ZEISS Aerospace Solutions

Blisk & Bladed Rotor

Precision at all altitudes

Seeing beyond

Discover

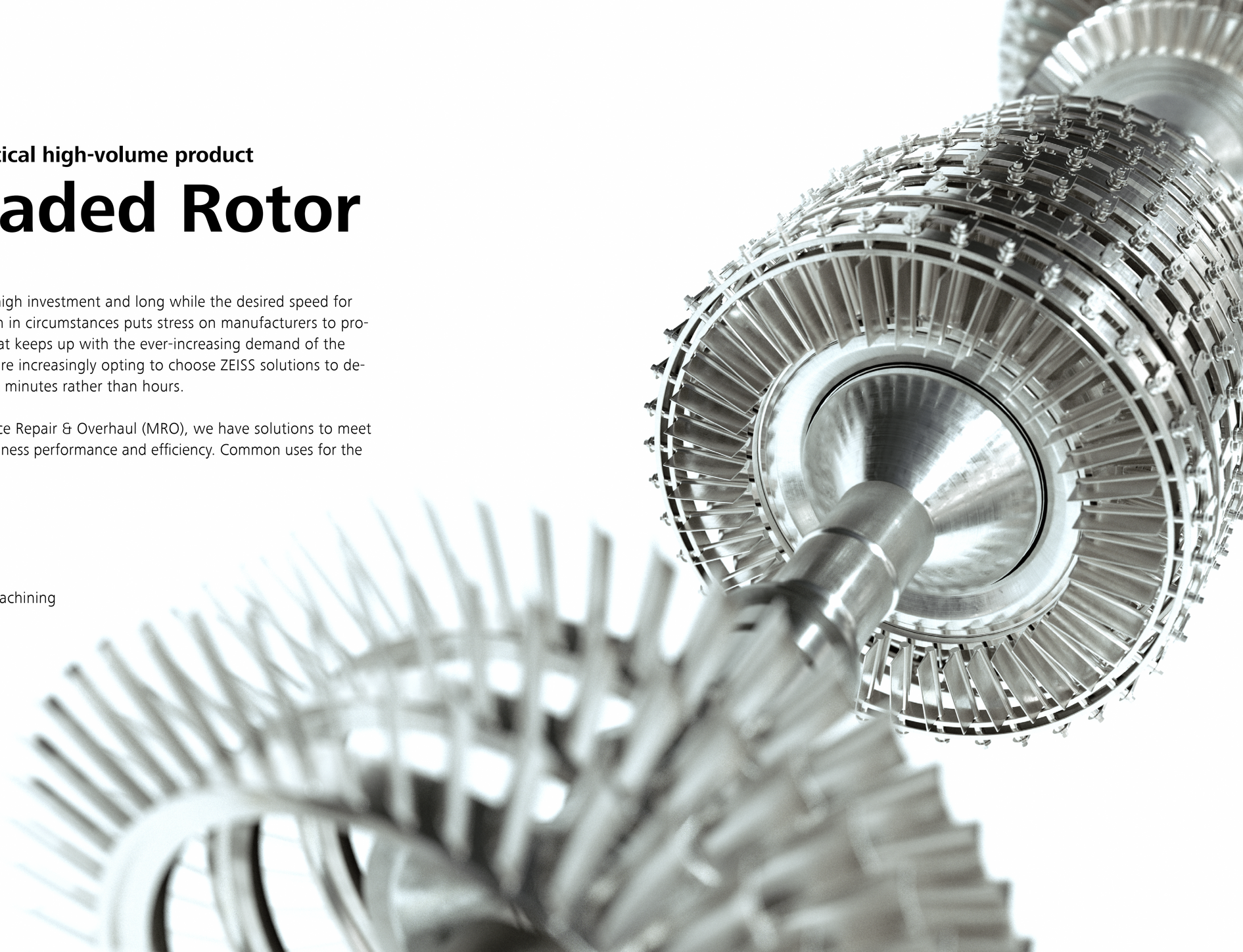
Modern measurement of a critical high-volume product

Blisk & Bladed Rotor

The processes for manufacturing blisks are a high investment and long while the desired speed for measurement is as short as possible. This clash in circumstances puts stress on manufacturers to produce high-quality blisk products at a speed that keeps up with the ever-increasing demand of the aerospace market. Our aerospace customers are increasingly opting to choose ZEISS solutions to deliver the fast, reliable and repeatable results in minutes rather than hours.

