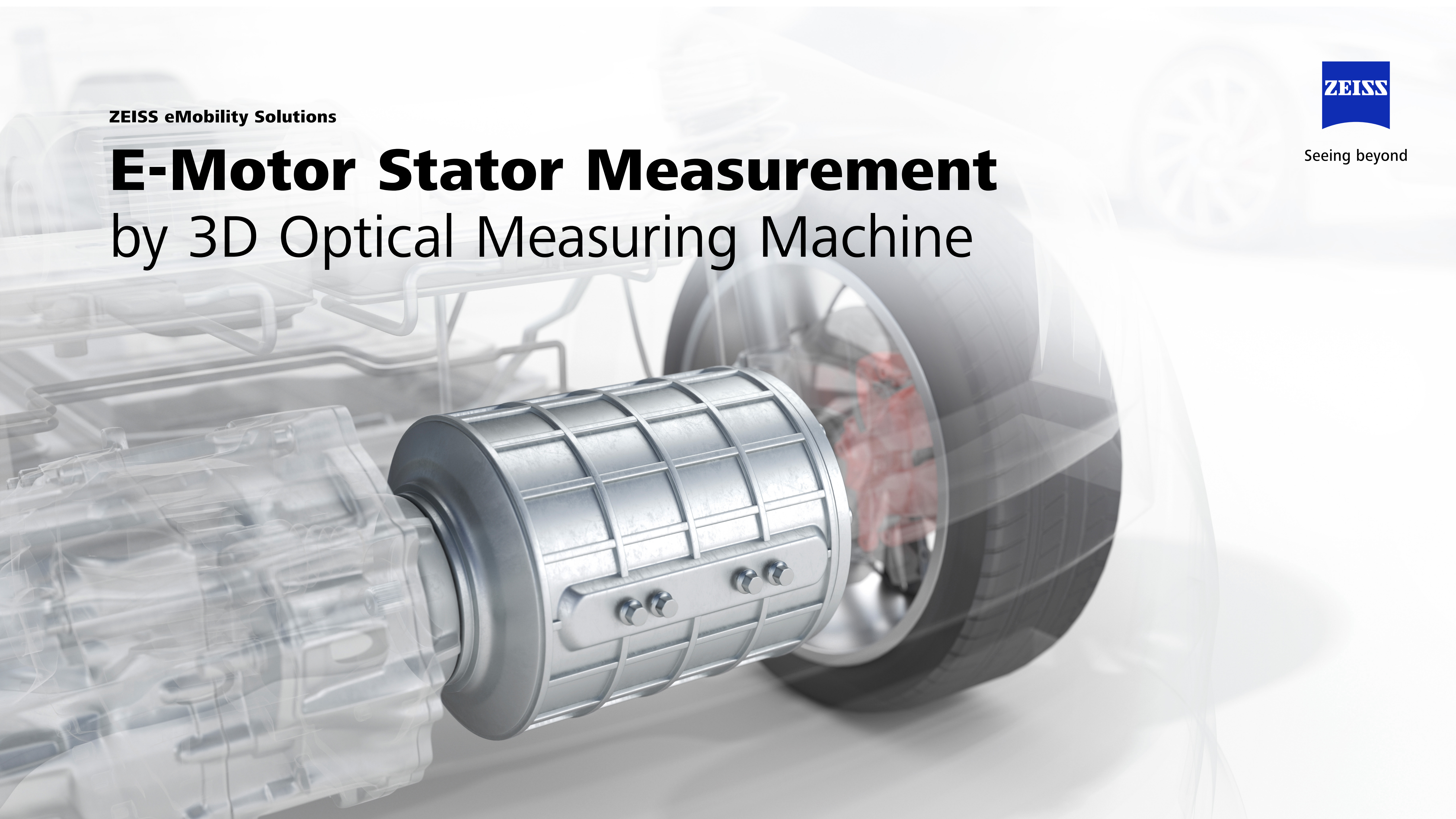


ZEISS eMobility Solutions

# E-Motor Stator Measurement by 3D Optical Measuring Machine



Seeing beyond





