eBook

Accelerate Design Cycles and Lower Production Costs

With MultiJet Printing for Rapid Prototyping and Design Verification

3D SYSTEMS
Additive Manufacturing Solutions

Contents

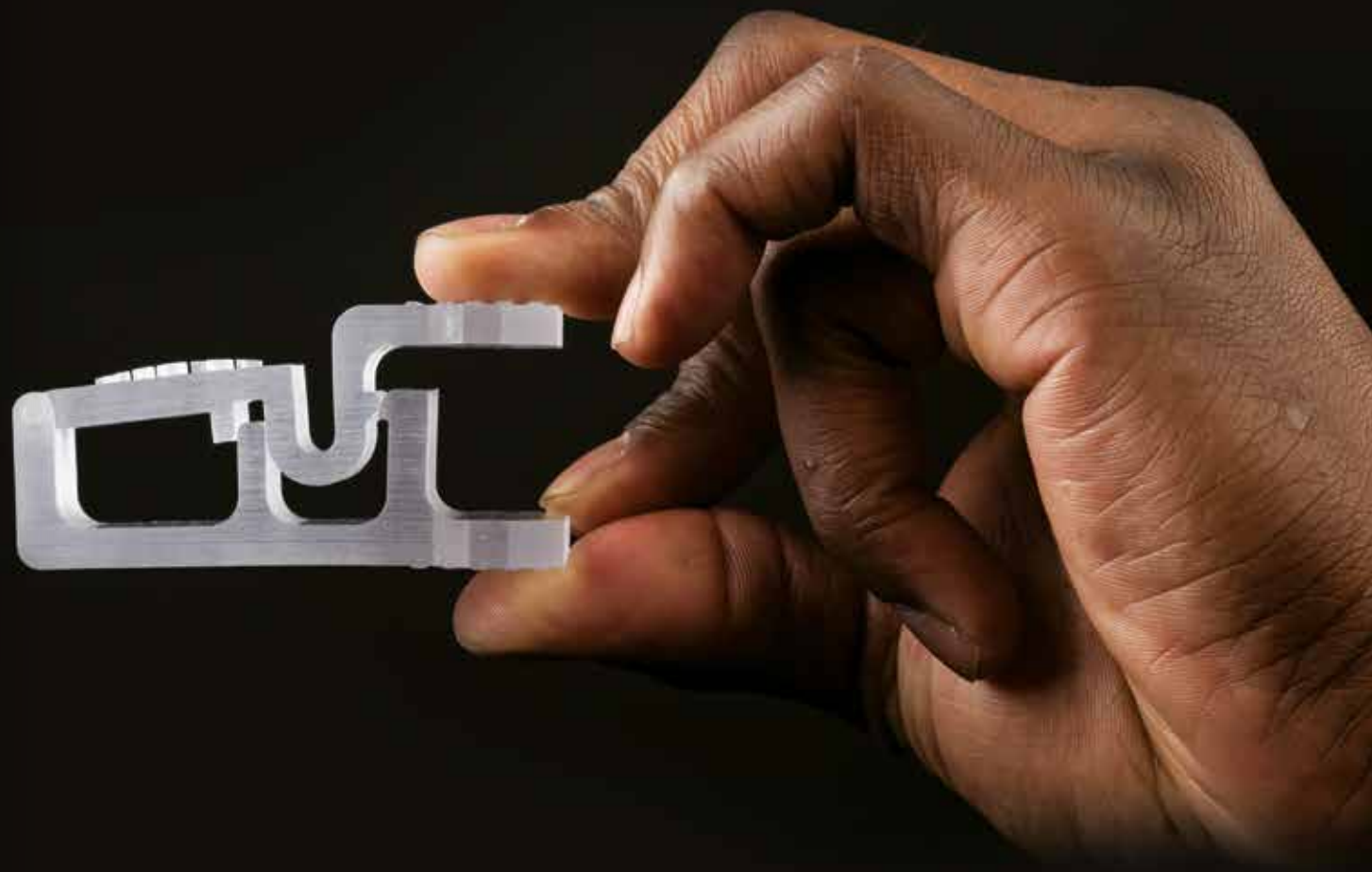
Introduction

Today's product development landscape is characterized by high demand for variety, increasing customer expectations and near constant innovation.

