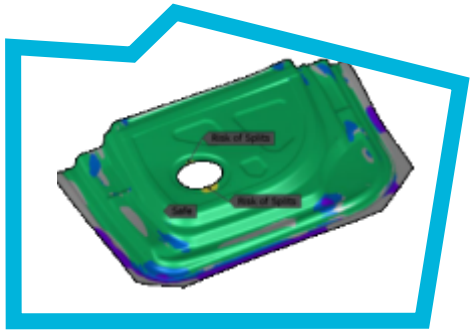
EDGE THE PRECISION BLANKS COMPANY

Body-in-white

FOCUS CUTTING EDGE

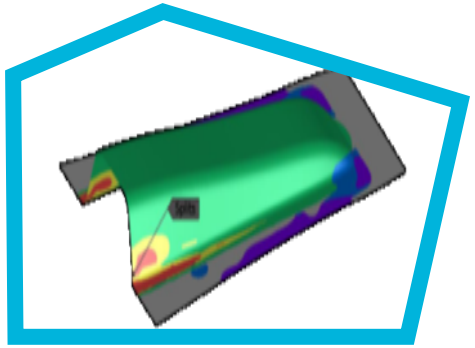
Simulation of three critical components: Door inner, B-pillar section, wheel house



- In AutoForm R7, three different component geometries were simulated and the specific behavior of HSC-cut blanks was examined
- For this purpose, the material data in the software are supplemented by the experimentally determined measured values
- A door inner, a B-pillar and a wheel house were examined
- The most important failure criteria considered are max. failure and the edge crack criterion.

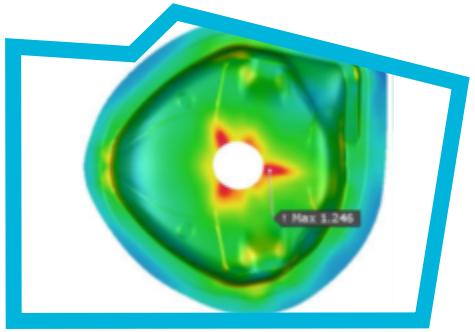
Max. Failure

- The max. failure value describes the main deformation occurring in relation to the theoretically tolerable main deformation (according to FLC).
- Cracks occur from a value of ≥ 1
- Components are usually designed up to 0.8, i.e. with 20% process reliability



Edge Crack Criterion

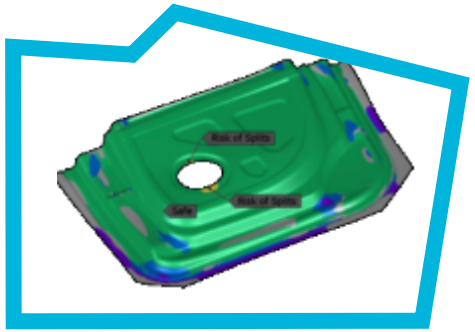
- The Edge Crack value describes the ratio of "current plastic work" to "critical plastic work".
- From a value of ≥ 1, edge cracks occur
- Components are usually designed up to 0.8, i.e. with 20% process reliability
- The input parameters are the experimentally determined maximum tolerable values of main deformation (max. edge strain).



