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LIBERTAS™ technology unlocks AM blades and vanes production



Additive manufacturing allows much greater design freedom but can be hampered by design for manufacture restrictions. LIBERTAS technology gives that freedom back.

Blades and vanes designed for high-performance applications

From compressor impellers and blisks, to turbine blades and nozzle guide vanes, blades and vanes are among the most performance-critical components found in aerospace, energy and industrial flow systems. Their geometry directly influences efficiency, thermal management, power output and component life.

As manufacturers continue to push the boundaries of efficiency and durability, blade and vane designs have become increasingly sophisticated. Thinner aerofoils, advanced cooling features and highly optimised flow paths are helping engineers unlock higher levels of performance in increasingly demanding operating environments.

LIBERTAS technology has been developed to help manufacturers realise these next-generation designs. By enabling smoother downskin surfaces and reducing reliance on support structures, LIBERTAS technology helps overcome key manufacturing challenges associated with additive manufacturing of complex blade and vane geometries.

The challenge with traditional manufacturing

Producing advanced blade and vane geometries using conventional manufacturing methods can be difficult and costly especially on smaller, compact designs.

Miniaturised gas turbines are enabling compact, powerful and efficient options across multiple applications.
In power generation they enable multi-fuel, high-output powerpacks for stationary or mobile applications.
For aerospace, they enable UAVs to attain extended, high-speed flight in both fixed-wing and multi-bladed units. But these applications demand low manufacturing costs whilst maintaining high levels of performance. Traditional subtractive processes experience greater limitations at these smaller scales making reliable production challenging.

Tool access, even when using 5 or 6-axis machine tools becomes more restricted. Length-over-diameter (L/D) ratios become unfavourable, leading to unwanted tool-tip push-off and ultimately poorer accuracy and poor surface finish. This is exacerbated by exotic alloys with a tendency to work-harden where chip formation is sub-optimal and required material removal rates is not possible.

In many applications, manufacturing limitations can ultimately influence the final geometry, restricting designers from achieving the optimal aerodynamic solution.

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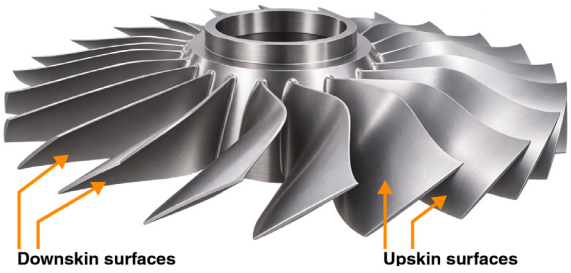
Introducing LIBERTAS™ technology

Despite metal additive manufacturing's advantages, blade and vane production remains one of the most demanding and multifaceted applications.

Many geometries contain shallow downskin surfaces and overhanging features that traditionally require support structures during the build process.

While supports enable successful builds, they can create several challenges:

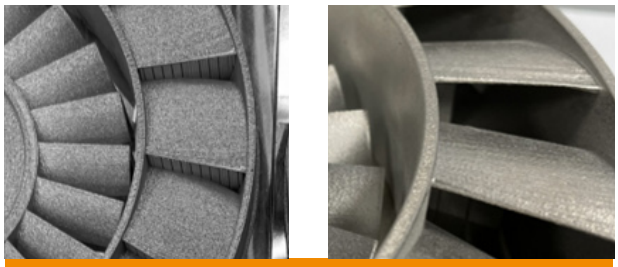
- Increased material consumption
- Longer build preparation
- Additional post-processing
- Restricted access to complex features
- Surface witness marks after support removal



A typical blisk with overlapping leading and trailing edges, shallow downskin surfaces and supported regions.

LIBERTAS technology – a production enabler

LIBERTAS technology enables the viable production of components featuring bladed structures that previously could not be considered for Laser Powder Bed Fusion (LPBF) processes. By dynamically adapting laser power across the geometry of a part, rather than relying on a blanket approach, LIBERTAS technology allows for a more intelligent build process, applying the optimum laser power where it's needed. This isn't just an incremental improvement: it unlocks the ability to take maximum advantage of LPBF without the previous design for additive manufacture (DFAM) limitations, restoring many of the design freedoms that make AM so attractive.



A blisk nested within a Nozzle Guide Vade (NGV). The image on the left shows conventional support strategy. Right shows the effect of LIBERTAS technology. This shows significant reduction in support material of 95% and improved surface finish.

Summary:

LIBERTAS technology enables the viable LPBF production of bladed and vaned components, removing many traditional design and manufacturing constraints associated with additive manufacturing. The ability to form complex geometries and consolidate assemblies opens up new possibilities for performance gains and productivity enhancements.

www.renishaw.com/additivemanufacturing

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