Functional element technology
In many industries components are equipped with elements such as nuts, bolts and screws. 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 contaminations or component distortions is required.

The connections provide good retention, particularly with regard to torques and press-out forces, 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.

<table>
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<tr>
<th>Technical advantages</th>
<th>Economical advantages</th>
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<tr>
<td>+ Fast processes that are easy to perform</td>
<td>+ Energy-saving processes</td>
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<tr>
<td>+ Verifiable connections</td>
<td>+ More cost-effective than welding technology</td>
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<tr>
<td>+ No filler material required</td>
<td>+ Lowering of personnel and labor costs</td>
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<td>+ Automatic feed in of elements possible</td>
<td>+ No rework required (e.g. painting)</td>
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<td>+ No heat development and distortion of the workpiece</td>
<td>+ Savings with regard to logistics costs, as only a few different functional elements need to be procured</td>
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<td>+ High positioning accuracy of the elements</td>
<td>+ Cost savings with regard to quality assurance</td>
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<td>+ No contamination of the workpiece during application</td>
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Functional elements can also be found in products like washing machines and dishwashers, heating elements, door frames and consumer electronics.

<table>
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<th>Application examples</th>
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<tr>
<td>Trunk lid/ trunk deck</td>
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<td>Hood/ front opening</td>
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<td>Spoiler/ Spoiler attachment</td>
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<td>Back shelf</td>
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<tr>
<td>Door sill/ door seal carrier</td>
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<td>Fender</td>
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Functional elements can also be found in products like washing machines and dishwashers, heating elements, door frames and consumer electronics.
TOX® PRESSOTECHNIK provides you with the best technological solutions and complete turnkey systems from one source. In addition to the most widely used processes for the installation of functional elements, our employees are also working on individual solutions. This is made possible through our experience, existing ideas and designs and our wide range of standard components.

### 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 force-locking connection.

#### Riveting
The element is inserted into a pre-punched component. It gets deformed and a solid connection is created.
We develop the most effective solution for your application through preliminary testing. We perform these tests on your samples which we test and analyze.

We also determine all parameters for your application including the required press force and tool geometry. We establish which system and processing technology can be used for your application.

Before we deliver the system we check the real processing results of the system and record these in a test report.

**Documented quality**

For every system, the customer will receive a detailed test report from the TOX® test laboratory. Here, we analyze the production process and the retention force of the functional element, create a cross section and record the exact specifications.

Our documented delivery state of the system is based on these values and parameters.

**Your benefits:**

- Demonstrable connection parameters
- Documentation of the pressing and pulling power
- Documentation of the maximum permissible torque
TOX® PRESSOTECHNIK, with its decades of experience, provides you with competent know-how of systems for the processing of functional elements.

The automatic machines represent complex systems. The elements must be provided, separated, fed, placed and pressed in. All processes are also monitored and accurately analyzed, to achieve consistent quality and repeatability.

Through our long-standing cooperation with numerous manufacturers of functional elements, we are able to custom fit to 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.

**1 Hopper system**
Fully automatic systems for receiving and storing the elements.

**2 Feeder**
Fully automatic systems as an alternative to manual loading.

**3 Singulation and escapement**
Blow feed, pick & place or alternative solutions.
4 Control and process monitoring
- Control and operating panels
- Comprehensive software for controlling and monitoring all processes
- Monitoring of force and position, as well as all processes

5 Tool
Dies, suitable for the application and processing.

6 Setting head
The correct tooling for all element types and brands.

7 Drive
- pneumohydraulic
- electric
- hydraulic

8 Component fixturing
Designed for ease of load and fastener placement accuracy.

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

Sensors
In addition, different checks can be performed automatically with sensors.

Extensions
Intelligent extensions and accessories like turn tables, component ejection systems or slug removal realized in a custom designed system.
System designs

Different basic designs are possible for systems that process functional elements. Systems can be designed as tongs – stationary or mobile – or as a press. They can be constructed as fully automatic, semi-automatic or purely manual workstations.

Crucial factors for choosing the system over another are the potential integration into a production line, optimum feed-in, the desired working speed, the size of the components etc.

Design as robot tongs
The tongs are controlled by a robot. The elements are either supplied by means of docking via a station or through the chuting.

Design as C-frame freestanding unit
The component is handled by the robot and the elements are supplied automatically.

Machine design as a manual workstation
Manual insertion of the components and automatic or manual supply of the elements.
Components

Setting head

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 structural design of the setting heads differs depending on:

+ Shape of the functional element
+ Type of feeding
+ Required press forces
+ Drive versions (pneumatic, hydraulic, pneumohydraulic, electric)
+ Direction of setting (free, vertical from top, vertical from bottom, etc.)
+ The type of insertion

With the standard TOX® Setting Head, the elements are blown into the buffer area. They are separated with a pneumatic pusher, pushed into the retaining clip on the punch and retained. The light barrier detects whether the element is available and placed correctly. The ram then moves the element onto the component and presses it in.

