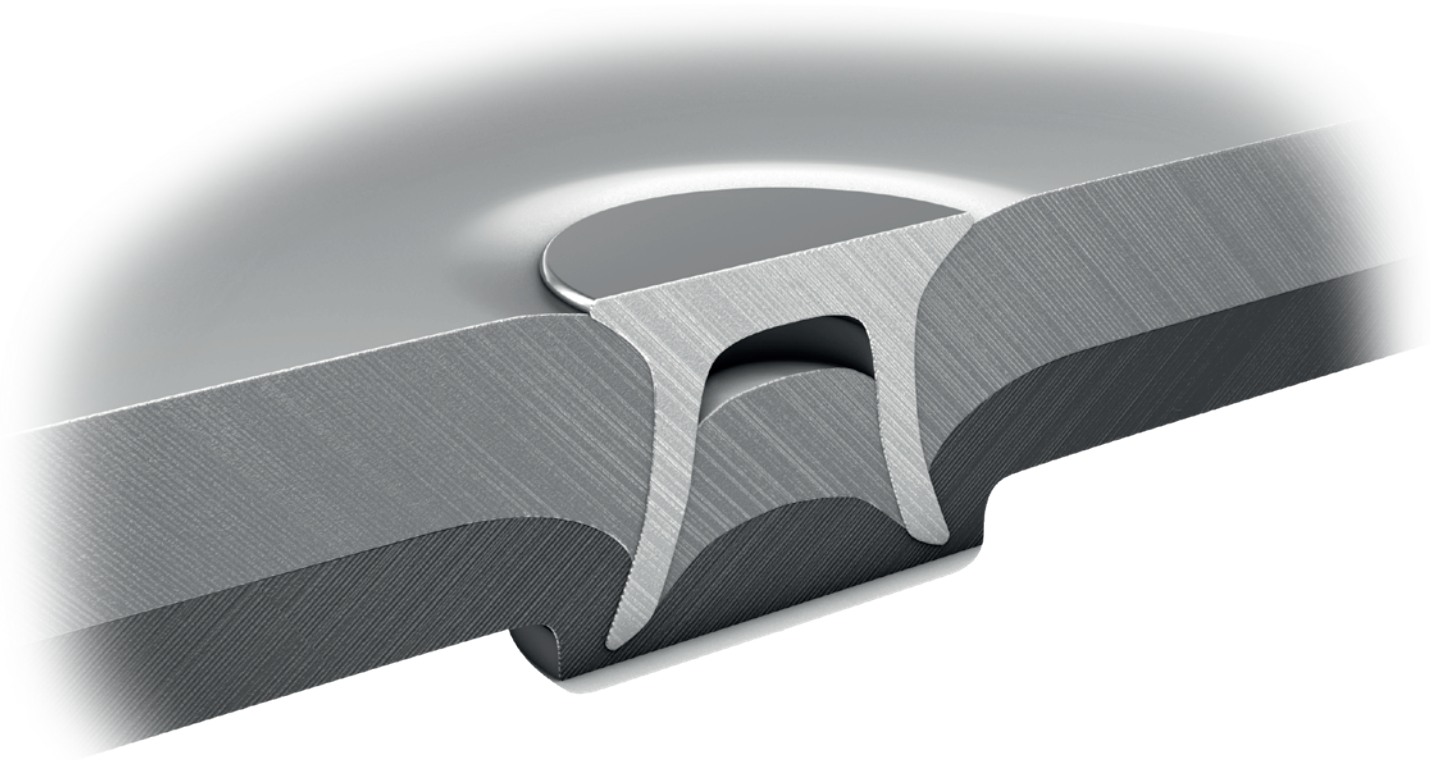
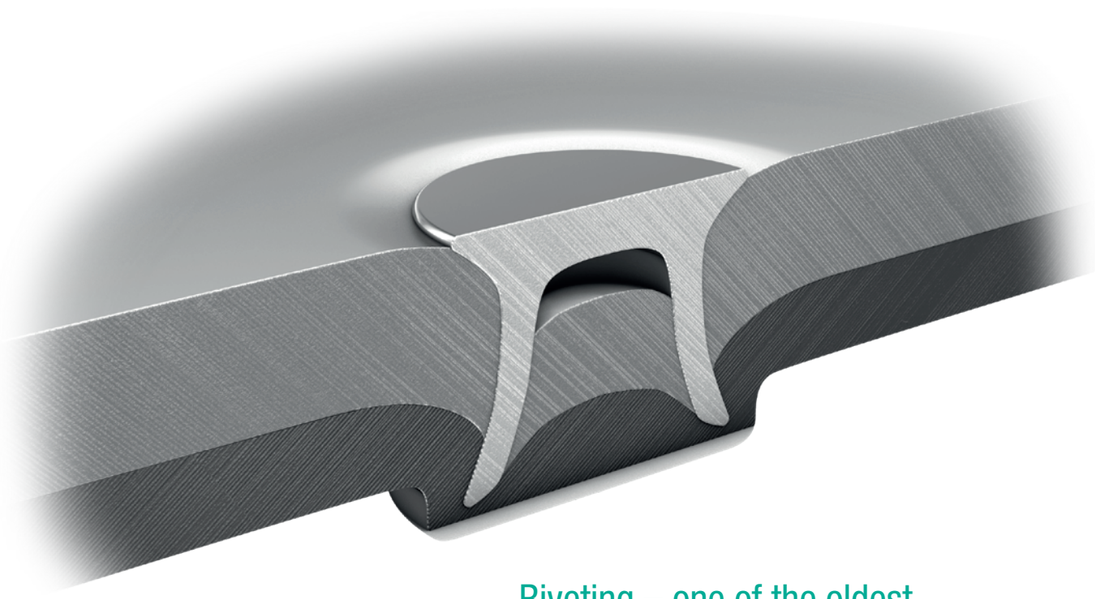
Riveting Technologies



