

GREAT DESIGNS IN
STEEL

TWENTY YEARS

**NEW SOLUTIONS FOR LIGHT
DUTY FRAME, BATTERY ELECTRIC
VEHICLES, AND WELDING AHSS**

Isaac P. Luther
TWB Company

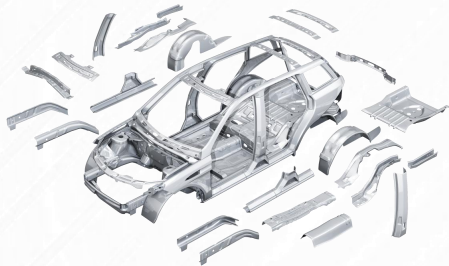


30 YEARS OF WELDING

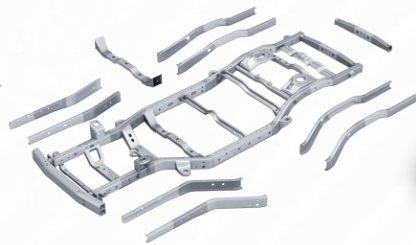


The right material in the right place for:

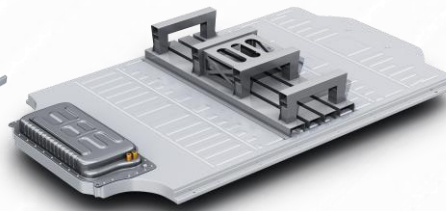
- Lightweighting
- Material Utilization
- Crash Energy Management
- Cost Management



