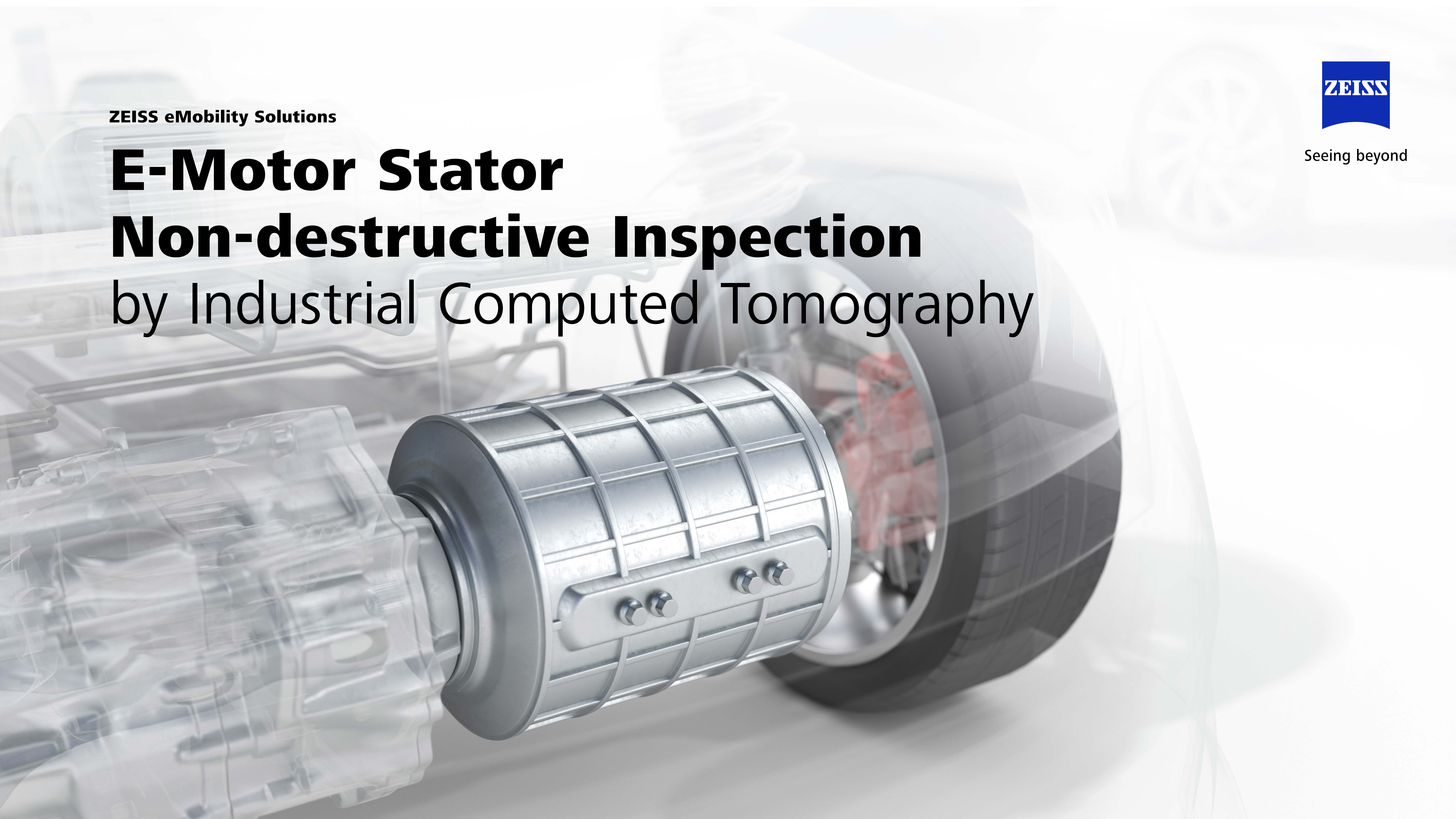


ZEISS eMobility Solutions

E-Motor Stator **Non-destructive Inspection** by Industrial Computed Tomography



Seeing beyond



