Clinching for carrying current

Clinching has long been proven in practice as highly efficient joining technology. One benefit of the secure joint, which is similar to a press button, will increasingly come into effect in the course of automotive electrification: the superior electrical conductivity compared to other joining processes. TOX® PRESSOTECHNIK knows which conditions must be met for clinching to be optimally used for electrical assemblies.

Automation, a versatile material mix as well as cost and energy savings – the challenges in automotive production are complex. Clinching is an efficient solution, joining sheet metals in a continuous forming process which is positive-locking and partially substance locking. At the same time, several points can be produced at the same time, within one process step. The procedure combines several advantages here: The pulling-pressing process does not damage the material surface and is highly flexible with regard to sheet metal thickness, quality and surface. Furthermore, several layers can be joined reliably with each other. With the process running without any heat input, as opposed to welding or soldering, there is no distortion in the workpiece. In addition, thermally sensitive materials, like plastic housings, can already be placed near the joint during joining without getting damaged. Moreover, the process can be monitored automatically and precisely. “These advantages are very important for another special characteristic of the joint: clinching connections are electrically conductive”, says Dr.-Ing. Wolfgang Pfeiffer, Managing Director of TOX® PRESSOTECHNIK GmbH & Co. KG.

Which is verifiable: Experts of the TU Dresden have analyzed amongst others the electrical properties of formed joints for copper and aluminium materials and defined the conditions for an optimum, long-term stable conductivity in the clinch point in another research project. A precise observation of the joint zone reveals one secret of the good conductivity of the eClinch point. During the pulling-pressing process, in addition to the positive locking and frictional connection, there is a also a partial substance locking in the form of so-called metallic micro-contacts. “The joined sheet metals practically flow together, resulting in an optimally conductive structure”, Dr. Pfeiffer emphasises.

Maintaining conductivity

However, it is not trivial to establish a conductive connection in the long-term. “The conductivity is significantly reduced due to corrosion or relaxation, i.e. a creeping dissolution or under mechanical or thermal impact.” In many regards, clinching compared to other connection types like gluing, welding, soldering or screwing, clearly has an advantage. It does not require any additional materials, does not cut into the surface and thus receives a protective coating, which flows with any deformations. It can join aluminium with copper, a material combination which is often used in battery modules, without creating an isolating intermetallic phase. The cold-forming technology is also suitable for the joining of sensitive battery cells without heat input. In addition, the procedure developed by TOX® PRESSOTECHNIK nearly doubles the effective joining surface, which significantly increases the conductivity of the round joint to other joining processes.

“To be able to fully enjoy these benefits, some constructional rules must be observed”, Dr. Pfeiffer emphasises. For an applied torque to be safely received by the conductive joining spot, TOX® PRESSOTECHNIK recommends the setting of of two eClinch points close to each other, for example by means of the eTWINpoint tool. The applied shear tension and cross tension values are not as critical, but still to be kept low. Furthermore, a specific X-dimension which indicates the residual bottom thickness must be complied with. “What is crucial here is the correct design of the eClinch tool. We check this before delivery of the system in our technical centre and document the result”, he says. In addition, the technicians examine the eClinch points with regard to the correct total thickness and ductility of the sheet metal materials as well as the condition of the tools. In order to enable permanent monitoring, TOX® PRESSOTECHNIK has developed a system which checks the required parameters in running operation. For this purpose, force sensors measure the press force during the joining process, whereby the travel measuring system ensures compliance of the residual bottom thickness by means of the cylinder movement. “With this, in addition to the strength, we also ensure the conductivity of each electrical connection”, the Managing Director stresses.

Focus on the risk

Safeguarding before and during the process is very important. If the micro-contact zones dissolve due to mechanical or thermal stress – the maximum temperature must not exceed 90 degrees Celsius – this can result in relaxation. “With the resistance reached, intense heat is generated locally in case of high currents, which can result in a failure of the joint”, Dr. Pfeiffer explains. “Such damage progression is just as feasible for any alternative processes. So increased care must be taken with electric contacts. The risk awareness and the knowledge of how to minimize the risk factors are ultimately crucial for a safe process.”

The sum of measures, starting with the correct construction, checking of the tools to be supplied and process monitoring in production make eClinching an efficient and safe joining process for electronic components. “Thanks to our competence, with our eClinch points we meet the demands of the electrical industry for long-term stable joints for energy transfer”, Dr. Pfeiffer says.

Image descriptions:

Image 1: The TOX®-TWINpoint enables a joint which is secured against rotation

Image 2: 6 mm TOX®-eClinch Point for contacting copper and aluminium

Image 3: Light-microscopic micrograph of a clinch connection, arrows show realized micro-contacts between 2 materials/components

Image 4: Several eTWINpoints as well as an eRound-Point within a car pre-fuse box

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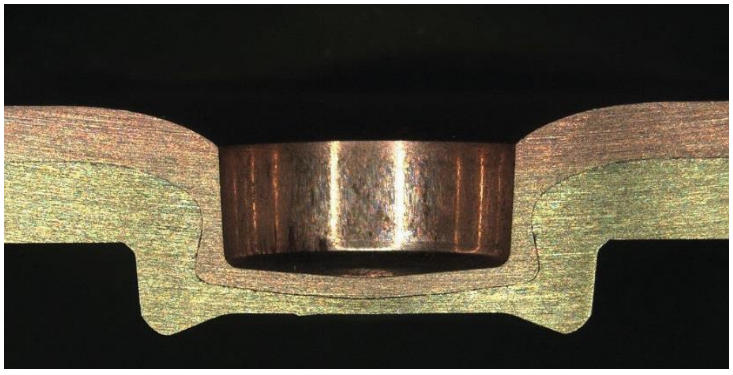

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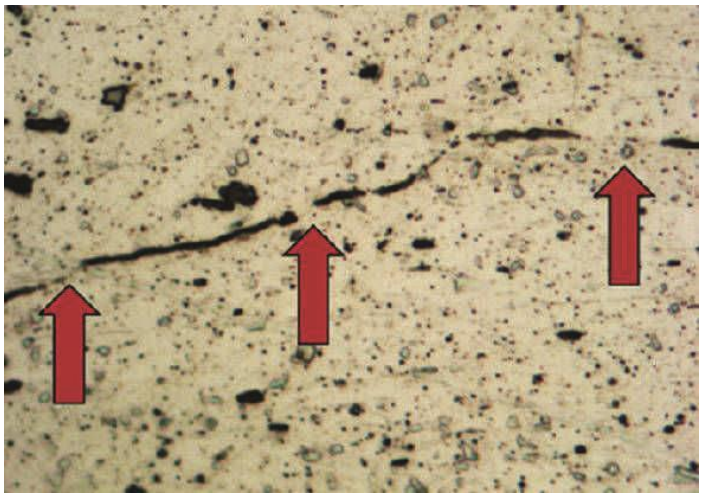

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