Nextema

Laser Manufacturing

Technologies for batteries

Nextema - company profile

- Established 2015 in Bologna, Italy
- Startup company of the University of Bologna
- Gathers the experience of many researchers over twenty years in the field of laser processing and advanced manufacturing
  - ***Welding / Cladding / Hardening / Cutting / AM***
- Nextema offers a wide range of technical solutions for different needs:
  - ***Manufacturing plants «Turnkeys Plants»***
  - ***Revamping in existing production plants***
  - ***Prototype manufacturing***
  - ***Production for third parties***

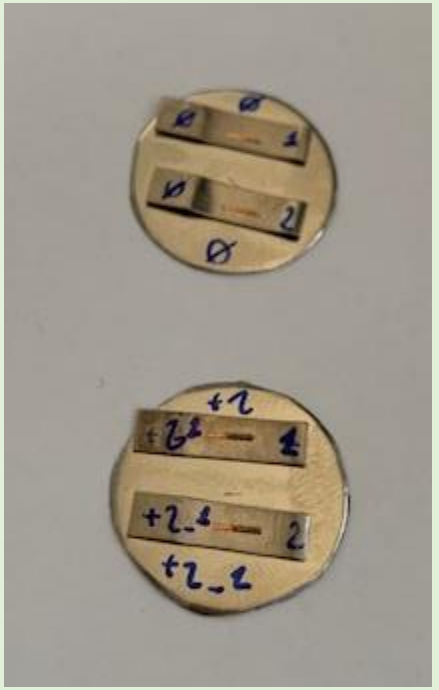
Nextema approach to battery pack welding

1. Evaluation of general Process Feasibility.
   - Different welding strategies are evaluated
   - **Intermediate report on best welding strategy**
2. Battery pack welding.
   - The welding strategy is applied to the battery pack, with laser focus set to zero at every welding position
   - The welding sections are checked
   - **Final report on battery pack weldability**
3. Small series production.
   - Up to 1000 packs
4. Supply of a customized production unit.

1. Evaluation of general process feasibility

The aim is to select the optimal welding strategy for the specific electrode materials and thickness adopted by the customer

- **Laser type**, mainly depending on the upper electrode material
  - Near Infrared
  - Blue (under development)
- **Focal length**, mainly depending on electrodes thickness
  - **Short**
  - **long**
- **Welding strategy**, mainly depending on desired seam weld geometry
  - **Linear**
  - **Wobbling**
  - **Pulsed**



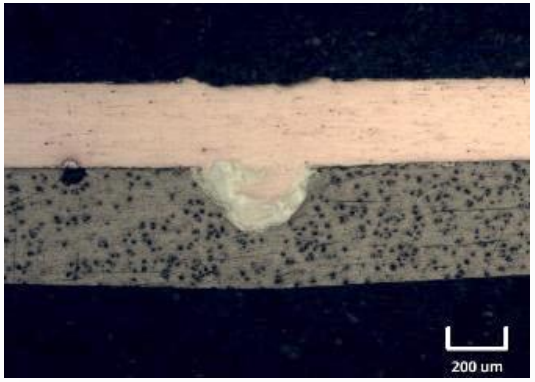
Electrodes are cleaned and positioned one on the other

Al – Cu electrodes

Copper 0,3 mm
Aluminium 0,45 mm

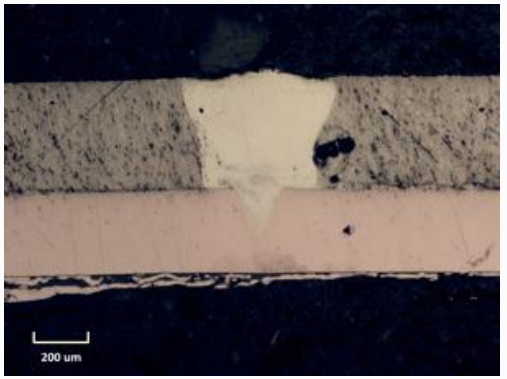
Short focal length

High focal length

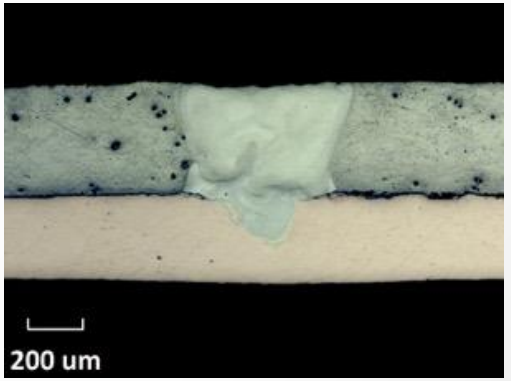


Aluminium 0,45 mm
Copper 0,3 mm

Linear



Wobbling

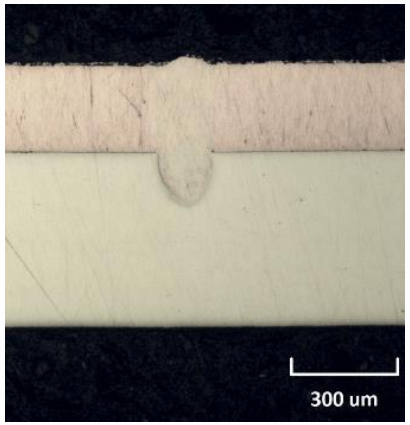


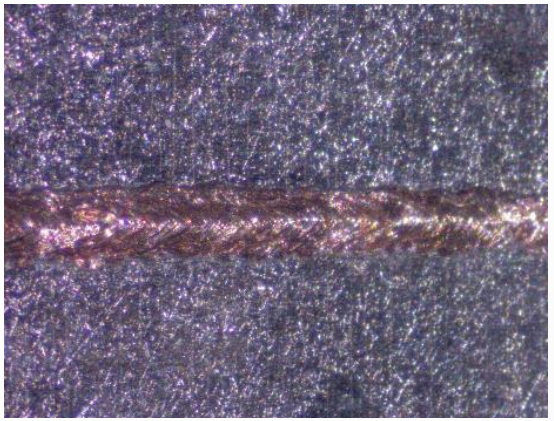
Mechanical properties:
100-130 kg for 40 mm length