# E-Motor quality control

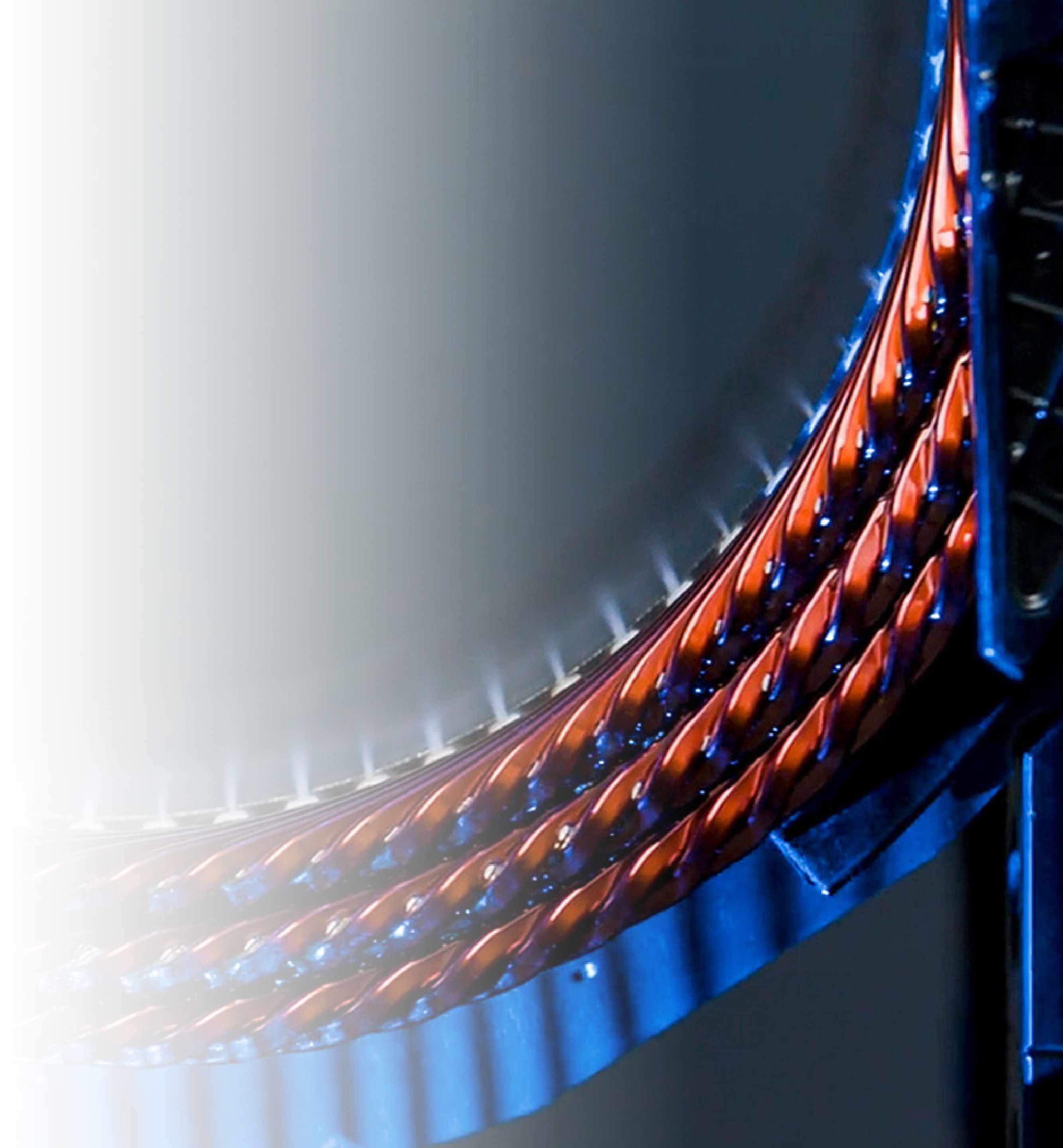
## ScanBox for full-field measurement

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 the reduction of stator process defects.

