

HP Multi Jet Fusion color technology and workflows

Embrace bold full-color printing from prototyping to production



With the introduction of the HP Jet Fusion 580 and 380 Color 3D Printers, HP has unleashed the power to innovate in full color. By combining its deep knowledge of color inkjet technology with its disruptive HP Multi Jet Fusion technology, HP is now capable of three-dimensional printing in brilliant color. Just as 2D color printing revolutionized the printing market, HP Jet Fusion color 3D printing has the potential to dramatically advance the course of the digital manufacturing revolution and accelerate the widespread adoption of 3D printing. This technical white paper details advantages of and use cases for 3D printing in full color, the science and technology behind HP Multi Jet Fusion color printing, and the digital workflow for preparing 3D color parts.

Why color?

Your life is full of color. Your 3D parts should be, too.

Color helps us understand an object's purpose—it guides our eyes and heightens our emotions. Consider the power of color in the products that surround you. A red warning sign tells you not to touch a hot surface. The map on your wall outlines different countries in contrasting colors, making them easy to differentiate. Even the bright neon design on your shoes serves a purpose—it is stylish, it improves your visibility when going for a jog, and it provoked an emotional connection within you, causing you to choose that shoe over others.

With the introduction of HP Multi Jet Fusion color printing, for the first time, creators are empowered to follow their ideas from 3D prototyping to production in full, functional color. HP Multi Jet Fusion color technology is designed to overcome trade-offs that have hindered 3D printing in color for years, including limited part strength and material properties, and expensive hardware costs. With engineering-grade thermoplastics with strong material properties, HP Multi Jet Fusion parts are designed for full functionality. Furthermore, with fine detail and high dimensional accuracy for small features, HP Multi Jet Fusion color parts can accurately portray form, fit, and function. And finally, with a cost-effective solution, even small- and medium-sized organizations can afford to take advantage of this cutting-edge color solution.

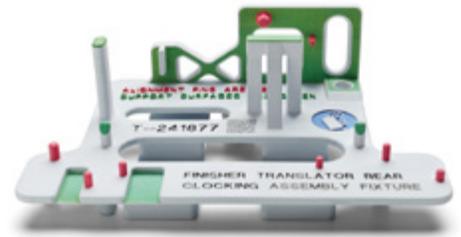
Use cases

When color is added to 3D parts, they take on new meaning. Use cases abound for color 3D printing in industries from healthcare to manufacturing to consumer goods.

Fixtures and jigs

Custom fixtures, jigs, and guides are standard tools in the manufacturing industry that enable repeatability and accuracy on production lines. Adding color-coded placement instructions, QR codes, and instructional symbols to these tools can help manufacturers take their production to a new level.

HP originally created the fixture to the right as a monochrome part for its inkjet manufacturing line. With color, HP was able to add specific information for the operator. The top of the jig states, "ALIGNMENT PINS ARE RED" and "SUPPORT SURFACES ARE GREEN" in their respective colors. The part has a name and number, an icon indicating gloves are necessary, and a QR code that can be scanned for further information.



Healthcare models

For years, doctors have been printing 3D models of organs to help them prepare for complex surgeries. When color is added to these models, it is considerably easier for doctors to differentiate between tiny veins and arteries when practicing procedures. In addition, these models are used as tools to explain what will happen in a surgery to the patient and their family.

At Phoenix Children's Hospital, doctors scan and print 3D models of their patients' hearts to practice surgeries. With a 3D model, doctors can find the best surgical path, which is critical when operating on children whose organs are small. This is a model of a girl named Jemma's heart.



Data courtesy of Justin Ryan,
Phoenix Children's Hospital

Medical casts and prosthetics

Imagine getting a brace for your sprained wrist that fits your body perfectly and suits your style. Or having a prosthetic that expresses your creative side. With custom coloring and design options available for these items, doctors could see significant improvements in their patients' overall medical experience.¹

This wrist splint, printed on an HP Jet Fusion color 3D printer, is strong enough to endure everyday use and it expresses a patient's colorful personality.



Data courtesy of Dr. Louis Ferreira,
PhD, Surgical Mechatronics Lab



Data courtesy of FreshFiber



Consumer goods

Fashion preferences can change overnight, leaving consumer goods manufacturers stuck with an inventory of products with unpopular colors or designs. However, with 3D printing in color, manufacturers of consumer products, like toys or cell phone cases, can change their design strategy overnight and even customize options for customers.¹

Prototypes and display models

When prototyping in color, designers can clearly visualize their creations and accelerate their design cycles. Furthermore, with the ability to color-code or label different prototype iterations, designers can help eliminate uncertainty around similar models that may be in the same print job, or even just lying around their office. When the final iteration of the product is decided upon, the same color choices can be used to produce accurate, colorful display models.