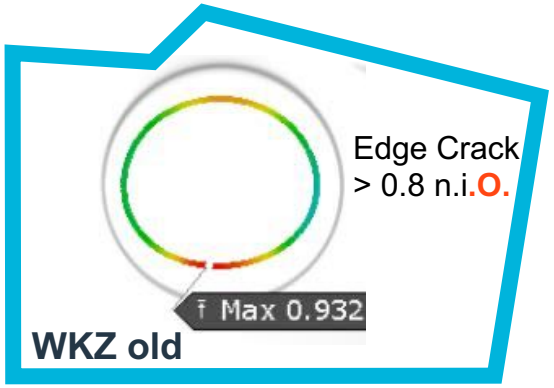
Source: FGU Stuttgart, November 2019

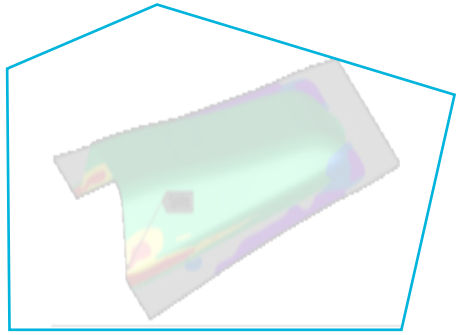
FOCUS CUTTING EDGE

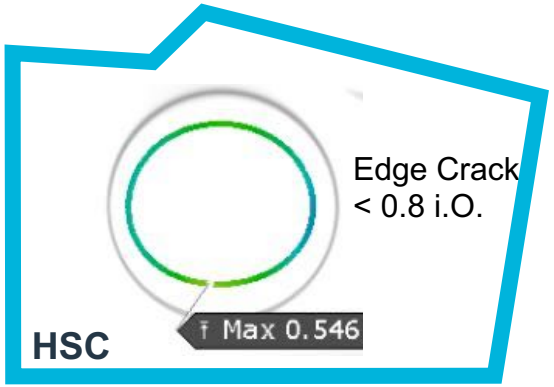
Brief summary of the results for the examination on the inner door panel

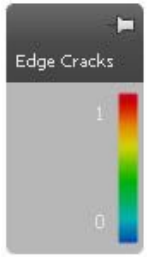


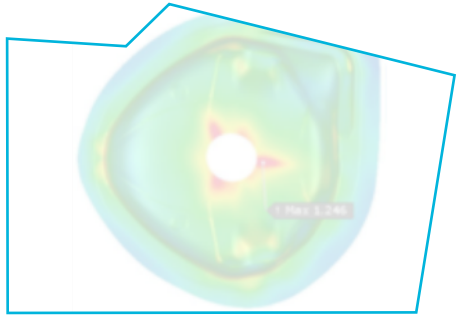
- The examined door inner part is crack-critical at the frame, therefore a relief hole is added
- With the relief hole the frame performs without cracks in forming
- However, after optimizing the contour of the relief hole, it is still crack-critical
- If the relief hole is milled, the higher residual formability can be used for the component design and method optimization is not required.
- If necessary, the improved performance can be used for a more extensive redesign of the entire component.
- Material: 5182, 1.15 mm







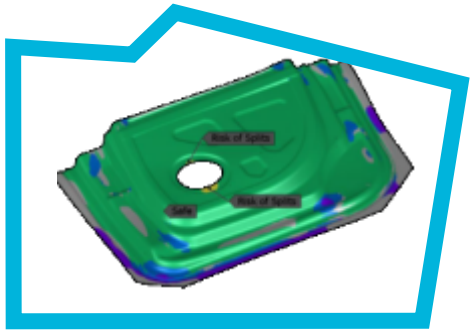




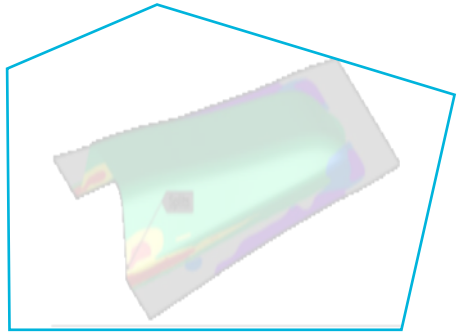
Source: FGU Stuttgart, November 2019

FOCUS CUTTING EDGE

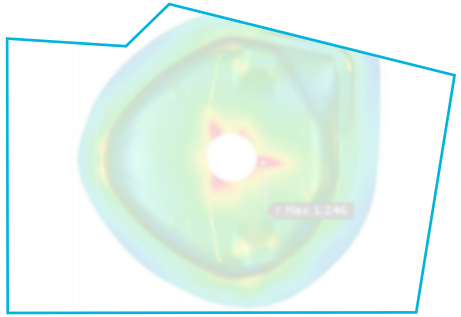
Possible conclusions for the forming process



shear cut relief hole → limited formability → lower process reliability → more complex method optimization / component modification (complex management)



HS cut relief hole → higher formability → higher process reliability → less time for method optimization / avoid component modification if possible

