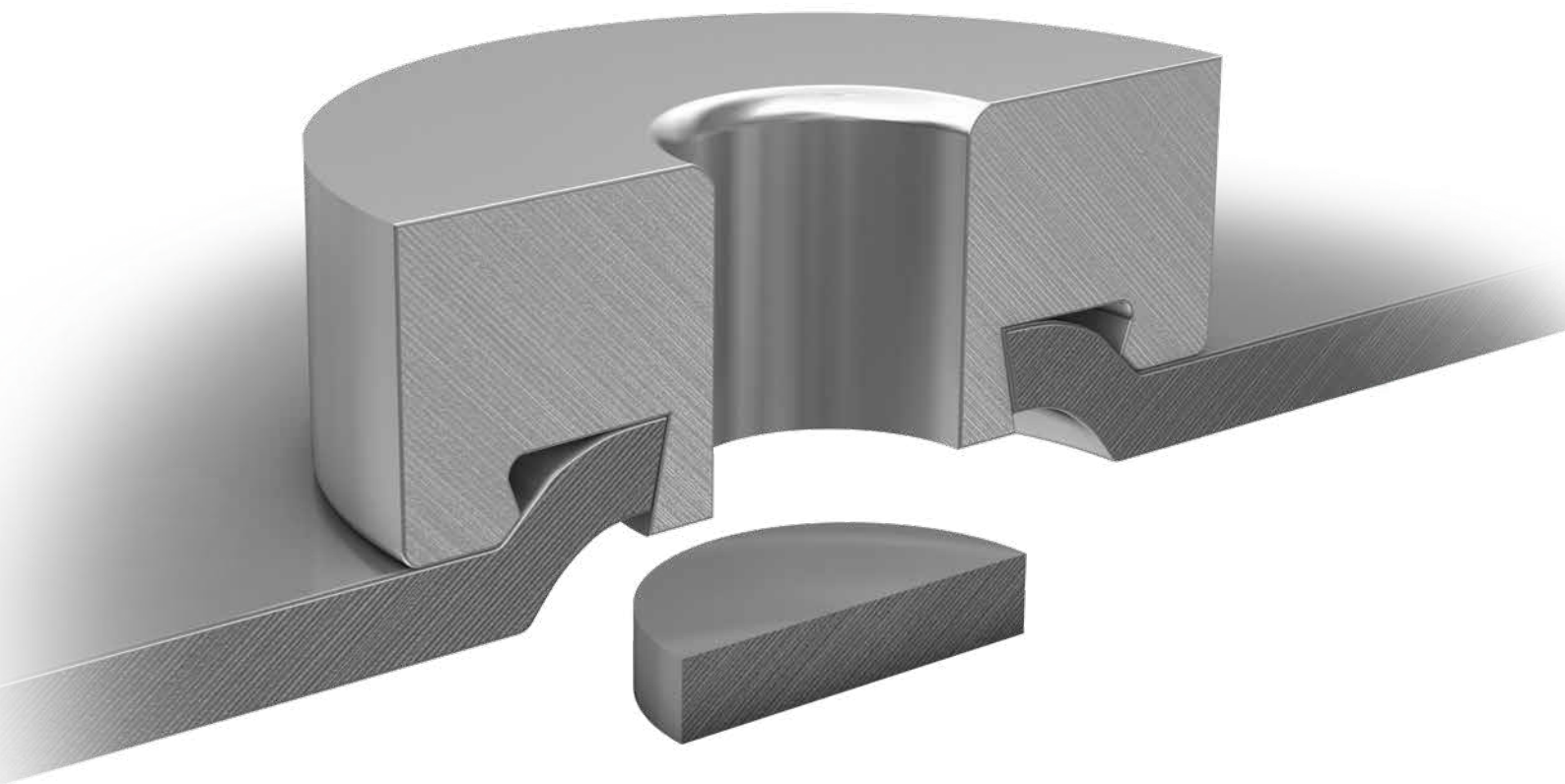


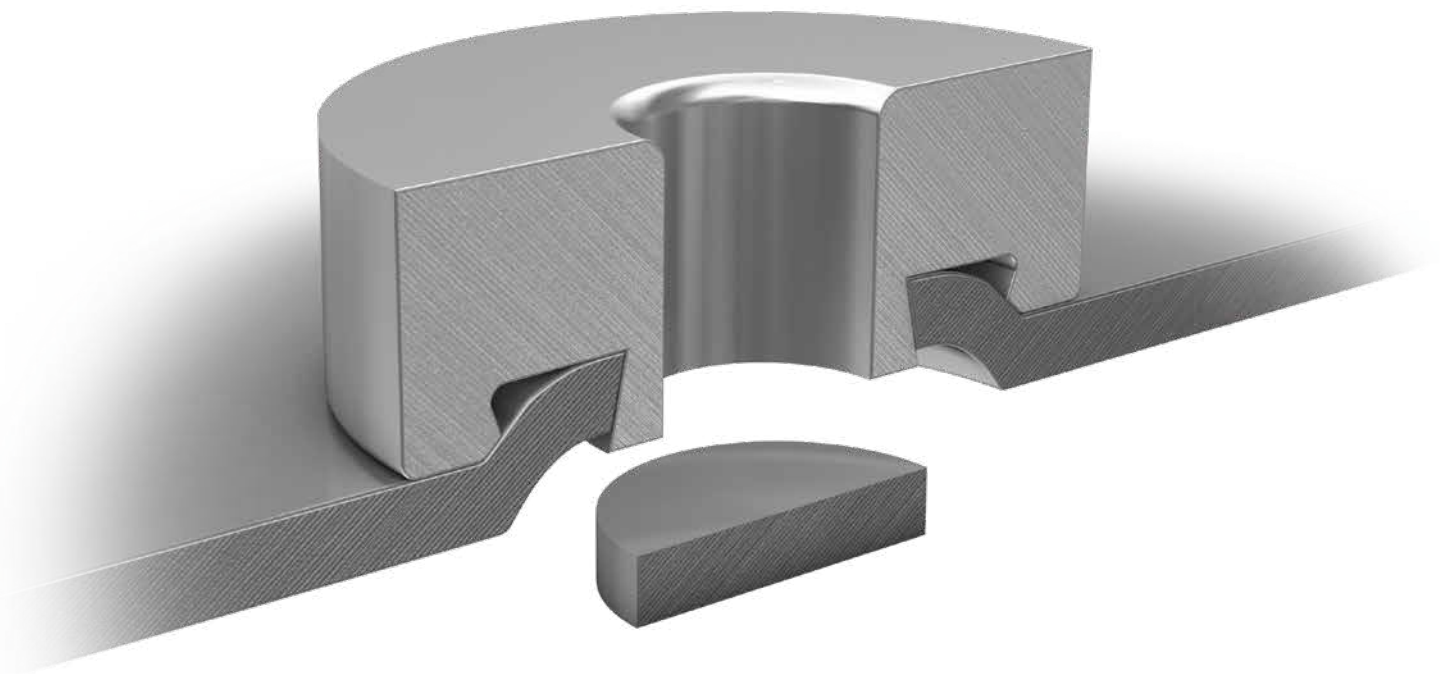


# Functional Element Technology



# Functional Element Technology

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This functional element punches through sheet metal and the cold forming process forms a tight connection.

## More Function in Sheet Metal

In many industries components are equipped with elements such as nuts, bolts and screws for special functions. Most of these so-called functional elements can be integrated into workpieces by means of pressing, punching, riveting or clinching processes.

The predominantly automated connections that can be made by means of cold joining technologies are significantly more cost-effective than conventional connections like welding, as no rework caused by contamination or component distortion is required.

The connections provide good retention, particularly with regard to torque and press-out force, and the consistent quality can be easily monitored through simple measurement procedures. The continuous documentation of the connection parameters is valued by users worldwide across a wide range of different industries.

The use of functional elements has already been proven in a wide range of applications. For each element there is a safe, fast and cost-effective procedure.



