

**“A Revolutionary Solution in the Area of Bending Technology – TWISTER<sup>2</sup>, an Innovative Machine Concept with a Fully Integrated Robot”**

The TWISTER<sup>2</sup> robot bending system was one of the highlights at this year's WAFIOS In-House Exhibition.

Multiple TWISTER<sup>2</sup> manufacturing cells were presented in a separate hall showcasing the latest tube bending technology. First introduced at the wire and Tube trade fairs in Düsseldorf in 2018, the concept has undergone further enhancements over the past year and has now been developed into a modular system perfectly tailored to the user's requirements. What makes this machine concept so special is the complete integration of a robot. The tube bending machine and the robot share one and the same user interface in the form of the WAFIOS programming system WPS 3.2 Easy Way, enabling the interaction of bending and handling tasks. This concept allows the flexible and efficient production of three-dimensional geometries while ensuring high process reliability and exceptionally easy operation. Based on this concept, WAFIOS Tube Automation presented a cell solution for the production of hydraulic lines comprising the automatic feeding in of components, the endforming machine, and the TWISTER<sup>2</sup>.

The automotive supply industry is just one of the areas in which the TWISTER<sup>2</sup> system is set to make an impact, for instance, in fluid-conveying systems such as fuel or air conditioning lines. The system can also be used in the area of e-mobility, for example, in the production of cooling and heating lines for the thermal management of modern batteries.

#### Conventional bending technology versus robot bending technology

In conventional single-head tube bending machines, the advance feed unit positions the component on a linear axis along the direction of the tube in the bending head. The linear guidance inevitably leads to reduced freedom in comparison to positioning the component using a 6-axis robot, as is the case in the TWISTER<sup>2</sup> system.

With the TWISTER<sup>2</sup> the robot undertakes both guidance and handling tasks, as well as the advance feed during the bending process. In day-to-day operation, the TWISTER<sup>2</sup> offers a greater degree of freedom when it comes to manufacturing parts and machine operation.

The standardized modular system provides this new level of flexibility and can be assembled to suit the user's specific application requirements.

When it comes to handling the tube, the robot has a range of gripper systems at its disposal. The WAFIOS rotary gripper with +/- 190° rotary angle is perfect for bending components using a clamp, particularly for geometries with long clamped straight sections, such as in air conditioning lines with flexible elements made from rubber hoses. The hydropneumatic gripper only has a limited rotary angle and tends to be used with bent parts with short clamped straight sections. This is also the case with the pneumatic gripper, which has a lower clamping force in comparison to the hydropneumatic gripper.

The bending head work areas now accommodate tube diameters ranging from 12.7 x 1 mm through to 20 x 2 mm. Bending heads are also available which enable single-direction bending or complete left- and right-hand bending in a single cycle. Depending on the parts involved, the magazine solutions range from single-layer magazines with symmetrical attachment parts, indexing magazines for tubes with flexible elements or asymmetrical attachment parts, and tube loaders for smooth

tubes (for forming cells, for example), right through to project-specific special magazines.

The fully integrated robot provides the system control with a particularly special function in terms of modular design. The program editor ensures that the software is able to cover the modular complexity. Standardized modules can be flexibly configured as integrated cells, for example, for integrating different magazines. Processes of the individual components of the machinery system can be linked with the geometry of the component. The processing order is determined within the program sequence. This helps create more freedom and options for variation for cell solutions with standardized modules, as well as for integrating even the most varied of process steps, be it final forming, winding, or welding.

The TWISTER<sup>2</sup> is operated like a conventional WAFIOS tube bending machine. The process is identical. First, the bend parameters are read and entered. Then the bending program is calculated automatically using the available technology and tool data. Next, the bending process is simulated, for example, to carry out collision checks.

During operation, the robot takes over the axes for the advance feed and horizontal and vertical movement, as well as for changing the processing direction. Users are not required to have any knowledge about robots in order to generate a bending program. Programming takes place via the WAFIOS hand-held operating device rather than the robot control panel.

The fusion of robot control and bending program is revolutionary in the world of robot bending systems. By bringing together these two aspects, the rotary gripper travels the bend approach length as path of the advance feed axis during the bending process. The robot and tool motions are calculated and are carried out simultaneously, while the interpolation of the axes takes place automatically.

In countless respects, the TWISTER<sup>2</sup> system is an extremely economical solution. Thanks to axis interpolation, clamping and unclamping of the tube gripper takes place during the bending process. Further benefits include increased tool flexibility, improved cycle times, and greater dimensional accuracy.

