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ATLAS TOOL, INC.

Atlas Tool, Inc. Develops a Sound Springback Compensation Process with the Help of PAM-STAMP 2G Software

THE CHALLENGE

· Optimize tool and die engineering to serve automotive customers with unmatched quality parts

· Perform springback manufacturing process with ultra-high strength and dual-phase steels in a minimum of time

THE BENEFITS

· Validates production process for accurate formability

· Brings decision early in the design phase

· Shortens die design cycle

· Increases tool and die quality

· Avoids wrinkles and splits

· Minimizes manufacturing risks

· Reduces engineering changes and downstream problems

· Accurately predicts accurately springback effects

"Advanced high-strength steels and particularly dual-phase steels are being utilized more and more by OEMs to improve safety, reduce weight and lower cost. The use of an advanced incremental simulation tool enables us to overcome the formability challenges posed by these materials and meet our customers' requirements in as little time as possible. We believe our expertise with PAM-STAMP 2G is a significant competitive advantage."

Mark R. Schmidt, Atlas Tool's President

Springback is an enormous challenge in sheet metal stamping. It is widely accepted by most people involved in Tool and Die engineering that FEA software, while being accurate for predicting formability issues, is not an accurate tool for predicting springback. However, Atlas Tool, with the help of ESI Group's PAM-STAMP 2G software, is proving that with a good sound engineering process along with clean CAD data and an expert design and build team they are able to accurately compensate for the effects of springback for high-strength and dual-phase steel for even the most aggressive product geometry.

The development of ultra-high strength and dual-phase steels makes the process even more challenging as these materials tend to spring back three to four times more than that of low-carbon sheet steel. Dual-phase steel combines two of the many crystalline structures that steel forms into, ferrite and martensite, to achieve greater strength than traditional high-strength steels. Dual-phase steel provides yield strengths between 550 MPa and 1000 MPa, while conventional high-strength steels fall within the range of 210 to 550 MPa. The result is improved crashworthiness and weight reduction. However, dual-strength steel provides some significant formability challenges. The material tends to work harden to the point that it cannot be reformed in subsequent operations. Dual-phase steels also generate higher levels of springback, which can create dimensional part quality problems.
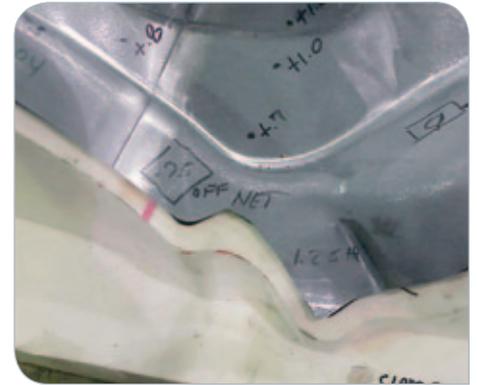
First part on gauge dimensions

Designing the die with incremental simulation

Several years ago, Atlas Tool made the decision to upgrade to simulation software capable of incrementally simulating the forming process with as many steps as needed to provide a much higher level of accuracy. Compared to other softwares, Atlas Tool selected PAM-STAMP 2G for its accuracy and ease-of-use. "Because we drive our design process using PAM-STAMP 2G we are confident we can go directly to hard tool from "virtual-tryout" knowing we will be better than 95% fit to gage, eliminating the need for prototype-tryout tooling," Broadworth said. "This includes challenges associated with laser-welded blanks, patch-welded blanks and ultra-high strength steel including dual-phase steel." In the beginning of the process, Atlas Tool engineers outline a preliminary die process and a draw-die development is drawn in Unigraphics CAD software. Care is taken to ensure that the binder and addenda surfaces are tangent to one another and the binder surfaces are fully "developable." These steps help ensure better manufacturability when machining
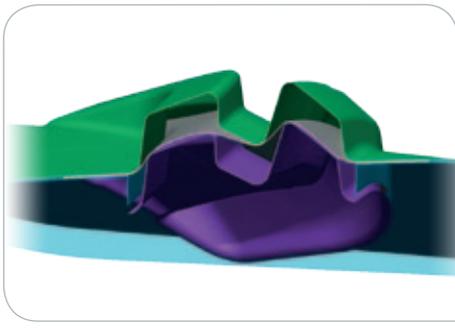
Cross-section of virtual die during forming simulation

and building the tools. This also makes certain that the tools closely represent the FEA model. Modeling physical drawbeads in the CAD software is also a key to a successful springback prediction.

After all the formability issues are solved using PAM-STAMP 2G, the task of compensating the CAD model for springback begins. PAM-STAMP 2G's fully automated springback compensation module is a key component in the process. The module provides a mapping of cloud-points to use when compensating the CAD data. These points are used inside of the thinkcompensator module, a product of think3 Inc. The thinkcompensator manipulates the surface data using the two sets of cloud points from PAM-STAMP 2G to provide an accurate surface model to use to build the tools.

Manufacturing the Tools

Communication between all departments is another key component in a successful process. The same data that was used in the die-simulation is used when cutting the

tooling. The tools are cut very accurately using the most sophisticated and accurate machining methods to ensure that very little handwork will be necessary and that the tools will be a very close representation of the stamping simulation. The binder tonnage information is passed on from PAM-STAMP 2G as well as the initial blank outline and the amount of blank draw-in during forming. Duplicating the results of the FEA is critical in a successful process.
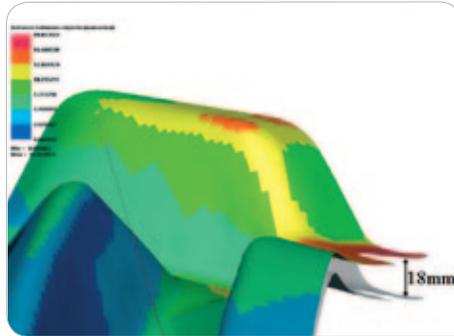
An early springback prediction created with PAM-STAMP 2G

A-Pillar example

This important process was used in the engineering of an "A-Pillar" for a major automobile manufacturer. A-pillars are becoming more difficult to form as automobile manufacturers increasingly specify that they be built from high-strength and dual-phase steel. It is vital to the safety of the passengers during a roll-over accident.This particular A-pillar exhibited very aggressive geometry with a 90 mm (3.5 inch) draw depth, which is considered a fairly "deep" draw for a part of

this nature. The fact that it required a laser-welded blank consisting of both 600DT (85KSI) dual-phase steel and 345MPa (50KSI) high-strength steel also made the job challenging. Early springback analysis using PAM-STAMP 2G showed about 18 mm (0.75 inch) of twist throughout the part after forming and trimming operations were completed. Atlas engineers determined early on that the draw-die would need to be compensated in order to produce a dimensionally acceptable part. The compensation process using PAM-STAMP 2G and think3 was then put to the test.

Initial part to gage

After compensating for about 18mm of twist through the center axis of the part, the first part to gage showed the A-pillar was accurate to within 1mm to the net surfaces on the gage.

In three weeks of simulation work, Atlas developed a design that the simulation predicted would meet all of the customer's requirements. Atlas tools predicted accurately with PAM-STAMP 2G the rupture risk of the A-Pillar. This demonstrates the potential to significantly reduce the cost and time needed to check the feasibility of automotive parts and to design and modify the tooling.

To find out more about ESI's solutions for Metal Forming Solutions, please visit : www.esi-group.com/metal-forming

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