# Advantages of the Functional Element Technology

## Versatile and full of options

Functional elements are available from various manufacturers. They differ in function, method of fastening and dimensions. Most elements can be pressed into common materials such as steel, stainless steel, high strength steel (boron), aluminum and fiber composite materials of 0.6 – 10 mm thickness.

The insertion of functional elements by cold joining process offers numerous technical advantages:

### Advantages:

- Fast work processes
- High precision positioning
- Energy-saving technology
- Joining without heat: No heat development at the workpiece or element
- Automatic and precise monitoring and documentation of the process
- Very good dynamic joining properties
- Flexible positioning on components due to high accessibility of the systems
- Wide range of applications

### Parts of the functional element

**Functional part**  
for the defined purpose of the element

**Joining part**  
for insertion into the workpiece



## Clinching Studs

The Clinching Stud is particularly suitable for workpieces that have to be gas- or liquid-tight, because the sheet metal is not pierced. For the processing of these elements we have held the patent for many years and are the technology experts.

### Versions:

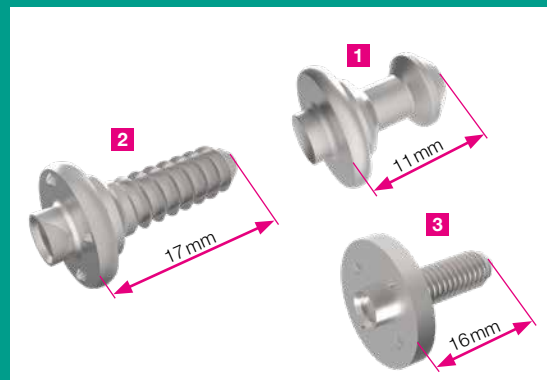
- Lens head **1**
- Coarse thread **2**
- Fine thread **3**

### Application materials:

- Steel sheet metal thickness 0.8 mm up to 1.2 mm
- Aluminum sheet metal thickness 1.2 mm up to 2.0 mm