Electrical resistence:
20-40 μΩ

Cu – Steel electrodes

Nickel plated Copper 0,2 - 0,4 mm
Nickel plated Steel 0,3 – 1,2 mm



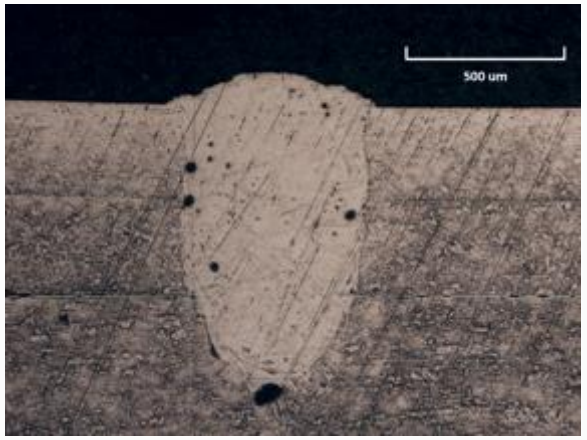


Performances:

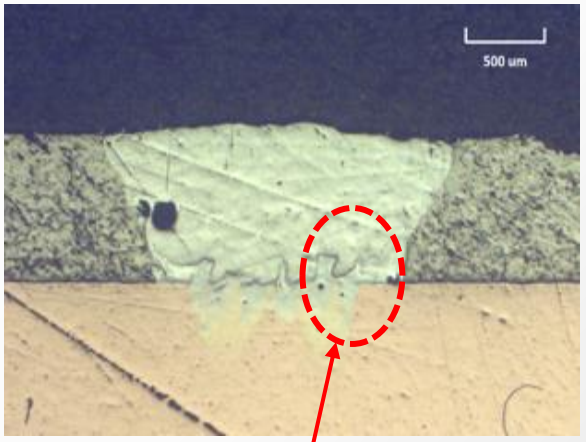
- **Process speed: 300-500 mm/s**
- **Mechanical properties: 300-400 N as a function of electrode thickness**
- **Electrical resistance: 10 - 15 mΩ**

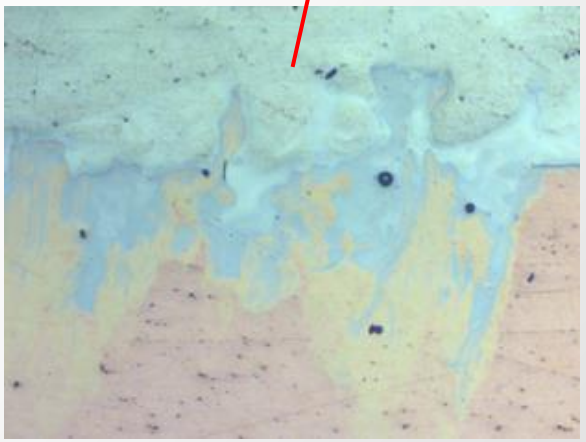
Three layers configurations

Two copper tabs on copper busbar, wobbling



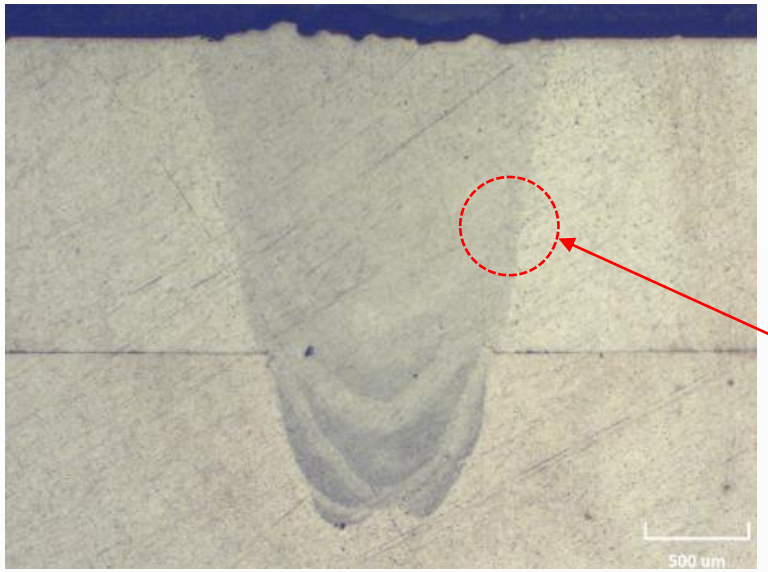
Two aluminium tabs on copper busbar, linear

