

GREAT DESIGNS IN **STEEL**

EFFICIENT PRODUCTION OF STRUCTURAL COMPONENTS FOR ELECTRIC VEHICLES WITH ROLL FORMING

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NEW CHALLENGES IN CAR BODY ENGINEERING

- Due to active & future CO₂ regulation laws the market share of battery electric vehicles (BEV) will increase compared to internal combustion engine driven cars (ICE)
- Standard body in white (BIW) designs, combined with the weight of the battery systems, especially SUVs will exceed maximum weight of 3.500kg (limit for passenger vehicle license in different countries)

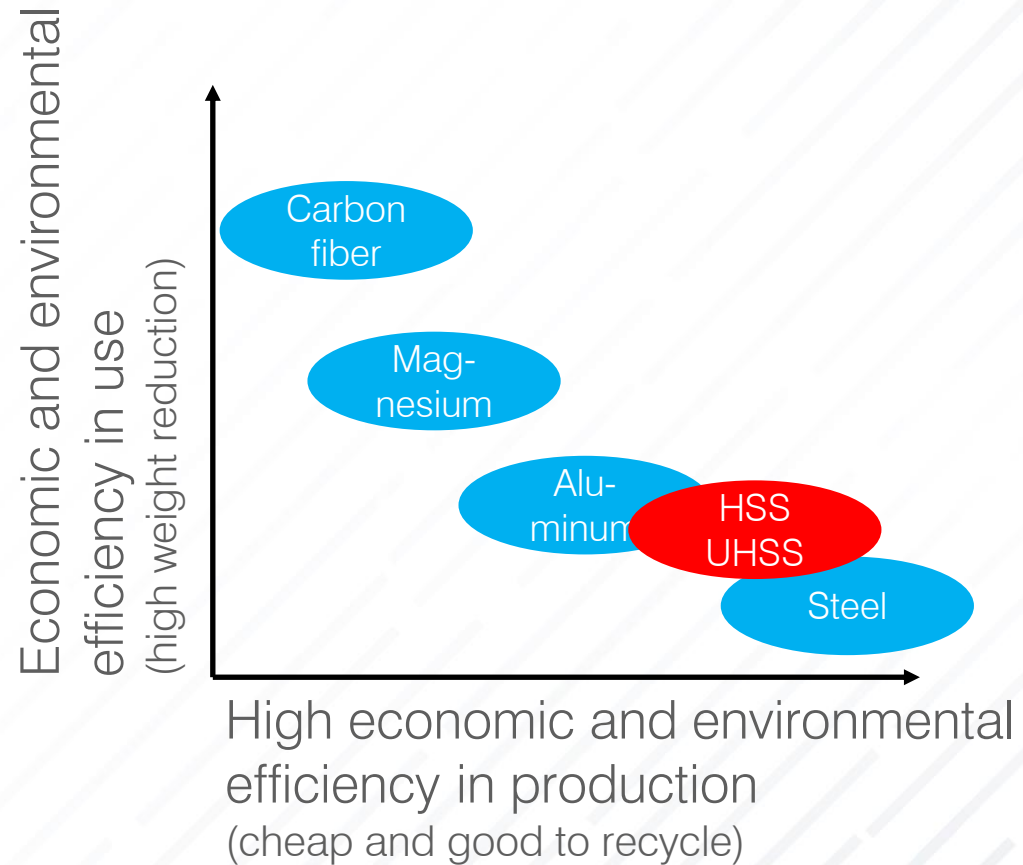
→ Need for lightweight design



LIGHT WEIGHT POTENTIAL

by the use of innovative materials

- Ideal lightweight materials are both, (economic and environmental) efficient in production and use
- Real materials tend to be either one or the other
- High strength steel (HSS) and ultra high strength steel (UHSS) alloys providing tensile strength of up to 1750 MPa compared to 270 – 400 MPa with conventional steel grades
- Compared to other lightweight solutions they are significantly cheaper and better to recycle



