casting is one of the few processes that can be used to cast metals with high melting temperatures to give complex shapes; it can also be used for low melting metals. The traditional uses of investment casting where for the shaping of silver, copper, gold, bronze, pewter and lead. Today the most significant engineering applications are those for nickel, cobalt and iron-based alloys.

Typical uses

Jewelry, dental implants, statuary, metal sculpture and decorative objects, blades for high temperature gas turbines and similar equipment.

The economics

Investment casting lends itself both to small and large batch sizes. For small batch sizes the process is manual, with low capital and tooling costs, but significant labor costs. When automated, the capital costs are high, but quality control and speed are greater. The production rate is increased by the use of multiple molds.

The environment

There are the usual hazards associated with casting molten metal, but procedures for dealing with these are routine. The mold materials cannot, at present, be recycled.

Links

MaterialUniverse

Reference