



Automati BRINGS PRESS LINE UP T

The automotive industry requires increasingly high production rates, maximum uptime, flexible production systems and reduced lead times. Recent consolidation means that companies such as DaimlerChrysler, GM and Ford have more brands, and in turn more variety in part specifications and schedules, forcing the need for maximum flexibility and responsiveness back to the supplier. This led one Tier One part supplier, AG Simpson (AGS), in April 2001, to upgrade the main press line at its Oshawa, Ontario, Canada, operation. The result: increased production flexi-

bility and throughput with a minimum of downtime for system install and die changes. The upgrade included robotics and control technology supplied by ABB Canada, Brampton, Ontario, Canada.

The subject of the upgrade, Press Line 111 is the workhorse at the Oshawa operation, responsible for producing steel bumpers for a Chevrolet full-sized truck. Seven mechanical presses form the line, with the lead double-action press featuring 1600-ton capacity on the inner slide and 900-ton capacity on the outer. Bed size here is 156 in. by 66 in. Following are six 800-ton presses

with bed sizes of 144 by 54 in. Line speed adjusts from 6 to 10 strokes/min.

Key to the line upgrade are ABB synchronized servo-driven six-axis robots. Mating the robots to the presses required advanced technology, witnessed by AGS engineers during a prototype demonstration of a single robot cell synchronized to a simulated press through the use of an encoder. Engineers were hopeful that the synchronizing technology would meet AGS' needs for maximum throughput and enhanced flexibility to move between multiple parts on a single press line.



On O SPEED

Rapid Installation a Must

But that was only a prototype—the robotic-line system would have to function in an unpredictable, harsh production environment, and meet an aggressive implementation schedule. When line production ceased on January 21, 2001, AGS shifted the work to its Cambridge, Ontario, operation. With costs for the shift approaching \$100,000/week, it was imperative that the upgrade be efficient and expedient. To help ease implementation, ABB and AGS personnel finalized concepts then prototyped and tested system components

AG Simpson has boosted its seven-press auto-part-production line with controls and robots employing advanced synchronization technology. The fast-paced upgrade also brings quicker job changeovers.

prior to install. In the concept stage, engineers created a universal restore process, ensuring that regardless of the stoppage scenario of the overall system, all robots and presses returned to a consistent home position immediately and reliably.

Fifteen ABB robots replaced 14 mechanical press loaders, with six mechanical conveyors converted to six servo-driven units. In addition, crews installed a flexible dual-blank cart destacker. Also, controls were upgraded across all the presses to ensure future linkage to an Allen Bradley Control-Logix 5555 Master Control PLC and maximum programming flexibility. Here, the installation of remote I/O communication and an extensive series of graphical operator interfaces allow for detailed press monitoring across critical variables such as tonnage, die protection and shut height. Use of the Master Control PLC allows maximum programming flexibility in the press line, according to ABB officials, facilitating production of multiple parts and reducing job-changeover time. The upgrade team completed programming for the Master Control PLC, safety PLC and graphical operator interfaces, paying careful attention to proper debugging of spontaneous line stoppages and development of proper response procedures to ensure minimal production interruption. Part recipes, created in advance, were fine-tuned after the upgrade to ensure flawless synchronization and maximum production capability.

Important in the controls upgrade was a separate safety PLC controlling all line-safety components from gate interlock devices across the line to safety control at the cell level. This offered triple-redundant processors as well as a modular safety bus network. The network, besides eliminating the need to hardwire all safeties back to one central control panel, offered flexibility in enhancing safety processes surrounding the press line.

All these upgrades not only have improved production flexibility but also have reduced downtime between die changes significantly. Time between last-part-off on one job to first-off on the next has been reduced from 13 hours to 30 min., allowing AGS to respond rapidly to changes in customer requirements and part volumes as well as market trends toward part varieties.

Robots and Presses Synchronized

The synchronizing technology employed in the line represents a considerable upgrade over conventional robotic press lines, according to ABB officials. Conventional lines employ “hand-shaking” between the press-status signals and the robotic controller, which only allows the press and robots to work in a start-and-stop mode. Typically, the robot waits for an external digital signal that represents press-ram status: fully open or fully closed. The robot then experiences a response delay, which causes an increase in cycle time. For automated press lines, this means



Through the use of robots with advanced synchronization technology, the AG Simpson plant in Oshawa, Ontario, Canada, has boosted speeds for production of steel pickup-truck bumpers on its main press line from 6 to 10 strokes/min.

increased automation time and cycle time; increased wear on presses and robot motors and brakes; and an increase in line energy consumption.