Riveting Technologies



Riveting – one of the oldest joining technologies – even reliably joins dissimilar materials

A simple joining technology

In many industries including automotive, aerospace and appliances joining of metal components is achieved using riveting technologies. Riveting is a proven, professional joining technology, permanently joining two workpieces together. As opposed to screws, rivets have the advantage of not needing a thread. Compared to thermal joining, they also join non-weldable materials, thus making them ideal joining elements for lightweight designs and hybrid components. Fast cycling and high production rates make riveting an attractive and reasonably priced joining process.

In serial production, riveting processes without pre-drilled holes are typically used. This means the riveting elements punch through and deform themselves into the materials to join them in one work step. These joints are characterized by high strength and one or both sides flush surfaces.

Riveting Technologies

The styles of rivets

An important part of mechanical joining technology is riveting. It is based on the principle of a positive locking and/or frictional connection. The rivet itself is inserted into the parts to be joined where the rivet and/or joined part material are formed. In some instances, punching processes accompany the actual forming process.

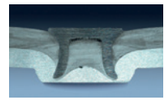
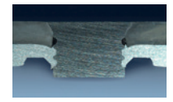
Self-Pierce Rivet
The self-pierce rivet (SPR) is a unidirectional element that functions as a punch through the top layer(s) of material. It has the most available applications.

- Higher joint strengths
- Air tight on the die side
- Ideal for high strength materials

Full-Pierce Rivet
The full-pierce rivet (FPR) is suited to joining high-strength, low elongation punch side materials to formable die side materials. It is also good for multi-layer applications.

- One rivet length for multiple material stack-ups
- Can be designed to be flush on both sides
- Ideal for joining lightweight and mixed materials

