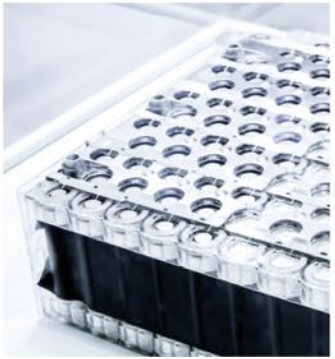


NAATBATT 2022

MICHAEL D LEIBER

SALES MANAGER, AMERICAS- MOBILITY & BATTERY SOLUTIONS

FEBRUARY 2022

manz

GLOBAL PRESENCE

Facts and Figures

Reutlingen (Germany)

Locations:

Tübingen (Germany)
Sasso Marconi (Italy)
Debrecen (Hungary)
Nove Mesto nad Vahorn (Slovakia)
North Kingstown (USA)
Suzhou (China)
Chungli (Taiwan)
New Dehli (India)

Headquarters:	Germany
R&D and Prototyping:	Germany, Italy, Taiwan
Production:	Slovakia, Hungary, China
Sales & Service:	Asia, Europe, USA

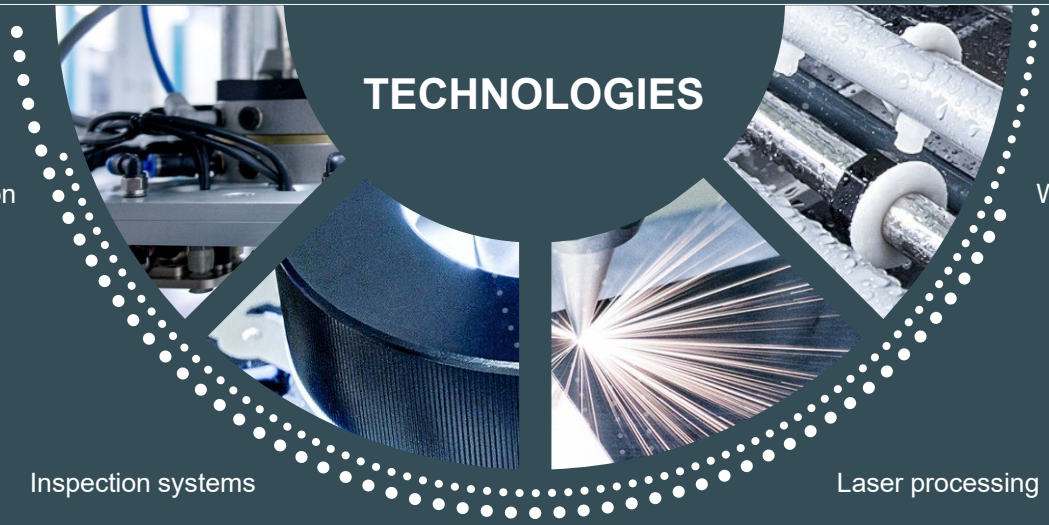
1987

1,400

55,000 m²

237 m €
2020

manz

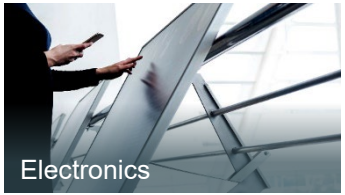


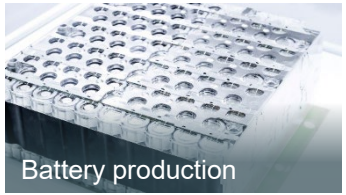
MOBILITY & BATTERY SOLUTIONS

SEGMENTS

INDUSTRY SOLUTIONS

INDUSTRIES

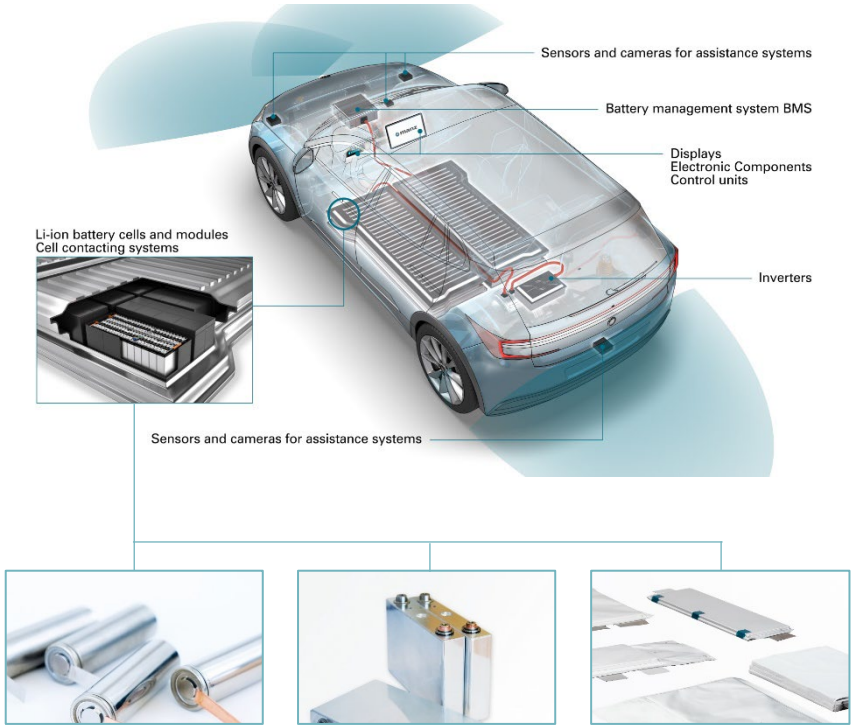




FOCUS ON AUTOMOTIVE AND E-MOBILITY

Range of services for the automotive industry