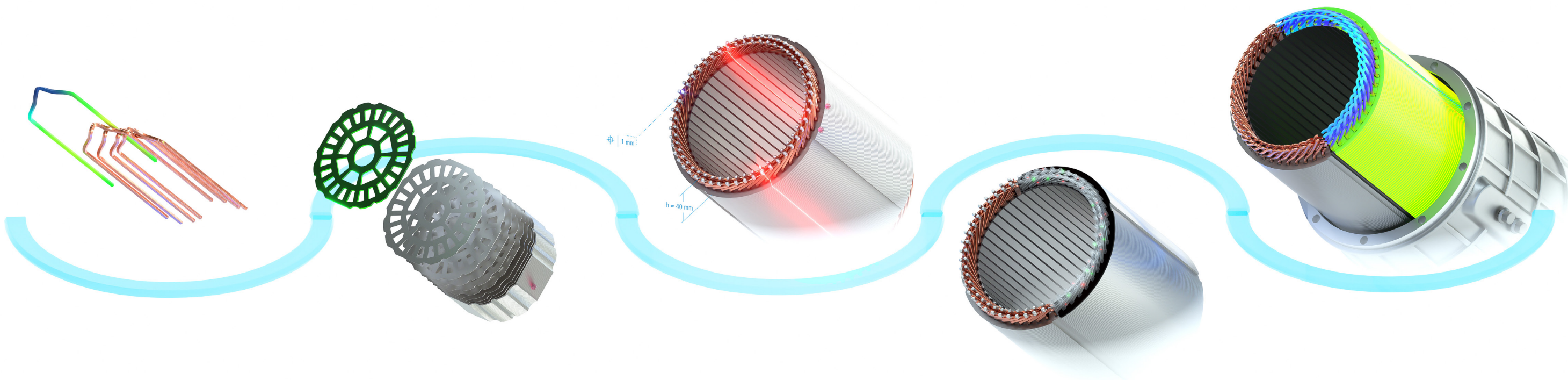
Furthermore, the design and manufacturing of stators will apply 800V platform application, requiring higher anti-discharge capability, insulation performance, thermal management performance, and so forth.



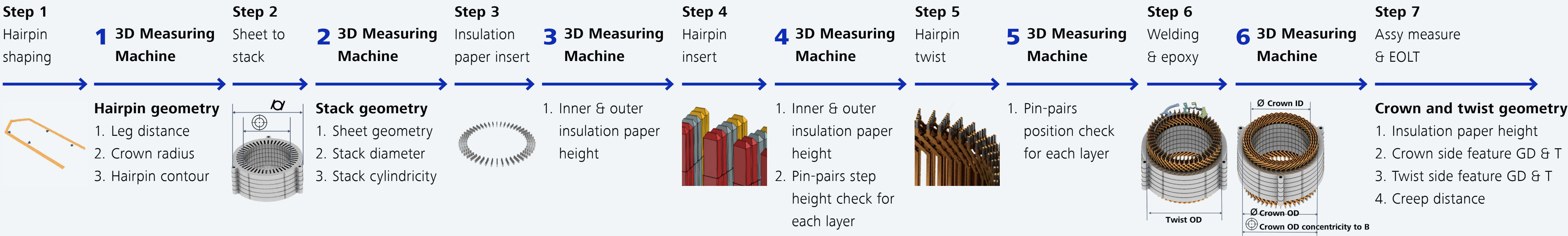
# E-Motor quality control

## Throughout manufacturing process

This is the overview of E-Motor manufacturing process. Each process requires quality inspection solutions to ensure E-Motor performance. 3D Optical solution can provide full-field cloud data to indicate the overall view of E-Motor during R&D and production process. Full geometry and dimension can be precisely measured to fulfill each quality gate.

