Exploring the 3rd International Conference on Hot Stamping Technology, Part I

New applications

BY EREN BILLUR AND TAYLAN ALTAN

Editor's Note: This article is Part I of a two-part series summarizing the advances discussed at the 3rd International Conference on Hot Stamping Technology. Part II, which will appear in the January/February 2012 issue, will discuss the new tools and equipment used in hot stamping. A three-part article providing an overview of this growing technology appeared in STAMPING Journal® from December 2006 to February 2007, and FE simulation of the process was discussed in the March/April 2011 issue.

Two leading research groups—one located at the Lulea University of Technology in Sweden and the other at the University of Kassel in Germany—organize the biannual International Conference on Hot Stamping Technology. Held in Kassel, Germany, in June 2011, the third of this series of conferences was attended by nearly 200 engineers and scientists from all over the world. The conference covered more than 50 presentations on various aspects of hot stamping, including tailored properties, tools and dies, coatings and corrosion, metal flow and formability, friction and lubrication, and process/computer modeling. In addition, several industrial applications, case studies, and innovative heating and pressing equipment were discussed.

Companies in Germany, Sweden, and Spain have been especially active and advanced in hot-stamping technology. Companies in North America, Japan, Korea, and India have a fast-growing interest in and application of this technology as well.

Part Complexity and Production Volume

Saab was the first automaker to use the hot-stamping process in 1986. The technology originally was applied to door beams, which were relatively simple geometries to form. As the technology evolved, it also was used to produce A- and B-pillars, roof rails, and bumper reinforcements. Today's complex tools with multiple-point hydraulic cushions make possible the hot stamping of parts such as transmission tunnels using tailor welded blanks.

In the auto industry in the 1990s four components per vehicle were hot-stamped; today that number has increased to 20 to 30. In addition, more and more automotive producers are switching to hot stamping to save weight, which increased the global hot-stamping part production volume from 3 million parts per year in 1987 to 95 million parts per year by 2007 (see **Figure 1**).[1, 2]

Tailored Properties

Hot-stamped parts are favored for their high strength—typically about 1,500 MPa (220 KSI). Ductility of the parts, however, is limited to a typical elongation of 5 to 6 percent. For improved energy absorption in a crash, increased elongation may be required in several locations in the same part, such as in an automotive B-pillar (see **Figure 2**).[3,4]

Previously more ductile reinforcements would be welded to the hot-stamped B-pillar, or the pillar would be made using tailor welded blanks (see **Figure 3**). Varying microstructure throughout the part is proposed to increase energy absorption by controlling microstructure transformation, which lowers the strength but improves the elongation (see

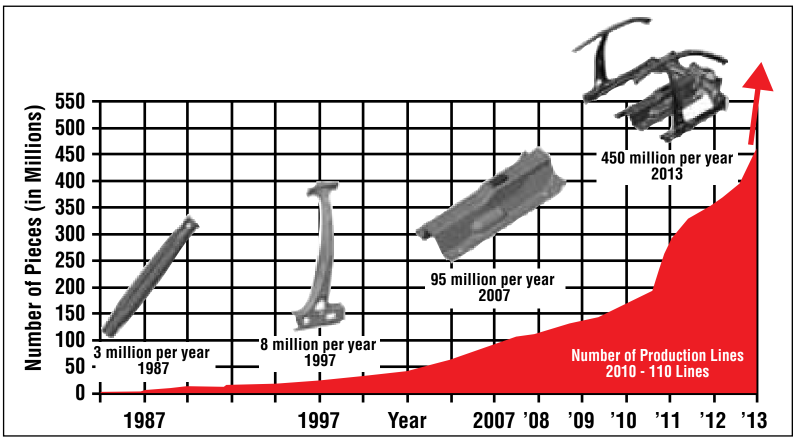

Figure 1

Both the complexity and production volume of hot-stamped parts have been increasing.[2]

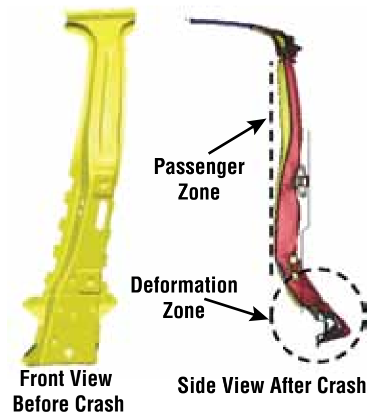

Figure 2

In a typical B-pillar, high strength is required in the passenger zone, which must remain straight after a side impact. However, a deformation zone with increased elongation is also necessary to absorb the energy of crash safely away from passengers.[4]

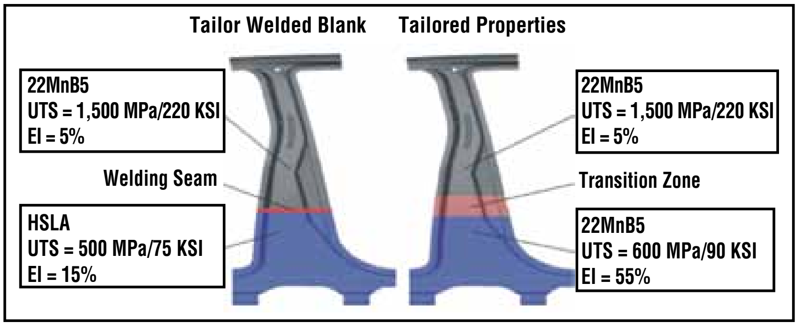

Figure 3

Locally increased elongation can be achieved by tailor welded blanks or tailored properties.

Figure 3). This can be achieved by three methods:

1. Partly austenitizing the workpiece by resistance heating
2. Locally heating the dies
3. Using tool materials with different thermal properties to slow down the cooling rate locally

ThyssenKrupp has made a trial die with local heating, stamping 1,000 B-pillars for further investigation. The company's challenge is to control the transition zone (see Figure 3), both in terms of length and mechanical properties.[5,6]

Trimming

Another challenge in the hot-stamping process is trimming. As the hot-stamped parts have very high strength, conventional trimming operations cause excessive tool wear or premature tool failure, increasing production costs. One solution to this problem is laser trimming, although this currently is a slow and costly alternative. Research and development on laser technology and automation is ongoing to make the use of lasers in trimming hot-stamped parts more cost-effective.

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Several new advances that are considered for trimming operations are:

1. Hot trimming, in which the trimming operation is completed within the same stroke as the forming operation. In this case, the part is trimmed using a cooled and hard-coated trim die, while the blank is still hot. Trimming speed determines edge quality.
2. Using tailored properties around trim lines to reduce the force required for trimming.
3. Optimizing the cutting angles and velocities in trimming operations.[7] ST

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Notes

1.H. Karbasian and A.E. Tekkaya, "A Review on Hot Stamping," Journal of Materials Processing Technology, *Vol. 210 (2010), pp. 2103-2118.*

2.R. Hund, "Continuous Improvement of Hot Forming Technology," in proceedings from the 3rd International Conference on Hot Sheet Metal Forming of High-Performance Steel, Kassel, Germany, July 13-17, 2011, pp. 189-200.

3.Ibid.

4.B. Macek, "Optimization Side Crash Performance Using a Hot-Stamped B-Pillar," in proceedings from Great Designs in Steel, sponsored by American Iron and Steel Institute, Livonia, Mich., March 8, 2006.

5.R. Hund.

6.J. Banik et al, "Tailored Properties," in proceedings from the 3rd International Conference on Hot Sheet Metal Forming of High-Performance Steel, Kassel, Germany, July 13-17, 2011, pp. 13-20.

7.R. Hund.