INFORMATIONSHEET BATTERY WIRE BONDING

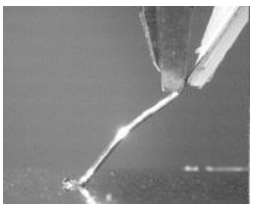
KEEPING YOU AHEAD

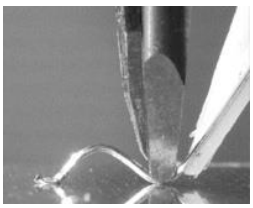
ADVANTAGES WIRE BONDING

Introduction Wire bonding Battery Packs
This is a system and method that links batteries in parallel to conductors using wire bonds that act as fuses in the event of an overcurrent condition in a battery. To protect the wire bonds in the case of a larger overcurrent condition, a fuse may be added in series to the parallel batteries.

Utrasonic wirebonding is used in the production of battery packs for the following connections : cell to cell, cell to busbar, cell to PCB. Typically round battery cells type (18650, 20700 or 21700) are widely used in battery packs for EV.

How does wire bonding works?
Wire-bonding (Ultrasonic Compression bonding) is a combination of three precise controlled parameters that form the bonding:
1.***Ultrasonic vibrational power*** *2.* ***Downwards force*** *3.* ***Time***





Typically during battery bonding the wire is pushed with a controlled force against the surface to be bonded, then the wire is vibrated at 60 kilo Hertz for 100 millisecond.

Advantages Wire bonding vs spot or laser welding.
Fusing Wires: Wire act as fuse, if a cell fails it will be isolated from the pack and the pack will continue to function.
The pack is not destroyed by a meltdown and will be fixable, and there is no danger to life from a simple cell failure.

No Heat: Heat is dangerous for an 18650 cell. No heat is used in ultrasonic compression bonding, unlike other methods like spot or laser welding. Only limited heat is generated by the friction which is very localized and only on the outer skin of the surface.

Clean Process: Wire bonding is a clean process and generates no sparks, residue materials or other possible contaminations, so no cleanup after.

Height: Wire bonding machines are capable bonding in height variations, the cell and bus bar can be in a different height. Next to that wire bonding machines give full control on the final loop shape design.

Testability: Wire bonds are easy to test on bond strength to ensure highest quality requirements. Unlike spotweld, which are hard to test and notorious for coming loose.

Flexibility: Wire Bondings have some flexibility due to their wireloop shape and material properties , in case of a pack flex they will not break. Spots welded packs are not flexible which make the connection easier to break.

Automation: Wire bonding allows full automation of the bonding process with CNC machines for higher efficiency, quality and decrease the amount of manual labour.

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Materials of busbars

Busbars are what connect the cells together in series. The question is from what conductive material (sheetmetal) to lasercut the bus bars: Nickel, Copper or Aluminium?

Mechanically, busbars for the battery pack of EVs/HEVs must be durable, capable of withstanding high levels of vibration while simultaneously providing rigidity to keep the integrity of the battery module assembly.

Electrically, connections must handle high current coming from the cells but also increasing voltage levels as cells of the future will be up to 5.0V per cell. As a result, the impact on the clearance and creepage distance for the electrical insulation will be significant. The performance of the connections depends also upon the composite materials used to construct the busbars.

Nickel is not the ideal electrical conductor, and is historically used only because it is easy to robot spot-weld. When it comes to conducting high current, aluminum and copper are better options.

Copper has the best electrical conductivity, best thermal conductivity and lowest thermal expansion. But on the downside copper will oxidate very fast due to its exposure to air. (A layer of oxidation on bonding surfaces have a strong negative effect on the bonding quality and bondability)

Aluminium is more than twice as conductive the Nickel, less sensitive to oxidation then copper, less costly and lighter in weight then copper. Alumiunium would be the best overall choice, and copper would be our choice in packs were spaces are tight.

