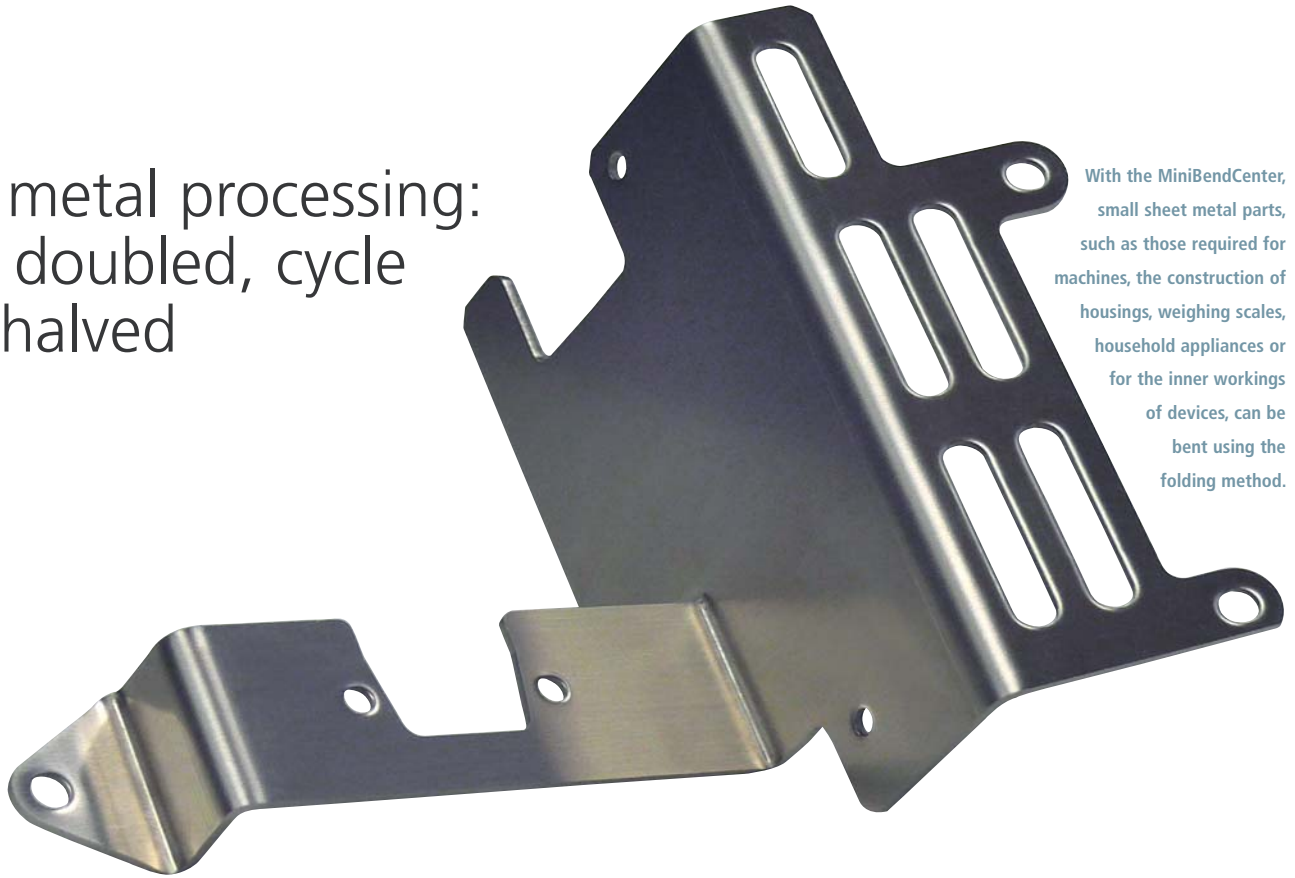


Sheet metal processing: speed doubled, cycle times halved



With the MiniBendCenter, small sheet metal parts, such as those required for machines, the construction of housings, weighing scales, household appliances or for the inner workings of devices, can be bent using the folding method.

