

Steel components for battery housings

at CBMM & Partners Mobility Tech Workshop

Berlin, 24th of May 2019

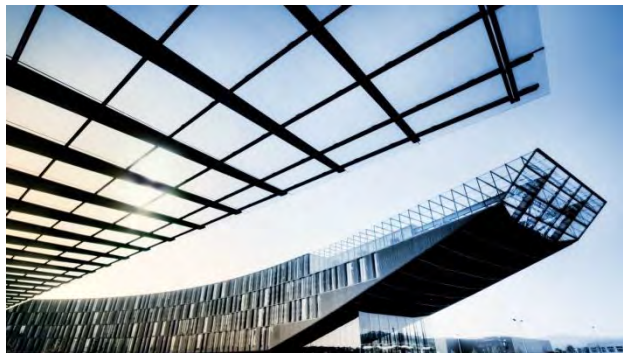


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The voestalpine group



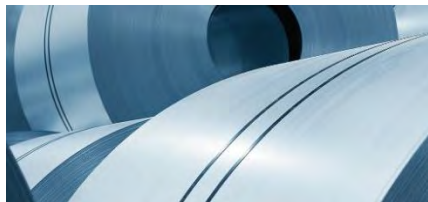
Headquartered in Linz, Austria

voestalpine is a leading technology and capital goods group with combined material and processing expertise, holding global top positions in its business units. The Group focuses on product and system solutions based on steel and other metals of the highest quality in technology-intensive industries and niches.



voestalpine divisions

As a publicly listed holding company, voestalpine AG manages four divisions that are each **world market leaders or one of the leading global suppliers.**



STEEL DIVISION

**Worldwide
quality leadership**
36% share of Group
consolidated revenue



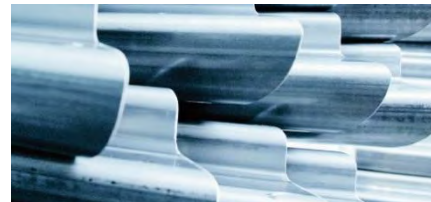
HIGH PERFORMANCE METALS DIVISION

**Global
market leader**
22% share of Group
consolidated revenue



METAL ENGINEERING DIVISION

**World
market leader**
22% share of Group
consolidated revenue



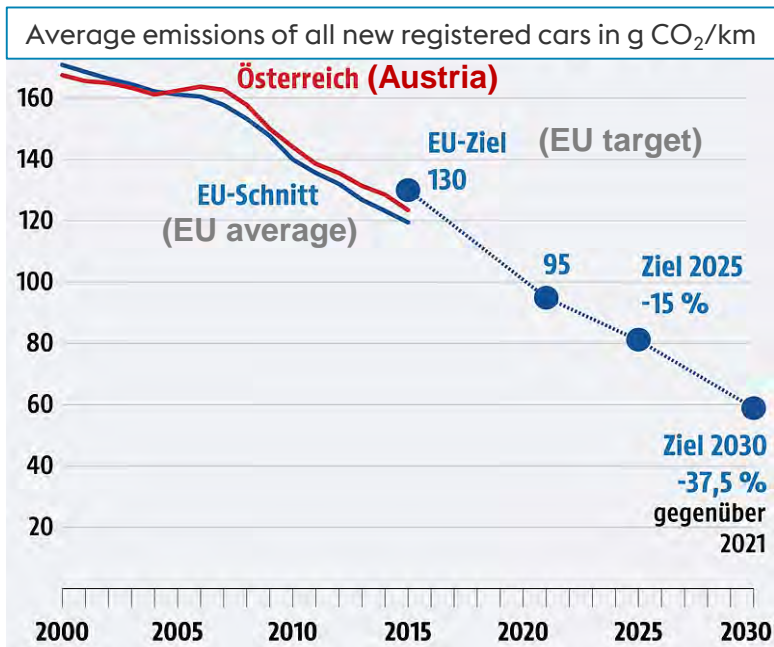
METAL FORMING DIVISION

**World's
leading supplier**
20% share of Group
consolidated revenue



Electro mobility

Aims of the European Union



Quelle: orf.at













- » 95g CO₂/km: 3,6l diesel or. 4,1l petrol /100km
- » For every additional gram: 95 € penalty / PKW
 - » Billions of € fines for car manufactures possible (FCA/Tesla)
- » Future regulations also for trucks and coaches (2025: -15 % CO₂ 2030: -30 % CO₂)

Targets can not be reached without electrification of the drive train!