Fusing Wires

The fusing behavior of Aluminium wire is mainly depending on the diameter and length of the wire.

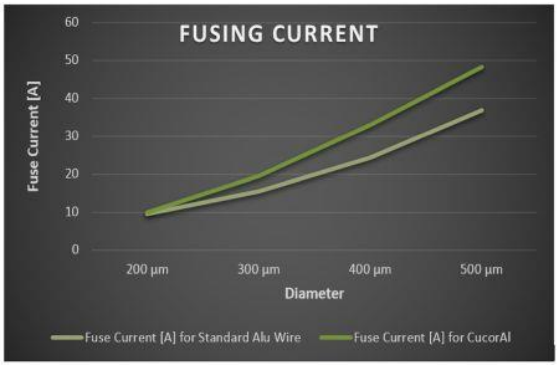

table from Heraeus bonding wires datasheet.

Wire Type	Diameter (µm)	Resistivity (Ω/inch)	Typical Fusing Current (amps)
Aluminum	100	0.0838	**3.5-4.0**
	125	0.0537	**5-6**
	200	0.0210	**11-12**
	250	0.0134	**16-18**
	300	0.0093	**21-23**
	380	0.0059	**20-35**
	500	0.0033	**50-60**

*http://www.rfcafe.com/references/electrical/bond-wire-specs.htm

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BATTERY WIRE BONDING SOLUTIONS

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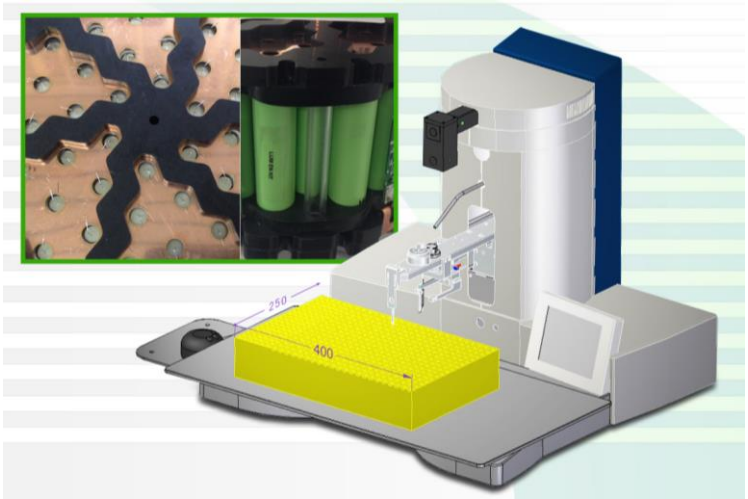
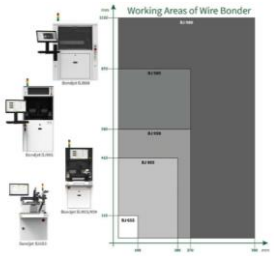
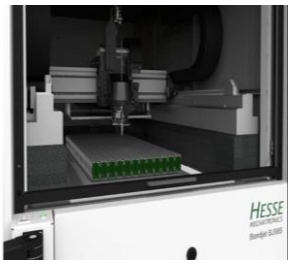


- MANUAL (SEMI-AUTOMATIC) HEAVY WIRE BONDER FOR WIRES Ø 100MM TO 500MM
- TABLETOP SYSTEM FOR DEVELOPMENT. PROTO AND LOW VOLUME PRODUCTION
- SEMI AUTOMATIC, MOTORISED Y & Z AXIS, HEIGHT SENSE AND PROGRAMMABLE LOOPPROFILES
- EASY TO USE SOLUTION WITH DIGITAL TOUCHSCREEN INTERFACE AND PROGRAM STORAGE
- GERMAN BUILT HIGH QUALITY SYSTEMS, FULL LOCAL PROCESS SUPPORT BY ACCELONIX ENGINEERS