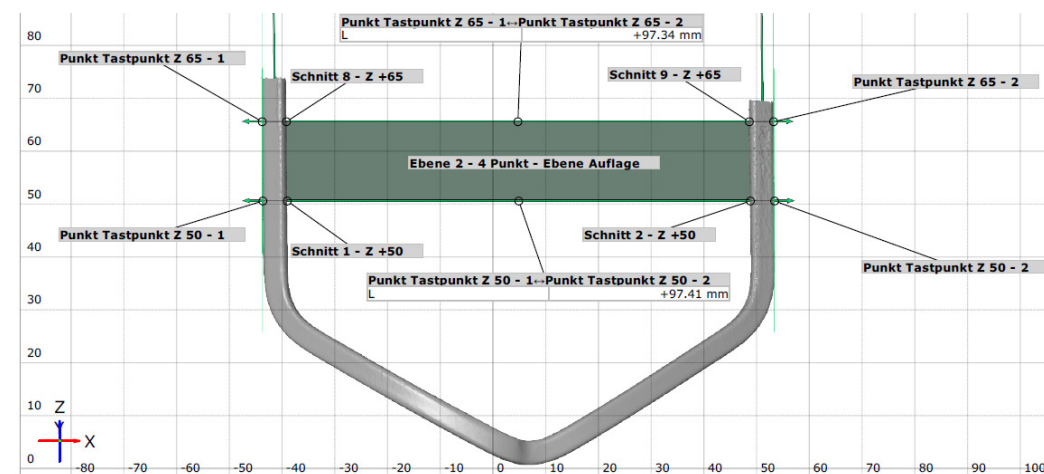


### E-Motor stator production process with 3D optical solution



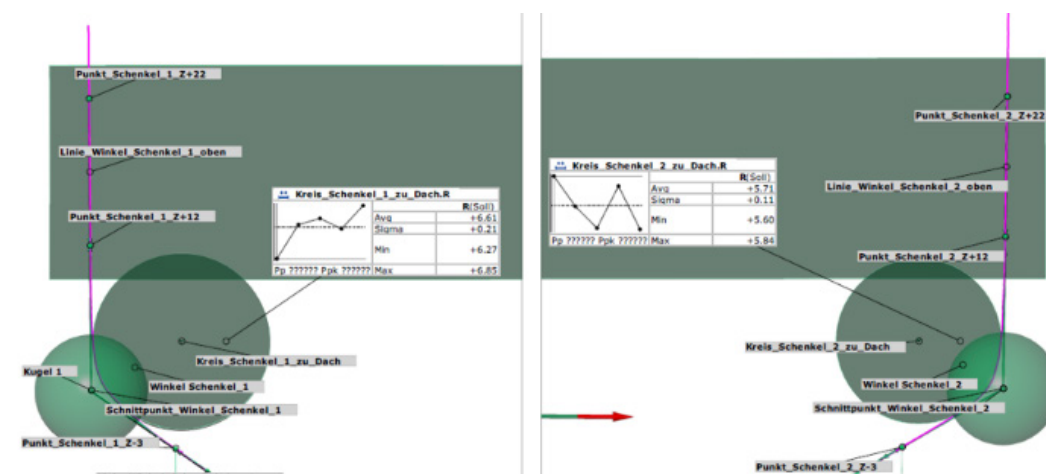


## Application areas of 3D Measuring Machine



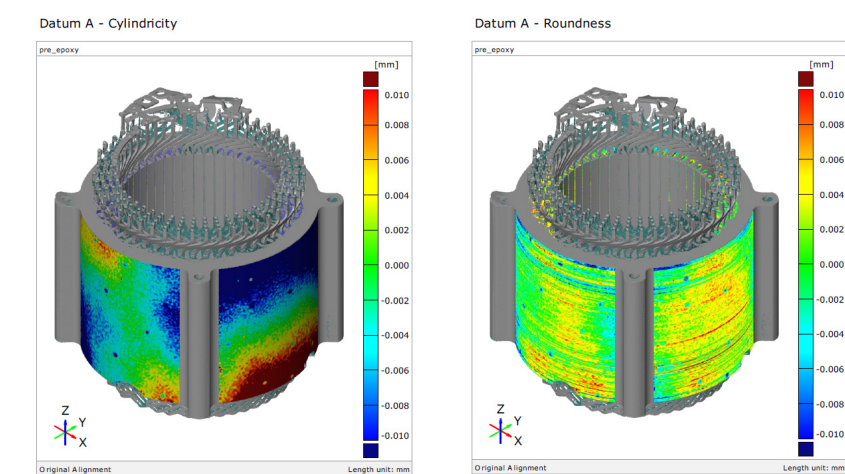
## Hairpin geometry

- Leg distance after bending
- Crown radius and angle after bending
- Spline curve analysis for RGD