Rivet Comparison

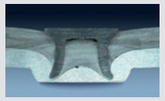
Rivets	Self-Pierce Rivet (SPR) 	Full-Pierce Rivet (FPR) 
Measurements of the typical rivets	Ø = 3.3 – 3.4 mm Rivet length 3.5 – 5.0 mm Ø = 5.15 – 5.5 mm Rivet length 4.0– 9.0 mm	Ø = 4.0 mm Rivet length 3.3 – 8.1 mm Ø = 5.0 mm Rivet length 3.9 – 8.1 mm
Material strength	< 1600 MPa	< 1500 MPa
Multirange capacity (different joining tasks)	low	very good
Multijoint capacity	possible	possible
Typical number of sheets	2 – 3	2 – 4
Flush surfaces	punch side	possible on one side and two sides
Pull strength (typical)	up to 2500 N	up to 2100 N
Shear strength (typical)	up to 4300 N	up to 3300 N
Minimum flange width	18 mm	16 mm
Layers cut	all except on die side	all
Gas-tight	yes, die side	no
Liquid-tight	yes, die side	no
Minimum sheet thickness on die side	1.0 mm	1.0 mm
Punched piece (slug) removal	no	yes
System complexity	medium	high
Electrical conductivity	average	average

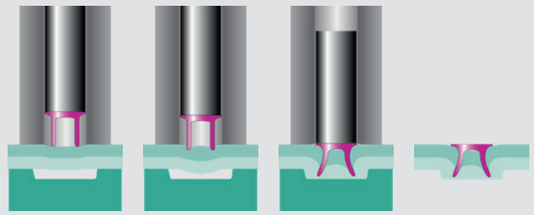
Process competence

Typical industrial riveting procedures

Self-pierce rivet (SPR)

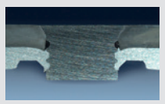
Universal and without slugs: The self-pierce rivet punches through the first material layer and forms the second to a closing head. The punched piece fills the hollow rivet shaft and is enclosed within it. This results in a high-strength and tight joint, which is flush at the top. This riveting technology is ideal for extremely flexible joints.

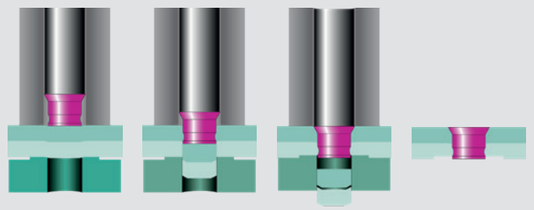




Full-pierce rivet (FPR)

Punching and joining in one step: The rivet punches through all sheet layers. The layer on the die side is formed in such a way that the material flows into the annular groove of the rivet and forms an undercut. This rivet joint can be formed flush on both sides and is ideally suited to joining high-strength materials.





Proven Process Quality

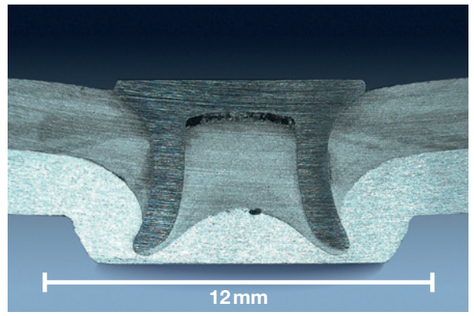
Continuous Quality Monitoring
A significant advantage of riveting is the simple quality control even in series production. By continuously measuring the force-travel-curve, each rivet connection can be checked. An additional analysis can be carried out by cross sections (cut through the rivet). The shear and pull strength can be determined in tensile tests.

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 rivet-die-combinations, 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 initial set-up of the delivered 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 (cut through the rivet), the exact formation can be examined under the microscope for analysis. If necessary, optimizations can be made.

System competence

The technology for industrial riveting

TOX® PRESSOTECHNIK, with its decades of experience, provides you with competent know-how of systems. Regardless of the manufacturer of your rivets, 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.

