

# Wipe 80-KSI Steel to a 16-deg. Overbend?

Not likely. Instead, a DaimlerChrysler satellite stamping plant turns to rotary-bender tooling to tackle forming of vehicle side-sill inners.

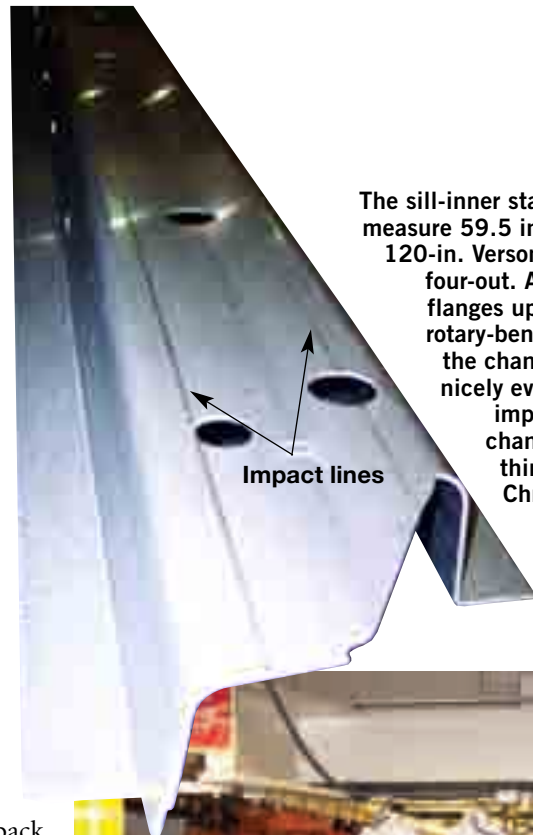
BY BRAD F. KUVIN, EDITOR

Preparing for a 2007-model launch, DaimlerChrysler die process engineer Dan Nieschulz, of Advanced Stamping Manufacturing Engineering, turned his attention, back in mid-2004, to one particularly challenging stamping: a sill inner, of 0.060-in.-thick low-carbon high-strength steel, to be stamped at a satellite plant in Belvidere, IL. While the plant specializes in stamping Class A closures, fenders and side panels, it also stamps some structural components. However, it's had little experience with 80-ksi material, and had never stamped relatively thick high-strength steel. Until now.

"The part, which entered production in January 2006, is essentially a channel with flanges and takes 12 deg. of springback, with one side open 6 deg. and the other side open 7 deg.," says Nieschulz. "We first form the flanges up, then wipe the sides back down to form the channel. Bending them underneath the post to attain the needed springback posed quite a challenge."

## Rotary Benders to the Rescue

The sill-inner blanks measure 10.25 in. wide by 59.5 in. long and are produced as a double blank on the plant's 300-ton blanking press. To optimize material utilization, Nieschulz, working with the Belvidere stamping-plant team (including Jack Tappainer and Bob Nelson), designed the stamping process to run four-out on a



The sill-inner stampings, which measure 59.5 in. long, exit the 120-in. Verson transfer press four-out. After wiping the flanges upward, the die's rotary-bending tools form the channel. Notice the nicely even and straight impact lines at the channel bends, one thing the Daimler-Chrysler operators look for as they visually inspect the parts exiting the press.

Impact lines



120-in. transfer press. Volumes are especially high since the part is used cross-platform on three new 2007-model-year vehicles in the DaimlerChrysler C-line—the Dodge Caliber compact car and two Jeep compact SUVs, the Compass and Patriot. Now running three shifts, the neighboring 3.7-million-sq.-ft. assembly plant can produce more than 300,000 units annually.

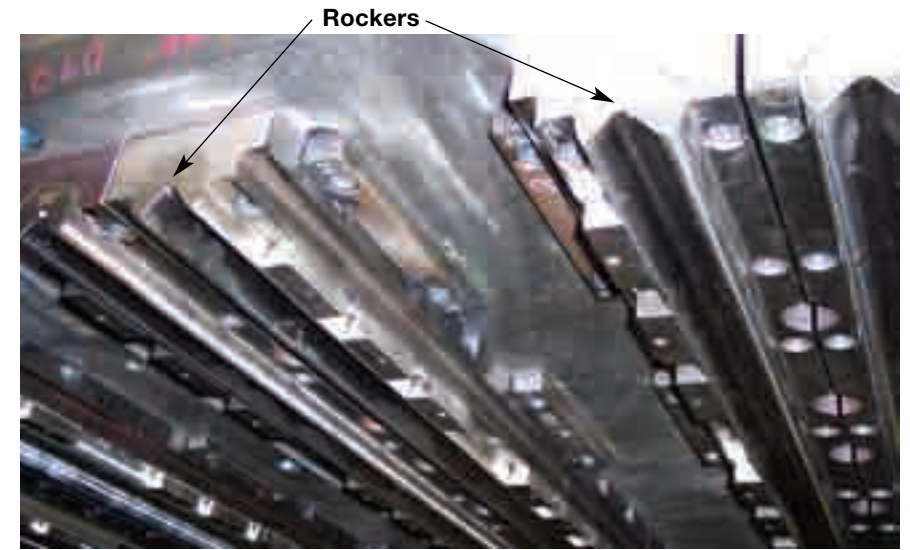
"Stamping four-out creates eight 5-ft. lengths of line, or nearly 480 linear inches of bend," Nieschulz says. "Wiping the parts would have required more than 1100 tons."