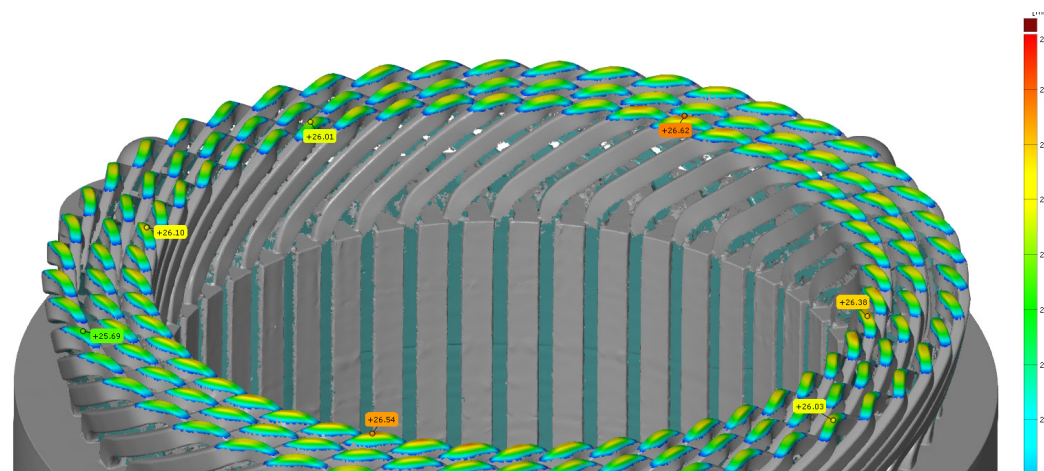
## Process capacity analysis

- Fully automatic evaluation of hairpin production
- Fully automatic evaluation for stator production
- Process optimiziation with batches 3D data



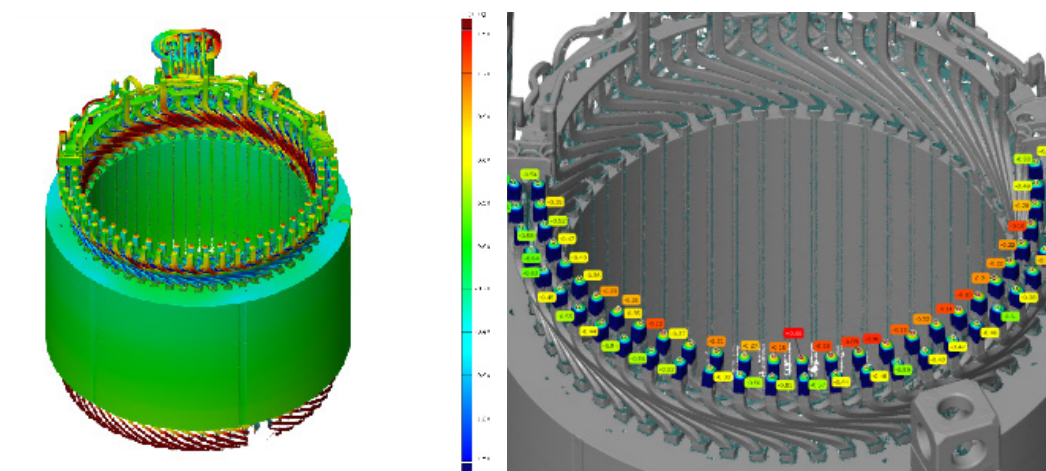
## Sheet stack geometry

- Single piece of sheet thickness and dimension
- Stack surface flatness
- Stack diameter and cylindricity