Trends in welded blanks



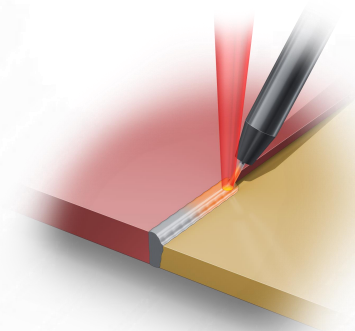
Welded blanks in frame



Advanced battery applications



3rd Gen Steel Development

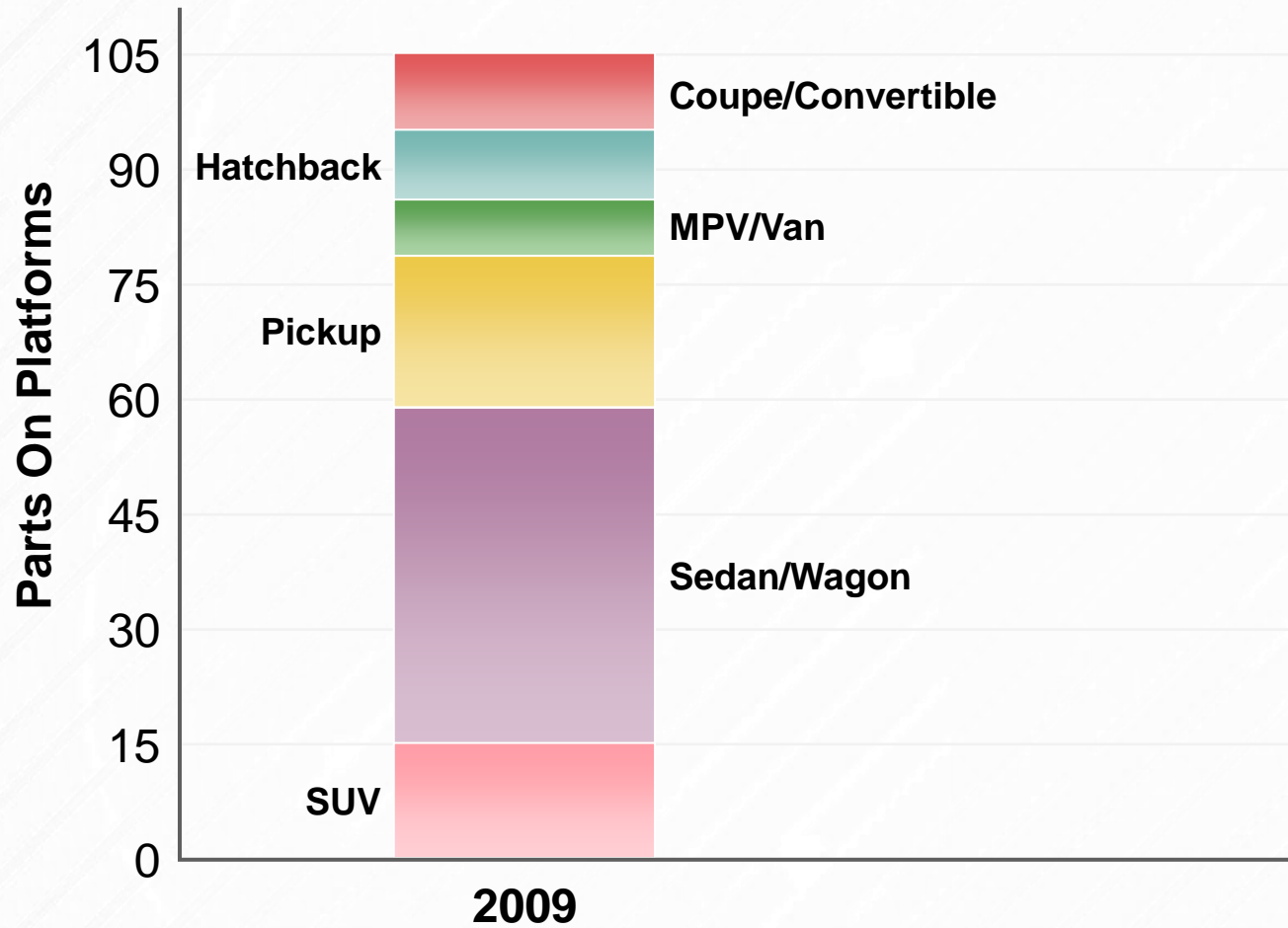


