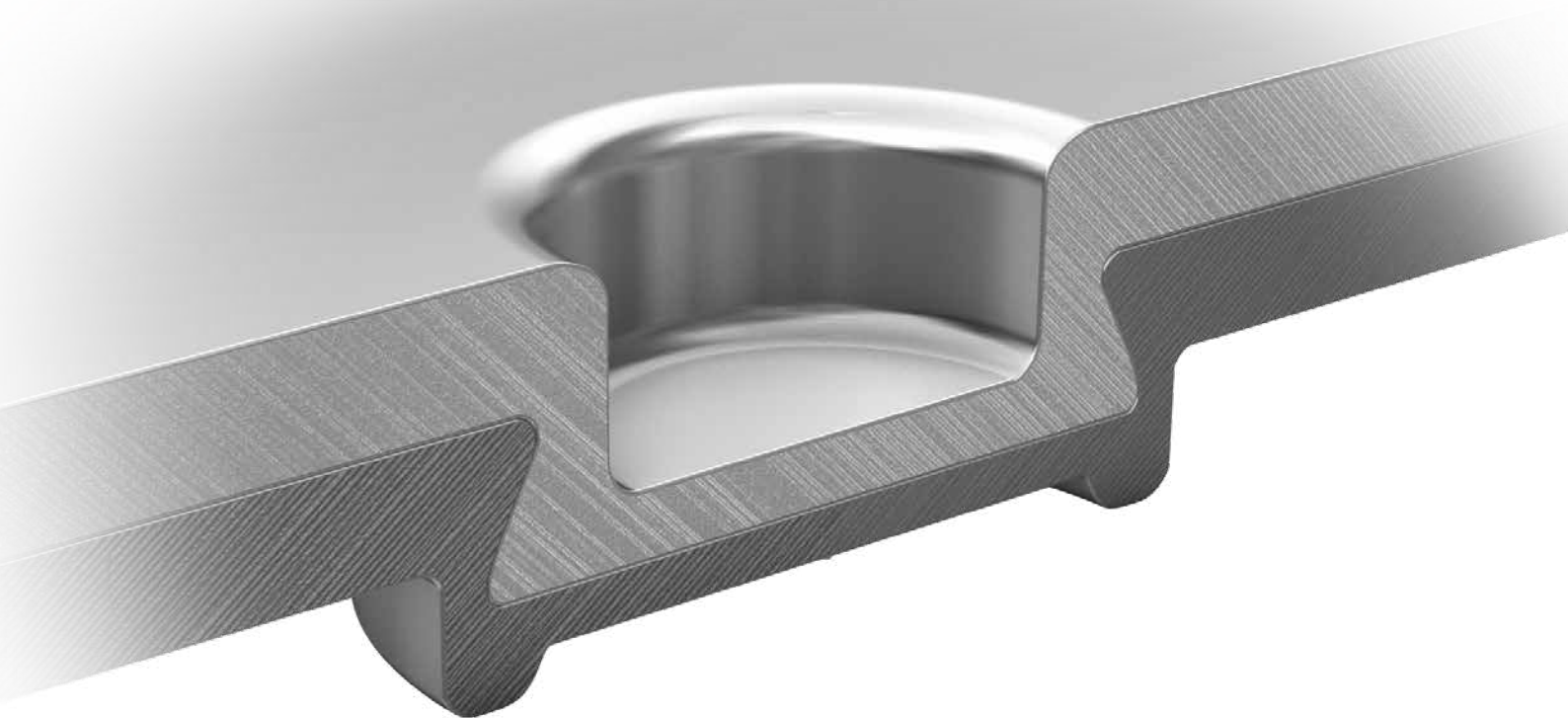
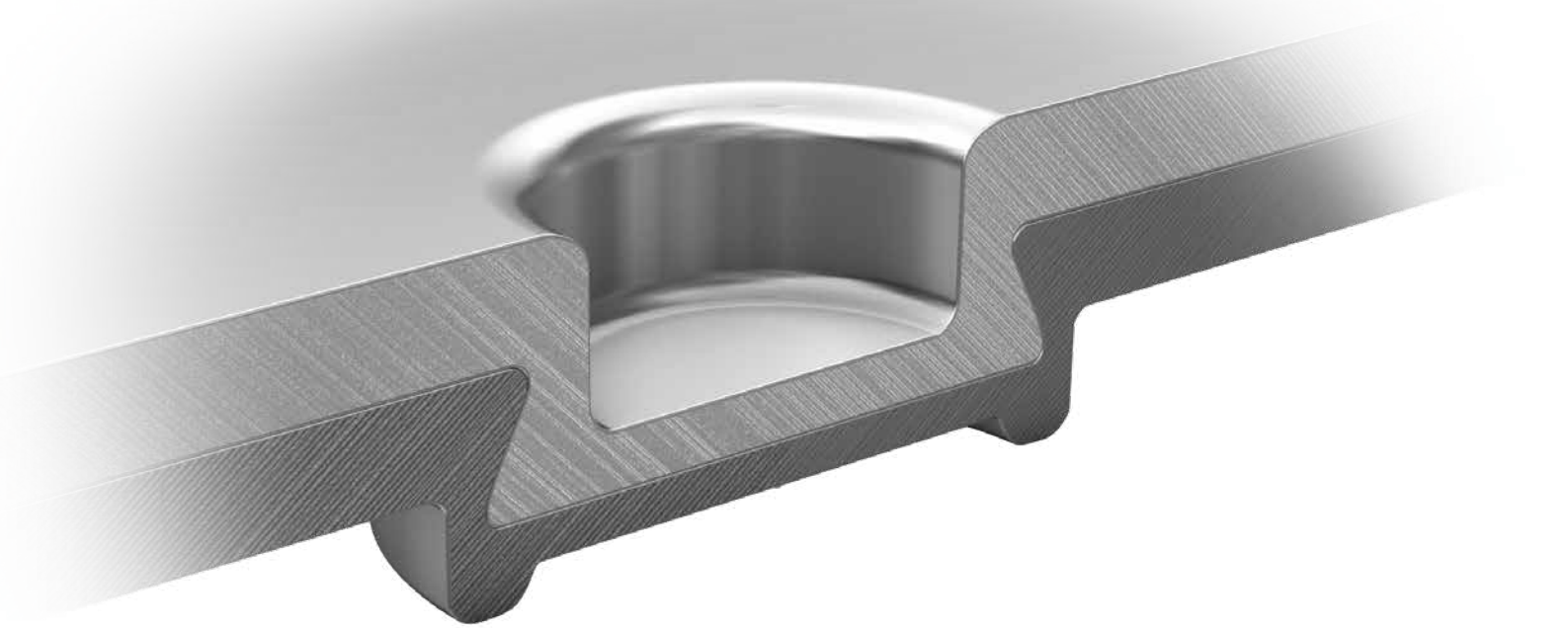


