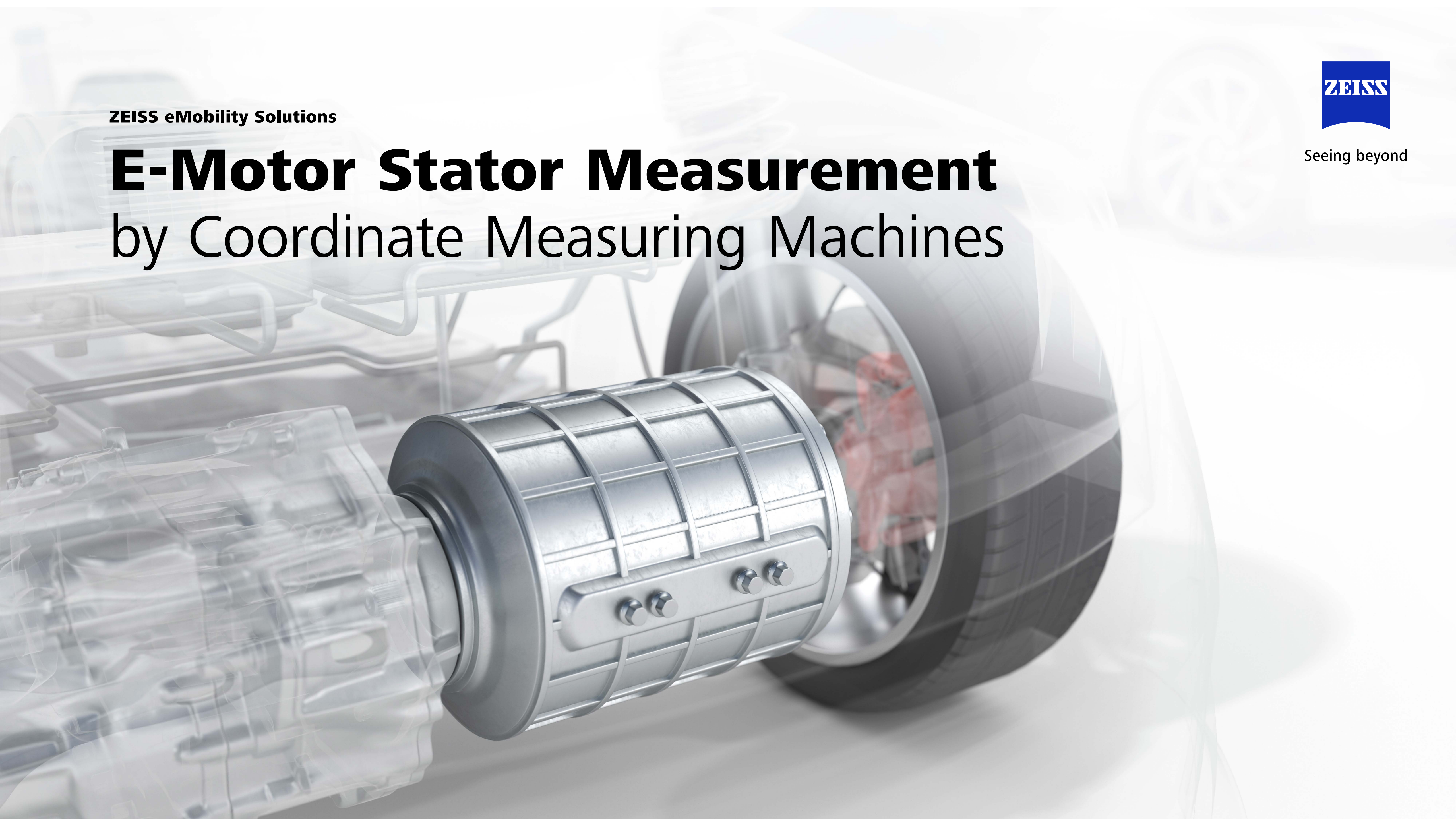


ZEISS eMobility Solutions

E-Motor Stator Measurement by Coordinate Measuring Machines



Seeing beyond



Stator quality control

CMM solutions for full dimensional measurement

Electric motors are the actual powerhouses of an electric vehicle – they combine high speed and enormous torque, as well as constantly optimized power density. In order to achieve maximum performance with little wear, all components must interlock precisely.

