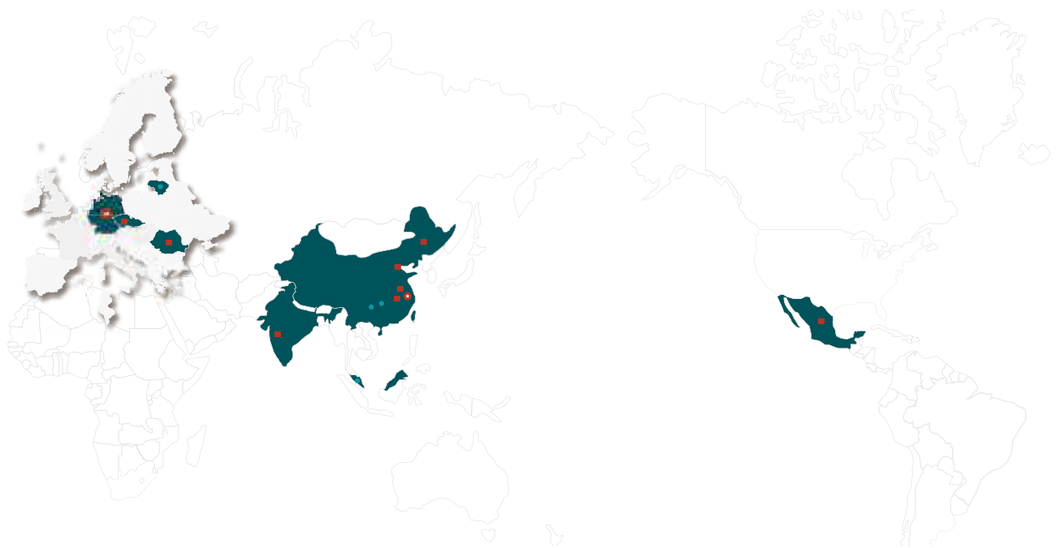
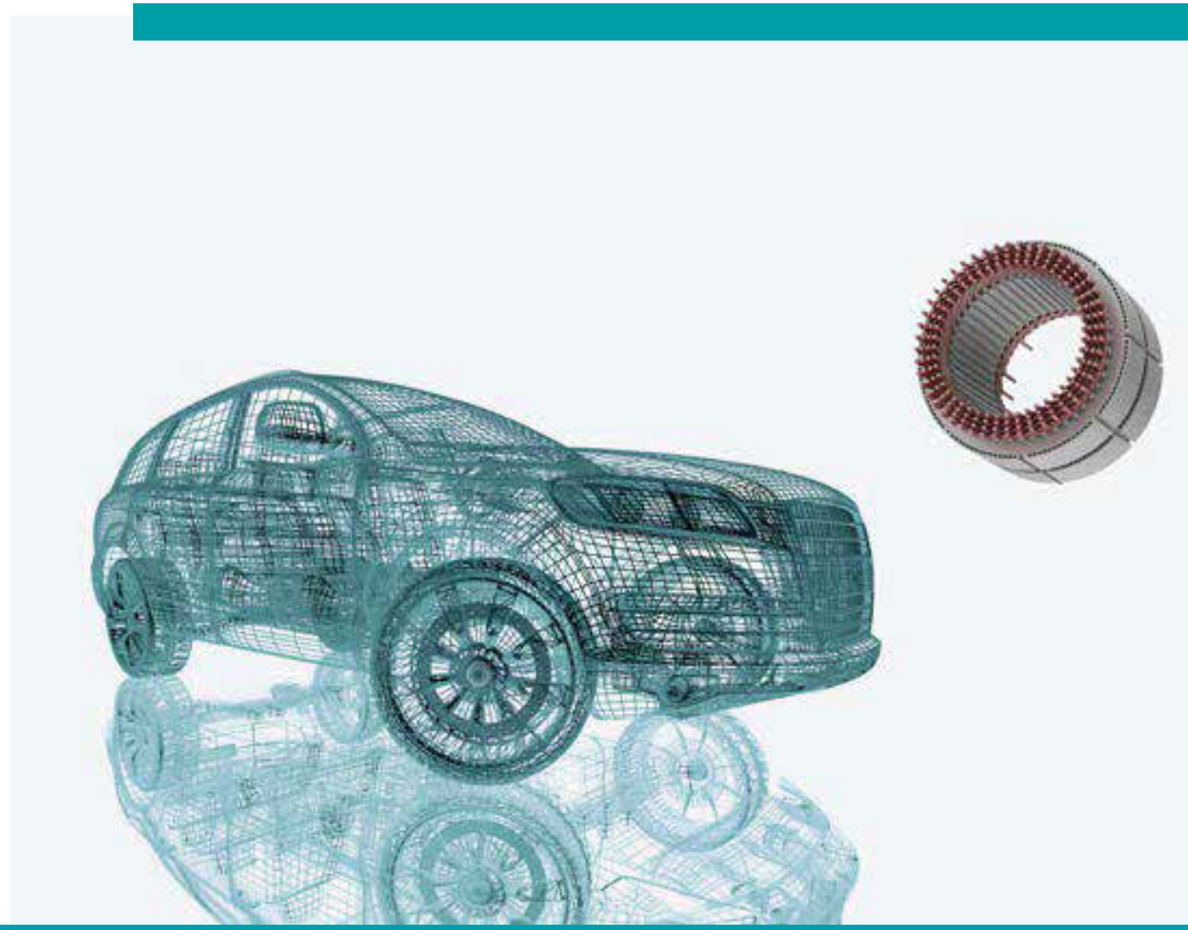
Global Layout