This air duct model has a QR code to scan for more information and displays information about where different air flows should be directed.

Art

Artists' ideas should not be limited by their ability to machine or injection mold a part for their work. With 3D printing, artists have full creative freedom to create shapes that have never been seen before. And, with the addition of color in 3D printing, they can give their creations more depth.¹

HP Multi Jet Fusion color technology

HP developed a solution for 3D color printing through a combination of complex chemistry and more than two decades worth of research in inkjet printing.

To understand color printing, first consider the original HP Multi Jet Fusion technology process. After each layer of plastic powder material is laid across the print bed, HP inkjet printheads accurately print fusing and detailing agents on top of the powder. Then, a heating lamp goes across the print bed. Any area with the HP fusing agent, which is black, absorbs the infra-red waves from the light, like a black T-shirt on a sunny day. As the light is absorbed in this area, the plastic powder melts, fusing sections of each part together at the voxel level. Conversely, in areas with the HP detailing agent, the powder remains white and is cooled, leaving it unfused and free to be reclaimed for future builds. This process works beautifully for producing black parts, but, in order to print color, HP needed a process to print primary colors, and most importantly, white.

To print white parts, HP needed to find a chemical agent that absorbs infra-red light like the original black fusing agent, but also transmits visible light so it could be combined with dyed agents to create color. HP scientists scoured the world for this agent, and, after an exhaustive search, finally discovered the HP bright fusing agent. The agent itself is colorless, which preserves the natural white color of the plastic powder. Then, to print color, HP uses cyan, magenta, yellow, and black (CMYK) agents—just like on a 2D printer—along with the HP bright fusing agent. And, just like the original black fusing agent, the bright fusing agent absorbs infra-red waves to melt the powder.

During printing, in fraction of a second, thousands of inkjet nozzles release color, fusing, and detailing agents. All layers are fused together with infra-red light, allowing parts to have both brilliant color and strength.

At launch, HP is coloring only the outside of parts to maximize part properties. However, more capabilities are on the horizon for voxel-level control.

The future

The development of the HP bright fusing agents and the ability to print functional parts in color is just the beginning. As you read this, HP scientists are hard at work researching new agents, including those that can control the conductivity of voxels, which allows you to print circuits, and the printing of photoluminescent dyes that are only visible when shown under a UV light.

All HP Jet Fusion 580 and 380 Color 3D Printers have slots for eight agents, all of which can be used to support future innovations. Currently, printing in color only uses seven of these agent slots for detailing, original fusing, bright fusing, and CYMK agents. When considering reconfigurations for future agents, the possibilities are endless.

Digital workflow

Supported file formats and color file creation

When you are ready to take advantage of HP Multi Jet Fusion color 3D printing, you first need to create color 3D models.

You can add color, texture, meshes, and decals to your parts in most major 3D modeling software. Refer to your software's guidelines for how to best add color to your parts before exporting your files.

HP SmartStream 3D Build Manager supports color 3MF, OBJ, and VRML v.2 (also known as VRML 97) files. It also accepts STL files, but these files do not include color information.

Many common 3D design software tools export these file formats. However, if your 3D design software cannot export 3MF, OBJ, VRML v.2, or STL files, you can convert them to an accepted format as well as add color to them in 3D software such as Magics, NetFabb 3D Builder, or Blender.

HP SmartStream color capabilities

After saving your color 3D parts as a 3MF, OBJ, or VRML v.2 file, open them in the HP SmartStream 3D Build Manager.

In HP SmartStream, you can add or remove color to a part by selecting it and choosing the paint bucket icon on the menu on the right of your screen.

A window will appear with a color map, which allows you to choose from a full range of color choices. You can also add a custom RGB or HEX color-code or select "Remove color" to eliminate all color information and print your part in white.

As you select different colors for a part, the entire color of the part changes in the display. You can select multiple parts to change them to the same color, or you can color different parts in different colors.

Furthermore, by clicking the global color correction icon on the right side of the screen below the paint bucket, a menu will pop up that will allow you to tweak the hue, saturation, and value of your colors—just like you would on a 2D picture editing software.

When you are finished adjusting the color to your preferences, simply press "Send to print" to begin the HP Multi Jet Fusion color 3D printing process and start producing functional color parts.

Connect with an HP 3D Printing expert or sign up for the latest news about HP Jet Fusion Color 3D Printing at

hp.com/go/Color3DPrint

Learn more about HP Multi Jet Fusion technology at

hp.com/go/3DPrint

1. HP is in the process of obtaining USP verification for skin contact as of March, 2018.

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