The stator winding is the most essential component of the E-Motor. At present, flat wire motors are gradually replacing round wire motors as the main form of EV drive motors with the cause of copper-filling-rate. The so-called flat wire motor refers to the use of flat copper wire for the specified sub winding, which is made into a shape like to a hairpin, threaded into the stator slot, and then welded together at the other end of the hairpin. We also call as hairpin stator.

The processing technology for hairpin stators is complex. For instance, the insulation layer of flat copper wire is prone to damage after bending, leading to gaps or surface damage. Defects are also easily formed at the welding sites of flat wires. Currently, the development of a newer generation of winding wire types, such as Xpin, poses greater challenges for welding. Whether it's Hpin or Xpin, precise control over the key dimensions of flat wires is essential to ensure to reduce stator process defects.

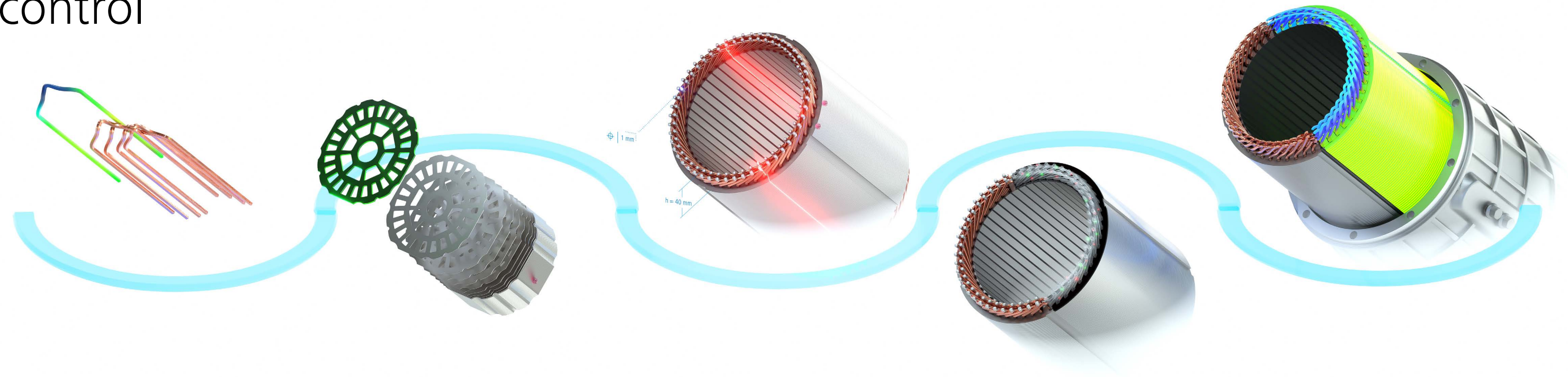
Furthermore, the design and manufacturing of stators will apply 800V platform application, requiring higher anti-discharge capability, insulation performance, thermal management performance, and so forth. insulation performance, thermal management performance, and so forth.



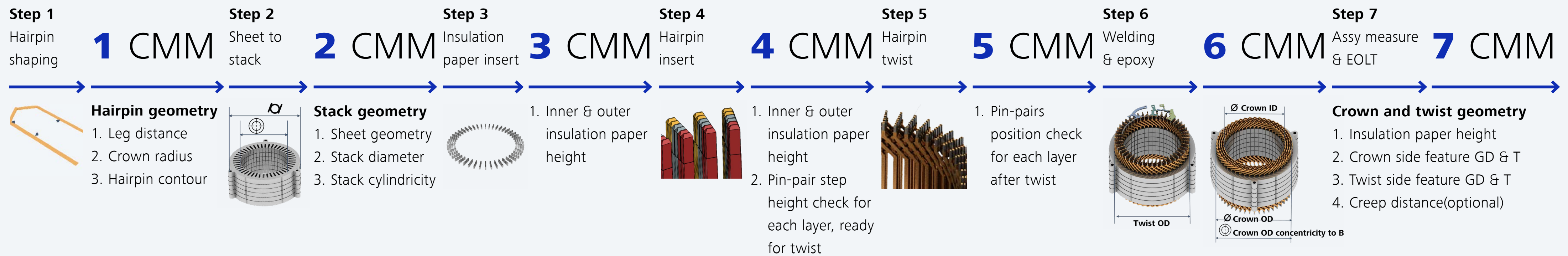
Manufacturing process

CMM technology enhances quality control

This is the overview of stator manufacturing process. Each process requires quality inspection solutions to ensure E-Motor performance. CMM solutions can provide geometry characterization measurement throughout the production process.