### Retention forces:

- Maximum pulling force: up to 2,200 N
- Maximum torque: up to 20 Nm





White goods and consumer electronics



Spoiler / Spoiler Attachment



Medical equipment



Heating elements and door frames

Hood



Fender

Door sill /  
Door seal carrier

Trunk lid

Back shelf

# Process competence

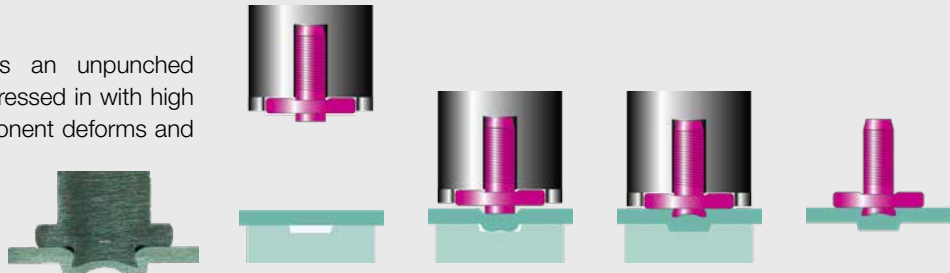
## The best technical solution for every application

We provide you with the best technological solutions and complete turnkey systems from one source. In addition to the most widely used processes, our employees also work on individualized solutions.

### Process without pre-punching

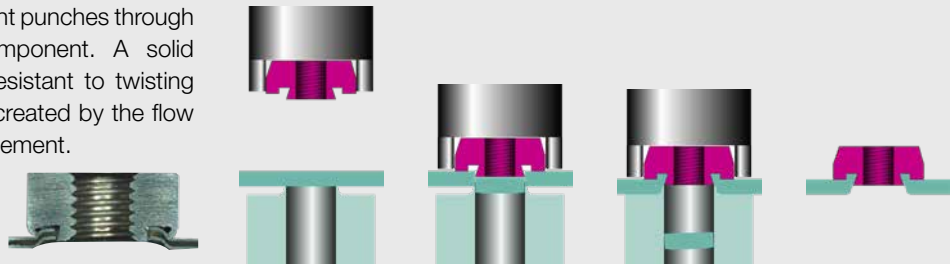
#### Self-Clinching

The element meets an unpunched component and is pressed in with high pressure. The component deforms and creates a solid clinch connection.



#### Self-Piercing

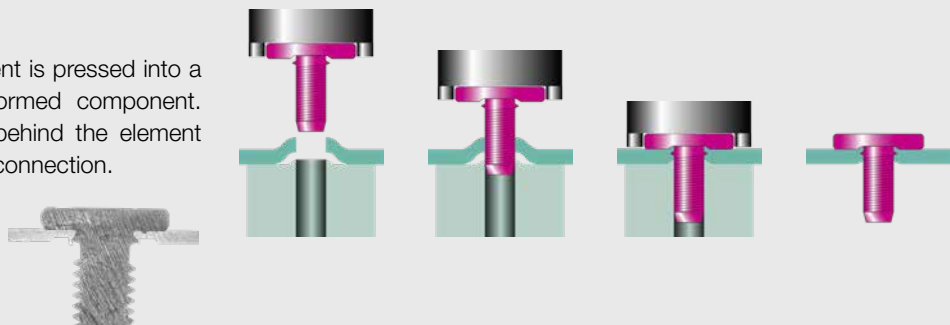
The functional element punches through the unpunched component. A solid connection that is resistant to twisting and pressing out is created by the flow of material into the element.



### Process with pre-punching

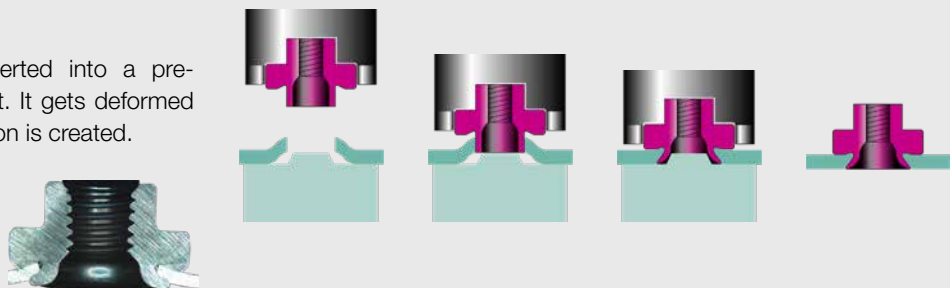
#### Press Fitting

The functional element is pressed into a pre-punched and formed component. The material flows behind the element and ensures a solid connection.



#### Riveting

The element is inserted into a pre-punched component. It gets deformed and a solid connection is created.





## Proven Process Quality

### Continuous Quality Monitoring

A significant advantage of inserting functional elements with our technology is the simple quality control in series production. By continuously measuring the force-travel-curve, each connection can be checked. An additional analysis can be carried out using cross sections (cut through the element) push out, pull through and torque tests can be confirmed through testing.