From forging, to finished part and Maintenance Repair & Overhaul (MRO), we have solutions to meet the demanding requirements for improved business performance and efficiency. Common uses for the ZEISS Aerospace Solutions include:

- Metallurgy
- First article inspection
- Trend Analysis
- CFD/ FEA Analysis
- Production measurement for forging and machining
- Advanced, connected software
- MRO quality assurance
- Reverse engineering



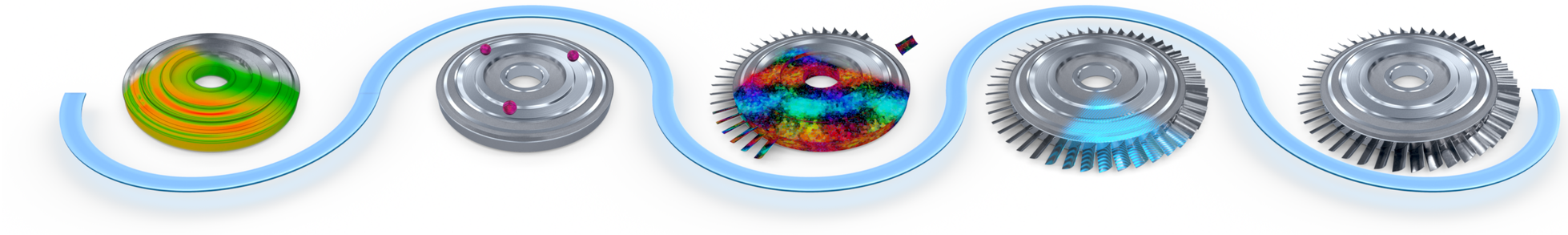
Engineered for performance

Blisk & Bladed Rotor Inspection

A bladed disk, also called a ‘blisk’ or integrated blade rotor (IBR), consists of airfoils machined into a rotor disk to form a single part. Blisks are mainly used in high-pressure compressors, and increasingly in low pressure compressors including the fan blades.
Newer bladed disk designs include so-called ‘blums’: a combination of several bladed disks on a drum with multiple stages. Measuring bladed rotors is highly complicated due to their exotic sizes, shapes and special machining techniques, including unique combinations to achieve the desired characteristics. However, ZEISS solutions can meet all these demands.

Get all steps of the manufacturing process right

Follow us along to learn about the ZEISS know-how at every stage of the blisk and bladed rotor inspection and production process: Five production steps need to be mastered thoroughly to ensure the overall safety requirements and quality.



