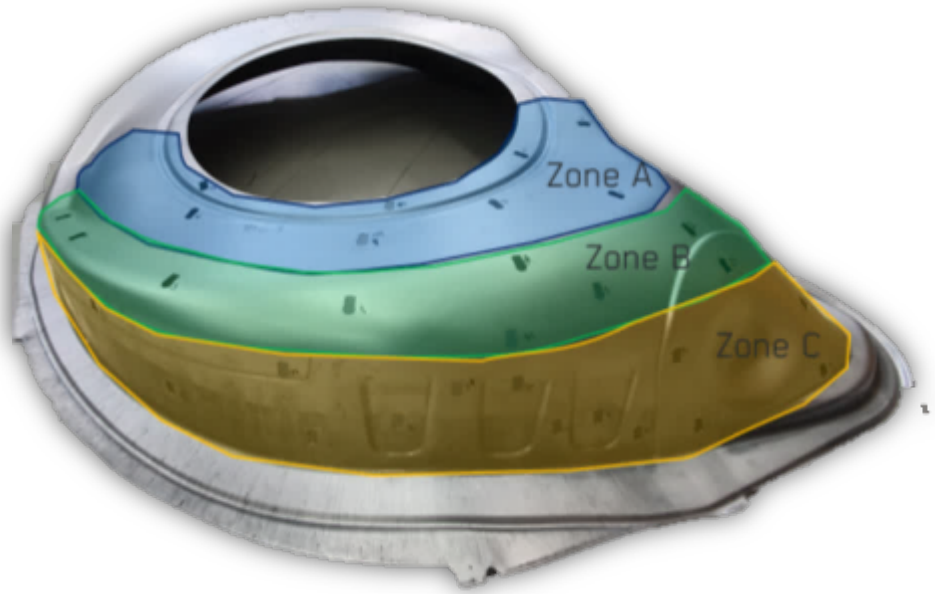
EDGE THE PRECISION BLANKS COMPANY

Precision Blanks

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.

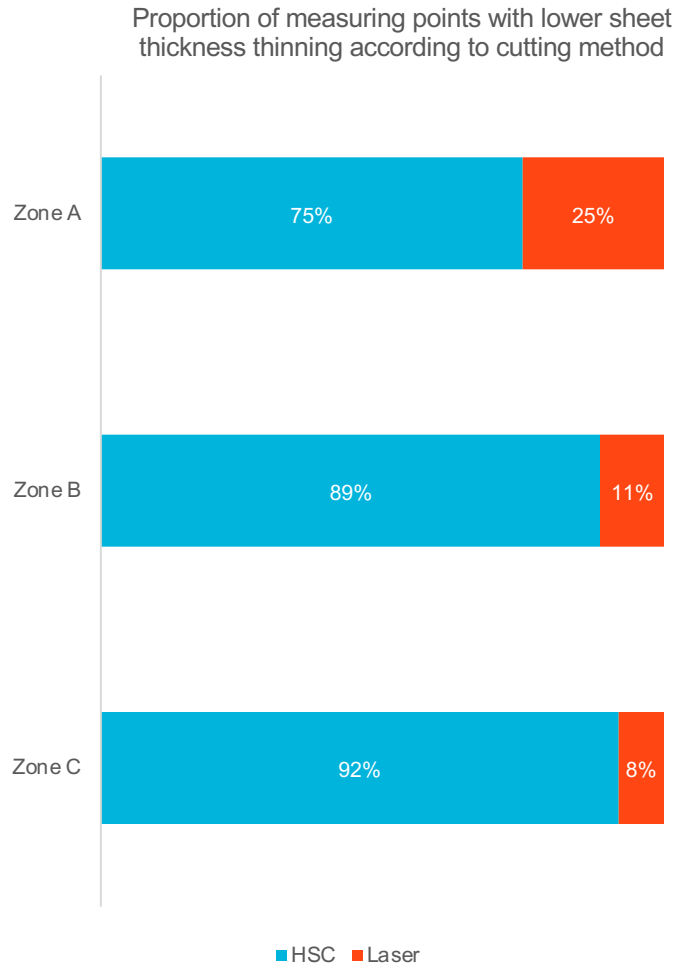


Source: FGU Stuttgart, EDGE, September 2020

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, EDGE, September 2020

What makes us different?