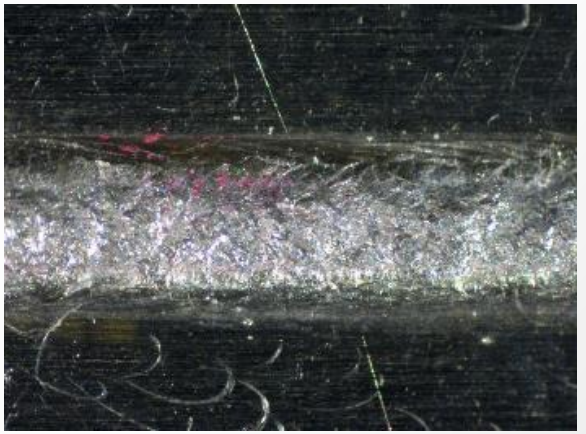


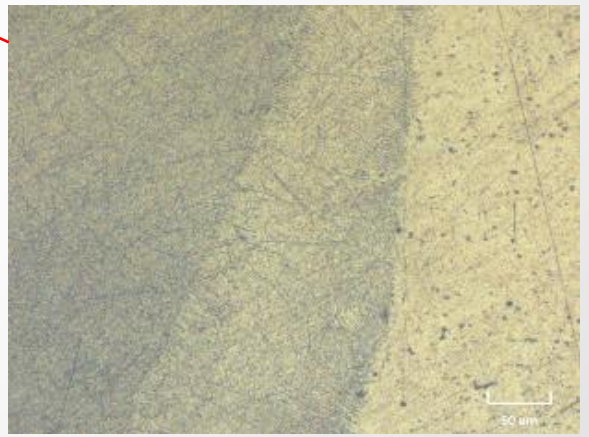


Al – Al configurations
Welding of cases

Aluminium 6082 1,5 mm
on Aluminium 6082 4 mm

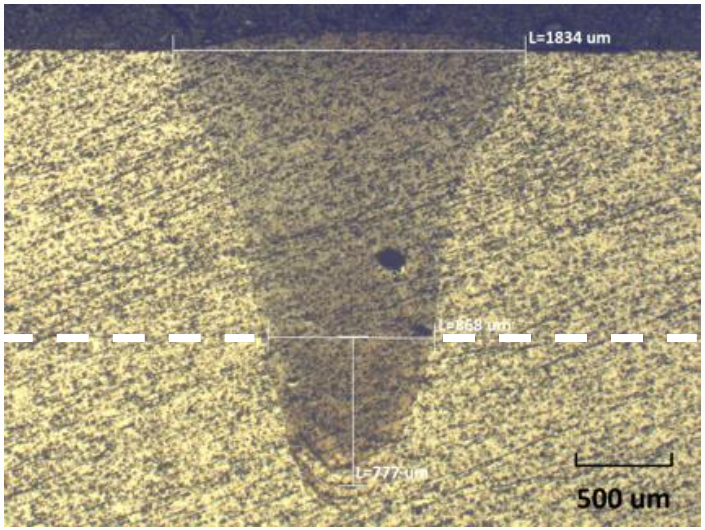






Al – Al configurations
Prismatic cells

Al 1050 1,5 mm on
Al1050 4 mm

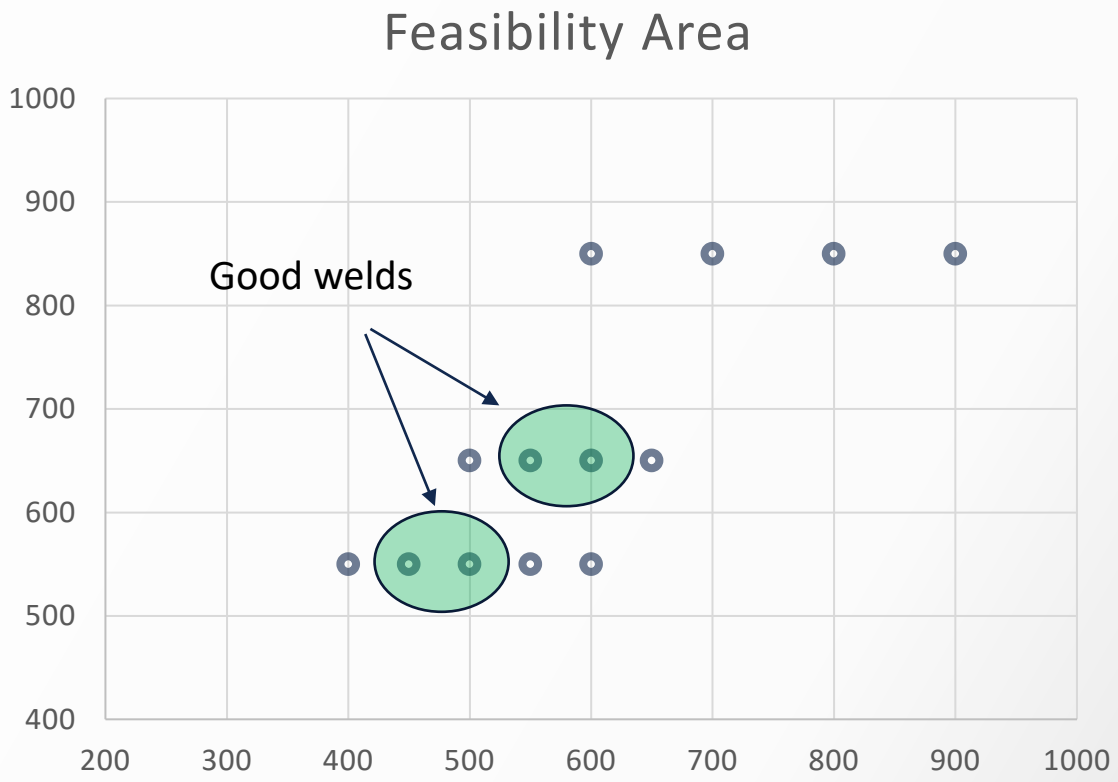


ACTIVITIES

- Microstructure evaluation / effect of shielding gas
- Mechanical properties
- Electrical resistance
- Temperature monitoring during welding

