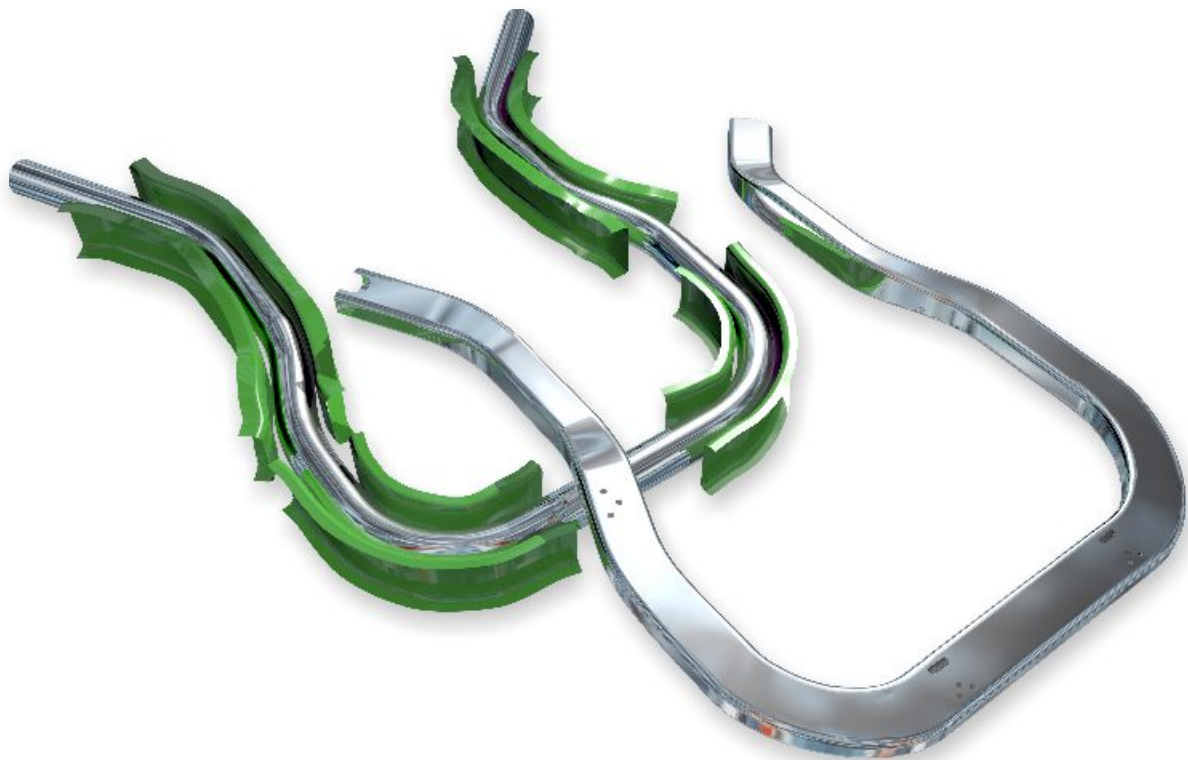


AutoForm TubeXpert

Software Solution for Rapid Tool Design
and Simulation of Bending, Forming
and Hydroforming Processes



- ▶ Rapid tool and process design for tubular parts
- ▶ Verification of multiple alternative manufacturing concepts for quality and cost improvements
- ▶ In-depth understanding of entire forming process for tubular parts through forming process window evaluation
- ▶ Shorter development time and reduced tooling, material and production costs
- ▶ Improved process reliability for robust manufacturing

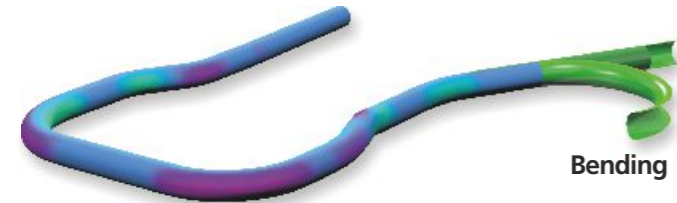


AutoForm TubeXpert

The Highly Intuitive All-in-One Software Solution for Tube Experts

With the AutoForm TubeXpert software solution, users can carry out a complete virtual tryout of the hydroforming process including all process steps, such as bending, preforming, hydroforming, annealing, calibration, cutting, springback, systematic process improvement and process robustness as well as springback compensation. This software solution is used by part designers, process engineers as well as tool and die makers to evaluate tube bending, forming and hydroforming tool designs and process layouts.