The MiniBendCenter from the mechanical engineering firm RAS produces sheet metal parts fully automatically with the highest precision and cost-effectiveness. So that the complex bending process, complete with workpiece and tool handling, can proceed in a coordinated fashion, RAS has equipped its machine with a PC- and EtherCAT-based automation platform from Beckhoff during a re-engineering of the system.

RAS Reinhardt Maschinenbau GmbH, based in Sindelfingen, southwest Germany, has developed advanced machines for forming, bending, stamping and cutting sheet metal for over 70 years and is able to impress end-users again and again with technically innovative solutions. With the MiniBendCenter, which was introduced by RAS in 2009, small sheet metal parts can be bent, such as those required for machines, the construction of housings, weighing scales, household appliances or for the inner workings of devices. Press brakes have been considered the standard in this field up to now, while the folding technique was reserved exclusively for bending large format sheet metal. The MiniBendCenter now proves the opposite and shows that the folding technique is also economical and highly productive for the manufacturing of small, complex bent parts as well.

The metal sheets are fed to the bending center, aligned and measured automatically; tooling likewise takes place automatically. Subsequently, the metal sheet is positioned on the bending line by a manipulator or a stop system and clamped by upper and lower cheeks. The bending cheek swivels upwards or downwards and bends the metal sheet to the desired angle. Since the clamped part of the metal sheet remains horizontal while the other bent part leaves the support level, this procedure is very easy to automate.

Automation at the highest level

The MiniBendCenter is designed for processing blanks up to a format of 600 x 600 mm (23.6-in x 23.6-in) and a thickness of up to 3 mm. The process runs fully automatically. The steel sheets are fed in, which are preferably laser-cut and contained in a magazine, are separated and aligned in the take-up section of the MiniBendCenter and taken up by a manipulator, which has them optically measured at a station. The blank is clearly identified with regard to its size and position and exists 'logically' in the MiniBendCenter. The manipulator subsequently transports the blank to the bending line and guides it through all bending steps, i.e. from tool to tool, without loss of precision. Since the machine determines the exact position of the sheet in the manipulator once and does not release the sheet again afterwards, it does not require stops. "This procedure leads to fast bending processes, high output, large leaps in productivity and low unit costs," stresses Willy Stahl, Managing Partner of RAS Reinhardt Maschinenbau GmbH.

The required tools for the bending process are taken from the tool storage and installed in the bending cheek fully automatically. A CAM system developed by RAS supplies the machine controller with the data regarding the necessary tool lengths per station. A total of 14 axes, 11 of them servo axes, drive the upper and lower cheek, the bending cheek, the



The RAS MiniBendCenter is a fully automated, highly productive manufacturing center, which manufactures small, complex bent parts using the folding method.



A suction system grips the uppermost blank and brings it to the transfer table, where a manipulator takes over the part. This guides the sheet past an optical measuring station in the first step.



The steel sheets, measuring up to 600 x 600 mm (23.6-in x 23.6-in) with a thickness of up to 3 mm, are fed to the bending center, aligned and measured fully automatically. The tool change is likewise automatic.

manipulator and the tool changer. So that the complex bending process, complete with workpiece and tool handling, can proceed in a coordinated fashion, RAS has installed the Beckhoff automation platform during the re-engineering of the machine. It consists of a Beckhoff C6925 Industrial PC with a separate CP6932 Control Panel as the HMI, TwinCAT PLC and NC I automation software, EtherCAT I/O terminals and EtherCAT, the ultra

fast communication system. The TwinSAFE solution from Beckhoff was also implemented for secure safety data transmission.

Highest consistency and repeatability of the processes

All axes of the machine are driven by servomotors with digital controllers. This guarantees automatic processes with the highest consistency

and repeatability. "The MiniBendCenter performs all movements via cam plates with different groups of movements, which are coordinated with one another via a virtual axis," explains Jochen Meier, the RAS developer responsible for the programming of the bending center: "We describe the entire bending process by means of so-called bending tables, which are tied to NC I channels. This way, we have defined individual NC I channels with the position tables for the associated servo axes for the tool changer, the manipulator, the upper cheek, etc."