Process window / feasibility

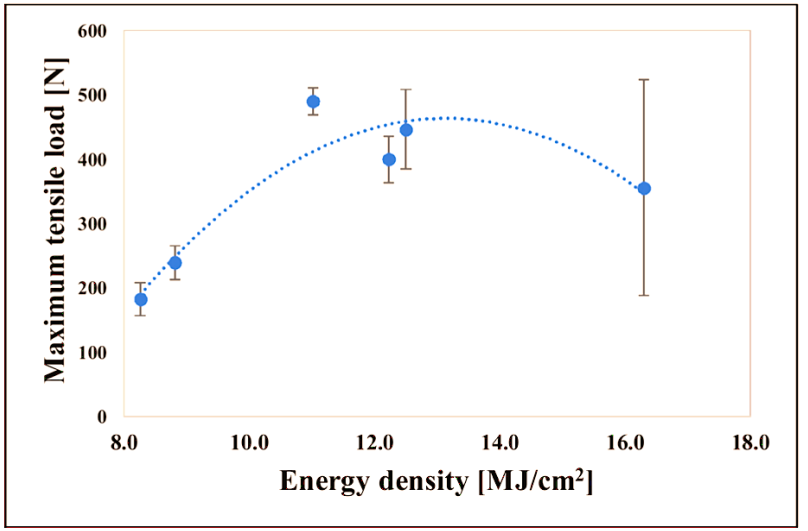
- Main process parameters are varied in order to establish the amplitude of process window feasibility
- The bigger the feasibility area, the better the process in relation to future product variation



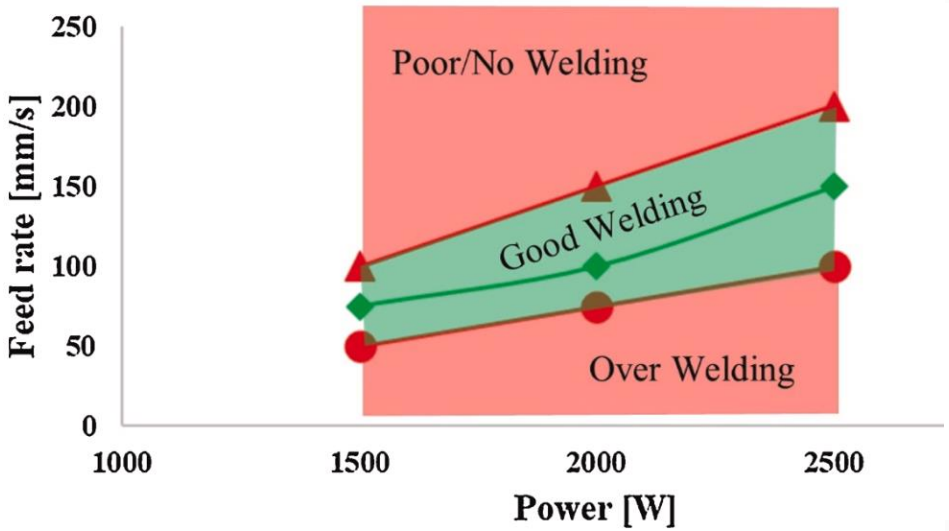
Welding Performances

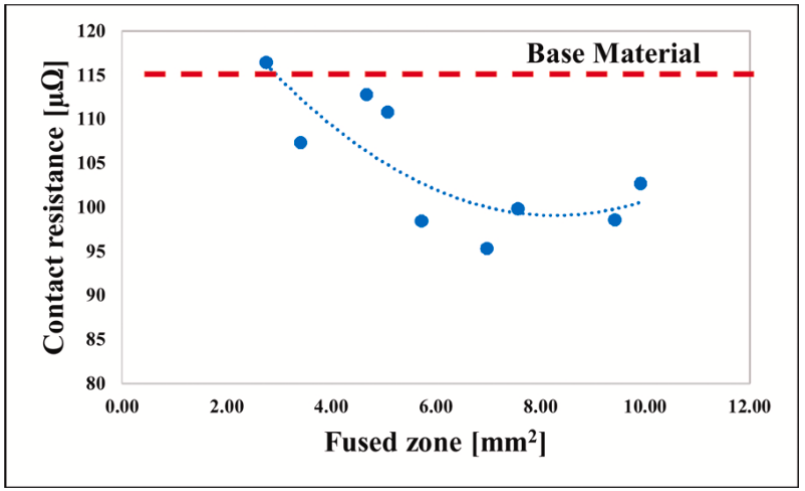
When performances must be optimized, the process window is analysed also in terms of:

- electrical resistance
- mechanical properties

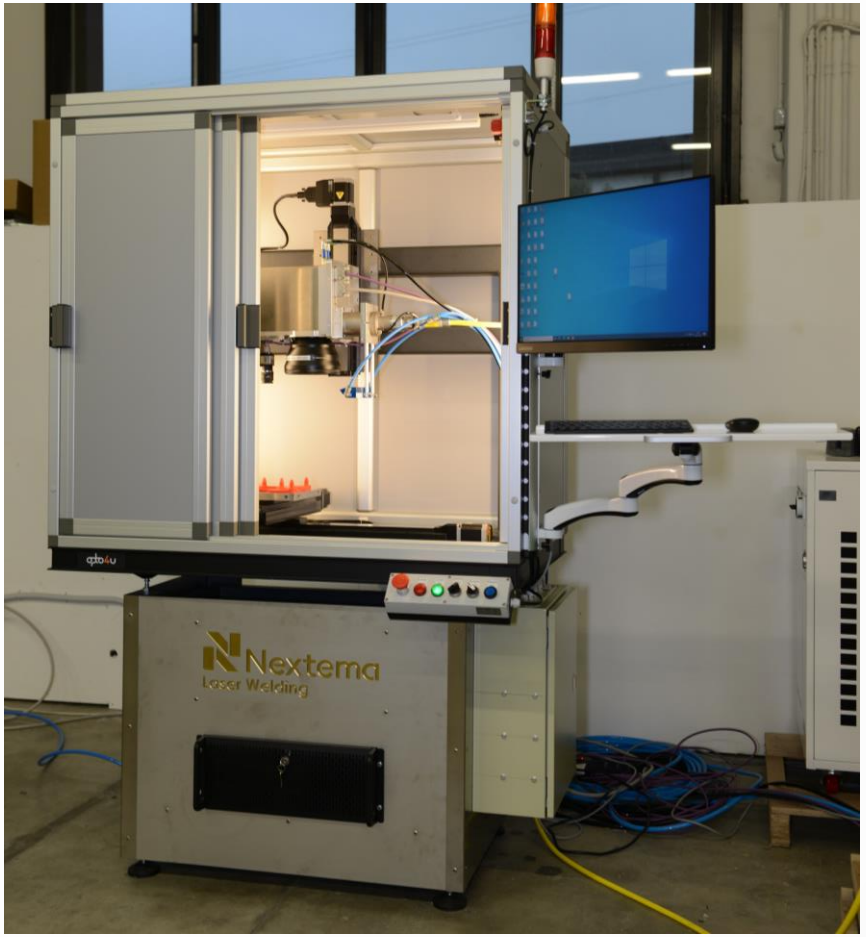


HAIRPINS



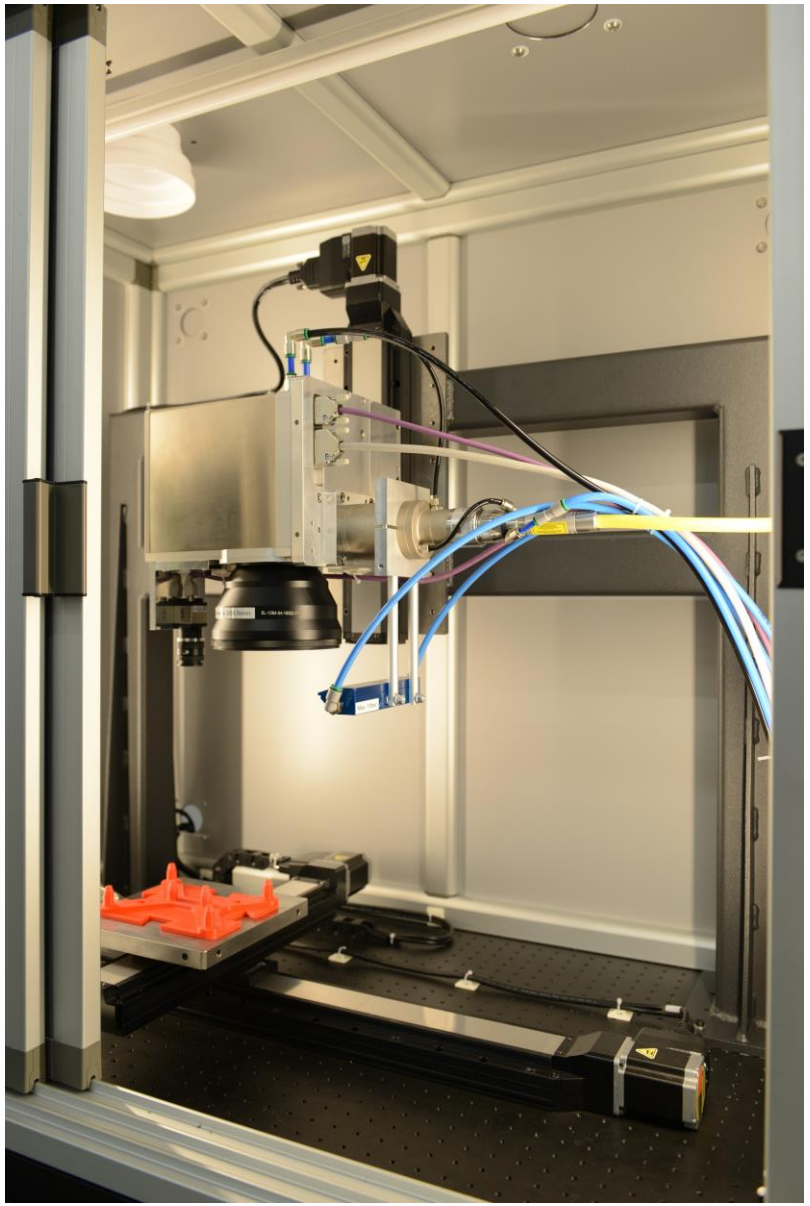


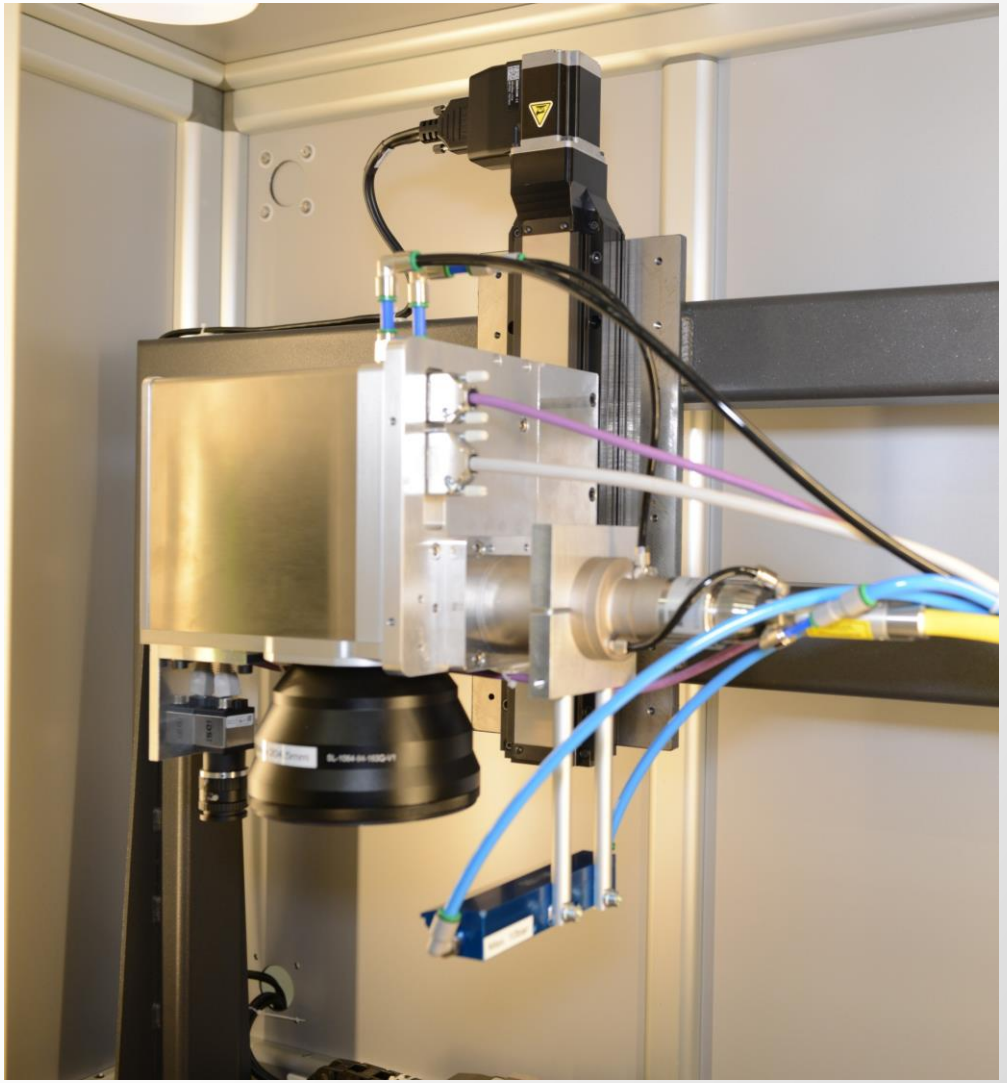
Nextema prototyping welding cell



- Laser source depending on the application
- Three axes system
- Galvanometric Head with two axes with pointing camera.
- Automatic adjustment of laser focus at every welding position
- Control software
- Aspiration unit with HEPA filter.
- Class 1 cabin, inspection window, security interlock.
- Optical base and support.
- CE Certified

