TOX®-Clinching-Technology

The TOX®-Clinching-Joint: a buttonlike connection, to join sheet metals together.
The high-efficient joining process

Automation, a diverse material mix as well as 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 reconcile modern products, new materials and rational 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 pulling-pressing process. All this without damaging the surface, through simple forming technology.

In hybrid joining, clinch points fix 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.

How does a TOX®-Joint hold?

In the TOX®-Clinching process the undercut of the joined layer in the neck area creates the high retention forces.

Creation of a TOX®-Clinching-Joint

Penetration Compress Emergence of contour Filling Lateral spreading Finished TOX®-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:
- Joining without heat: no distortion of the workpiece
- Ideal for hybrid connections.
- No additional materials required
- Automatic and precise monitoring and documentation of the process
- Strong connections
- No contamination of the workpiece
- No damage of the coating or surface

**Point sizes:**
Diameter 2 - 26 mm

**Sheet metal thicknesses**

<table>
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<tr>
<th>Thickness</th>
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<tr>
<td>0.1 mm</td>
<td>up to</td>
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<td>12 mm</td>
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**Clinching works**

with different materials
with different surfaces
of different thickness
in multiple layers
Technical Advantages

Flexible 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.

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. galvanisation) are maintained. The surface is not damaged by any cutting process – the coating flows with the material and remains intact.

Dynamic strength
The life of the TOX®-Round Joint lasts much longer than that of a weld point. It has a superior dynamic strength without physical notch effect in the joint.

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

Fügeverfahren:
Clinching TOX®-Round-Joint
\( d_m = 8 \text{ mm} \)

Punch Riveting with Semi-hollow rivets 5.3 x 5.0 mm

Spot welding \( d_L = 5 \text{ mm} \)

Source: FOSTA P283
Economical Advantages

Cost saving and emission-free

Excellent cost savings
Directly compared to spot welding, the TOX®-Clinching is approx. 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 security.

This effect is even increased with multi point applications.

Emission-free and energy-efficient
As clinching is a cold forming process, there are positive environmental aspects resulting from this:

- 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
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, is flush 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 fluid behind 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 2 mm, it is ideal for sheet metal thicknesses of 0.1 - 0.5 mm and for slim flanges. For this reason, it is also optimally suited as eClinch-Point.
If the elevation on die side presents a problem:
with the TOX®-Flat Joint, the elevation of the clinching process on die side is pressed flat again in a second round using a flat die. A minimum point elevation of only a few tenths of a millimeter remains.

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

TOX®-TWINpoint

The TOX®-Joint for difficult cases: 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 pulled through the pre-punched material for this purpose. The process only requires low joining forces and can also be applied in multi-point tools.

TOX®-Vario-Joint
TOX®-eClinching

Very low contact resistance makes TOX®-eClinching ideally suited to 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.

**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 torques. 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 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 one step
- Very robust connections
- No pretreatment required
- Joining process without heat
- Very low contact resistance
- Easy monitoring and documentation of the shear and tensile strengths
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 by cross sections (cut through the point). The shear and pull strength can be determined in tensile tests.

Preliminary tests in the TOX®-Technical Center
Prior to collaboration, we will already work on the most effective solution for you in our laboratory. 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 processing results. We will create a cross section and analyze the joining process and the retention forces of the rivet. Everything will be documented in a detailed test report. The delivery condition 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-series workpieces

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.

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

2 Frame
Forces that occur as a result of the clinching process are absorbed by a frame (in case of tongs or presses) or by the columns of a column press.

3 TOX®-Drives
The forces required for clinching can be created by electromechanical servodrives or pneumohydraulic, hydraulic or pneumatic cylinders.

Control and process monitoring
- From external impulse to the complete PLC control including safety technology
- Software for controlling and monitoring all processes
- Monitoring of all processes

Safety devices
Safety door, light curtain, safety controls etc.

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

Accessories
We provide numerous accessories for example the spraying systems for spraying the tools and materials, or the ToolCheck, which constantly checks that the die is error-free. But also strippers, compensation carriages and many more.
Different basic designs are possible for clinching systems. Systems can be designed as tongs – stationary or mobile – or as a press.

Crucial factors for this are the potential integration into a production line, optimum feed-in, the desired working speed and the size of the workpieces.

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.
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 centres - with suitable special coatings depending on the individual application.

Every tool set comes with its 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 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 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 means 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
Due to 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 downtimes can be avoided thanks to predictive maintenance.

Advantages
- One control for different application technologies and machines
- Import of process parameters from customer network
- Autoconfiguration 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. robots, measurement sensors, feeding systems etc.)
- Network communication via e.g. OP-C UA / MQTT
- Simplified cabling
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”.

Frames and Columns

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

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.
TOX®-Drives

High forces are needed for clinching to press the punch into the material. Therefore high joining forces are required, which can be generated by pneumatic, hydraulic or pneumohydraulic cylinders or electromechanical servo drives.

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 – 2000 kN.

TOX®-ElectricDrive
Modular electromechanical servo drive systems with press forces up to 1000 kN.

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 chains 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 are keeping an eye on the high efficiency of the later process chain at all times and place our customer’s requirements at the center of our work. We are committed to finding the best solution for optimising the manufacturing processes according to our customer’s requirements.

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

**Identify demand**
An extensive consultation forms the basis of each concept for us – for special machines as well as production systems. We use much experience and a high level of expertise to identify the framework conditions, determine the required components, and sketch out a first system layout. In our lab we can perform sampling runs with original materials, components and elements in parallel.

**Development process**
The specific system concept is forwarded to our construction department, which creates the machine layout and generates detailed drawings for production. The components are manufactured or procured according to plan and the system is mounted. Then, the electrics are installed and the control components are configured.

**Commissioning**
On completion, the machine is test driven. Once everything corresponds to the requirements and planning, acceptance occurs in-house – if desired, together with the customer. Following delivery, set-up and connection of the system, commissioning is supported by our qualified personnel.

**After-sales service**
The operating personnel receives extensive training. Either at our premises or on site at the original machine. Often, we also support initial production and provide advice and assistance. When everything is running smoothly, all that is required are regular maintenance tasks.
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.
Multi-point tool with 120 punches and dies, which is used for joining sheet metal in an automated production.

TOX®-Press joins heating elements for cars.

TOX®-Press joins lamp parts.
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 clinching fuses to metal parts.

**TOX®-Press**
for white goods. It clinches fridge housing parts.

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