To top it all off, product lifetimes are shrinking. The result is driving greater competition among manufacturers with the pressure to do more, better and faster.

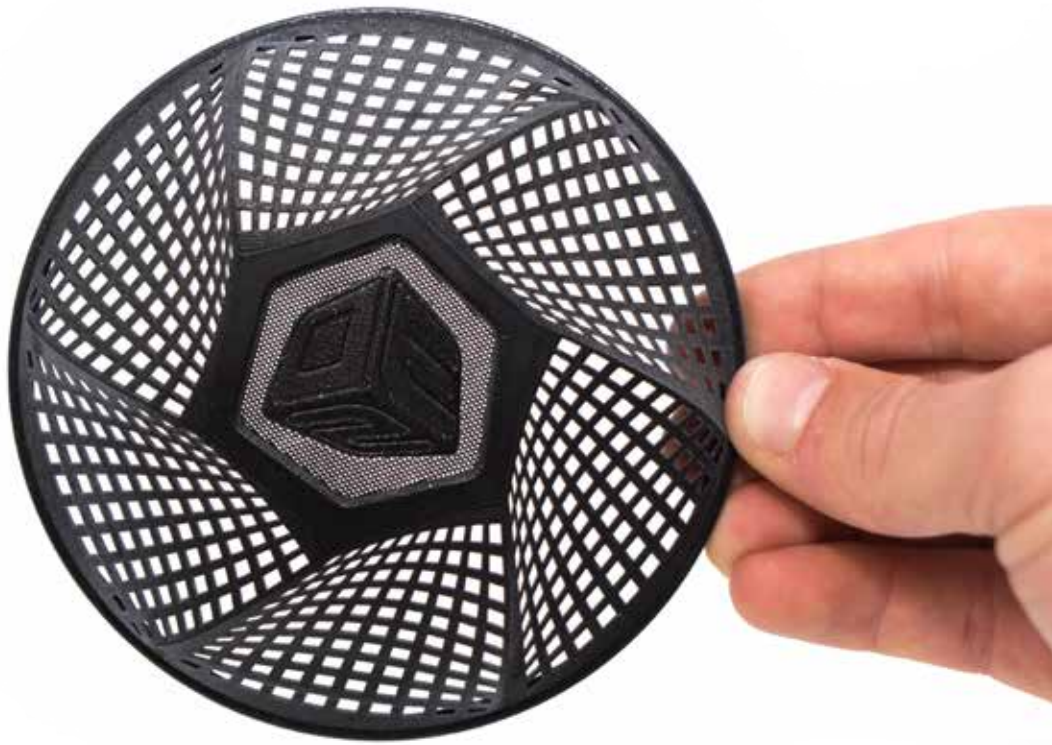
No Olympian has ever taken home a gold medal without intensive training. In the same respect, no winning product design has ever been the result of beginner's luck. Product development is training for game day and requires cycle after cycle of effort, feedback, and improvement.

To stay competitive in an environment that is perpetually shrinking time to market, manufacturers need to meet and break new release schedules in their product development cycles. Rapid prototyping offers that opportunity.



When to Prototype and Why

The product development process is made up of several iterative loops to arrive at an end product. Each iterative loop provides new knowledge about what works and what doesn't. It can be a time-consuming process, but it is one that cannot be skipped.



Prototyping is a key element of product development, and should be brought in at the right stage for optimal impact. When is that, you ask? As early as possible.

For companies with deep and shallow pockets alike, time is the resource in shortest supply. Rapid prototyping with 3D printing helps companies shorten the time it takes to produce and evaluate physical product models to advance timelines, take advantage of market shifts, and win customers.

Just as designers are pushing simulation forward in their process, bringing prototyping into the early stages of product development is a cost-effective way to create a virtual feedback loop, increasing product knowledge and insight with every iteration.

An increased frequency of iterations means designers have the time and opportunity to improve designs while still delivering within or before deadline. 3D printing prototypes allows compression of the product design cycle with the potential for far superior products at completion.