TOX®  PRESSOTECHNIK

TOX®-Clinching Technology



TOX[®]-Clinching Technology



The TOX[®]-Clinch Joint:
a buttonlike connection, to
join sheet metal together.

The highly efficient joining process

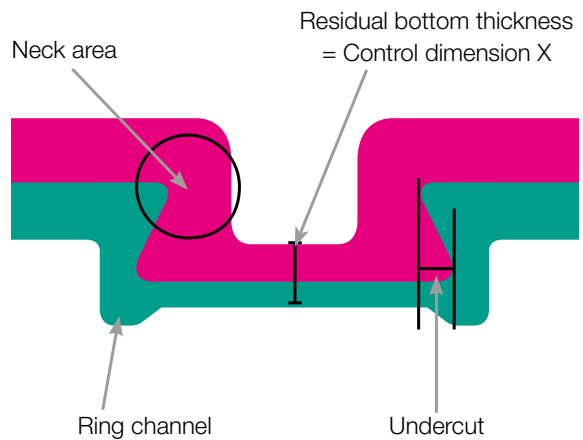
Assembly automation, multi-material stack ups, fastening costs and energy savings – the challenges for sheet metal forming are multifaceted. Automotive and appliance manufacturers as well as general metal processors must rely on innovative joining procedures to assemble modern products using new materials and manufacturing processes from a technical and economical point of view.

The cold joining process TOX®-Clinching is a highly effective solution for this purpose. During clinching or press joining, the sheet metals to be joined are connected force- and positive-locking with each other in a continuous forming process. A wide range of materials can be joined with this press-forming process, all without damaging the surface.

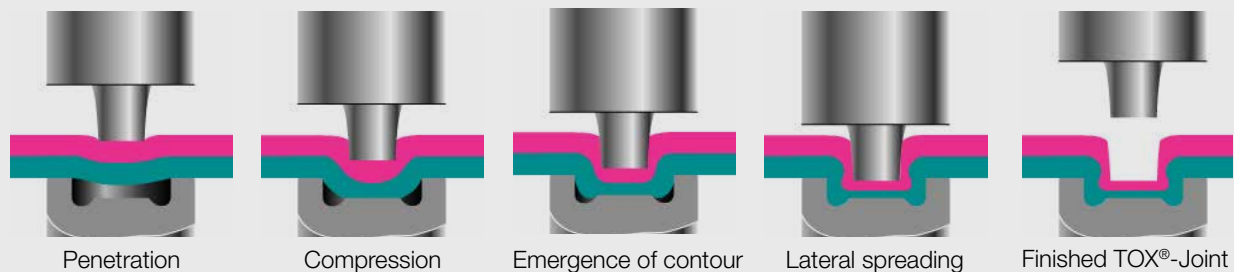
In hybrid joining, clinch points locate and relieve the adhesive bond during and after hardening – the specific properties of both techniques complement each other optimally. This means that the combination of both joining technologies results in innovative joining options.

Why does a TOX®-Joint hold?

In the TOX®-Clinching process a punch displaces material into a die. Through plastic deformation and reverse flow of the material the joint forms an undercut to generate the holding force.



Creation of a TOX®-Clinching Joint



Advantages of the TOX[®]-Clinching Technology

Versatile and full of options

Flexibility

With the clinching process, sheet metals of different qualities, surfaces and thicknesses can also be joined with adhesive or other intermediate layers.

Different materials

The TOX[®]-Clinching Technology can be used for numerous material combinations. Whether it is steel, aluminum, copper, brass or stainless steel – all materials can also be joined in combination. Continuous development and experience with a large number of applications have resulted in long tool life.

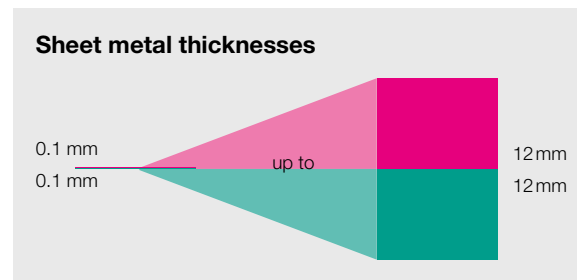
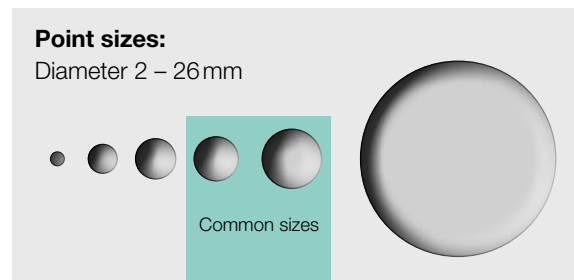
Excellent Electrical conductivity

The clinching process provides the best electrical conductivity compared to other mechanical joining processes. This makes clinching ideally suited to electrical assemblies and devices.