Electro mobility

Manufacturers 2021

Country	Expected production EV and PHEV until 2021 ['000 cars']	Top 3 models per country
	 6.843	BAIC EU260 EV; SAIC Roewe 550 PHEV; BAIC EV200
	 3.058	Tesla Model 3; Tesla Model S; Chevrolet Bolt
	 2.247	Audi etron, Mercedes C PHEV, BMW i3
	 1.023	Nissan Leaf; Toyota Prius PHEV, Mitsubishi Outlander PHEV
	 763	Renault ZOE Z.E., Peugeot 208 EV, Renault Kangoo Z.E.
	 632	Hyundai Ioniq EV, Kia Niro PHEV; Kia Soul EV

Source: Index Elektromobilität, Roland Berger & fka Aachen, 2018



Electro mobility

Why steel?

- » What have a high volume **VW Golf 7 TSI Blue Motion 1.2** and a **Carinthian Drautaler cheese** in common?



?



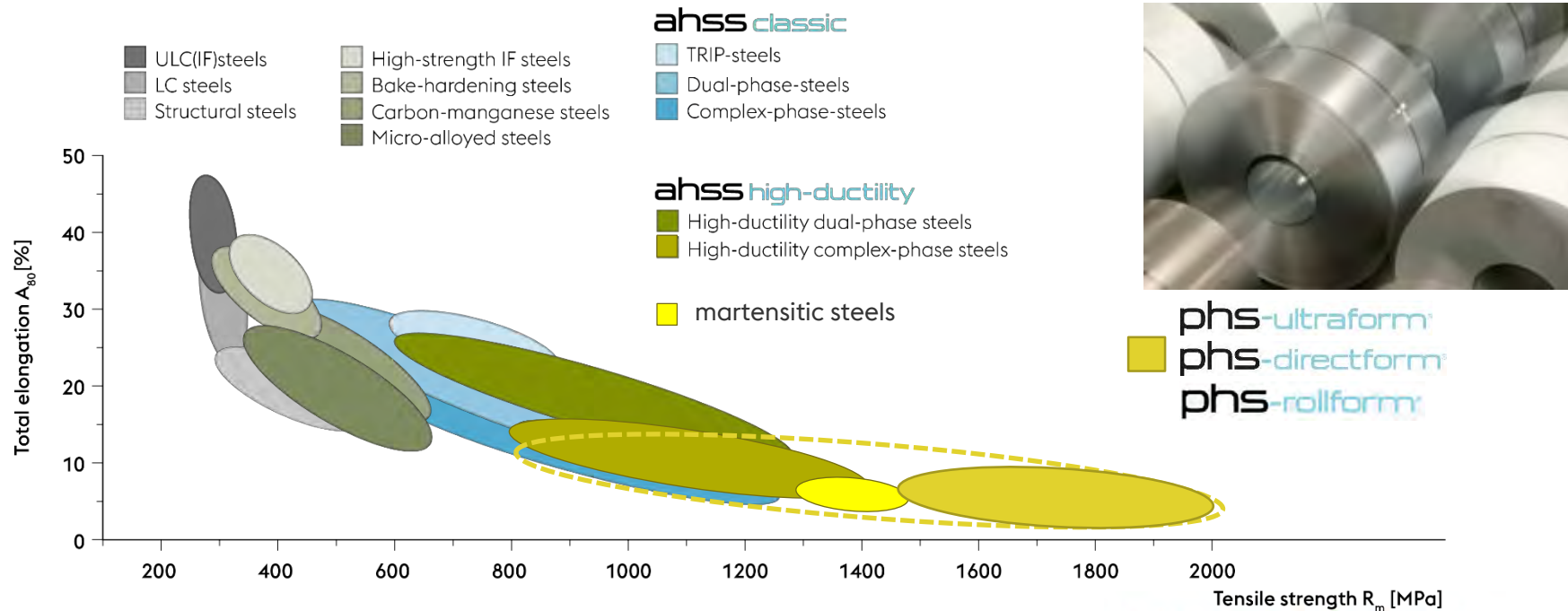
€ / kg

- » Demand for cost effective **steel solutions!**



voestalpine Stahl GmbH

Range of products - Cold rolled steel sheets





Component production

Deep drawing - Exp. B-Pillar Dual phase steel

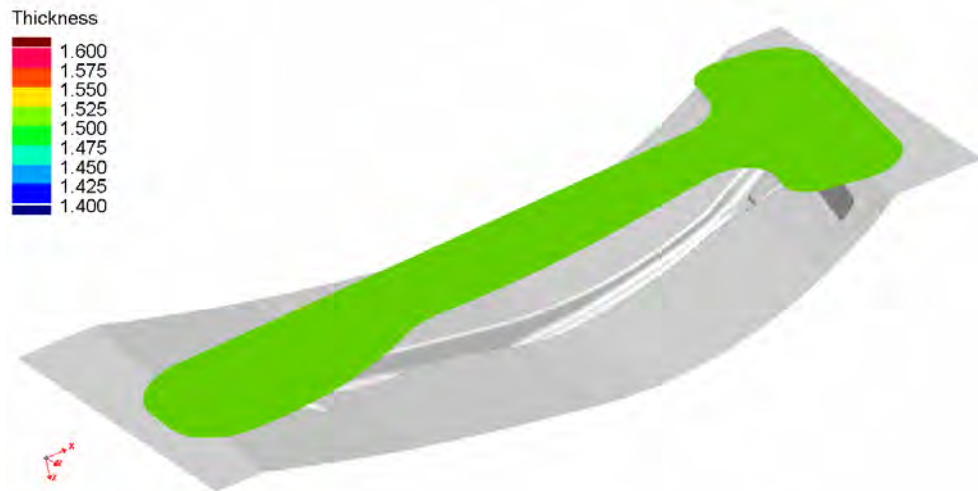




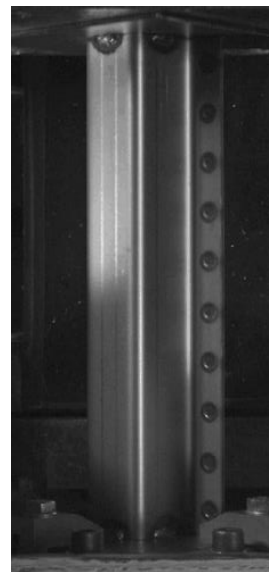
Component production

Dual phase steel - deep drawing and crash test simulation

Deep drawing simulation



Crash test