Faster Time to Market

Achieving prototypes in hours, rather than days or weeks, enables companies to accelerate time to market and deliver superior products in shorter timespans.

With 3D printed prototypes, designers can have new iterations of a design prototyped daily, enabling the evaluation of 12–15 new iterations in the same time it takes one prototype to be produced using traditional processes.

Companies that want to measure success in reducing and improving their product development process should examine two key factors:

Lead times: total elapsed time from concept development to initial production.

Engineering effort: the total man-hours required to go from concept development to initial production.

Taking these factors into consideration, transforming a design into a physical object has never been more efficient or affordable than with rapid prototyping solutions.

MultiJet 3D printing for rapid prototyping can dramatically improve development cycles by reducing lead times and engineering effort.

Prototyping for Agile Manufacturing

Creating physical prototypes with 3D printing is part of an iterative, agile design and manufacturing process that promotes four strategic benefits by:

Facilitating design modularity:
Breaking products down into logical modules for rapid prototyping can help companies speed up their design process and advance product outcomes. Each design module opens new opportunities and options to explore in parallel.

Accelerating knowledge generation:
Each prototype provides new information that is hard to gain in other ways. This information can be quickly and intuitively shared among all team members.

Advancing communication with process partners:
Product development is often a collaborative process. Sending 3D files back and forth to be prototyped is a fast way to explain design changes and stay on the same page.

Fostering a culture of knowledge:
Incorporating prototyping as part of an agile, iterative product development process instills and reinforces the quest for better product knowledge.

Considerations Before Getting Started

Although prototypes are relevant throughout product development, the purpose they serve evolves as product development approaches product launch. For some products, advanced evaluation stages require new approaches to prototyping, whereas other products allow for greater consistency in prototyping methods.

A few questions to ask when selecting a prototyping technology include:

- **What is the purpose of the prototype? Is it for show or testing?**
- **What material properties are needed to simulate appearance or test to achieve the desired result?**
- **How fast, how many, and where do you need the prototypes?**
- **What is your budget?**
- **Do you need the capabilities in-house, or should you outsource?**

Types of Prototypes

There are essentially two main types of prototypes: those that need to look like the end product, and those that need to perform like the end product. Of course, there are plenty of gradients in between, but this simplified view can help you identify where your needs fall on the appearance-function spectrum.

APPEARANCE MODELS

As the name suggests, an appearance model is a high-level visualization of a product or design idea. The uses and purposes of appearance models can vary greatly throughout product development and can add value at any stage.

Early prototype appearance models offer an opportunity to evaluate and evolve designs, whereas compelling functional appearance models at later stages can be used to solicit consumer feedback or help secure investors or buyers.

FUNCTIONAL MODELS

Once a system has been defined theoretically, it must be made practical. Functional models can confirm the form, fit, articulation, and interaction of components to ensure product designs are on track or enable fine-tuning for the desired results.

With a high precision 3D printing process, the parts produced will reflect the CAD data provided, resulting in high-quality prototypes for thorough fit and function testing.

Rapid Prototyping for Appearance and Concept Models

Transform your design into reality with fast design iterations, physical proof-of-concept and scale models that help to fast-track product development.

Teams can quickly turn CAD files into highly realistic physical parts and assemblies for aesthetic review, internal evaluation, trade shows and sales presentations.

MultiJet Printing (MJP) technology and materials enable a range of prototypes, from clear materials that can be tinted and dyed, to elastomeric materials that mimic rubber-like parts, tough gray materials that are ready for painting and finishing as well as multi-material printing in a single build for a more realistic evaluation of products that are made of multiple materials.

For advanced appearance models that may require meticulous painting, assembly, or a hybrid manufacturing approach including CNC milling, vacuum casting, color developing, mechatronics or engineering services, **global On Demand services** are available to supplement capabilities and offset demands on in-house resources.

APPLICATION BRIEF

Tinted and Dyed Parts with MultiJet Printing

When adding color to a part is important to project success, a few simple steps can transform high quality clear VisiJet® MultiJet Printing materials with incredible results.