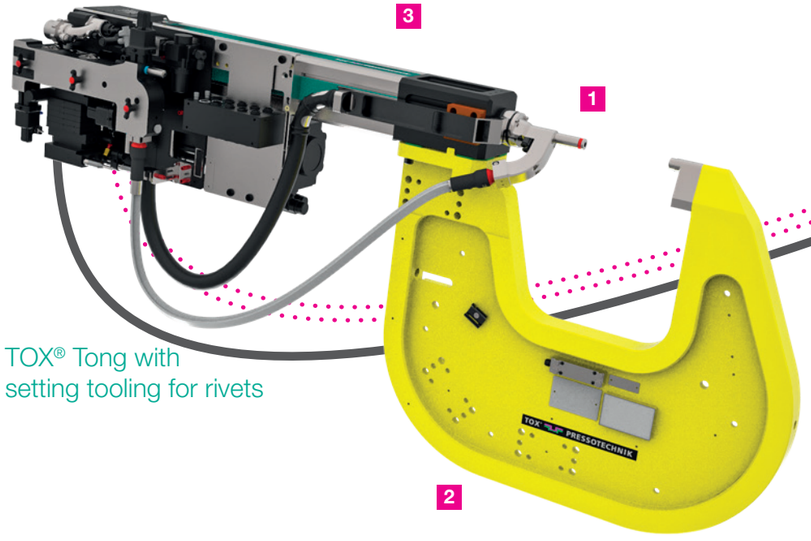
The following modules are required for riveting applications:

TOX® Tong

Setting tools 1
The rivet head and die together form the centerpiece. They drive the rivet into the workpiece and are adapted individually to each rivet.

Frame 2
The high forces occurring during riveting are absorbed in a low-deflection C-frame.

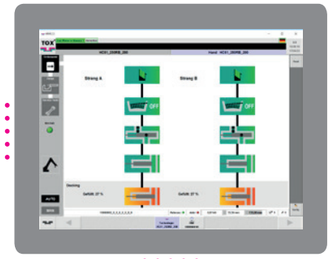
TOX® Drives 3
The forces required are generated by electromechanical servo drives or pneumohydraulic Powerpackages.



TOX® Tong with setting tooling for rivets

TOX® Rivet feeding

TOX® Control and process monitoring



Customer Network

TOX® Rivet feeding

TOX® FeedingUnit 4
Preparation of the rivet occurs in our compact enclosure. The hopper, vibratory bowl, escapement and blow feed prepare the rivet for delivery to the setting head.

Loading Station (Docking) 5
The tong fills its magazine with the required rivet here.

TOX® Control and process monitoring 6

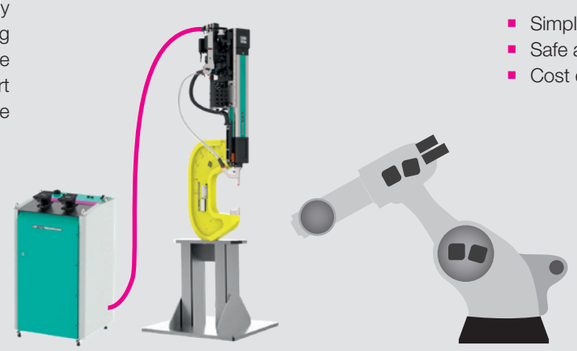
- Ranging from external impulse to complete PLC controls built to the highest safety standards
- Multi-technology controls available for additional processes
- Monitoring of process and machine parameters

System competence

Automatic Rivet Delivery for Tong Systems

Stationary BlowFeed System

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

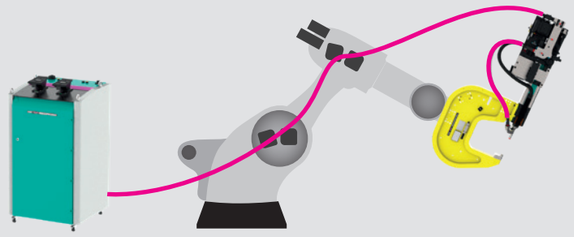


Advantages

- Simple
- Safe and reliable
- Cost effective

Robot-carried BlowFeed System

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

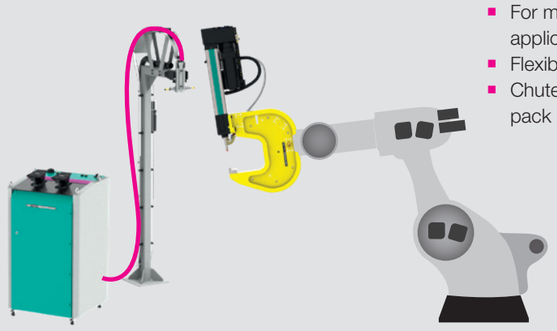


Advantages

- For large workpieces
- Safe and reliable
- Fast

DockFeed System (Magazine)

The rivets 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 rivets until the magazine is empty.