### Preliminary tests in the TOX® Technical Center

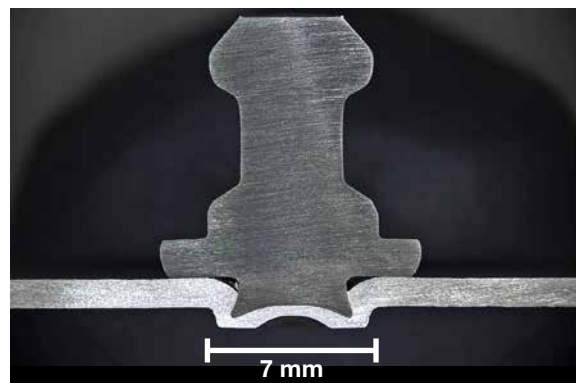
Prior to collaboration, we will work on the most effective solution for you in our lab. Here we will perform preliminary joining tests on your samples, which we test and analyze afterwards. We will also determine all parameters for your application, including the required press force and suitable tools, 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 element. Everything will be documented in a detailed test report. The initial set-up of the delivered system is based on these determined values and parameters.

## Advantages

- Demonstrated joining quality in pre-tests and during series production
- Measurement and documentation of push out, pull through and torque-out
- Documentation of the joining quality
- Production of pre-production parts



With a cross section (cut through the element), the exact formation can be examined under a microscope for analysis. If necessary, optimizations can be made.

# System competence

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## The technology for element insertion

TOX® PRESSOTECHNIK, with its decades of experience, provides you with competent know-how of systems. Regardless of the manufacturer of your functional elements, we are able to customize your application using a wide range of components and modules. Your customer-specific requirements are met down to the last detail utilizing standard system components thanks to our modular design.

### Stationary TOX® Tong

#### Setting equipment and tools **1**

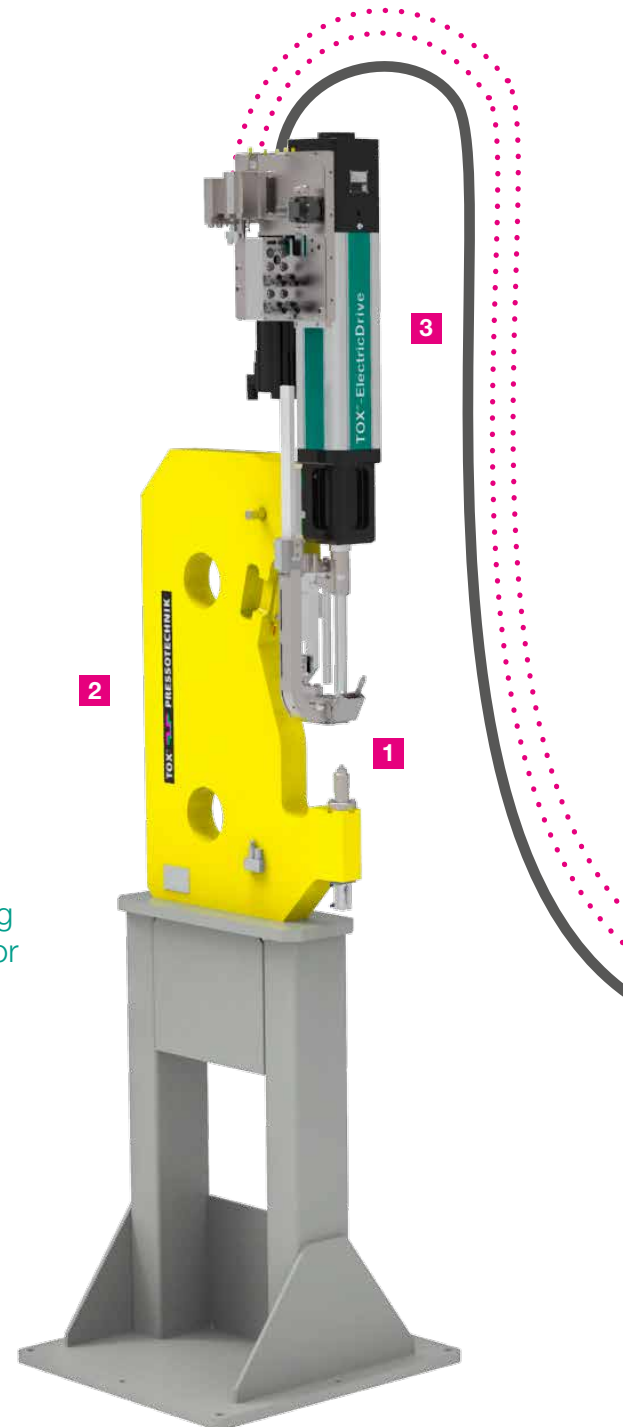
We determine the correct setting tools for every functional element. The centerpiece is the setting head and the die.

#### Frame **2**

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

#### TOX® Drives **3**

The forces required are generated by electromechanical servo drives or pneumohydraulic Powerpackages.