E-Motor quality control

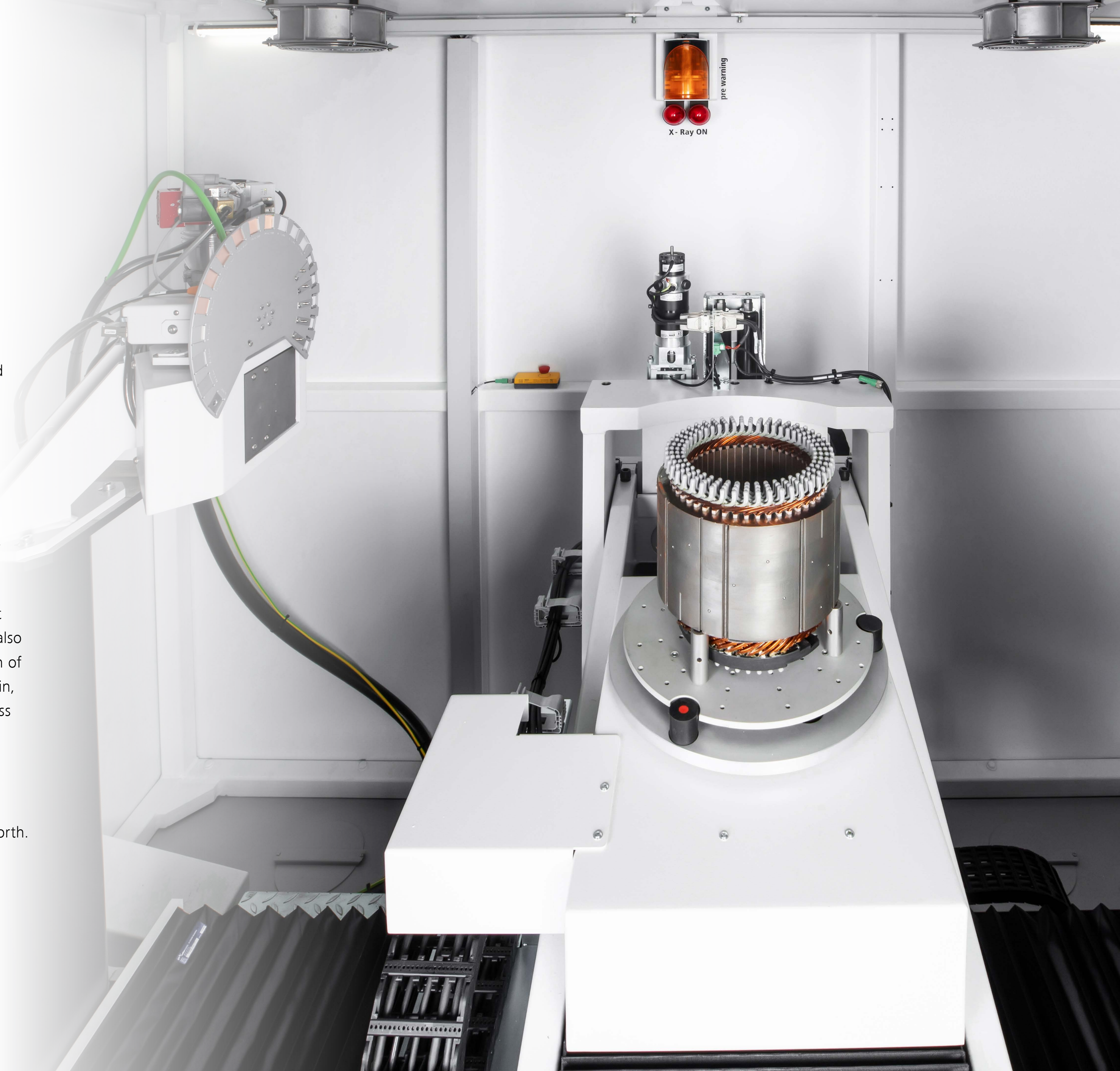
CT solutions for internal failure and electrical property

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.