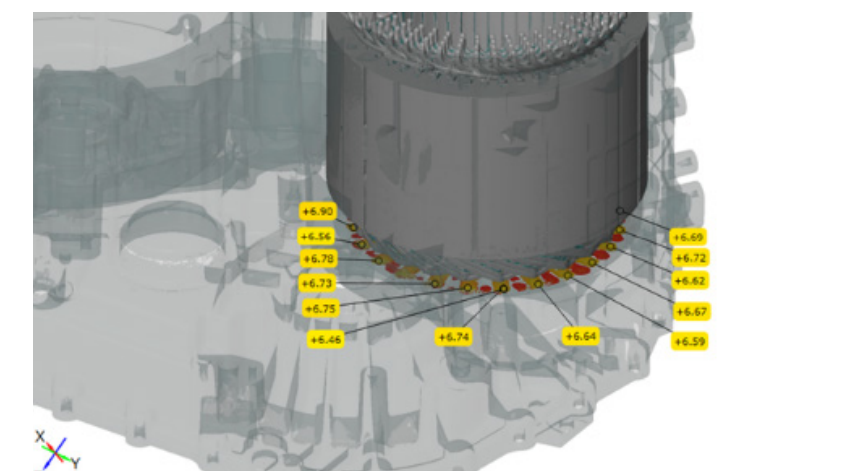
## Crown and twist geometry

- Insulation paper height of ID and OD
- Crown and twist side feature geometry
- Creep distance of 800V stator



## Welding ROI geometry

- Hairpin welding ball geometry and position
- Busbar bridge position and height
- U,V,W lug bolt hole height and position

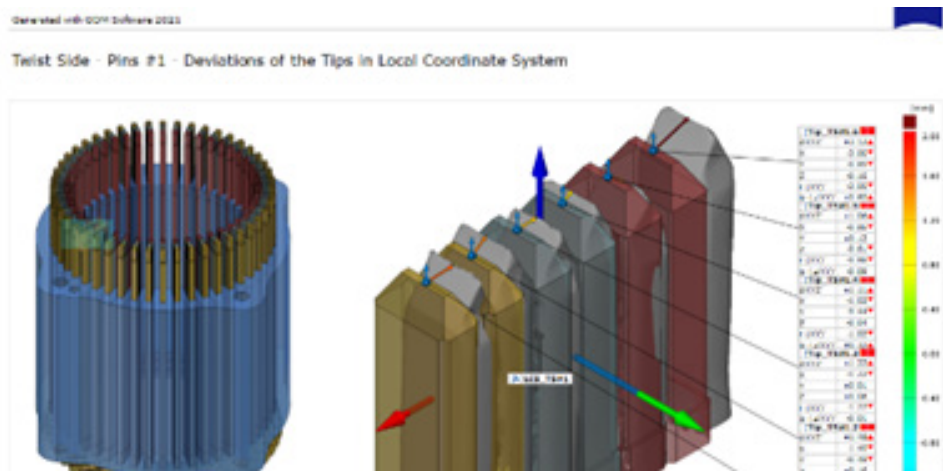


### Insulation and discharge dimensions

- Top point check for crown and twist side
- Discharge gap between each welding layer
- Epoxy material thickness



# Value proposition of ZEISS solution



**Visualization by full field cloud data**

- Evaluate R&D prototype and production process
- Indicate electrical performance



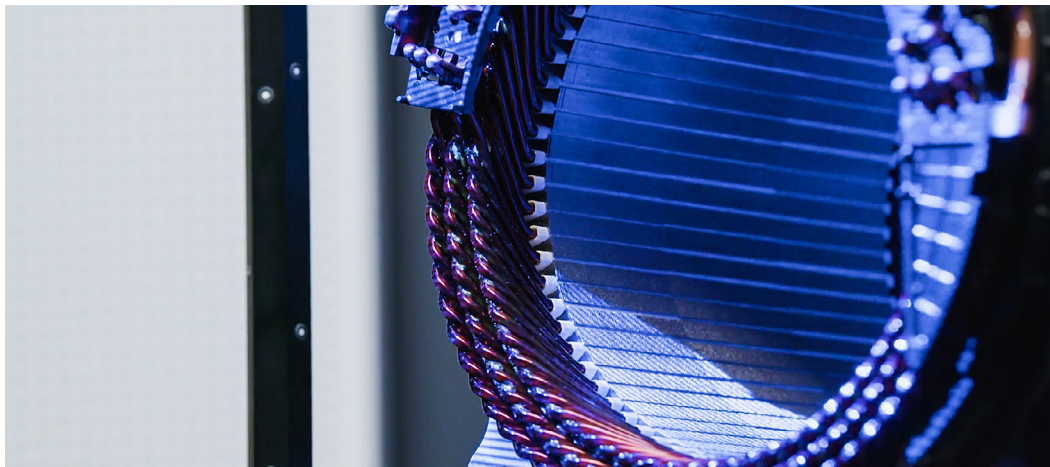
**Virtual measuring room**

- Provide drag-and-click simulation including robot automation and camera programming by curved surface and feature definition with CAD data