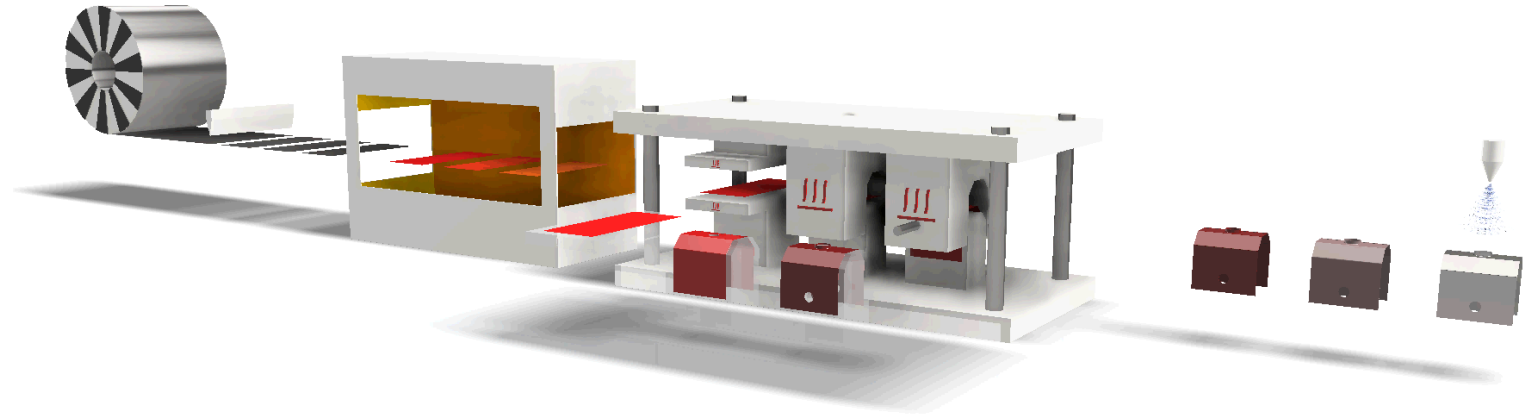
Crash simulation





Component production

pht - directform/multiform – direct press hardening process

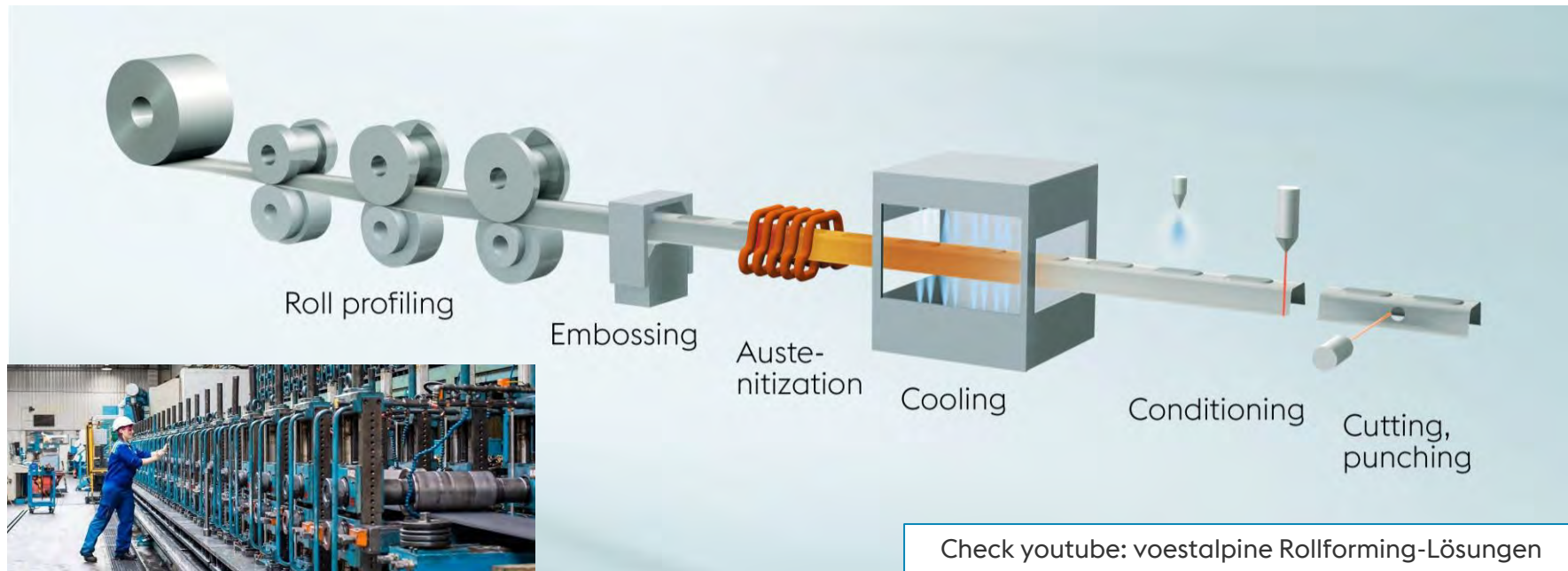


Check youtube: pht-directform Prozess: Eine Weltneuheit für den Leichtbau



Component production

phs-rollform – roll forming with subsequent martensitic hardening



Check youtube: voestalpine Rollforming-Lösungen

voestalpine Stahl GmbH

12 | May 24, 2019 | Steel components in battery housings

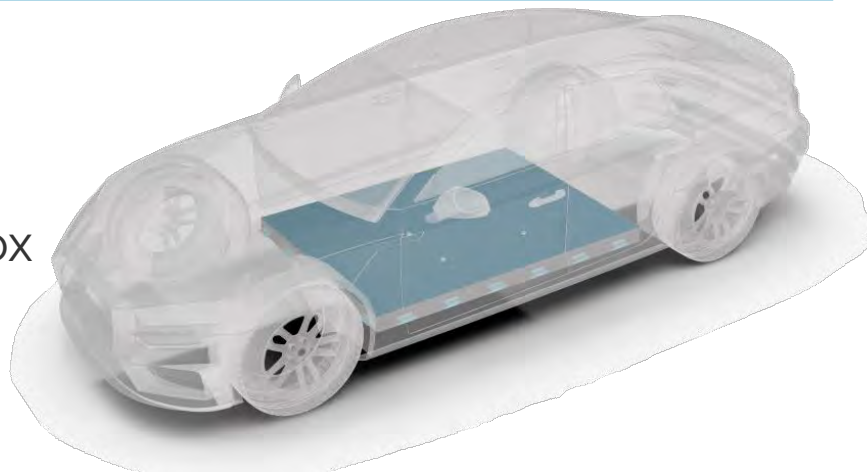
voestalpine

ONE STEP AHEAD.