From aluminum to steel

FROM ALUMINUM TO STEEL

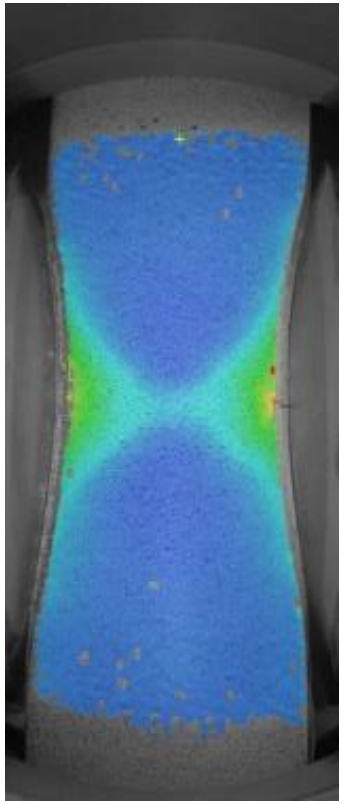
Development of the HSC process for steel from deep drawing to high strength grades

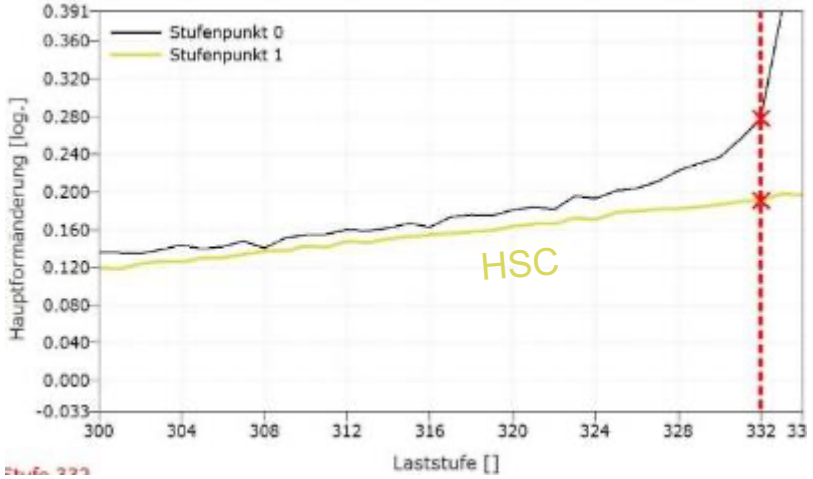
- In 2015, EDGE developed and patented the HSC process for manufacturing precision milled aluminum blanks.
- In 2020, EDGE has now comprehensively developed the process further by means of new milling methods and new cutter geometries and has applied for a patent for the geometry milling of steel sheets.
- While we had already more than tripled the feed rates for aluminum in the meantime, the aim was also to achieve these speeds for the milling of steels right from the start. This was achieved at the beginning of 2021.
- EDGE is able to mill deep-drawing grades as well as high-strength DP and CP grades (DP800/1000, CP-W 800). These are particularly interesting with regard to the edge-related cracking tendency in the chassis.
- With regard to the future milling of formed components, we have already proven that we can also mill hot-formed manganese-boron steels using this process.