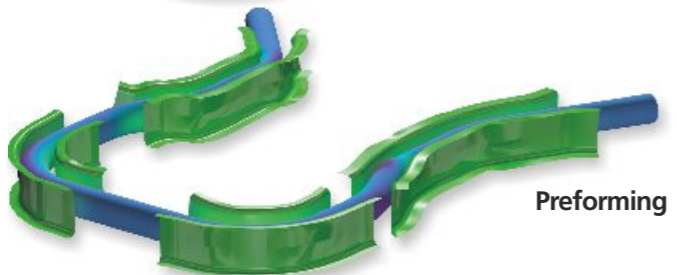
Starting from the initial part geometry, AutoForm TubeXpert allows users to rapidly generate all necessary tool geometries as well as to simulate and evaluate the complete forming process of tubular parts. The software solution provides a comprehensive in-depth understanding of bending, forming and hydroforming processes and allows the systematic identification of tool design and process improvement potentials.



Bending

Bending

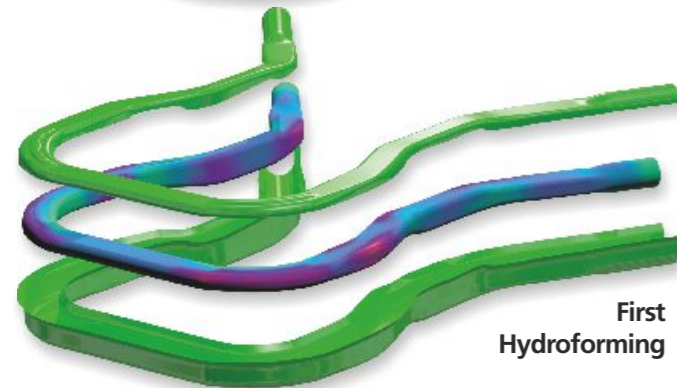
AutoForm TubeXpert enables users to automatically determine the bending line of the tube. This software offers the necessary bending operations and bending radii, which can be adjusted according to company specifications. AutoForm TubeXpert simulates the bending operations taking into account all of the necessary bending tool geometries, such as bend die, clamp die, mandrel, etc., and process steps. Forming issues such as splits, excessive thinning, wrinkles and distortions, can be easily identified and countermeasures, such as springback compensation, can be initiated within the software.



Preforming

Preforming

Complex part geometries may require additional forming operations which are carried out after the bending and before the hydroforming operations. AutoForm TubeXpert enables the rapid generation of tool designs for preforming operations. The preforming process step can be specified with or without inner pressure and process layout alternatives can be evaluated regarding formability issues.



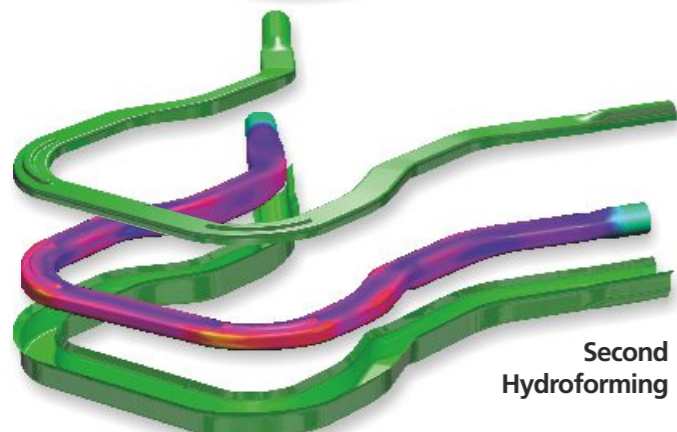
First Hydroforming

Hydroforming

AutoForm TubeXpert enables the generation of tool geometries for both the final and intermediate hydroforming steps. The process setup allows users to control the hydroforming process by pressure, displacement or volume. The high flexibility of the process setup enables alternative



Annealing



Second Hydroforming



Cutting

process validations, such as high, multistep high and (low) multi pressure hydroforming. Based on the simulation results, users can gain valuable insights regarding the entire tube hydroforming process. The quality of the simulation results is further improved through TriboForm friction functionalities.

Annealing

Additional process steps, such as annealing, are required for certain complex hydroformed parts. Through the annealing process, strains which result from prior operations are eliminated. With AutoForm TubeXpert, annealing can be carried out after any forming process step and results can be evaluated accordingly.

Cutting

AutoForm TubeXpert supports the cutting process steps for tube ends as well as the piercing and flanging of holes. As a result, tube length and the related material costs can be optimized.

Springback

With the increasing usage of high strength materials, the analysis of springback is gaining in importance. AutoForm TubeXpert enables accurate springback simulation and evaluation after any forming process step.

Systematic Process Improvement and Process Robustness

Finding suitable process parameters, such as applied pressure, often involves a great deal of manual effort. The systematic process improvement feature in AutoForm TubeXpert makes it possible for users to automatically find process windows for different parameters. In addition, AutoForm TubeXpert offers intuitive possibilities to analyze the impact of process variations, such as friction and pressure, to guarantee robust production processes.