One of many great strengths of 3D Systems MultiJet Printing technology is its high precision and high-fidelity capability, allowing parts to be printed true-to-CAD and with very good surface quality. MJP technology allows for high quality visual models and end-use parts, for prototyping assembly and fixture needs.

VisiJet materials can be dyed or tinted very easily with off-the-shelf dyes, resulting in stunningly realistic opaque, translucent, or clear colored parts.

These parts are typically used for a variety of advanced design verification and functional prototyping applications — in industries such as automotive, aerospace, consumer goods packaging, electronics, medical devices and more Applications include:

- Bottles
- Housings and enclosures
- Lenses
- Light covers

Download the Application Guide

Dyed automotive lenses

VisiJet M2R-CL color keyring with clear coating dyed with standard colors with 1% concentration (60 °C and 30 min)

Functional Prototyping for Design Verification and Testing

Once a part or assembly has been designed, practical testing is a necessity to confirm that it functions as expected.

MJP delivers many advantages to product designers and production engineers by way of quickly, cost-effectively, and accurately being able to test the part or assembly for: form and fit testing, assembly validation, including snap-fits, water-tight applications, fluid flow visualization, functional testing of plastic and elastomeric products and more.

Additive manufacturing enables the production of robust transparent parts that can be tested in-situ, for example on an engine, to track and review oil and air flow, as well as assembly clash checking using MJP clear materials.

Additive materials for MJP enable production of living hinges, as well as providing true-to-life parts for screwing, pressing , and drilling.

Prototypes of packaging enable fast and consistent hands-on testing by both designers and customer focus groups to establish that it meets brand guidelines as well as customer approval.

Functional prototypes to meet almost any purpose can be quickly delivered using MultiJet Printing and the wide range of materials available to meet almost any prototyping purpose.

CASE STUDY

Span Tech Develops Innovative Conveyor Systems with MultiJet 3D Printing

Machine manufacturer accelerates design cycles and lowers production costs with 3D printed prototypes.

Founded in 1989, Span Tech is recognized as a global leader in unique and customizable conveyor systems that are used in a wide range of industries, from food and beverage production to packaging distribution, cosmetics, pharmaceuticals, and more.

Always on the lookout for innovative solutions to keep ideas and test systems flowing, Span Tech owner Bud Layne has made 3D printing part of his company's development process. To further increase its in-house capability, Span Tech purchased a 3D Systems ProJet® MJP 2500 Plus using VisiJet® Armor (M2G-CL) and VisiJet® M2R-BK materials. Since installation, Span Tech has used these 3D printed parts to validate designs within a test system to introduce faster and more frequent design cycles, increase innovation, and boost confidence in final tooling investments.

"With the ProJet 2500 we can go through trial and error before we invest in tooling so we don't have to spend time and money updating the mold."