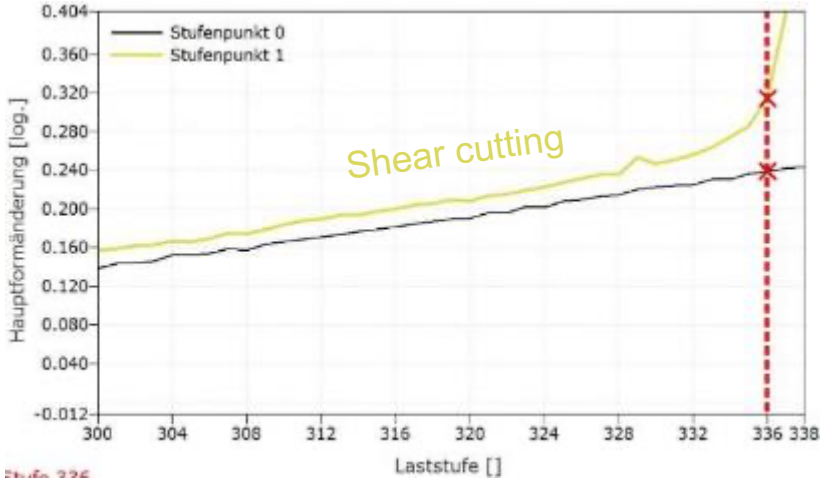
FROM ALUMINUM TO STEEL

Diabolo tests on shear cut vs. HSC cut edges, DP1000
2.0 mm thickness

- In both tests, as in the previous tests, the material failure occurred on the shear cut side of the specimen.
- The strain curve of the most heavily loaded area on both sides of the specimen shows that just before failure, the strains on both sides differ significantly.
- Locally higher strain values (at the same load) were found at the shear cut edge.
- The residual formability of an HSC-milled steel plate edge is higher than shear cut edges.



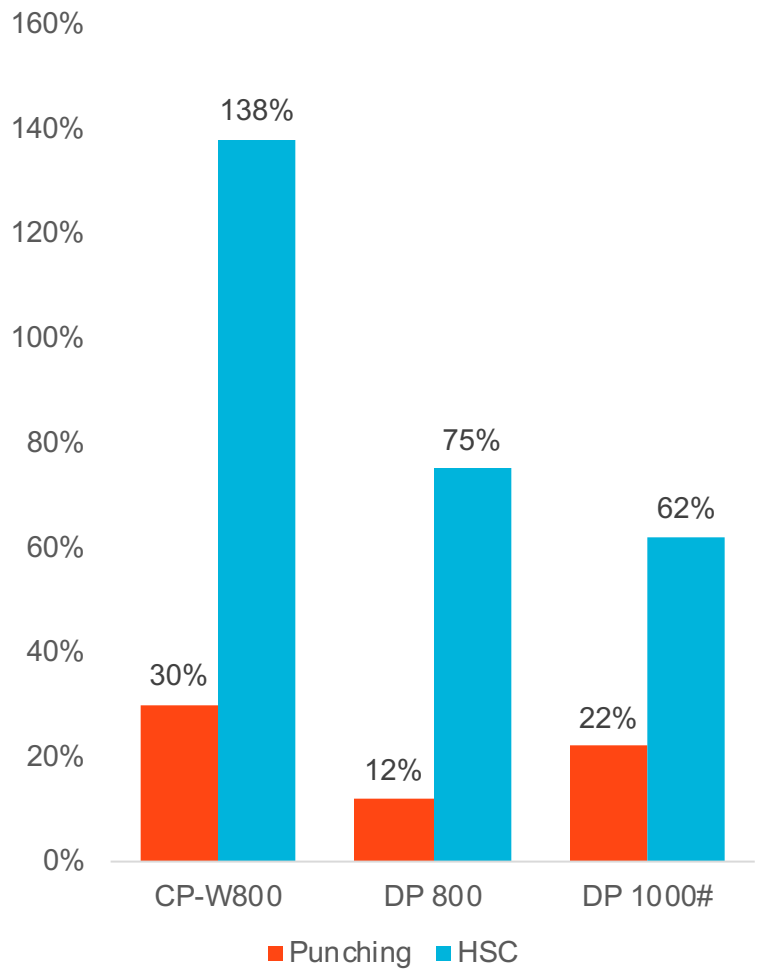




FROM ALUMINUM TO STEEL

Hole expansion tests on high-strength cold-forming steels CP-W 800, DP 800 and DP 1000 (1.5 and 2 mm thickness)

