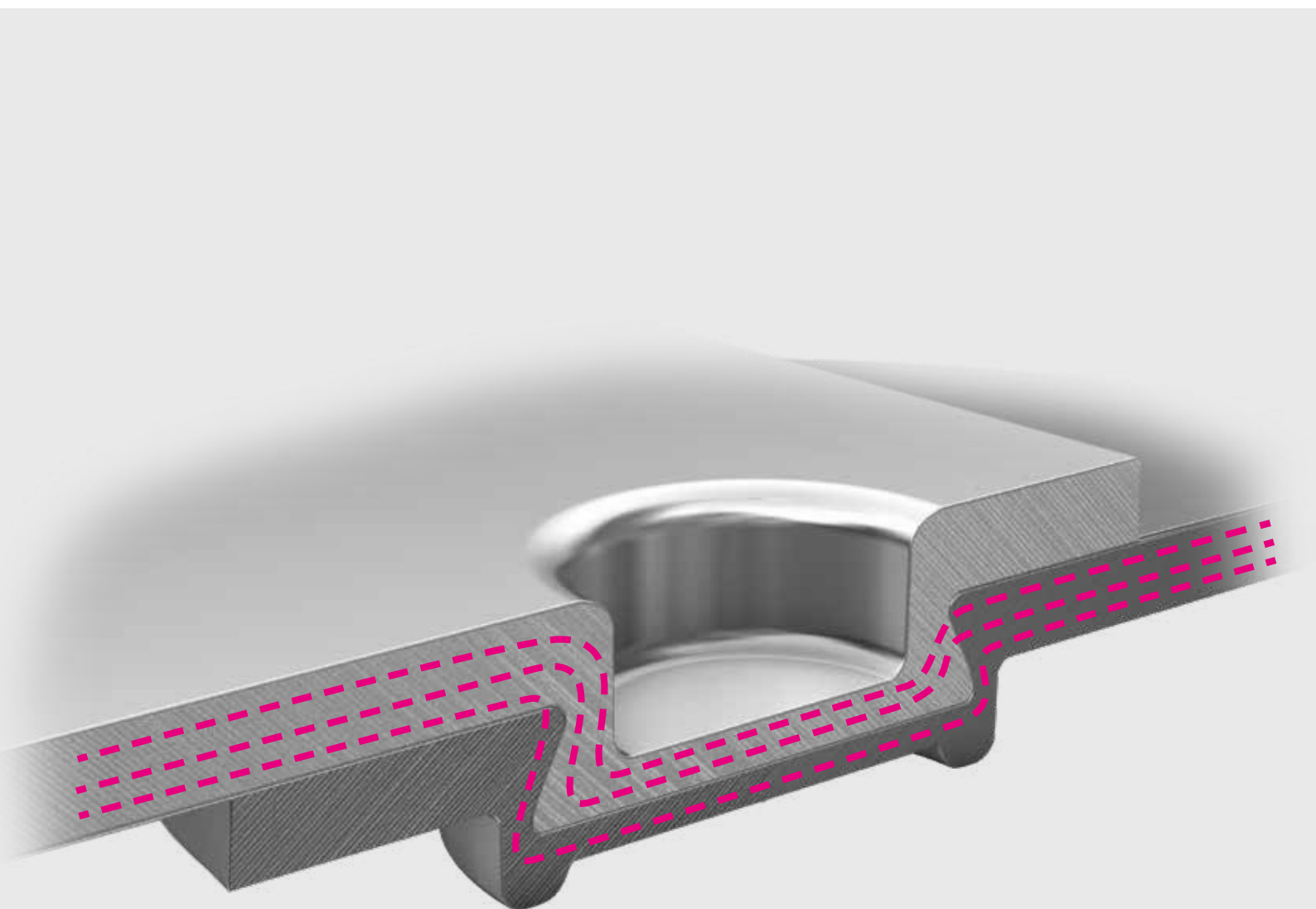


TOX® eClinching Technology

Electrically conductive connections

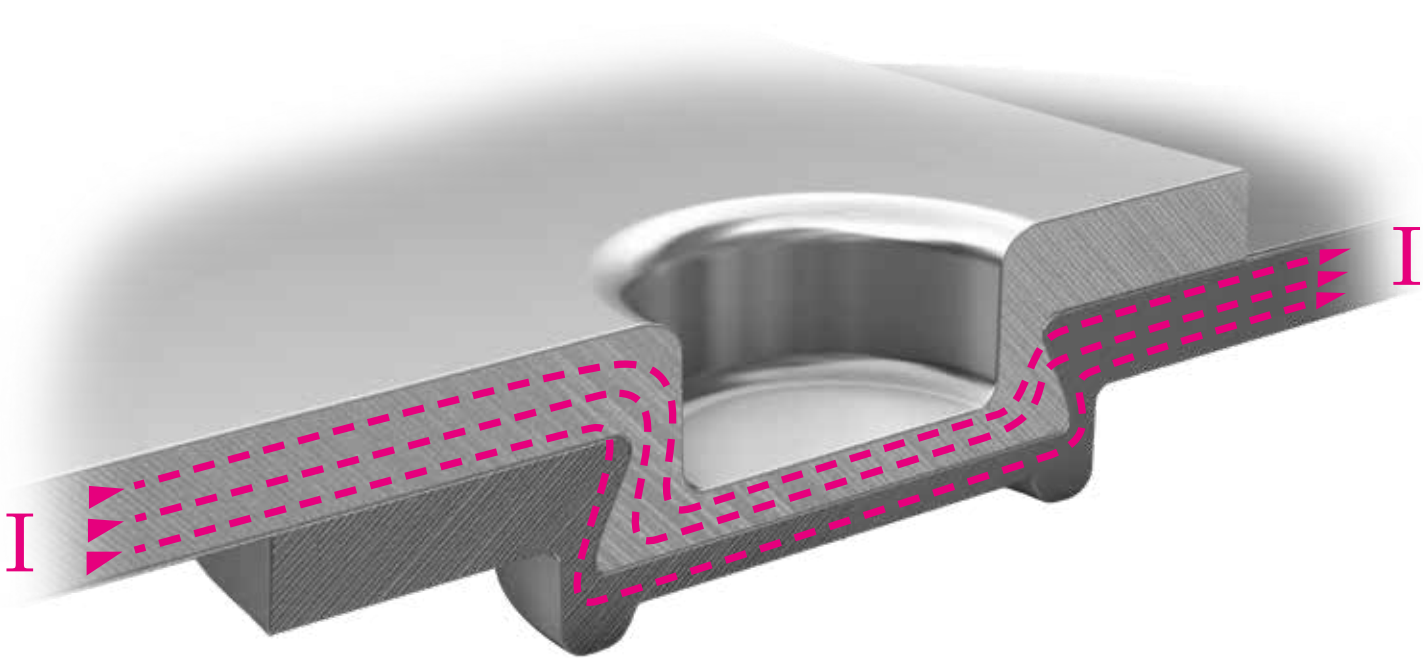


Power point with low resistance

TOX® eClinching technology extends the conventional clinching process in order to realise precise connections of electrical components. It provides the advantages of very high retaining forces and easy quality monitoring, alongside excellent electrical conductivity.

The TOX® eClinching procedure is ideally suited to the production of electronic components. Possible applications include LED traces, fuses and the contacts of battery cells.

Compared to conventional soldered, welded and screwed connections, TOX® eClinching provides a better alternative, as the surfaces do not require pretreatment and the process does not need any heat input.



TOX® eClinching creates excellent, electrically-conductive connections through metallic microcontacts.