RAS uses TwinCAT NC I for interpolating movements. "TwinCAT NC I offers the possibility of configuring a virtual axis as an interpolating axis. This is defined in turn as a master axis, to which several slave axes are coupled by means of cam plates. Besides that, the NC I channel is not fed in the classic way via an NC file, but rather via a table created in the PLC," explains Dieter Völkle, responsible sales representative from the Beckhoff branch office in Balingen, Germany. Jochen Meier is completely satisfied with what has been achieved: "With the MiniBendCenter we have taken our leave of the traditional point-to-point travel; on the basis of TwinCAT NC I and the fast EtherCAT bus system, the axes can now be driven interpolatively. This solution was not possible with our original CAN bus-based control concept."

Simultaneously executed movements halve the cycle time

The utilization of TwinCAT NC I automation software has not only allowed RAS to optimize the processes – since all axes now drive interpolatively with one another – but so-called risk drives are also possible. "We start a new movement here, because we know that the other motion axes, e.g. the 3 axes of the bending cheeks, have already been driven to the decisive point. As a result, we were able to cut the cycle time in half," stresses Jochen Meier. Dieter Völkle comments on the complexity of the motion control: "The heart of the automation is the control via two NC I channels, which are 'fed' via the TwinCAT PLC. One of the NC I channels has 3 main and 5 auxiliary axes; one of these auxiliary axes functions in

turn as the master of 3 slave axes coupled via cam plates. Thus, up to 9 axes can be in motion simultaneously."

The bending program is generated via 3D simulation on the computer

At RAS, the automation of the sheet metal bending process begins with the design and work planning. "Since our customers deal increasingly with medium or small lot sizes nowadays, a powerful programming system is the basic prerequisite for economical production," explains Jochen Willmann, the RAS development manager responsible for the control technology.

"The CAM system, which is based on a 3D platform, permits the programming of complex bent parts in less than 30 minutes. The programmer determines the complete processing of the sheet metal part step by step from the 3D model. Once the bending program has been created on the computer, the MiniBendCenter has all the information it requires to generate the machine-specific operational sequence," adds Joachim Köhler, mechanical development manager at RAS. This way, the machine operator has virtually no programming tasks any more. The CAM software generates the complete machine program by transferring the 3D model back to the 2D level of the machine. The 2D model is applied offline on the machine as it were, wherein the measuring and orientation points are also specified. The processing program is then checked on the screen during work planning in the context of a virtual simulation, wherein the simulation program uses the real machine environment that exists as a 3D model in the system.

The processing program includes not only the handling of the blank through the respective production steps, from the measurement through all bending stations to the deposition of the finished sheet metal part; the preparatory process steps such as tool handling are also programmable via RAS-CAM. The tools for the different bending tasks stored in the MiniBendCenter's tool magazine are each provided with a code. On basis



A scanner recognizes the tools and inserts them with pinpoint accuracy into the cheeks by means of a matrix code.



Before bending begins, a tool changer equips the individual bending stations automatically. The machine controller receives the necessary tool lengths per station from the CAM system.



Once three points of the blank have been measured, the system knows the precise take-up position of the blank and corrects all deviations from the theoretical gripping position of the manipulator on the way to the first bending station.



Jochen Meier, RAS developer responsible for the programming of the bending center



Jochen Willmann, control technology development manager at RAS



Joachim Köhler, mechanical development manager at RAS

of this barcode, the tools are identified by the tool changer, removed from the magazine and installed in the correct order. After completion of the job, the tool changer automatically removes the tools from the machine and replaces them in the magazine.

