ADDITIVE MANUFACTURING/ 3D PRINTING CAPABILITIES AT THE 3M BIC

Our Additive Manufacturing/ 3D Capabilities at the 3M BIC are outline below:

FUSED DEPOSITION MODELLING (FDM)

Technology: Ultimaker 3

Use: Rapidly produces low-cost concept models and pre-prototypes. The technique is often used to introduce people to '3D thinking'.

About: With FDM the layers are created using melted filament that is extruded through a nozzle. This is repeated layer by layer until the part is completed. This process is sometimes called Fused Filament Fabrication (FFF)

Our FDM machines can be used for a wide range of materials including PLA, PP, ABS, TPU. This is an ever-evolving arena with manufacturers finding increasingly exotic material blends for different purposes.

FDM prints are cheap to make and are ideal for rapid prototyping, model making and enclosures. Functionality of final parts will very much depend on the material chosen, as well as the design of the parts.

Advantages:

- ✓ Can be quite fast so good for quick prototypes
- ✓ Wide range of materials available
- ✓ Cost-effective way of producing custom thermoplastic parts
- ✓ Relatively low cost of parts

STEREOLITHOGRAPHY (SLA)

Technology: Formlabs in SLA

Use: Can form objects in a range of materials including tough clear polymers, dental materials and castable 'waxes' to enable jewellery or fine scale model design and manufacture.

About: Stereolithography is one of the oldest AM technologies. Build platform is lowered down into a Vat of liquid resin. UV light is directed on to the resin in the pattern of the first layer. The build platform then moves upwards, and additional layers are created on top of the first.

The detail and surface finish of SLA parts is among the best available and it is perfect for intricate models and dimensional accuracy. Standard resins are not ideal for parts requiring toughness and strength, although the range of resins designed for functional parts is improving.

Advantages:

- ✓ High quality surface finish
- ✓ Good for fine features and visual quality
- ✓ Very high dimensional accuracy
- ✓ Homogeneous mechanical and thermal properties
- ✓ Good range of materials

SELECTIVE LASER MELTING (SLM)

Technology: Renishaw AM400 and AM500

Use: Can produce prototypes in medical stainless steel and titanium. Although costly, it can produce fine, intricate objects designed by algorithmic software in ready to use materials.

About: Selective Laser Melting (SLM) uses a directed laser to melt a thin layer of metal powder. A new layer of powder is then spread across, and the process is repeated, with each layer fusing into the previous ones.

We can currently produce metal parts in 316L Stainless Steel and titanium (Ti6Al-4V) and Inconel 625. Density of parts is >99%, so parts are functional. Coupled with FEA and Generative design, innovative and lightweight geometries can be modified and created using SLM.

Advantages:

- ✓ Shapes and geometries which are difficult to make using traditional subtractive manufacturing are possible.
- ✓ Short time-to-market, without custom tooling
- ✓ Flexibility of process
- ✓ Easy to incorporate lightweight lattice structures
- ✓ Cut down on waste as powder that is not incorporated into the shape can be reused
- ✓ Excellent mechanical properties, increasingly comparable to traditional parts such as casting and forging

SELECTIVE LASER SINTERING (SLS)

Technology: EOS P110 in PA2200, soft touch (flexible) materials and Alumide, a metal-like nylon polymer

Use: Powder bed fusion is the method of choice for robust components, capable of being used in demanding environments. It can produce rigid, tough items with almost as much detail as SAL resins but can withstand daily use.

About: With Selective Laser Sintering (SLS) layer of powdered material is spread over the build platform (usually 0.1mm thick). A laser is used to sinter the material in the pattern of the first layer. A new layer of powder is spread across the bed and the laser fires across the new powder creating the second layer, fusing it with the first. This is repeated layer by layer, to build up the 3d part.
In contrast to SLM, with SLS the laser does not fully melt the powder but heats it to the point that the powder can fuse together on a molecular level.

SLS prints are usually in PA2200, a type of Nylon 12. Items made with SLS are accurate and can be used for functional parts as they are. We can also dye parts if particular colours are required, but the range is relatively limited to primary and secondary colours.

SLS is ideal for small to medium batch production as it is one of the few AM technologies that does not require support during building and the whole of the build volume can be utilised

Advantages:

- ✓ P2200 polyamide generally tough, strong finish
- ✓ Can be used for functional parts and prototypes
- ✓ No supports needed, so build orientation is not an issue, good for complex parts
- ✓ Whole of Build Volume (mm) can be utilised so it lends itself small to medium batch production (more so than other AM processes)
- ✓ Can be dyed in a range of colours
- ✓ Very little post processing needed

MATERIAL JETTING

Technology: Projet MJP 2500 Plus

Use: Fine detail models for artwork, display, film, architecture. Material developments mean it is increasingly used for working prototypes with tougher more resilient resins. Often used for making dental casts and surgical/anatomical modelling.

About: Layers of resin material are sprayed on to a bed (in similar way to inkjet printers). The layers are then solidified (cured) with Ultraviolet light.

Surface finish is very good, and the range of materials that can be used with this process allow for functional parts to be made. It uses wax supports which are melted away in post processing leaving no marks on the final product

Advantages:

- ✓ High quality surface finish
- ✓ Good for fine features and visual quality
- ✓ Very high dimensional accuracy
- ✓ Homogeneous mechanical and thermal properties
- ✓ Good range of materials