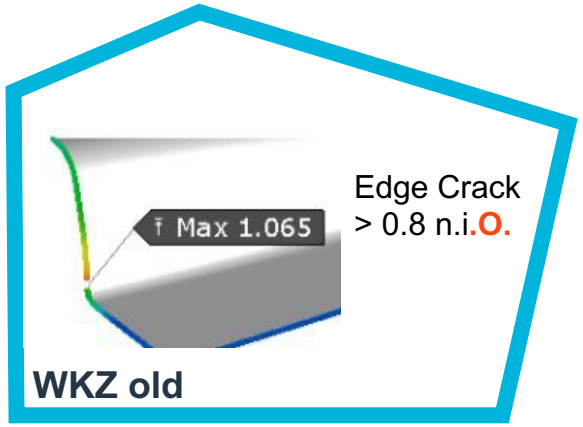


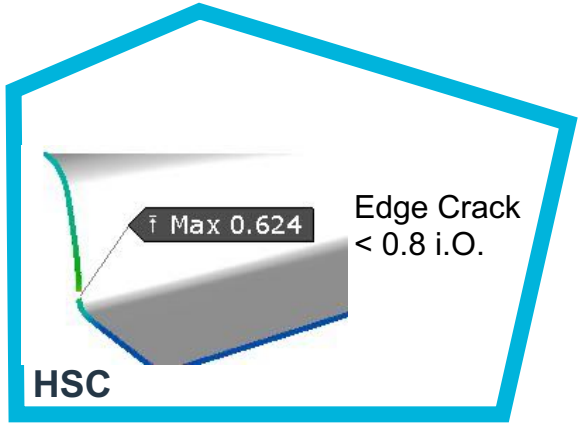
Source: FGU Stuttgart, November 2019

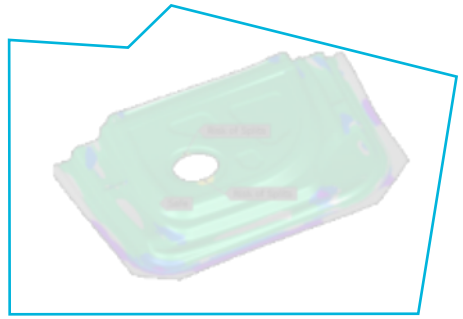
FOCUS CUTTING EDGE

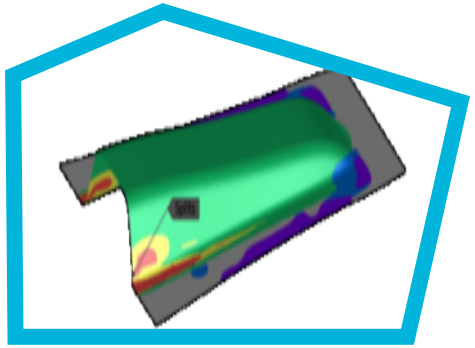
Brief summary of the results for the examination on the B-pillar

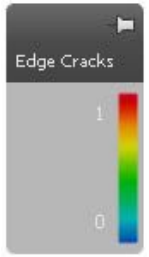
- To avoid the edge cracks at the open head of the B-pillar segment, the part must be manufactured with soft beads and low blank holder force.
- This means that the material consumption is greater and the stiffness of the component is poorer
- In the sample simulation, the heavily cut edge (old tool) is already cracked (Edge Crack > 1), but the milled edge still has a high residual forming capacity (Edge Cracks = 0.624 > 0.8)
- Production with harder beads and higher blank holder force is possible, which saves material.