Ablation alternative PHS welding

APPLICATION TRENDS



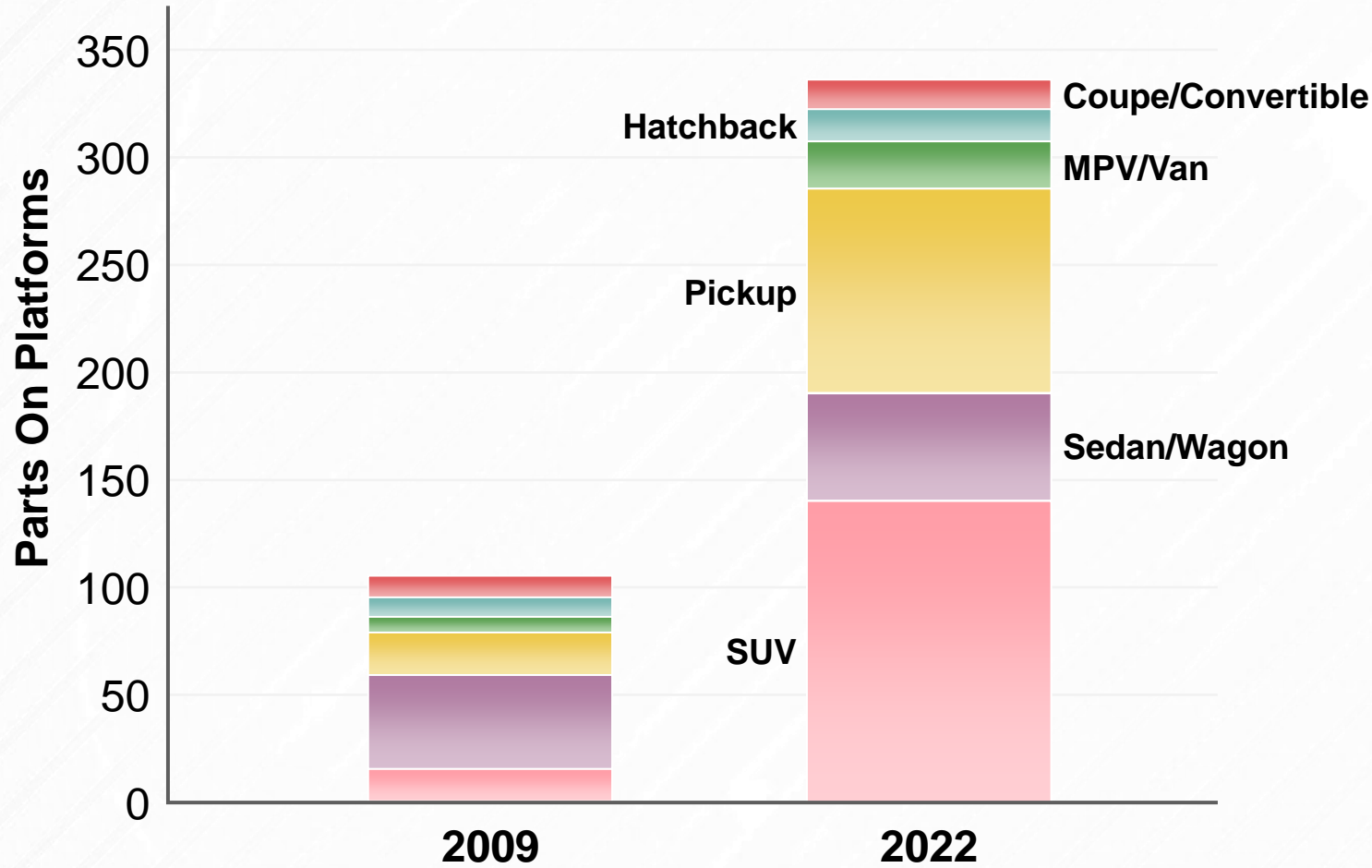
Welded Blanks By Vehicle Type



APPLICATION TRENDS

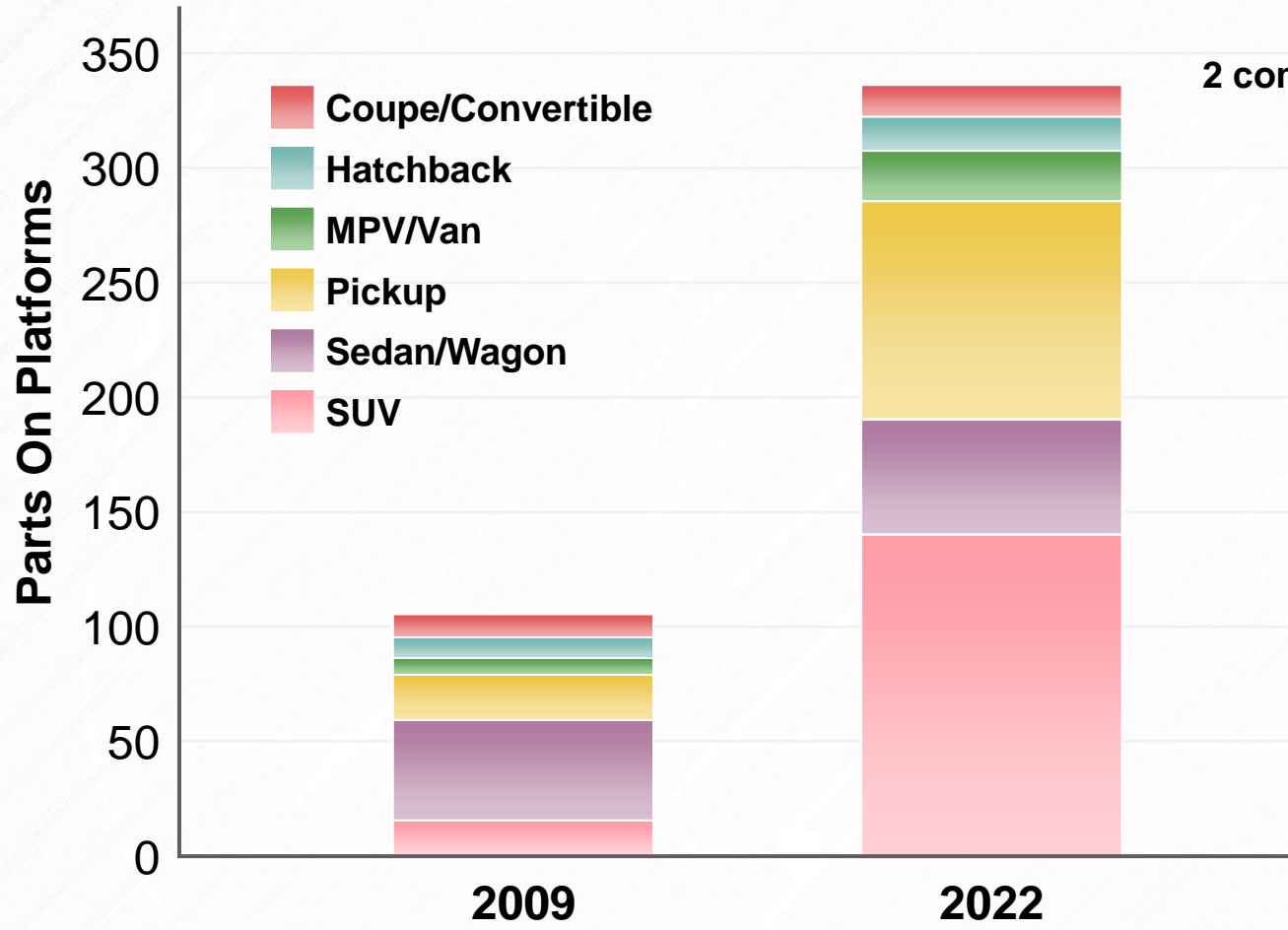


