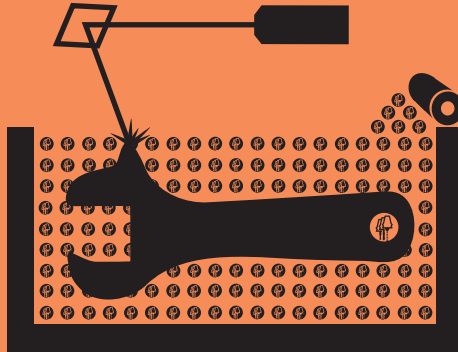
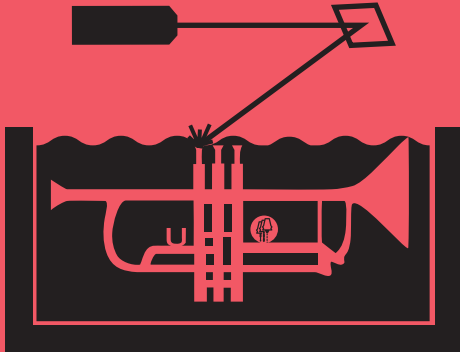


Quick Reference: 7 Families of Additive Manufacturing

According to ISO/ASTM52900-15 (formerly ASTM F2792)



VAT PHOTOPOLYMERIZATION

POWDER BED FUSION (PBF)

BINDER JETTING

MATERIAL JETTING

Alternative Names:

SLA™ - Stereolithography Apparatus
 DLP™ - Digital Light Processing
 3SP™ - Scan, Spin, and Selectively Photocure
 CLIP™ - Continuous Liquid Interface Production

Alternative Names:

SLS™ - Selective Laser Sintering; DMLS™ - Direct Metal Laser Sintering; SLM™ - Selective Laser Melting; EBM™ - Electron Beam Melting; SHS™ - Selective Heat Sintering; MJF™ - Multi-Jet Fusion

Alternative Names:

3DP™ - 3D Printing
 ExOne
 Voxeljet

Alternative Names:

Polyjet™
 SCP™ - Smooth Curvatures Printing
 MJM - Multi-Jet Modeling
 Projet™

Description:

A vat of liquid photopolymer resin is cured through selective exposure to light (via a laser or projector) which then initiates polymerization and converts the exposed areas to a solid part.

Description:

Powdered materials is selectively consolidated by melting it together using a heat source such as a laser or electron beam. The unused powder surrounding the consolidated part acts as a support material for overhanging features.

Description:

Liquid bonding agents are selectively applied onto thin layers of powdered material to build up parts layer by layer. The binders include organic and inorganic materials. Metal or ceramic powdered parts are typically fired in a furnace after they are printed.

Description:

Droplets of material are deposited layer by layer to make parts. Common varieties include jetting a photocurable resin and curing it with UV light, as well as jetting thermally molten materials that then solidify in ambient temperatures.

Strengths:

- High level of accuracy and complexity
- Smooth surface finish
- Accommodates large build areas

Strengths:

- High level of complexity
- Powder acts as support material
- Wide range of materials

Strengths:

- Allows for full color printing
- High productivity
- Uses a wide range of materials

Strengths:

- High level of accuracy
- Allows for full color parts
- Enables multiple materials in a single part

Typical Materials

UV-curable Photopolymer Resins (with various fillers)

Typical Materials

Plastics, Metal and Ceramic Powders, and Sand

Typical Materials

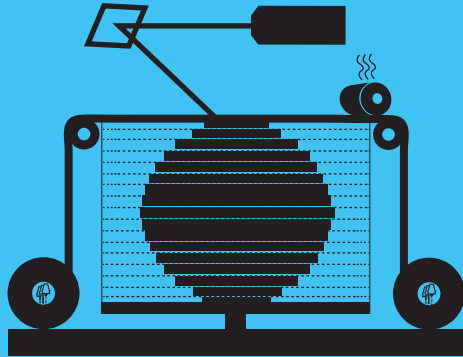
Powdered Plastic, Metal, Ceramics, Glass, and Sand.

Typical Materials

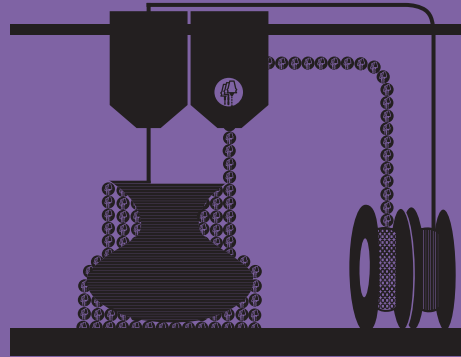
Photopolymers, Polymers, Waxes

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SHEET LAMINATION



MATERIAL EXTRUSION



DIRECTED ENERGY DEPOSITION (DED)



HYBRID

Alternative Names:

LOM - Laminated Object Manufacture
 SDL - Selective Deposition Lamination
 UAM - Ultrasonic Additive Manufacturing

Description:

Sheets of material are stacked and laminated together to form an object. The lamination method can use adhesives or chemical bonding (paper/plastics), ultrasonic welding, or brazing (metals). Unneeded regions are usually cut layer by layer and removed after the object is built.

Strengths:

- High volumetric build rates
- Relatively low cost (non-metals)
- Allows for combinations of metal foils, including embedding components.

Typical Materials

Paper, Plastic Sheets, and Metal Foils/Tapes

Alternative Names:

FFF - Fused Filament Fabrication
 FDM™ - Fused Deposition Modeling

Description:

Material is extruded through a nozzle or orifice in tracks or beads, which are then combined into multi-layer models. Common varieties include heated thermoplastic extrusion (similar to a hot glue gun) and syringe dispensing.

Strengths:

- Inexpensive and economical
- Allows for multiple colors
- Can be used in an office environment
- Parts have good structural properties

Typical Materials

Thermoplastic Filaments and Pellets (FFF);
 Liquids, and Slurries (Syringe Types)

Alternative Names:

LMD - Laser Metal Deposition
 LENS™ - Laser Engineered Net Shaping
 DMD™ - Direct Metal Deposition

Description:

Powder or wire is fed into a melt pool which has been generated on the surface of the part where it adheres to the underlying part or layers by using an energy source such as a laser or electron beam. This is essentially a form of automated build-up welding.

Strengths:

- Not limited by direction or axis
- Effective for repairs and adding features
- Multiple materials in a single part
- Highest single-point deposition rates

Typical Materials

Metal Wire and Powder, with Ceramics

Alternative Names:

AMBIT™ - Created by Hybrid Manufacturing Technologies

Description:

Laser metal deposition (a form of DED) is combined with CNC machining, which allows additive manufacturing and 'subtractive' machining to be performed in a single machine so that parts can utilize the strengths of both processes.

Strengths:

- Smooth surface finish AND High Productivity
- Geometrical and material freedoms of DED
- Automated in-process support removal, finishing, and inspection

Typical Materials

Metal Powder and Wire, with Ceramics

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