› Raw Material

› Disc and Hub Machining

› Linear Friction Welding

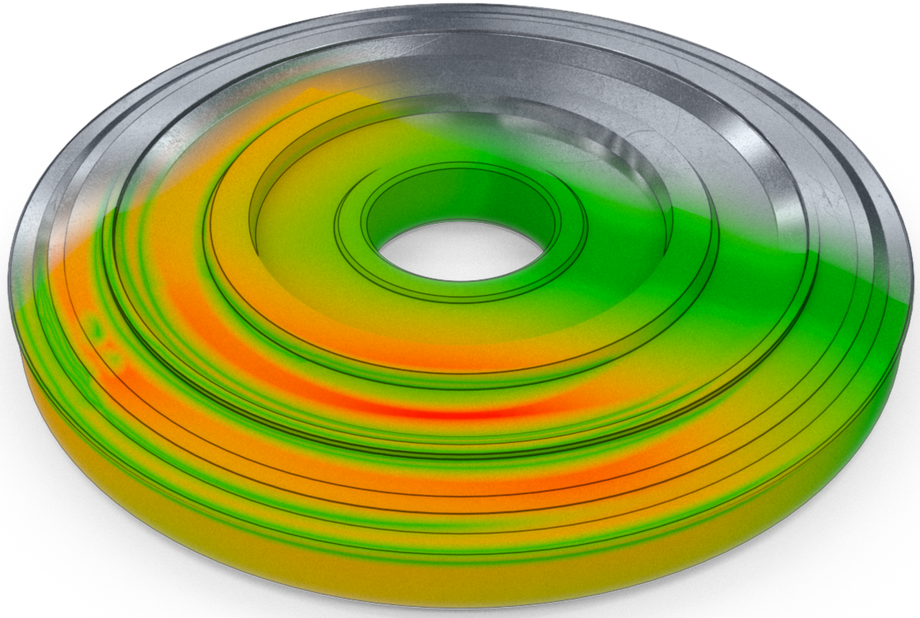
› Airfoil Machining

› Final Validation

Production Step 1

Raw Material

The process input is the material which could be billet, forged disk or airfoils.



Challenges

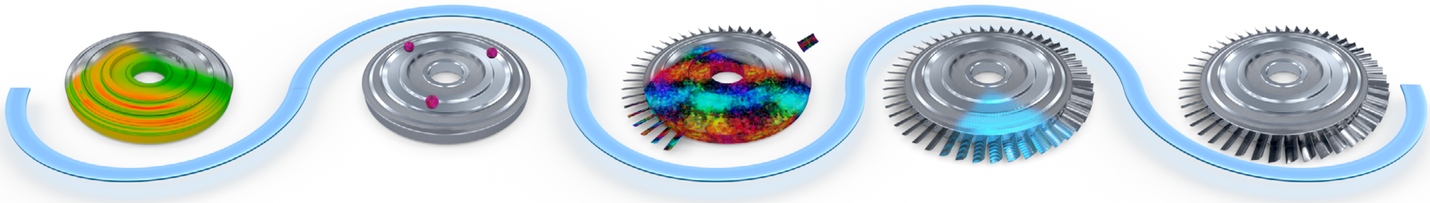
The integrity of the raw material is critical to the the final product. Thorough inspections of the material composition, purity, and conformity of its shape are essential, especially when dealing with forgings.

- Precision forging
- Accurate shape and form
- Tool/die wear, monitoring and life
- Critical importance of material properties

Our Solutions

ZEISS Microscopy Solutions are the perfect compliment to the production of raw materials checking their metallurgical composition. The forging shape and dimensional characteristics are best checked with ZEISS ScanBox for the full field measurement and inspection of the product.

- Automated 3D scanning with ZEISS ScanBox for full process understanding
- Measuring the mold/die over time to establish wear limits
- Digitally assemble parts in the software to solve issues
- Sub-micron resolution for metallurgical properties like grain structures, using ZEISS Microscopy Solutions.



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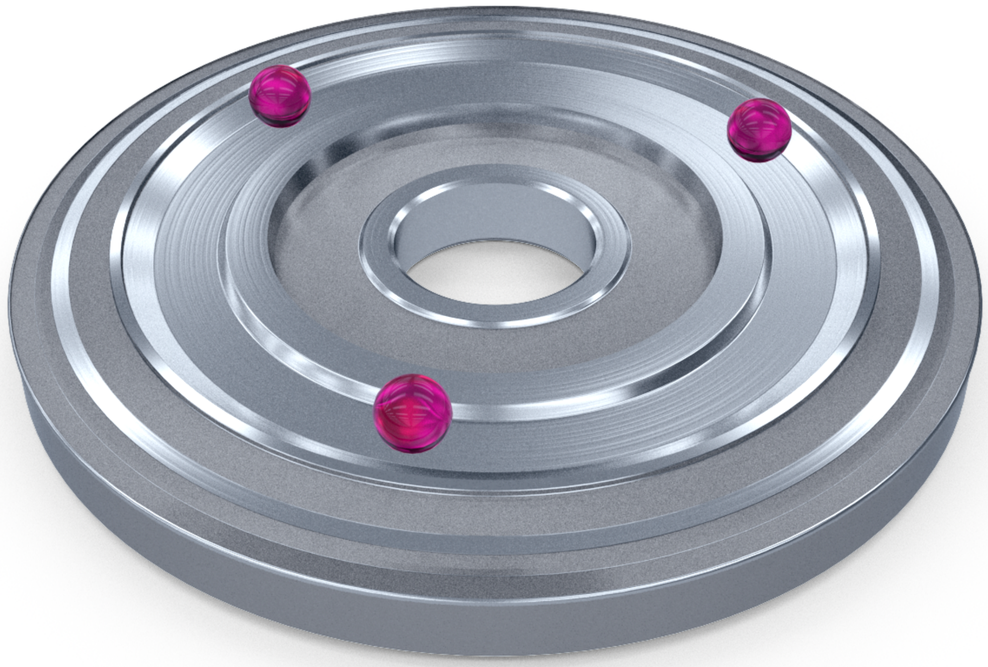