In comparison to conventional tube bending machines, the TWISTER<sup>2</sup> system offers significant savings in terms of procurement costs. For a classic brake line, a magazine for the feeding station, a bending machine, and a handling robot are usually needed. Whereas WAFIOS TWISTER<sup>2</sup> only requires the addition of a magazine, offering greater freedom and flexibility.

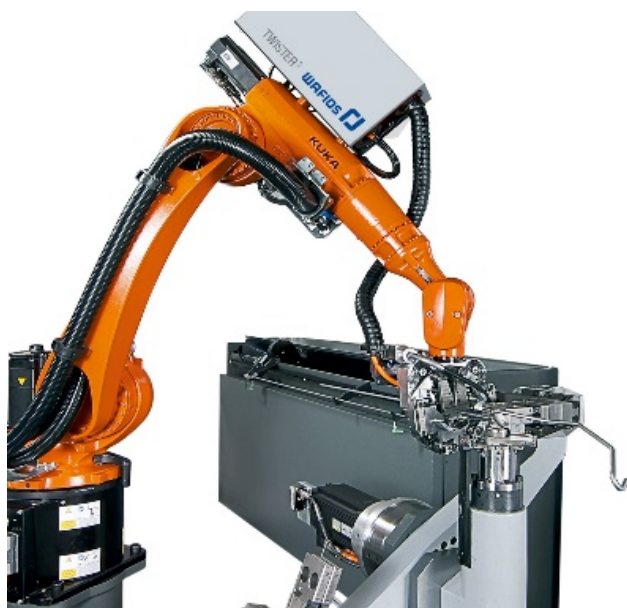


Fig. 1 WAFIOS TWISTER²

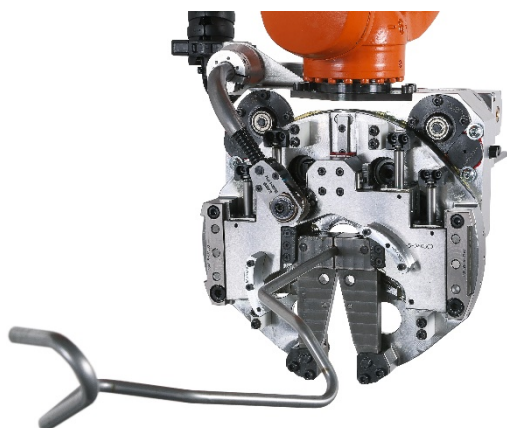


Fig. 2 WAFIOS TWISTER² gripper tool



Fig. 3 Bending head

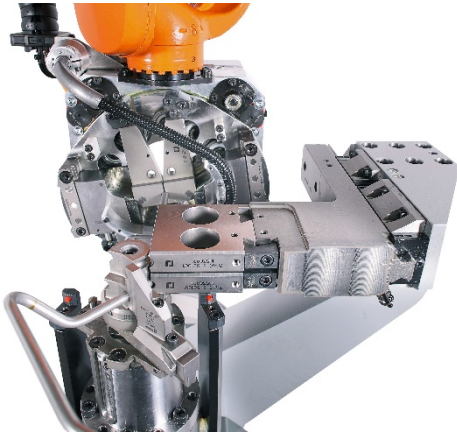


Fig. 4 Tool area

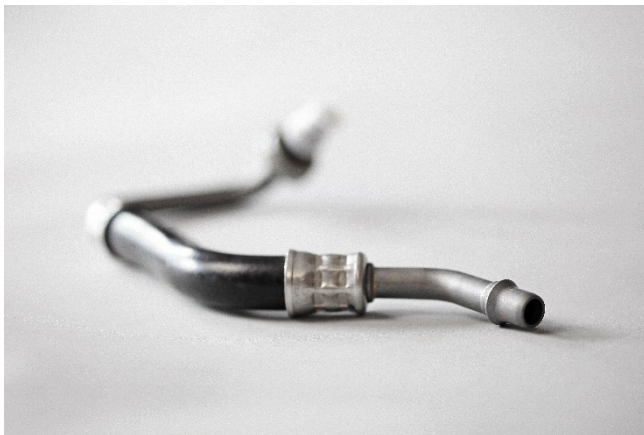


Fig. 5 TWISTER² application model – Hydraulic line



Fig. 6 TWISTER<sup>2</sup> application model – Fluid line



Fig. 7 TWISTER<sup>2</sup> application model – Steering hydraulics