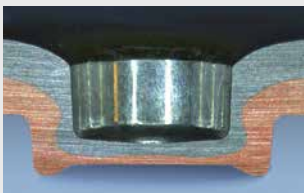
The TOX[®]-Clinching Technology offers numerous technical advantages:

Advantages:

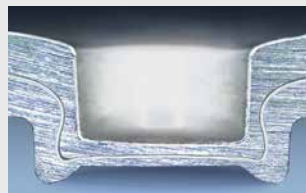
- Joining of similar or dissimilar materials
- Joining without heat: no distortion of the workpiece
- Ideal for hybrid connections or auxiliary parts
- No additional materials required
- Automatic and precise monitoring and documentation of the process
- Strong connections
- No contamination of the workpiece
- No damage to the coating or surface



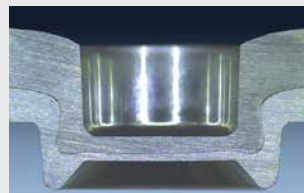
Clinching is possible



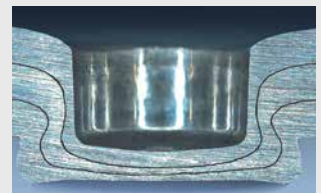
with different materials



with different surface finishes



with different thickness



with multiple layers



Lighting assembly



Automotive part



Airbag crashbox



Washing machine housing



Washing machine drum



Electric motor housing



Heating elements



Back-up fuse box



Automotive seat component

Technical Advantages

Strong and durable

High static strength

Clinch connections achieve high static retaining forces of up to 70% of a weld point. They also have a positive strain hardening, maintain the surface coating and are generally also more economical. Additionally mixed-material joining can be realized.

Corrosion-free joining technology

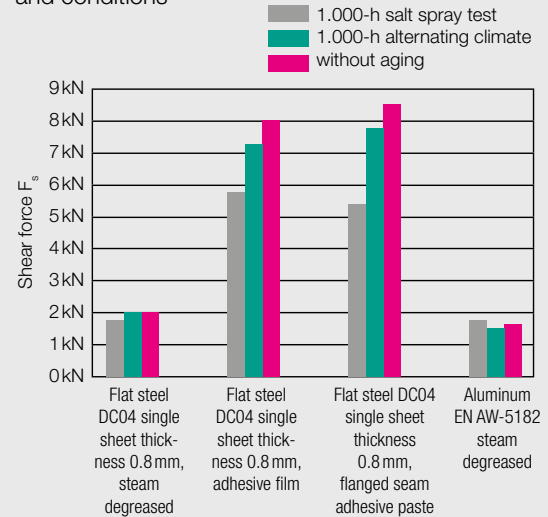
The corrosion test proves: Because the surface coating is not damaged during the round joint process the anti-corrosive properties of the joined sheet metals (e.g. galvanization) are maintained. The surface is not damaged by any cutting process – the coating flows with the material and remains intact.

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.

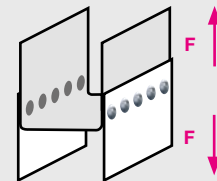
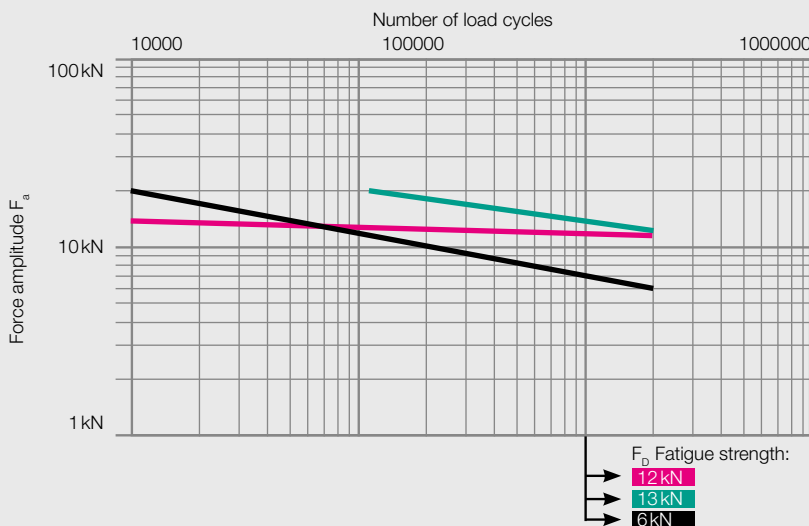
TOX®-Clinching Joint Corrosion test

Holding strength with different materials and conditions



Dynamic strength

Strength of clinch, punch rivet and spot welding connections under oscillating shear strength load (endurance fatigue test).



Material:

Flat steel ZStE 420
Single sheet thickness 1 mm

Joining technologies:

Clinching TOX®-Round-Joint
 $d_w = 8 \text{ mm}$

Riveting with semi-tubular rivets
5.3 x 5.0 mm

Spot welding
 $d_w = 5 \text{ mm}$

Source: FOSTA P263

Economical Advantages

Cost saving and emission-free

Excellent cost savings

Directly compared to spot welding, TOX®-Clinching is approximately 40% cheaper with regard to investment, operating and tool costs. This is ensured by the following technical advantages:

- Reduced investment due to long service life of the TOX®-Tools
- Low ongoing operating costs, as no procurement of additional materials or elements
- Rational production due to the high degree of automation
- Energy savings, as no heat needs to be generated
- No post-processing required
- Continuous quality control provides verifiable quality

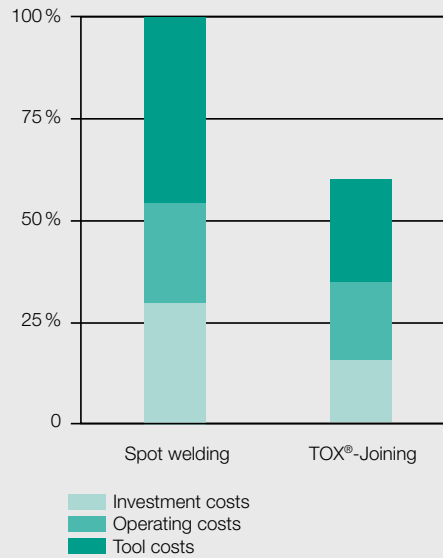
Cost savings compound with multi-point applications.

