Multipoint-control die cushion systems for stamping complex parts

Part I: Blank holder force application

Editor's Note: This article is Part I of a three-part series on multipoint control (MPC). Part II, which will appear in the October issue, discusses forming complex stainless steel double sinks. Part III, to appear in the November issue, discusses blank holder force prediction in MPC systems.

This column was prepared by Ajay Yadav of the Center for Precision Forming (CPF) (formerly Engineering Research Center for Net Shape Manufacturing), The Ohio State University, Taylan Altan, professor and director.

Blank holder force (BHF) control is an important variable in the stamping process. Conventionally, nitrogen cylinders, hydraulic cylinders, or pneumatic cushions apply constant force on the blank holder throughout the stroke.

Several stamping press manufacturers supply multipoint-control (MPC) systems that consist of several individually programmable hydraulic cylinders, or "pins." By being able to vary the force during the press stroke at each pin location, you can improve material flow during drawing into the die cavity. This helps prevent wrinkles and splits and reduces thinning throughout the formed part.

One of the most successful applications of an MPC system is deep drawing stainless steel sinks. To obtain close part tolerances in this forming operation, the tooling must not tilt during off-center loading. For this MPC application:

- BHF is applied in a stationary condition and is not affected by the tilting of the press slide.
- Appropriate BHF distribution is achieved according to part geometry.
- A hydraulic system applies forming force that is not affected by the off-center loading.

Figure 1 shows a press that achieves these functions.[1] In this press, the bottom dead center (BDC) position of the slide is defined by mechanical stops. An MPC unit, consisting of short-stroke cylinders, is located on top of the press table. Multiple forming elements or punches in adjustable positions are integrated in the press bolster

Figure 2 shows a similar press concept that uses an MPC unit but also allows individual BHF control at localized regions around the blank perimeter.[2] After the blank is placed on the lower die, the press slide moves downward until BDC defined by mechanical stops. The dies are closed using blank holder cylinders

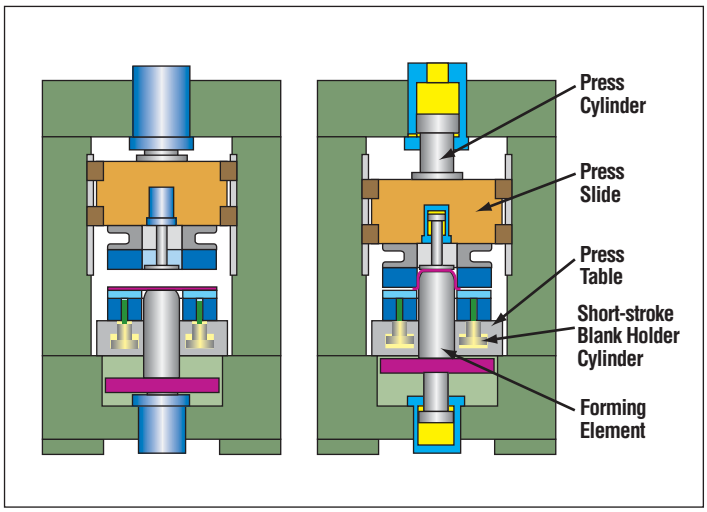

Figure 1

In this press with an MPC unit, the bottom dead center (BDC) position of the slide is defined by mechanical stops. BHF is applied independent of press slide movement. [1]

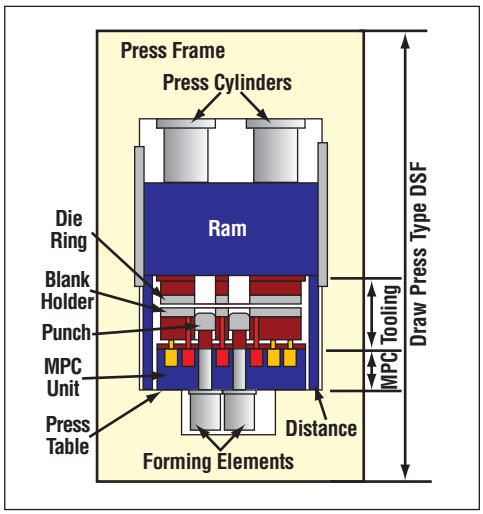

Figure 2

In this press equipped with an MPC system, BHF is initially applied uniformly over the entire sheet surface. Secondary hydraulic cylinders apply a local BHF at critical locations for precise control of metal flow.[2]

Figure 3

As an alternative to cushion pins used in MPC systems, Electronic Shimming™ has been developed that moves individual shims up or down to adjust blank holder pressure.[3]

that apply a uniform blank holder pressure over the entire sheet surface. A secondary hydraulic circuit applies a localized BHF for precise control of metal flow in critical areas near the forming zone. The part then is formed by the upward motion of the forming element or punch.

In both press designs, eccentric loading caused by product design does not affect the programmed BHF profiles and the forming force. Also, the geometric stability under dynamic loading conditions is improved.

As an alternative to cushion pins used in MPC systems, Electronic Shimming™ has been developed to apply different pressures to the blank holder (see Figure 3). This electronic-hydraulic system consists of a plate that is 80 millimeters (3 inches) thick with built-in membranes and shims. The membranes are controlled by a programmable logic controller to transfer hydraulic pressure to the blank holder plate.ST

Taylan Altan is a professor and director of the Center for Precision Forming (CPF) (formerly Engineering Research Center for Net Shape Manufacturing), The Ohio State University, 339 Baker Systems, 1971 Neil Ave., Columbus, OH 43210-1271, 614-292-9267, fax 614-292-7219, www.cpforming.org. The CPF conducts research and development; educates students; and organizes workshops, tutorials, and conferences for the industry in stamping, tube hydroforming, forging, and machining.

Notes

1. *www.schulergroup.com*
2. *K-J, Pahl "New Develpments in Multi-Point Die-Cushion Technolgoy,"* Journal of Materials Processing and Technology, *Vol. 71, No.1 (1997), pp. 168-173.*
3. *www.hydraulico.com*

Write 7 on reply card