Welded Blanks By Vehicle Type

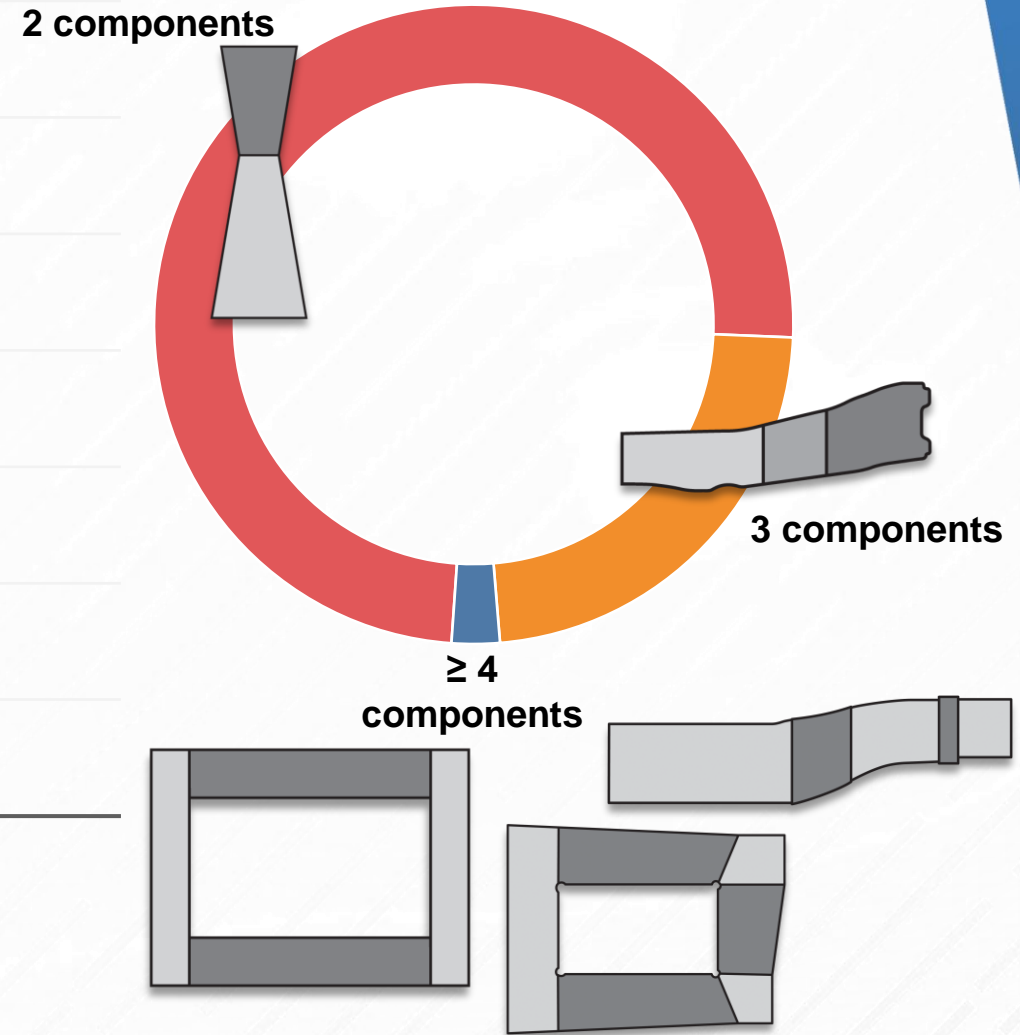


APPLICATION TRENDS

Welded Blanks By Vehicle Type



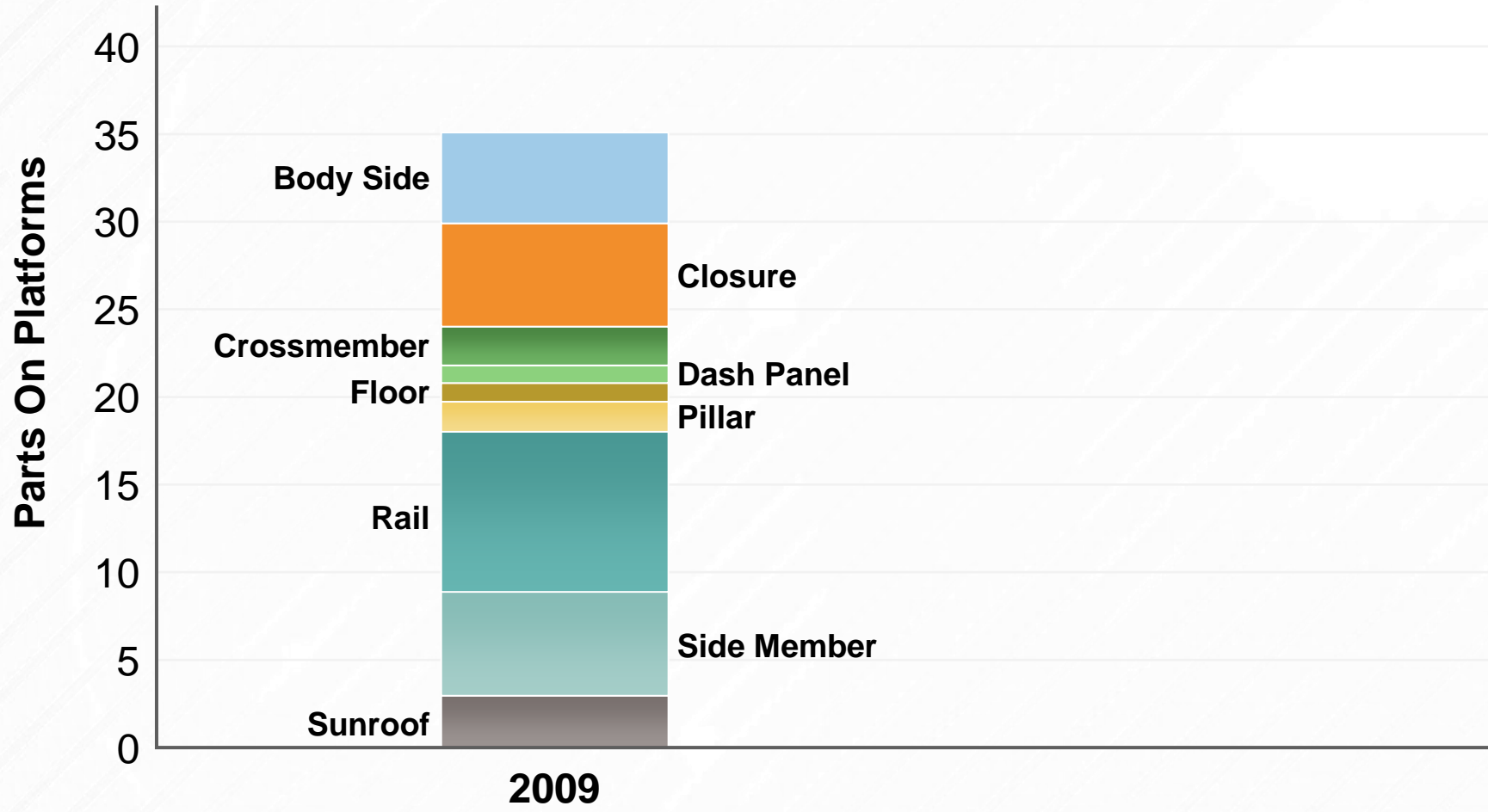
Driving Consolidation