The new modular battery box system for efficient e-mobility

» Target:

Development and production of a modular, scalable battery box including configurable and integrable functions in a TOOLBOX



» Requirements:

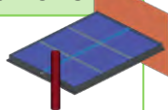
Regulatory standards (GB/T, ECE R100), Bottom impact 20kN,

Battery capacity >70kWh, module height 80mm

Dimensions: 2.000mm x 1.500mm x 120mm, parts production/a: 150.000

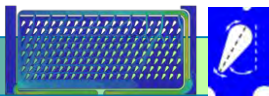
1. Analysis of relevant regulations

- Thermal requirements
- Crush & shock tests
- Supplementary industrial standards



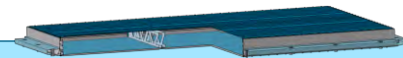
4. Optimization

- Matching of functional solutions with degree of target fulfilment
- Alternation of set targets (e.g. focus on lightweight design, tightness, ...)



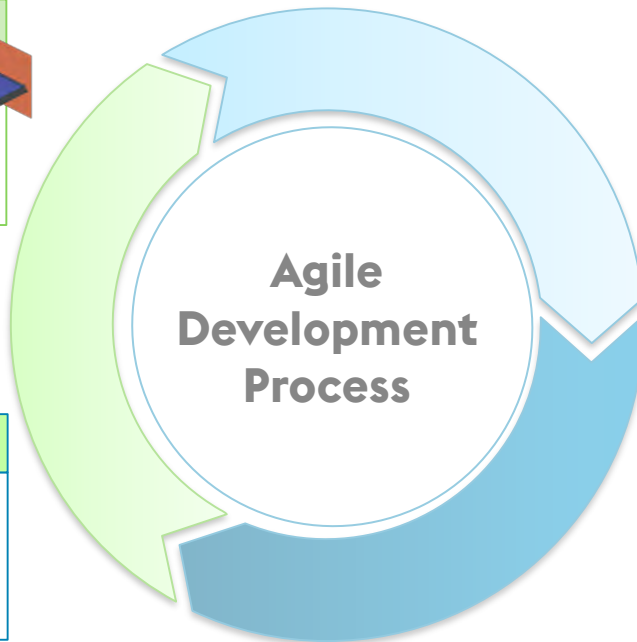
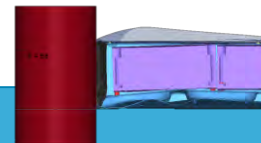
2. Conceptual Design

- Generation of possible solutions
- Draft and discussion of ideas
- Detailed constructive elaboration

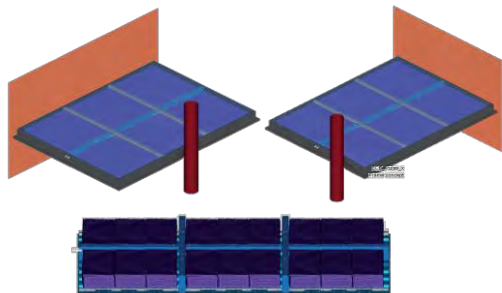


3. Validation

- Analysis of elaborated designs
- Simulations and hardware testing
- Evaluation of test results