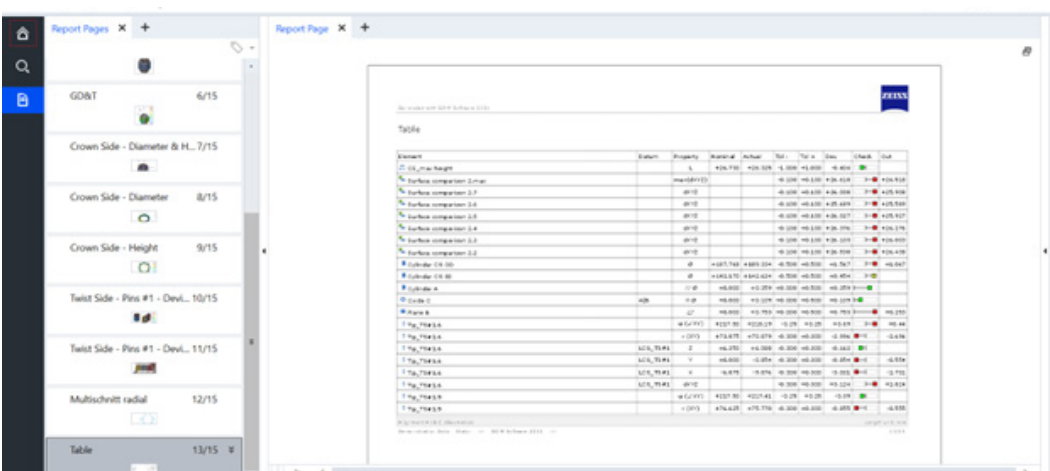
**High efficiency to collect and analyze data**

- Compared with tactile solution, much faster data collection and report generation



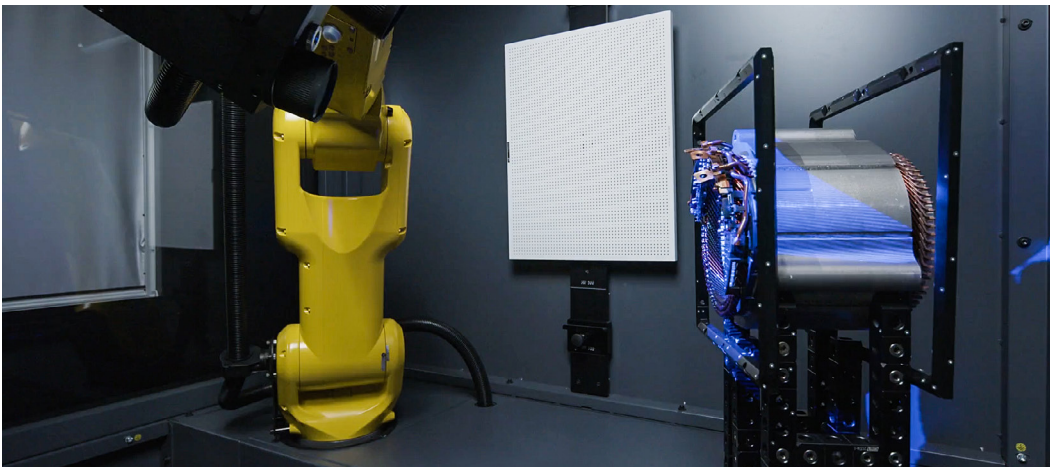
**High accuracy with true value measurement**

- Tested and certified by physikalisch technische bundesanstalt (PTB) Germany and national institute of standards and technology (NIST) USA



