Description

Image

Image caption

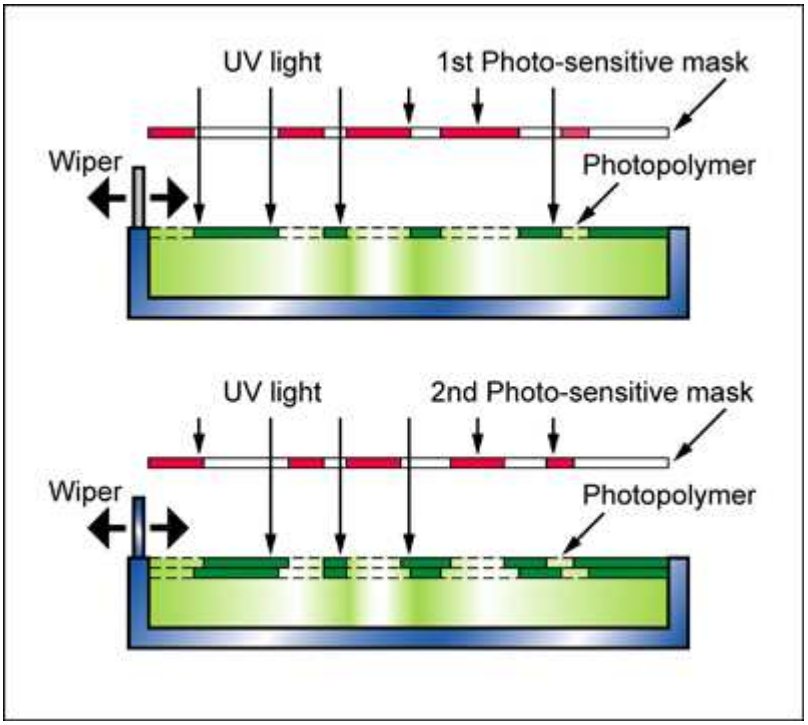
(1) Photocuring resins are typically epoxides, urethanes, polyethers, or polyesters, each of which provide specific properties to the resulting material © Dzhang2680 at Wikimedia Commons (CC BY 3.0) (2) Operating Vector General display of the XM1 (M1 Abrams prototype) tank with BRL-CAD circa 1980 © at Wikimedia Commons [Public domain] (3) Full-color object printed with internal moving parts © KKHausman at STEMulate

The process

SOLID GROUND CURING (SGC) is an additive manufacturing technique which differs in concept from laser-based methods. A negative image of the layer of the part to be produced is created electrostatically on a glass plate (as in a photocopier). The mask is positioned over a bath of photo-sensitive resin and the clear areas cured by exposure to UV light. The resin is wiped clear, leaving hardened areas intact. Wax is applied to the top surface to provide support to the cured resin, and solidified by chilling. The top surface is then milled back to the required thickness and the next layer of resin is applied for curing. As with other additive manufacturing processes, a CAD solid model of the part is required.

This technique is now obsolete, having been superseded by Mask Projection Stereolithography (MPSLA) which does not require chilling or milling during the building process.

Process schematic



Material compatibility

Polymers - thermoplastics	✓			
Polymers - thermosets	✓			

Shape

Circular prismatic	✓			
Non-circular prismatic	✓			
Flat sheet	✓			
Dished sheet	✓			
Solid 3-D	✓			
Hollow 3-D	✓			

Economic compatibility

Economic batch size (units)	1	-	10	

Physical and quality attributes

Mass range	* 0.1	-	80	kg
Range of section thickness	0.7	-	100	mm
Tolerance	0.1	-	2	mm
Roughness	* 100	-	150	µm

Process characteristics

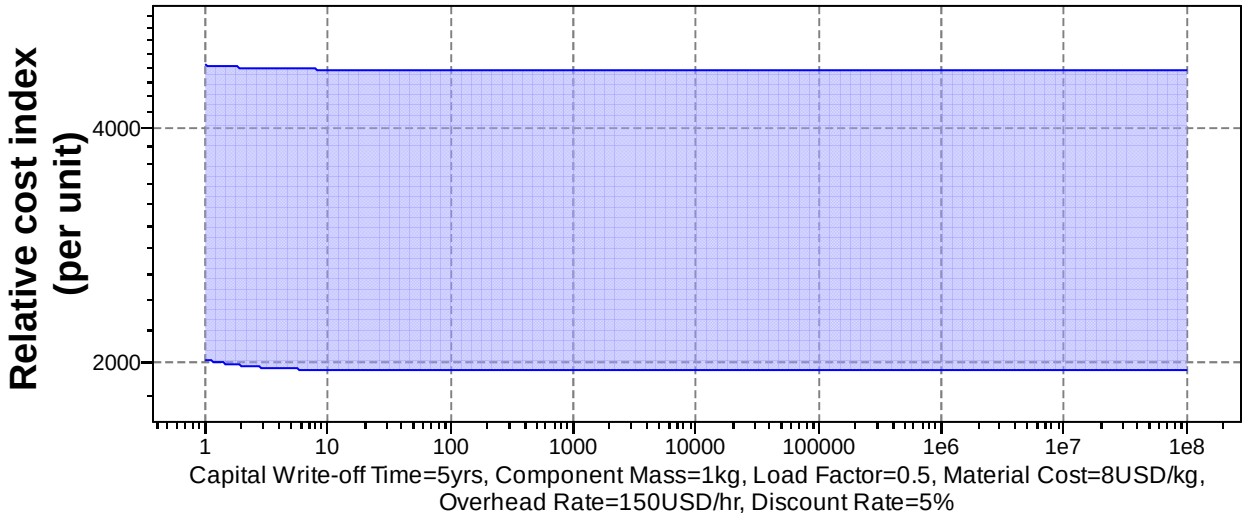
Primary shaping processes	✓			
Discrete	✓			

Prototyping	✓

Cost model and defaults

Relative cost index (per unit)	* 1.94e3	-	4.77e3	

Parameters: Material Cost = 8USD/kg, Component Mass = 1kg, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Capital cost	5.66e5	-	7.54e5	USD
Material utilization fraction	* 0.5	-	0.7	
Production rate (units)	0.04	-	0.1	/hr
Tooling cost	* 37.7	-	94.3	USD
Tool life (units)	1	-	2	

Supporting information

Design guidelines

Complex models possible including ready assembled multi-component products.

Technical notes

The process is limited to resins that can be photo-polymerized, most based on acrylates.

Typical uses

Making prototypes and models quickly from CAD systems.

The environment

Photopolymers are thermoset materials and cannot be melted again for reuse. Care needed with environmentally hazardous solvents used to clean up models. Direct exposure to the laser beam must be avoided. The resins are volatile, requiring good ventilation.

Links

MaterialUniverse

Reference