Emission-free and energy-efficient

As clinching is a cold forming process, there are positive environmental aspects including:

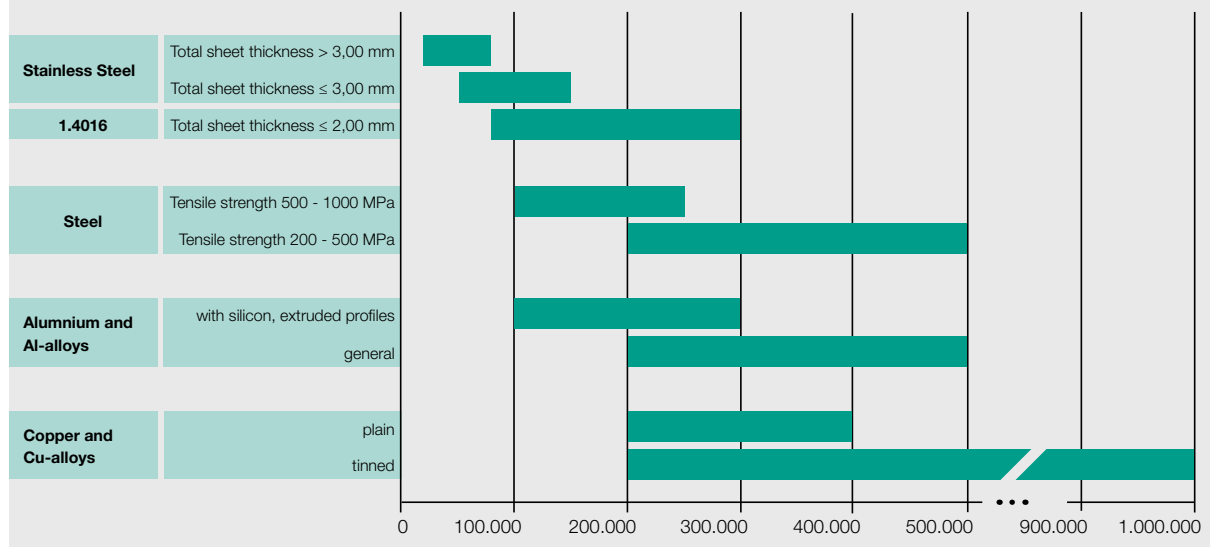
- No poisonous vapors or gases
- No harmful effects for the operating personnel
- Low noise despite short cycle times
- No consumption of coolants, oils or gases
- No disposal of chemicals or waste

Comparison of costs per joint



Expected Number of joints until tool change (Punch and Die)

The actual tool life will be determined after joining-tests of the particular application.



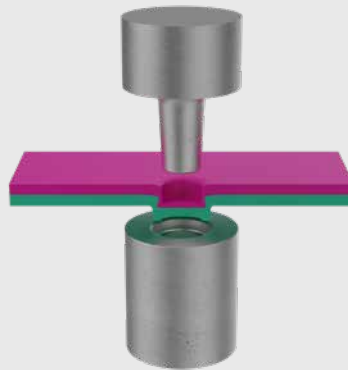
Process Competence

The perfect joint for every application

TOX® PRESSOTECHNIK provides you with the best technological solutions and complete systems from one source, the respective design will be tailored to your specific joining tasks. An important step here is the selection of the clinch point shape:

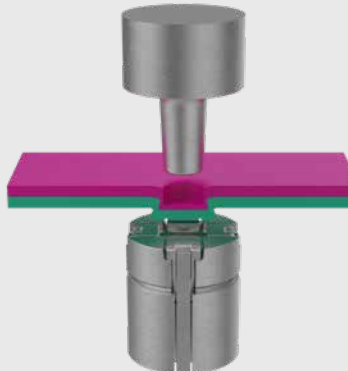
TOX®-Round-Joint

The classic: A round punch presses the materials to be joined into the die. The result is an aesthetically pleasing round button, which joins clearly without any burrs or sharp edges the sheet metals. The protective layer, e.g. paint, flows and does not get damaged.



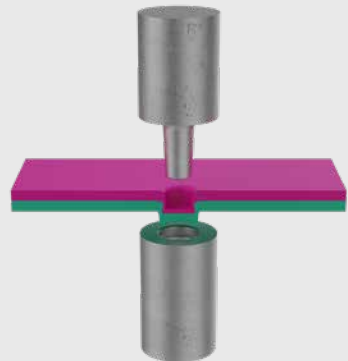
TOX®-SKB

The special die consists of solid and movable segments. The solid segments center the material and the punch. The movable elements allow flow of the material in the joint – especially with sheet metal of different thickness or when using adhesives between the sheet layers.



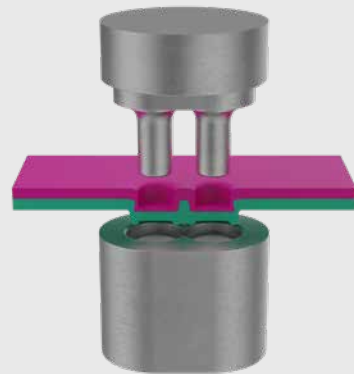
TOX®-MICROpoint

The miniature TOX®-Round-Joint is our answer to component miniaturization. With a diameter of 2mm, it is ideal for sheet metal thicknesses of 0.1–0.5mm and for slim flanges. For this reason, it is also optimally suited as an eClinch-Point.