Bar-Wound Stator
Smart Manufacturing Solution Provider



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COMPANY PROFILE

Located in Changzhou, footprints across the globe. ruhlamat Huarui Automation Technologies (Changzhou) Co., Ltd., founded in November 2021, is a globalized company dedicated to providing bar-wound stator smart manufacturing solutions and services to global customers.

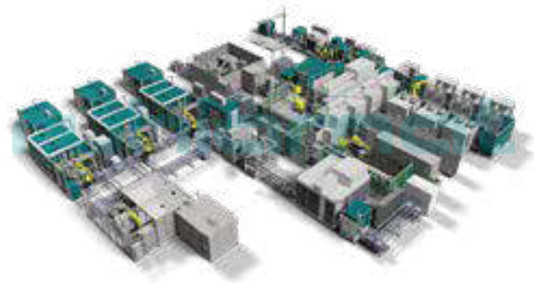
Its core R&D team consists of ruhlamat (Suzhou) senior engineers, with extensive and professional experience in the industry. The plant in Changzhou covers 20,000 m^2 , equipped with a sample workshop and professional manufacturing facilities.

BUSINESS SCOPE

To provide bar-wound stator manufacturers worldwide with smart production line and services, with OEM services in the second phase

Bar-Wound Stator Automation Line

- Flexible automation solutions
- Compatible with multiple products
- PV production line



Bar-Wound Stator Sample Production

- Trial production
- Compatible with stators of multiple diameters (120-280mm)
- Compatible with bar-wound of multiple layers

Bar-Wound Stator R&D and Service Support

- Multiple processes: bending, twisting, welding (laser/TIG)
- Personnel training, production support and skills improvement
- Analysis and R&D on products with customers
- Leaping capacity based on lean improvement

