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Markforged

METAL 3D-PRINTED BRACKET

3D-PRINTED COMPOSITE TAPPING FIXTURE

Address More Manufacturing Challenges with Composite and Metal 3D Printing

Both high-strength composite 3D printing and metal 3D printing are valuable fabrication methods. Used separately, they address a broad spectrum of manufacturing use cases. Together, they enhance each other and provide clever solutions.

In this paper, we'll discuss several ways you can leverage these complementary technologies to quickly improve your manufacturing processes.

Metal or Strong Composites?

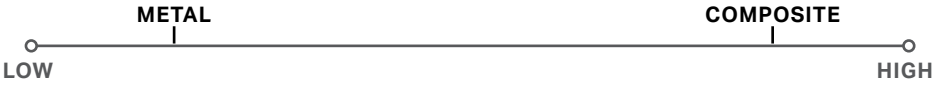
Markforged composite printers uniquely embed continuous reinforcing fibers — carbon, fiberglass, or Kevlar® — to print parts up to 23 times tougher than ABS, while Markforged metal printers fabricate stainless steel parts. Each printing technology leverages the advantages of additive manufacturing to create parts suited for different aspects of the manufacturing process. By understanding their strengths, you can maximize the utility of high-strength 3D printing in your operation.

Optimize Your Parts for Specific Qualities

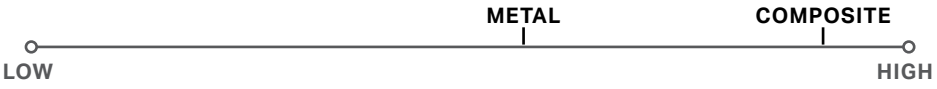
Metal and high-strength composite parts have varying material properties that lend themselves to different applications.

