Advanced copper hairpin laser stripping

G.G.





Growth history



In Euro million



- Hairpins are one of the most common winding components for high power and high efficiency electric engines for powertrain applications.
- High conductivity metal (generally copper) is electrically isolated with special external coatings with multiple different polymeric layers.
- The welding process requires clean and decoated conductors for the best results. Limited amount of surface residual is allowed.



- Hairpin stripping can be performed in traditional way (mechanical) or using Lasers
- The traditional approach is not flexible (format variations need long setup with part change and regulation), complex setup requiring hi-skills operator and "analogic" results in production due to blade sharpness or brush status
- Laser cleaning is a fast, efficient, accurate and industrial proven process. Parameters can be saved into "recipes" for easy and quick selection.





The laser cleaning process can be applied «in-line» as a process station





- The Laser Cleaning process can be performed, at industrial level, with CO₂ and Fiber lasers.
- The "stripping station", using galvanometric scanners controlled by fast real-time sw-driven embedded solution can work "on-thefly" and it can remove the conductor while it is moved and transported by master hairpin forming station
- The quality of cleaning (i.e. the amount of surface residual) can be easily measured with an hand tool, a "RFU meter". The RFU, Relative Fluorescence Unit, is a quantitative measure of residues of fluorescent contamination on the surface.



- El.En. has developed an Electro-Optical platform for integrators.
- Laser sources, Galvo scanners, HW controllers, SW SDK for PLC integration are a complete ecosystem for stripping process solution.
- El.En. Platform supports CO₂ and Fiber lasers.



Laser cleaning process

The CO₂ laser wavelength is well suit for fast insulator removal. Power range <300...700> W is required for high productivity industrial process.

PROS:

- The conductor is not affected by any thermal stress and the surface is absolutely not engraved neither reduced in section as side effect.
- Fast and robust industrial process.
- Copper is not subject to oxidation: possible off-line process.

<u>CONS:</u>

RFU level achieved not the best possible

With CO₂ laser





Laser cleaning process

Cleaning with mid-power Pulsed Fiber laser is necessary as post CO₂ treatment for lower RFU level.

PROS:

- Very low RFU values. Best condition for perfect welding process.
- Reduced smoke and dust created during process. >99% of the insulating coating is removed by previous CO₂ treatment.
 CONS:
- Laser process requires more complex setup for fast production rate
- The Copper is subject to fast oxidation process. No stocks possible



With CO₂ and fiber laser



Complete stripping laser station





CO₂ laser station



El.En. key components



RF333//RF555//RF777//RF888//RF899

10.6 µm, 350W – 850W Self-refilling technology Never Ending Power (NEP)

- Pulsed Laser
- Peak Power up to 1800W
- Integrated optical beam shape filter
- Integrated 10/100 Ethernet TCP/IP connection
- Integrated shutter with red laser diode
- Optional internal certified safety shutter
- Integrated CPU with LCD panel for HMI with auto-modulation capability
- Internal separated RF power



NEP lasers



- Self Refilling technology
- No refurbishing needed
- Constant power emission over the years
- More stable industrial processes



Scanning head system

- 3 Axis 35mm Scanner Galvo Head
- Low Inertia Beryllium mirrors
- DSP Digital Drives
- Fast Z linear motor for focus compensation
- FOV available 200x200 to 500x500mm
- CO₂ and Fiber 1070nm available

- Embedded real-time control unit
- 19" 2U Industrial rack with multi-range AC input
- 10/100 Ethernet TCP/IP connection
- Single cable for Digital Link and Power to Galvo Head
- Sw library C# .dll for easy PC integration
- 16 OptoCoupled I/O and Encoder Input for native Onthe-fly support







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