Creation of conductivity

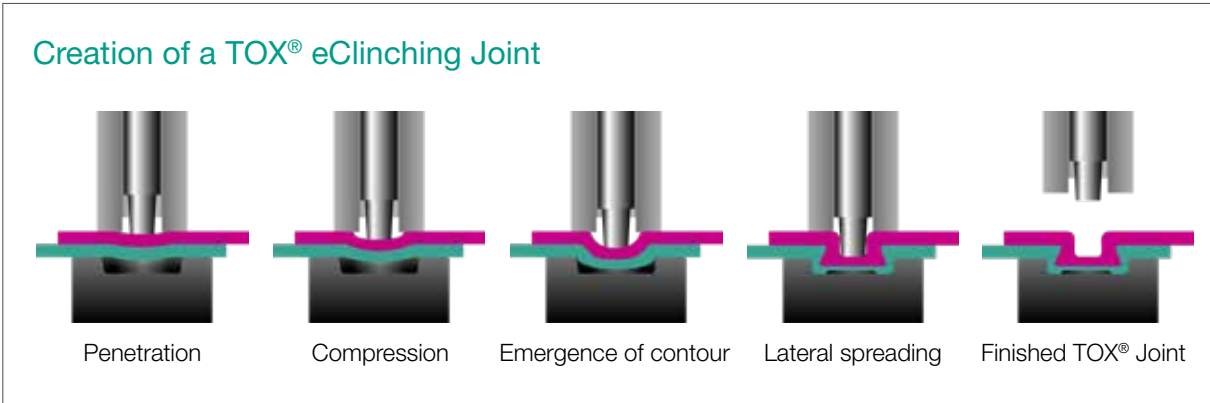
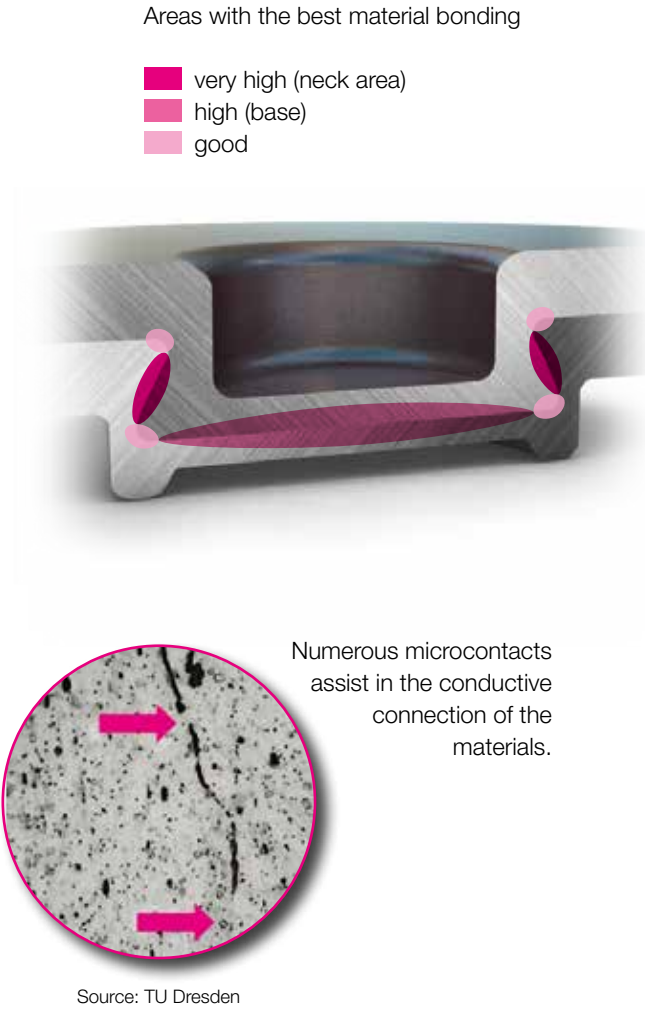


In TOX® eClinching, a punch presses the sheets to be joined into a mould. The undercut created by the plastic deformation ensures that the clinching point has a high load-bearing capacity. In addition, a form-fit and partially material-fit connection with excellent electrical conductivity is created.

Joining zone with optimum material adhesion
During the clinching process, a partial material bonding occurs in the joint zone in addition to the form and force fit: the joined sheets flow into each other in such a way that a large number of micro-contacts are created. The increase in surface area during the joining process breaks up oxide layers, resulting in an optimally conductive connection with minimal contact resistance.

Enlarged contact surface
The effective contact surface is almost doubled with the clinch forming process. It increases more significantly in thicker materials. This expanded surface area also increases the conductivity of the joint.

Flowing coatings
Soft coatings, for example tin coatings on copper, flow without removal while being thinned to a few µm in thickness. The conductivity is maintained.