- Production equipment for all current li-ion battery cell geometries as well as modules
  - Cylindrical cells (winding)
  - Prismatic cells (winding/stacking)
  - Pouch cells (winding/stacking)
- Production solutions for various components of the electric powertrain and automotive electronics
  - Cell contacting systems
  - Battery management systems and inverters
  - Displays
  - Sensors and cameras for assistance systems



MANZ CORE BUSINESS

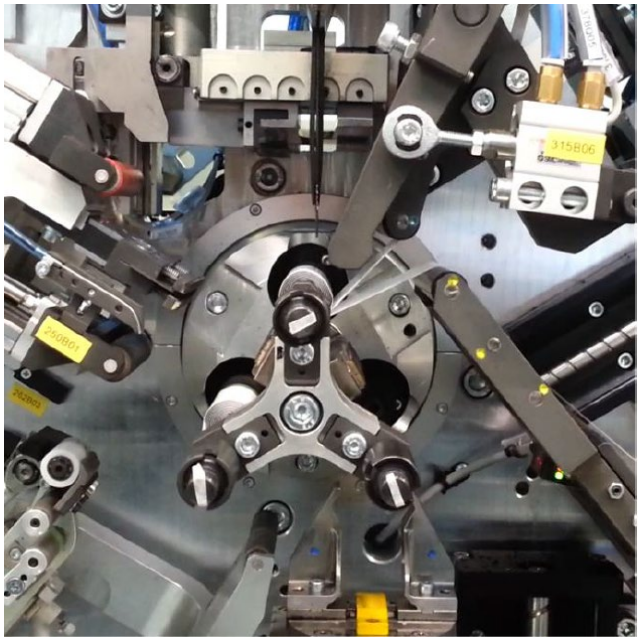
Slurry Mixing	Notching	Aging I	Cell Preparing	Cell to Pack
Coating	Winding	Formation	Terminal Cutting	Pack Assembly
Calendering	Roll2Roll Drying	Aging II	Module Assembly	Electrical Assembly
Slitting	Laser-Ablation	Degassing	CCS Contacting	Final Assembly
	Forming	Testing & Sorting	End of Line Test	Charging
	Cell stacking / fixing			End of Line Test
	Tab Welding			
	Packaging / Sealing			
	Electrolyte filling			
	Pre-Formation			
	Quality Control			

