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Automated Line Pays

The addition of six presses and seven robots allows Kapco Inc. to tackle a 37,300-part/week automotive job requiring seven separate forming operations.

In 1997, an automotive manufacturer approached metal stamper Kapco Inc., Grafton, WI, with a job requiring seven different operations and a production rate of 37,300 parts per week, each measuring 17.5 in. long by 4 in. wide and 0.95 in. thick. To handle the new business, Kapco added six presses tended by seven material-handling robots, and built a new facility to house the operation. The one-of-a-kind production line, up and running in late 1998, has catapulted Kapco into a new arena of growth, capability and profit-generating capacity, according to company officials.

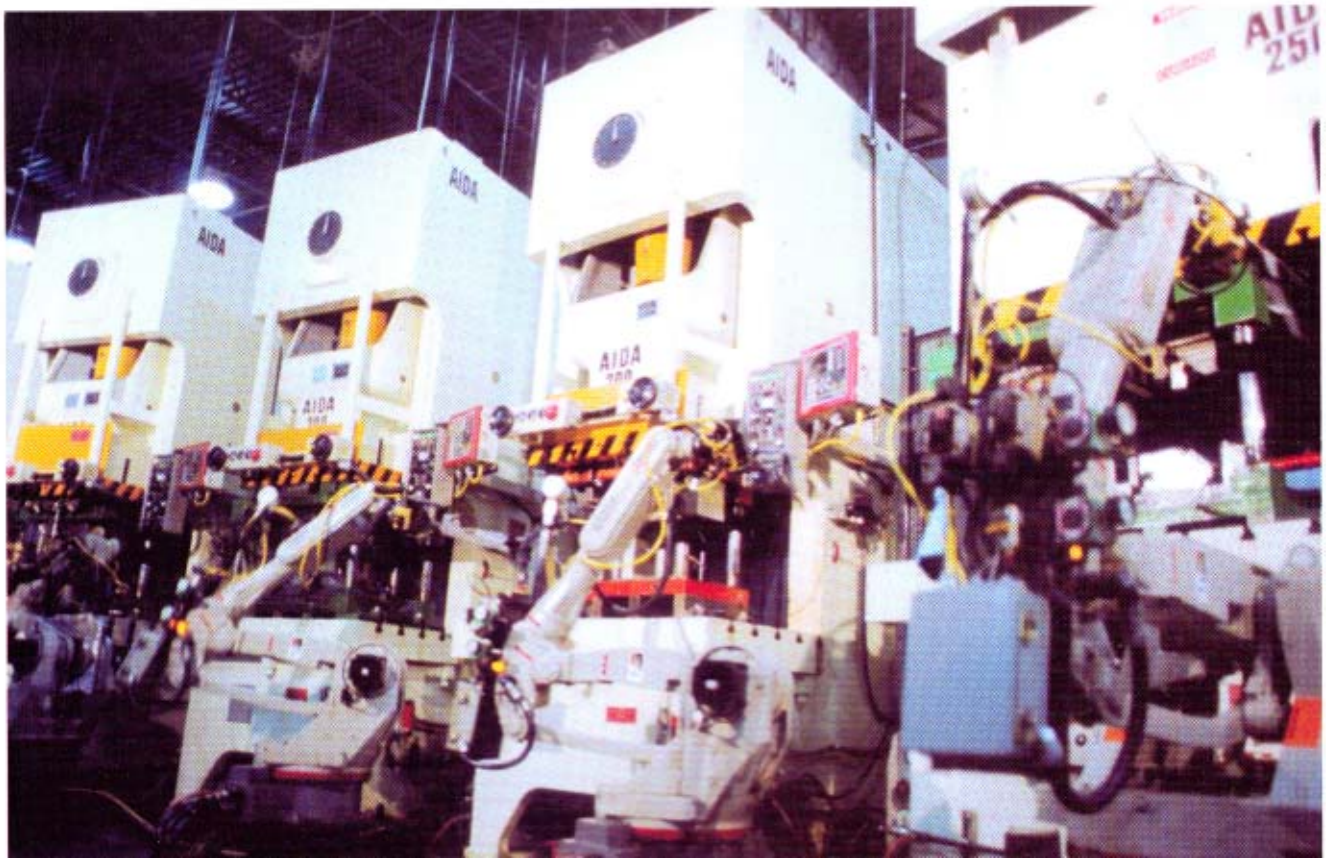
The Tier-Two/Tier-Three supplier manufactures component pieces for the automotive, lawn-and-garden, electric-motor, health-and-fitness, construction-equipment and heavy-truck markets. Its one-stop-shopping solution covers everything from stampings to drilling, tapping, fabricating, welding, painting and decorative coatings.