Production Step 2

Disc and Hub Machining

Creating the interface and weight relief features for the compressor blisk is a precision activity.

Challenges

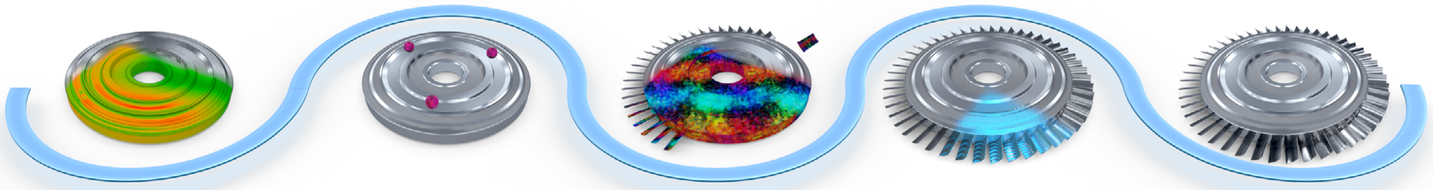
Measuring precision bores, as well as weight relief grooves which may not have direct access in an accurate and timely manner.

- Harsh environment with large batches of blades
- Blade casting final dimensions
- Non-destructive analysis
- Wall thickness measurements

Our Solutions

ZEISS PRISMO fortis with its high-accuracy is perfect for fulfilling the needs. Measurement cycle times are not a problem when the ZEISS PRISMO fortis is coupled with an integrated rotary table which makes light work of the axis-symmetrical features.

- ZEISS PRISMO 7/12/7 fortis, incorporates ZEISS CMM Acceleration Mode for Aero Applications
- ZEISS C99m controller and parameters for ZEISS VAST Rotary (ZVR) and ZEISS VAST Rotary Axis (ZVRA)
- Up to 300mm/s scanning speed providing up to 70% time savings
- Excels on the shop floor as well as measurement rooms



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Production Step 3

Linear Friction Welding

Adding pre-forged blades to the disc body using mechanical rubbing is a technique used by some companies in manufacturing blisks.