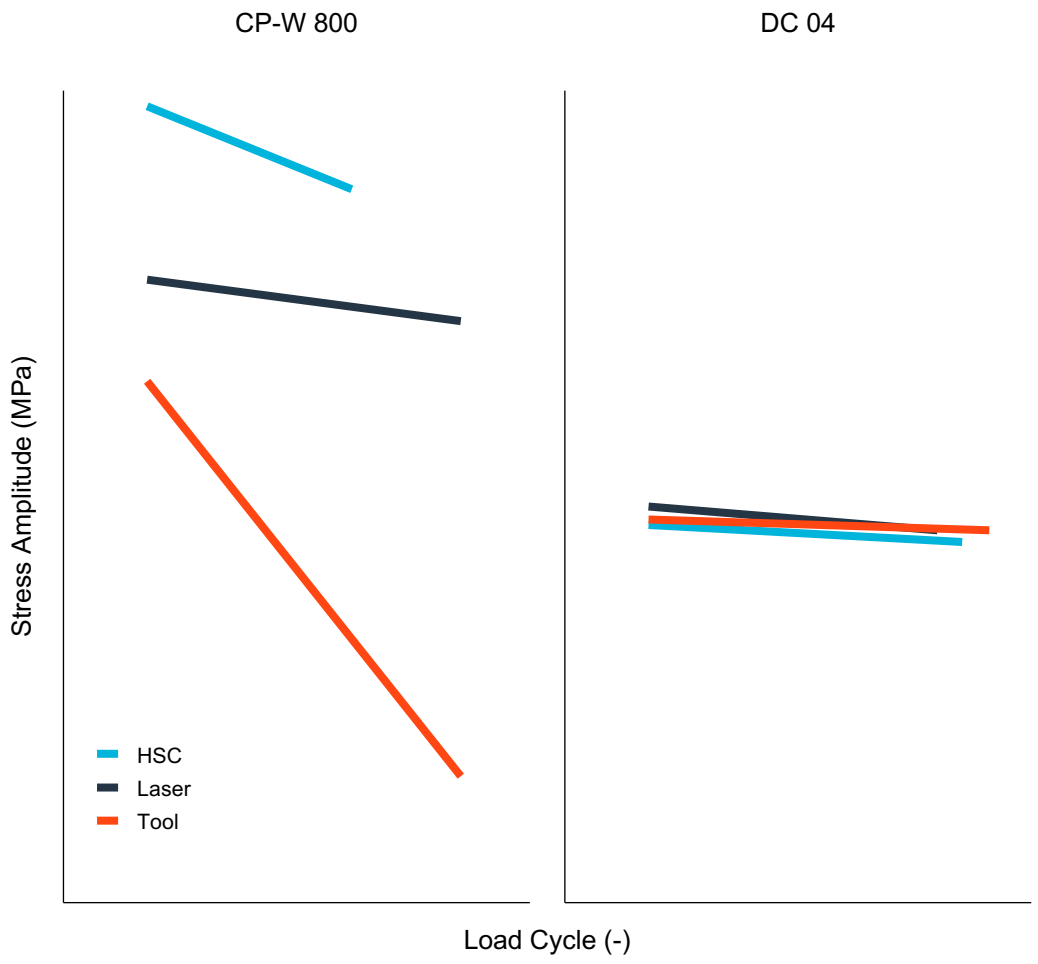
- Complex-phase steels are used extensively in chassis components and are subject to high fatigue loads. Dual-phase steels deliver excellent performance properties for high demands in body components.
- However, the grades are susceptible to edge cracking and harden strongly in the edge area due to thermal and shear processing.
- It was necessary to prove that the damage- and burr-free production of cutting edges by means of HSC counteracts these phenomena. Accordingly, ISO16630 hole expansion tests were carried out.
- The expansion capacity of HSC-cut holes is three to seven times higher compared to punched geometries.
- The same behavior was reproduced with alternative punch cone geometries such as flat-bottom punches and different angles on cone punches (50°, 120°).



FROM ALUMINUM TO STEEL

Fatigue behavior especially of CPW-800 after cutting

- With a well-known Tier 1, we carried out fatigue tests on shear-cut, laser-cut and HSC-cut high-strength steel grades and were able to prove that the fatigue fracture behavior, depending on the fatigue load, is significantly more positive for HSC-cut edges. In comparison, a fatigue-insensitive DC04.
- In particular, with the development of 3D milling processes, but also with the design of final contour cutting edges in the blank, these results can be used for the redesign and improved performance of chassis components.
- The data are not further dimensioned for reasons of confidentiality.