Scott Barbour, Span Tech R&D Engineer

CHALLENGE

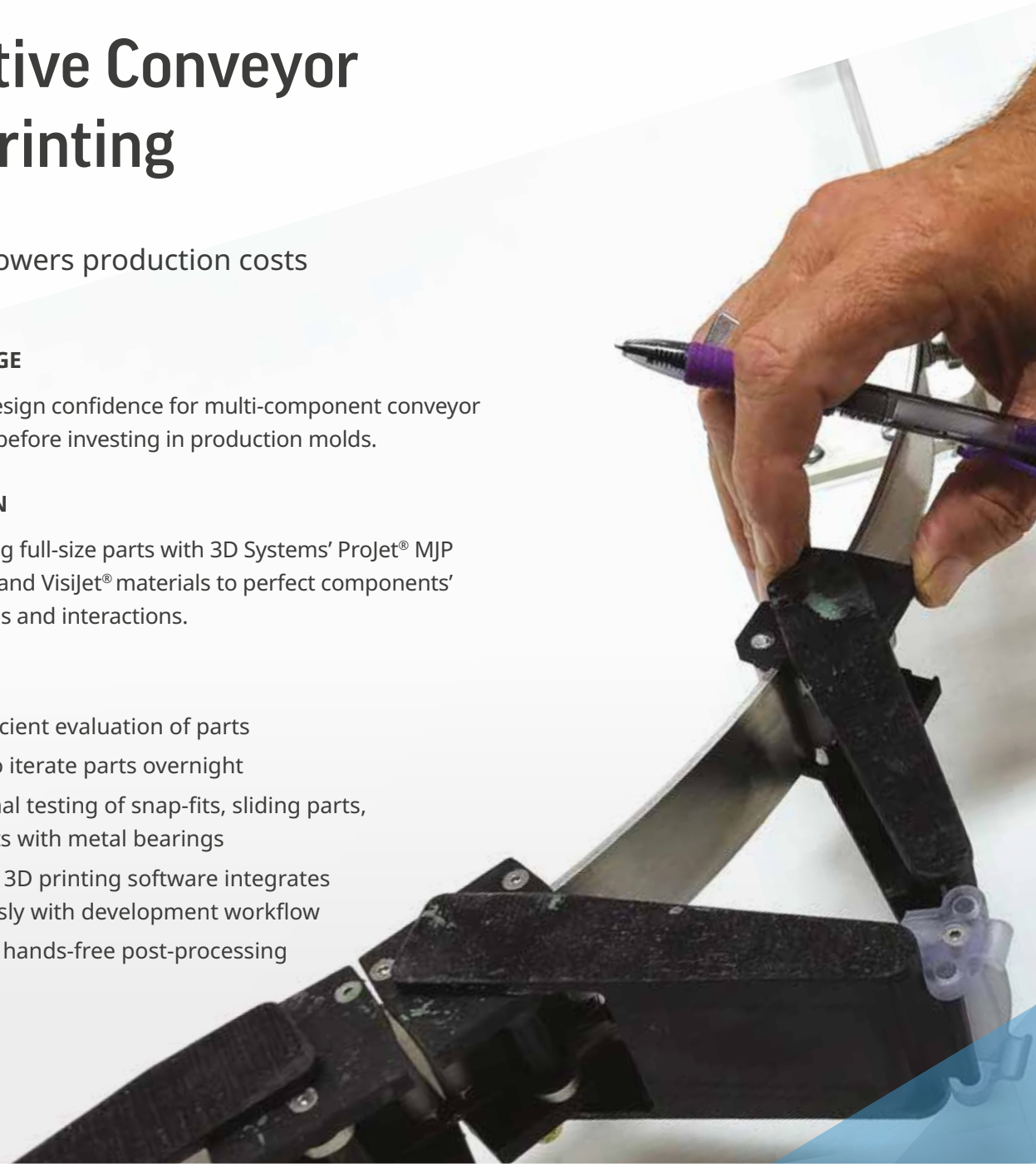
Achieve design confidence for multi-component conveyor assembly before investing in production molds.

SOLUTION

Prototyping full-size parts with 3D Systems' ProJet® MJP 2500 Plus and VisiJet® materials to perfect components' dimensions and interactions.

RESULTS

- Cost-efficient evaluation of parts
- Ability to iterate parts overnight
- Functional testing of snap-fits, sliding parts, and parts with metal bearings
- Intuitive 3D printing software integrates seamlessly with development workflow
- Virtually hands-free post-processing



CASE STUDY

Lightweight Parts

Up to 70% part weight reduction with 3D Sprint® Shells and Infill capability

With MultiJet Printing, users have the capability to reduce weight of printed parts, typically with no impact on the visual or dimensional accuracy of the part, using a shell and infill pattern as part of part creation.