Bar-Wound Stator Mass Production Line Gen1

CT 75s

OEE≥85%

98%
First Pass Yield

90-180mm
Lamination stack

① Lamination loading & stator unloading

② Insulation paper insertion

③ Common U-pin forming

④ Cross-layer U-pin and l-pin forming

⑤ Basket insertion

⑥ Pin insertion

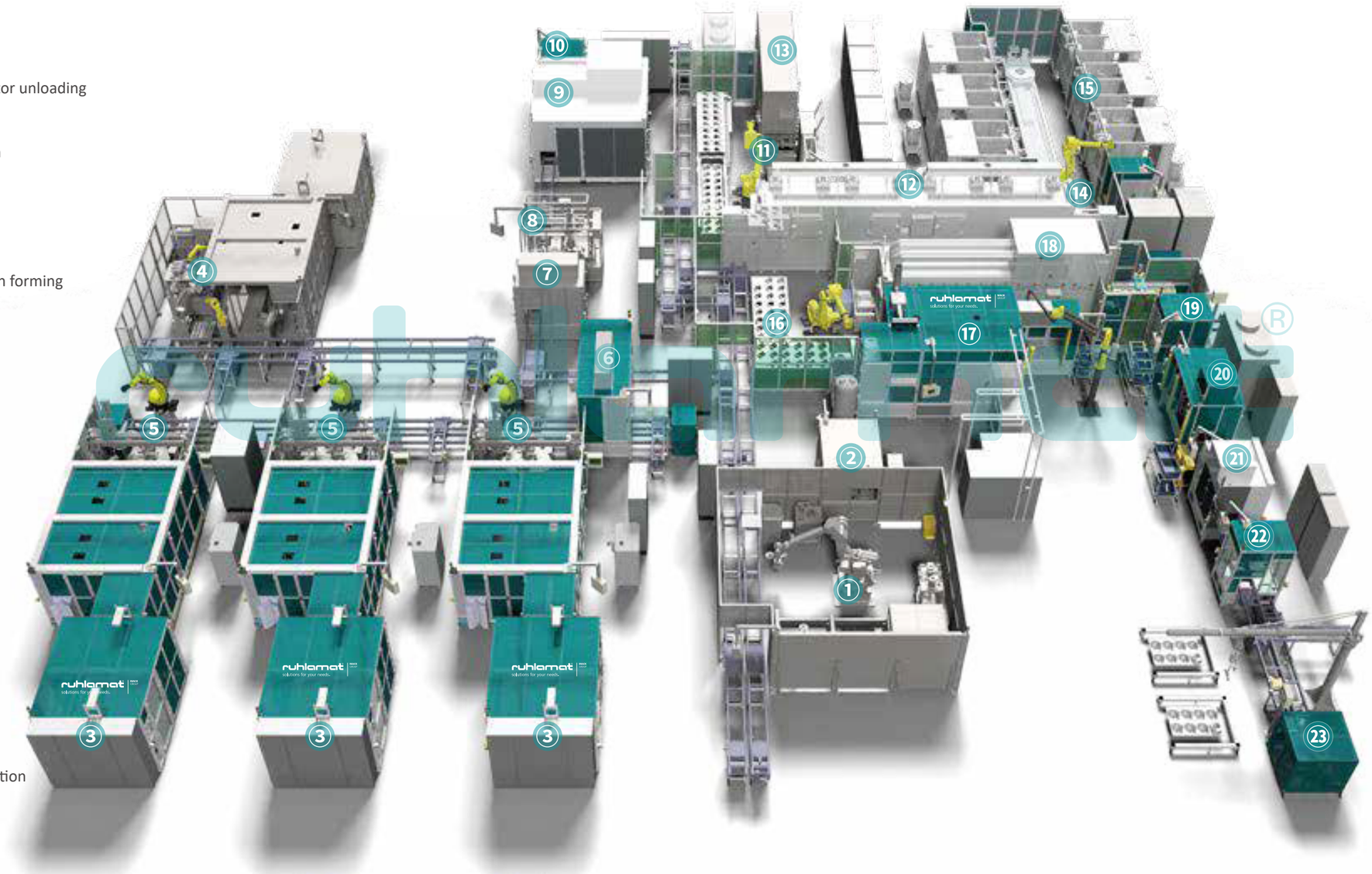
⑦ Expanding

⑧ Twisting

⑨ Pin cutting and laser welding

⑩ AOI test

⑪ Robot-1 & Lamination surface ceanliness inspection



⑫ Preheating and curing oven

⑬ Cooling machine

⑭ Robot-2

⑮ Trickling by electric heating and gelling

⑯ Buffer after trickling

⑰ Housing assembly

⑱ Cooling oven

⑲ Leakage test

⑳ Busbar assembly

㉑ Busbar welding

㉒ EOL test

㉓ Unloading

Bar-Wound Stator Mass Production Line Gen1

CT: 120s

OEE≥85%

98%
First Pass Yield

90-180mm
Lamination stack

① Lamination Loading & Stator unloading

② Insulation paper insertion

③ Cross-layer U-pin and l-pin preparation

④ Pin forming

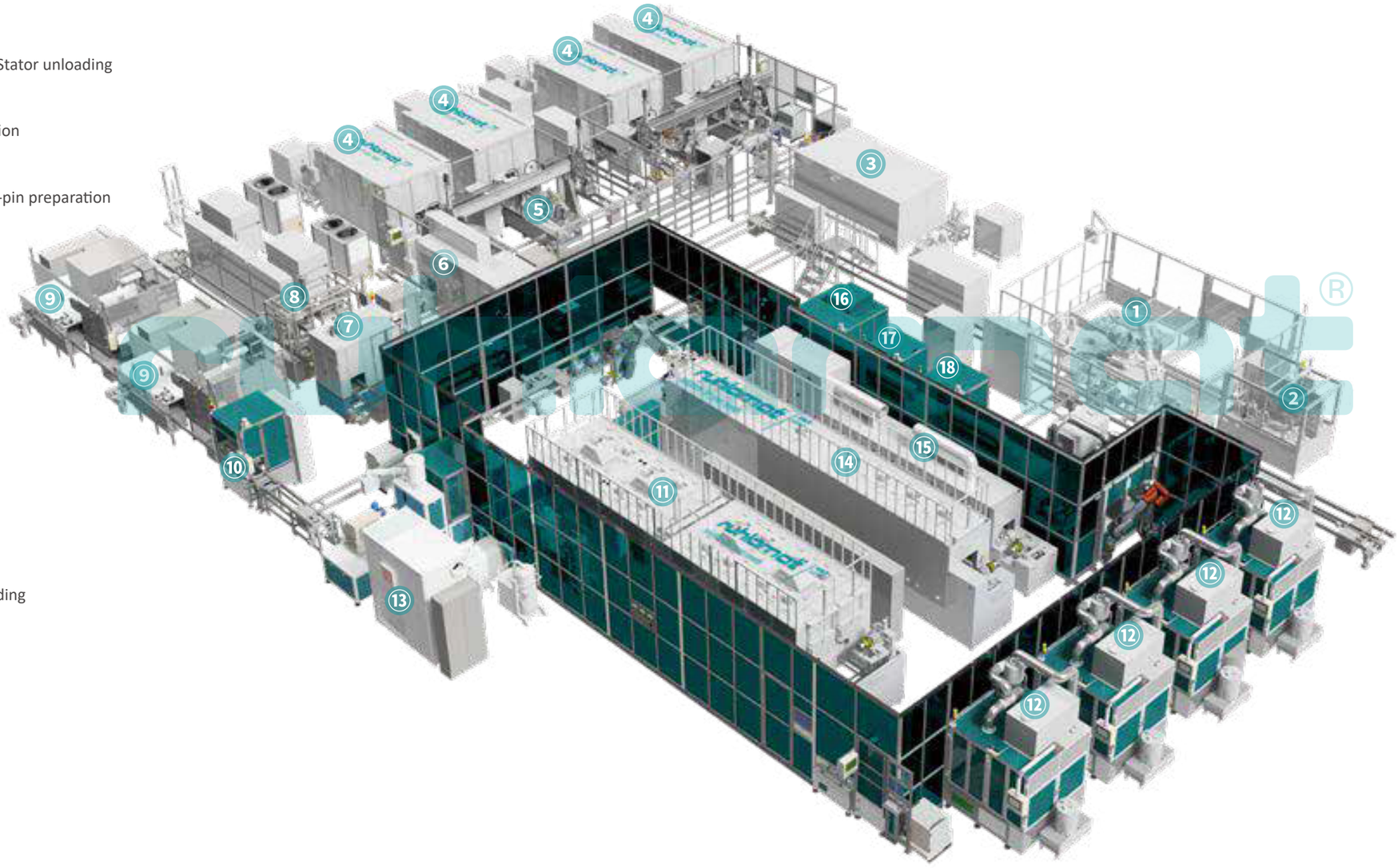
⑤ Basket insertion

⑥ Pin insertion

⑦ Expanding

⑧ Twisting

⑨ Pin cutting & laser welding



⑩ AOI test

⑪ Stator preheating & Glue curing & Coating preheating oven

⑫ Trickling by electric heating and gelling

⑬ Coating

⑭ Coating curing oven

⑮ Cooling oven

⑯ Typhoon cleaning

⑰ NTC assembly and EOL test

⑱ Final Inspection

Bar-Wound Stator Mass Production Line Gen2

- Bar-wound stator mass production line Gen2 features high flexibility, with modular design. High-speed automatic changeover can be realized in 50% of the stations, with that for whole line less than 45 minutes.
- The process stations for pin forming, stripping, automatic basket insertion, automatic PIN insertion and welding are upgraded and iterated, thus achieving a significant increase in the OEE and automation rate of the whole line, with the CT down to 30s at least.
- The innovative pin forming station can meet the production of all types of pins in one stator.