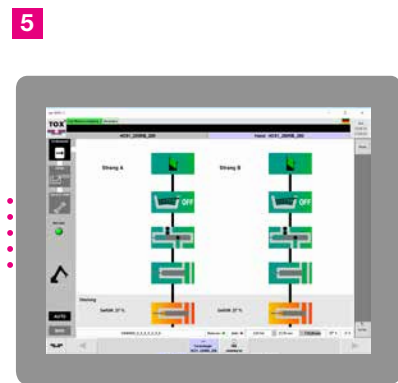
Stationary TOX® Tong  
with setting tooling for  
functional elements



TOX® Element feeding



TOX® Control and process monitoring



**Customer Network**

### TOX® Element feeding

#### TOX® FeedingUnit **4**

Preparation of the element occurs in our compact enclosure. The hopper, vibratory bowl, escapement and blow feed prepare the element for delivery to the setting head.

### TOX® Control and process monitoring **5**

- Ranging from external impulse to complete PLC controls built to the highest safety standards
- Multi-technology controls available for additional processes
- Monitoring of process and machine parameters

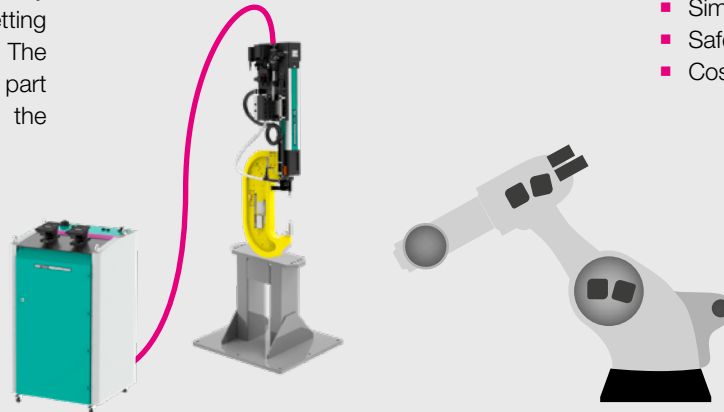
# System competence

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## Automatic Element Delivery for Tong Systems

### Stationary BlowFeed System

The element will be directly delivered to the setting head through a chute. The robot positions the part inside the press for the element to be set.

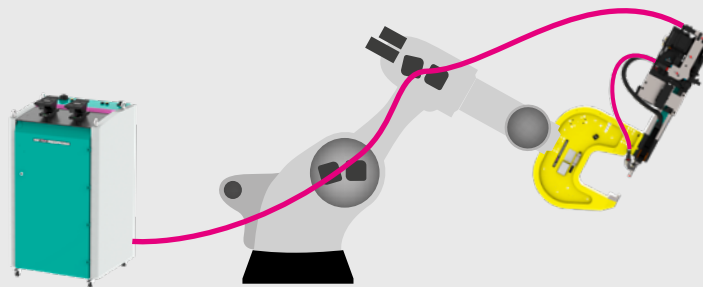


### Advantages

- Simple
- Safe and reliable
- Cost effective

### Robot-carried BlowFeed System

The element will be directly delivered to the setting head through a chute. The robot will position the tong to the part for the element to be set.

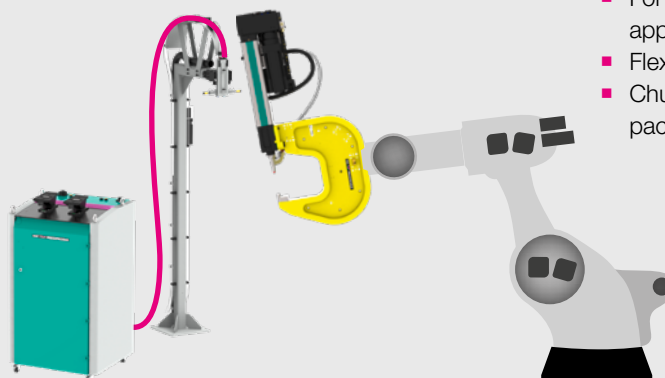


### Advantages

- For large workpieces
- Safe and reliable
- Fast

### DockFeed System (Magazine)

The element will be delivered by chute to the docking station. The robot carries the tong to the dock to fill the magazine. It then positions the tong to the part to set the elements until the magazine is empty.



### Advantages

- For multi-technology applications
- Flexible
- Chute-free robot dress-pack

## Versions

Different basic designs are possible for systems that process functional elements. 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.

### Stationary tongs

For integration in production lines and equipment, stationary machine tongs are suitable. The workpiece will be presented by a robot and the element will be inserted by the press.

### Robot tongs

A mobile tong is moved and controlled by a robot. The elements are either supplied by a docking station or through a feed chute.