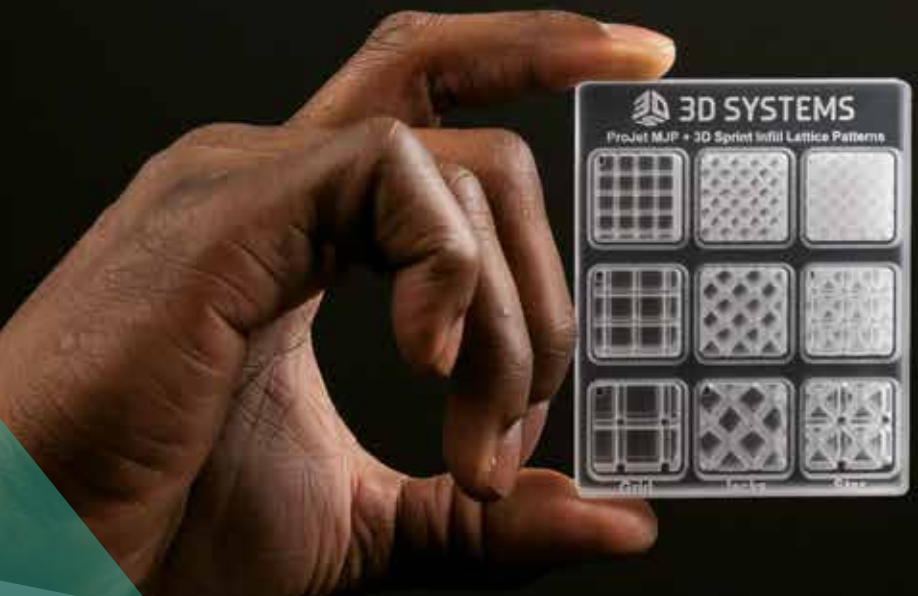
The function works by creating a shell of any desired thickness and then adding an infill within the shell with a given density. This feature can reduce part weight and material usage by 30%.

SOLUTION

3D Sprint offers features called “shells” and “infills”, which enable users to create a sparse fill within a solid part and drain the support wax inside.

RESULTS

- Easy three-step process to create a sparse filled part
- 70% weight reduction achievable
- 30% cost reduction achievable
- Weight reduction while maintaining part integrity
- Easy melt-away supports removal from within the part



Shells and infills allow you to design specific wall thicknesses and infill densities and to add drain holes for the ultimate weight reduction.

MultiJet Materials for Functional Prototyping

Most commonly used to prototype parts that will be injection molded, MJP materials can be handled just like traditional thermoplastics such as acrylic, polypropylene, polycarbonate, and ABS.

All the VisiJet® rigid and engineering materials for MJP printers can be press fitted, machined, drilled, and tapped, and deliver robust material properties and functional versatility, with accurate and perfect surface finishes. These materials are a rigid or semi-rigid thermoset, meaning they will not melt or easily gum-up with heat.

The ProJet MJP 2500 Plus delivers parts in rigid white, black, tan, gray, and clear materials, as well as elastomeric materials with outstanding elongation and full elastic recovery.

The ProJet MJP 5600 printer and material system simultaneously prints and blends flexible and rigid photopolymers, to achieve prototypes with varying degrees of flexibility, transparency, and differentiated shades in one part.

MJP is an ideal technology for your prototyping application if:

1. You need high fidelity, true-to-CAD parts
2. You require robust material properties and functional versatility
3. Good surface quality is important for your use case
4. You need repeatable accuracy with fine details and complex geometries
5. Easy operation and simple post-processing is required for high productivity and true simplicity, from file to finished part

Rigid and engineering materials can be drilled, pressed, and tapped with standard hardware

MJP Engineering-Grade Materials

These materials bring a new level of durability and strength to MJP printing, simulating ABS toughness with high impact resistance, or polypropylene with exceptional pliability, all with a superior clear finish.

VisiJet Armor M2G-CL

Tough, clear, simulating ABS

PROPERTIES:

- Tough and durable
- Balance of strength and flexibility
- Impact resistant
- Transparent

GOOD FOR:

- General purpose moldels
- Functional prototyping
- Snap-fit assemblies
- Fluid flow visualization
- Jigs, fixtures and tools
- Patterns, dies and molds

VisiJet ProFlex M2G-DUR

Tough, clear, simulating polypropylene

PROPERTIES:

- Tough and durable
- Flexible, with extreme pliability
- Impact resistant
- Transparent

GOOD FOR:

- Functional prototyping
- Snap-fit assemblies
- Living hinges
- Fluid flow visualization
- Jigs, fixtures and tools
- Patterns, dies and molds

MJP Rigid Materials

VisiJet Rigid materials print highly rigid, durable, plastic parts that look and feel like injection molded parts with an exceptionally smooth finish. Rigid materials are available in a variety of colors from white, black, and clear, to gray and tan.