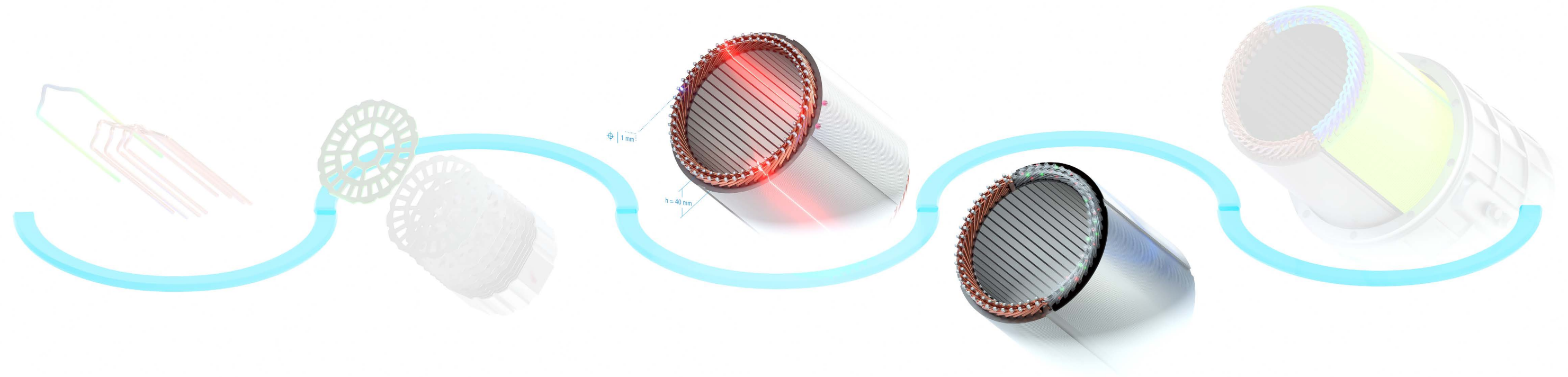
Furthermore, the design and manufacturing of stators will apply 800V platform application, requiring higher anti-discharge capability, insulation performance, thermal management performance, and so forth. insulation performance, thermal management performance, and so forth.