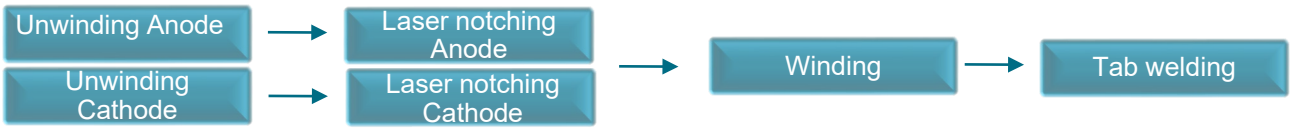
- Manz Products and Technologies
- Manz – Suppliers and Partners

MANZ WINDING TECHNOLOGY

Following the market evolution

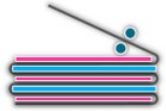
- A maximum flexibility in cell design
  - Cylindrical (from 18650, 21700 up to 4680
  - Pouch & hard case
  - Tab less or not
- Different processes in one single machine:
  - Integrated laser notching & tab welding
  - Smaller footprint
  - Cost efficiency
- Throughput
  - 1000mm electrodes: up to 38ppm





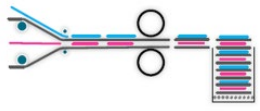
LAMINATION OR Z-FOLDING?

DIFFERENCES OF COMPOUND GENERATION TECHNOLOGIES FOR MONOCELLS



Z-FOLDING

++	High precision placement of electrodes / separator
++	Cell size scalability
+	Process complexity
–	Capex/ppm
+	Cell stability/ safety
–	Expected future improvement(ppm)
–	Footprint per ppm
+	Patent free



LAMINATION/STACKING

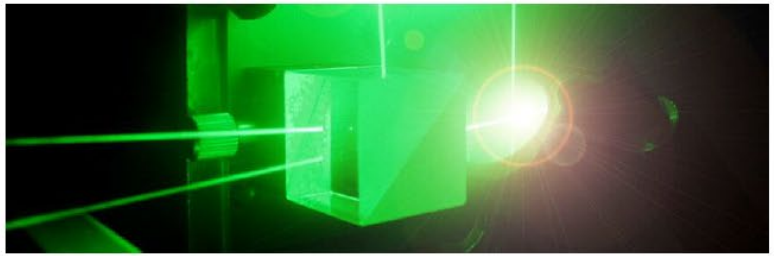
++	High precision placement of electrodes / separator
++	Cell size scalability
+	Process complexity
++	Capex/ppm
++	Cell stability/ safety
++	Expected future improvement(ppm)
++	Footprint per ppm
- +	Patent free

CASE STUDY EU AUTO MFG		
2 x 10GW & 2 x 51PPM (83.7% OEE)		
250 days & 3 shifts/day		
Category	**Lamination**	**Z-Folding**
Required space	**3.240 m² (47%)**	4.992 m² (72%)
Free space	**3.672 m² (53%)**	1.920 m² (28%)
Single machine	**48 pcs (2x10GWh))**	80 pcs (2x10GWh)
Required space	**3.240 m² (47%)**	4.992 m² (72%)
Free space	**3.672 m² (53%)**	1.920 m² (28%)
Single machine Δ	**1.09**	
Total Price Δ	**0.64**	
Utilities (OPEX)		
Electrical power	**70% Energy Savings**	
Compressed air	**21% Savings**	
Exhaust Power	**16% Savings**	

LASER COMPETENCE

A Manz know-how since 2009

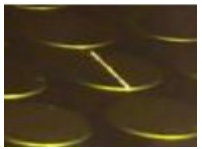
- Our R&D center in Reutlingen:
  - Various applications: welding, notching, cleaning, cutting, ablation
  - Development and Definition of processes and production solutions
- Laser Lab Rental
  - Professional tests and samplings with laser experts
  - State-of-the-art laser equipment
  - First steps in real conditions

