Servos Offer Solution for AHSS

Servomechanical presses provide solid options in combatting tough-metal challenges such as springback, reverse tonnage and more.

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We're well on our way to running out of adjectives to describe the new steels invading our forming and fabricating operations: high-strength steel… advanced high-strength steel (AHSS)… ultra-high-strength steel. Before super-duper-strength steels hit the market, we've got to learn to tackle what we already have, and develop plans for what's coming. That's the focus of R&D throughout manufacturing, and a major theme of the EWI Forming Workshop, co-sponsored with Precision Metalforming Association and held in October at Ohio State University.

One presentation, Successful Forming of Aluminum and AHSS Using a Mechanical Servo Press, offered up servomechanical-press solutions for forming ultra- and AHSS and combatting such hazards as springback and reverse tonnage. Beginning with a general comparison of mechanical, hydraulic and servomechanical presses, Shrini Patil, product manager for Aida-America, dug deeper into AHSS issues faced by stampers, and presented some shop-floor examples where servos shine.

More Energy at Lower Speed

Hydraulic presses provide capacities exceeding 50,000 tons, dwarfing those for mechanical (less than 6000 tons) and servo-driven (to 3500 tons) machines. As for speed and torque, hydraulic units maintain full torque throughout the stroke, with speed diminishing toward the top. On the other hand, traditional mechanical presses provide diminished speeds toward the bottom while maintaining torque on a standard torque curve. While servomechanical presses hold to the standard torque curve, they exhibit speed versatility throughout the stroke, as we'll find in upcoming examples. On the next set of features—repeatability, energy management, maintenance and operating cost—servo-driven presses win hands-down, according to Patil. The technology behind such capabilities translates to a high initial cost, but also the lowest lifecycle cost, he says, while providing attributes that aid in forming difficult materials.

Energy Ready When Needed

Let's look more closely at one servomechanical-press feature, energy

management, and how that can impact AHSS forming. As Patil explains, more press energy and tonnage are required in order to form a part if that same part must be produced from AHSS instead of medium- or low-carbon, or high-strength, low-alloy steel. Mechanical presses use flywheels to store energy and then provide it during forming operations. Servo-driven presses provide alternatives. Aida, for example, employs a capacitor-bank energy-management system, where capacitors store energy in DC form, with capacitor sizes based on a user's speed and stroke requirements. Here, the capacitors are charged continuously, and when the servo motors need excess energy, such as when drawing or coining, the capacitor banks bump up the supply. During the nonforming cycle, incoming electricity charges the capacitors so that they can supply extra energy when needed.

For slower-running applications, such as those often associated with AHSS, capacitors have more time to accept a charge, enabling full charging, and providing more energy, more efficiently, throughout the stroke for forming.

Quicker Advance and Return Aids Strokes/Min.

Even if more forming energy becomes available with a servo-driven press, strokes/min. and, in turn, productivity suffer due to the need for slower forming speeds when working with AHSS, right? Not so, Patil explains, thanks to the adjustable velocity along the stroke length, an important advantage inherent in servo-driven presses.

Suppose that part production includes a relatively deep draw of dual-phase (DP) 1400-MPa steel. Obviously, forming this material requires more energy than when working with DP 600-MPa steel, and may, for example, entail the need for six draw stations instead of three. And again, forming speed must be slowed. Whereas parts from the lower-strength material may be produced at 30 strokes/ min., working with the stronger material may require speeds not surpassing 15 strokes/min.

Stampers employing a servo-driven press can run at 15 strokes/min. during forming, but during all nonforming portions of the stroke, the press runs at top speed, thus achieving an overall speed of 30 strokes/min. and keeping production on track.

Effective in Battling Springback

Springback represents a huge challenge when stamping AHSS. At the EWI conference, Patil provides the example of a wing-channel project, where DP 350-MPa steel exhibits significant springback. Due to workhardening, separate restrike stations won't work. A shop-floor servo-press solution involved restrikes in the same cycle at bottom dead center, again, owing to the ability of servo-driven presses to control motion during the stroke. Within that single cycle, the tool restrikes two more times at bottom dead center for about 0.2 sec. each time, and uses heat as an ally to provide improved part definition and set the wings at required 90-deg. positions.

Reverse-Tonnage Reversal

Patil sees more and more cases of reverse tonnage, or snapthrough, in his travels, especially on older presses built before the dawn of AHSS. Reverse tonnage results from the release of pressing force when the part material fractures. This energy and vibration transfers through the tooling and press, and may result in significant damage. Presses not built to deal with the stresses and strains of forming AHSS are candidates for succumbing to reverse tonnage. Patil asks how a metal former without tonnage-monitoring capability knows if a press is experiencing reverse tonnage.

"When you see pieces falling off of your press, that's a sign of reverse tonnage," he bluntly assesses.

Shock dampeners provide some protection on traditional mechanical presses, says Patil, who offers the variable-stroke-speeds benefit of servo presses as a reverse-tonnage answer. Using a pressroom example, Patil describes a blanking die placed in a standard crank-motion mechanical press. Measurement reveals 114 tons of forward press force and reverse tonnage of 9 tons. The same die then is placed in a servomechanical press, with the ram descending rapidly prior to slow blanking. Not only does the bottom-stroke speed reduction lower the noise level significantly, from 101 to 75 dB, but forward force reduces to 104 tons, with reverse tonnage dropping to 2.6 tons, well within the recommended reverse-tonnage limit of 20 percent. Aida-America, Patil reports, will present this demonstration of a 70-percent-plus reverse-tonnage reduction at FABTECH in Booth D46027. **MF**