### Hand tong

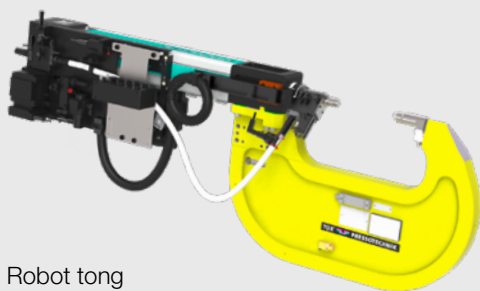
For low volume production a hand-held tong can be utilized. The element can be delivered from the chute, a magazine or be hand loaded.

### Presses / Machines

Machines can be designed as fully automatic, semi-automatic or purely manual workstations. The workpiece is manually loaded into the machine. The machine will then insert element(s) per a customized plan.

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

## Versions



Robot tong



Machine

# Components

## TOX® Setting heads

The requirements of the setting technique, particularly of the setting head, are crucial for the different types of functional elements. Based on our years of experience and laboratory tests for each application TOX® PRESSOTECHNIK can select and develop the suitable setting head.

The design of the setting head will be determined by the method of part positioning, press force required and drive type. The setting direction (up, down, free, etc.).

### Advantages

- Die and setting head as an integrated solution
- Process-reliable separation of elements
- Slim tool design for tight spaces
- Maintenance-friendly design
- High guide accuracy
- Components with low wear

### Versions

#### TOX® Setting Head for nuts

Designed for special nuts that are punched into thick sheet metal. An additional stroke removes the slug.



#### TOX® Setting Head for elongated bolts

Processes individually blown in elements with internal travel to secure the element and drive with the required press force.



#### TOX® Setting Head for clinch rivet elements

For elements that are blown individually, indexed and clinched into the component in a downward movement.



## TOX® Dies

The die is the crucial counterpart of the setting head and ensures the correct formation of the joint.



## Feeding hoses

The elements will be delivered to the setting head through special chuting. Depending on the element shape, they are round, rectangular or profiled.



## TOX® FeedingUnit

The TOX® FeedingUnit includes the sorting and delivery equipment for safe and reliable element delivery. This system is outside of the robot cell for easy refill. It includes:

**Hopper:** This is the fill location that holds large quantities of elements. The feeder bowl receives its elements from here.

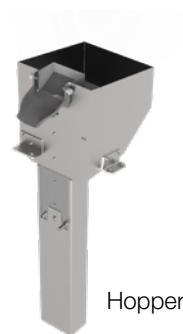
**Feeder Bowl:** This feature orients and delivers the element to the escapement for delivery.



### Escapement:

The oriented elements are singulated here for delivery to the setting head. From here the element is typically blown through a chute to the setting head.

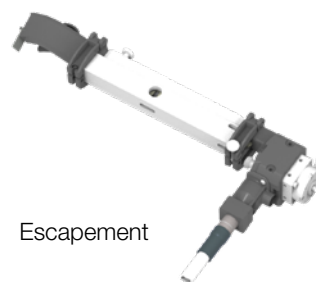
The TOX® FeedingUnit can fit many processes thanks to our modular system. We also validate our designs for each system offered to ensure that manual manipulation is not required.



Hopper



Feeder Bowl



Escapement

# Components

## 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.

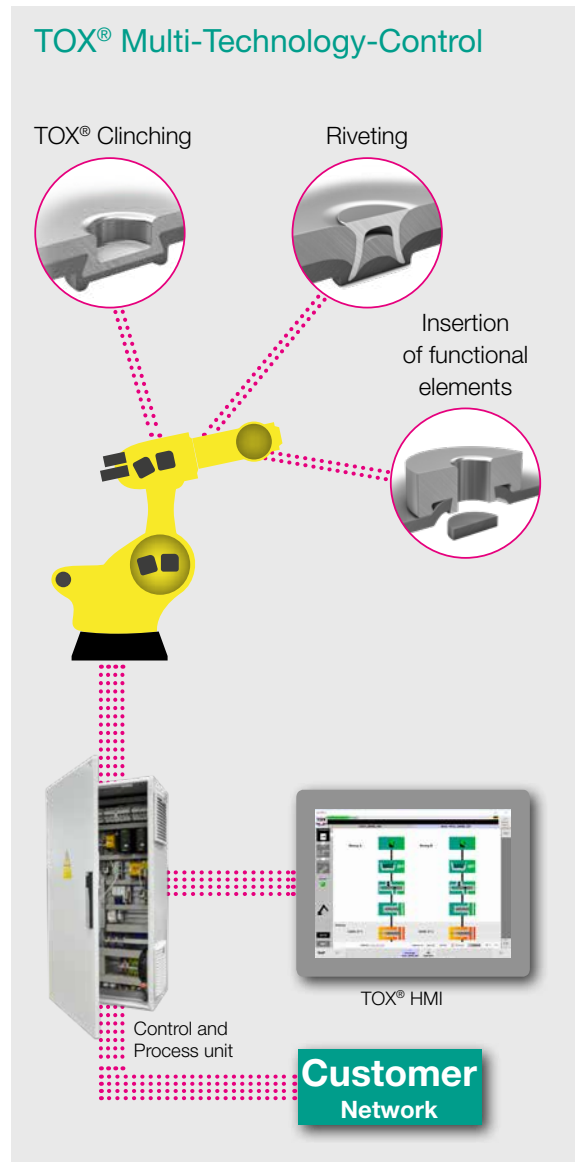
Additionally, the intuitive TOX® HMI software allows easy installation and operation of the system. It is clearly structured and internationally understandable.