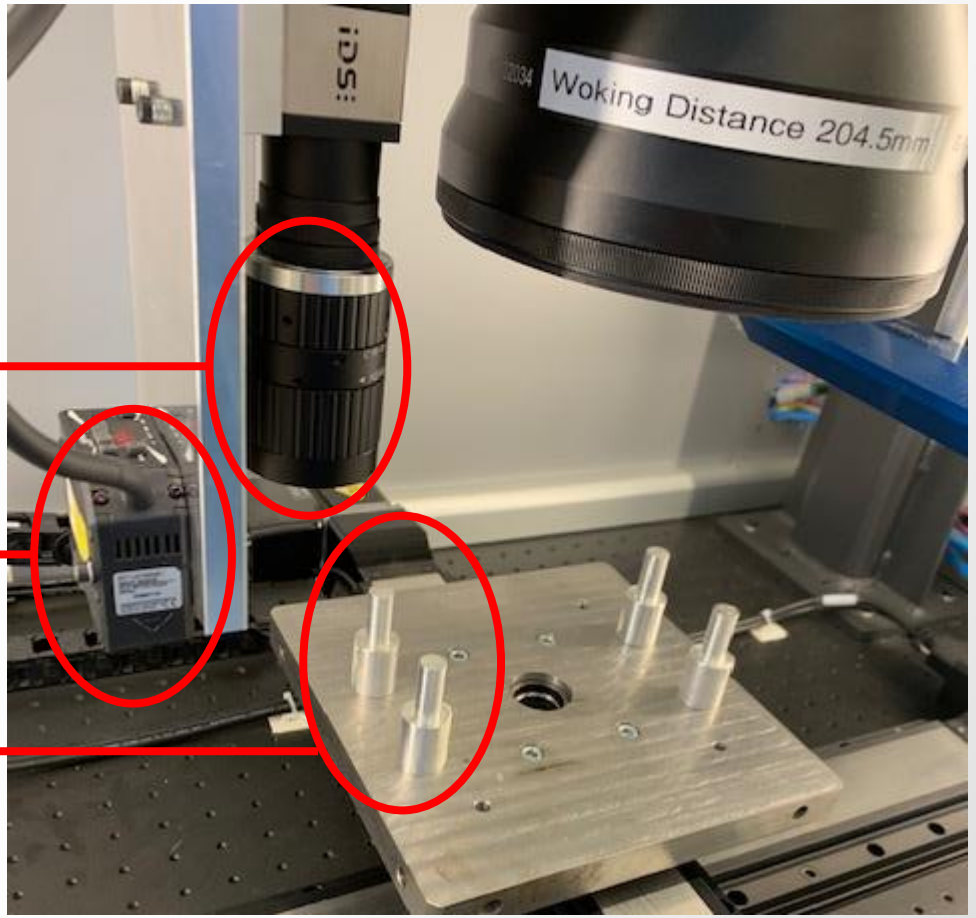
Nextema Prototyping Cell





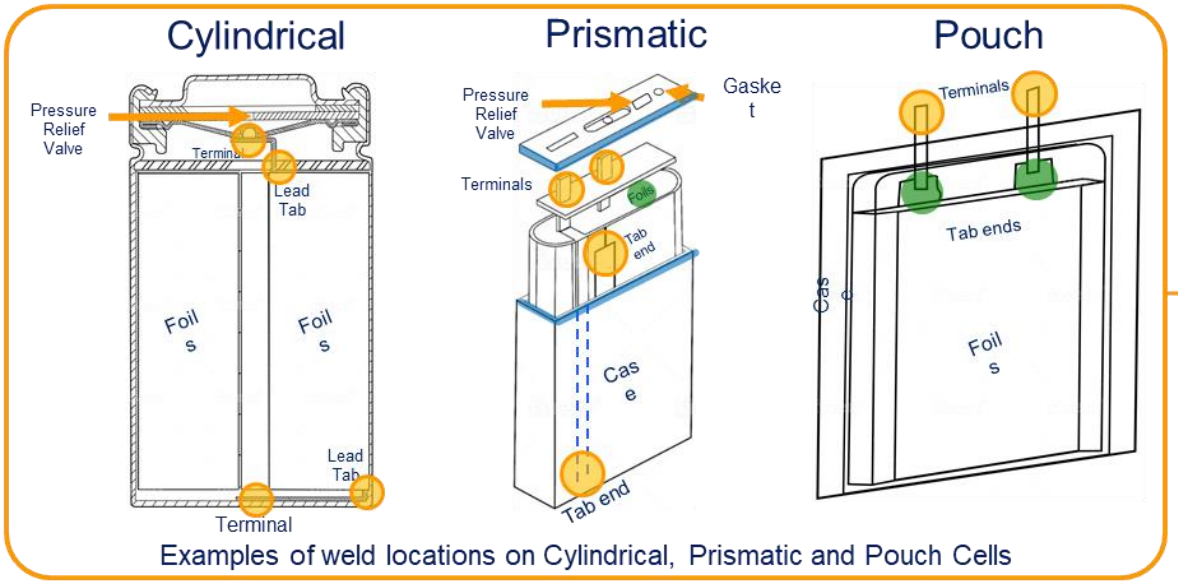
Battery pack welding

For battery pack welding it is of outmost importance that the laser focus is perfectly positioned at every welding position