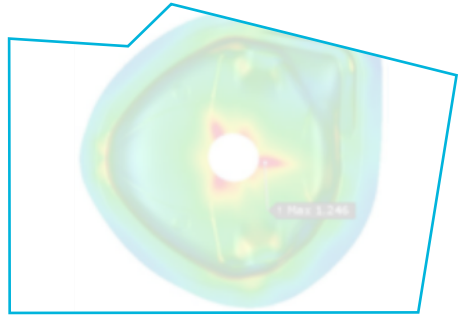








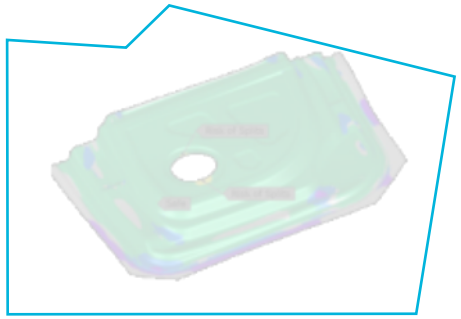




Source: FGU Stuttgart, November 2019

FOCUS CUTTING EDGE

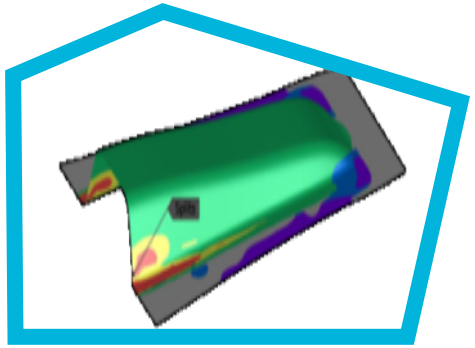
Possible conclusions for the forming process



tool cut edge → softer beads

softer beads → more material feed → higher material consumption

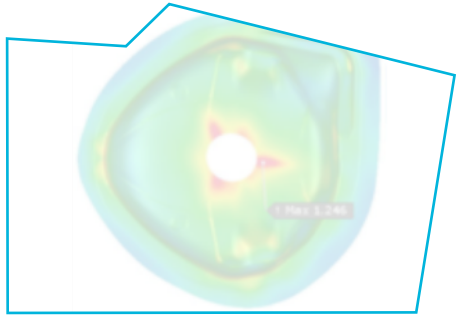
softer beads → lower degree of deformation → lower work hardening → lower stiffness of the component



tool cut edge → hard beads

hard beads → less material feed → lower material consumption

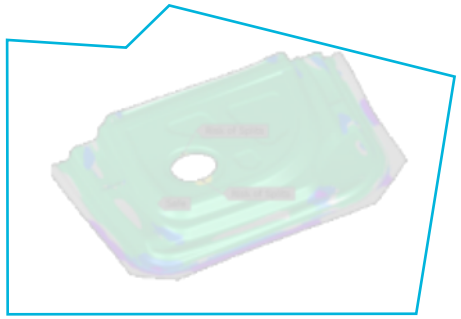
hard beads → higher degree of deformation → higher work hardening → higher stiffness of the component