Information taken and rearranged from:
Singer, R.: Leichtbau ist schwer. In: Akademie Aktuell 3-2012, pp 12-13
https://badw.de/fileadmin/pub/akademieAktuell/2012/42/0312_06_singer.pdf
and
N.N.: Auto Industry Finds Steel Solution for Lightweighting (2017):
<https://newsroom.posco.com/en/auto-industry-finds-steel-solution-lightweighting/>

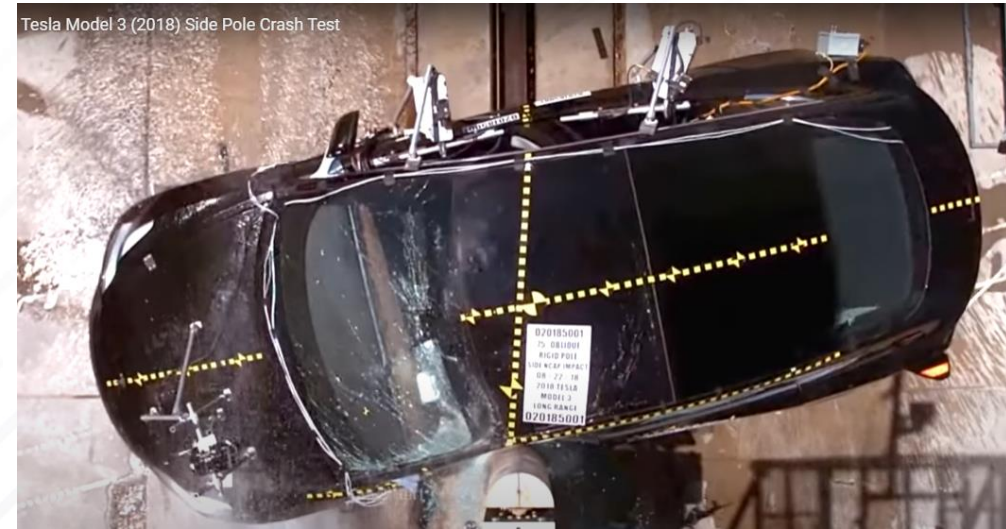
NEW CHALLENGE: CRASH BEHAVIOUR

- With changing the drive concept from ICE → BEV the crash structure must protect the battery system to ensure drivers safety
- Due to footprint of the battery systems, crash zones are reduced up to 50% and have to be massively reinforced



Reference:
<https://www.autoevolution.com/news/2016-volvo-xc90-crash-tested-by-euro-ncap-guess-the-overall-score-video-99648.html>