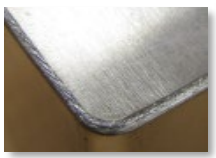


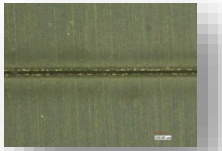
LASER COMPETENCE

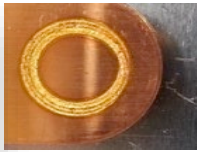
A Manz know-how since 2009

- The BLS500: Scalable solution
  - Flexible loading solutions
  - Flexible & precise clamping fixtures
- Safe & stable process
  - Accurate weld location
  - Constant laser focus position at each weld location
  - Monitoring
- High quality welding results for:
  - Many material combinations
  - Different material thicknesses









LASER WELDING OR WIRE BONDING?

Comparison

QUALITY

Mechanical strength
- Very good **mechanical strength** by substance-to-substance bond
- **Best results of tensile test**: up to 2000 N/mm²

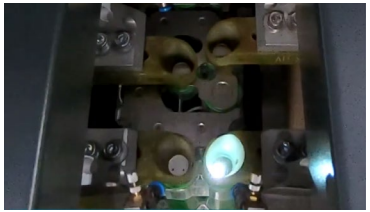
Crack behavior
- Mixing of material causes negative effect on crack behavior; can be limited by adjusting laser parameters which allow a smaller welding pool

Electrical performance
- **Very good electrical performance** by **low contact resistance**
- Possibility to provide a **large contact area**

Heat input
- **Limited heat affected zone** and high energy density; temperatures can rise up to 20.000 °C directly in the welding pool
- Process parameters need to be considered to reduce heat affected zone

PERFORMANCE

Throughput
- **Fastest throughput** compared to other processes
- Loss of cycle time by generation of **zero gap possible**
- Depends on specific energy input
- Cycle time 0,1 sec per welding
- **Parallel welding possible**



COSTS

Purchasing | Operating | Changeover

- Highest initial investment for equipment
- Further expenses for establishing laser safety measures (e.g. laser safety officer)
- Same system with **small adjustments** in design in case of **format change,** only the parameters have to be adjusted
- **No** additional **costs** for **tool changeover**

ADVANTAGES

- Very **high precision** welding
- **High speed**
- Very **flexible**, process can be adjusted, no tool changeover, applicable to all applications (cell to cell, sensing, BMS)
- Contactless process
- Several **welds** can be welded **in parallel**

DISADVANTAGES

- Needs good joint fit-up for **zero gap**
- **Material dependencies**
- **High initial costs**

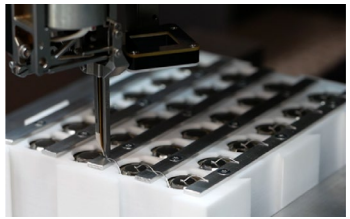
QUALITY

Mechanical strength
- **Good,** as **laser and ultrasonic welded** connections are materially bonded
- **Small contact** area **reduces mechanical strength**

Crack behavior
- The crack behavior of the material is slightly more influenced compared to laser or US-welding

Electrical performance
- Almost no dilution and thus small area with increased electrical resistance
- **Small contact area**, thus not feasible for pouch cells with high power

Heat input
- Very **limited heat input** and thus almost no dilution or damage caused by melting



PERFORMANCE

Throughput
- **Slow process**, as each **connection** is addressed **individually**, leads to losses in cycle time
- **No parallelization** possible, wire must be bonded to each individual cell
- Cycle time is **1 bond per sec**

COSTS

Purchasing | Operating | Changeover

- Placing current collector rail for connection as an additional process step
- Same investment like laser welding or ultrasonic welding plus feeding system of wire process