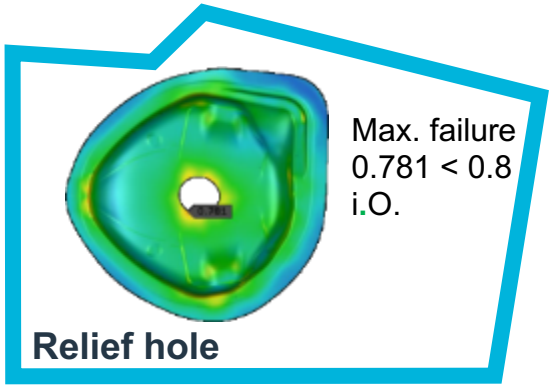
Source: FGU Stuttgart, November 2019

FOCUS CUTTING EDGE

Brief summary of the results for the wheel house examination

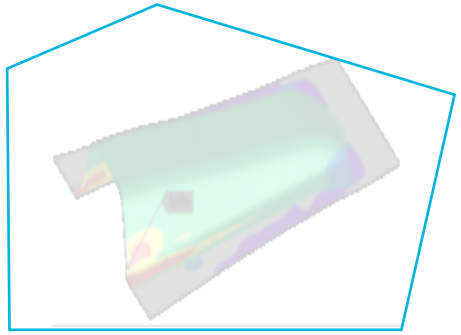


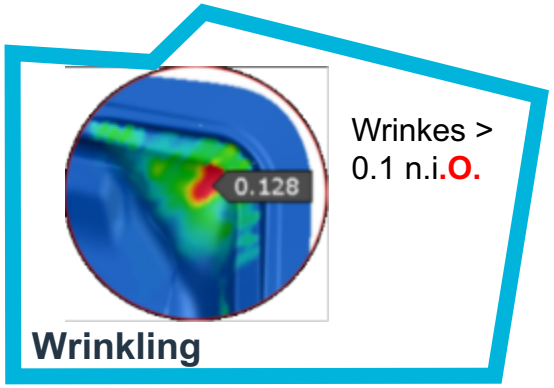
- In order to avoid the edge cracks at the relief hole, the part must be manufactured with soft beads and lower sheet holder force.
- This is accompanied by increased material requirements, wrinkling occurs in one corner
- In addition, the max. failure value of 0.781 is very close to the load limit. Fooming with harder beads and higher blank holder force is not possible.
- Material 6016 T4, 1.70 mm



Max. failure 0.781 < 0.8 i.O.

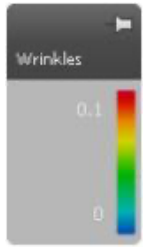
Relief hole

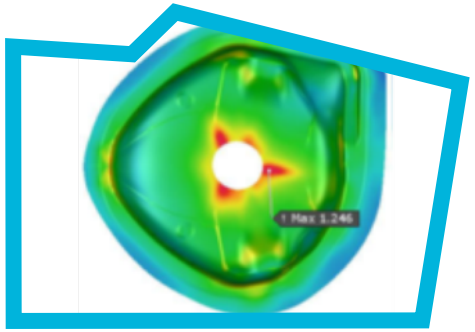




Wrinkes > 0.1 n.i.O.

Wrinkling

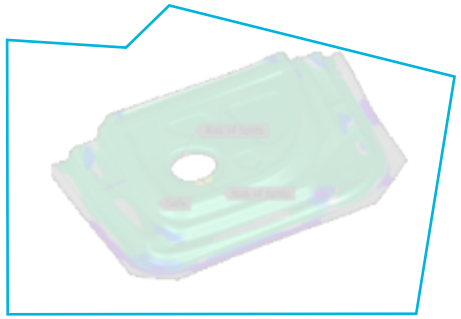




Source: FGU Stuttgart, November 2019

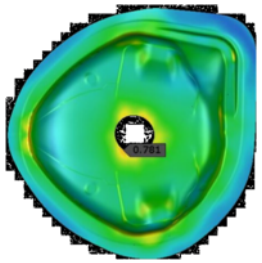
FOCUS CUTTING EDGE

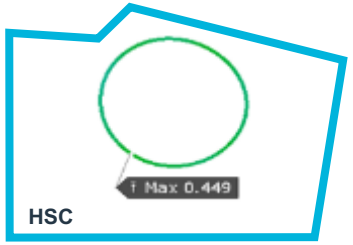
Brief summary of the results for the wheel house examination



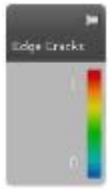
- If the relief hole is produced with the HSC process, a higher residual forming capacity is achieved

Edge Crack
0.817 > 0.8
n.i.**O.**

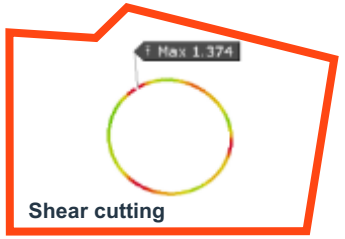




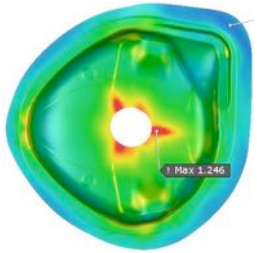
Edge Crack
0.449 < 0.8
i.O.

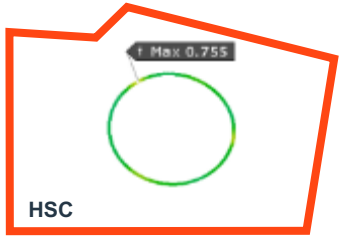


- If the component is produced with harder beads and higher sheet holder force, material can be saved. However, with shear-cut relief holes, these then crack. HSC-cut relief holes do not crack.