APPLICATION TRENDS



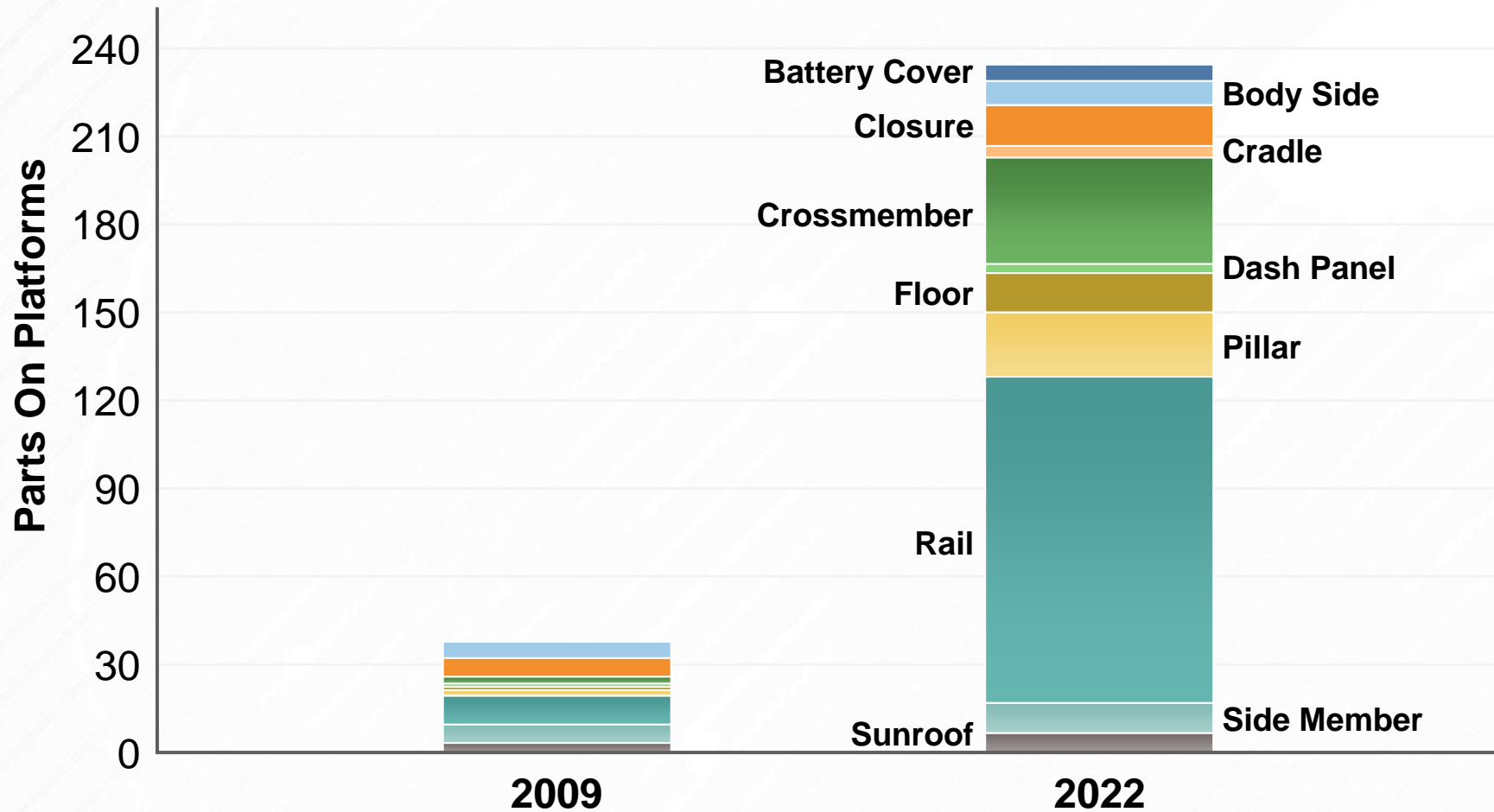
Welded Blanks On Trucks and SUVs



APPLICATION TRENDS

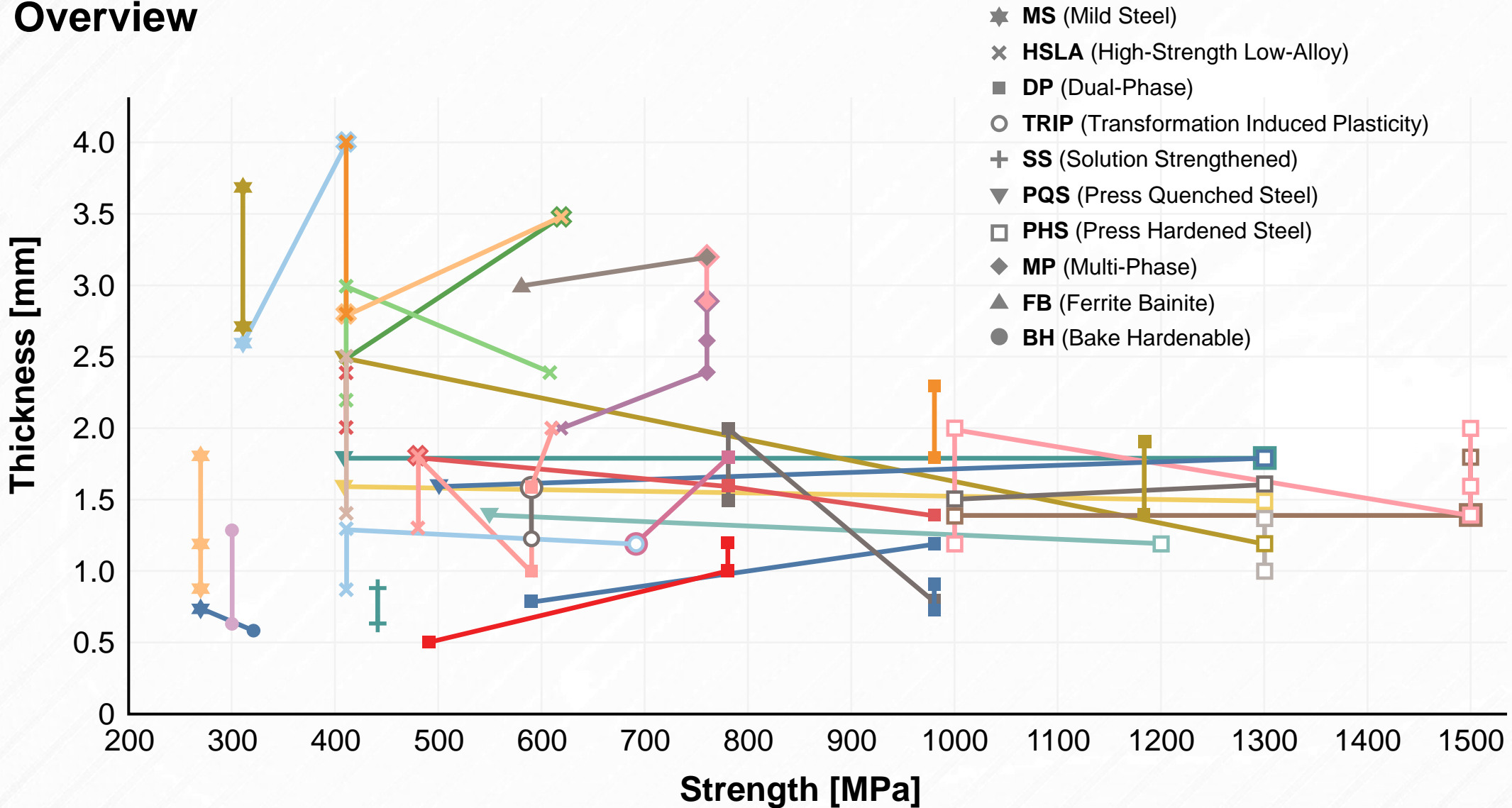


Welded Blanks On Trucks and SUVs