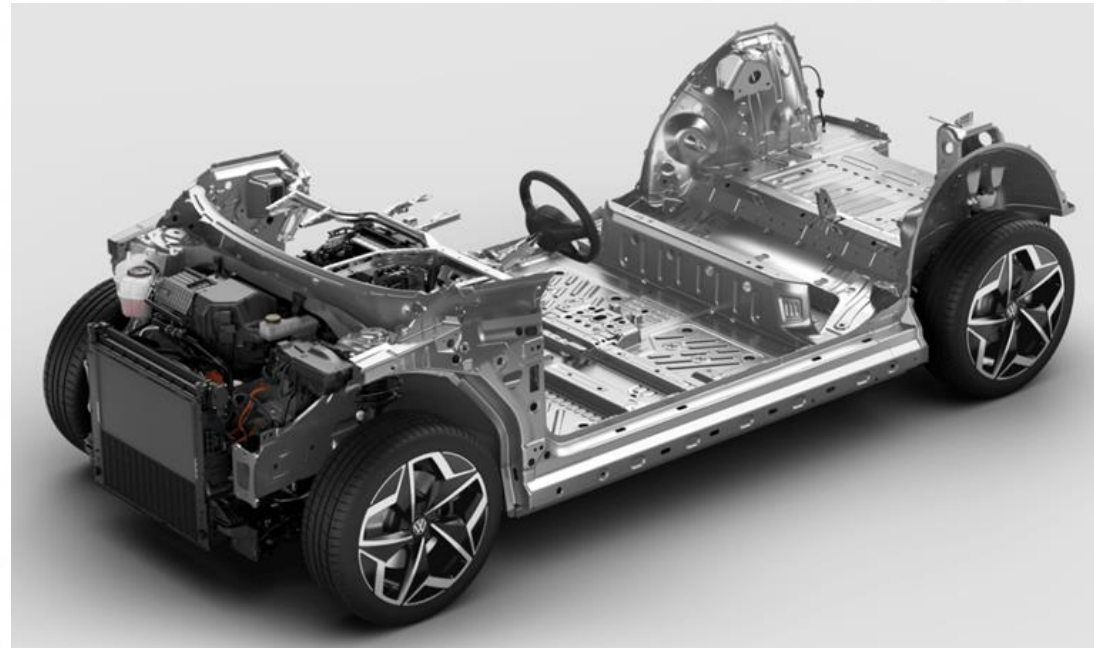
Reference:
<https://www.palkormayer.com/work/tesla-model-3-bi-w>














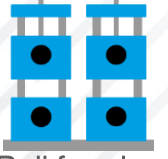
CONSEQUENCES FOR COMPONENTS

Which profile shapes getting developed due to the new challenges?

- Closed section which are stiffer than open profiles
- Multi chamber parts for a maximum energy absorption
- Made from UHSS materials
- Including holes, embossing and 3D cut-off-geometries



OPPORTUNITIES AND LIMITS OF DIFFERENT MANUFACTURING METHODS

		Challenges							
									
		High strength materials	Closed (multi chamber) sections	(Inline) punching	(Inline) Embossing	Cold forming	Output	Traceability	Checked quality
Solutions? ↑ ↓	 Bending	😊	😞	😊	😊	😊	😞	😊	😊
	 Extrusion	😞	😊	😊-(😞)	😞	😞	😊	😞	😊
	 Deep drawing	😊	😞	😊	😊	😊-(😞)	😊	😊	😞
	 Roll forming	😊	😊	😊	😊	😊	😊	😊	😊

➔ Roll forming is perfectly suitable for forming automotive profiles from UHSS

MULTI CHAMBER PROFILE MADE FROM UHSS

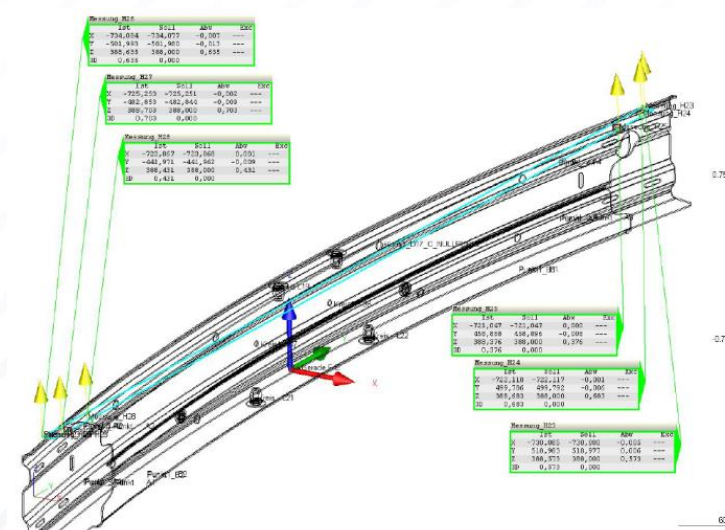
Objective:

- Mass-production of a bumper profile, multiple welded and 100% traceable for all relevant safety requirements
 - Ultra high strength steel (MS1200)
 - Multi chamber cross section