Kapco's partnership with Aida Dayton Technologies Corp., Dayton, OH, for the presses and Motoman Inc., West Carrollton, OH, for the robots was key to eliminating the obstacles this job presented, according to Kapco's Tom Kacmarcik Jr., president of manufacturing. And those obstacles were many.

"Our company has never turned down a job, no matter how big the challenge," he says. "Our first step was to find the most economical way to make the line productive. To do that, we needed six presses and we initially considered adding extra operators to run the line. But we soon found that even if we added 14 operators and ran two shifts a day, we were still 3000 parts short of what the customer needed. We also realized we didn't have the floor space to house the job."

Kapco turned its obstacles into an opportunity and broke ground for a new state-of-the-art 83,000-sq.-ft. manufacturing facility (see sidebar).

The next step was to find a press manufacturer that could provide six presses for the new facility. To do



the job, the first press in the line had to be a 600-ton progressive-die press. Kapco selected the Aida PMX.

Link Motion Clinches Press Choice

The PMX's unique link-motion setup provided the foundational support the line would need to operate successfully (Fig. 1). Link motion enhances metalforming operations in progressive-die work by maintaining the press slide near the bottom of the stroke for a greater number of crankshaft degrees of rotation than conventional crank or eccentric-motion presses, according to Aida officials. Its ability to reduce punch velocity holds pressure on the workpiece longer. Material has more time to flow because it is in the work portion of the stroke about 30 percent longer than with a conventional crank or eccentric-motion press.

Link motion uses this additional time to allow the part to "set" dimensionally. Thus the link drive can minimize springback and improve a part's dimensional stability and accuracy without lengthening overall cycle time. The link drive's modified slide motion allows the slide to regain the extra time spent at the bottom of the stroke as it travels through the nonworking portion of the stroke, resulting in improved part accuracy and reduced die cost.

"The link motion was the key characteristic that allowed us to start processing the part," Kacmarcik Jr. says. "When we began running production on the PMX, we saw productions rates we had never seen before. The link motion allowed us to run the job faster while our tooling ran slower. I was able to get the speed I needed without tearing the die apart by running the job that fast."

For Kapco, extended die life was an important consideration.

"We maintain our customers' tooling, so the ability to extend die life was critical for us," Kacmarcik Jr. explains. "This automotive-part job required us to run high-strength material (Grade-50 steel) that puts a lot of wear and tear on dies. The company we initially used to outsource the first operation had run parts on a conventional press and had to perform maintenance every 50,000 parts. With the new 600-ton progressive-die press, we ran 200,000 parts before we performed our first minor die maintenance."

That led to a pleasant problem.

"With all this increased production due to higher volume coming out of the press, we started to experience more downtime per hour in running it," he explains. "Since we were producing more parts per hour, we had more downtime for container changes and scrap removal. To fix that, we installed some finished-goods boxes and added conveyors with dividers. When one container is filled with material, a conveyor divider shifts the pieces off to another container. The press can keep going, giving the operator plenty of time to take the full container out and bring an empty one in. We just swap the containers in and out. For a job-shop stamper, that is a great problem to have."

Dividends

More Presses Needed

With the 600-ton press specified, Kapco still needed five presses to complete the line. "Job shops don't have deep pockets and we needed to maintain our versatility because we never know how long we'll have a job or what types of jobs will be coming through the door," Kacmarcik Jr. explains.

