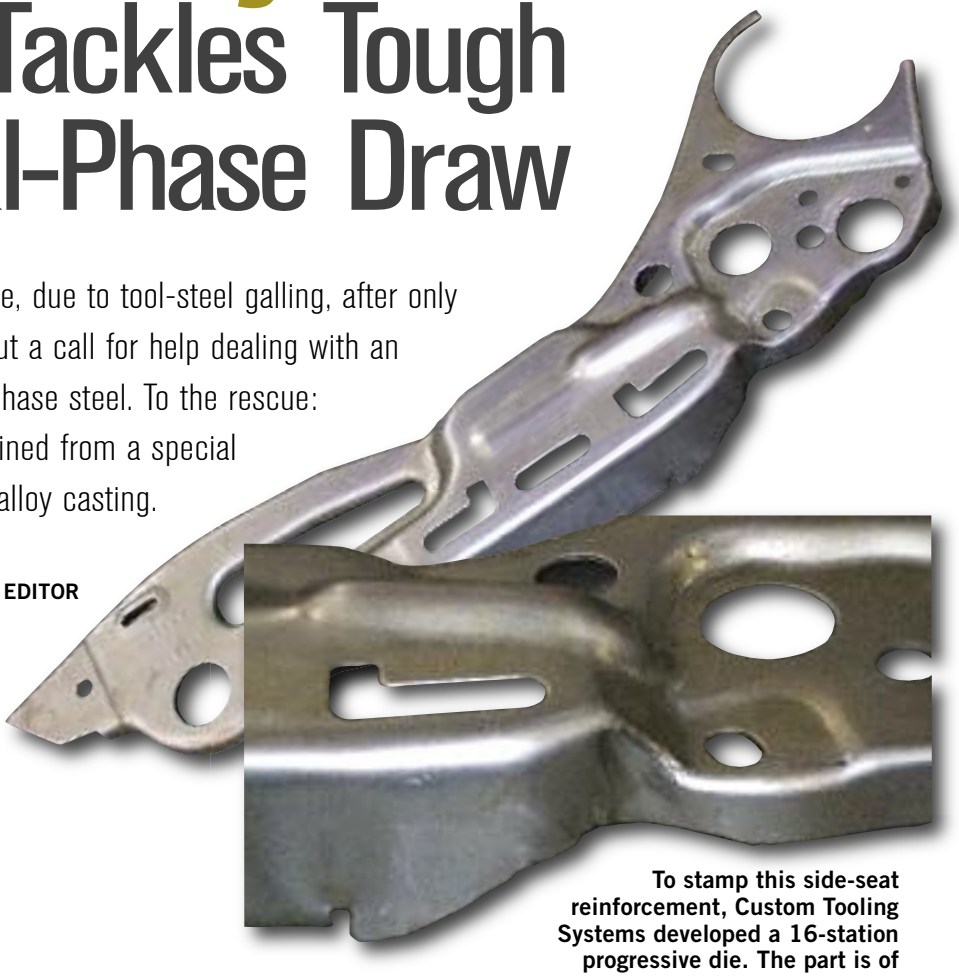
Copper-Alloy Die Insert Tackles Tough Dual-Phase Draw

Experiencing a die-insert failure, due to tool-steel galling, after only 7500 hits sends out a call for help dealing with an automotive-seat stamping of dual-phase steel. To the rescue: a new insert machine machined from a special hardened copper-alloy casting.

BY BRAD F. KUVIN, EDITOR



To stamp this side-seat reinforcement, Custom Tooling Systems developed a 16-station progressive die. The part is of 1.5-mm dual-phase steel, which posed significant tooling challenges, particularly in the area where the top surface steps down ¾ in. and then gets flanged 90 deg. For that challenging form station, CTS machined a tool insert of a hardened copper-alloy casting, and to date the tool has made more than 100,000 hits.

When its customer, Johnson Controls, Inc. (JCI), could make only 7500 hits before being forced to remove a worn die insert and replace it with a freshly coated insert, Custom Tooling Systems (CTS) went back to the drawing board to find a better—a much better—solution. The Zeeland, MI, tool and die shop had successfully completed a 41-die order for JCI in 2007, valued at $10 million, yet this one die proved tricky. The die, part of a package to stamp all of the seating components of a 2008 model-year vehicle program, comprises 16 stations to stamp seat-side reinforcements. The challenge: stamping the large part from a 1.5-mm (0.059-in.)-thick dual-phase steel, Docol 800 from Swedish supplier SSAB.

"The first time JCI ran this tool," shares CTS president John Bouwkamp, "it made 7500 hits before one of the form stations experienced excessive galling. Then, when carbide failed in the application as well, we turned to a special hardened copper alloy for the die insert, and the progressive die has run for more than eight months now, making more than 100,000 hits without requiring maintenance."

The Troubling Station

Of the 41 dies in the seat-stamping package, four process Docol 800 sheet. For these dies, CTS used D2 rather than A2 tool steel. For the dies not stamping Docol 800, trim steels are of A2. Yet, even using coated D2, the form tool in the reinforcement application failed to hold up.

"At that die station, the top surface of the part steps down ¾ in., then gets flanged 90 deg.," says CTS floor supervisor Tom Runyon. "And, the clearance radius specified created a lot of galling of the coated D2 insert. The radius goes from 0.080 in. and blends out to 0.125 in. Where this extreme flange condition is, it more or less kinks the inside radius to a no-radius condition, or almost square inside.

"Forming Docol, we find that you get two hits," Runyon continues. "The first hit can move a lot of steel. But with the second hit, the material has hardened so much that you can't really move the steel too much or it will split."

Where Carbide Fails, Copper Alloy Succeeds

After JCI experienced galling failure after 7500 hits with the die, it asked

More on Docol 800

Swedish supplier SSAB Tunnplat manufactures Docol cold-rolled dual-phase (DP) alloys from 0.5 to 1.6 mm thick. Docol 800 DP comprises 1.5 Mn, 0.2 Si, 0.12 C, 0.04 Al, 0.015 Mn, 0.015 Nb, and 0.0002 S. Mechanical properties: 116-131-ksi tensile strength, 72.5-94.3-ksi yield strength, and an n-value of 0.11.

Dual-phase steels have a microstructure that blends ferrite and martensite, giving them their relatively low yield point and high ultimate tensile strength. DP steels also boast a relatively high strain-hardening rate, beneficial in terms of formability and energy-absorption capacity. SSAB recommends a minimum internal bending radius of one times material thickness and a limited drawing ratio of about 2.0.

CTS to try carbide for the troubling tool insert, rather than have to keep a spare insert in hand and have the inserts coated every 7500 hits, at a cost of $600 to $700. However, machining a carbide insert proved disastrous, as it shattered before it even made one hit. "We tried three times, to no avail," says Runyon.

Instead, CTS went with a copper alloy for the insert, DieAce SO390 from Sankyo Oilless, Sterling Heights, MI. DieAce, a special hardened copper-alloy casting, is designed to eliminate galling and scoring in harsh drawing and forming applications. SO390, one of three DieAce alloys, has a hardness of HB 270-290 and 0.5 percent minimum elongation. Sankyo says that the alloys can be cast to size, leaving only a minimal amount of stock for finish machining.

"We were able to mill the insert in 6 hr.," says Runyon, "and overnight ship the new insert to JCI. "So far, after more than 100,000 hits, the material's lubrication properties and wear resistance have kept the die in the press without requiring any maintenance." **MF**