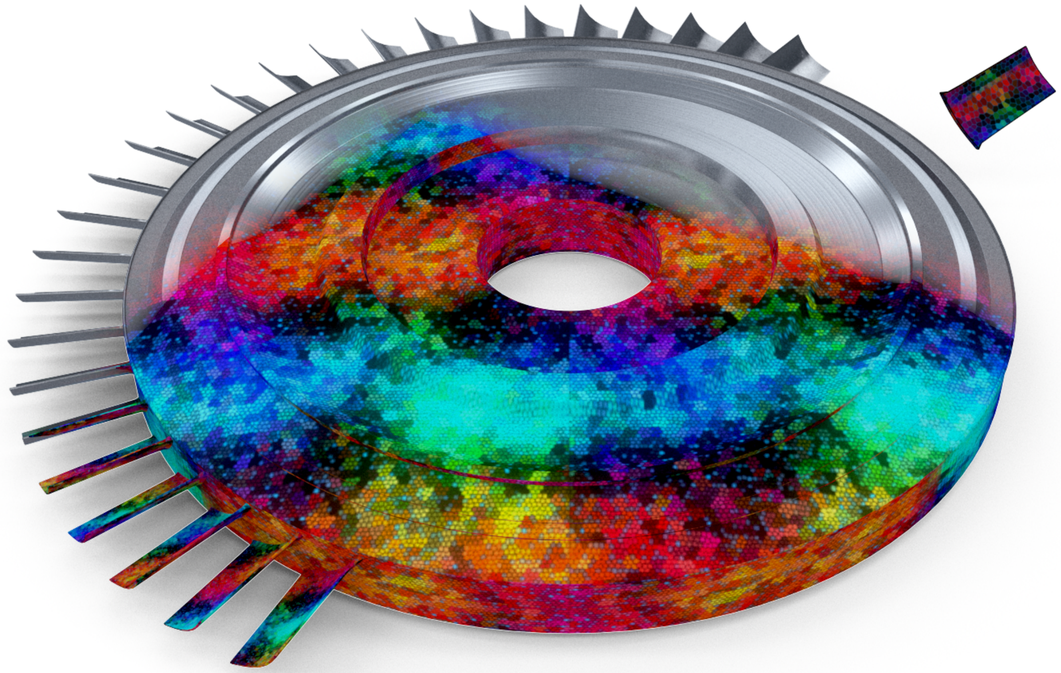
Challenges

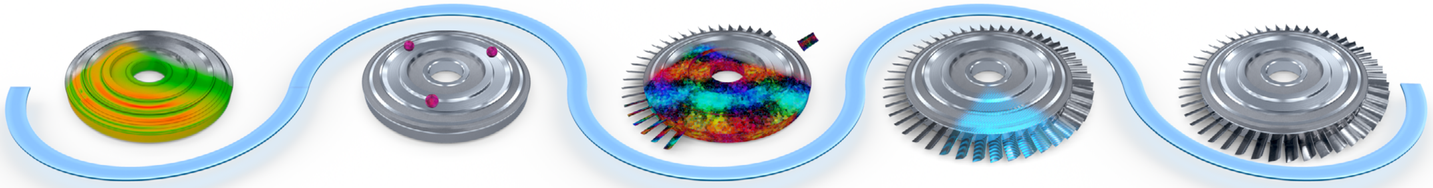
Inherently from the process of welding, there is excess material at the connection between the root of the airfoil and the disc, requiring further machining. Additionally, the material properties at the joint need to be verified before finalizing the manufacturing process.

Our Solutions

ZEISS Microscopy Solutions are the only way in the development of the process to to ensure complete verification of the metallurgical conformity of the weld.
ATOS 5 for Airfoil combined with the ZEISS ScanBox is the optimal way to measure the dimensional characteristics of the joint. Often the 3D scan data is combined with adaptive machining processes to get the perfect blend from airfoil to annulus.

- ZEISS ScanBox with ATOS 5 for Airfoil - for high-speed, high-resolution 3D scanning
- ZEISS Microscopy Solutions - for evaluation of metallurgical properties, grain structures and boundaries





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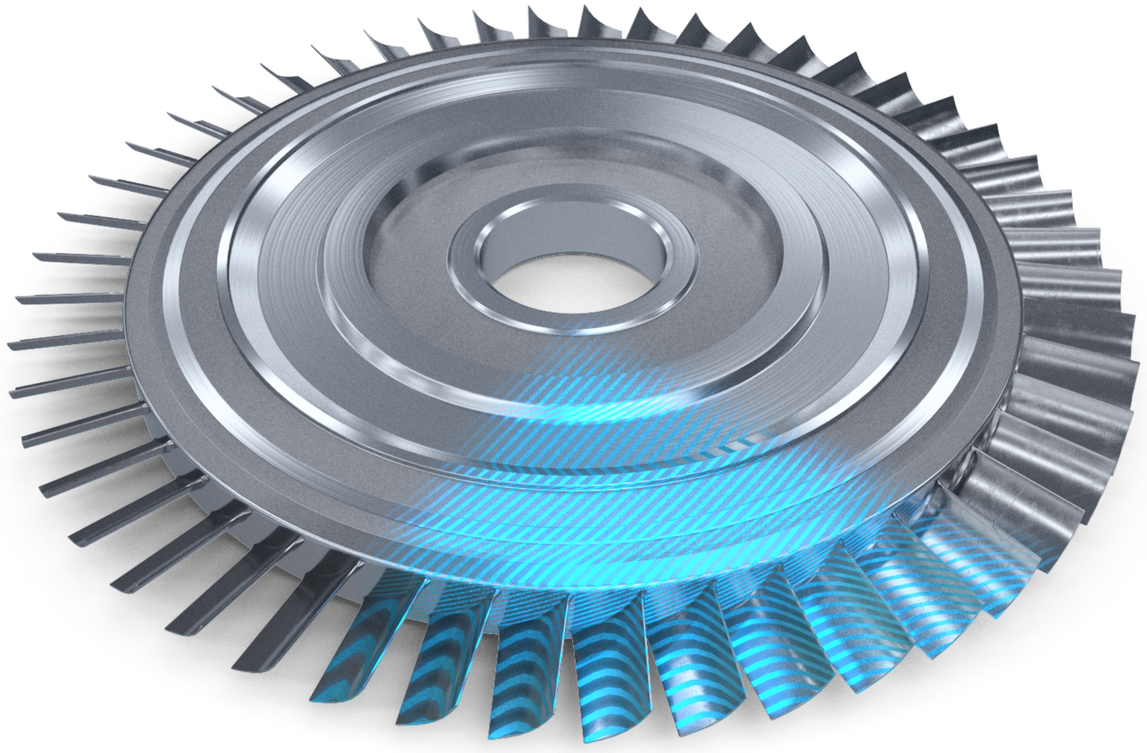