HESSE
MECHATRONICS

- HIGH SPEED FULL AUTOMATIC HEAVY WIRE BONDERS
- LARGEST WORKING AREAS IN THE MARKET UP TO 700 X 1132 MM
- SINGLE BONDHEAD CAN HANDLE WIRES FROM Ø 50MM TO 600MM
- AUTOMATION : MANUAL BATCH LOADING OR FULLY AUTOMATED INLINE OPERATION
- BONDHEAD WITH NON-DESTRUCTIVE PULLTEST & PIQC SENSOR FOR 100% QUALITY MONITORING IN REAL-TIME
- GERMAN BUILT HIGH QUALITY SYSTEMS, FULL LOCAL PROCESS SUPPORT BY ACCELONIX ENGINEERS





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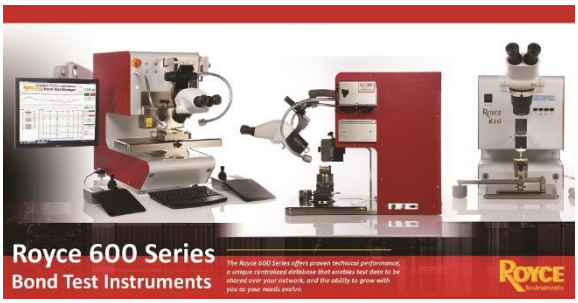
BATTERY BONDING TEST AND CONSUMABLES

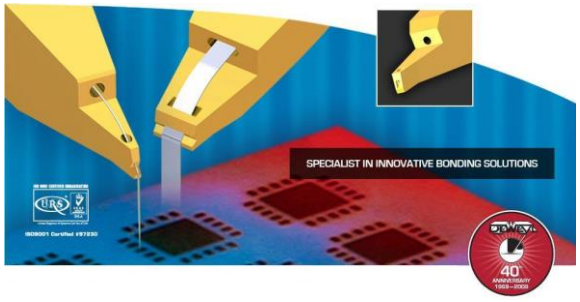
ROYCE INSTRUMENTS

- *BONDTESTERS FOR TESTING THE BONDING QUALITY*
- *NON-DESTRUCTIVE AND DESTRUCTIVE TESTING*
- *PULL AND SHEARTESTING THE WIRE BOND*
- *FULL SPC FUNCTIONALITY*



DEWEYL TOOL COMPANY INC

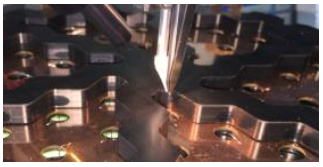
- *LARGE WIRE BONDING WEDGES*
- *SOLUTIONS FOR MANUAL, SEMI-AUTO AND AUTOMATIC BONDING EQUIPMENT*
- *AVAILABLE IN TUNGSTEN CARBIDE, TITANIUM OR CERAMIC*

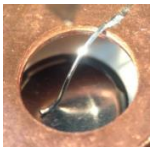


ACCELONIX BATTERY BONDING SERVICES

Accelonix keeping you ahead.

- *ACCELONIX HAS EXPERIENCE IN THE WIRE BONDING AND HANDLING OF BATTERY PACKS WITH LITHIUM-ION CELLS*
- *BONDING SERVICE FOR PROTOTYPES TO LOW VOLUME PRODUCTION*
- *HEAVY WIRES : 100UM TO 500UM, RIBBONS UP TO 300X2000UM*
- *ACCELONIX AND OUR PARTNERS HAVE MANY YEARS OF EXPERIENCE WITH WIRE BONDING AND TESTING.*





FOR MORE INFORMATION ABOUT OUR WIRE BONDING SOLUTIONS AND SERVICES FOR BONDING BATTERYPACKS PLEASE FEEL FREE TO CONTACT US DIRECTLY VIA INFO@ACCELONIX.NL OR BY PHONE +31 (0) 40 7501650.

OR VISIT OUR COMPANY WEBSITE: **WWW.ACCELONIX.NL**.

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