



MASSIVIT

New Realms in Automated Tooling for Aerospace Composites

with Large-Scale Additive Manufacturing





Aerospace Tooling for Trapped Composites – Overcoming Challenges

Aerospace hollow composites have traditionally been manufactured using mandrels and cores that are time-consuming and complicated to produce. Tooling technology ranges from multi-part aluminum or steel molds to inflatable, silicon bladder molds. These methods demand high costs and are labor-intensive – requiring multiple stages of tooling, especially when undercuts or complex geometries are involved.

This white paper explores how Massivit's automated tooling technology and advanced water-breakable material address common aerospace production challenges. It examines how additive manufacturing can significantly reduce tooling time for large hollow composites by allowing mandrels to be directly printed within a few hours.



Figure 1. Full-scale mandrel (left) and resulting composite skin (right) 3D-printed with Massivit's water breakable polymer

Part Name	Dimensions	Weight of Sacrificial Material	Print Time
Air Intake	15 x 17 x 24 in. (382 x 424 x 615 mm)	4.25 kg	5:54 hours

Breakthrough Wash-Away Material

Dimengel Water Breakable (DIM WB) material is a revolutionary 3D-printing material that is transforming the aerospace industry. Engineered specifically for the Massivit 10000 additive manufacturing series, DIM WB is a UV-curable, gel-based **water-breakable material** with high viscosity that cures on-the-fly while printing. It enables ultra-fast production of sacrificial cores for trapped composites, reducing time-to-market and expanding design possibilities for aerospace manufacturing.

Why Additive Manufacturing?

Additive manufacturing (AM) **automates tooling**, providing directly printed mandrels in **significantly less time** than with conventional tooling. This digital fabrication method allows for easy creation of complex and intricate designs and overhangs that are challenging to achieve with machining methods or traditional aluminum tooling.

Milling a mandrel using a traditional lathe presents limitations for **complex geometries**. Extracting the mold from the skin once laid up is challenging, particularly with metal mandrels which are rigid. Additive manufacturing utilizes three axes (X,Y and Z) to digitally achieve a given design, regardless of how complex.

Massivit's automated tooling allows for **lighter** mandrels than those produced via legacy processes.



Additive production also dramatically **decreases material waste** compared with conventional subtractive methods. With traditional processes, an initial large raw block of metal, wood, foam, or other material is machined down to achieve the required geometry, thereby shaving off an enormous percentage of the material block and generating significant waste. The Massivit 10000 system deposits DIM WB material precisely according to a digital CAD design, using only the amount of material required. Unlike other 3D printing technologies, the Massivit 10000 requires almost no infill or support structures.



Part Name	Dimensions	Weight of Sacrificial Material	Print Time
Air Intake	50 x 15 x 11 in. (1258 x 372 x 288 mm)	7 kg	10:13 hours

Figure 2. WB mandrel (left) with resulting composite air intake (right).

DIM WB – Simplified Tooling for Complex Designs

DIM WB is a proprietary, water-removable, breakaway material that permits the production of intricate hollow parts without needing additional support structures. Unlike traditional 3D-printing materials, DIM WB can be removed with ease through simple immersion in water, exposure to water fog systems, or mechanical peeling. This streamlined process makes it ideal for aerospace manufacturers to create large, complex components using composite layup.

Faster Production Cycles

The Massivit 10000 offers unprecedented print speed. It eliminates the need for support material removal associated with other 3D printing technologies.

Logistics Made Easy

DIM WB material enables creation of lightweight tools, making transportation easier.

Reliable Storage

DIM WB has a shelf life of up to one year when stored correctly in its sealed container, making it practical for on-demand production.



Simplifying your Tooling Workflow

The Massivit 10000 directly prints large cores and components within a matter of hours, based on a CAD design or a 3D-scanned object.

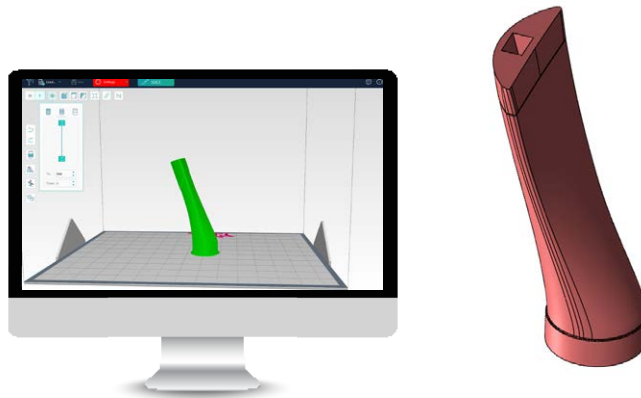


Figure 3. Toolpath of mandrel on Massivit's Smart (Slicer) Software



Figure 4. 3D-printed core

Figure 5. Wrapping 3D printed model with Carbon fiber sheet on a rotating jig

After light sanding, the mandrel is ready for carbon layup with the help of a vacuum bag. It can be placed on a rotating jig, enabling the application of epoxy and carbon-fiber sheets around the tool. Once laid up with carbon-fiber, the mandrel can be vacuum bagged and allowed to rest for the final cure.