Production Step 4

Airfoil Machining

Whether it’s full machining from stock material, or blending a linear friction welded airfoil, machining is a very time consuming process which has huge importance to the performance of the engine.

Challenges

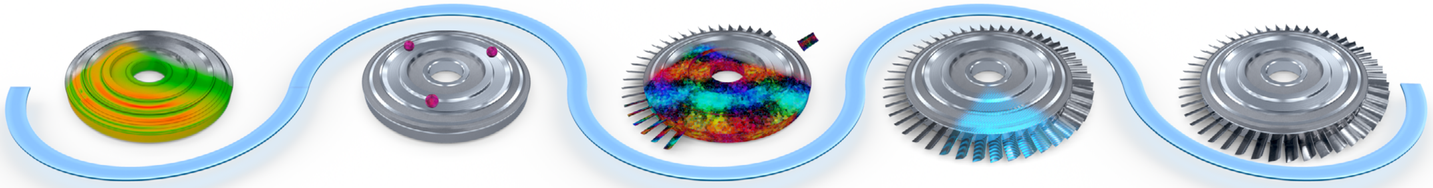
As airfoil geometries become increasingly complex, featuring twisted shapes and sharper edges, the need for efficient measurement solutions is crucial. With limited factory floor space and high production rates demanding faster measurement times, meeting these demands becomes of utmost significance.

- Blending of radii from airfoil to annulus
- High twist airfoils with small edge radii
- Surface finish

Our Solutions

ZEISS solutions tackle the above challenges head-on with speed, precision, and compact design. Whether it’s tactile or 3D scanning, ZEISS has the answer to aerospace customers’ needs.

- ZEISS PRISMO 7/12/7 fortis, incorporates ZEISS CMM Acceleration Mode for Aero Applications
- ZEISS C99m controller and parameters for ZEISS VAST Rotary (ZVR) and ZEISS VAST Rotary Axis (ZVRA)
- ATOS 5 for Airfoil with ZEISS ScanBox for high-speed 3D measurement of part.



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Production Step 5

Final Validation

At the final production stage, ensuring the product validation is crucial. Meeting regulatory and OEM requirements such as AS9102 and AS13003 is essential which encompass stringent and comprehensive standards.

