

# Designing for Robust Stamping - During Product and Tooling Design

Dr. Waldemar Kubli, CEO, AutoForm Engineering GmbH

**A**utoForm software is used by all 20 of the largest automobile producers worldwide, and by over 400 automotive suppliers, to reduce development time and costs in die design and sheet metal stamping.

From our position as a global provider of technologically advanced solutions for the automotive industry, we have developed a new software to improve stamping robustness.

## Stamping Reliability Problems

Today, all automotive OEMs and major suppliers have expertise in statistical process control and stamping simulation techniques.

Yet, today, every company that stamps sheet metal parts knows it cannot reach its OEE targets, and therefore loses money due to:

- unplanned press downtime and tool maintenance,
- missed production targets - due to the need to continually adjust the stamping process, and
- stamped parts that do not meet quality specifications (rejects).

Furthermore, every stamping department has experienced production problems that seem to be random or unavoidable, for example:

- after changing coils, it becomes impossible to meet part quality tolerances
- a slight change in a press parameter (e.g. lubricant, blankholder forces) or in a product feature



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**“Solving key stamping reliability and quality problems earlier in the vehicle development cycle - during product and tooling design - saves even more time and money.”**

(e.g. rounder edges) causes the stamping process to become so unstable that output drops precipitously

- after stamping thousands of parts that meet quality specifications, the part reject rate suddenly rises - even though nothing appears to have changed in the tooling or stamping process

Do these problems occur randomly, or are they predictable? If these problems are predictable, then can they be avoided, or at least minimized, thereby saving resources and money?

## Achieving Robust Stamping

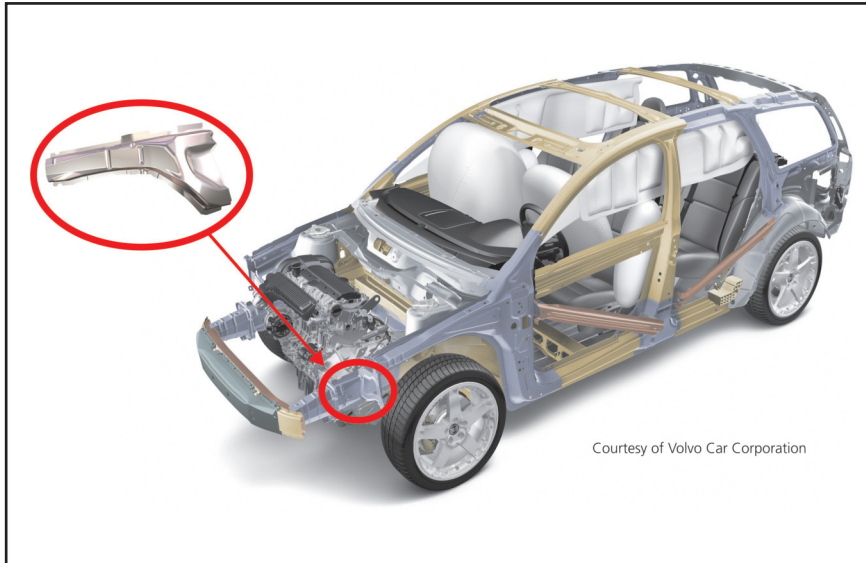
To address such issues, AutoForm R & D staff developed a new software, specifically to improve robust-

ness in sheet metal forming applications. For its technological innovations, the software (called AutoForm-Sigma) won the German MaschinenMarkt "Innovation Award" in 2004. Basically, these innovations are:

- 1 The software uniquely combines statistical process control techniques with sheet metal forming simulation.

This allows engineers to determine the process capability (Cpk) of stamping operations even during the earlier phases of product and tooling design. As a result, they can solve stamping reliability problems months before production start-up - a real money-saver for automobile manufacturers who are constantly striving to shorten their new product development cycles.

- 2 Variability and noise that are inherent in the factors that determine the stamping process - the coefficient of friction, tool forces, material characteristics, tool wear, etc. - are taken into account in the simulation, thereby better reflecting manufacturing reality. Such variability and noise are what so often cause stamping reliability problems. Their influence on stamping process robustness is now quantifiable and predictable, due to the combination of advanced stamping simulation techniques and stochastics in AutoForm-Sigma. The software



Volvo Cars is using AutoForm-Sigma to investigate the effect of variability in material properties on stamping production yield.

even identifies the dominant factor that has the most effect on a quality target (through influence and sensitivity analyses), so that engineers can then correct the problem, for example, by increasing the die radius to minimize the part reject rate.

Automatically, AutoForm-Sigma carries out multiple stamping simulations, changing design and process parameters and performing statistical analyses, until it finds the "robust optimum". This robust optimum corresponds to the most reliable overall conditions (e.g. lubrication, drawbeads, die radii) for stamping parts that meet a company's quality and production targets - even if material properties vary when changing coils, even if there is unexpected tool wear, even if press parameters fluctuate, etc.

3 Appropriate statistical algorithms have been selected and integrated ("black-boxed") so they can be used directly by designers and stamping engineers, reducing the workload on statistical analysis experts. Of special benefit to large companies such as automotive OEMs,

this enables concurrent engineering projects between product design, tooling design and stamping production departments, and also shortens the new vehicle development cycle.

#### Applications

Springback of the stamped part is a major issue in stamping reliability problems.

At DaimlerChrysler, AutoForm-Sigma has been used to validate stamping process reliability, with respect to springback caused by material variability and process variation. This provides valuable information and insights to opti-



Robust stamping operations take into account noise and variability inherent in the manufacturing environment (Courtesy of Schuler).

mize body assembly operations, where springback and clamping issues are involved.

At Volvo Cars, AutoForm-Sigma has been used to investigate the influence of variability of material properties on stamping production yield, with the goal of developing even more robust forming processes.

For the automotive industry in general, the trend to using sheet metals with more complex properties requires a better understanding of the effects of these properties on stamping robustness - which AutoForm-Sigma helps to provide.

#### Conclusion

Traditionally, companies have focused on stamping robustness during the manufacturing phase, through their production and quality departments.

Today, AutoForm-Sigma allows companies to also address stamping robustness issues during the *earlier* phases of product and tooling design. In other words, companies can now develop the best product designs and the best tool designs for a robust stamping process.

This means that potential stamping problems can be solved earlier in the vehicle development cycle, saving more time and resources. This also means faster time-to-market for new car models, with obvious advantages. ■

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