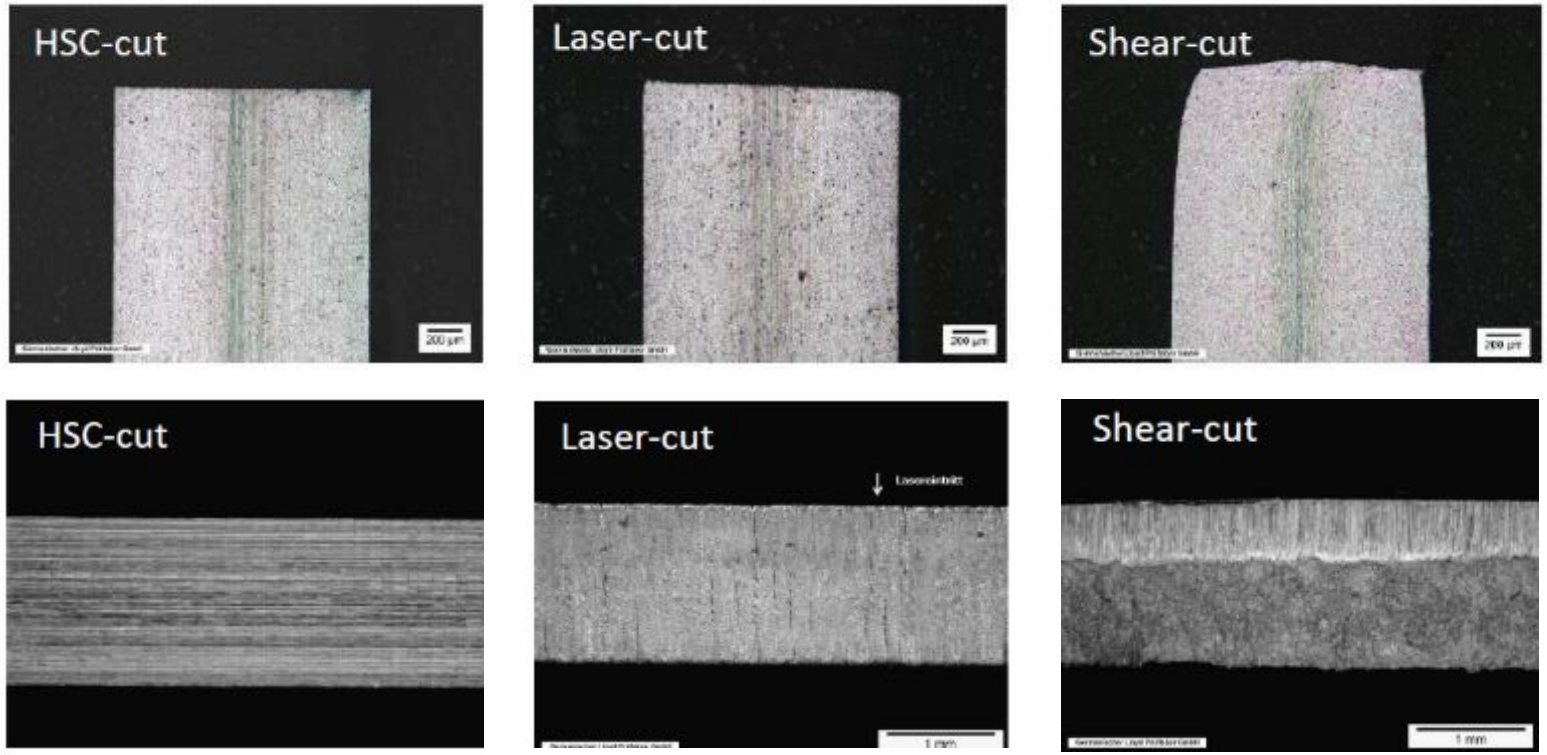
What makes us different?