STRENGTH TO WEIGHT

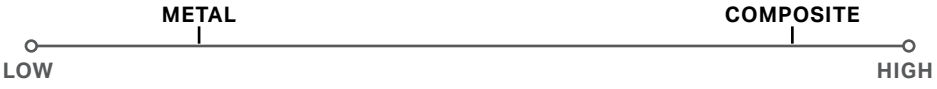
SHOCK ABSORBENCY



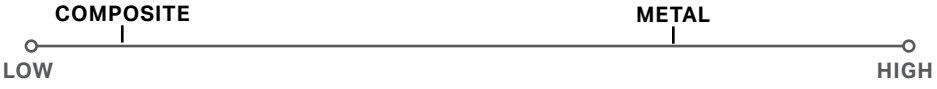
TOUGHNESS



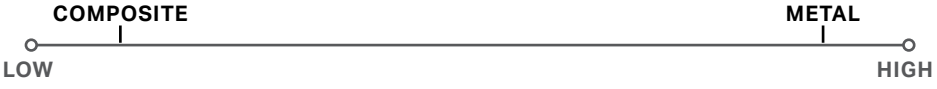
NON-MARRING



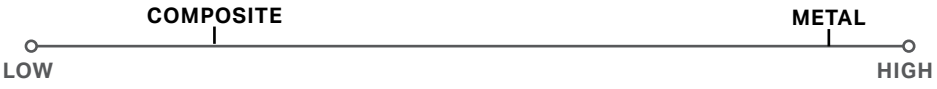
ISOTROPIC STRENGTH



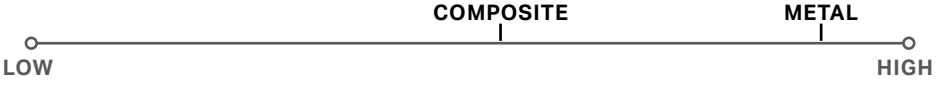
SURFACE HARDNESS



WEAR RESISTANCE



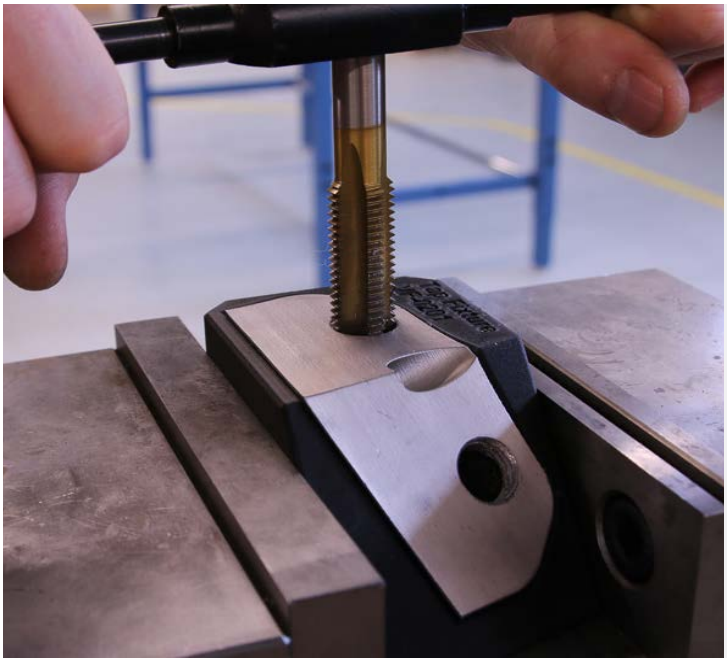
HEAT RESISTANCE



Complex Metal Parts Create the Need for Printed Fixtures

While all parts require design for manufacturing, metal 3D printing allows you to print part geometries that are expensive or impossible to machine. Printed metal parts can be post processed with conventional metal fabrication processes like tapping, polishing, or machining. However, with the freedom to design intricate metal parts comes a problem — **the more complex the part, the less likely standard workholding can hold it.**

Composite 3D printers enable fabricators to manufacture high-strength conformal workholding without consuming machine bandwidth. With them, you can produce low-cost tooling and fixturing capable of handling high loads and machining fluids. For low-volume metal parts, printing both the metal part and the high-strength composite fixture will simplify your workholding design process while ensuring a perfect fit.



APPLICATION

Tapping Fixtures

Use printed composite workholding to align and support printed metal parts that require post-processing techniques like tapping.

This metal part sits in a conformal composite fixture that orients the holes vertically for easy tapping. The tough composite fixture easily withstands the clamping forces applied by the vise to secure the part.

