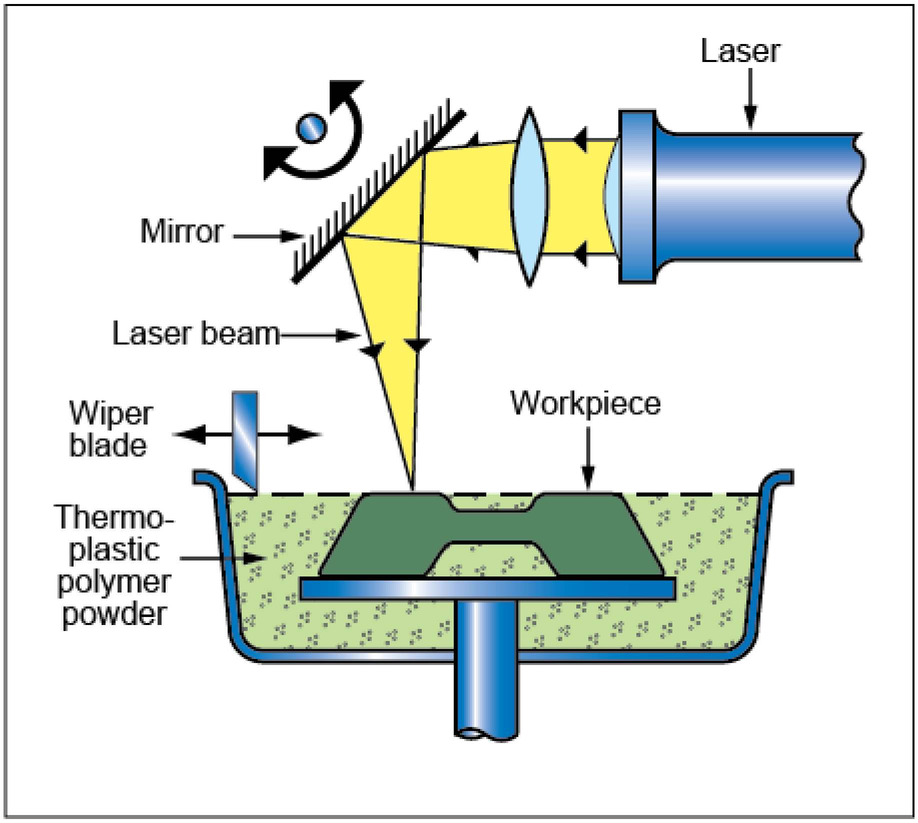
Description

Process schematic



The process

SELECTIVE LASER SINTERING (SLS) is an additive manufacturing technique that operates on the same principles as stereolithography, but uses a fine, heat-fusible powder (a thermoplastic or wax), which is fused together by a scanned laser beam to build the model. A new layer of powder is then swept across the surface by a wiper or milling head and the process repeated, building the model layer-by-layer. The surface is stepped due to the layers so it requires machining after manufacture to reduce the roughness. As with other additive manufacturing processes, a CAD solid model is used to create and STL file that drives the scanning system.

The process is also known as laser sintering.

Material compatibility

Polymers - thermoplastics	✔

Shape

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

Economic compatibility

Relative tooling cost	low			
Relative equipment cost	high			
Labor intensity	high			
Economic batch size (units)	1	-	100	

Physical and quality attributes

Mass range	0.22	-	22	lb
Range of section thickness	31.5	-	3.94e3	mil
Tolerance	7.87	-	31.5	mil
Roughness	3.94	-	4.92	mil
Surface roughness (A=v. smooth)	C			

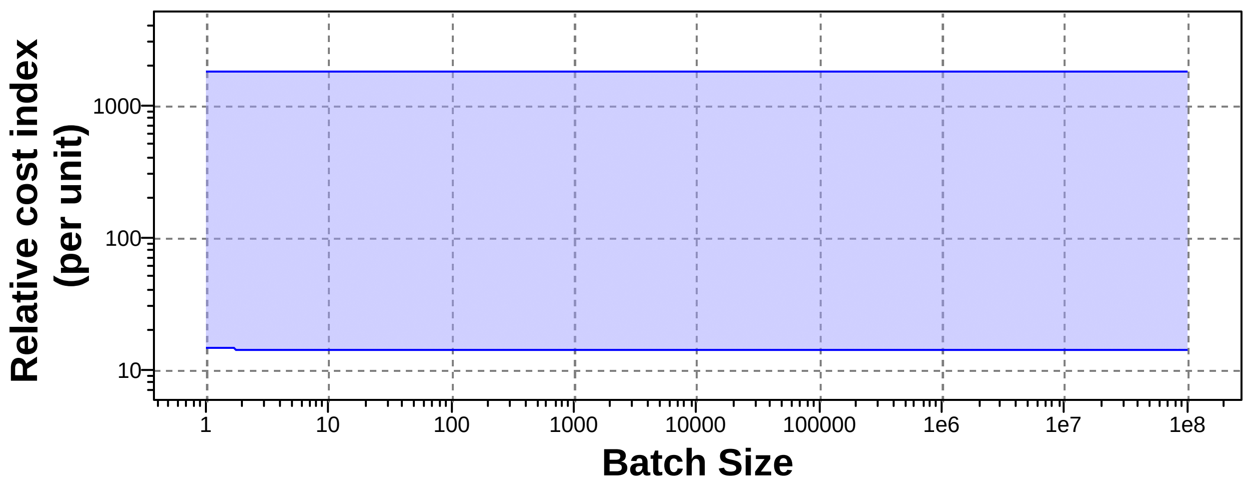
Process characteristics

Primary shaping processes	✓
Discrete	✓
Prototyping	✓

Cost model and defaults

Relative cost index (per unit)	* 14.2	-	1.8e3	

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	1.8e5	-	8.5e5	USD
Material utilization fraction	* 0.5	-	0.7	
Production rate (units)	* 0.1	-	400	/hr
Tooling cost	* 0	-	0.1	USD
Tool life (units)	1e5	-	1e6	

Supporting information

Design guidelines

All shapes can be made without the need for support structures in addition to the main body of the object. High complexity is possible, particularly when using nylon - these can be functional with snap fits, screw threads and living hinges. A single layer is about 0.15 mm thick, defining the surface roughness of the as- sintered model, but further finishing can reduce this to 10 microns. Parts are not fully dense, with distributed porosity throughout.

Technical notes

The build envelope (L x W x H) ranges from 381 x 330 x 457 mm to 550 x 550 x 750 mm
.
Typical layer thickness is 80 - 150 µm. Material is sintered at 900 - 5000 cubic cm per hour.

A range of model materials can be used including polycarbonate, PVC, ABS, nylon (unfilled and glass-filled), polyester, polypropane, polyurethane, and investment casting wax. As an example of the quality achieved: SLS Nylon parts have a density of 970 kg/m^3, tensile modulus of 1.6 GPa, tensile strength of 38 MPa and elongation to failure of 2%. Takes place in enclosed nitrogen-filled chamber.

Typical uses

Polymer SLS is used for rapid fabrication of polymer prototypes, models and sacrificial patterns for metal

The economics

Powder bed fusion is the most expensive type of additive manufacturing due to the inert environment in which it must operate. It can cost around $800,000 for an industrial SLS machine.

The environment

Direct exposure to the laser beam must be avoided. The prototype can be crushed into powder for

Links

MaterialUniverse

Reference