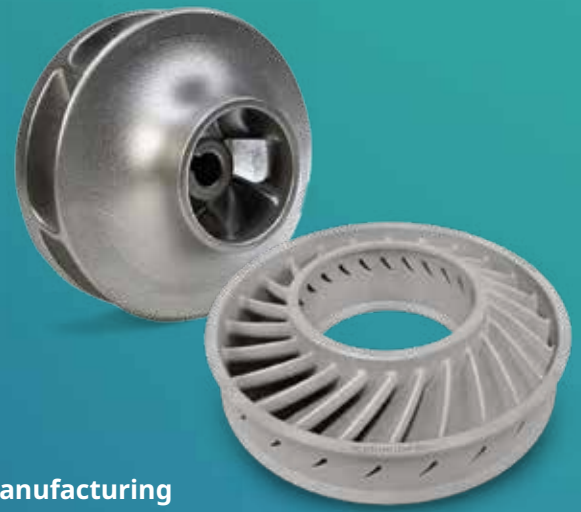


# Direct Metal Printing for Turbomachinery

Improve Performance,  
Uptime, and Efficiency

Direct Metal Printing (DMP) is getting rapidly adopted for the manufacturing of turbomachinery components such as turbo pump casings, stator vanes, impellers, and fuel injectors. The DMP technology enables increased fuel efficiency, performance, and reliability with consolidated components and complex functionally optimized geometries, while simplifying the supply chain. Today, advanced 3D printing technologies and design strategies enable you to unlock new designs for turbomachinery applications and shorten design cycles resulting in an accelerated and cost-efficient path-to-market.



## Turbo Pump Casing

High-productivity with  
industry-leading part quality

Explore replacing traditional manufacturing routes like investment casting with DMP for producing turbomachinery components. DMP benefits from simplifying the supply chain by shortening the processing steps in the manufacturing workflow by 3 times and reducing the lead time from 12 to 3 weeks compared to investment casting.

The new LaserForm Ni718 (A) laser parameters for 120  $\mu\text{m}$  layer thickness on the DMP Factory 500 yields high productivity with industry-leading part quality. The robust DMP machine architecture has established a repeatable fidelity delivering complex geometries ranging from large cross-sections to fine features with excellent density (typ. 99.9%) and superior surface quality.

The turbo pump casing with a diameter of 445 mm was printed seamless in 75 hours on the DMP Factory 500. This cost-competitive solution was achieved by combining the high-productivity Ni718 parameters with 3D Systems NoSupports™ build strategies.



Turbo pump casing with a diameter of 445 mm printed seamless in 75 hours with the DMP Factory 500.

“Using the DMP Factory 500 technology enables us to outperform our competitors when it comes to the quality of metal series components. The robust and productive printer combined with 3DXpert’s advanced build strategies have reduced our lead times and has accelerated our design cycles allowing us to scale our AM services.

Our DMP printers produces surface smoothness, part accuracy, narrow tolerances, and high repeatability even with critical features such as cooling channels. Our customers rate DMP part quality as the best in the industry today.”

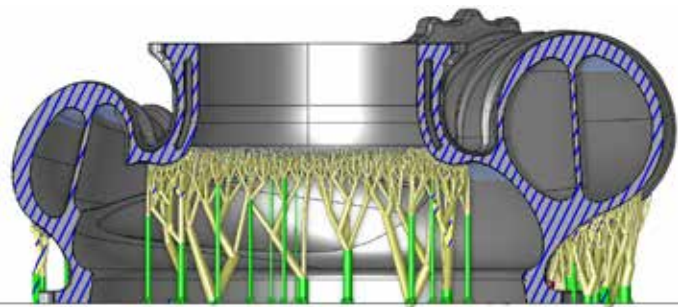
— Marco Salvisberg, Business Development Manager  
Additive Manufacturing | GF Casting Solutions

# Turbo Pump Casing Cont.

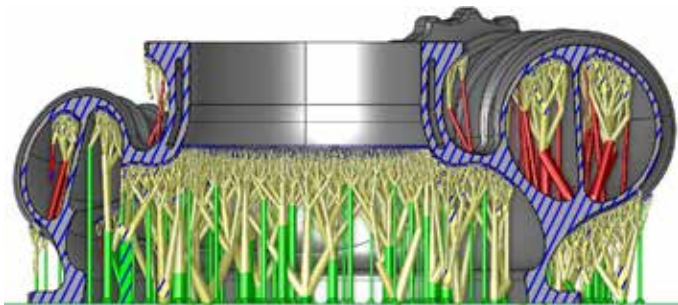
## Unlock New Applications with NoSupports™

With 3D Systems NoSupports build strategies you can expand the design envelope, accelerate design cycles, and unlock new applications. Today, design features such as large internal channels and cavities, turbine blades, and domes can be direct metal printed with far less or even without support structures. The NoSupports innovation pushes the DMP technology to new heights and expands its economic viability, while broadening the DMP application space across multiple industries.