New dimensions in sheet metal processing

The unusually high degree of automation of the MiniBendCenter can be used by all potential sheet metal processing plants. The processing center and the RAS programming tool can, but are not required to be networked with one another. The processing program can be loaded to the Beckhoff Industrial PC in other ways, e.g. via the USB interface or from a CD. "The concept of the system is that the virtual and real worlds are identical; that is to say, we image the designed workpiece in RAS-CAM the way it should be in reality. Therefore, the designed part must also contain the actual dimensions and radii, so that, if possible, no manipulations need to take place afterwards," explains Joachim Köhler. Jochen Willmann adds: "The workpieces intended for processing are sometimes so complex that

they can no longer be programmed with traditional editing methods in any case. Our concept of obtaining good results by the upstream insertion of this programming tool has paid off. The consequence in the machine environment was that we needed a powerful and flexible automation platform that is able to implement the CAM specifications with high quality. We have solved that optimally with PC Control from Beckhoff."

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The workpiece, which is clamped by an upper and lower clamping foot, is moved through the machine without a support table by the manipulator. It thus has all degrees of freedom: Apart from the rotation from bending side to bending side, it can move the sheet to the bending line, it can drive along the side of the machine and it can lift the sheet out in an upward direction.



A Control Panel detached from the Industrial PC serves as an operating and visualization platform.

Interview with Dipl.-Ing. Willy Stahl,
CEO of RAS Reinhardt Maschinenbau

At the BlechExpo 2009 trade show in Germany, RAS demonstrated the MiniBendCenter, an outstanding, fully automated machine center for the production of small bent parts. The automation has been completely redesigned in the meantime and a control platform from Beckhoff has been integrated. What are the reasons and goals associated with that

Willy Stahl: With the MiniBendCenter we want to perform very fast processing cycles, for which we need an open control platform that enables all machine functions and, on top of that, offers a comprehensive connection to the outside world – in other words, Internet capability. The latter in particular is of great importance to our service department. That's why we decided to redesign the machine controller.

From the customer's point of view, the coupling of the sheet metal bending center with job planning could gain in importance. How do you evaluate such possibilities?

Willy Stahl: These couplings are standard for us. With our bending centers for the processing of large parts it is possible to work through complete job lists. The customer can compile the daily requirement in the production planning, generate a job list from it and then work through it on the bending center.

How do you react as mechanical engineers to the development that more and more functionality is making inroads into software?

Willy Stahl: With the MiniBendCenter a total of 14 axes, 11 of them servo axes, are in use and so naturally the software increasingly gains in importance, because the necessary integration and networking are only possible by means of software. But beyond that our bending center represents a module within the customer's process chain, and we can very well imagine additionally achieving the connection to the shelf systems or utilizing a robot for loading and unloading. However, this would mean additional axes. That is precisely why the integration capability of the Beckhoff controller and its openness and flexibility were important selection criteria for us.



What qualifications do your customers need to have for such a highly automated machine?

Willy Stahl: We as mechanical engineers have moved everything onto our side that could make the handling of the machine difficult, complex or complicated. Thus the introduction of the MiniBendCenter has become as simple as possible for the customer. Many functions that run internally and in an extremely complex manner in the background are ultimately simple to operate from the point of view of the customer – at the front end, on the touchscreen.

The interaction of the operator with the machine is extraordinarily well-designed in terms of graphics and the transparency of the processes is ensured. The user is normally more likely to have difficulties with situations in which there is a problem due to a malfunction. How can you help the customer in such cases?

Willy Stahl: Beckhoff has also provided for ideal conditions here, so that we can access all hardware components via the PC. We can connect to our customers' bending centers via data networks using remote maintenance and query the status of the machine.

Will RAS be presenting the MiniBendCenter once again at the EuroBlech 2010 trade show?

Willy Stahl: We are certainly planning to. If we can manage it by the time of the trade show, our customers will also get to see a further 'tidbit'. However, we cannot divulge any more details than that at present.

RAS Reinhardt Maschinenbau GmbH

Innovation shapes the profile of the German mechanical engineering company RAS Reinhardt Maschinenbau GmbH, which developed the first fully automatic bending center, the Multibend, some 20 years ago and since then has continually brought new solutions onto the market for the cutting, bending, forming and punching of sheet metal. RAS is an owner-run, medium-sized company that generates turnover of approximately 35 millions Euros with around 210 employees