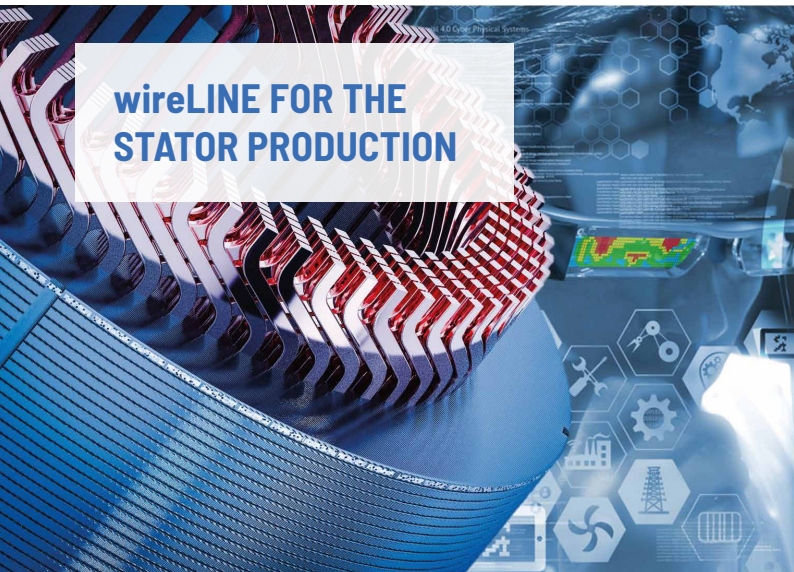
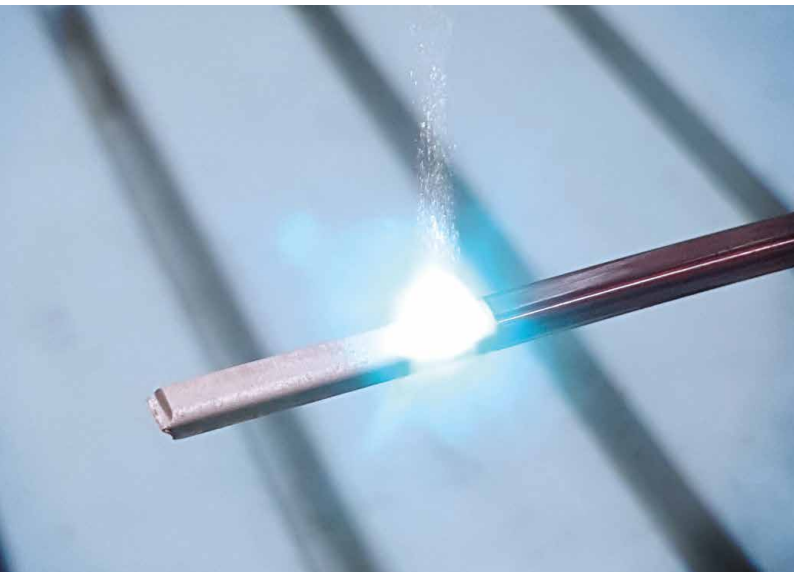


E-MOBILITY - wireLINE TECHNOLOGY FOR EFFICIENT DE-COATING



wireLINE FOR THE STATOR PRODUCTION

Stators for the production of electric motors, picture: PEM, Aachen



Hairpin insulation by means of laser technology

PRODUCTION SOLUTIONS FOR STATOR MANUFACTURING

The production of stators often involves the use of copper wires that are coated with a varnish layer or insulation to protect them against short-circuits. In the production of electric motors, enamelled copper wires with special insulation coatings made of plastics are used. Typically, temperature-resistant plastics such as polyamidimide (PAI), polyetheretherketone (PEEK) are used for this.

To obtain optimal welding and soldering results, the insulation coating must be partially removed before joining.

This paint removal can be carried out via mechanical methods or - much more reproducible and process-reliable - using the wireLINE from cleanLASER.

During de-coating for welding pre-treatment, the raw material is supplied from the „coil“ and the coated wire is cut into pieces, typically 100 to 800 mm long, for winding into pins.

