Well-filled order books call for intelligent solutions. In its efforts to realize capacity increases, the renowned small motor manufacturer set its sights on the robotized automation of a machine tool – and has come up with some impressive detail solutions.

For over 50 years, Dunkermotoren GmbH has been developing and producing precision drives, including brushless DC servo motors and brush-loaded DC motors. Its portfolio also includes planetary and worm gears, as well as brakes and encoder systems. With over 800 employees at its headquarters in Bonndorf in Schwarzwald, Dunkermotoren is the largest employer in the region. The company has a workforce of about 1,100 worldwide.

The supplier is faced with constantly growing demands for quality motors, to be used in all possible applications from assembly technology to venetian blind drives. At Dunkermotoren, where emphasis is placed on a very high degree of vertical integration of first class products, highly automated production processes are the first choice. Two factors play a critical role here: floor space and output targets. The former is in short supply, the latter are ambitious.

An automation solution realised by experienced system integrator EGS demonstrates how high-output solutions can look in practice. The task at hand was to design a robot-assisted feeding solution for an index ABC lathe with end shields. “We chose this automatic production lathe because it can produce turned parts – in our case end shields for our GR engine series – flexibly and economically. Our main concern, however, was the reliable automation of this machine, with which three primary objectives were to be achieved: reduced non-productive times, increased autonomy and a small footprint,” says industrial engineering specialist Tobias Bäumle, who is responsible for this project at Dunkermotoren.

Not an off-the-peg solution

For EGS Automatisierungstechnik from nearby Donaueschingen it was a routine assignment, as it had already realised robot solutions hundredfold for similar applications. It was able to roll out suitable feed systems in the form of the in-house SUMO series of pallet changing systems, on the basis of which even special solutions are quickly implemented.

EGS project manager Hartmut Pfalzgraf explains why the standard pallet changers were not an option at Dunkermotoren, and an individual solution had to be found: “Dunkermotoren uses its own specific workpiece carriers, on which the end shields pass through the production process. To ensure maximum efficiency in production, we had to discount additional handling procedures for transferring these parts. What remained was the integration of the existing workpiece carriers into the automation process.”

A glance at the installation suffices to see how perfectly EGS succeeded in the practical implementation of the task. What strikes the observer is the space-saving solution, in which the robot cell docks onto the machine within the smallest of spaces.
It is only thanks to the extremely compact Yaskawa Motoman MH12 robot that the cell was realized in the given small footprint. In this application, the six-axis robot truly comes into its own in terms of manoeuvrability, range and dynamics.

The key features of this trailblazing end-to-end solution are six defined positions within the robot cell for workpiece carrier pallet stacks, grouped around the six-axis robot. Five of these positions are for full pallets; one of them serves the sole purpose of stacking the empty pallets. The start of the production process is the manual loading of the cell. For this purpose the operator pushes five floor rollers fully loaded with workpiece pallets and one floor roller to accommodate the empty pallets into the system and starts the process.

Automatic gripper change at one-minute intervals

The robot’s job now consists of picking up a full workpiece carrier and placing it in a pre-determined position, at which the six-axis robot carries out the separation and delivery to the index lathe. Once all parts of a pallet have been separated, the robot deposits the empty pallet at the specified place and the process is repeated with the next pallet.

For this complex task the Motoman MH12 requires two different gripper systems: one for handling the complete workpiece carrier and a second one for separating the end shields. Because the gripper change takes place prior to and after processing each individual workpiece carrier, and this at one-minute intervals, EGS opted for an automatic gripper changing system.

The handling processes push the six-axis robot close to its limits in terms of payload, dynamism and agility. Its payload of 12 kg is only just sufficient for handling a full workpiece carrier, which depending on the bearing shield version can be loaded with up to 50 parts. The task is even more challenging in respect of its motion profile. The bottom workpiece carrier of a stack of pallets is located almost at floor level, whereas the transfer position of the individual workpieces is about half a metre above the index machine.

As in hardly any other application, the vertical range of the robot plays a decisive role here. “In order to reach the respective end positions in this operation, we had to place the six-axis robot on a pedestal at a precisely calculated position. This is the only way to handle this range of tasks with the extremely agile and compact MH12. A larger robot had to be ruled out due to the limited space,” stresses Pfalzgraf.

Reduced cycle times with the triple gripper

A further design highlight is the workpiece gripping system, consisting of three individual grippers arranged at 120 degree intervals. Bäumle explains why this solution is so important for productivity: “With the triple gripper we can pick up three parts in succession, directly from the pallet, and transport them in one journey to the transfer position on the lathe. This arrangement is critical for meeting the cycle time requirement. In addition, due to the multiple intake of raw parts the robot has a time buffer for pallet changing.”

The feed system that conveys the parts from the transfer position of the robot to the index machine was also designed in-house by EGS. The parts are carried easily and reliably to the chute of the lathe via a highly flexible conveyor-brush feed with a wide adjustment range that is fed with parts by the robot. Following processing, the bearing shields are discharged onto a round table with ready-placed product baskets.

Production strategist Bäumle talks enthusiastically about the automatic feeding of the lathe: “By reducing the cycle and non-productive times, we were able to increase output by about 25 %. One of the reasons is a 500 % higher degree of autonomy than in the previous process. After loading the cell with five pallet trucks, 2,400 parts are located in the system with the largest bearing shield version with a diameter of 63 millimetres. In other words, we work a complete shift completely autonomously.”
High availability – high degree of autonomy

The high level of availability, to which the reliability of the Yaskawa robot makes a crucial contribution, is the prerequisite for exploiting the theoretically determined autonomy in practice. Here again, the experience gained at Dunkermotoren since the system was commissioned in 2016 has been very good. Unscheduled system downtimes are the absolute exception and they are almost never due to technical reasons.

This high degree of autonomy has resulted in a significant reduction in non-productive times while feeding the machine, which in turn has boosted the output of the system overall. “Furthermore, this solution is highly flexible. At present only three bearing shield versions for much sought-after motors are passing through a system that is basically designed for a wide variety of versions. But the end-to-end solution consisting of an index machine and automation can be seen as an all-inclusive package that is capable of eliminating our capacity bottlenecks while satisfying the high quality and productivity demands at Dunkermotoren,” sums up Bäumle.