Destined to run under a 1500-ton ram in two-ram press, the job worried Nieschulz. "We generally try to form parts that require less than 80 percent of rated ram capacity," he says. "We were concerned that if, on this job, the press were to bottom out, we could possibly blow the overload-protection system."

To reduce the tonnage and to double production from the original two-out process design to the desired four-out process, Nieschulz investigated bender tooling as an alternative to wiping the part. Benders (from Ready Technology, Inc., Dayton, OH) transfer press vertical motion into a rotary forming operation, allowing overbending past 90 deg. while dramatically reducing required press tonnage. For Nieschulz's job, press tonnage using the benders dropped to a mere 185 tons to form all four parts in one press cycle.

The production die holds 16 of the rotary forming tools, which measure 29 in. long with 2-in.-dia. rockers. It takes two tools per 59-in. bend for a total of four tools per part.

"We're making two rights and two lefts at the same time," says Mike McCabe, die shop and quality supervisor, "usually a big no-no. Usually we make a right and a left. But our repeatability is so good with this setup that we can get away with it, thanks to the quality of the die. We do a right-left right-left cycle."



The sill-inner production die holds 16 of these rotary forming tools (from Ready Technology), which measure 29 in. long with 2-in.-dia. rockers. It takes two tools per 59-in. bend for a total of four tools per part. The tools transfer press vertical motion into a rotary forming operation, allowing overbending past 90 deg. while dramatically reducing required press tonnage.

Part tolerances call for  $\pm 0.5$  mm on the sidewall-spread dimension; Ready quotes a bend-angle tolerance using its tooling of  $\pm 0.5$  deg., without coining the material.

The bend tooling is mounted on its own separate station, "so if we should receive a batch of steel that runs a little thicker or thinner, we can raise or lower the ram to adjust the bend angles as needed," says McCabe. Tooling is all of D2 steel. Trim and pierce steels are titanium-nitride coated; form steels are coated using the thermal-reactive diffusion (TD) process, which creates a layer of pure vanadium carbide on the tool steel.

"Did we know in advance that the process required these tool coatings? Not necessarily," says McCabe, "but since this is our first real experience with these high-strength alloys, we decided to investigate the wear characteristics of the coatings when forming and cutting these alloys at relatively higher gauges."

## Absolutely Flat

Particularly challenging to production stamping of these parts is yielding flat blanks from the shop's blanking line. "When the part comes out of the blanker, it has to be absolutely flat," McCabe says. "Any bow will transfer

**Editor's Note:** To view a video of the production setup described in this article, log on to [www.metalforming-magazine.com](http://www.metalforming-magazine.com) and surf to our online Multimedia Center.

through to the finished part after stamping, because the material is so hard that we can't rework it. Our blanking line employs an automated single-setting 19-roll leveler (from Automatic Feed Co., AFC) and as the coil pays down, the changing camber of the material becomes a challenge. However, with the help of AFC we were able to tune the leveler so that we produce blanks to the required flatness regardless of where we are in the coil, by more or less running the leveler at capacity in terms of the pressure we apply to the material as it enters the blanking press."

McCabe and Nieschulz also had to carefully design the blanking process to allow its 300-ton press to handle the high-strength part. "We staggered every punch and trim steel so that they don't hit all at once," says Nieschulz. "Our calculations showed that otherwise, we would have needed more than 500 tons to blank this part. Now, at cutoff we're at 260 tons."

The plant feeds blanks, delivered from blanking press to production press via

## At A Glance

Belvidere Satellite Stamping Plant  
Floor Space: 337,000 sq. ft.

Employment: 134 on two shifts

Equipment: Three automatic transfer presses

(2) 120-in. Verson presses with 2200-ton entry ram and 1500-ton exit ram

(1) 180-in. Verson with 2700-ton entry ram and 1500-ton exit ram

One Tandem press line

Danly 180-in. 2000-ton draw press

(4) 1000-ton presses

One automatic blanking line featuring a 300-ton Verson press

rail-mounted AGVs, onto a 120-in. tri-axis 1993-vintage Verson transfer press with two rams—a 2200-ton entry ram (two stations) and a 1500-ton exit ram (three stations). The die lineup employs three working stations that begin by piercing all of the holes in the double blank in the first press station, then separates the blanks for subsequent forming operations. The second die sta-

tion, still under the entry ram, wipes the flanges upward. The final three stations include an idle, rotary bending and another idle under the exit ram. Target production rate is 16 strokes/min.

"We originally were going to run these sill inners one-out on a progressive die, but couldn't get the material from our supplier in the coil width to match the length of the part," says Nieschulz, recalling the program beginnings in mid-2004. "We then developed the four-out process with the blanks nested four across the coil width to optimize material utilization."

The plant brings in precision-slit coils with a width tolerance of +0.010 in. and -0. "We prefer to pay up front for precision coils," says McCabe, "rather than see our scrap rate increase. "And, we also wind up with material that works with our process better and results in less tonnage on the ram, since we don't have to trim those 5-ft. lengths of line. The only scrap we're generating is from notching and hole punching." **MF**