These I-pins are then bent into half loops, inserted into the perforated stator laminations and then soldered or welded together to create closed windings.

INDUSTRY REQUIREMENTS

- All-sided de-coating, complete absence of varnish, high reproducibility with fluctuating varnish layer thickness
- Preservation of the copper wire cross-section to avoid oversizing
- High technical availability, low cycle time
- Part-tolerant process, as the wire and especially the coating are often subject to production tolerances
- Contamination-free de-coating
- Space-saving integration into the production line and processing on running wire

COPPER WIRE DE-COATING WITH wireLINE DIRECT AND wireLINE MIRROR

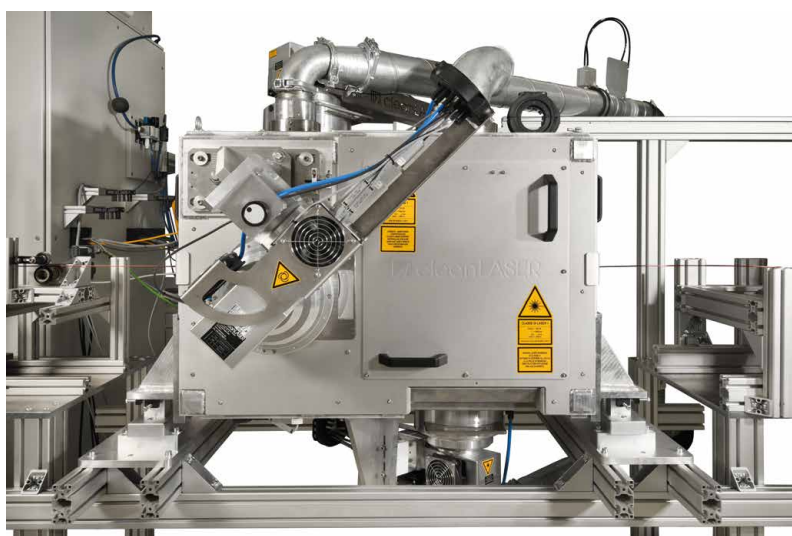
cleanLASER has developed the laser-based wireLINE decoating optics in two options: wireLINE DIRECT and wireLINE MIRROR. Both designs enable residue-free decoating of copper wires with RFU values < 5 . Due to the touch-free technology the systems operate wear-free with a low power consumption of approx. 4 to 5 kW in non-stop operation. The laser beam is to a large extent reflected at the copper surface so that the ablation process stops. This prevents the reduction of the wire cross-section.

The wireLINE technology allows processing over long insulation stripping lengths on the running wire. Due to the almost continually active laser, a high process efficiency is achievable. On-the-fly processing enables a wide and variable speed range. The wireLINE technology modules can be easily integrated into existing production lines and can be operated intuitively via the software's graphic user interface.

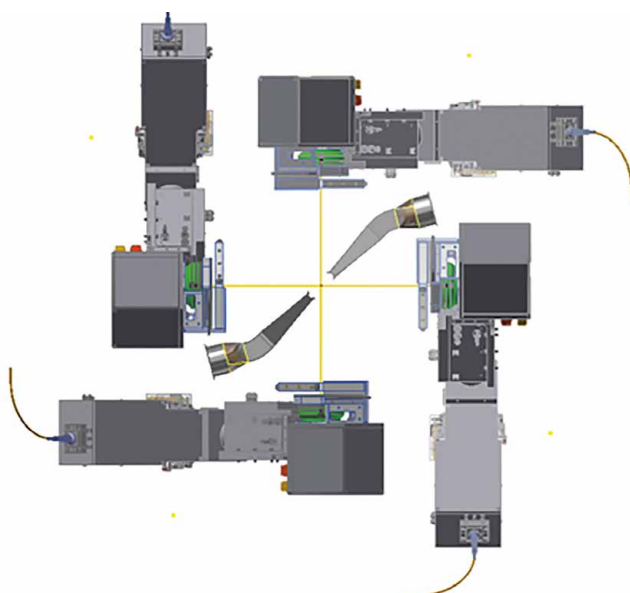
wireLINE DIRECT

TECHNOLOGY wireLINE DIRECT

- Direct beam on the wire via 4 optics and 4 laser systems
- Local capture of the particles via radial suction
- Large working distance
- Paint stripping area up to 340 mm length
- Wire feed up to 1 m/s
- Particularly suitable for alternating wire types
- Highest throughput rates