Constant high conductivity with high retention forces

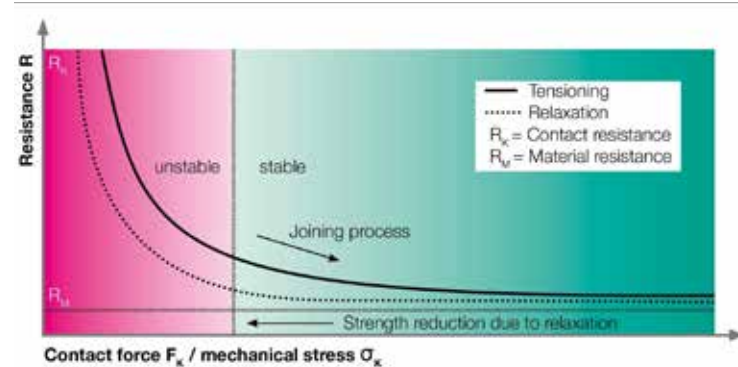
As clinch connections safely withstand mechanical stresses (e.g. torques) and temperature changes in the long-term, when compared to other joining processes, the relaxation of the connection is not a significant factor. The contact resistance will therefore be constantly low, and the high conductivity will be maintained. This makes the procedure ideally suited to meet the high demands of the electrical industry.



Relaxations in the contact area

A TOX® eClinching point remains safely in the stable (green) range. Joint relaxation, which is principally unavoidable, is insignificant and practically not quantifiable.

If the process-specific characteristics are not observed, there is a risk of entering the unstable (red) range.

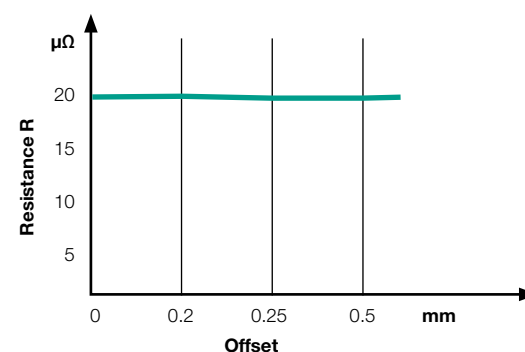


Tolerant procedure

To ensure electrical connection, it is important to consider crucial steps in the design phase. Perfect joint formation with an ideal remaining bottom thickness and the resulting high conductivity can only be achieved by using optimized TOX® eClinching tools. Even with multi-material clinch joints, the contact resistance does not increase significantly and the high conductivity is maintained.

Contact resistance with tool misalignment

TOX® eClinching joints were tested with increasing offset, and the contact resistance was measured. The result: The high conductivity is maintained even for off-center clinching points.



Versatile and flexible application options

Precision in serial production

With exact placement of the technology in a production tool, the TOX® eClinching points can be precisely positioned on the piecepart. Process monitoring checks the joining process to ensure the high quality of the connections.

Consistent dynamic strength

In comparison to spot welding, the clinching process does not have the negative properties of the notch effect. This allows the joint strength to remain constant over various load cycles.

Control dimension X guarantees conductivity

The remaining bottom thickness of a joint affects the electrical conductivity. As TOX® eClinching enables simple quality monitoring for series production, the continuous measurement of the control dimension X ensures the consistent conductivity of the connection.

Flexible with regard to material combinations

Different material combinations – including those that cannot be soldered or welded – can be joined with the TOX® eClinching technology. For example, aluminum and copper are a common combination in battery modules and can be joined without creating an isolating intermetallic phase. It is also ideally suited to the joining of sensitive battery cells without heat input.

Advantages

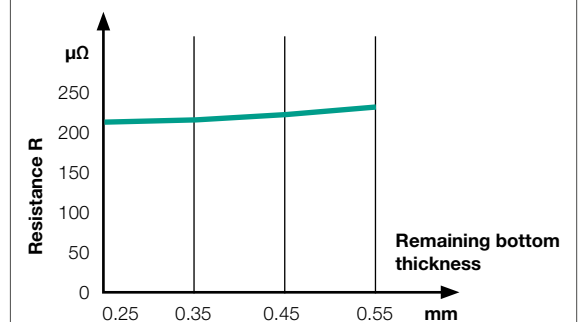
- Frictional connection, positive locking and material bonding in one process
- Highly robust connections
- No pretreatment required
- Joining without heat input
- Very low contact resistance
- Comprehensive documentation of the relevant process data

The remaining bottom thickness correlates to the contact resistance

The remaining bottom thickness of a TOX® eClinch point is called control dimension X.



Compliance with this dimension is important, as the greater the remaining bottom thickness, the higher the resistance.



TOX® eClinching connects



Aluminum in copper



Copper in aluminum



Copper in brass



Steel in steel and many others.