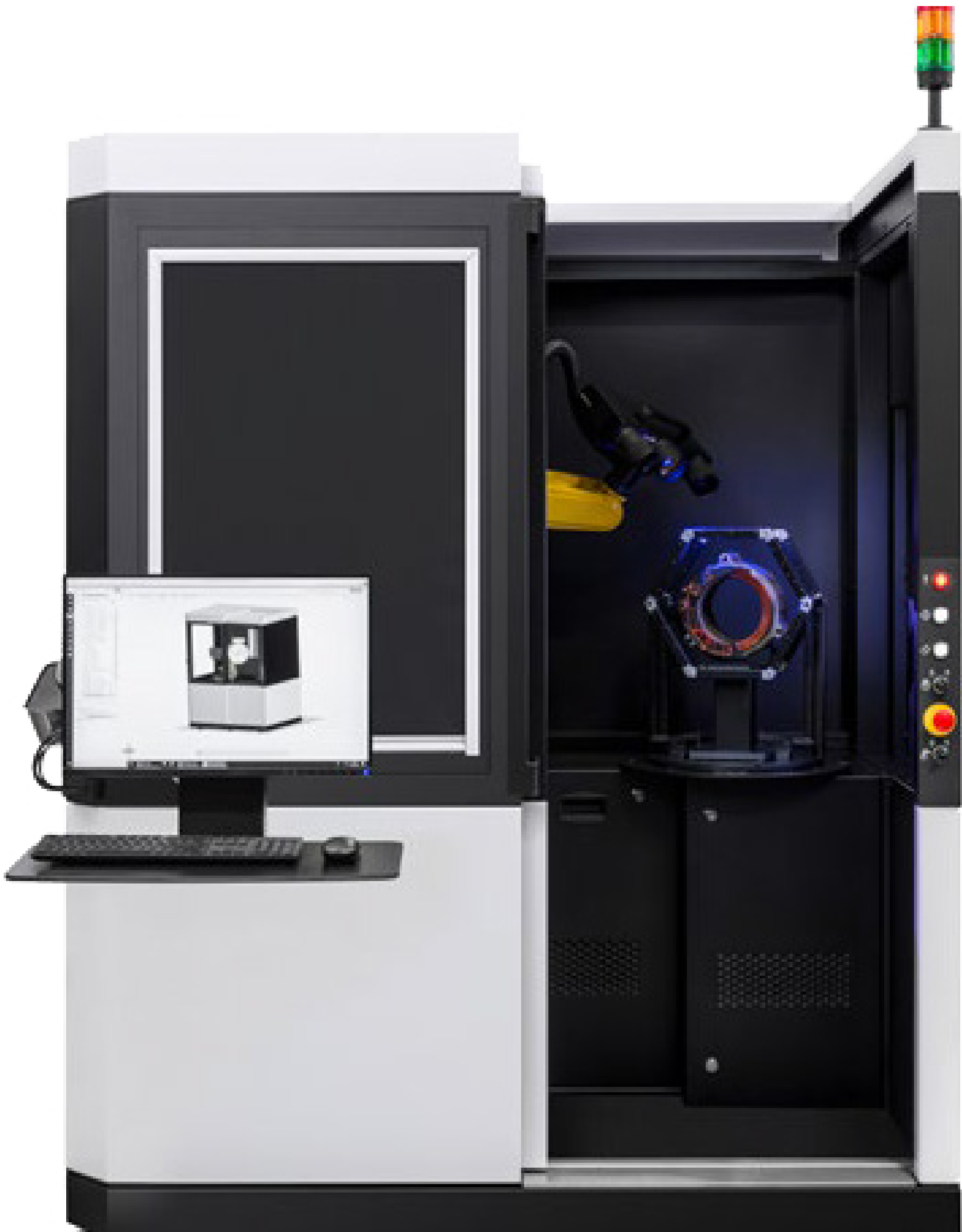
**Easy-to-use advanced 3D analysis software**

- Easy to create measuring template for all types of workpiece
- 100% flexible quality requirement set



**Single solution for various material of stator**

- Provide optics design for transparent coating
- Fixture design to cover all stators



## Recommended portfolio

**Mobile stand-alone measuring machine**

ZEISS ScanBox 4105 for eMotors

Dimensions	1700 x 1200 x 2100 mm
Power supply	Standard 100 – 240 V (1-phase, 16 A)
Max. part size	Φ 500 mm
Max. part weight	100 kg
Opening width	680 mm
Floor installation or fixation	not required, mobile
Sensor compatibility	ATOS Q for eMotors
Software	ZEISS INSPECT Optical 3D



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