Challenges:

- Constant forming of variable UHSS alloys
- 2 x defined welding process
- Secured quality by traceable production



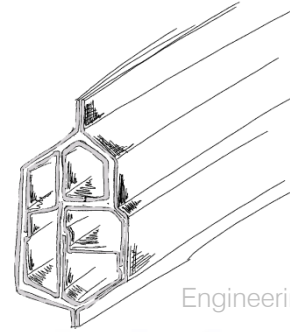
OBJECTIVE OF THE MANUFACTURING SYSTEM

Possible profiles:

- Material: Mild to ultra high strength steel
- Cross section: Open, single and multi chamber tubes
- Features: Punching, embossing, 3D-bending, ...

Possible Applications:

- Rocker, door reinforcements
- Bumper
- Battery trays

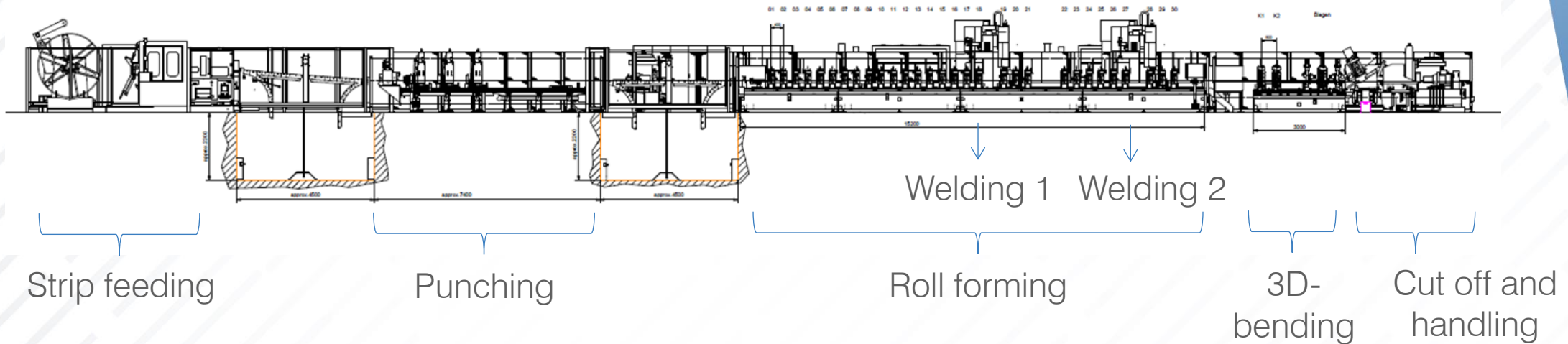


Engineering idea for Rocker incl. reinforcement



LINE SET-UP

Footprint of a sample line:



Main components:

- Strip feeding line, with 21 roll leveler
- DREISTERN pre-punching system
- DREISTERN roll forming system with 30 forming stations up to 2,5mm UHSS
- Intelligent roll forming & quality control systems
- Up to four Laser welding systems
- Inline 3D-Bending station
- DREISTERN flying cut-off system for multiple tool assembly