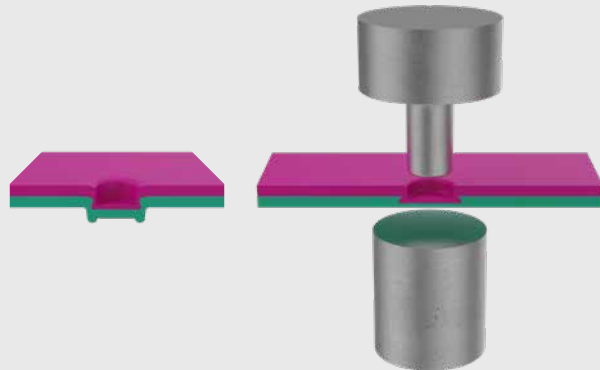
TOX®-TWINpoint

This double cavity die provides protection against rotation and increases the joint strength compared to the single joint. It is ideal for small flanges and limited installation space. When eClinching, it also makes sure the design requirements are met.



TOX®-Flat-Joint

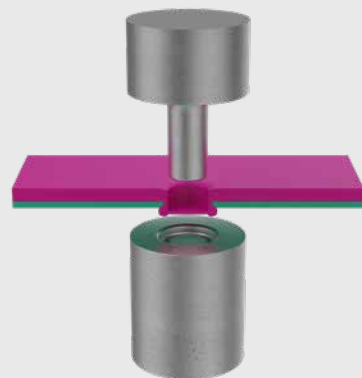
If the protrusion on die side presents a problem: with the TOX®-Flat Joint, the protrusion of the clinching joint on die side is pressed flat again in a second round using a flat die. A minimum protrusion height of only a few tenths of a millimeter remains.



TOX®-Vario-Joint

The TOX®-Joint for difficult combinations: Joining of sheet metal with large differences in thickness, joining of high strength or non ductile materials with ductile materials or joining of non metallic materials.

The sheet metal is driven through the pre-punched material for this purpose. The process requires low joining forces and can also be applied in multi-point tools.



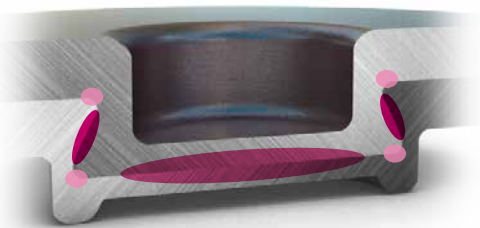
Process Competence

TOX®-eClinching

Very low contact resistance makes TOX®-eClinching ideally suited for electrical components and is an efficient alternative to solder, welded and screwed connections.

Long-term stable energy transfer

The secret of the good conductivity of the TOX®-eClinching-Point is the joint zone. During the clinching process, in addition to the positive locking and force locking, there is also an adhesive bond: The joined sheets flow together, resulting in an excellent conductive structure.



Areas with the highest adhesive bond

- very high (neck area)
- high (bottom)
- good



Know-how for maximum conductivity

For maximum conductivity some design rules must be taken into account for eClinching. If a piece part will be mechanically stressed, the TOX®-eTWINpoint is our recommendation, because it can withstand torque. The TOX®-eMICROpoint is suitable for joining small components, because it delivers good adhesive bond on a small diameter.

Material mix

TOX®-eClinching joins aluminum with copper, a common combination in battery modules, without creating an isolating intermetallic phase. Soft coatings, like for example tin coatings on copper, are also formed without damage. eClinching is also perfect for joining heat-sensitive battery cells. The process nearly doubles the effective contact surface, which increases the conductivity of the TOX®-Point significantly.

Advantages

- Force locking, positive locking and adhesive bond in on step
- Very robust connections
- No pretreatment required
- Joining process without heat
- Very low contact resistance
- Extensive documentation of relevant data

Proven process quality

Continuous quality monitoring

A significant advantage of the TOX®-Round Joint is the simple quality control even in series production. By continuously measuring the residual bottom thickness (the control dimension "X"), each joint can be checked. An additional analysis can be carried out using cross sections (cut through the point). The shear and pull strength can be determined via tensile tests.

Preliminary tests in the TOX®-Technical Center

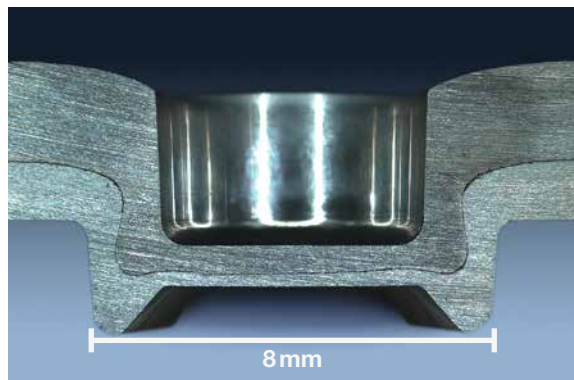
Prior to collaboration, we will work on the most effective solution for you in our labor. Here we will perform preliminary joining tests on your samples, which we test and analyze afterwards. We will also determine all parameters for your application, e.g. the required press force and suitable tools, and we will establish which system can be used for your joining application.

Final check of the machine parameters

Before we deliver a system, we check the real process results. We will create a cross section and analyze the joining process and the retention forces of the joint. Everything will be documented in a detailed test report. The initial set-up of the system is based on these determined values and parameters.

Advantages

- Demonstrable joining quality in pre-tests and during series production
- Measurement and documentation of the shear and tensile strengths
- Documentation of the joining quality
- Production of pre-production parts



With a cross section of the clinching joint, the exact formation can be examined under the microscope for analysis. If necessary, optimizations can be made.

System Competence

Equipment for TOX[®]-Clinching

TOX[®] PRESSOTECHNIK with its decades of experience provides you with competent know-how for clinching systems.

To achieve the best results for joining, systems are composed of proven components. Customer-specific requirements are fulfilled down to the last detail. All system components are matched to each other thanks to the modular principle.

Tools **1**

Durable tools are necessary: punches and dies that are precisely adapted to materials, thickness and joining force.