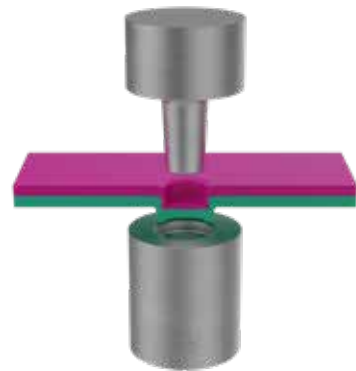
The perfect TOX® eClinch point for maximum conductivity

To ensure electrical conductivity in the long-term, some design principles must be observed in the selection and design of the tools. The basis is the TOX® Clinch Point shape, which is optimized to achieve the desired material bonding.

The following point shapes are available as conductivity-optimized versions for TOX® eClinching:

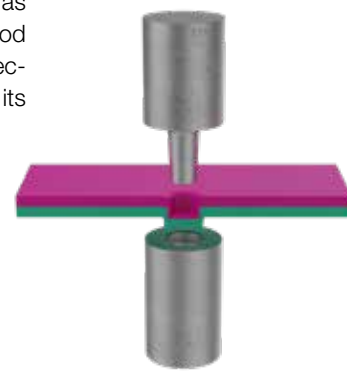
TOX® eRound point

The classic: A round joint presses the materials to be joined into a round, rigid mould. The result: a round joint without edges and burrs joins the sheets.



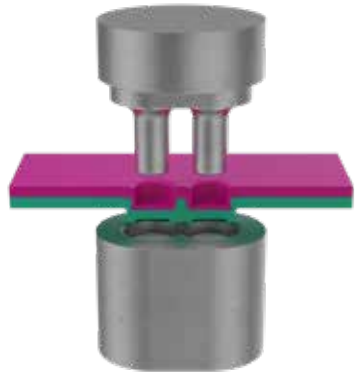
TOX® eMICROpoint

The TOX® Round Joint in miniature is our answer to component miniaturisation. With a diameter of 2 mm, it is ideal for sheet thicknesses of 0.1 - 1.2 mm. As an eClinch joint, it is ideal for joining small components, as it ensures a good material connection despite its small diameter.



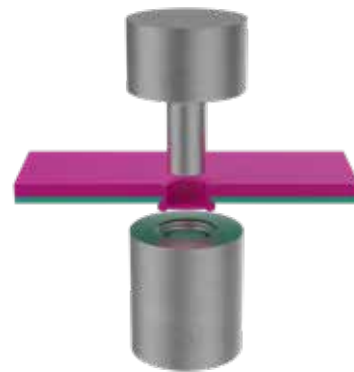
TOX® eTWINpoint

The double joint offers torsion resistance and significantly increases the joint strength compared to the single point. This makes it ideal for eClinching to safely absorb torques.