Precision for battery boxes

PRECISION NOT ONLY AT THE EDGE

Dimensional accuracy and precision cutting improve assembly processes for battery boxes

Comparison of different cutting methods



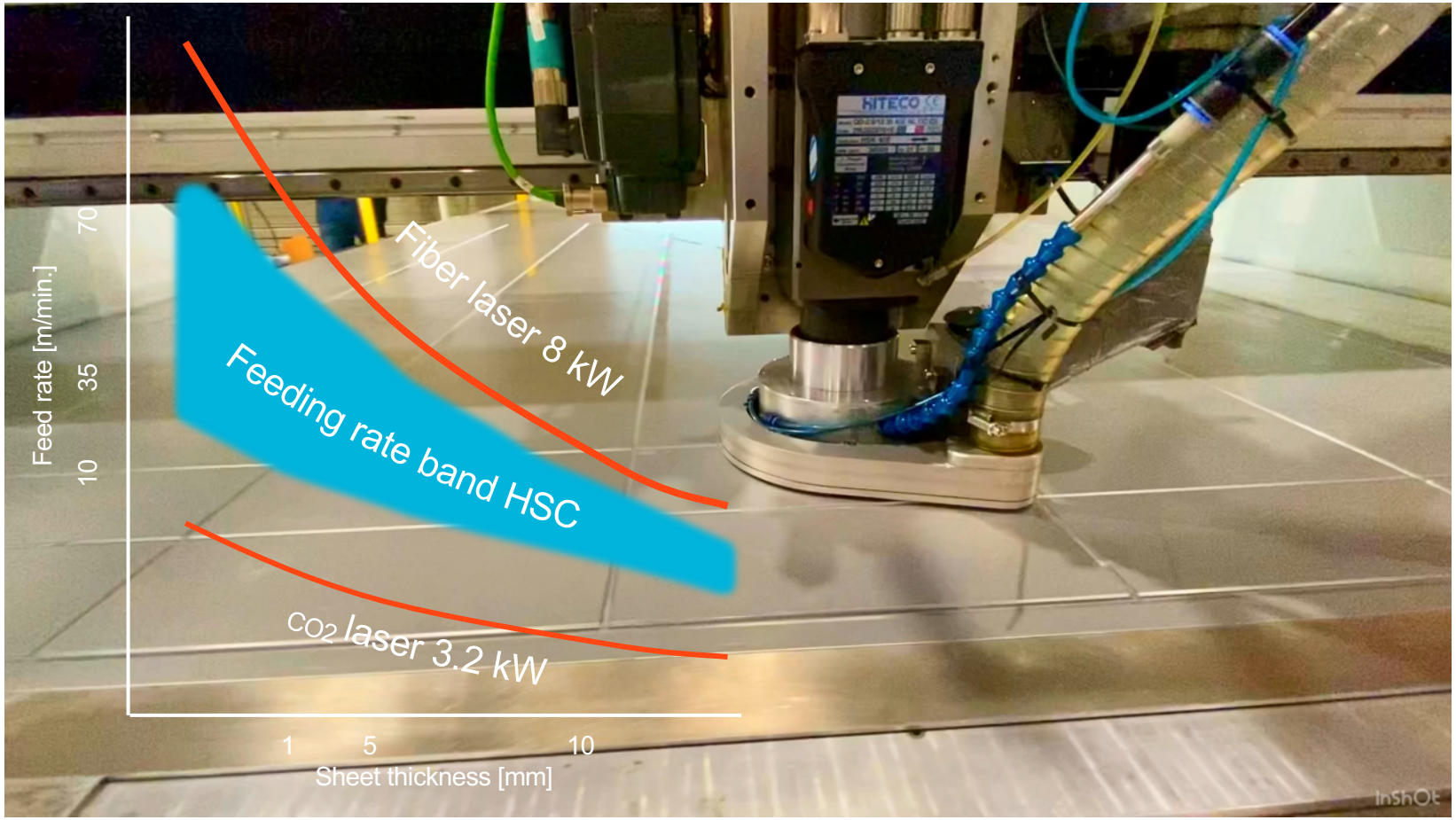
Roughness aluminum	Ra µm	Rz µm
HSC	0.21	1.16
Laser	1.94	10.29
Shear	4.52	23.75

Hardness aluminum	Vickers HV1
HSC	71-74
Laser	75-86
Shear	96-127

PRECISION NOT ONLY AT THE EDGE

Speed and precision

- For sheets of 2 mm thickness, we currently achieve feed rates of up to 55 m/min, which now makes HSC cutting competitive with high-speed lasercutting processes.
- However, the produced cut edge is considerably better and almost undamaged by heat or shear influence.