Frame **2**

The high forces occurring during inserting are absorbed by a low deflection frame.

TOX[®]-Drives **3**

The forces required for clinching are created by electromechanical servo drives or pneumohydraulic Powerpackages.

Control and process monitoring

- Ranging from external impulse to complete PLC controls built to the highest safety standards
- Software to control all processes
- Monitoring of process curves

Safety devices

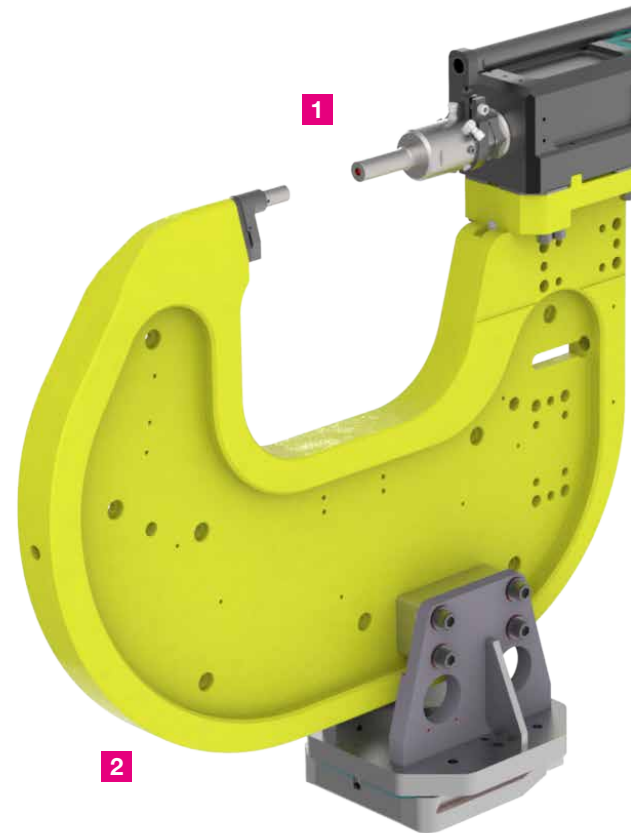
Safety door, light curtain, safety controls etc.

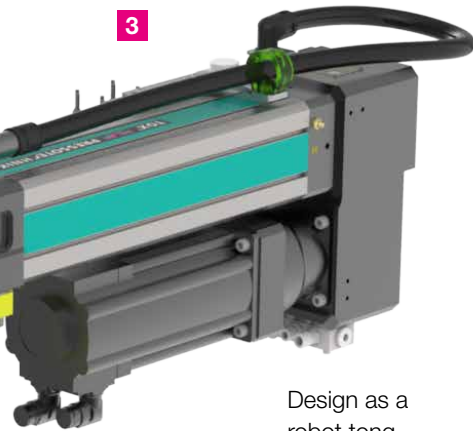
Sensors

Sensors for automatic control of the process and sequence parameters: Pressure, force-position measurement and position sensors.

Accessories

We provide numerous accessories for example the spraying systems for lubricating the tools and materials or the ToolCheck, which constantly checks that the die is not damaged. We also have strippers, compensating slides and many more options.





Design as a robot tong

System designs

Different basic designs are possible for clinching systems. Systems can be designed as tong – stationary or mobile – or as a press.

Crucial factors for choosing one system over another include the potential integration into production lines, optimum feed-in, the desired working speed and the size of the components.

Robot tong

The tongs are controlled by a robot. It moves precisely to the positions at the sheet metal parts to be joined.

Machine tong

For integration in machines and devices. Ideally driven via a central TOX®-Powerpackage X-KT system.

Hand-held tong

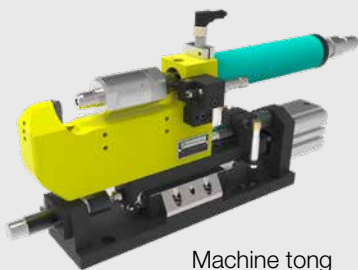
Flexible and easy to handle: Hand-held tongs are ideal for small series production.

Machine

Machines can be constructed as fully automatic, semi-automatic or purely manual workstations.

TOX® PRESSOTECHNIK is certified to build safety rated work stations.

Designs



Machine tong



Hand-held tong



Machine

Components

TOX®-Clinching Tools

In the clinching process, the tool set plays the most important role. The suitable tool set is determined in the TOX®-Technical Center for each clinching process, guaranteeing the required retention forces.

A tool set always consists of a punch and a die. All tools are produced from highest quality materials on precision machining centers – with suitable special coatings depending on the individual application.

Every tool set comes with its own tool passport with individual information for your production and maintenance department. Our objective is to ensure reliable, safe and long-lasting production for you.



TOX®-ToolCheck

The optional accessory TOX®-ToolCheck can check the condition of the die during the process, which ensures that joining always occurs with an intact die. Defects are detected immediately.



TOX®-Spraying System

The workpiece surface and/or tools can be sprayed with a special liquid before the joining process. Then the joining and stripping forces of the tools are reduced and the forming of the material is made easier.



Flexible control-software for the integrated production

Flexible Multi-Technology Control

One system - many possibilities! Our multi-technology control operates and monitors all functions. It is drive-independent and can be used for any technology. When a robot changes its tong, the system recognizes the parameters and can continue working immediately. This yields the highest degree of flexibility.