### Integrated Production

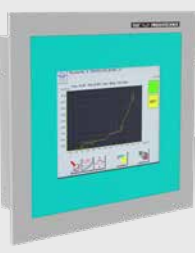
Using numerous interfaces, it is easy to connect the TOX® Equipment to a company network. The system components communicate with each other via fieldbus. Processes can be continuously monitored and improved with the data collected here. Feedback from the production process can be used to optimize the technology parameters. 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



## Process Monitoring Devices



The quality parameters of the element insertion can be examined and documented by a separate device.

## Sensors

Optional sensor systems can be used to check and display fill levels, process progress and also quality characteristics of the elements.





## Frames and Columns

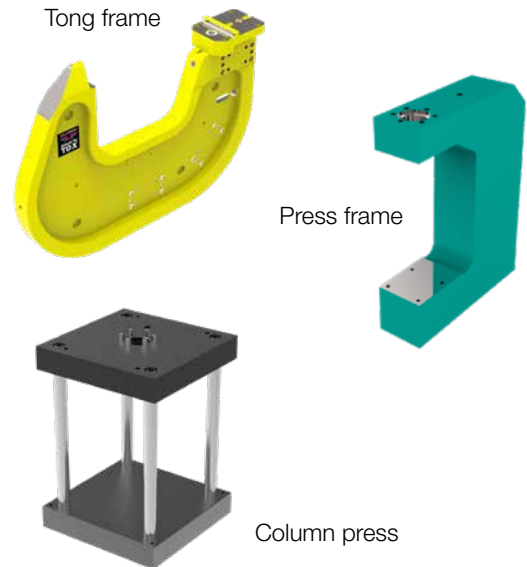
The forces that occur during insertion of functional elements are absorbed by a C-frame or the columns of a column press. The design takes into account interfering contours, total weight, piece part accessibility, working conditions and occupational safety.

### Frames

Robust 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 tools. They can be manufactured in various sizes, but all have the same precision and ease of access.



## TOX® Drives

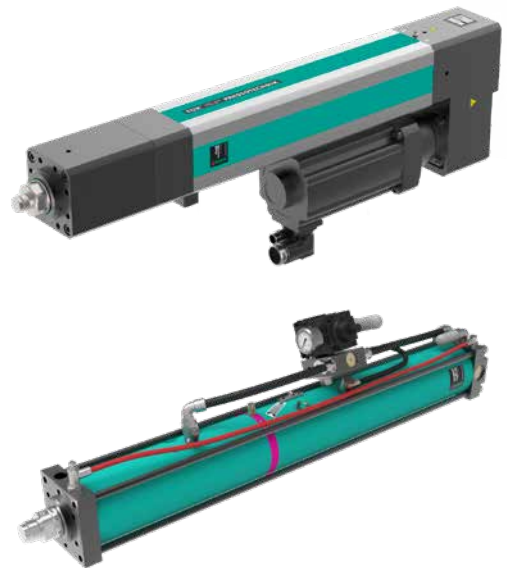
The insertion of elements requires high forces on the setting head. This forces are generated by electromechanical servo drives or pneumohydraulic Powerpackages.

### TOX® ElectricDrive

The modular electromechanical servo drive systems generate press forces up to 1000 kN.

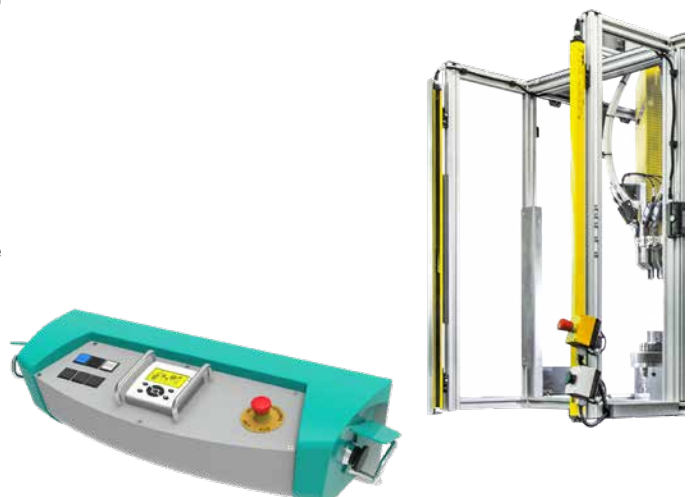
### TOX® Powerpackage

The strong pneumohydraulic drive, which is already used worldwide in thousands of machines. Available with press forces of 2 – 2000 kN. A special Powerpackage version X-KSD is used for pierce elements to damp the break trough.



## Additional Components

Information about additional components like controls, part fixtures, safety devices and accessories can be found on our website [www.tox.com](http://www.tox.com).