ADVANTAGES

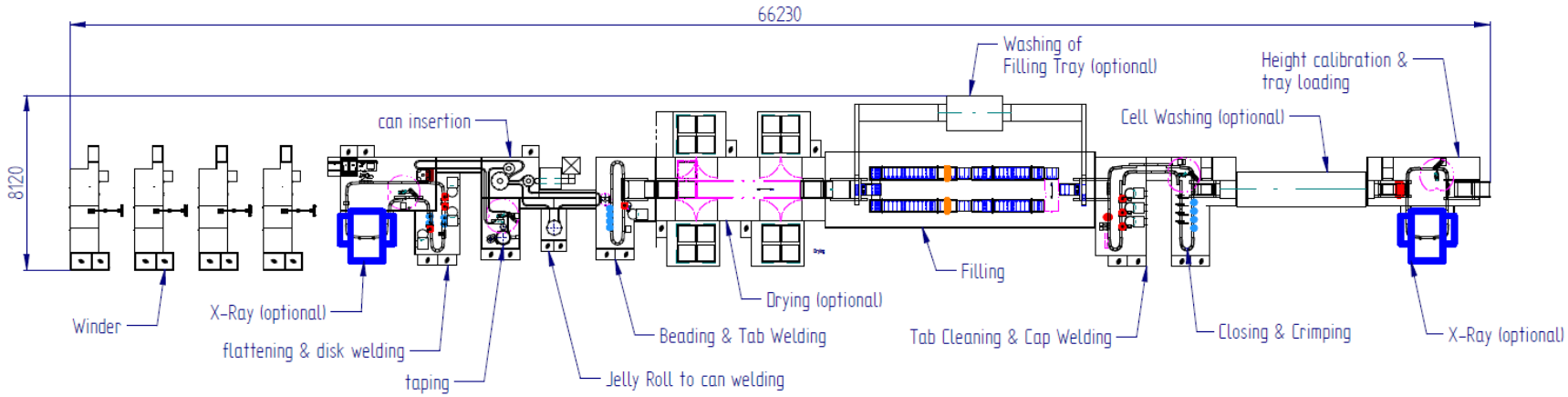
- Process **integrated quality control**
- **Flexible** process
- Establishing of **zero-gap possible**
- **Rework** possible due to flexibility of the system

DISADVANTAGES

- **Each connection** is addressed **individually**, leads to losses in cycle time
- Challenging solution for **cooling/ heat conduction between cell and cooling medium because of thin wire** (depends on pack design)

CELL ASSEMBLY LINE

Fully automated 21700 cylindrical assembly line → 120 ppm (approx. 700 MWh)



Material Flow Simulation support

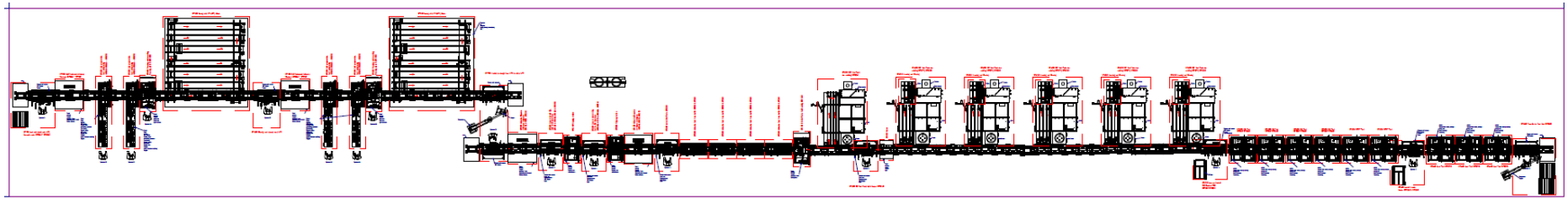
- models connected processes with stochastic behavior and provides detailed statistics of the resulting interactions of processes, buffers and the complete line
- enables the fast **implementation and evaluation of scenarios** to
  - Increase of Efficiency and utilization--Increase of output--Reduce lead time--Optimization of layout--Define the logic to control the material flow
- increases the understanding of interactions and relationships in the production by visualizing the processes