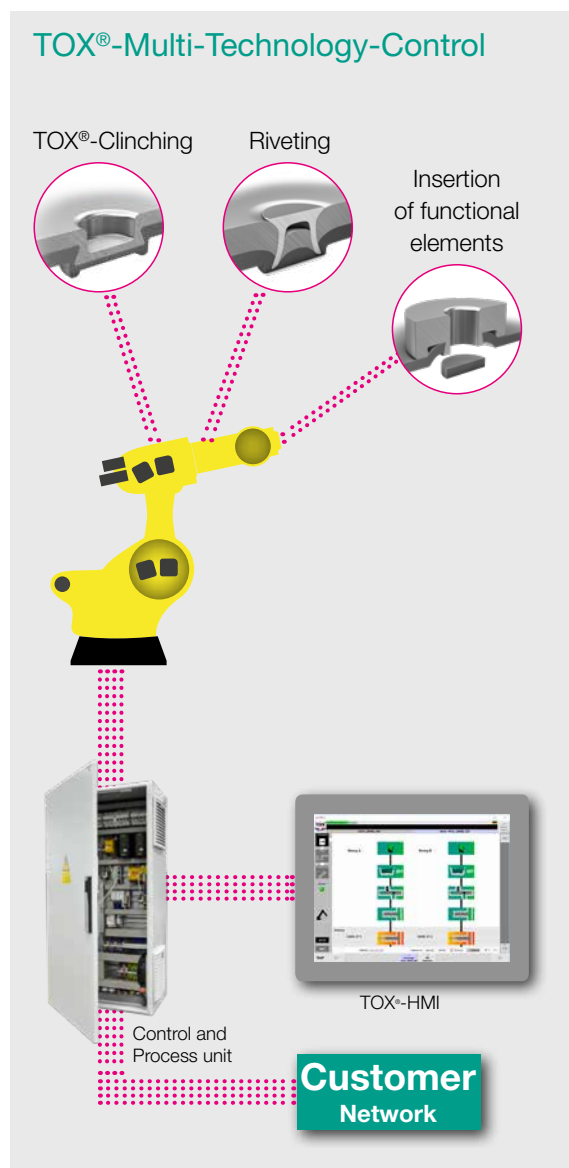
Additionally, the intuitive TOX®-HMI software allows easy installation and operation of the system. It is clearly structured and internationally understandable.

Integrated Production

Using numerous interfaces it is easy to connect the TOX®-Equipment to a company network. The system components communicate with each other via fieldbus. The data collected there enables continuous monitoring and improvement of the processes. Feedback from the production process can be used to optimize the technology parameters (e. g. residual bottom thickness). Unnecessary maintenance work and downtime can be avoided thanks to predictive maintenance.

Advantages

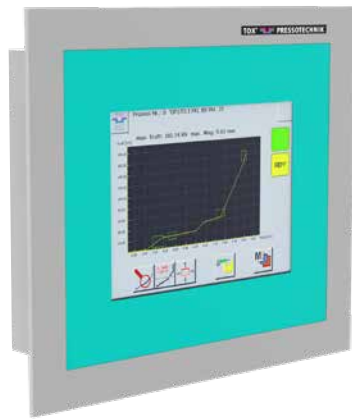
- One control for different application technologies
- Import of process parameters from customer network
- Auto-configuration of system components
- Condition Monitoring: Storage of operating hours, maintenance counter, tool information etc.
- Preventive Maintenance avoids downtime
- Dynamic process monitoring
- Numerous interfaces for connecting periphery units (e. g. measurement sensors, feeding systems etc.)
- Network communication via OPC UA/MQTT



Components

Process monitoring devices

Clinch monitoring was specifically developed for the TOX®-Clinching Technology. The monitoring systems CEP 400 and CEP 400 T allow the complete monitoring and documentation of the essential quality parameters of the process. Force sensors measure the press force during the joining process and a travel measuring system monitors compliance with the control dimension "X".



C-Frames and column presses

The forces that occur during clinching processes are absorbed by C-Frames or the columns of a column press. The designs takes into account interfering contours, total weight, piece part accessibility, working conditions and occupational safety.

C-Frames

Torsion-resistant frames are used for tongs and presses. We respond to the specific requirements with standard frames or individual designs.

Column presses

Column presses are particularly useful for multi-point clinching tools. They can be manufactured in various sizes, but all have the same precision and good handling.

Tong frame



Press frame



Column press

TOX®-Drives

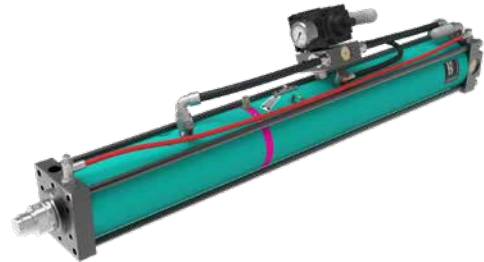
High forces are needed for clinching to press the punch into the material. These forces are generated by electromechanical servo drives or pneumohydraulic Powerpackages.

TOX®-Powerpackage

The strong pneumohydraulic drive, which is already used in thousands of machines all over the world. It is available with press forces 2 – 2000kN.

TOX®-ElectricDrive

Modular electromechanical servo drive systems with press forces up to 1000kN.



Additional components

Information about additional components like controls, piece part holders, safety devices and accessories can be found on our website tox-pressotechnik.com.



Individual Solutions for our Customers

TOX® PRESSOTECHNIK designs process flows more economically – with special systems, intelligent assembly systems and fully automatic feeds with integrated additional functions. We possess long-standing experience and comprehensive know-how in the development and design of these systems.

We look to create highly efficient systems to match our customer's designated work flow. We are committed to finding the best solution for optimizing the manufacturing processes according to our customer's requirements.

For this reason, our machines are the product of close cooperation between our customers and our project managers. Our service team will also be on hand quickly and reliably at all times following delivery.

Identify demand

An extensive consultation forms the basis of each concept for us – for special machines as well as production systems. We use our experience and high level of expertise to identify the basic needs, determine the required components, and sketch out an initial layout. In our lab we can produce samples with original materials, components and elements in parallel.

Development process

The specific system concept is forwarded to our design department, which creates the machine layout and generates detailed drawings for production. We produce or procure the mechanical components according to the design and assemble the system. There after the electrical components are installed and the controller is configured.

