Description

Process schematic

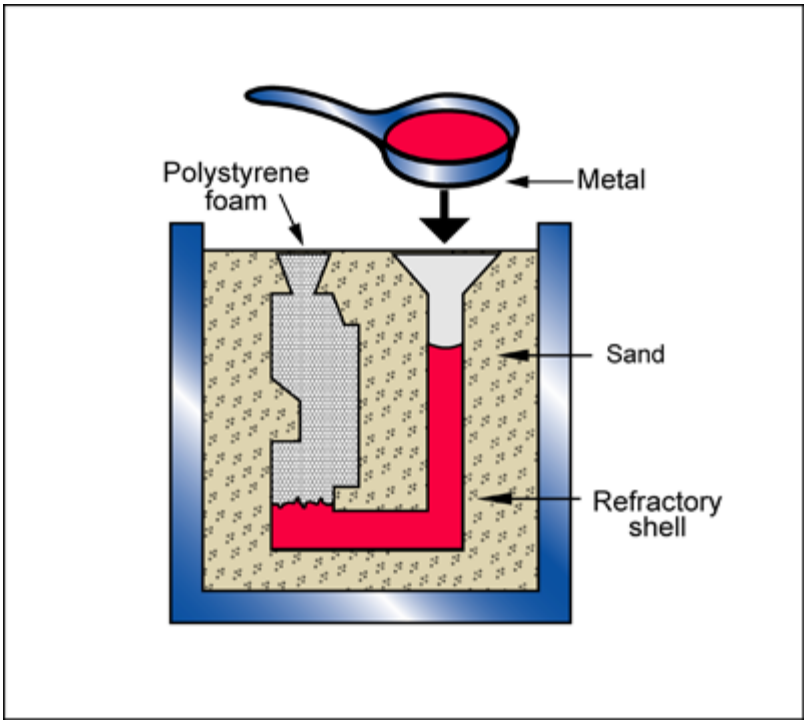


Figure caption

Evaporative mold sand

The process

In EVAPORATIVE PATTERN CASTING, a pattern is made of polystyrene foam and is coated with a refractory coating. It is then embedded in dry unbonded sand which is vibrated to produce a rigid mold.
The polystyrene pattern is vaporized when the mold is filled with molten metal. Patterns are made by machining blocks of expanded polystyrene. Because the pattern does not have to be removed, very complex shapes with undercuts and re-entrant angles are feasible.
Cores are eliminated and no sand binders are needed.

Tradenames

Policast, Styrecast, Full mold

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	low			
Labor intensity	medium			
Economic batch size (units)	1	-	1e3	

Physical and quality attributes

Mass range	1.1	-	55.1	lb
Range of section thickness	138	-	3.94e3	mil
Tolerance	39.4	-	98.4	mil
Roughness	0.787	-	7.87	mil
Surface roughness (A=v. smooth)	C			

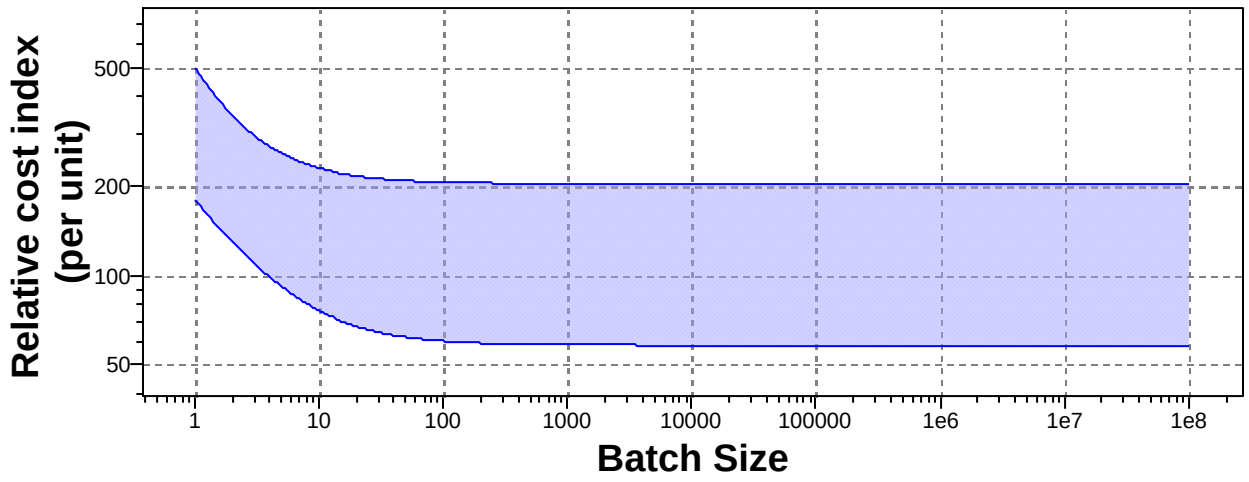
Process characteristics

Primary shaping processes	✓
Discrete	✓
Prototyping	✓

Cost model and defaults

Relative cost index (per unit)	58.5	-	204	

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	492	-	3.28e3	USD
Material utilization fraction	0.4	-	0.6	
Production rate (units)	1	-	10	/hr
Tooling cost	82	-	328	USD
Tool life (units)	3	-	30	

Supporting information

Design guidelines

Because no cores are required, very complex shapes can be produced. Undercuts and reentrant angles are feasible.

Technical notes

Evaporative mold casting can be used to shape any non-refractory metals with a melting point high enough to vaporize the pattern (thus not lead, tin or zinc): aluminum alloys, cast irons, carbon and low alloy steels, and wear and heat resistant alloys. The process allows great freedom in shapes, without draft or mold joint line, which reduces finishing requirements. The cast surfaces may show the bead structure of the pattern, but reasonable detail can be reproduced.

Typical uses

Automotive components such as inlet manifolds, heat exchangers, cylinder heads and blocks, crankshafts, and exhaust manifolds. Also used for pipe fittings, valve castings and wear resistant castings.

The economics

The process is used for moderate to high levels of production because of its low tooling costs, moderate capital costs, high output rates and high material utilization.

The environment

Soot and hydrocarbons are produced during pouring. Expanded Polystyrene is combustible. Proper ventilation is essential and good standards of housekeeping and safety should be maintained. Mold materials are almost entirely reclaimable.

Links

MaterialUniverse

Reference