Advantages

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

Versions

Different basic designs are possible for rivet-systems. 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 rivet will be inserted by the press.

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

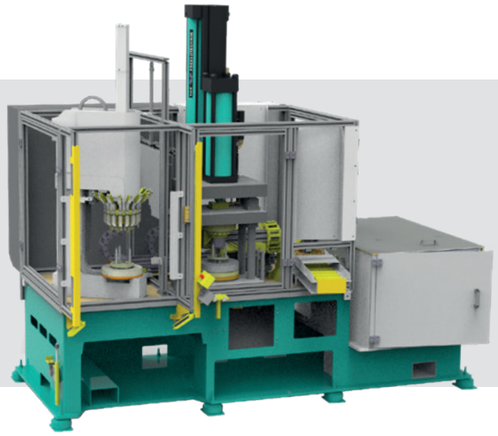
Hand tongs
For low volume production a hand-held tong can be utilized. The rivet can be delivered from the chute, a magazine or be hand loaded.

Presses / Machines
Machines can be designed as fully automatic, semi-automatic or purely manual workstations. The work-piece is manually loaded into the machine. The machine will then rivet per a customized plan.

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

Versions

Hand tong



Machine

Components

TOX® Setting heads

You define the element – we develop the suitable setting system. The different types of rivet place different demands on setting technique and rivet head.

Thanks to long-standing experience and the possibility of performing lab tests at our facilities, we supply the suitable rivet head for each rivet and each application. The structural design of the rivet heads differs depending on:

- Type of rivet
- Type of feeding
- Required press force
- Drive version

Advantages

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

Versions

TOX® Setting Head for self pierce riveting

TOX® Setting Head for full pierce riveting

TOX® Dies

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

Feeding hoses

Aflter sorting and singulation, the rivet is transported through a specially shaped chute to the setting head.

TOX® FeedingUnit

The TOX® FeedingUnit includes the sorting and delivery equipment for safe and reliable rivet 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 rivets form here.

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

Escapement:
The oriented rivets are singulated here for delivery to the setting head. From here the rivet is typically blown through a chute to the setting head.

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

Hopper

Feeder Bowl

Escapement

Components

Flexible control-software for the integrated production

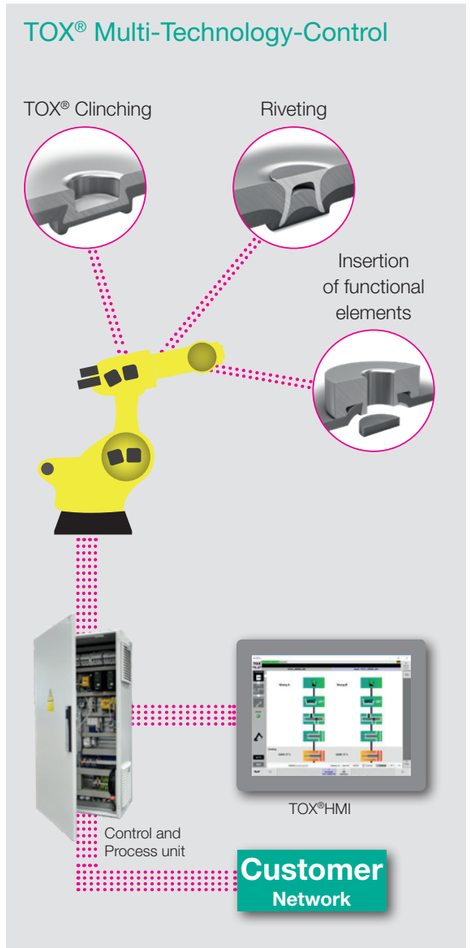
Flexible Multi-Technology Control
One system - many possibilities! Our multi-technology-control operates and monitors all functions. It is drive-independent and can be used for any technology. When a robot changes its tong, the system recognizes the parameters and can continue working immediately. This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

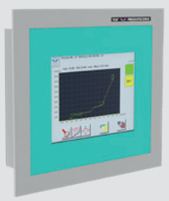
Integrated Production
Using numerous interfaces, it is easy to connect the TOX® Equipment to a company network. The system components communicate with each other via fieldbus. Processes can be continuously monitored and improved with the data collected here. Feed-back from the production process can 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 riveted joint can be examined and documented by a sperate device.