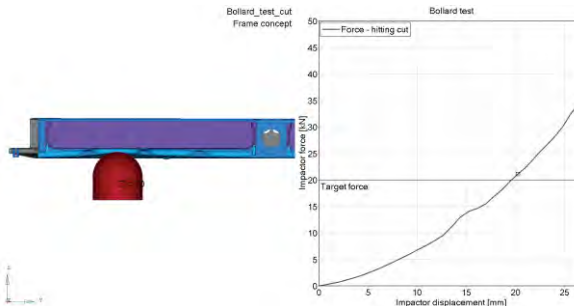


Boundary conditions - Crash requirements & Thermal Management



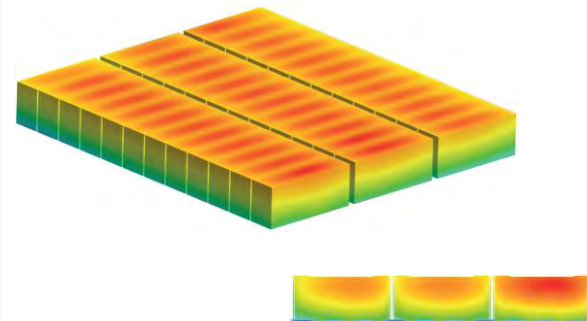
➤ Crush test in x- / y- direction

- GB/T 31467.3 / ECE R100
- 100 kN
- Quasi static
- No fire / no explosion



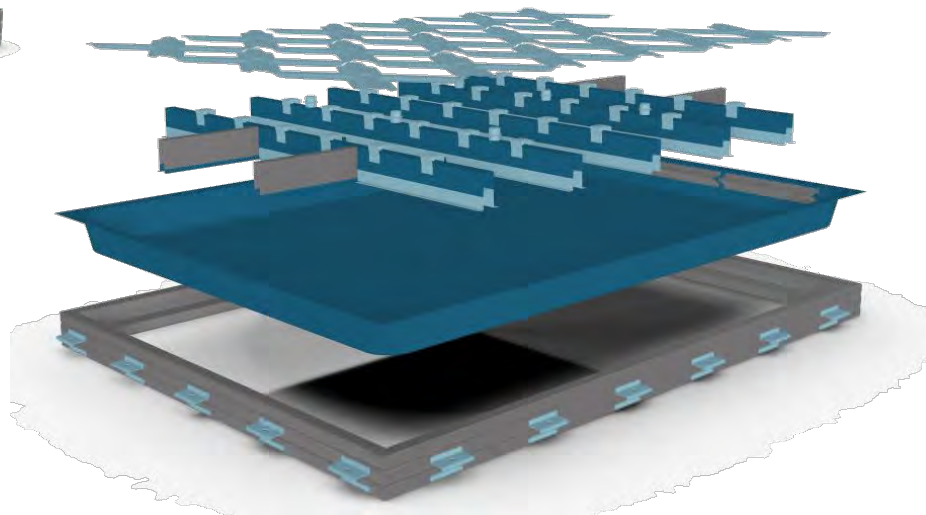
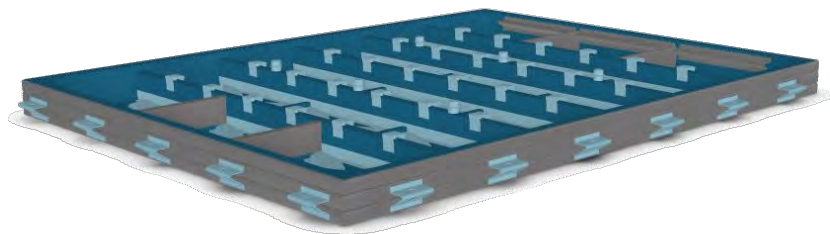
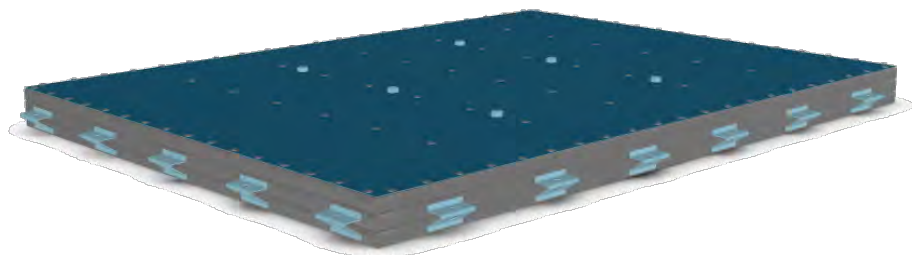
➤ Vertical crush (pole) test

- 20kN bottom impact
- Quasi static
- No fire / no explosion
- Accord. customer requirements