① Loading lamination

② Insulation paper insertion

③ Pin forming

④ Basket insertion

⑤ Pin final insertion

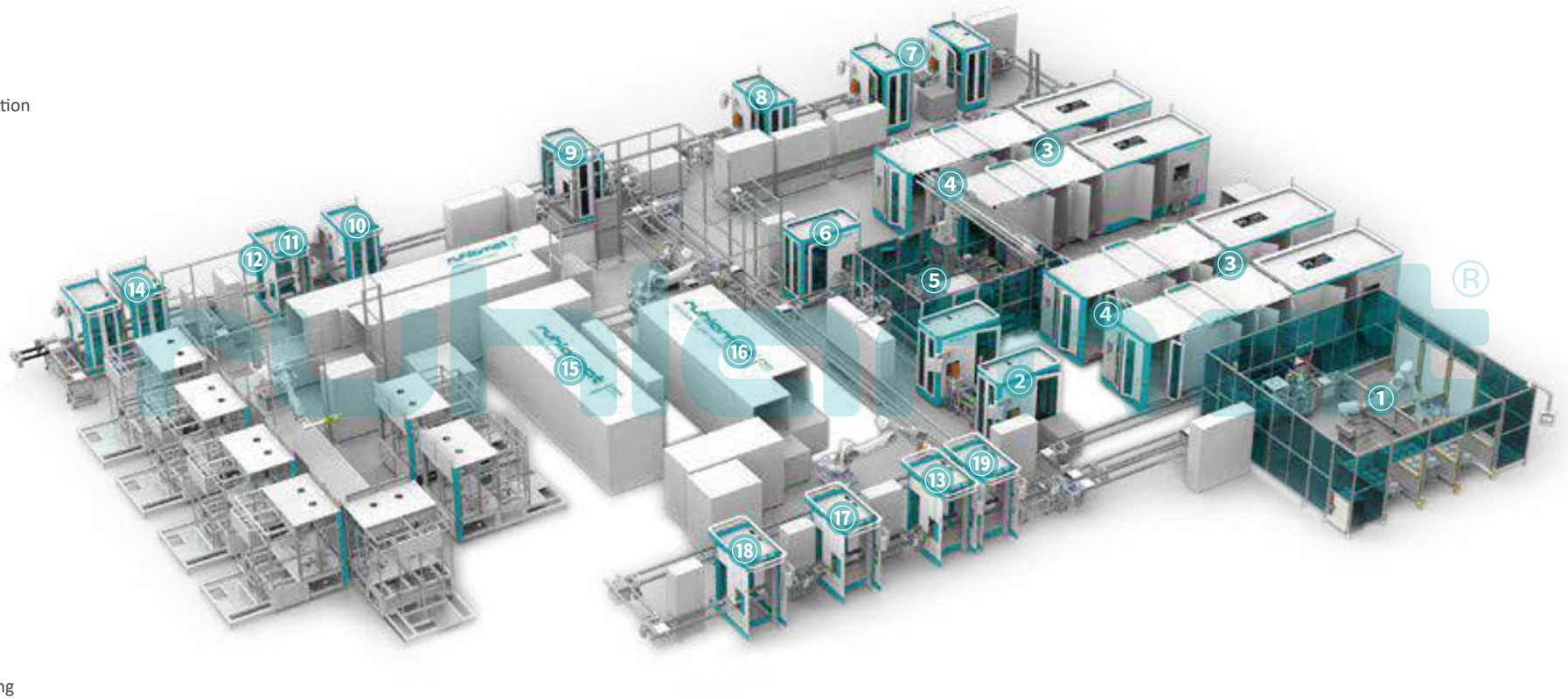
⑥ Expanding

⑦ Twisting

⑧ Cutting

⑨ Laser welding

⑩ Inspection and cleaning



⑪ AOI Test and measurement of welding height

⑫ Flipping/Installing busbar welding fixtures/Crown side forming

⑬ EOL Test

⑭ Typhoon 1 and HV Test

⑮ Heating oven & Trickling

⑯ Curing

⑰ Typhoon2

⑱ GP12

⑲ Final Inspection

CT down to **30s**
or 75/90/100/120s

High Compatibility
4/6/8 layers, 48/54/72 slots

30%
Area saved

50-270mm
Lamination stack

OEE≥**85%**

Self-learning
Intelligent production

High Flexibility
A single machine can meet the production of all types of pins in one stator

2-3%
Copper wire saved

98%
First Pass Yield

120-280mm
Lamination diameter

Automatic Changeover
by software

95%
Automation rate

Standard Station

High-Flexibility Pin Forming Station

- The first innovative design in the industry.
- High flexibility: Innovative 2D/3D moulding mode, free of hardware replacement. Through updating software, a single machine can meet the production of all types of pins in one stator, which covers processes like straightening, stripping, 2D, 3D, and pre-insertion of the wire. The solution is made according to the customer's production capacity requirements to achieve a flexible production mode and set aside interfaces for the future expansion of the production.
- 2-3% copper wire is saved: Non-destructive cut-off process.
- 7.2 million RMB copper wire is saved: Based on 600,000/pcs annual production capacity.

Specifications & Features

- CT≤1.5s/pin
- The software-empowered changeover enables all types of pins in one stator to be produced by a single machine
- Modular design, with mould/milling/laser peeling optional to the customer
- Wire feeding length error +/-0.1mm
- Non-destructive cut-off chamfering, with copper costs saved (2-3%)
- Automatic insulation testing of the pin on line (optional)

Standard Station

Insulation Paper Insertion Station

Specifications & Features

- CT≤75s/pcs (48 slots)
- Forming size accuracy: ±0.15mm