Sensors

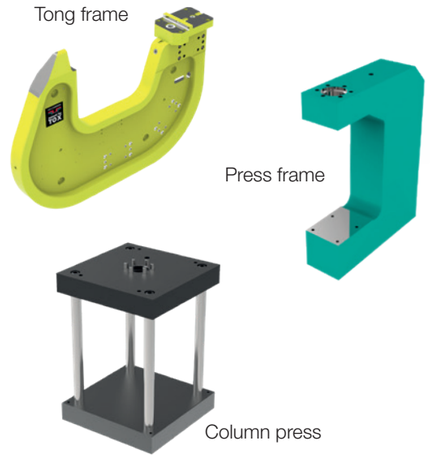
Optional sensor systems can be used to check and display fill levels, process progress and also quality characteristics of the elements.

Frames and Columns

The forces that occur during riveting 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.

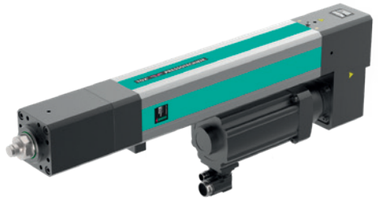


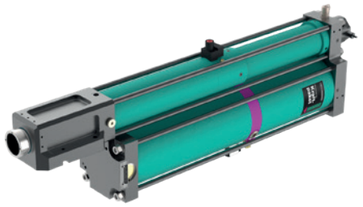
TOX® Drives

Large forces are needed to set a rivet joint. These required joining forces are generated by electro-mechanical servo drives or pneumohydraulic Powerpackages.

TOX® ElectricDrive
The modular electromechanical servo drive systems generate press forces up to 1000 kN. A maximum of 80 kN is required for riveting therefore most drives used have 30 – 100 kN.

TOX® Powerpackage
The strong pneumohydraulic drive, which is already used worldwide in thousands of machines. Available with press forces of 2 – 2000 kN.





Additional Components

Information about additional components like controls, part fixtures, safety devices and accessories can be found on our website www.tox.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

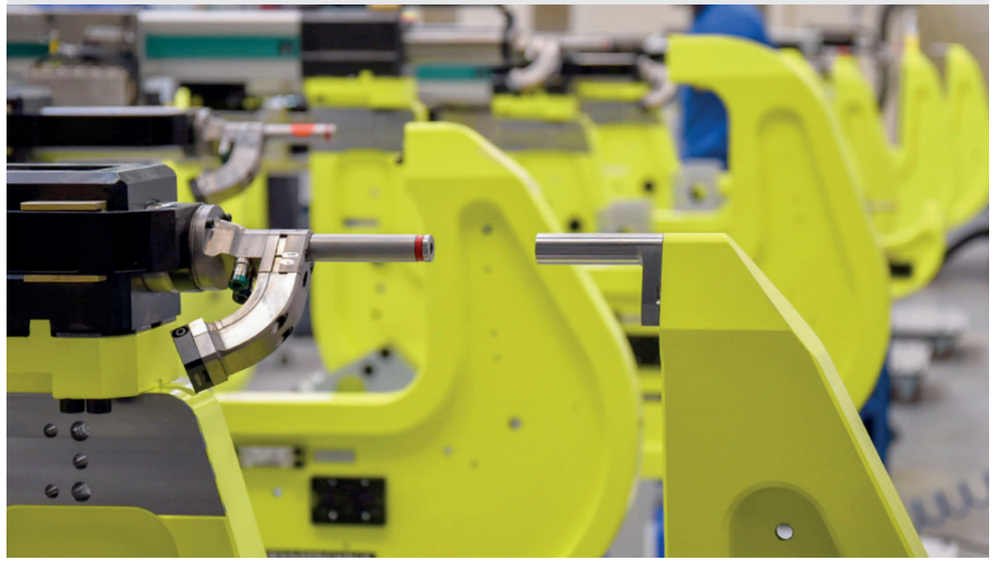
Once complete, a trial run of the system is performed. Once everything meets customer expectations, the customer approves the system. Following delivery, set-up and installation of the system, commissioning is performed by our qualified personnel.