Figure 6. Mandrel wrapped with carbon fiber sheet

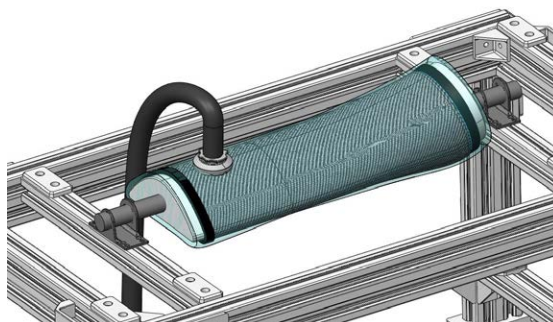


Figure 7. Vacuum pressure after layup.

The mandrel supports the composite structure both mechanically and thermally, regardless of how complex the geometry.

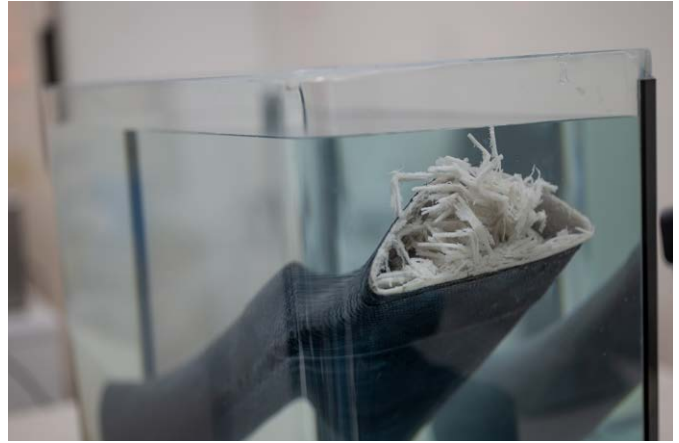
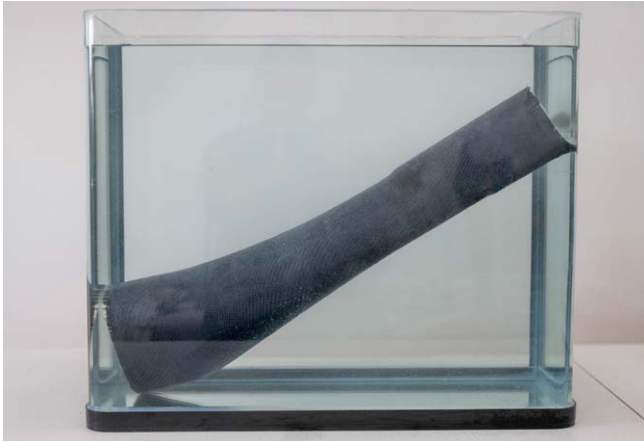


Figure 8 & 9. 3D-printed mandrel encased with carbon skin, submerged in plain water bath.

It is then placed in a bath of plain tap water. The WB polymer is designed to display swelling in a limited manner, causing it to break away into small flakes. These flakes are not water-soluble and therefore can be filtered out of the water bath, allowing the water to be reused. Alternatively, the material can be peeled off after exposure to a water fog system or removed by any mechanical means.



Figure 10. End part: hollow, carbon skin.

The custom-designed, hollow carbon skin is now ready according to your required design.



Aerospace and other Applications of DIM WB

Design and Complex Prototyping at the Click of a Button

Aerospace designers can swiftly create complex prototypes and iterate new versions quickly. This enhances creativity and allows companies to bring products to market faster.

On-Demand Tooling

DIM WB is perfect for automating essential cores and mandrels.

Efficient Repairs and Maintenance

When repairs are needed, aerospace companies face mounting downtime and costs. DIM WB allows hollow composites that are damaged to be replaced quickly inhouse, speeding up repair timelines.

Automotive, Energy and Beyond

Sacrificial cores can additionally benefit production of automotive composites as well as ducts, pipes, vents, and funnels for management of air, fluid, and energy.

A Matter of Scale

Additive manufacturing options already exist in the market for production of washable mandrels of a relatively small size. The Massivit 10000 offers a build volume of 4'8" x 3'8" x 4'11" (1.42 x 1.11 x 1.5m), so a full-scale composite part can be laid up on a single-part printed mold without the need to join parts together, thereby improving overall accuracy.



Figure 11. Massivit 10000 additive manufacturing system.

Additive manufacturing simplifies mandrel production for aerospace production offering rapid tooling and prototyping that is lighter, more precise, waste-free, and can be easily customized to fit specific design requirements.