# Individual Solutions for our Customers

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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

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## Stationary Tongs

for pressing in self  
piercing nuts.



## 4-Column-Press

with multi-point tool  
for car body parts.



## Machine with 4 C-frames

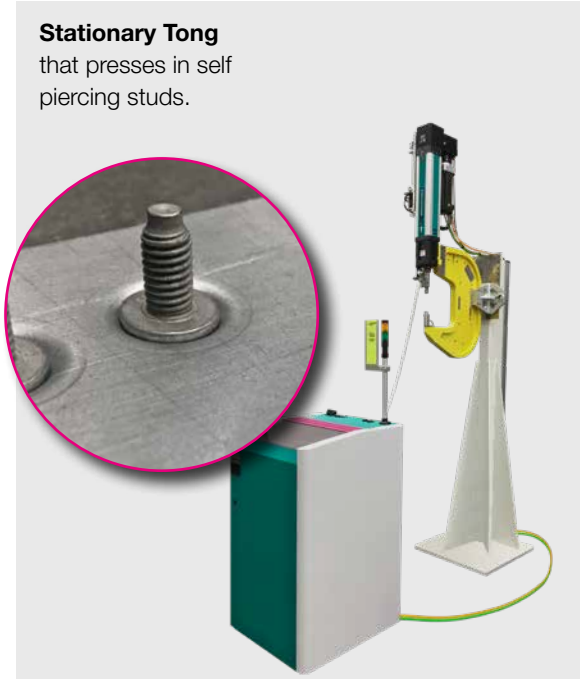
as a manual workstation for  
pressing in nuts.



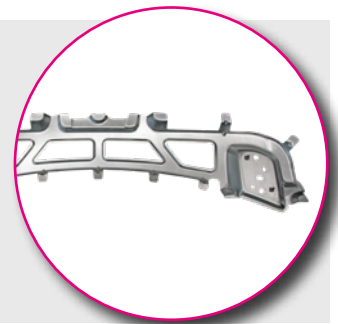
**Stationary Tong**  
for pressing in pierce  
nuts in an axle support.



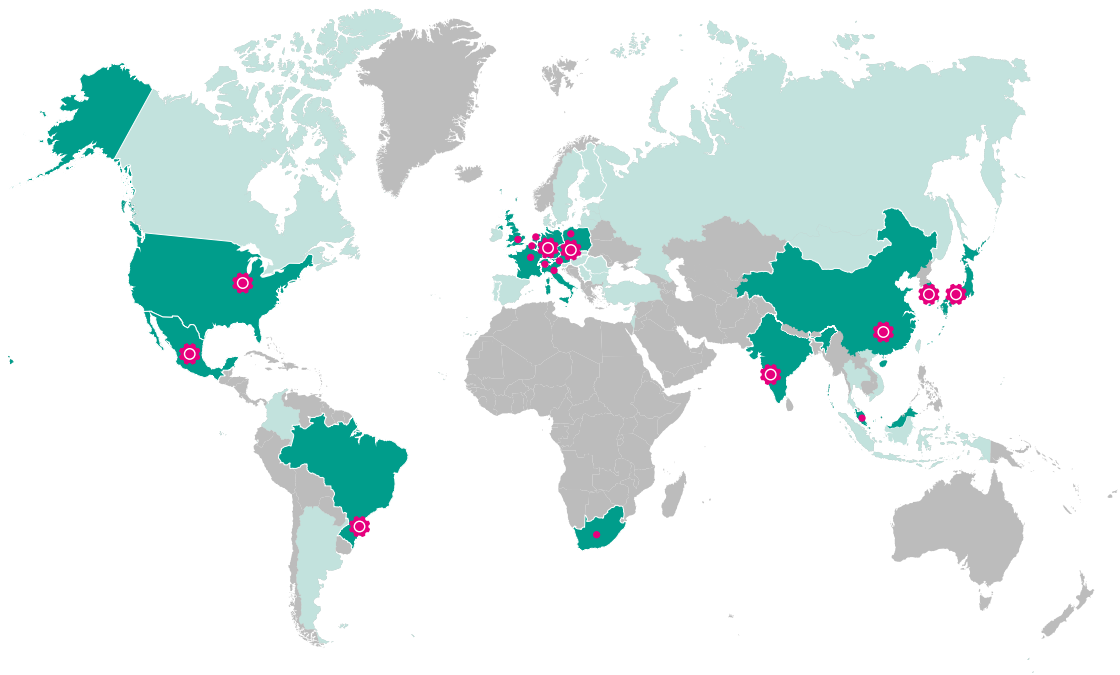
**Stationary Tong**  
that presses in self  
piercing studs.



**C-Frame Press**  
as a manual workplace.  
It presses in rivet bolts in a  
part of a car hood.



**4-Column-Manual Press,**  
which presses in grounding  
studs into the unpunched  
wheel arch of a car.



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Find your local contact partner at:  
[www.tox.com](http://www.tox.com)

840194 / 85.202309.en Subject to technical modifications.