After-sales service

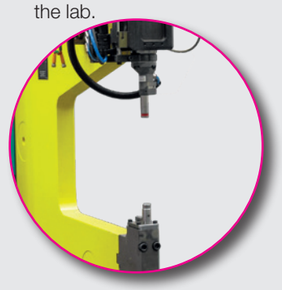
We train the operating personnel extensively – either at our premises or on site using the delivered system. Often, we also support initial production and provide advice and assistance. When everything is running smoothly, we are happy to perform regular maintenance tasks on request.

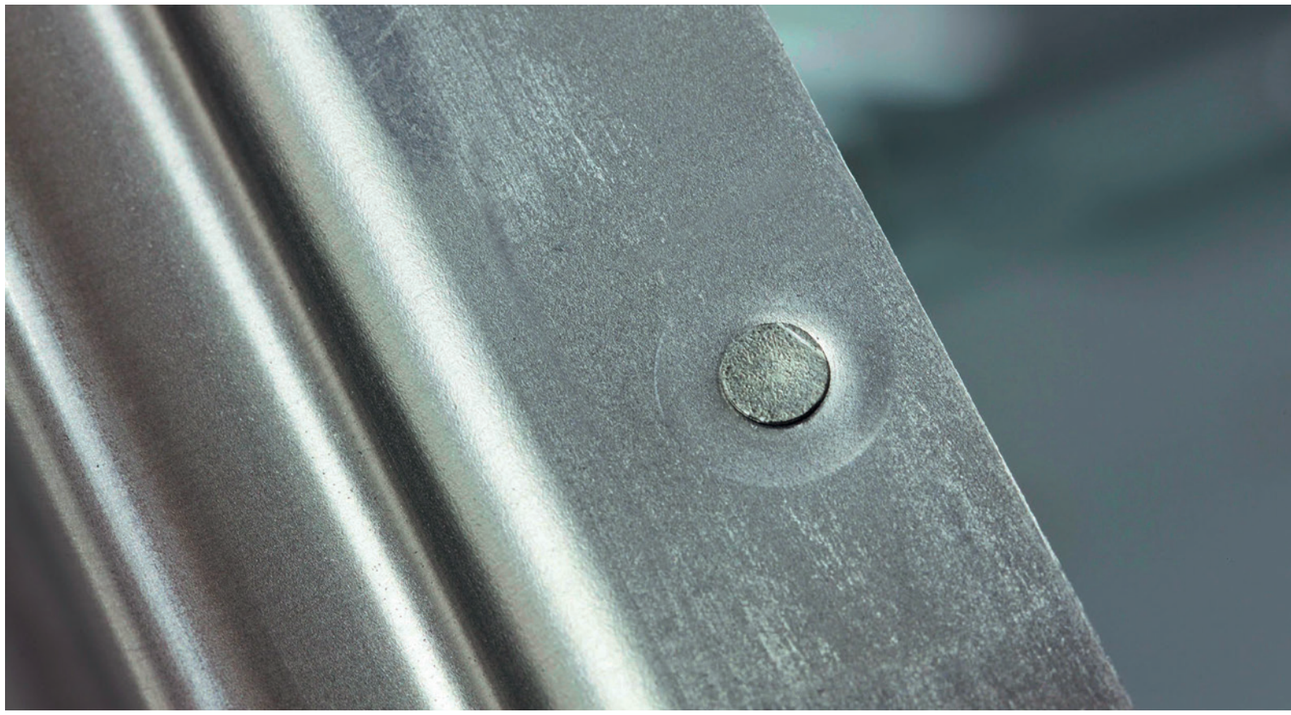
Application examples

TOX® Riveting robot tongs are often used in the automotive industry.