Combining design for AM with NoSupports strategies allows further improving the fuel efficiency, performance, and lifetime of turbomachinery components.



Optimized build design using NoSupports build strategies.

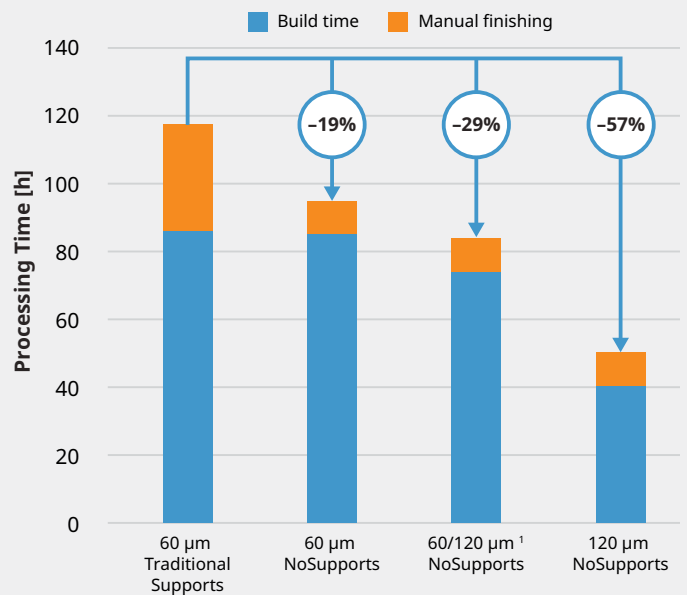


Build design using traditional support structures.

## Reduce Manufacturing Cost and Lead Times with NoSupports™

With NoSupports you can manufacture turbomachinery components faster and more cost-effective, without compromising on part quality.

A case study on the turbo pump casing highlights these benefits using the high-productivity Ni718 laser parameters and NoSupports. The turbo pump casing exhibits large internal channel and cavities with low-angle overhang features. Applying NoSupports simplifies the build design and reduces the necessity for internal support structures which are difficult to remove after printing. The images on the left-hand side show cross-sections of the turbo pump casing with the optimal design using NoSupports build strategies and the same design using traditional support structures. The optimized design yields a part-to-support volume ratio of 95% compared to 80% for the design with traditional supports. The bar chart below shows the relative productivity gains in processing time when using the high-productivity Ni718 laser parameters (120 μm) and NoSupports strategies. Moreover, applying NoSupports allows to save 69% of manual finishing time on the turbo pump casing.



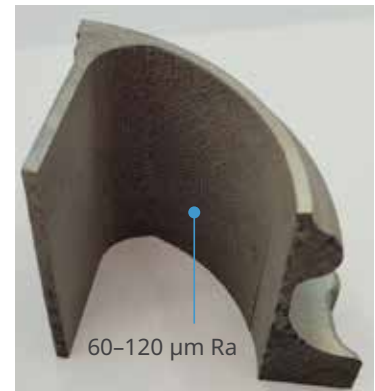
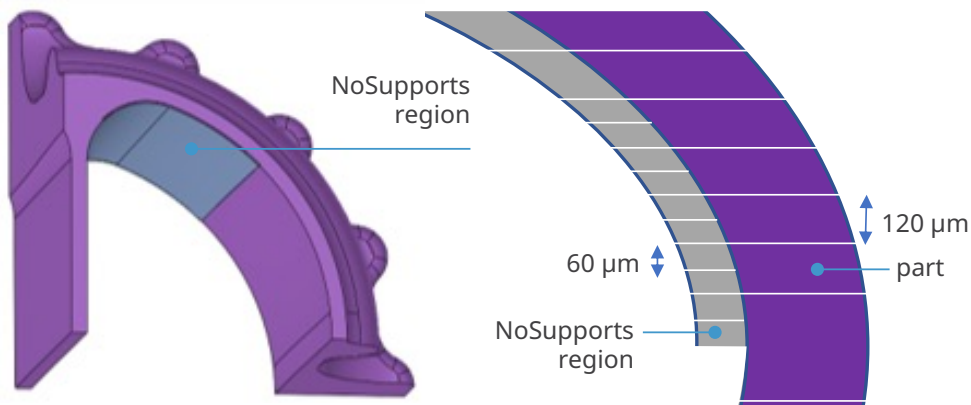
<sup>1</sup> Bulk printed in 120 μm layer thickness with contours and NoSupports regions printed in 60 μm layer thickness.

# Optimize Productivity and Surface Quality with 3DXpert's Advanced Strategies

With 3DXpert's advanced 3D-zoning and super middle strategies, you can print the bulk of the turbo pump casing in 120  $\mu\text{m}$  layer thickness, while printing contours and NoSupport overhang zones in 60  $\mu\text{m}$  layer thickness. This approach allows optimizing both productivity and surface quality. The turbo pump casing exhibits an as-printed surface roughness of 120  $\mu\text{m}$  Ra for areas with an overhang angle of 20°.