E-Motor stator production process with CMM solution



Application areas of CMM measurement



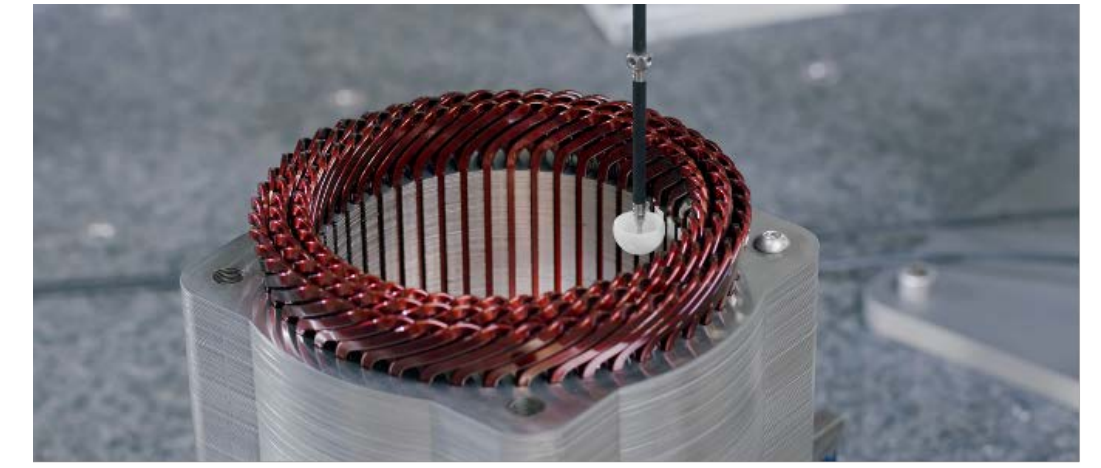
Hairpin geometry and insulation

- Acquire high-precision data of hairpin leg distance
- Acquire hairpin Crown radius & angle with laser sensor



Insulation dimension

- Obtain hairpin insulation coating thickness with optical sensor



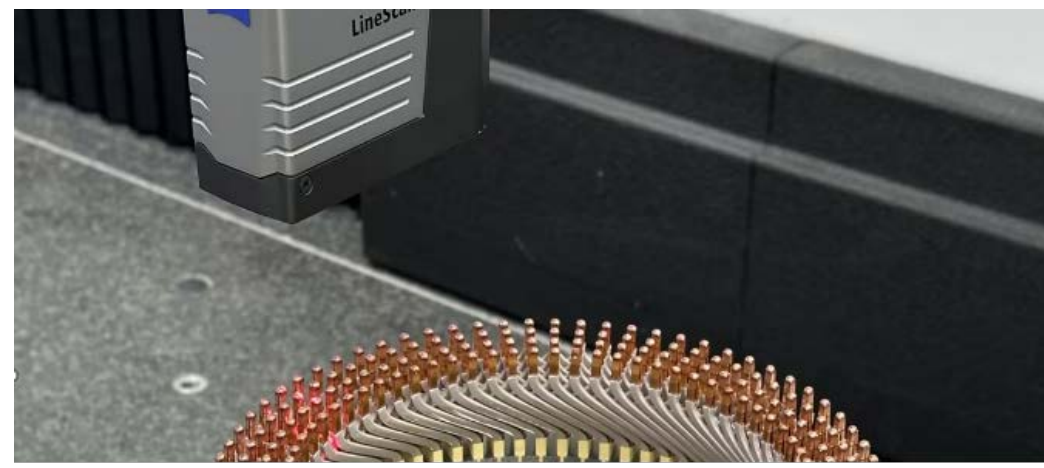
Sheet stack geometry

- Measurement of 2D stack sheet geometry to control quality before assembly
- Measurement of Joint stack diameter & cylindricity to control quality after assembly