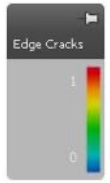


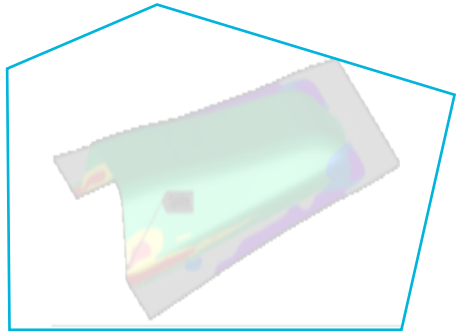
Edge Crack
1.374 > 1
n.i.**O.**

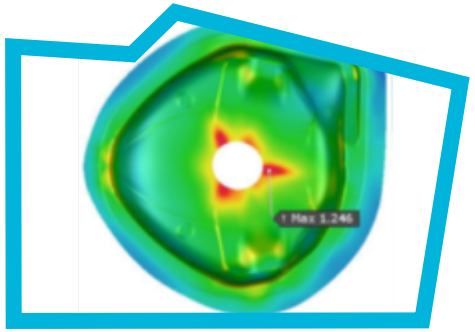




Edge Crack
0.755 < 0.8
i.O.



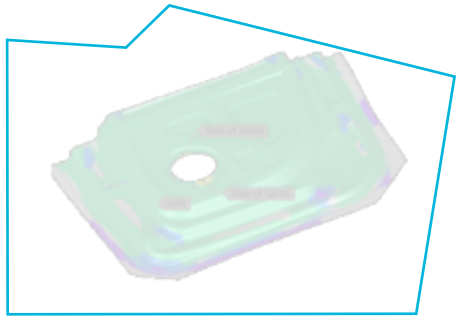




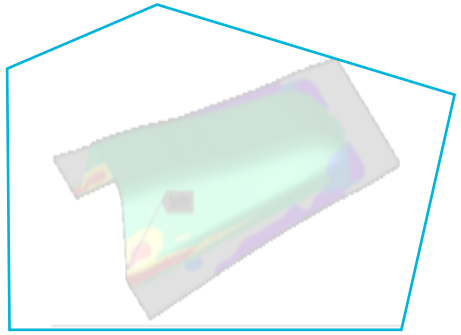
Source: FGU Stuttgart, November 2019

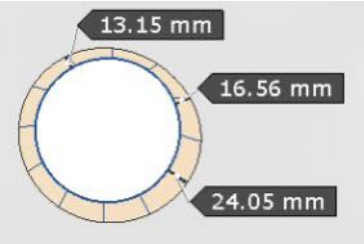
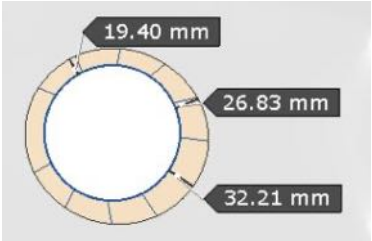
FOCUS CUTTING EDGE

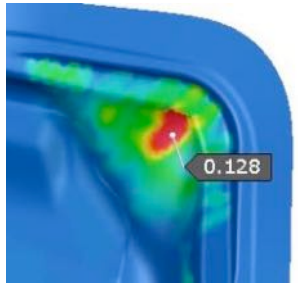
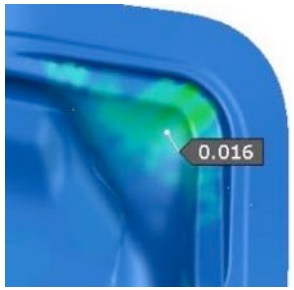
Brief summary of the results for the wheel house examination