- Paper insertion length varies from the core thickness, with the accuracy: ±0.15mm
- Forming heating function with the temperature control ±3 ℃
- Automatic unwinding and tension control
- Insertion of anti-warping
- Paper scrap cleaning
- Paper shift without scrap
- Paper jam alarm

Standard Station

Basket Insertion Station

Specifications & Features

- CT≤1.5s/pin
- Pin type anti-error
- Pin anti-deformation
- Compatible with multiple winding designs
- Combing pins to prevent the disorder of layers or feet of pins
- Flexible design of basket tooling, enabling efficient changeover

Standard Station

Expanding Station

Specifications & Features

- CT≤3.5s/pin/gripper
- Z-direction compensation when expansion
- Pin position correction
- Pin position testing after correction
- Coating destruction free for bar-wound stator
- Flexible design, compatible with different diameters and grooves of the stator, and the number of clamping jaws can be increased/decreased up to 16 groups at most

Standard Station

Twisting Station

Specifications & Features

- CT≤60s/pcs
- Torque monitoring
- Moulding force monitoring to ensure that the product is not damaged
- The angle of rotation of each layer is controlled by an independent servo
- Each layer of the twisted head mould can be made independent of the Z compensation to ensure that the height of the welded end of the twisted head, no need to cut the head, which can save copper costs
- Before twisting the pin and in the process of twisting the pin should be prevented from U/I pin tampering
- After the head of the twisted head pin position detection and product cleaning
- Prevent damage to bar-wound enamel

Standard Station

Laser Welding Station

Specifications & Features

- CT=0.25s/welding point
- Welding fixture has independent power for each slot, no gap for clamping
- Shielding gas is protected during welding with a welding fume extracting system
- PFO welding guide, pin position/pin height/pin clamping gap
- Welding slag cleaning
- Automatic disassembly of welding fixture
- Welding points free of cutting
- Automatic visual testing of welding point quality