MODULE PRODUCTION LINE

Fully-automated production line for 21700 cylindrical cell modules

Automotive module

- 35s / module → 103 modules / h
- Double-side module, 2x 132 cells
- Module size ~ 560mm x 160mm x 140mm
- Line size: ~115m x 10m
- Light Assembly platform, modular and flexible
- **Material Flow Simulation Support**



BATTERY MANUFACTURING SUSTAINABILITY

Challenges for a sustainable battery production

Cost & time reduction

- Digitalization (AI, digital twin, big data, …)
  - Increasing quality
  - Reducing downtime
  - Increasing output
  - Reducing maintenance cost
  - Increasing process stability
- Lead times < 12 months

Economical

Carbon footprint

- Green battery passport
- Limited utilization of hazard material/dry processes
- More efficient resource and energy use Second use
- Design to recycling
- LCA modelling studies

Environmental

Education

- Job reskilling and training
- Communication to prosumer to accept the new technologies
- Generate a local supply chain
- Interconnect academia and industry to drive innovation

Social

SUSTAINABLE INNOVATION

Lithium-Ion Battery Factory of the Future (LBF)

- A European Funding Project (IPCEI)
- Highly efficient machines and processes for fully automated production of next-generation lithium-ion batteries
- Manufacturing of cylindrical, pouch and prismatic cells and modules
- Generation 3 (Gen3a and Gen3b) and Generation 4 (Gen4)

Technology roadmap:

- expanding larger size for all formats(cylindrical, pouch & hard can prismatic)
- Smaller more compact tooling design, footprint
- Micro-environments, address material handling and costs
- Partnering for both resource and portfolio expansion to address the GW factory demand

RECENT SUCCESSES

New projects

Manz AG
9,099 followers
1w • Edited •

#Manz has received an order worth around USD 20 million from a leading producer of semiconductors. For chip production, Manz AG's new customer relies on the innovative Fan-Out Panel Level Packaging (FOPLP) process. ...see more

Manz AG: New order from the semiconductor industry | Manz AG

Manz AG
9,099 followers
1mo •

Manz has been assigned by UK battery cell technology developer and manufacturer Britishvolt to implement the first expansion stage for cell assembly of a production line for the manufacture of lithium-ion #battery cells in Northumberland, Northern England. More information in our #corporatenews: https://bit.ly/3pf3iCj

#LithiumIonBattery #BatteryProduction #EnergyStorage #EMobility #ElectroMobility

Manz AG wins major order from Britishvolt | Manz AG

Manz AG
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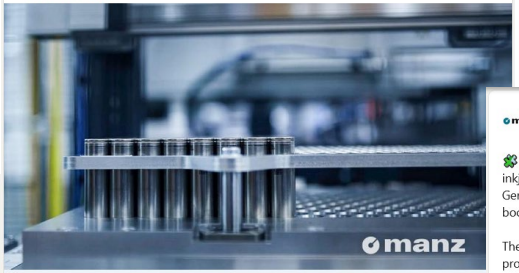
In the course of the overall steady increase in demand for Li-ion #battery systems, #Manz has now received an order from one of Germany's leading battery manufacturers for an assembly line to produce battery modules from wound round cells. The order volume is in the upper single-digit million-euro range and will affect revenues and earnings next year. More information in our corporate #news.

#batterymanufacturing #batterytechnology #enigneering #technologynews #energystorage



Manz AG: Continued strong demand for efficient production solutions in the battery sector | Manz AG

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#Manz has received an order in the mid-single-digit million-euro range for an inkjet system to print on products and packaging for Ravensburger, one of Germany's leading manufacturers of games, puzzles, activity products and children's books.

The #direct2shape printing enables efficient and flexible production with high productivity and reduced production costs.

More information in our press release: https://bit.ly/3s8gtXt

#digitalprinting #functionalprinting #productionsolutions #automationconcepts #printing #productivity

Manz AG: Order from Germany's leading toy manufacturer | Manz AG

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ENGINEERING
TOMORROW'S
PRODUCTION