

# The perfect foundation for precisely parameterizable, robot-assisted tightening processes

## RESULTS

- Ensured absolute process reliability, high flexibility, and zero-defect rates
- Provided high-functionality and flexibility for complex, robot-assisted processes
- Created a new high-precision, electropneumatic concept with integrated monitoring
- Reduced air consumption with compact, functional, and powerful pneumatics

## APPLICATION

Enabling robot-assisted auto body manufacturing

## CUSTOMER

Weber Schraubautomaten GmbH, Wolfratshausen, Germany

## CHALLENGE

Auto body manufacture in the automotive industry is leading the way in terms of these technological applications. As a central element, the body is a crucial element for the passive safety of vehicles, and is a load-bearing connection for virtually all components.

Demand for flow drill screws as a cold bonding technique for steel and aluminum is growing, especially in the automotive industry. Absolute process reliability, high flexibility, and zero-defect rates are crucial criteria when it comes to the increasingly popular automated tightening technology.

Materials have to get both lighter and sturdier, yet remain as cost-effective as possible. Advantageous for vehicles, this mixed construction places rigorous requirements on connection and bonding technology: Each individual material requires specific designs, which increases the complexity of material joining. The different parts have to be not only connected securely and permanently, but also easy to disconnect.



*“The special characteristics of flow drill screw processes place high demands on the underlying systems, which we can meet with Emerson’s proportional valve technology.”*

**Wolfgang Wagenstaller**  
Head of Mechanical Design at  
Weber Schraubautomaten

### SOLUTION

With over 20 years of experience with flow drill screws for auto body manufacture, Weber Schraubautomaten GmbH is a developer and recognized as the technological leader. The company's advanced tightening processes for state-of-the-art materials and compounds are based on in-depth knowledge expertise. This also applies to its RSF series flow drill screw systems, whose robust and reliable design has convinced renowned automotive manufacturers to use Weber Schraubautomaten's products.

In the latest generation of flow drill screw systems, Emerson's valve technology provides the perfect foundation for precisely parameterizable, robot-assisted tightening processes. The key to collaboration was the pneumatic specialists' comprehensive expertise in proportional control technology.

### Proportional control technology

"The special characteristics of flow drill screw processes place high demands on the underlying systems, which we can meet with Emerson's proportional valve technology," stresses Wolfgang Wagenstaller, responsible for mechanical design at Weber Schraubautomaten. "The process is extremely complex, which has to be reproduced in the process parameters especially. This is why high functionality and modularity are important criteria when selecting a pneumatic system. Components from Emerson offer these characteristics, while meeting our wishes for compact sizes and integration of the required I/O modules, including bus system."

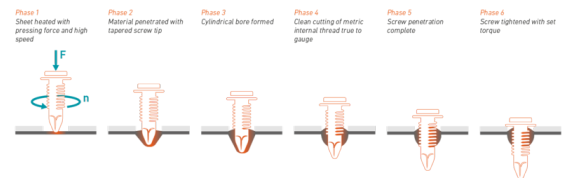
Using the advanced flow drill screw systems, workpieces are connected with a single mating surface without predrilled holes. Near the joint, the material is heated and becomes viscous, forming a flow hole. The screw then cuts a metric thread true to gauge, tightening to the defined torque when the head is reached. The pronounced shape of the thread results in an ultra-tight connection. If necessary, a flow drill screw can also be replaced with a standard metric screw later on.

### Extremely flexible thanks to exact parameterization

In close collaboration with Emerson, the engineers from Weber Schraubautomaten created a new electropneumatic concept, with the innovative AV03 Advanced Valve system as the critical element. In combination with electropneumatic pressure regulators, it is characterized by high precision and pressure that can be documented at all times. Furthermore, I/O modules capture the electrical signals from the sensors.

**"Our patented depth gradient recognizes changes to depth while the screw penetrates the material. This ensures switching at the right point in time, which only works with agile, fast valve and sensor technology."**

**Robert Stützer**  
Head of Testing Robert Stützer at Weber Schraubautomaten



*The flow drill screwing process takes place in several phases.*

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During the process, the EV03 series pressure regulators immediately detect a possible pressure drop or increase in the pneumatic system's circuit. The required pressure change is generated dynamically based on a target/actual value comparison on the output side. Ralf Wiethoff sees this as the foundation for streamlined processes: "Only a tightening process that can be parameterized in just this way offers flexible adjustment options that are absolutely crucial in this type of application."

The AES fieldbus connection allows the valve system to be integrated into the system's control structure, allowing compact, functional, and powerful pneumatics to be installed decentralized right where the actuators are. This enables shorter lines, which reduces dead volumes and pressure losses, and ultimately leads to lower air consumption.

### Switching at just the right moment

The details reveal just how flexible the tightening system has to be: The right combination of force and speed is essential for every single screw. Flow drilling requires high forces and torques, while thread-forming requires lower forces since the pitch of the screw determines the penetration velocity. The force applied should only ensure the bit's force application in the screw. In practice, this means several flow drill screws located next to each other may require different process curves.

"Our patented depth gradient recognizes changes to depth while the screw penetrates the material. This ensures switching at the right point in time, which only works with agile, fast valve and sensor technology," says technologist Robert Stützer, explaining the joining-specific features.



*The designers Ralf Wiethoff (middle) and Wolfgang Wagenstaller (right, both Weber screwdrivers) in conversation with...*

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