Kapco ordered four Aida NC1 200-ton gap-frame presses and one NC2 250-ton gap-frame press. The bed sizes—54 in. right-to-left and 33 in. front-to-back for the 200-ton models, 106 in. left-to-right and 36 in. front-to-back for the 250-ton model—easily accommodate the dies being used for the automotive part. The ability of the gap presses to single-stroke on a daily basis at the

New Equipment Receives New Home

The 83,000-sq.-ft. facility that Kapco built in Grafton, WI, to house its new automated press line was the latest in many efforts by the company to increase space.

Over the years, Kapco outgrew its original 62,000-sq.-ft. facility, also in Grafton. The company could not find additional space in that area, so it housed three presses at a new location in Slinger, WI, about 30 minutes west of Grafton. But as equipment was added, the company found it still needed space. In Jackson, WI, midway between Grafton and Slinger, the company opened a warehouse to store product. But when Kapco was awarded an automotive job that necessitated the automated press line, the company set out to build a new plant.

"Neither one of the current facilities could take on this job as no floor space was available," explains Tom Kacmarcik Jr., Kapco president of manufacturing. "So when this new, 83,000-sq.-ft. facility opened, we closed the Slinger location and those three presses went to the new location. We also closed the Jackson warehouse and that product went to the new facility."

But the original Grafton plant lacked floorspace, so three presses were moved from there to the new Grafton facility, where they joined the 600-ton press, the five gap-frame presses and seven robots needed for the new automotive job. The company recently purchased a 400-ton press, which also is housed at the new facility. About 140 employees work at the two Grafton operations.

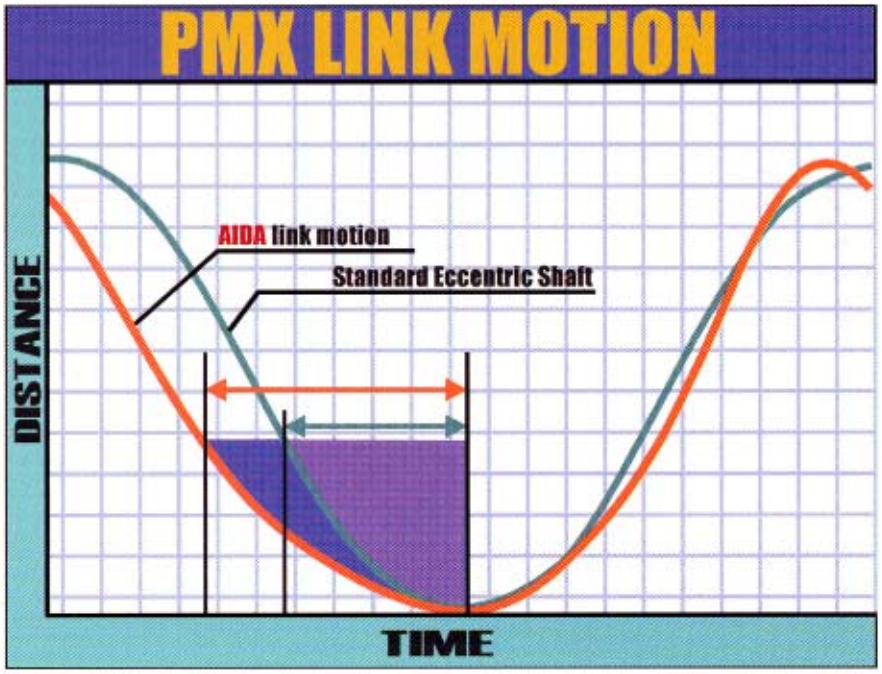


Fig. 1—The slide motion of an Aida PMX link-motion drive as compared to a conventional mechanical crank press. With link motion, the press spends as much as 30 percent more time near the bottom of the stroke, holding pressure on the workpiece longer, according to Aida officials. This minimizes springback by giving additional time for the workpiece to set dimensionally.