Crown and twist geometry

- Acquire high-precision data of insulation paper height, crown & twist sides GD&T after the insertion of hairpins
- Precise measurement of creep distance with tactile sensor



Welding ROI geometry

- Obtain accurate hairpin welding balls geometry & positions
- Measurement of Busbar bridge height, and U,V,W lug bolt hole height & position



Partial discharge dimensions

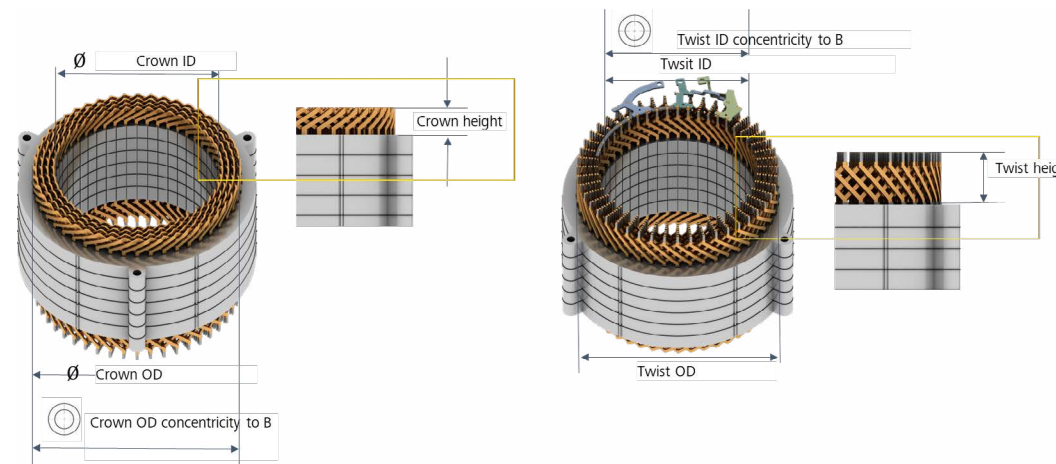
- Measurement of highest points of crown and twist side
- Final check for PDIV Distances between each welding layer

Value proposition of ZEISS solution



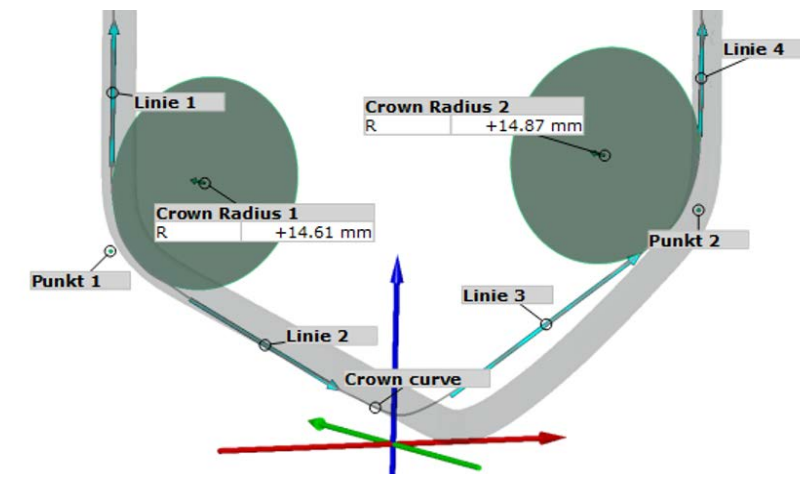
Increase efficiency with ZEISS MASS system

- Multiple sensors ensure capability of measuring all quality requirements
- Automated sensor switching ensures reliable and efficient measurements