Springback Compensation

With AutoForm TubeXpert, users are able to compensate springback caused by bending, forming and hydroforming. Based on springback results, bending lines as well as CAD geometries are automatically modified to fulfill requested quality requirements. Thus, a complete digital process chain is achieved, starting from part geometry to final tool geometries.

With AutoForm TubeXpert, users are equipped to meet the increasing demands regarding part complexity, ever higher part quality requirements, implementation of new materials as well as increased process complexity.



Springback Compensation

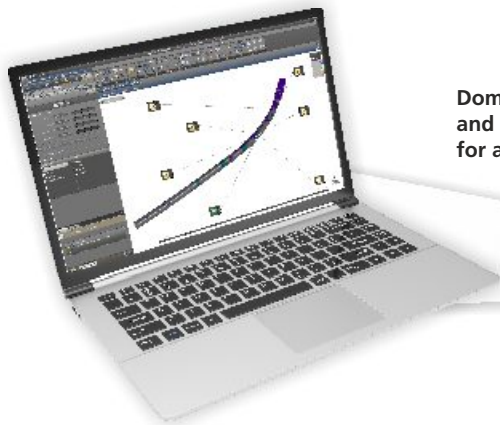
Systematic Process Improvement and Process Robustness

Springback

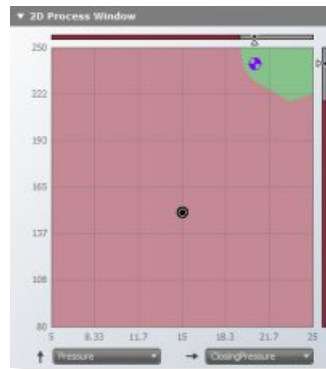
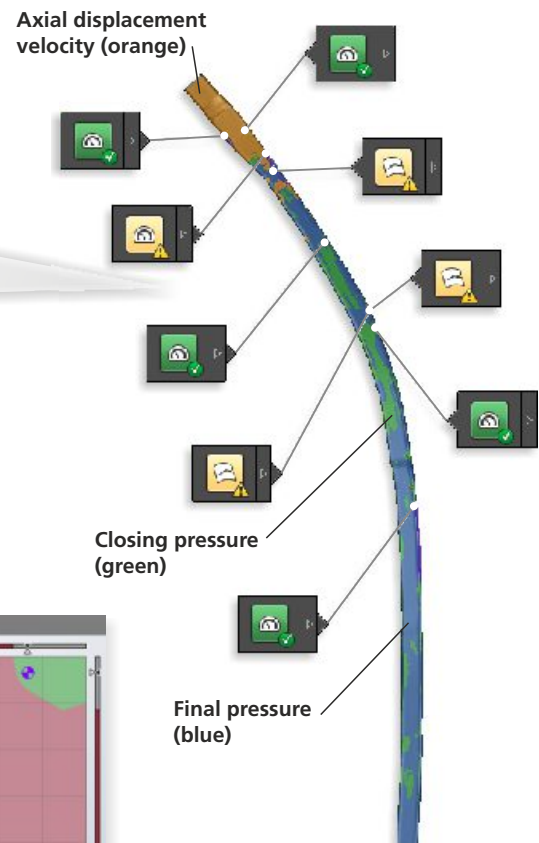
AutoForm TubeXpert

Systematic Process Improvement and Robustness Analyses for Tube Forming Processes

AutoForm TubeXpert enables users to quickly generate and evaluate alternative tool designs and process layouts by using systematic process improvement instead of manual optimization. Process robustness supports further analyses related to part production by using highly intuitive setup and evaluation functionalities. With AutoForm TubeXpert, companies benefit from shorter development times, reduced tooling, material and production costs as well as improved process reliability.



Dominant process variables and detected forming issues for an investigated roof rail.



2D process window for varied final pressure (y-axis) and closing pressure (x-axis). Green area shows a proper process window with respect to detected forming issues.

To reduce both engineering costs and time, the 2D process window allows for an intuitive evaluation of parameter studies. By using systematic process improvement, users define varying parameters, such as applied pressure and axial feeding, for optimization. As part of the simulation result, users receive a complete process prediction for all defined variations. Based on this, the optimal result can be found within the green area through an automatic evaluation.

In regards of process reliability, process robustness predicts the influence of varying parameters as friction, material parameters or applied pressure, on the production process. Evaluations include expected reject rates, dominant process parameters and best/worst case analyses. As a result, companies can efficiently reduce reject rates and tryout loops through advanced validations of the actual part parameters.

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