

## Rapid Prototyping / 3D Printing Processes & Materials

### 3D Printing

3D Printing or 3DP is the fastest and most economical rapid prototyping process on the market today. 3DP with the Z Corp 3D Printer technology utilizes a high performance plaster composite powder and CMYK color binders to create full 24 bit color concept models. The Z Corp Z650 3D printers utilized by EMS deposit the binders at 600 x 540 DPI in the X & Y direction onto a bed of powder. This process is repeated at a layer thickness of 0.0035" in the Z direction. 3DP is most commonly used for concept modeling, fit checks, ergonomics, presentation models, and architectural models. Additional uses include vacuum forming and metal casting patterns.

**Pro's** – very fast build time, lowest price process, 3D color, best value.

**Con's** – not as strong or flexible as other processes



Z650 3D Printer

### Stereolithography (SLA)

SLA rapid prototyping is one of the most widely utilized rapid prototyping processes in the RP industry. SLA uses a vat of liquid UV-curable photopolymer resin and a UV laser to build parts one layer at a time. The top of the line SLA machine (i-Pro 9000XL) has the ability to make parts up to 59" long without bonding or gluing.

Numerous materials are available to simulate ABS and Polypropylene and other plastics. In addition, SLA is widely popular for its Somos Watershed XC 11122 optically clear material. SLA is a great process for concept models, master patterns and appearance models, and medium to large thin walled parts.

**Pro's** – very large parts can be done, very good resolution, many materials available

**Con's** – Complex machines, expensive materials, average speed to build parts.



3D Systems iPro 9000

### Selective Laser Sintering (SLS)

SLS is an additive manufacturing process in which builds parts layer by layer using a powerful laser to fuse small particles of powder together. SLS is most commonly known for it's nylon 12 material available with glass, aluminum, and carbon filled blends making it popular for functional testing. Also available is Duraform EX, which is commonly used to create living hinges.

The unique materials available for selective laser sintering make it a great solution for functional testing as well as limited run production. SLS is most commonly recommended for the aerospace and medical industry because they are robust, accurate, and heat resistant.

**Pro's** – very strong materials, ability to make living hinges, heat resistance

**Con's** – Complex process and machines, expensive materials, some geometries can be a challenge



3D Systems sPro 230

## Fused Deposition Modeling (FDM)

FDM is a rapid prototyping process that extrudes plastic through a heated nozzle head one layer at a time. FDM materials come in a variety of blends and colors. Most utilized materials included ABS, polycarbonate (PC), and Ultem 9085 – a heat resistant material. The surface finish is generally coarse, but can be smoothed chemically. FDM is most commonly used for functional testing without features smaller than .02".

**Pro's** – functional parts built in plastics

**Con's** – slow build time, coarse surface finish.



Fortus 900mc FDM System

## PolyJet

PolyJet is a rapid prototyping process where photopolymer materials are extruded through a printhead then cured by UV light. The Objet Connex500 is a polyjet machine that jets these materials at incredibly thin 16 $\mu$  layers. More notable, its ability to print multiple materials at once to create different durometers as well as simulate overmolding. PolyJet is good for small thin walled parts and projects requiring a rubber-like material.

**Pro's** – very good resolution and surface finish

**Con's** – materials don't hold up well to stress or heat, can be more expensive than SLA depending on geometry shape



Objet Connex 500

## Direct Metal Laser Sintering (DMLS)

DMLS is an additive manufacturing process where a metallic powder is laser sintered 1 layer at a time in 20 $\mu$  thickness. These powders are available in titanium, stainless steel, cobalt chrome, and aluminum making them popular in the aerospace, insert tooling and medical fields.

There is an immense amount of labor to prepare these builds and post processing the parts. As a result, DMLS is typically the best option only for high profile projects in which a metal part is required, but machining is not feasible.

**Pro's** – fully dense metal parts with complex geometries and cooling vents

**Con's** – Complex process, very expensive



EOSint M280 DMLS System

## Cast Urethane Molding (RTV molding)

RTV Molding is a multi-step low volume manufacturing process best for batches of 20 parts. Typically a master pattern is first made from a stereolithography part which is then used to form a silicone mold. After the silicone has set, the master is removed and new part is casted using a two-part polyurethane. Cast Urethane Molding is typically the next step after rapid prototyping when manufactured parts are needed, but budget and/or time does not allow for injection molding or CNC machining. Because there are a large variety of cast urethane materials and colors available, cast urethanes are very popular for low volume production runs.

**Pro's** – closest simulation of production materials, many colors and materials

**Con's** – 2 week or more lead time. Cost.



Mold, pattern and final part

## CNC Machining

CNC machining is a subtractive manufacturing method where material is removed from a solid block of foam, wood, metal, wax and other materials. Most projects require multiple passes be made until the final part shape is acquired. CNC Machining is a great economical solution for parts too large for 3D printing or higher volume

**Pro's** – ability to create large parts, cost effective, many materials choices

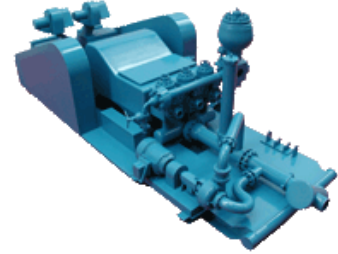
**Con's** – Time, limited geometry



Haas CNC Machining Center

## Additional Finishing Options

EMS offer a full line of additional finishing options including sanding, priming, waxing, dyeing, painting, plating, RF shielding and heat resistance coatings.



Painted SLA model