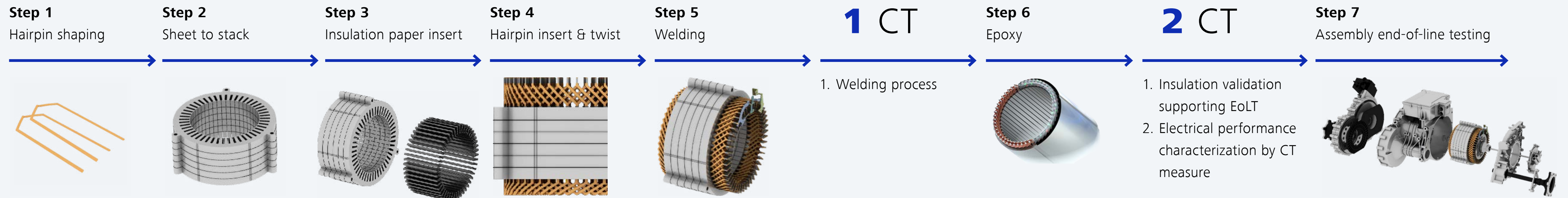
E-Motor quality control by CT

Throughout manufacturing process

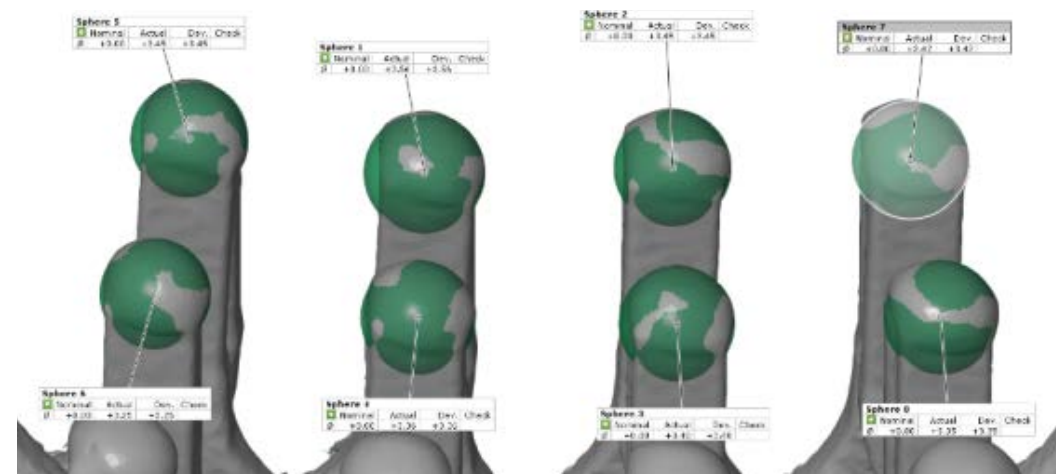
This is the overview of E-Motor manufacturing process. Throughout the process, the Welding and Epoxy process has quality requirements that affects the performance of E-Motor. CT non-destructive solution can efficiently measure discharge dimension, detect welding and epoxy defects.