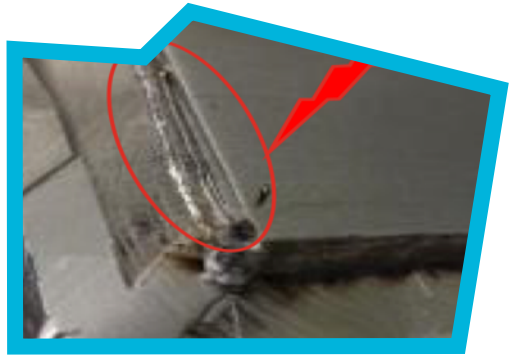
The graph shows estimated values independent of the material

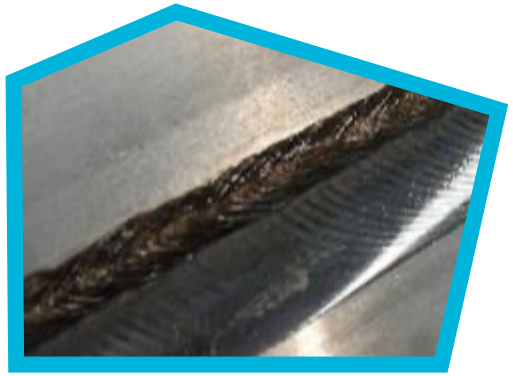
PRECISION NOT ONLY AT THE EDGE

Dimensional accuracy and precision cutting improve assembly processes for battery boxes

Typical design with base plate with continuous joint for water tightness

Main challenges	Laser welding
• Preparation / machining of the MIG welded frame for a flat joining surface. • Burrs on one side of the plate • Radius edge / rollover on the other side	• Close tolerance of the base plate gap to the frame → fewer / no burrs • narrow position tolerance of the panel edge • Meeting the edge directly at the starting point • reliable continuous joint





PRECISION NOT ONLY AT THE EDGE

Dimensional accuracy and precision cutting improve assembly processes for battery boxes

Several trials have been carried out with HSC blanks on different products and applications, each with very good results and reduced rework due to the improved capability for the laser welding process

- No burrs on both sides
  - Flat plate perfectly meets flat frame
- Rectangular edge
  - Laser joint meets / melts root zone
- Tight geometric tolerances
  +/- 0.5mm instead of +/- 1.0mm to 1.5mm on the outer edges
  - Meet starting point of the laser seam
- 100% visual inspection
  - No chips on the surface
- Homogeneous material structure
  - Perfect preparation for welding