Challenges

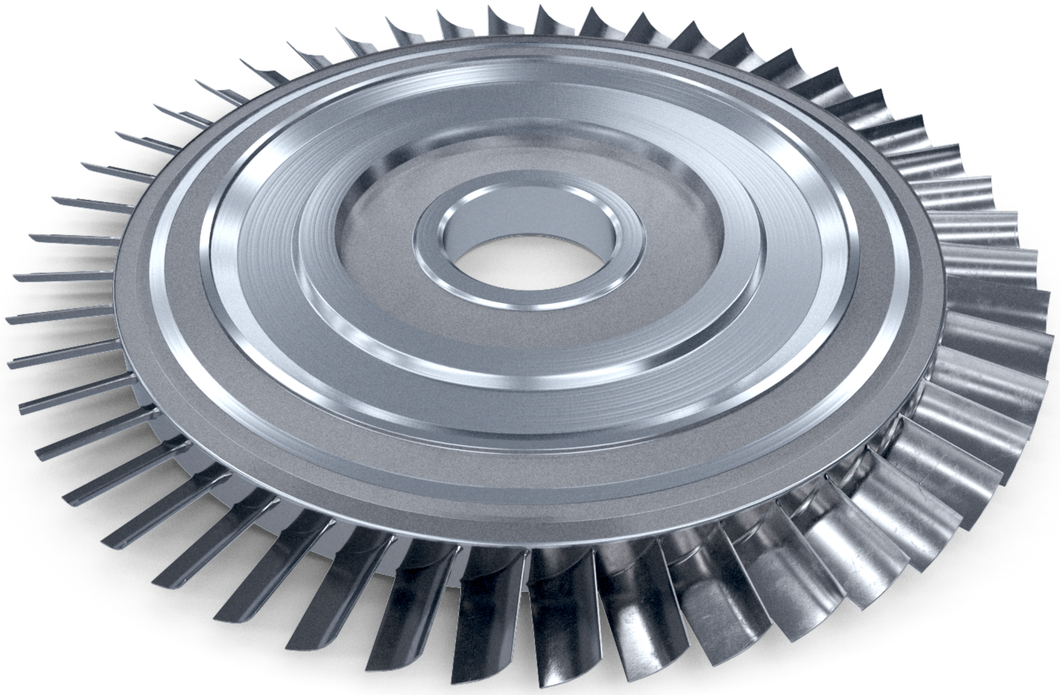
There are extensive set of validation requirements on a blisk with different on complimentary solutions available to fulfill all requirements.

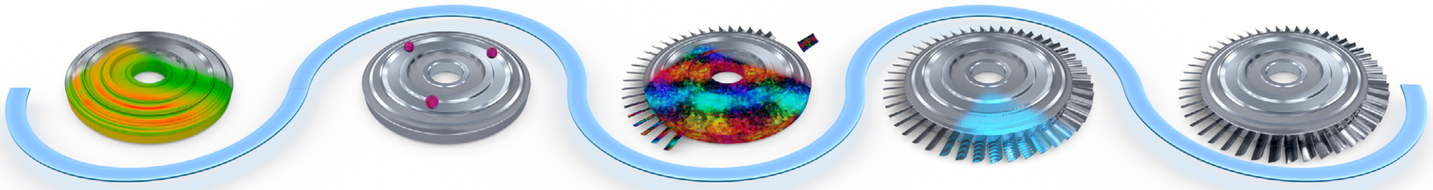
- AS9102 Reporting style
- Hundreds, sometimes thousands of features
- Comprehensive requirements (GD&T, airfoil analysis, surface, metallurgical specifications and more)

Our Solutions

The comprehensive range of high-precision tactile, multisensory, optical, and microscopy solutions within the ZEISS suite fulfills numerous essential characteristics for validation. The ZEISS Quality Suite, including, tools like Blade Inspect Pro, efficiently compiles results and thoroughly qualifies part characteristics according to the drawing specifications and related quality and engineering standards.

- ZEISS PRISMO 7/12/7 fortis – Highest accuracy guaranteed
- ATOS 5 for Airfoil – Verification of freeform geometries
- ZEISS Microscopy Solutions – Microstructure analysis, surface characterization and capture of visual defects
- Surface inspection with Surfcom or ZEISS CMM with ZEISS ROTOS





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ZEISS Industrial Quality Solutions

Enabling our customers to manufacture a better future

Bridge-Type & Multisensor CMMs

High accuracy and precision
for repeatability and reliable results

Optical 3D metrology

Industrial non-contact 3D scanners
for fast and precise measurements

ZEISS Integration Series

Automation and Integration Solutions for
increased throughput and process optimiza-
tions.