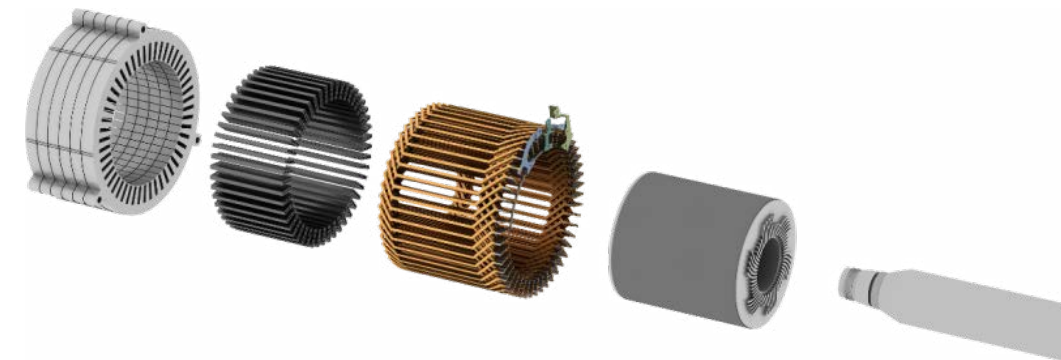
Reduce cost by controlling every quality gate

- Single purchase of one CMM solution fits for all quality gates during production



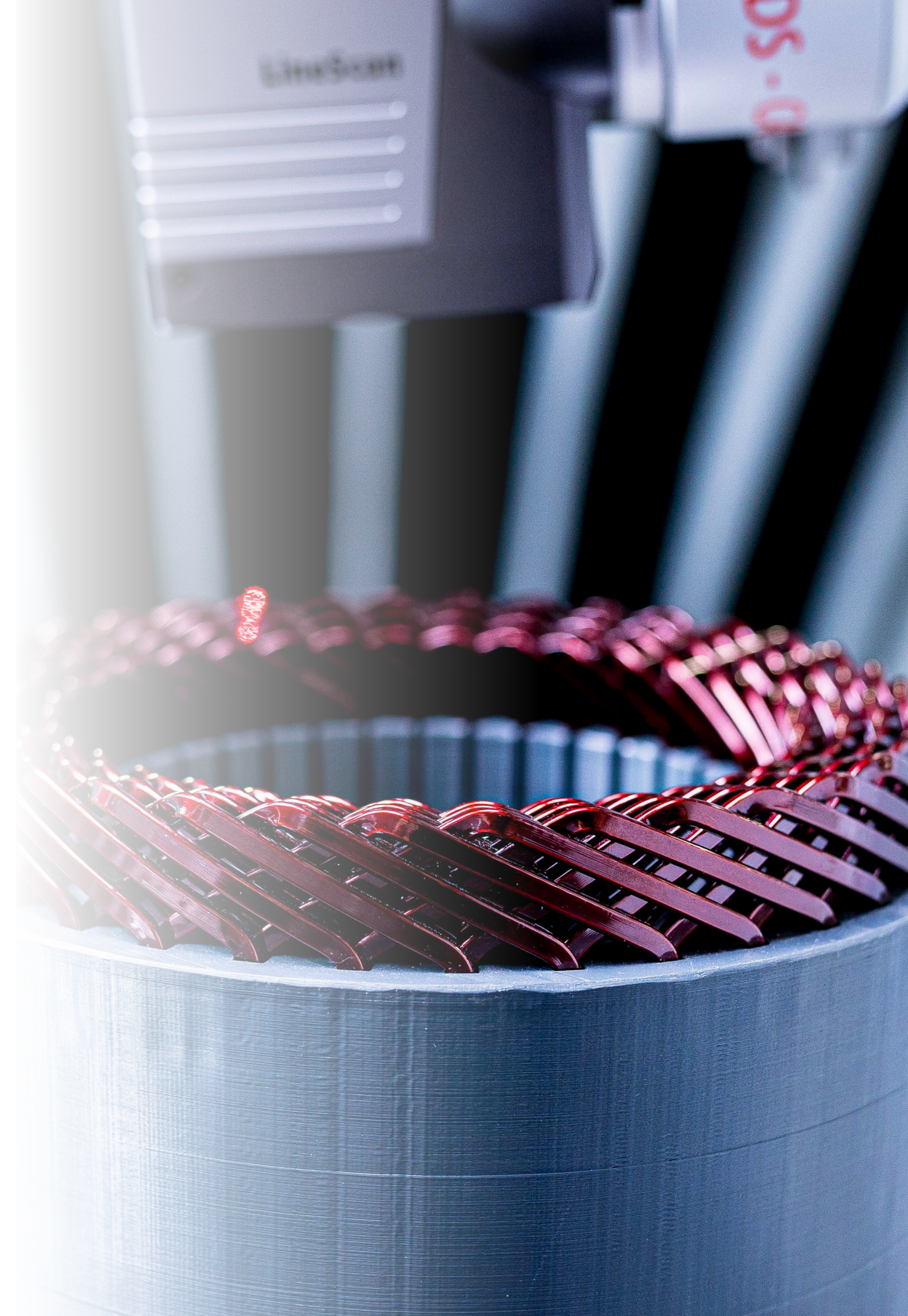
Increase reliability with 3D software analysis