Advanced technology in processing and networking of status and command signals for automated press loading and unloading enables synchronization of all presses and related automation on the AGS line. Key is the ability to synchronize the press-to-press stamping sequence based on press-specific cam angles regardless of press speed while the loader and unloader robots work synchronized to each press but independently from each other. The resulting optimized production sequence permits continuous stamping with increased production throughput while increasing the availability and reliability of the stamping line.

An analogy to synchronizing the process of press loading and unloading is the traffic-light effect. Speeding up to reach a traffic light requires braking abruptly when the light turns red and high acceleration from a complete stop after the light turns green. A better approach is to maintain a constant speed when approaching the red light, a speed at which the light will turn green before you have to slow down. This permits constant movement without rapid deceleration and acceleration. In a robotic-press-line setting, this extends robot life while allowing travel to the end destination in less time or at least in the same amount of time.

But what speed is the right speed? The goal for synchronizing the robot loader and unloader to a stamping press lies in ensuring that the robot can reach the correct position at the right moment. Accurate positioning and timing requires continuous supervision of the press position via an encoder sensor and continuous speed adjustment to ensure repeatable positioning, capabilities built in to the upgraded line.

For press-to-press synchronization needed in the AGS seven-press line, an incremental encoder is mounted to each press' cam drive to communicate the press-ram speed and position for each stamping cycle. The press angle, which

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determines the linear position of the press ram, can be programmed through manual input or through automatic input from the press encoder, allowing real-time visualization of press position in the robot timing processor unit for robot control. Through monitoring of the press-ram linear motion, the robot loader and unloader directly synchronize to the stamping cycle, allowing each robot to reach its required position

at the correct moment without stopping the press cycle and without incurring excessive acceleration and deceleration of the robotic motion. The timing of a robot on the AGS line to arrive at its programmed position is accurate to within 20 msec., meaning the robots move where they are supposed to move at the precise moment as determined by the control program, in synch with press-ram travel.

Upgrade Boosted by Automated Line Control



AG Simpson (AGS) increased operating efficiency of its upgraded automated press line by integrating fully automated line supervisory control, courtesy of the ABB StampMaster system. This gives line operators complete control in setting cam angles and speed profiles for press-to-press and press-to-robot synchronization, and provides them with production, line and equipment status updates. It also assists in diagnostics and troubleshooting, and provides automated interaction for scheduling of daily tasks for production, maintenance, quality and production optimization. The operator can access all this information from the shop floor, the Intranet or the Internet.

With the line-control system, production status is determined by monitoring real-time feedback on speed, position and loading capacity of each press and robot. Machine efficiency status is determined by monitoring the operating parameters of each robot to predetermined load and timing data, which permits optimizing of line performance during production runs.

Direct links to diagnostic data and operational instructions allow AGS operators to control and maintain the stamping process with virtually no downtime caused by traditional failure modes on equipment and process components, according to ABB officials.

Furthermore, the diagnostic module of the StampMaster software records and computes current and historical process status and failure-mode data in order to analyze and predict reliability and maintainability of each component and the complete process.

Automation Brings Advantages

In sum, the line automation upgrade brings AGS a number of advantages:

- Continuous running of presses, allowing line production increases from 6 strokes/min. for conventional stamping to a maximum of 10 strokes/min. for synchronized stamping;

- Reduced wear on press components including brakes and clutches, increasing line availability and reliability while reducing its life-cycle cost;

- Improved robot safety as clear programming and automatic press and robot speed adaptation minimize collision risks;

- Ability of robots to adapt themselves to line-speed changes;

- Any number of positions available in robot paths, allowing creation of different speed profiles with many points.

The synergies developed in automation technology and data processing, displayed on the AG Simpson line, allow future applications of robot-to-robot synchronization, enabling real-time communication on speed and position feedback between press loading and unloading robots. The result will be transparent robot programming allowing both robots to reach a geometrical programmed position at the same time.

Upgrade Meshes with Restructuring

The upgrade occurred at a key juncture in AGS history as the company was restructuring in the midst of its acquisition by J2 Management Corp. Automation of the main press line fell in step with the stated philosophy of the "new" AGS: to fully exploit innovative and creative technology, in order to improve competitive positioning within the automotive industry and to provide superior quality and service to customers.

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