wireLINE DIRECT: special optics for all-sided in-line de-coating of wire



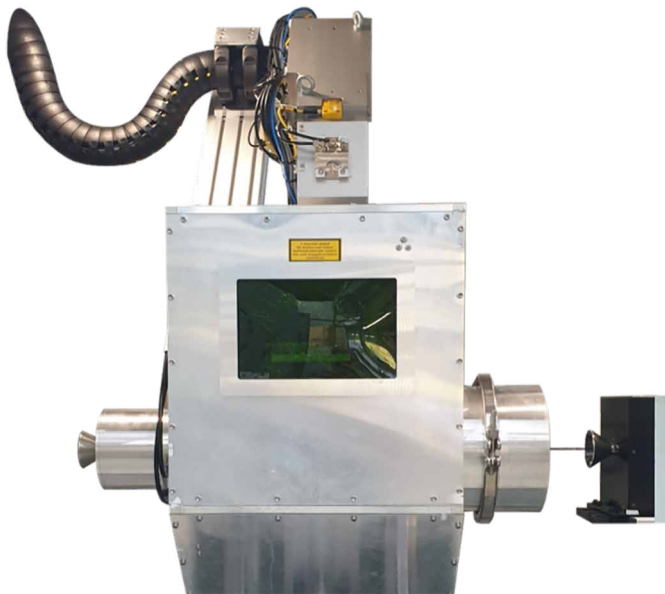
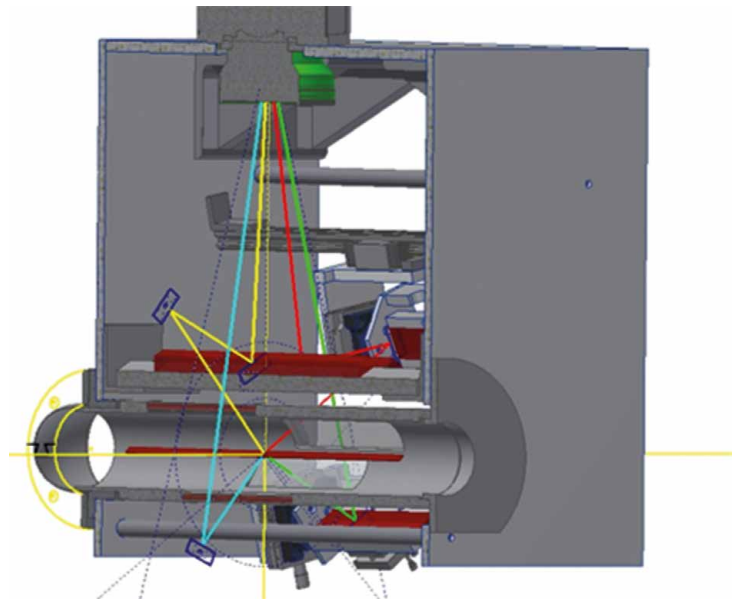
BENEFITS wireLINE DIRECT

- Very short cycle times due to high total laser power, e.g. PAI 80 - 90 μm , 3.6 mm² x 20 mm length, approx. 0.55 s
- Easy set-up of the process
- High flexibility for different wire cross-sections
- Compact integration module - low space requirement
- Minimal costs per de-coating process at high output rates

wireLINE MIRROR

TECHNOLOGY wireLINE MIRROR

- Beam-path compensated mirror unit for all-round irradiation of the wire with only one laser beam source
- Axial flow suction pipe with integrated cross-flow for efficient particle capture
- Paint stripping area up to 290 mm length
- Special configuration for one wire type