Advantages

The advantages of the TOX® setting heads are:

+ 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

Setting head designs

**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 nuts and screws**

The elements are pushed via a chain, separated at the setting head, retained in a retaining clip and then inserted into the component from bottom to top.

**TOX®-Setting Head for elongated bolts**

Processes individually blown in elements with its own stroke, holding the elements safely in the punch and ensuring transmission of the required press force.

**TOX®-Setting Head for clinch rivet elements**

For elements that are blown individually, cross-pushed and clinched into the component in a downward movement.
Components

Hopper systems + Feeder

Prerequisite for smooth process flow: safe and reliable feeding of elements.

A hopper is used for stocking larger quantities of functional elements to be pressed in. The feeder bowl and escapment are adjusted to the desired manufacturing process depending on the type, shape and size of the element.

Control and monitoring system

The special control unit and process monitoring controls all processes, links numerous interfaces on customer side and checks and archives the quality data.

Base frame with control and drive electronics for the feed system. Ideally, the hopper, feeder bowl, control and drive electronics form one unit.

Singulation and escapement system

Singulation is required for the processing of some functional elements. The type of the functional element defines the feed method into the setting head. In most cases, this occurs by means of blown air and molded hoses.

Sensor modules that check the elements for dimensions or quality can be integrated here.

Blowing device

Element chute to the setting head

Buffer area for the elements

Monitoring of the fill level

Pneumatic slider for singulation of the elements includes sensor-supported discharge of defective parts.

Non-conforming part discharge
Components

Sensors
Fill levels, process progress and quality features of the elements to be processed are monitored and displayed with optional sensor systems.

For example thread detection for the functional element (figure on right). Here it is ensured that the singulated element meets the quality requirements. If it does not meet these, it is discharged.

With this technique, a long-term, consistently high production quality can be achieved.

Drives
The insertion of elements requires high forces on the setting head. These required joining forces are generated by pneumatic, hydraulic, pneumohydraulic or servo-electrical drives.

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

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

Additional components
Information about additional components like fixtures, controls, process monitoring, safety equipment and accessories can be found at www.tox-de.com.
The company TOX® PRESSOTECHNIK

Competent advice and excellent technical implementation

TOX® PRESSOTECHNIK designs economical machines using our special components, intelligent assembly systems and fully automatic feed mechanisms with integrated monitoring. We have long-standing competence and comprehensive know-how in the development and design of these systems.

We keep an eye on the process requirements at all times and place our customers as the center of our focus. We are committed to finding the best solution for optimizing the manufacturing processes according to their requirements.

Our machines are the result of the close cooperation between customers and our project managers. After sale our service team will be on hand quickly and reliably once the systems are delivered.

Reliable service worldwide

- Comprehensive experience with different applications in different industries (automotive and supply industry, white goods industry, medical technology and many more)
- TOX® PRESSOTECHNIK is your active partner – from planning to operation of the system
- Support for commissioning and process optimization
- Training at the customer’s site or at TOX® PRESSOTECHNIK
- Remote service possible
- Factory calibration and repair service

Competent advice and excellent technical implementation
Our strategic process for highest customer satisfaction

Advice
The system is designed based on extensive consultation with the customer. The components are put together with know-how and expertise, creating an initial system layout.

Prototyping
Prototyping runs are performed with original components and the functional elements.

Design
Concrete planning is applied to our design, where the machine layout and detailed drawings are created.

Manufacturing
All project-specific components are produced using the latest manufacturing machinery.

Assembly
Manufactured parts are then assembled and electronic and control components mounted to complete the machines.

Approval
Once completed, the machine is tested for functioning. Once all customer requirements are met the customer is then invited in for machine approval.

Commissioning
Following installation of the system, commissioning on site can be performed by our qualified personnel.

Training
Machine operators, service personnel and other responsible persons can be trained upon request. This can be done on site with the machinery or at our facility.

Service & Maintenance
For maintenance tasks and safety measurements, the TOX®-Service Team will be happy to assist. Remoteservicing of a system is also possible.
Functional element technology

Application examples

Machine for pressing in self-punching nuts into a suspension strut dome of a car (sheet thickness 4.0 and 5.5 mm). Special features: Slug ejection and verification of elements using lasers for high process reliability.

Manual workstation for the riveting of nuts into a pre-punched and pre-formed hinge reinforcement in an automotive application. Manual loading of the functional elements and the two components (left and right).
A system for pressing pierce-nuts into unpunched components. The system is operated fully automatically: a robot positions the component and an external impulse control initiates the work process.

A 4-column manual press, with which ground bolts are pressed into the unpunched wheel arch of a car. The components are loaded by the operator, the bolt is fed automatically.