E-Motor stator production process with CT solution

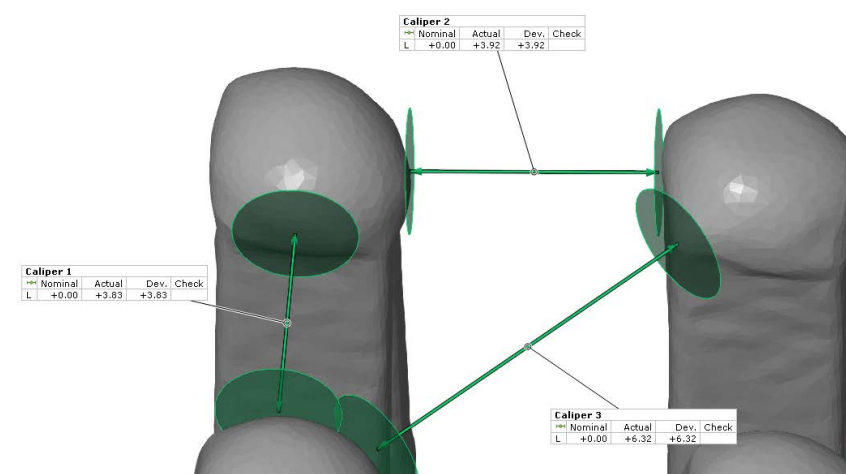


Application areas of CT inspection



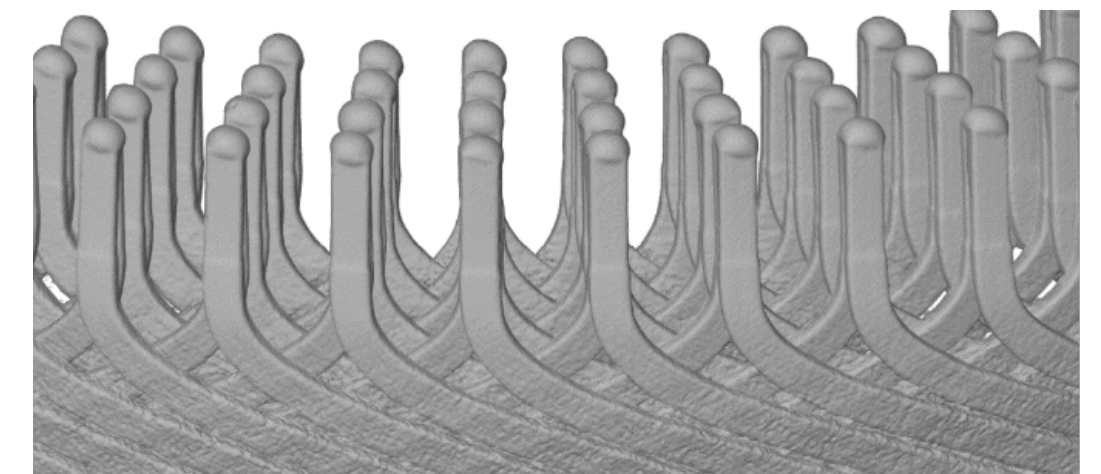
Welding ROI geometry measure

- Volume of each welding ball
- Length*Width of each welding ball



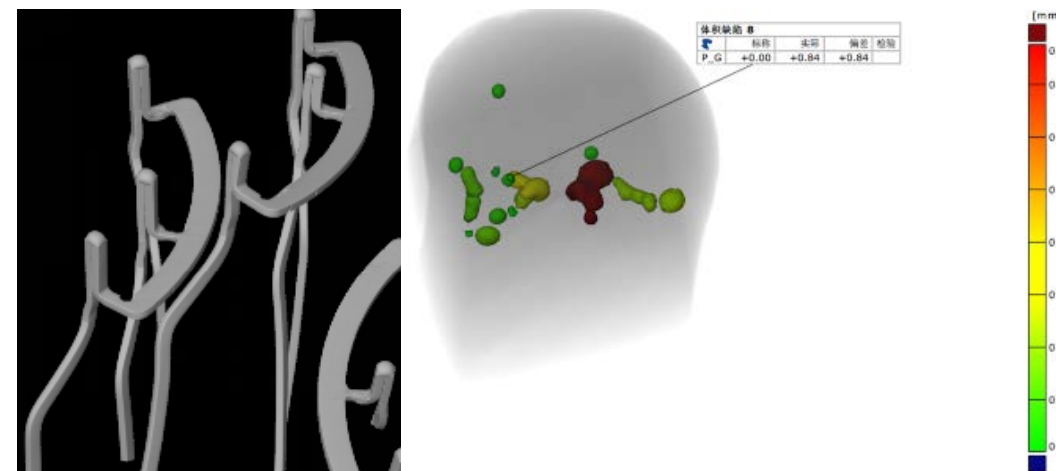
Insulation gap geometry measure

- Partial discharge clearance
- De-coating height



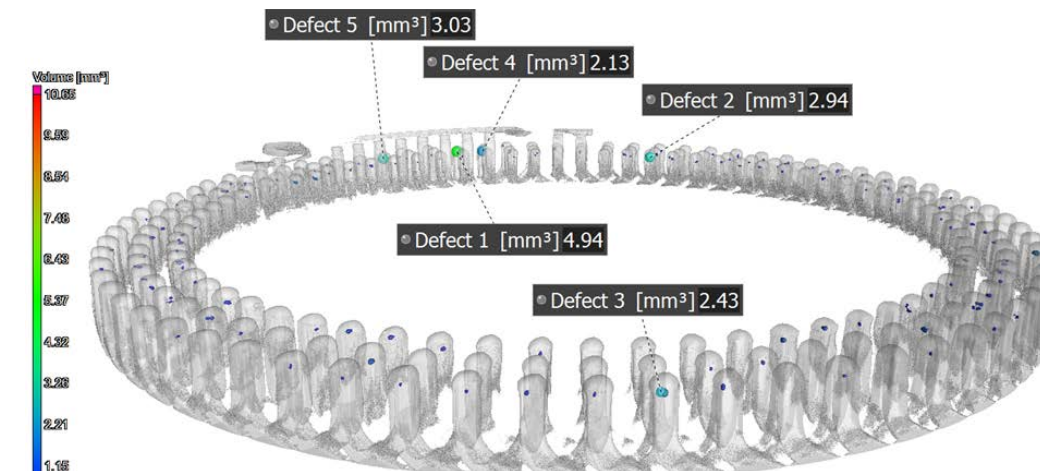
Discharge features measure