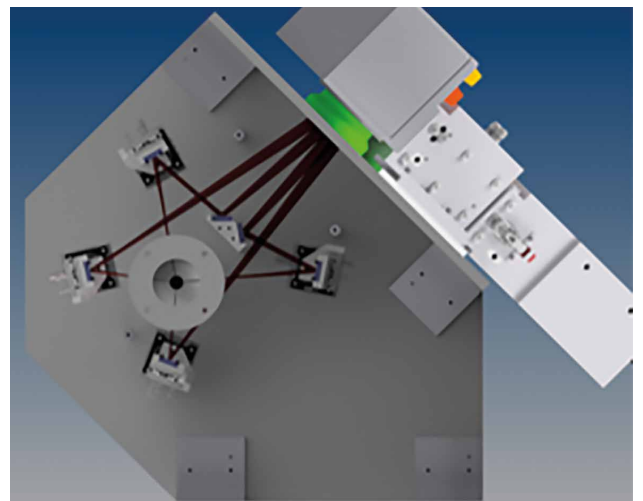


BENEFITS wireLINE MIRROR

- Short cycle times due to high laser power (up to 500 watt), e. g. PAI: 80 - 90 μm , 3.6 mm^2 x 20 mm length, approx. 1.2 s
- Reduced installation length: approx. 940 mm
- Low investment costs
- Integrated suction solution

Options for wireLINE DIRECT and MIRROR

- Interface to the company's production data management system
- Software-controlled adaptation to different wire cross-sections
- Camera-based process visualisation
- Inline process monitoring: Highly dynamic, camera-based monitoring of results at wire feed speeds of 0.5 m/s



wireLINE STATIC

STAND-ALONE SOLUTION WITH FIXED STOP MODULE FOR DIFFERENT WIRE CROSS SECTIONS

The wireLINE STATIC version allows not only hairpins but also busbars with larger cross-sectional areas and stripping lengths to be processed in a static position.

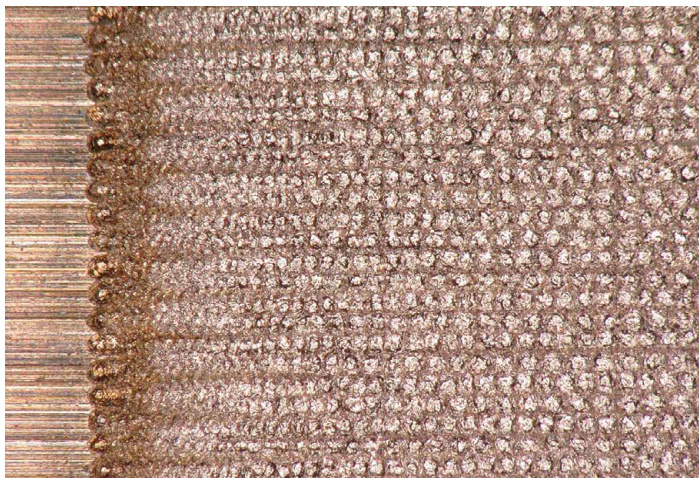
The wireLINE STATIC is designed as a stand-alone solution with a fixed stop module. The variably adjustable end stop enables different stripping lengths for the wire ends, which are typically < 60 mm. The wireLINE STATIC can be equipped with various power classes up to 500 watt and is classified as a complete system in laser class 1.

TECHNOLOGY wireLINE STATIC

- Stand-Alone solution with a fixed stop module
- Different stripping lengths, typ. < 60 mm
- Pneumatic clamping system for wire fixation during processing
- Foot switch for initiating the laser process
- Adaptable to versatile wire cross-sections
- Integrated suction module for efficient particle collection
- Design as sitting or standing workstation, optional robotic operation



subject to technical changes 21-10



Microscope image of a laser-treated copper surface

BENEFITS wireLINE STATIC

- Multi-sided processing in one set-up possible
- Variable design for de-coating on 2 or 4 sides possible
- Static processing of the free wire end
- Version with variable or fixed end stop
- Wire end processing of wires previously cut to length possible

PLEASE CONTACT US. WE ARE HAPPY TO ADVISE!

 cleanLASER
cleaning with light