LINE SET-UP



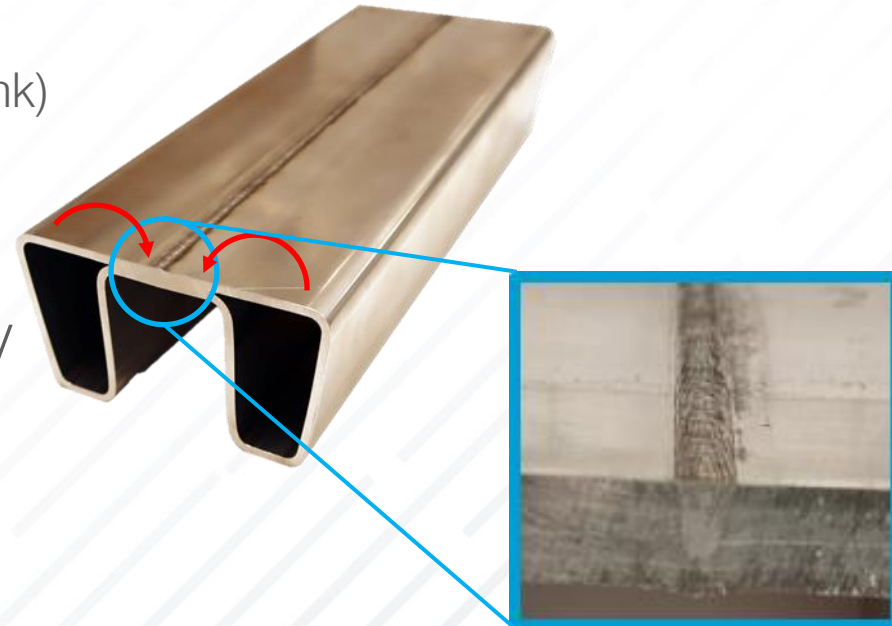
QUALITY MANAGEMENT IN WELDING

Challenge:

- Securing/Tracking of weld quality in multi chamber welding
 - Works for ordinary weld seam (eddy current check, picture check)
 - Fails for a B-shape geometry with only one weld seam
 - 3 joining partners (2 band edges + 1 bottom blank)
 - Defined joint between top and bottom layer

Vision:

- Inline quality control analyzing all relevant quality parameters in the weld zone