Looking to the Future

Evolving high-performance materials combined with fast additive technology is empowering aerospace manufacturers today to automate and innovate their production workflows. Discover how the Massivit 10000 and DIM WB material can elevate your aerospace production processes today.

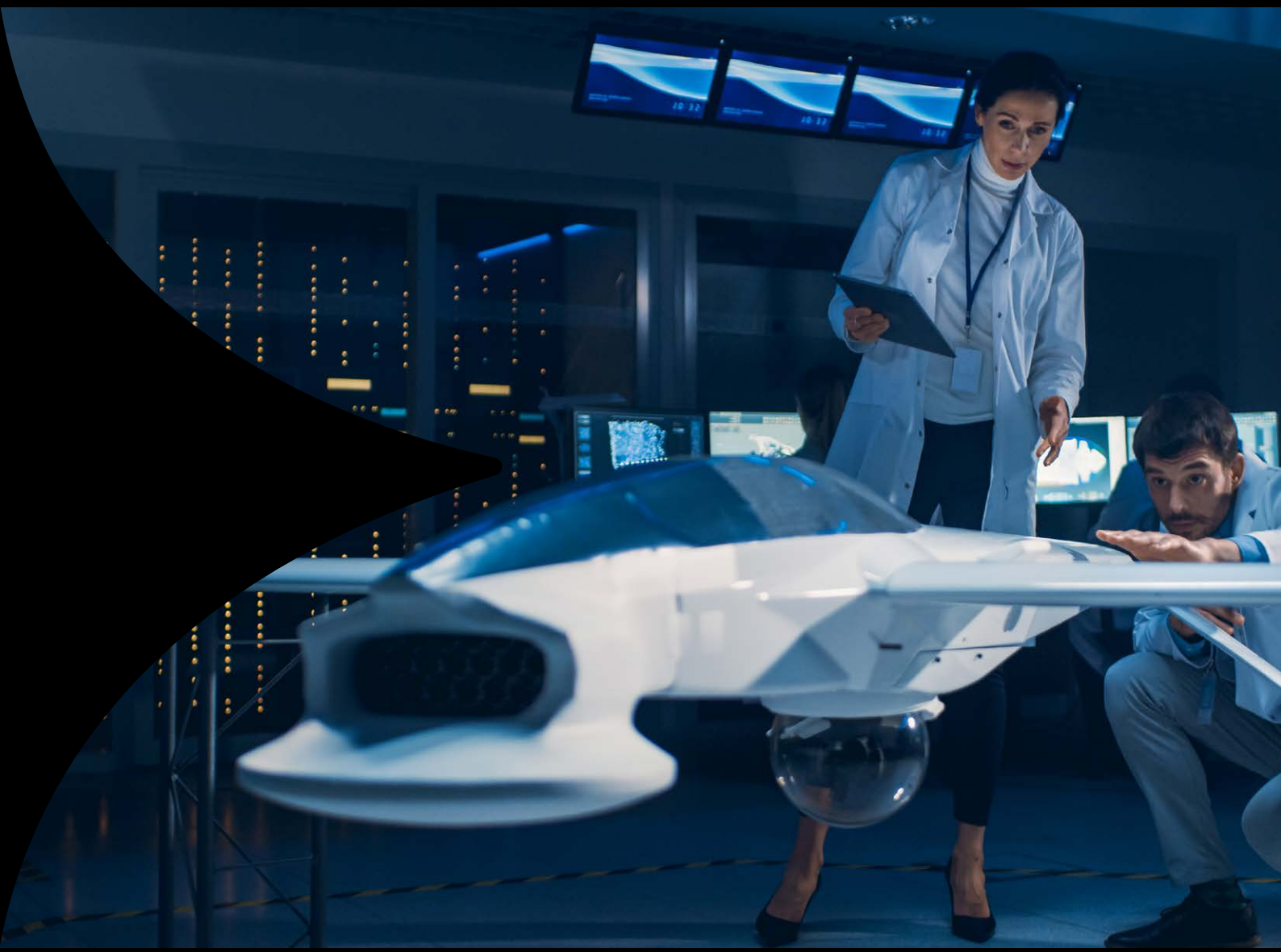
"We have been utilizing the Massivit 10000 in our operations for several years and can confidently say that it has exceeded our expectations in terms of reliability and performance. In industries like aerospace and defense where precision and accuracy are paramount, the Massivit 3D printer consistently delivers outstanding results. Its innovative technology and robust design enable us to achieve high-quality outputs with minimal downtime. We highly recommend Massivit 3D printers to any organization seeking dependable and precise 3D printing solutions."

– **Ryan Van Deest, Senior Development Engineer, Ursa Major**





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For further information about aerospace manufacturing with Massivit 3D Printers, please contact us:

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