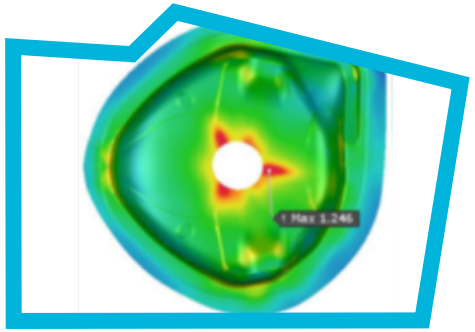


- Since the milled hole can be stretched more by approx. 8 mm, more material can flow from the inside.
- This results in a possible material saving of approx. 5%.
- The part can be manufactured with harder beads and higher blank holding force, which significantly reduces wrinkling



HOLE EXPANSION	
tool cutting	HSC
	

WRINKLES	
tool cutting	HSC
	



Source: FGU Stuttgart, November 2019

FOCUS CUTTING EDGE

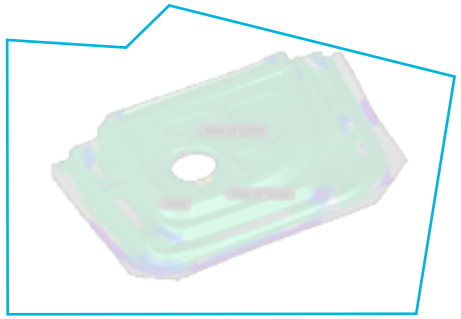
Possible conclusions for the forming process

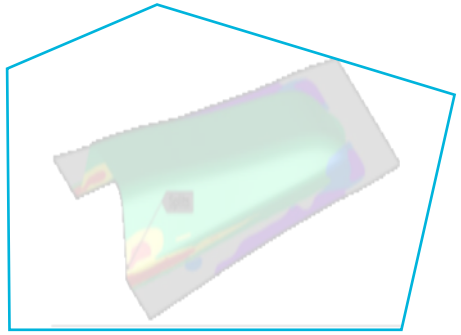
tool cut relief hole → soft beads & lower blank holder force

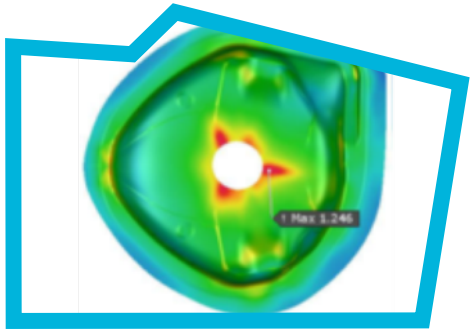
- → more material feed → More material consumption
- → More wrinkles → poorer component quality

HSC relief hole → hard beading & higher blank holding force

- → less material feed → less material consumption (- 5%)
- → less wrinkles → better component quality