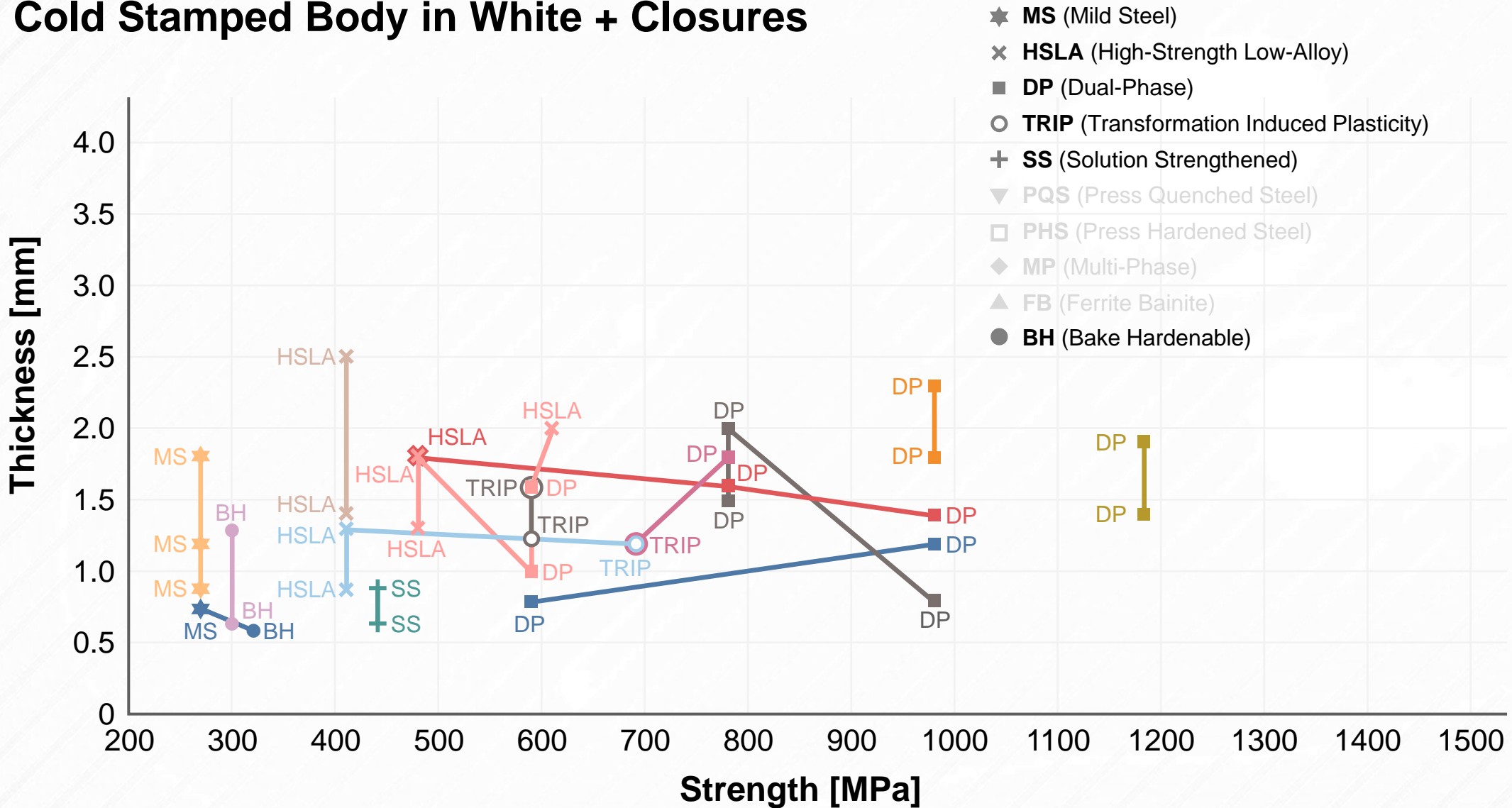
MATERIAL USAGE

Overview



MATERIAL USAGE

Cold Stamped Body in White + Closures

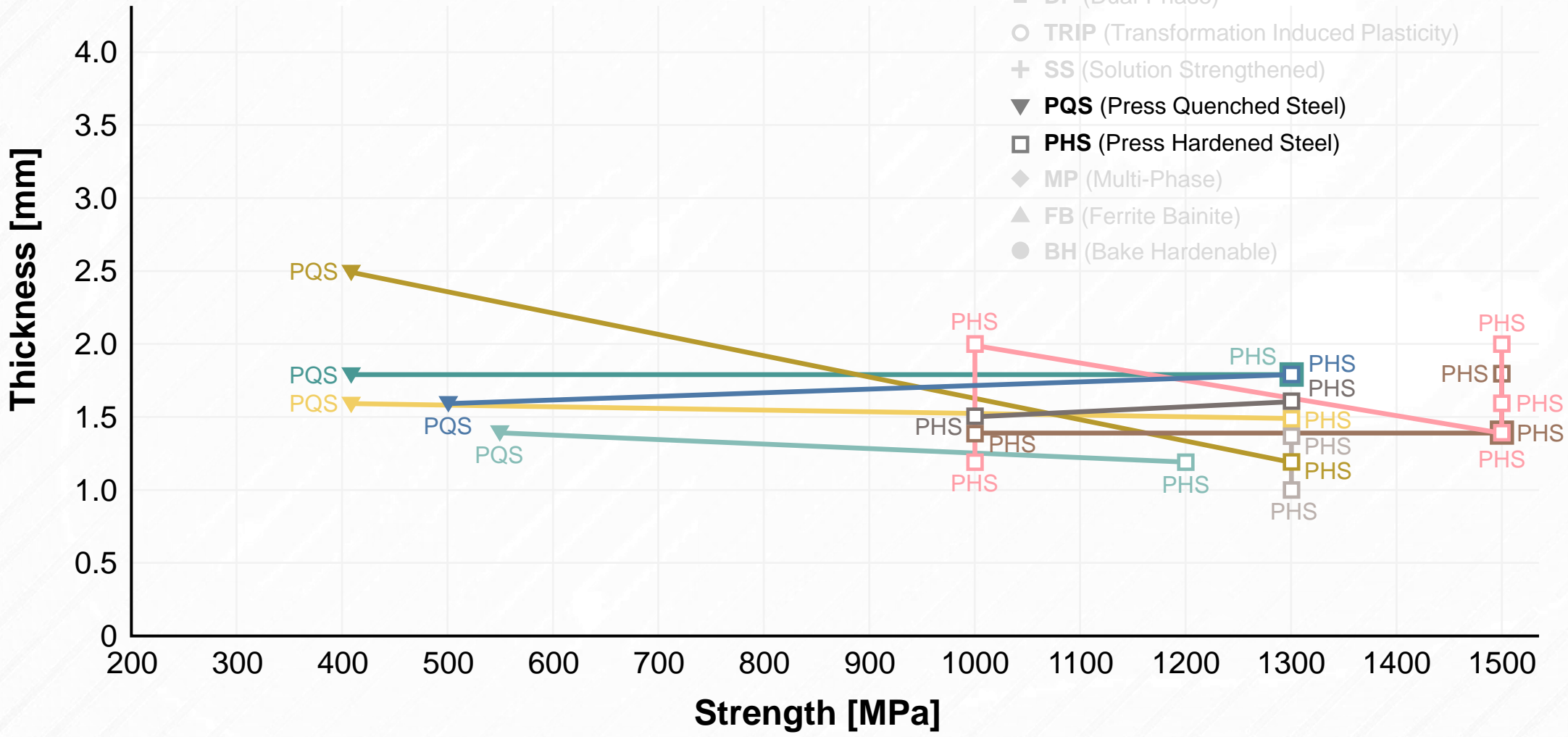


MATERIAL USAGE

Hot Stamped Body in White