Industrial CT- & X-Ray Solutions

Non-destructive quality control
to make the invisible visible

Industrial Microscopy Solutions

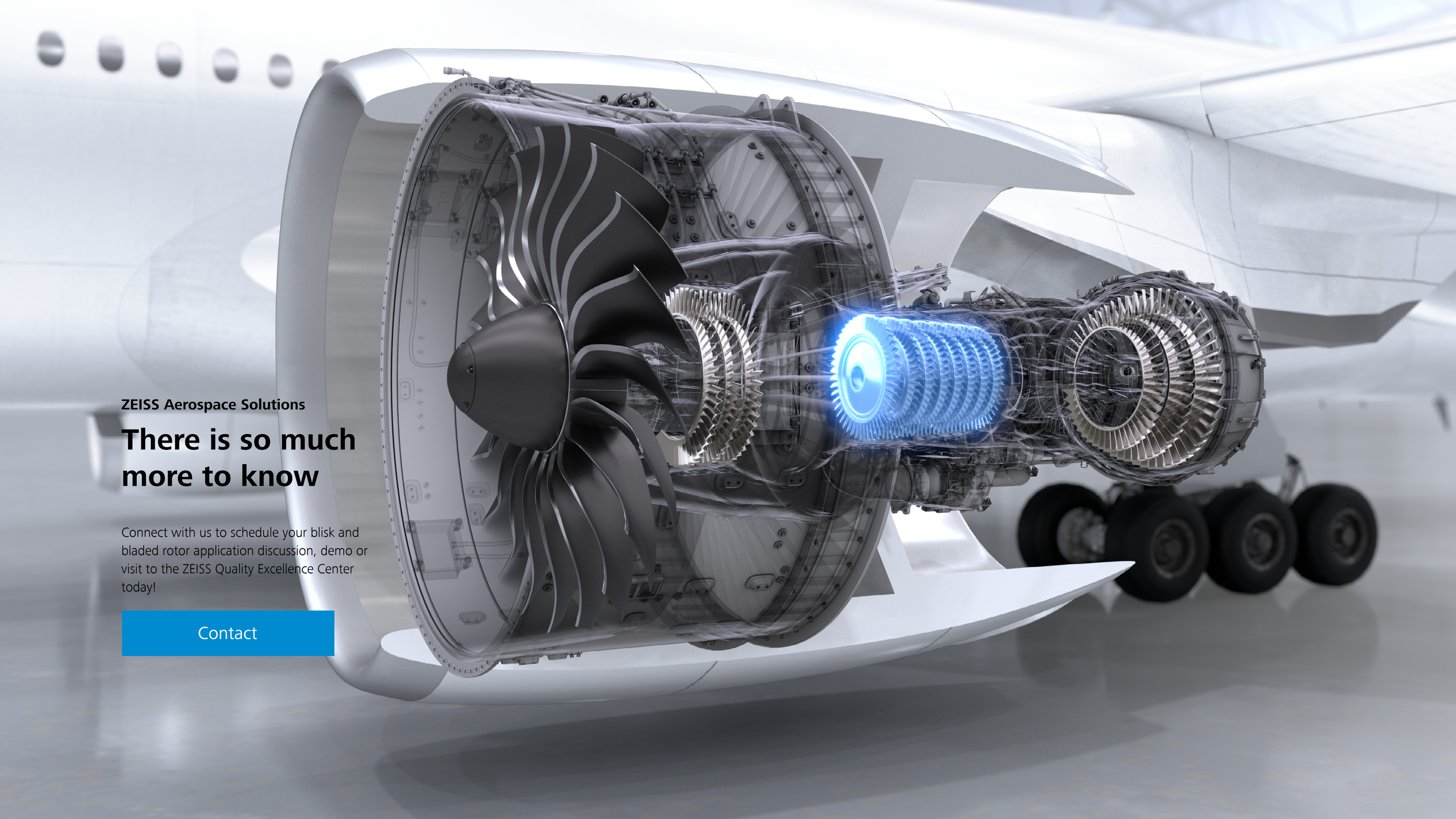
Connected portfolio to accelerate
decision making

Software & Quality Intelligence

Measurement, evaluation and management
software for all quality data

ZEISS Services

Machine repair, software and hardware
training, aftermarket services, contract
inspection and more



ZEISS Aerospace Solutions

There is so much more to know

Connect with us to schedule your blisk and bladed rotor application discussion, demo or visit to the ZEISS Quality Excellence Center today!

Contact