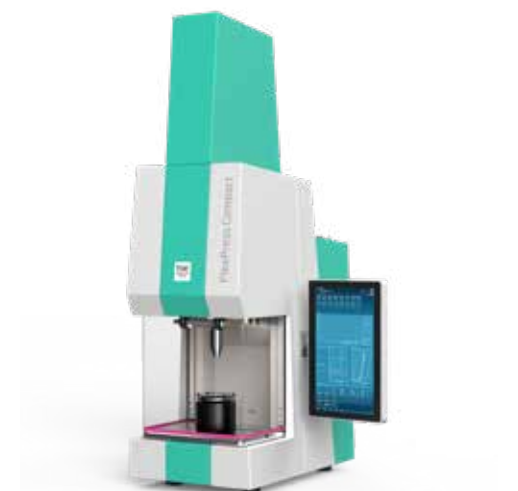
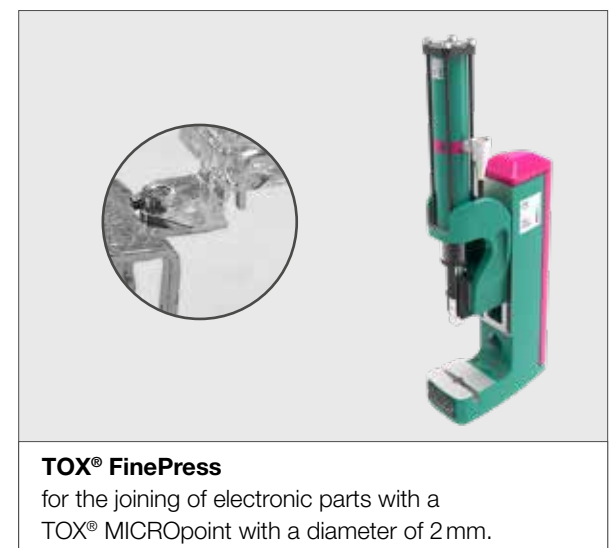
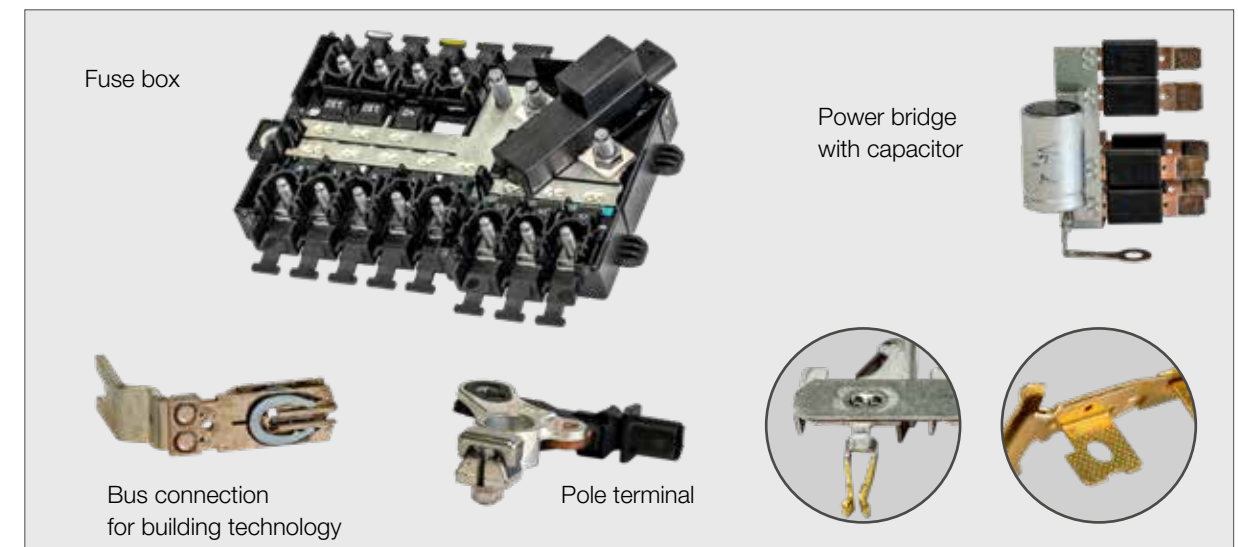


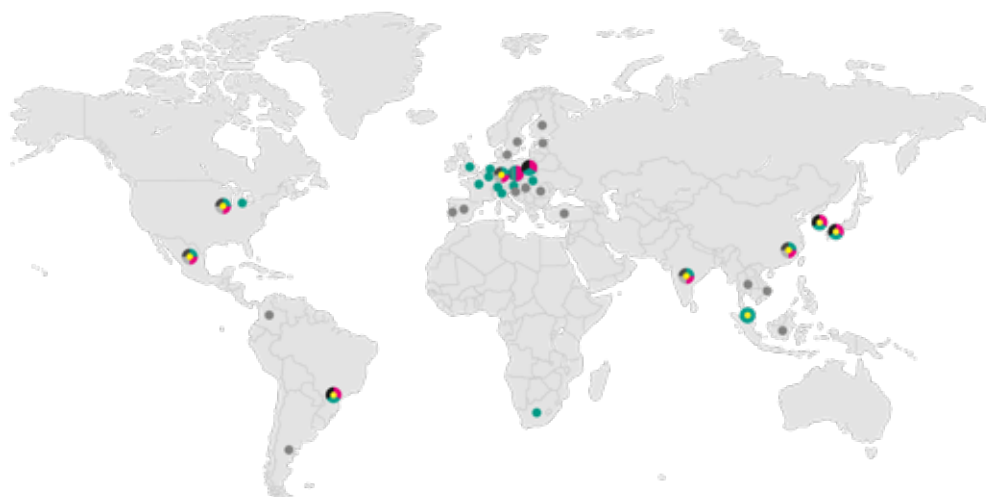
TOX® eVARIO point

The TOX® joint for difficult cases: Joining sheet metal with large differences in thickness, with high-strength, non-plastically mouldable materials or non-metallic materials.



Applications in action Individual and flexible





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