PROPERTIES:

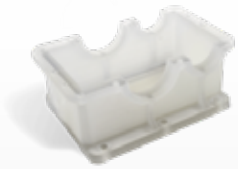
- Rigid and durable
- Smooth surface finish
- Moisture resistance
- Biocompatible capable (varies by material)

GOOD FOR:

- General purpose moldels
- Functional prototyping
- Water-tight applications
- Rapid tooling
- Medical applications

VisiJet M2R-GRY
High contrast, rigid gray

VisiJet M2R-BK
Rigid black



VisiJet M2R-CL
Rigid clear

VisiJet M2R-WT
Rigid white

VisiJet M2R-TN
High contrast, rigid tan

VisiJet M2R-BK
Rigid black

VisiJet CR-CL 200
Rigid clear

VisiJet CR-WT 200
Rigid white

MJP Elastomeric Materials

High performance elastomeric materials for MJP printers have an amazing elongation and Shore A hardness. Suitable for prototyping a wide range of mechanical applications requiring rubber-like functionality, these materials are ideal for gaskets, overmolds, and other applications requiring flex properties.

PROPERTIES:

- Rubber-like
- Excellent compressive characteristics
- Medium hard to high elongation options
- Translucent or opaque black

GOOD FOR:

- Design verification and testing of:
  - Gaskets
  - Piping
  - Seals
  - Sensor pads
  - Cable guides
  - Bumpers
  - Treads
  - Overmolds
- Medical modeling applications

VisiJet M2E-BK70
Tough black elastomer

VisiJet M2 EBK
Elastomeric black

VisiJet M2 ENT
Elastomeric natural

VisiJet CE-BK
Elastomeric black

VisiJet CE-NT
Elastomeric natural

MJP High Temperature Materials

With heat deflection temperatures up to 250°C, VisiJet heat resistant materials offer high stability for testing under elevated temperature conditions and for rapid tooling applications.

PROPERTIES:

- Heat deflection temperature up to 250 °C
- Excellent humidity/moisture resistance
- Rigid and transparent
- Biocompatible capable

GOOD FOR:

- Molds and dies for rapid tooling applications
  - Thermoforming
  - Eggshell molding
  - Injection molding
- Functional testing in warm environments
  - Under-the-hood components
  - Heated fluids and gasses flow analysis
  - Electronics enclosures/cases
- Biocompatible, medical device applications
- Sheet metal forming
- Eggshell molding
- Injection molding

VisiJet M2S-HT90
Thermal resistant, up to 90°C, transparent, biocompatible

VisiJet M2S-HT250
Best in class high temperature resistance, up to 250°C, translucent, biocompatible

Courtesy of Antleron

MJP Multi-Material Composites

In addition to printing in pure base VisiJet CR and VisiJet CE materials, the ProJet MJP 5600 can precisely mix elastomeric and rigid photopolymers together, voxel-by-voxel, to achieve superior mechanical properties and custom performance characteristics to meet your exacting specifications. An entire object can be printed in any of these composites, or a user can easily select a specific region of a part to be any number of different material combinations.

VisiJet Multi-Material Composites

Dozens of material choices within one part

PROPERTIES:

- 5 base materials: rigid white, black, or clear, elastomeric black or natural
- 100+ Plus more than 100 composite combinations
- Varying degrees of flexibility, material transparency and differentiated colors

GOOD FOR:

- General purpose moldels
- Functional prototyping
- Multi-materials assemblies testing
- Water-tight applications
- Over-molding
- Jigs, fixtures and tools
- Patterns, dies and molds

CASE STUDY

Bushnell Verifies High Detail Optics Designs with the ProJet MJP 2500

True-to-CAD accuracy and quick 3D printing speeds of 3D Systems ProJet MJP 2500 fast track product development at Bushnell.

When it comes to optics, looks can be deceiving. Hours upon hours of design, development, and trial and error are poured into the final products Bushnell offers in the sporting goods aisle, from binoculars and rifle scopes, to any of the other high quality visual aids the company produces.