➤ Analysis of temperature homogeneity on cell level

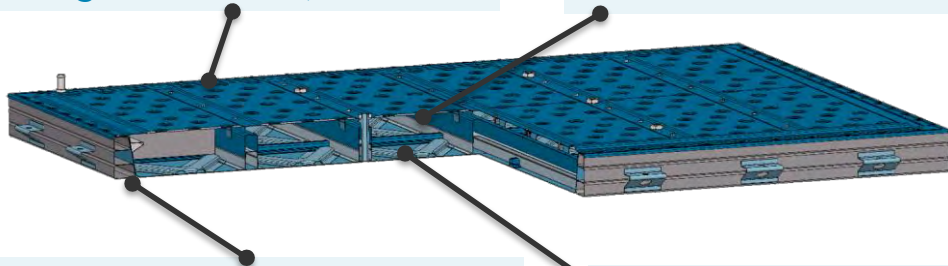
- $T = 15^{\circ}\text{C} - 40^{\circ}\text{C}$, $\Delta T < 5 \text{ K}$
- Low pressure loss in the integrated cooling system





- » two-layer steel cover with integrated cooling in combination with overhead modules (functional integration in cover)

- » No cooling fluid within the battery box (increased safety)



- » Multi chamber –side section & tight tray (scalable crash-concept)

- » deep-drawn & reinforced bottom structure (functional integration of underbody protection)

Performance

- » highest safety & tightness
- » scalable crash-concept
- » high permissible intrusion length in pole test

Weight

- » 103kg
 - 20 kg outer section
 - 27,5kg tray
 - 21,5kg framework
 - 17 kg cover & integrated cooling
 - 13 kg reinforced bottom



» integration of cooling hose system into long sections

» Multi chamber – Side section



» bottom with effective reinforcement for side & bottom- up forces

» variable & scalable bottom structure

Performance

- » exceptional modularity
- » excellent Thermal Management
- » Good Performance in pole test

Weight

- » 100kg
 - 23 kg outer section
 - 12,5kg framework
 - 34,5kg bottom and bottom framework
 - 13 kg cooling
 - 13 kg cover



» cover with stamping & integrated long sections w. load-bearing capacity

» PHS - outer section & multi chamber section for crash protection



» light weight - cross bar structure (weight optimized)

» Aluminum-Sandwich bottom plate: cooling integrated, effective reinforcement

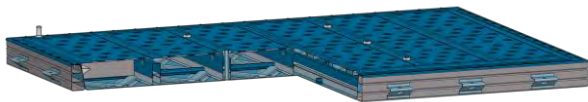
Performance

- » Ultra light weight variant
- » Steel → cost efficient light weight construction
- » Aluminum-bottom plate supports at impact of side crash
- » Functional integration of cooling in bottom plate

Weight

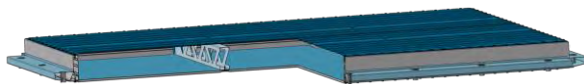
- » **55,55kg**
 - 18,7 kg outer section
 - 4,2 kg crossbar
 - 8,1 kg cover
 - 19,0 kg bottom plate w. integrated cooling

Tray Design



- Maximum safety & strength

St-Al Hybrid Design



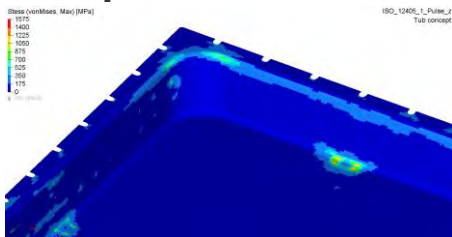
- Maximum weight savings

Frame Design



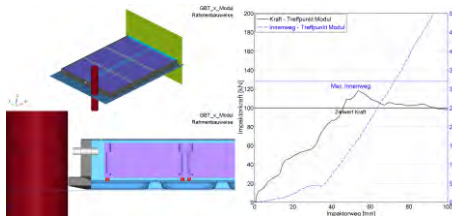
- Maximum modularity

phs-ultraform ®



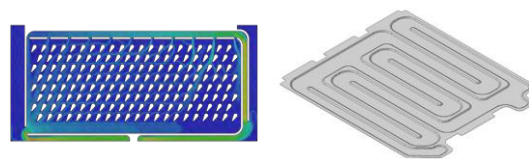
- Highest durability

Crush-Performance



- Highly scalable

Thermal management



- Smart cooling solutions





Conclusion

- » Steel in battery housings
 - » Cost effective for high production volumes
 - » voestalpine development support
 - » Know-how in production processes
 - » Know-how in steel (formability, crash behaviour, corrosion protection, joining)
 - » Material models for forming and crash freely available
- » flextronic – modular battery housing
 - » Toolbox for concept design
 - » Supplier for concept design and manufacturing of battery housings

flextronic

Thank You!

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