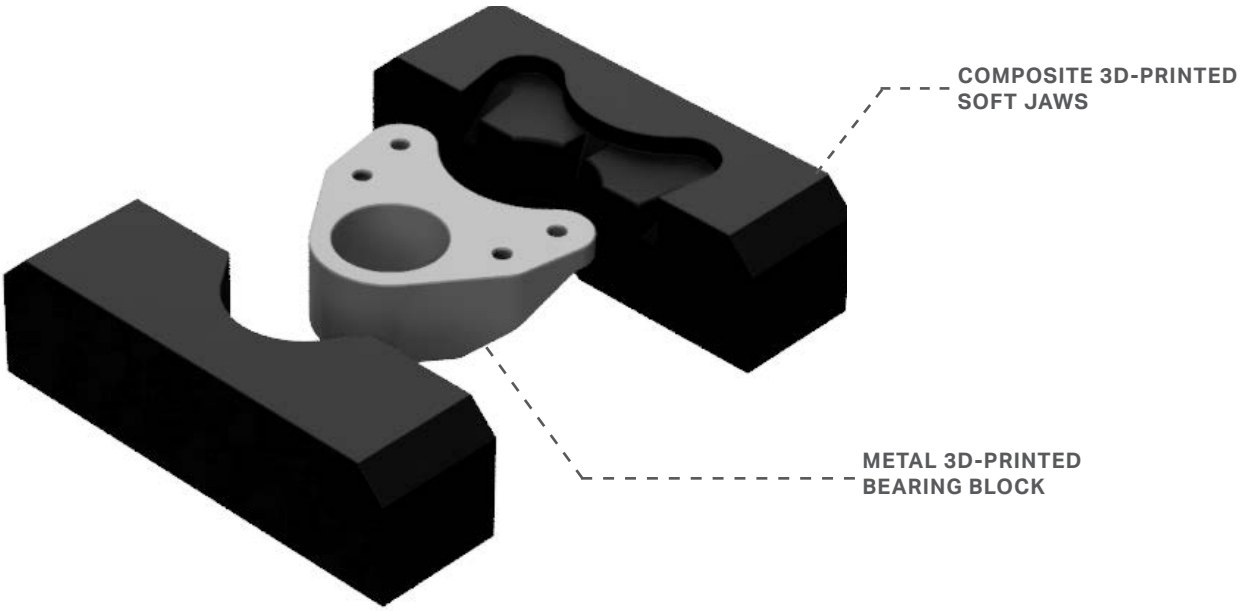
Effectively Hold Uniquely Shaped Parts

If you can print a part in metal, you'll be able to easily print its composite workholding. Printing composite fixtures for metal 3D-printed parts solves the conformal workholding problem efficiently — whether for tapping, post machining, or QA inspection.

Simplify Your Tooling Design Process

3D-printed workholding is faster and simpler to create than its machined counterpart.

1. First, CAD a fixture blank in your preferred program.
2. Import your part, orient it, and perform a boolean subtract operation.
3. The result will be a fixture that you can simply print, as opposed to the programming and machining process of traditional soft jaws.



APPLICATION

CNC Mill Soft Jaws

In this example, a machinist uses custom-printed workholding to fixture a metal 3D-printed bearing block that requires post-machining for precision.

The conformal composite soft jaws match the complex contours of the metal part. The composite jaws are tough and chemically resistant, making them durable in the machine shop.

Print Metal Tool Inserts for Composite Tools

Custom tools are often prohibitively expensive to create. 3D printing makes these tools affordable. Tools are often made of multiple materials to maximize performance: many hammers, for example, have hard, heavy metal heads and light, shock-absorbent fiberglass handles. Access to both a metal and a composite printer provides the flexibility to leverage both materials' strengths to create extremely functional tools, as illustrated in the example below.

APPLICATION

Custom Wrenches

A metal 3D-printed insert fitted within a composite grip localizes hardness and wear resistance to the contact area.

The composite grip keeps the tool lightweight and ergonomic. Internal continuous fiberglass reinforcement makes it durable and robust, distributing the torsion loads applied from tool use.

Printing Custom, Multi-Material Tools Has Additional Benefits

1. By printing one composite handle/mounting piece that can interface with a wide variety of metal inserts, you can consolidate an array of tools into a more compact unit.

2. Swappable wear components also extend the lives of tools. When a handle or insert wears out, you can easily print a replacement instead of replacing the entire tool.

3. Isolating the metal insert as a separate part allows you to rapidly iterate on its design.

Use the Right Material for Tool Requirements

Metals and composites share one key material property: they're both high-strength. Leveraging the secondary properties of each material yields strong tools that can be either hard and wear resistant or tough and non-marring. These two fabrication methods are similar in execution, but produce parts with a wide variety of material properties.

APPLICATION

Line Interactions

Composite and metal 3D-printed parts fill different roles on the factory floor and can work together to support production. Here, metal 3D-printed end effectors hold threaded couplings during their manufacturing process.

Composite printed fixtures locate and align the couplings on the line. This is just one example of how two 3D printing technologies streamline manufacturing scale-up.

Markforged Covers the Spectrum of Manufacturing Needs

Having two different fabrication methods — one for 17-4 PH stainless steel, and one for industrial composites — enables you to 3D print parts for a wide range of requirements and use cases, from tooling and fixtures to low-volume end-use parts and functional prototypes.

Only Markforged composite printers embed continuous reinforcing fibers to print non-marring parts as strong as aluminum and resistant to corrosive fluids like cutting oil.

Markforged's free printing software provides one simple interface to operate all its printers.

INCREASE YOUR MANUFACTURING EFFICIENCY

Schedule a quick consult to learn which Markforged printers best address your challenges. We'll show you how quickly you can determine the time and material cost of printing your part.

3d.markforged.com/learn-more.html