Commissioning

Once complete, a trial run of the system is performed. Once everything meets customer expectations, the customer approves the system. Following delivery, set-up and installation of the system, commissioning is performed by our qualified personnel.

After-sales service

We train the operating personnel extensively – either at our premises or on site using the delivered system. Often, we also support initial production and provide advice and assistance. When everything is running smoothly, we are happy to perform regular maintenance tasks on request.



Application examples

TOX®-Robot tongs
for joining body parts in
the automotive industry.

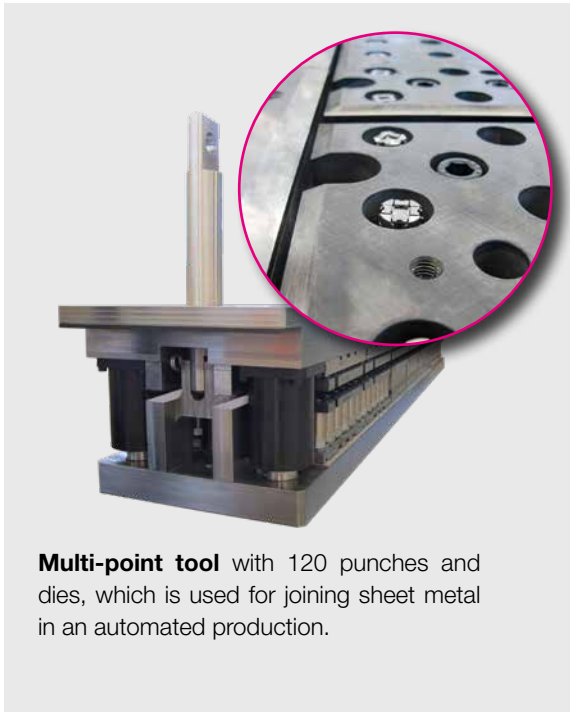


TOX®-Press
joins housings for
electric motors.



TOX®-Hand-held tong
for manual clinching.



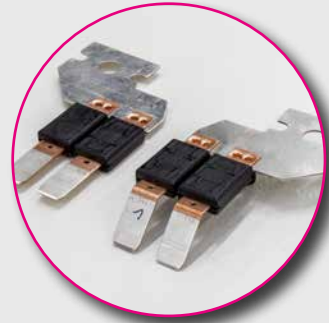


Application examples

Special tong
with 2 multipoint tools.



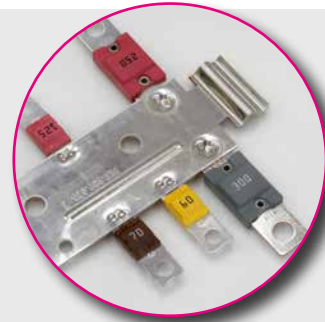
TOX®-Press
for eClinching of fuse parts.



TOX®-Press
joins seat rails for cars.



TOX®-Press
for clenching fuses to bus bars.

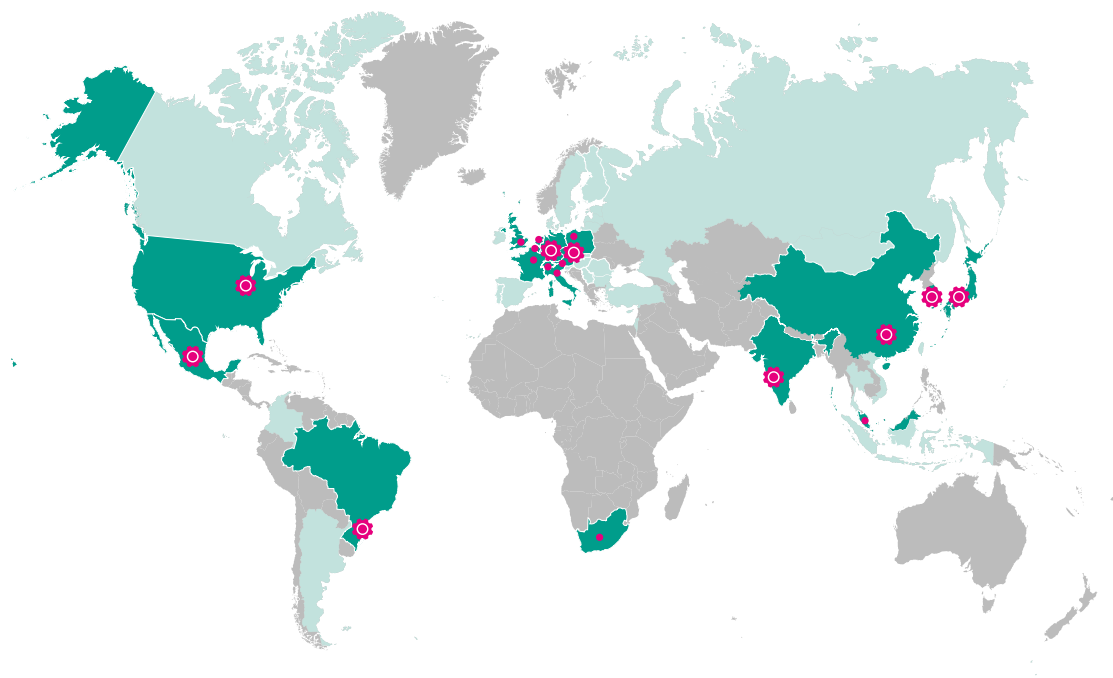


TOX®-Press
for appliances. It clinches
refrigerator housing parts.



TOX®-FinePress
for joining electric parts
with a TOX®-MICROpoint
of 2 mm diameter.





TOX®  PRESSOTECHNIK

TOX® PRESSOTECHNIK GmbH & Co. KG
Riedstrasse 4
88250 Weingarten / Germany

TOX® PRESSOTECHNIK L.L.C.
4250 Weaver Parkway
Warrenville, IL 60555 (USA)

Find your local contact at:
tox-pressotechnik.com

317874 / 80.202111.us Subject to technical modifications.