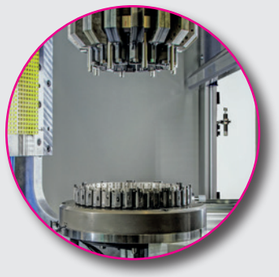


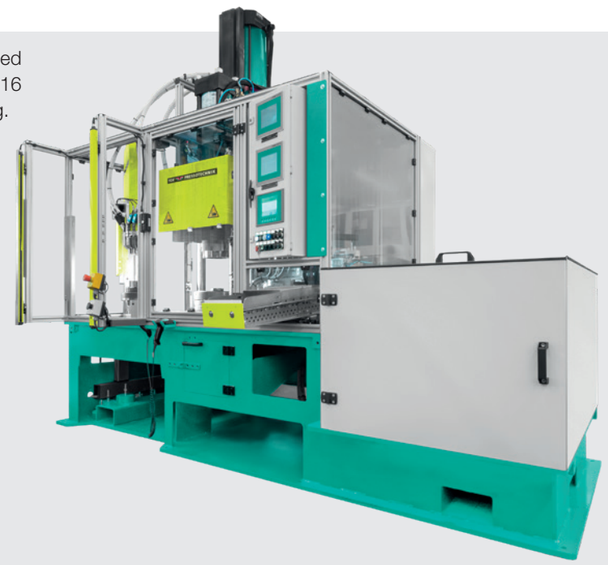
TOX® Press for the testing of different rivets in the lab.

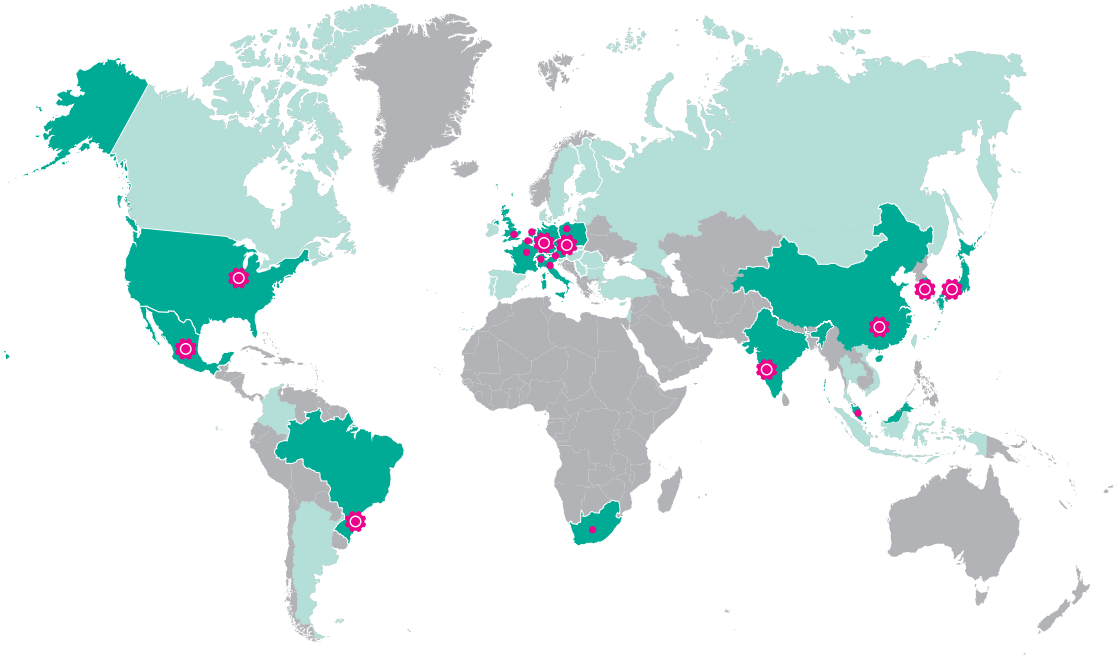




TOX® Press with partially automated workpiece handling for the setting of 16 full pierce rivets into a clutch housing.







TOX®

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