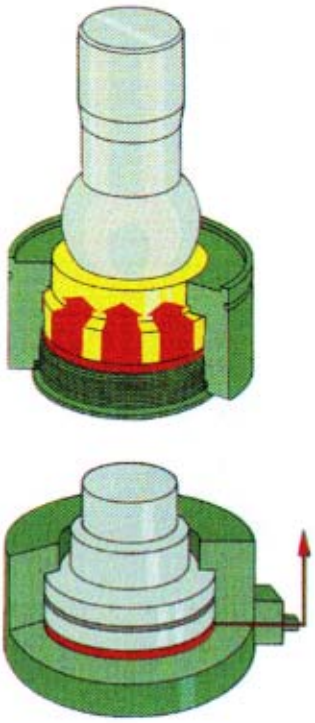


Fig. 2—Hydraulic overload protection is said to protect die and press components beyond the level provided by conventional presses.

speeds required by Kapco also were a consideration.

With presses on order and a new facility near completion, Kapco was putting the pieces in place. But the company still had a manufacturing problem. The line was still 3000 parts short, so Kapco began looking at ways to automate the line. The company's first option was to consider a mechanical transfer system.

But, like hiring additional operators, a mechanical transfer system brought its own set of problems to the Kapco job-shop environment.

Marrying Robots and Presses

"I knew the life expectancy on this job was only seven years and I didn't want to be in the position of having to throw away a transfer system that I couldn't use with anything else," Kacmarcik Jr. says. "So we decided to go with robotics. We contracted with Motoman, which had never tried that many robots in front of that many presses in such a tight configuration. But it was willing to take on the challenge."

Motoman officials determined that seven robots would be required to run the line and worked closely with Aida to ensure the robots would mesh with the operation of the presses. "A key issue was the capability to place the dies in exactly the same spot in the press each time they were used," Kacmarcik Jr. explains. "We were working with about 20 different dies so we determined that location holes for each of the dies would need to be drilled into the bolsters of the presses. I didn't have the capability to do that in-house."

Aida provided a solution. The presses were crated and ready for shipment from Aida's Dayton, OH, location, but Aida offered to uncrate the presses, take the bolsters off and machine holes to Kapco specifications.

"Aida sent me bolster diagrams," says Kacmarcik Jr. "I marked them and Aida did the work. When the presses arrived at my plant, they were ready to be placed on the line. The accuracy they gave me was more than adequate. The type of bushing arrangements I chose allowed for us—when we actually modified the tooling—to make mistakes and still allow the tooling to work.

Based upon drawings supplied by Kapco, Aida installed bushings into the bolsters. Kapco then could use drop pins to place the dies onto the press bed in their correct locations. This reduced changeover time—a must for this job, according to Kacmarcik Jr.

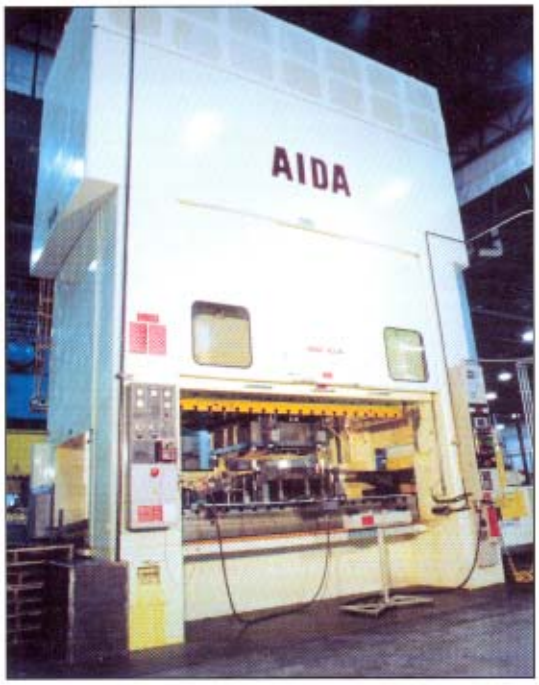
"If we completely change over the line, we have to change out all six dies and change the robot tooling," he says. "That now takes one operator only six hours to complete—changing out five presses and changing tooling on seven robots."