- Full-field mesh data visualization and analysis
- High-efficiency data acquisition, transfer and storage guarantee quality traceability



Deeper understanding of E-Motor

- Direct data usage of NVH analysis for craft departments
- Cooperation with R&D for electrical performance analysis



Recommended portfolio

Prepared for all challenges-today and tomorrow

ZEISS CONTURA 7/7/6

Length measurement error in μm : MPE_E0 1.5 + L/350

Max. scanning speed 150 $\frac{\text{mm}}{\text{s}}$

Measuring sizes 700mm*700mm*600mm



Benefits:



- ZEISS multi application sensor system(MASS)allows for tactile, optical, and roughness measurements to be performed on the same ZEISS machine.
- ZEISS RDS sensor is capable of reaching almost any position of each component with a step size of 2.5 degrees.
- ZEISS ViScan 2D optical probe offers full flexibility for fast measurements.
- ZEISS DotScan, a confocal white light probe, is particularly suitable for measuring sensitive surfaces.
- ZEISS LineScan enables rapid point cloud scanning, allowing for comparison with nominal CAD data or the creation of new CAD models.

ZEISS CMM software

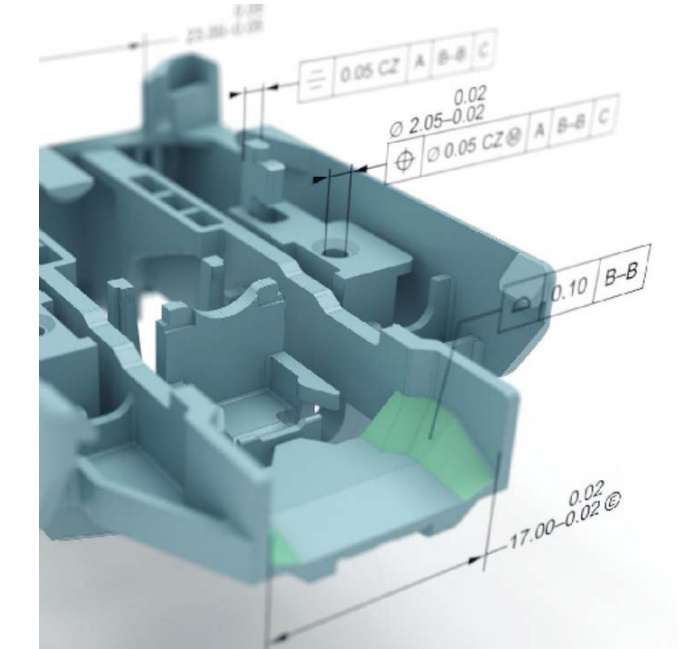
CALYPSO

Installation possibilities

CALYPSO simulation
Automation
Reporting

Performance enhancer

VAST probing
VAST navigator
VAST performance



Benefits:



- ZEISS CALYPSO VAST probing Significant reduction in time for single point measurements with accuracy and fast single point detection
- ZEISS CALYPSO VAST navigator improves scanning operations of VAST series tactile measurement machines by improving accuracy and significantly reducing the measurement time of circular paths
- ZEISS CALYPSO pallet optimizer reduces the number of sensor and stylus system changes during a pallet measurement in an automated way
- Faster measurement speed results in less time needed for the task. Like this, the utilization of the CMM can be maximized either in measurement labs or directly in line.

38
Sales & Service
Organizations

63
Quality
Excellence
Centers

11
Locations

245
Sales Partners
Worldwide

Global Metrology Network

Our global service network provides easy access to ZEISS expertise around the world. We use local teams to ensure a swift response and reduced downtime. Make your operations even more secure and reliable with ZEISS.

Find your perfect solution today.
Contact our global experts.

