New applications for servo-driven presses

Part II: New technologies and advancements

BY ADAM GROSECLOSE

Editor's Note: This article is Part II of a two-part series that reviews applications of large servo-driven presses used for forming automotive parts. Part I, which appeared in the June issue, discussed the stamping of automotive components.

Three Slide Axes of Movement

A servo press has been developed recently that can carry out an orbital motion.[1] The slide of the press has three axes of movement so that orbital and swinging motions can be achieved when the three independent servo drive systems are programmed correctly. So it is possible to adjust the top dead center (TDC) and bottom dead center (BDC) positions, as well as the stroke length of each slide corner. In orbital mode, within the design limits, the speed of the orbital motion and the inclination angle can be controlled.

An example of this press application is forming bearing sleeves. Conventionally, these sleeves are formed starting with a U-bent preform in a two-step process (see **Figure 1**). The preform first is formed to a round cross section (U-O bending) and then coined. During the U-O bending, the sharp edges of the U-bent preform scratch the upper die surface and lead to die wear.

A new process that uses the orbital/swinging capability of this new servo press can help prevent die wear and improve productivity (see **Figure 2**). In the new process, preforming and finish-forming operations are integrated into a single, three-part tool. A cylindrical bending punch attached to the bottom die can be moved vertically by the top die using a pressure cylinder. Thus, the U-bent preform is formed first.

At the final lower position, the cylindrical punch acts as a blank holder for the preform. During the downstroke, the top die comes down with the repetitive swinging motion to incrementally form the U-bent preform into a round sleeve. After the round form is reached, the top die comes down vertically to calibrate the round section. This process eliminates any significant relative motion between the sharp edges of the preform and the upper die, thereby reducing die wear.

Servo-driven Die Cushions

Several press manufacturers and servomotor suppliers have applied the servomotor drive principle to the design and control of die cushions (see **Figure 3**). The position of the die cushion is controlled by a pressure sensor within the servo die cushion. Therefore, the operation is similar to that of a hydraulic cushion, which commonly is used in mechanical and hydraulic presses.

Servo-driven die cushions also can be incorporated on multiple-point die cushions, so that the individual cushions can be controlled separately to optimize metal flow in the flange between the die and blank holder. In addition, the servo die cushion can be used to regenerate energy when the cushion is pushed down by the upper die and slide.

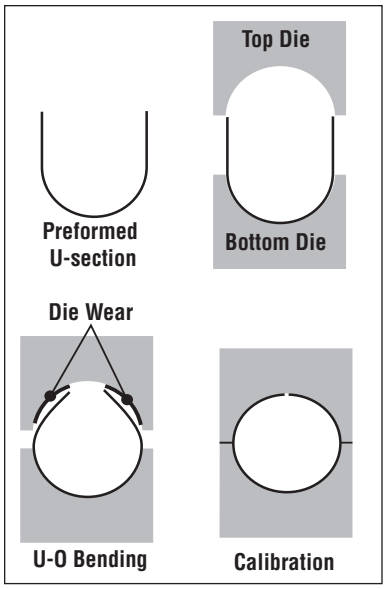

Figure 1

A two-step forming process produces bearing sleeves with the U-O bending technique. Courtesy of *Werkstattstechnik* online.

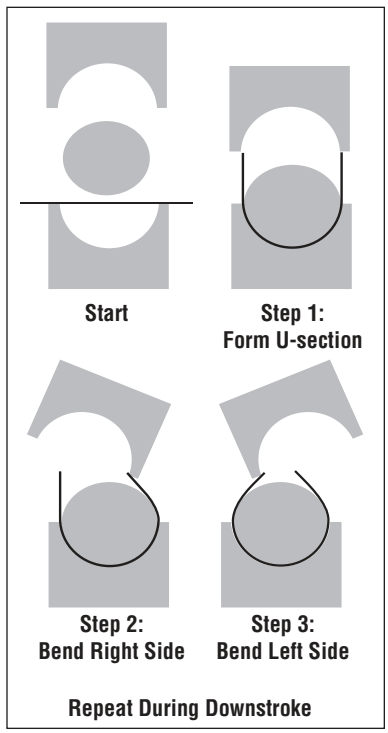

Figure 2

Bearing sleeves are formed using the orbital/swinging capability of the servo press. Courtesy of *Werkstattstechnik* online.

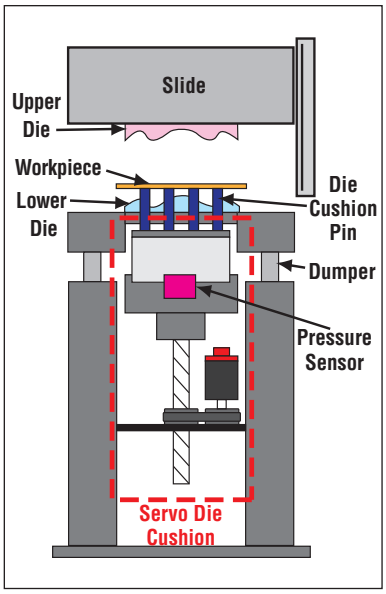

Figure 3

Single-point servo drive die cushion. Courtesy of GE Fanuc.

New Process Developments

Cold and warm forming of various advanced high-strength steels (AHSS) is being investigated using servo-driven presses. Tests indicated that springback can be reduced in V-bending of DP 980 steel by increasing the reduction in thickness, t_o ($\Delta t/t_o$), and the dwell time at BDC from 0.1 second to 0.5 second. Using a die set equipped with electric resistance heating located in a servo press that allows a certain amount of slide dwell, it is possible to heat an AHSS such as DP 980 up to 980 degrees C. This drastically reduces the springback and bending forces.

Similarly, resistance heating (up to 1,070 degrees C) was combined with servo motion control to hot-shear DP 980 to obtain sheared surfaces with reduced burr and fracture.

The servo-driven press has found a place in metal forming and in various new stamping applications. Research studies continue to be conducted to fully employ the capabilities of servo presses in various forming applications.

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Note

1. P. Groche and M. Scheitza, "Servo Press with a Slide of Three Axes of Motion" (in German), Werkstattstechnik *online, October 2007, v. 97, p. 760.*