Working closely with Motoman, Aida modified its press controls to operate in concert with the robots. Also, flexibility to handle other jobs was designed into the robots.

"We were responsible for the layout of the cell and positioning the equipment in the proper orientation as well as creating the programming that would allow the robots to interface with the control systems of the

presses," says Lyle Weaver, Motoman project manager.

"Communication with Aida was a critical element in carrying out these responsibilities," Weaver adds. "They provided us with the footprint for each press as well as the mechanical and electrical specifications so that we could determine press clearances to properly lay out the cell. We also had to coordinate our delivery schedules to ensure that the robotic work cell arrived at about the same time as the presses."



Kapco's automated press line is anchored by an Aida PMX 600-ton progressive-die press.

Flexibility is Key

"This line is not job-specific, like a transfer system might be," stresses Kacmarcik Jr. "We can run each robot at each press as its own separate work center—they don't have to be run in sequence. For example, we have one job where we run two totally different parts, and each part is presented on each end of the press-and-robot line. Their final operations actually occur in the middle of the line, then we convey the finished parts out the back of the two middle presses. Half the line runs one part, and half the line runs a second part. Then we can shut one side down for changeovers while the other side runs."

One Allen-Bradley Slick 500 controller runs the whole line and each robot has its own controller for its unique tasks. The main Allen-Bradley controller monitors each of those controllers, making sure each robot has completed its program and checking sensors—installed in each robot's grippers—to make sure each robot is handling a part correctly.

Kapco does not have an operator assigned to watch the control panel at all times. Instead, each morning an operator manually turns on all of the presses and robot controllers. Then the control panel takes over, allowing the operator to load and inspect parts, and move finished containers. If a problem occurs, the main controller houses troubleshooting logic, developed by Motoman, to help operators determine the cause.

Motoman also was required to design and build tools for the ends of the robotic arms. End-of-arm tooling on the robots include vacuum cups for flat blanks presented to the line, gripper fingers and mandrels specially designed by Motoman that allow pick-up through holes in the parts.

As Kapco worked to put the final pieces in place in late 1998 for the new press line, the line's versatility surfaced.

"I discovered that by combining the speed of the presses with automation, I only would have to run the line three days a week to meet the parts requirement for the automotive job," says Kacmarcik Jr. "I had to decide how to use the other two days of the work week. We added four additional parts to bring the robotic line to capacity."

Die Maintenance Cut by 70 Percent

The new equipment benefits Kapco in another way.

"The 600-ton PMX has given us extended run times between die maintenance," Kacmarcik Jr. says, adding that the press is available with long left to right lengths, which allow Kapco to use large, multiple-station progressive dies. "Two of the dies used for the automotive job are 120 in. long, 40 in. wide and weigh 17,000 lb each," Kacmarcik stated.

Equipped with Aida's Hydraulic Overload Protection system, the PMX's slide connection is configured to operate as a high-speed valve, eliminating pressure relief valves and large hydraulic-flow systems found on older presses with wrist pin and saddle bushing connections (Fig. 2). As a result, die and press components are protected beyond the level provided by conventional presses.

"With every job we have used the PMX for, we've experienced at least a 100 percent increase in production and at least a 70 percent decrease in die maintenance," Kacmarcik Jr. says. "Combining the presses with robots has improved our part quality by 200 percent."

The Results

At Kapco, blanks enter the 600-ton progressive-die press, which makes two parts on each stroke, and does some partial shaping. A robot then picks up these parts from a tree, thus beginning the part's journey through the robotic line, which consists of six operations on five presses—tended by seven robots—to create forms, holes and extrusions. From beginning to end, each part spends about 56 sec. in the line.

This marriage of presses and robots has given Kapco the capability and flexibility it needs to remain a major player in the automotive-stamping universe. **MF**

Information for this article was supplied by Aida-Dayton Technologies Corp., 7660 Center Point 70 Blvd., Dayton, OH 45424-6380. Tel. 937/237-2382. Details also were supplied by Kapco Inc., 1000 Badger Circle, P.O. Box 227, Grafton, WI 53024-0227. Tel. 262/377-6500.

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