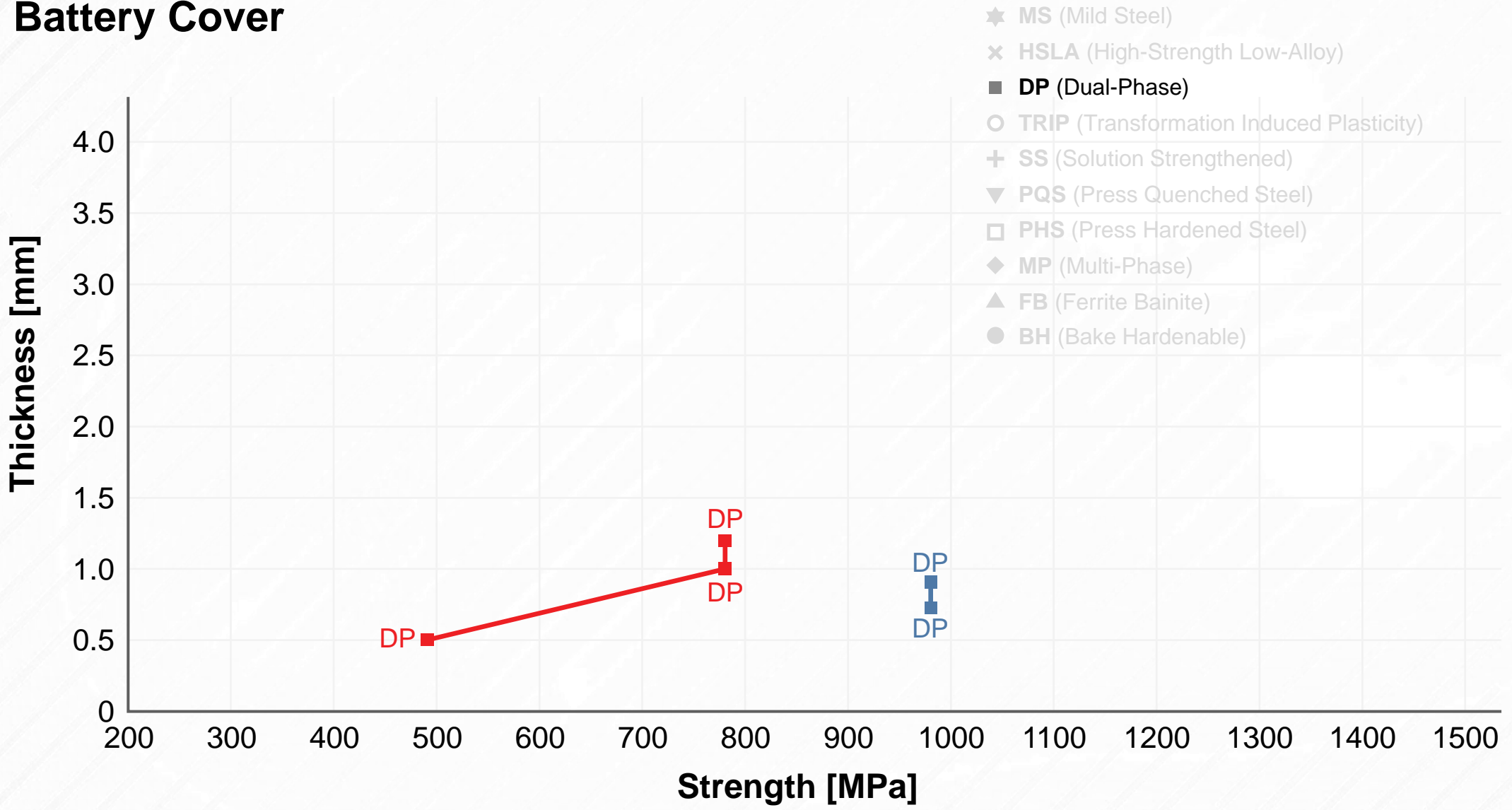


- ★ MS (Mild Steel)
- × HSLA (High-Strength Low-Alloy)
- DP (Dual-Phase)
- TRIP (Transformation Induced Plasticity)
- + SS (Solution Strengthened)