The NoSupports build strategy enables improved surface uniformity in the overhang zones and reduces the risk for dimensional variation caused by manual finishing. This approach results in easier surface post-processing and a superior dimensional accuracy of the finished part.

DF ANGLE	RA ( $\mu\text{m}$ )
30-40°	60
20-30°	80
<20°	120



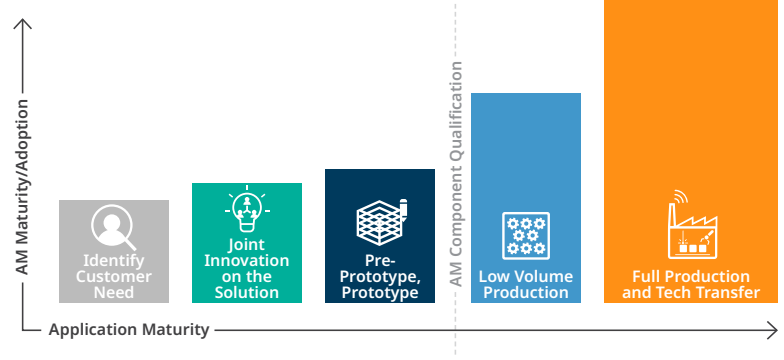
## Large-Sized Seamless Parts with DMP Factory 500

The DMP Factory 500 enables the production of seamless large parts the size of the full build volume (500×500×500 mm). This results in the highest surface quality for metal 3D printed parts and has no perceptual multi-laser stitching artifacts. Large-size seamless printing on the DMP Factory 500 allows for a part count reduction up to 200:1. The robust DMP architecture yields excellent repeatability and reliability, while meeting stringent quality and regulatory requirements for critical applications.

# Gain the Advantage with 3D Systems' End-to-End Solution

We combine validated technologies and materials with advanced software and comprehensive consulting services to offer a tailored end-to-end solution for industrial metal additive manufacturing. Our dedicated team of application experts works with you across every step, from pre-production to full-scale volume production.

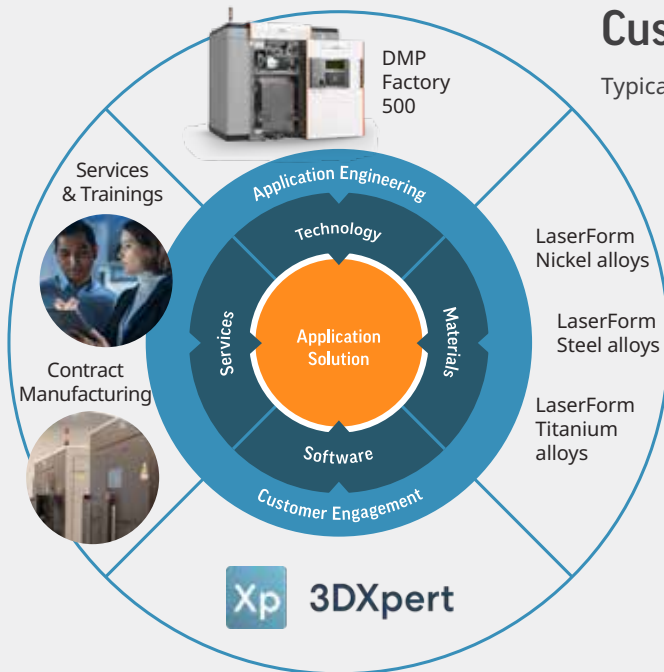
## Customer Journey in Additive Manufacturing



## Service and Training Modules for Industrial Customers throughout their AM Journey

Typical timeline

- |   |   |                                   |   |   |                             |
|---|---|-----------------------------------|---|---|-----------------------------|
| 1 | Applications Screening                      | 1 day                             | 6 | Validation and Qualification                | 5-8 months                  |
| 2 | Design for Metal AM                         | 1 day                             | 7 | Contract Manufacturing for Pilot Production | 5-18 months                 |
| 3 | Application Development                     | 6-18 months                       | 8 | DMP Technology Transfer                     | Customer/Application driven |
| 4 | Application Support                         | 1-day modules                     |   |   |                             |
| 5 | Gap Assessment for Validated DMP Production | 1 day on-site +, Report 1-2 weeks |   |   |                             |



## Accelerate and de-risk the development of your next application

Find out how 3D Systems' Application Innovation Group (AIG) and its team of experts can help you develop an application, reduce costs, shorten lead times and increase productivity. Schedule a free consultation today:

[3dsystems.com/consulting/application-innovation-group](https://3dsystems.com/consulting/application-innovation-group)



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