As a category leader for over 70 years, Bushnell promises its customers clarity, durability, and technology in order to provide the best possible user experience.

CHALLENGE

Achieve small, finely detailed parts with high resolution and tolerance without the time and cost of machining.

SOLUTION

A 3D printing workflow with 3D Systems ProJet MJP 2500, VisiJet M2R material and 3D Sprint® software.

RESULTS

- True-to-CAD accuracy on finely detailed, high tolerance prints
- Overnight design verification prints compared to previous wait times of weeks or months
- Significant cost savings realized through in-house prototyping capability
- Added value across departments via easy 3D printing access for fast and reliable test parts

Post-Processing Options for Appearance Models

Additive manufacturing materials for rapid prototypes can use many kinds of post-processes and finishes for realistic look. These apply not only to MJP, but to all additive technologies, including stereolithography, selective laser sintering, non-contact membrane printing (Figure 4), and entry-level industrial systems.

PAINTING AND LACQUERING

3D printed prototypes can be painted, lacquered and finished for realism to show concept car body parts, appliances, medical devices and more.

TINTING AND DYEING AND CLEAR GLASS

Clear materials from MJP are very receptive to tinting and dyeing to create realistic prototypes of lenses, headlamps and colored bottles and packaging. Clear prototypes can be processed to resemble clear glass through sanding and clear coating.

Learn more

DRILLING, TAPPING AND PRESS FITTING

MJP true-to-CAD precision and materials enable to create parts that need to be assembled and used for testing with standard hardware. MJP rigid and engineering materials can receive direct tap screws, metal inserts, screw bosses and drilling, without cracking or failing.

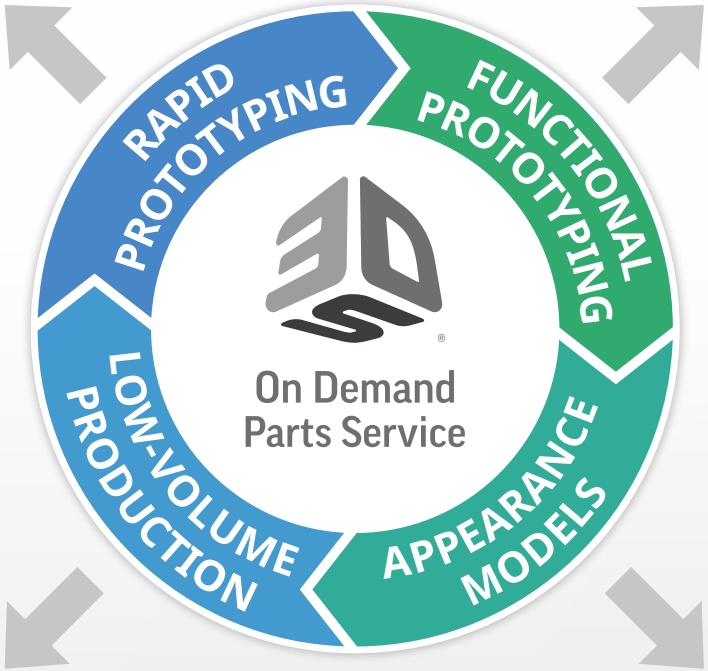
Learn more about drilling with MJP

Rapid Prototyping On Demand

3D Systems On Demand delivers the technologies, processes, tools and expertise to quickly translate your designs into manufactured parts.

Customers rely on the engagement with our engineers to help speed time-to-market, fuel innovative design, and provide access to the widest range of processes and materials across our facilities worldwide.

- For fast design iterations and part testing
- Quick turnaround times
- Consistently high quality



- Assess real-world usability, ergonomics and manufacturability
- Additive and traditional manufacturing processes
- Lower costs and reduce design risks

- Reduce tooling costs
- Iterate designs
- Diverse range of technologies available

- Transform your design into reality
- Comprehensive range of materials and processes
- Trusted by manufacturers across the world

What's Next?

Interested in learning more about rapid prototyping and 3D printing?

Get in touch today – we will be right with you.

Get in Touch

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