- Creep distance of H/X-pin
- Thickness of epoxy material



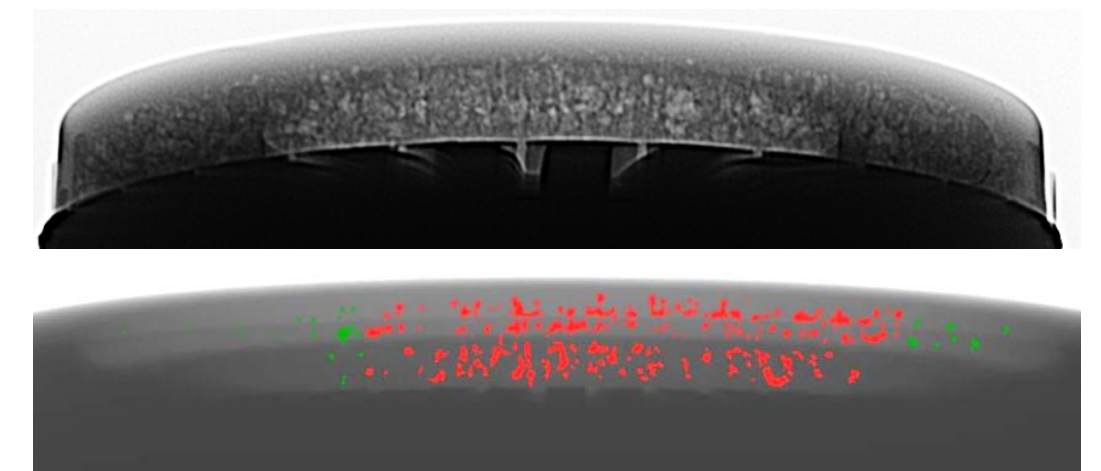
Busbar welding defect detect

- Volume and max size of each welding pore
- Porosity of welding region



Hairpin welding defect detect

- Max pore automatic classification
- Interconnection area of each welding region



Die-casting rotor defect detect

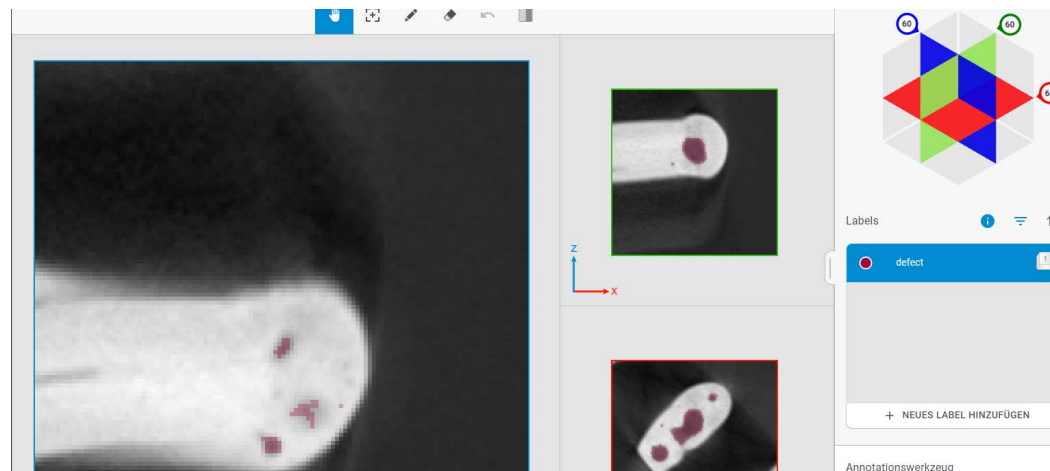
- Automatic defect detect
- Inline or at-line automation solution