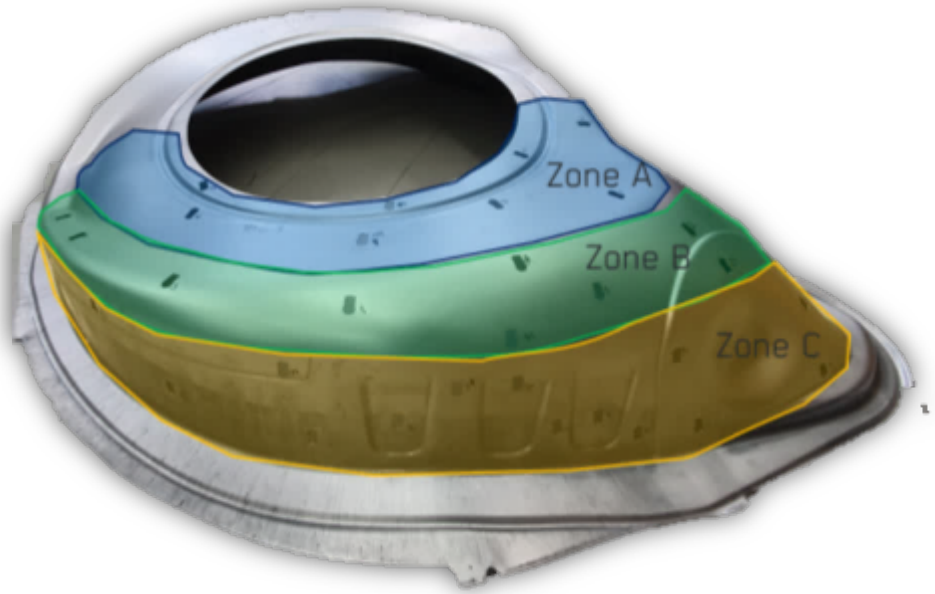


Source: FGU Stuttgart, November 2019

FOCUS ON THE ENTIRE COMPONENT

Verification of the results on the real component

- To validate the results, tests were carried out on a real component (wheel house) together with a partner (OEM).
- The comparisons between die-cut and HSC-cut parts provided identical results to those obtained in the simulation described previously.
- In addition, it was investigated to what extent the influence of thermal cutting (laser) also affects the forming behavior of the real component.
- The actual change in sheet thickness was determined over the entire part contour relative to the real initial sheet thickness by means of keyhole measurement.
- The determination was carried out in three zones with different forming stresses and at randomized 42 measuring points.

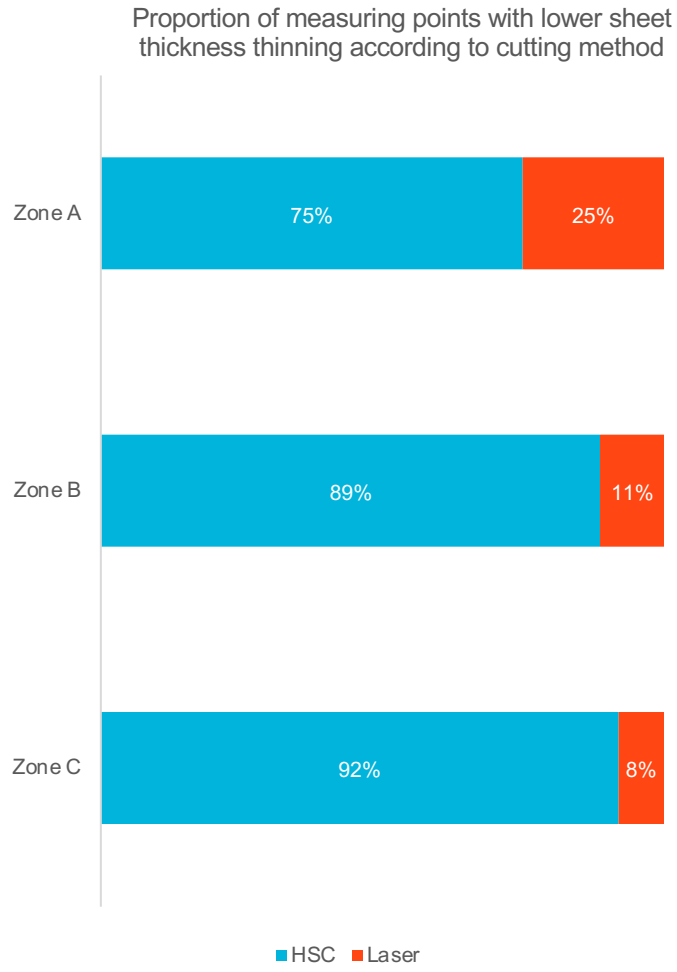


Source: FGU Stuttgart, MNC, September 2020

FOCUS ON THE ENTIRE COMPONENT

Main results of the study

- The cutting process of the blank has an influence on the thinning or residual sheet thickness over the entire component and not only at the component edges.
- This indicates an influence of the condition of the blank edge on the forming process
- When using an HSC-cut blank, the sheet thins out less over the entire component than with laser-cut blanks, i.e. HSC-cut blanks generally provde higher residual formability.
- A positive effect of the HSC blank can be seen particularly in zone C, where the proportion of measuring points with lower thinning is 92%.
- This could, for example, reduce material usage (e.g. smaller blank) and still ensure process robustness.
- For a scientific explanation of this effect, further investigations are necessary in order to be able to exploit it specifically



Source: FGU Stuttgart, MNC, September 2020

Thank you very much!

I am looking forward to your message!

Max Brandt, Managing Director
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info@edgeblanks.com
M +49 (0)152 2589 0472