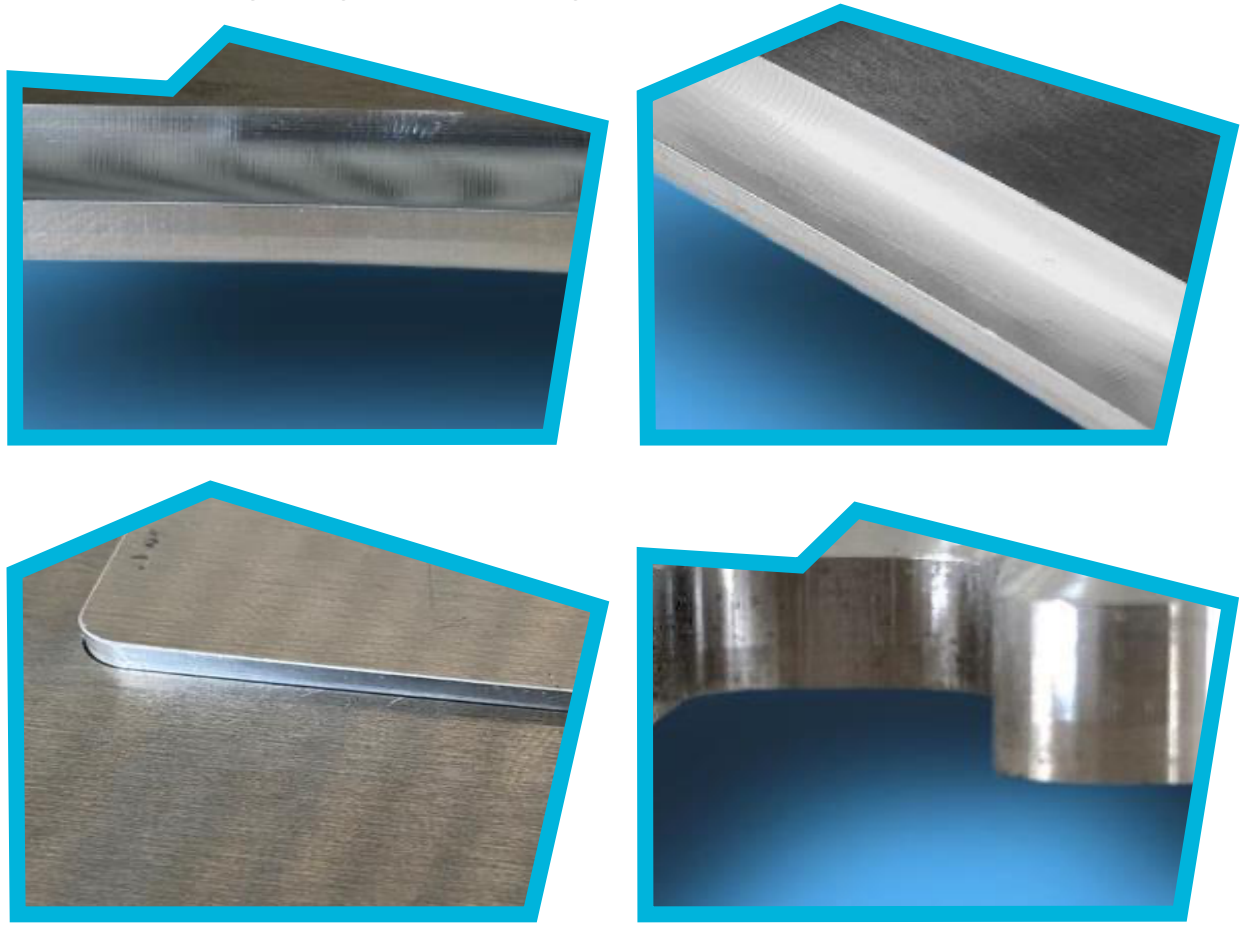
MORE THAN JUST AN EDGE - TAILORED EDGES®.

Tailored Edges give cut edges properties that optimize subsequent operations

- When it comes to specific edge preparation issues, we are increasingly seeing requests for geometric edge preparation to improve downstream manufacturing.
- Tailored Edges® can improve joining operations in assembly, especially when welding with filler wire (incl. Tailor Welded Blanks).
- The form fit of the blanks before adhesive joining can be improved, resulting in a reduction in the number of prefeeding and clamping operations.
- Tailored Edges® offer options for undercut operations, multiple radii, angles, holes, drillings and pockets.

MORE THAN JUST AN EDGE - TAILORED EDGES®.

Tailored Edges give cut edges properties that optimize subsequent operations



10 mm plate thickness for better illustration. Tailored Edges® are generally not limited to specific sheet thicknesses.

- In particular, the low tolerances resulting from the high sealing requirements in the battery box demand high precision in the manufacture of the sheet and plate components.
- The present requests require high tolerance compliance, which can be ensured by precise HSC milling and drilling.
- Smallest radii with highest dimensional precision and - if reasonable - geometric optimization of cutting edges, enables the production of battery box components with numerous geometric requirements.

Thank you very much!

I am looking forward to your message!

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