Value proposition of ZEISS solution



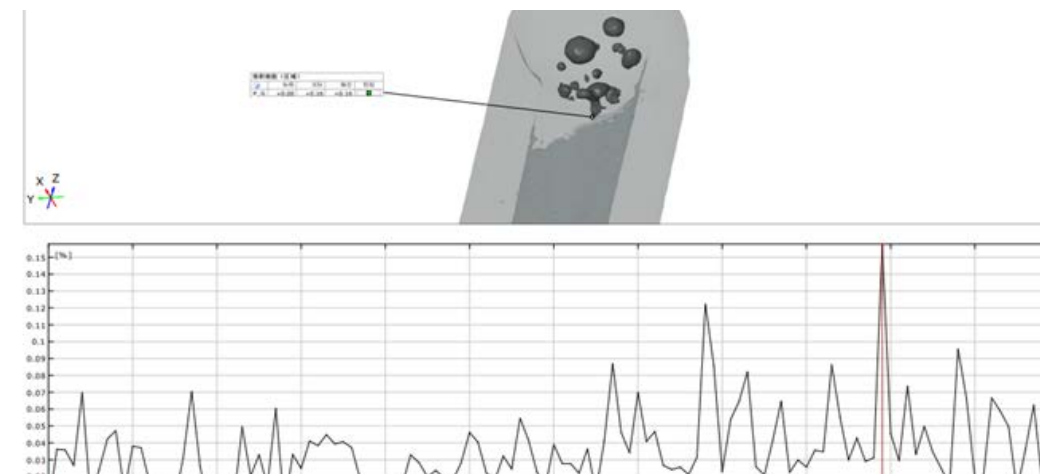
Metrology reliability

- High accuracy: $MPE_{SD} = 4.5 + L/50 \mu m$
- Critical character and defect size precise evaluation



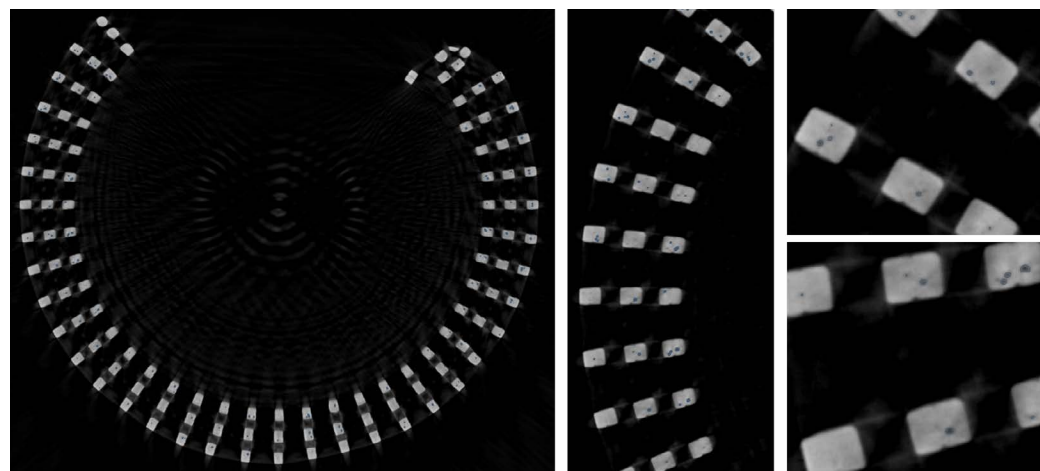
3D software full portfolio

- Easy to visualize and inspect CT data
- Defect detection further optimized by ZEISS deep-learning graphic software



Process optimization

- ANOVA optimize process with graphic data
- Non-destructive detect process defects



Performance indicator supporting EOLT

- Electrical performance and NVH analysis
- Insulation analysis of 800 Voltage E-Motor



Recommended portfolio

Reliable advanced CT system

ZEISS METROTOM 1500

X-ray tube	225 kV / 500 W
Source-to-detector	1500 mm
Detector size	427 mm x 427 mm
Detector resolution	3072 px x 3072 px
Pixel size	139 μ m
Measuring volume (diameter x height)	615 mm x 800 mm

Benefits:



- 3k detector for high-resolution capture
- 6.7 m² footprint for flexible installation
- 870 mm part height and 50 kg weight
- Fulfils VDI/VDE 2630 sheet 1.3



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.