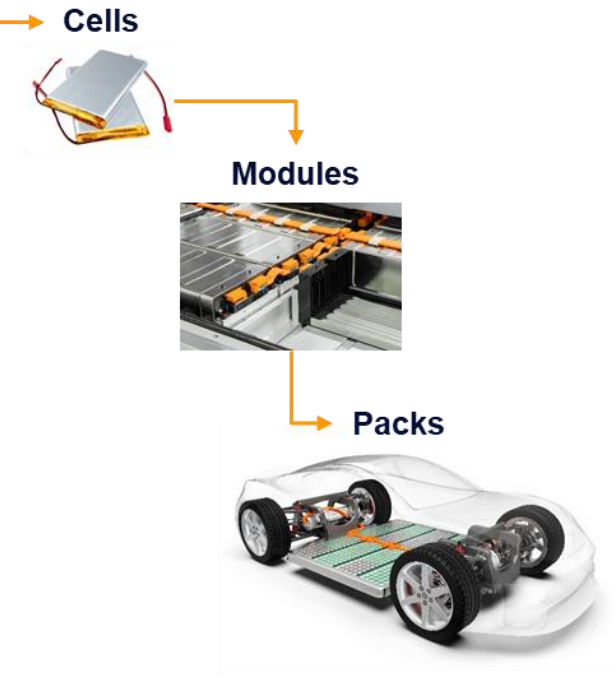


Types of battery pack

EV Battery Cell Types



Examples of weld locations on Cylindrical, Prismatic and Pouch Cells



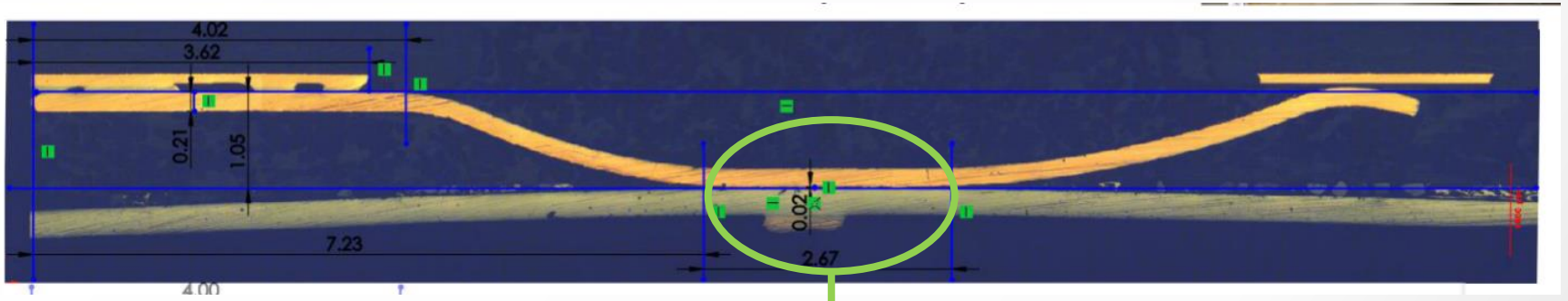
> 70% are Lap Welds Butt/Edge Welds Multi Foil Welds

Battery pack welding

Example of a battery pack made by 48 cylindrical cells, with 96 welding on two sides

(Courtesy of University of Bologna)

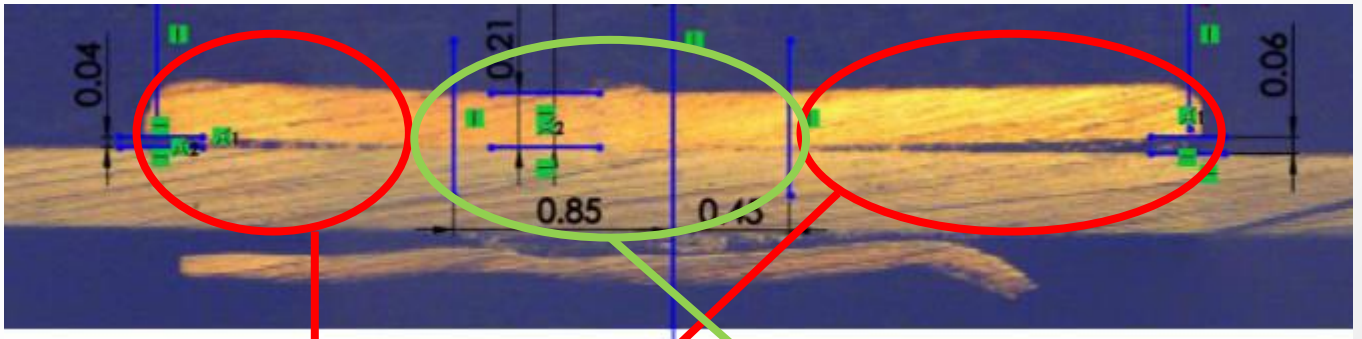
Evaluation of contact zone (1)



Contact zone; the battery pack manufacturer must inform Nextema about the exact location of available contact

Evaluation of contact zone (2)

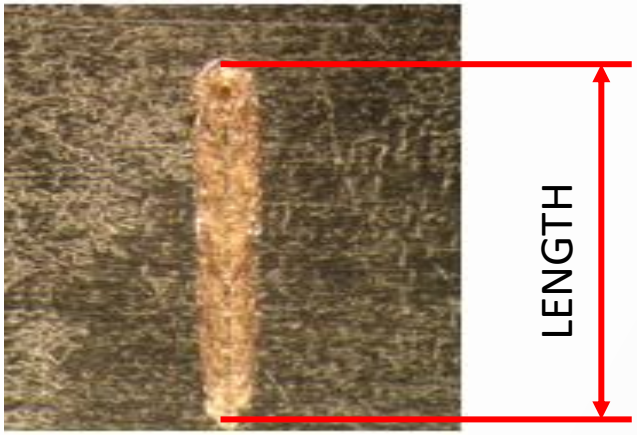
For sound welding it is of outmost importance that the two electrods are perfectly positioned with zero gap between them.

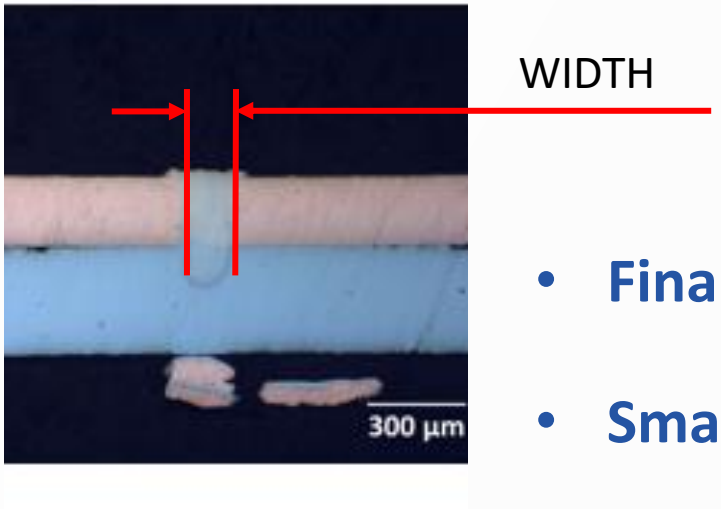


GAP between upper and lower electrodes

NO GAP zone.
The welding line must be kept within this limit

Battery pack welding





Within the useful area, length and width of the welding paths determine the useful section for the joint, leading to overall:

- Electrical resistance
- Mechanical properties

- **Final report on battery pack weldability**
- **Small series production (up to 1000 packs)**

Ongoing welding developments in Nextema:

1. Adoption of laser blue source, in particular for the copper application, due to the higher absorptivity index and more stable melt pool
2. Integration of sensors in AI environment for early failure detection

CONTACTS

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