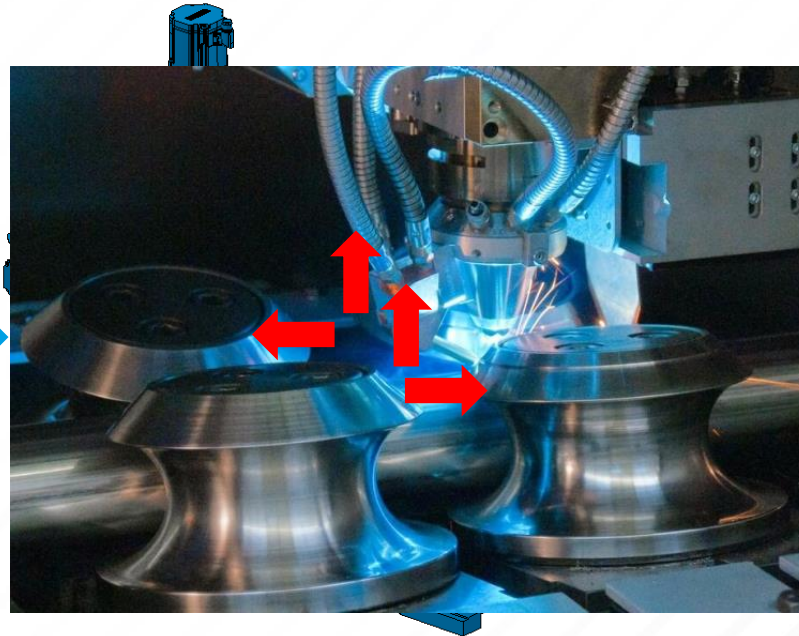
TYPICAL LASER WELDING PROCESS

Easy to set/control

Feed speed
Laser Power
Focus and Position
Filler wire
Process gas

Visible without destruction

Geometry of joint
Heat affected zone



Input

Output

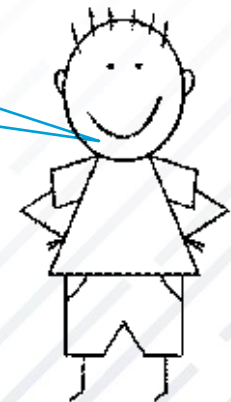
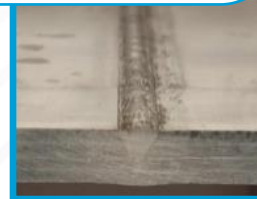
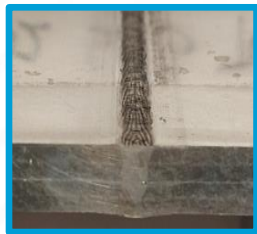
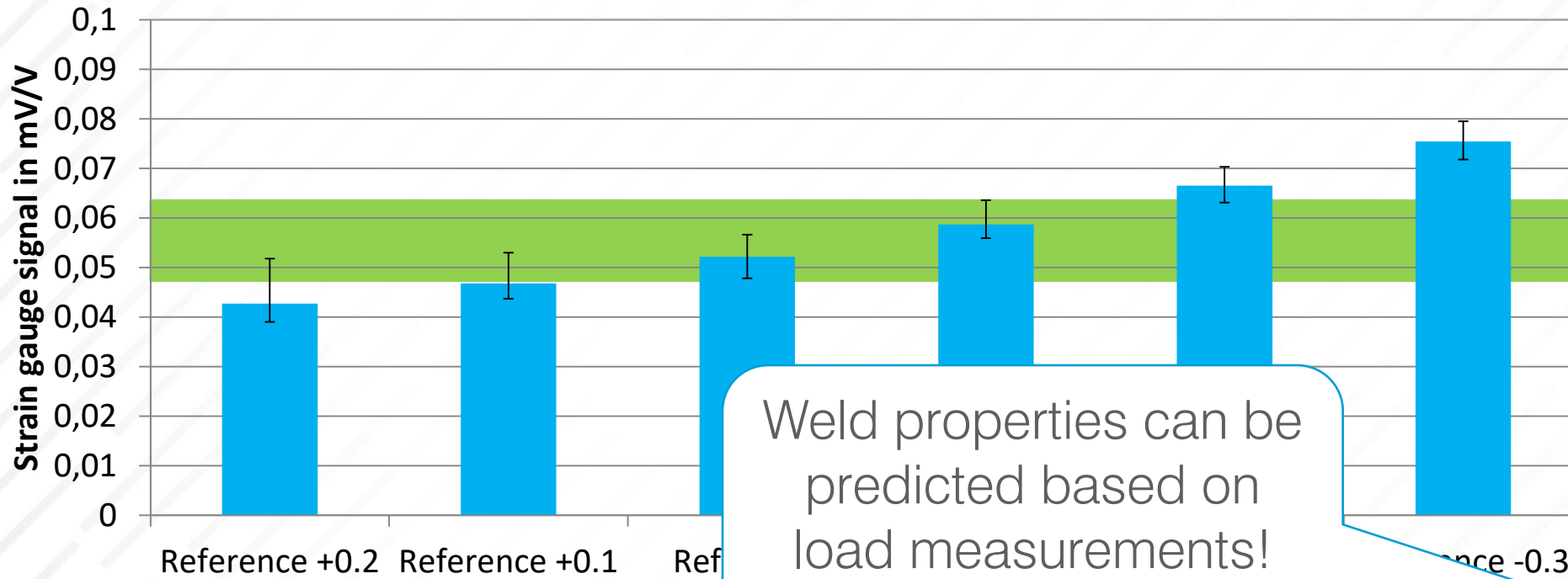
Blank width
Quality of strip edge
Pre-formed geometry

Welding depth
Strength of the weld

Difficult to set/control

Visible after destruction

QUALITY PREDICTION BASED ON MEASUREMENTS



CONCLUSION

- New car body structures of BEVs put new challenges on sheet metal manufacturing
- Well established manufacturing methods come to limits
- Roll forming offers an attractive alternative to manufacture profile shaped components, even from high strength steel alloys
- Roll forming manufacturing complete parts in only one step AND assure the quality due to inline process monitoring and control



FOR MORE INFORMATION

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