COMBINED CONTROL

Universal stretch-bending machines revalued with Panel PC and Soft-PLC

The Lewa Attendorn GmbH employs a Panel PC and Soft-PLC to conveniently teach its universal sheet metal and profile stretch-bending machines complex three-dimensional programs with 12 to 16 axes. In the automatic mode, the duo controls the intensive data traffic to special hydraulic control modules and delivers precise, reproducible and absolutely crease-less bending results.

If all elements of the universal stretch-bending machine model 30/15/10 for a renowned automotive supplier are in their basic position, it does not appear too spectacular. Its real capabilities, however, quickly become apparent in the setup mode, if one tries to imagine how a series of movements by the individual axes would three-dimensionally bend a profile inserted into the machine. For sure, if one realizes that the movements in automatic mode are not carried out step-by-step, but instead interpolated simultaneously. In addition, factors such as the spring-back properties of the material need to be considered.

Simultaneous movement of 16 axes coordinated

No less than 10 controlled and 2 uncontrolled axes can be employed at the same time: The two main swivel axes U and X can each be moved discretely by 150° (-30°/+120°) and their center distance be varied from 500 to 2500 mm. The maximum stretching force is 30000 N, the bending torque 15000 Nm. Massive swivel arms contain stretching towers that hold the gimbal-mounted elements used for stretching the profile during the bending process. They can be moved horizontally (V, Y) as well as swiveled horizontally (F, D) and vertically (P, S) by 15°. There are also height axes (W, Z) and a swivel axis each for the chuck heads (Q, T).

With the exception of the horizontal stretch swivel axis (F, D), all axes are driven by hydraulically controlled servo motors.

Also requiring control are machine functions such as "move stretching towers", "clamp work piece", "move swivel arm", "clamp stretching towers" and "clamp swivel arms". In the maximum configuration, this machine model can have 16 axes - the most extensive machine made by this manufacturer so far counted 21 axes.

The amount of axes and functions results in very complex programs that often include up to 6000 values in multiple subprograms. Correspondingly powerful must be the control system. Like in earlier versions, the "teach-in" method for creating, optimizing, managing and, if required, modifying programs was to be available as well, e.g. to quickly and easily adjust for material properties that differ from batch to batch. Lewa Attendorn has chosen a concept with "distributed intelligence", employing an industrial Panel PC 670 from the Simatic HMI spectrum by Siemens. The central HMI utilizes ProTool/Pro, the configuration and visualization software from the same house.

Master the control tasks with "distributed intelligence"

The PLC functionality of the entire machine is handled by a Simatic WinAC RTX Soft-PLC, which also covers deterministic requirements and runs on a real-time subsystem for Windows NT. "This is a very fast solution without communication-slowing hardware between the HMI system and the PLC," states
Controller and drives

A bending program is always divided into switching instruction sets - comparable to specifying a basic position - and bending instruction sets - with which the individual hydraulic axes are moved to a desired position. Up to 16 switching instruction sets - each with up to four directly or conditionally executable functions - or bending instruction sets can be input in every screen mask and be combined to form the operational sequence. The goal is to accommodate as many actions as possible in a single instruction set to keep the cycle times low (on average 60 to 90 seconds from pick-up to pick-up) and the productivity on a high level. The operator can either input switching functions and motion paths numerically or "teach" the operations in jog mode and then transfer them to the program. Regardless of the method employed, an optimized sequence program is created in a very short time, which - stored in the recipe management database - can be linked to the corresponding bending tool and recalled for the automatic operation at the touch of a button.

In this specific application, the precise products are three-dimensionally formed window tracks made of U-shaped extrusion-molded aluminum profiles, which are later attached inside the window opening of the door frame and guide the windows. Since even the smallest irregularity - caused by uncontrolled compression of the material - would stand out on the painted outer surface, the profile has to be stretched - controllably - while being bent to prevent compressions, kinks or creases from forming.

With other bending forms, this machine can also shape roof rails, trim strips, coverings for A and B pillars or any product made of aluminum (or aluminum-like) profiles with a maximum cross-section of 30 x 30 mm. This universality expands the field of the stretch-bending machine by Lewa Attendorn far beyond the automotive realm.

the responsible design engineer of Lewa. The data from ProTool/Pro - stored in CSV archives - is sent PC- internally to the Soft-PLC via the OPC interface (OLE for Process Control). Another advantage of this pure, PC-based software solution is that the entire memory of the Panel PC can be used for PLC tasks.

Decision criteria for the Simatic Panel PC 670 with 10.4" TFT display (resolution of 640 x 480 pixels) and membrane keyboard included its large memory capacity - previously 256 MB, now up to 512 MB - and its proven ruggedness and reliability in rough industrial environments.

The devices are extremely shock- and vibration-resistant (5 g/1g) with dustproof faceplates meeting the IP65 degree of protection. In this application, the end user also requested the optional 24 V DC service to ensure certain "emergency operation properties". Programmer Uwe Engelmann has learned to appreciate the front-mounted USB port for connecting a mouse or full-size keyboard, with which he can conveniently edit programs onsite. For potential customers from the automotive industry and other segments it is important to know that the Panel PC 670 possesses all current interfaces including Profibus, MPI (Multi-Point-Interface), Ethernet (10/100 MBit), COM (two times) as well as LPT and thus can be, for example, integrated into higher-level company networks without additional plug-in cards. Slots are available for one PCI, one shared ISA/PCI and one PCMCIA card (cardbus slot type III).

The enormous computing power required for controlling the positions, forces and torque values of the many hydraulic axes is provided by the EB32 electronics module developed by Siemens Cologne.

This module - mounted at the back of the machine - collects the encoder signals of the individual axes and controls the flow rates of the various proportional valves via analog signals. With control times of less than one millisecond (for four axes), a positioning accuracy of 1/100 of a mm is achieved.