- ▼ PQS (Press Quenched Steel)
- PHS (Press Hardened Steel)
- ◆ MP (Multi-Phase)
- ▲ FB (Ferrite Bainite)
- BH (Bake Hardenable)



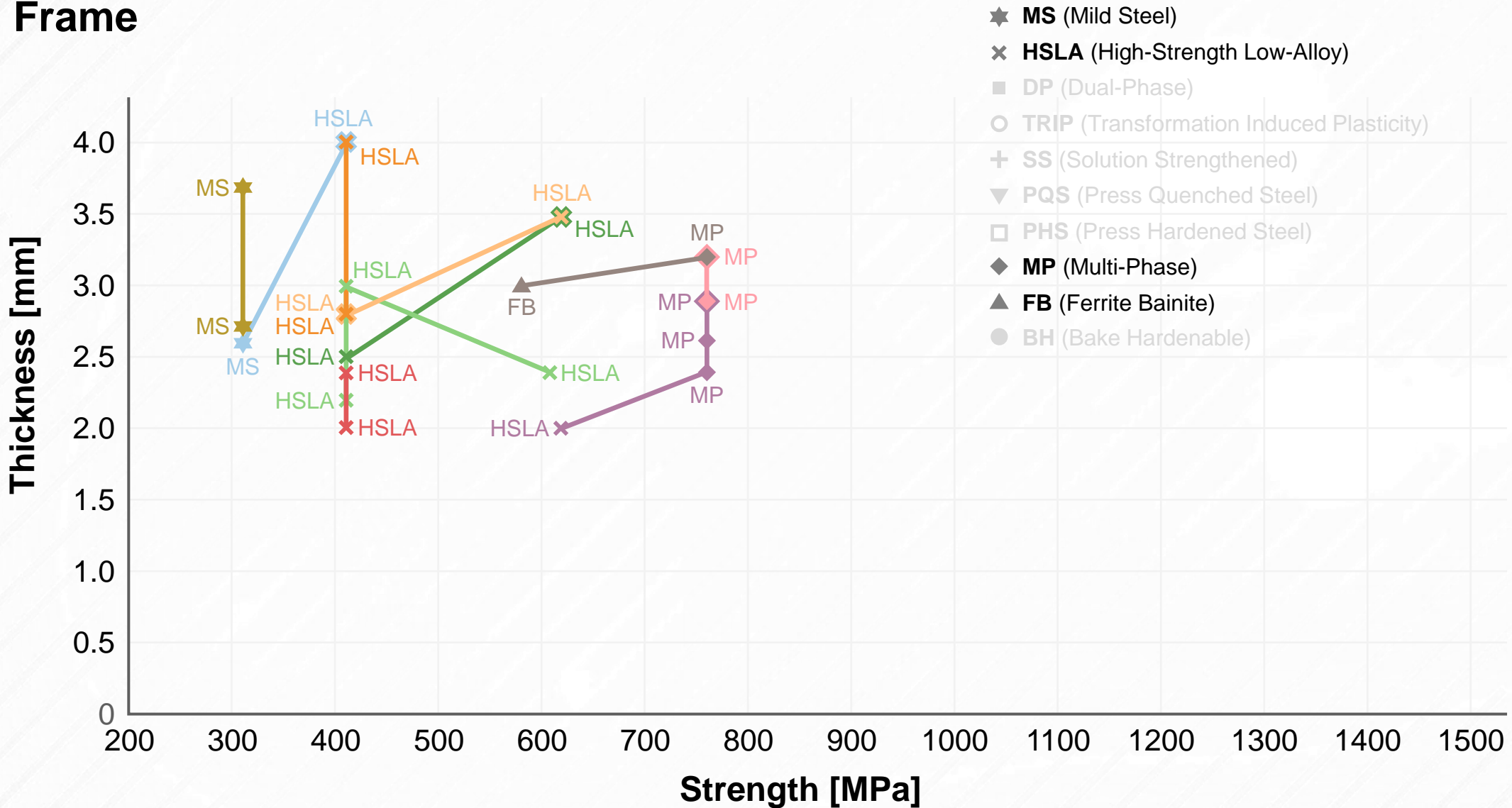
MATERIAL USAGE

Battery Cover

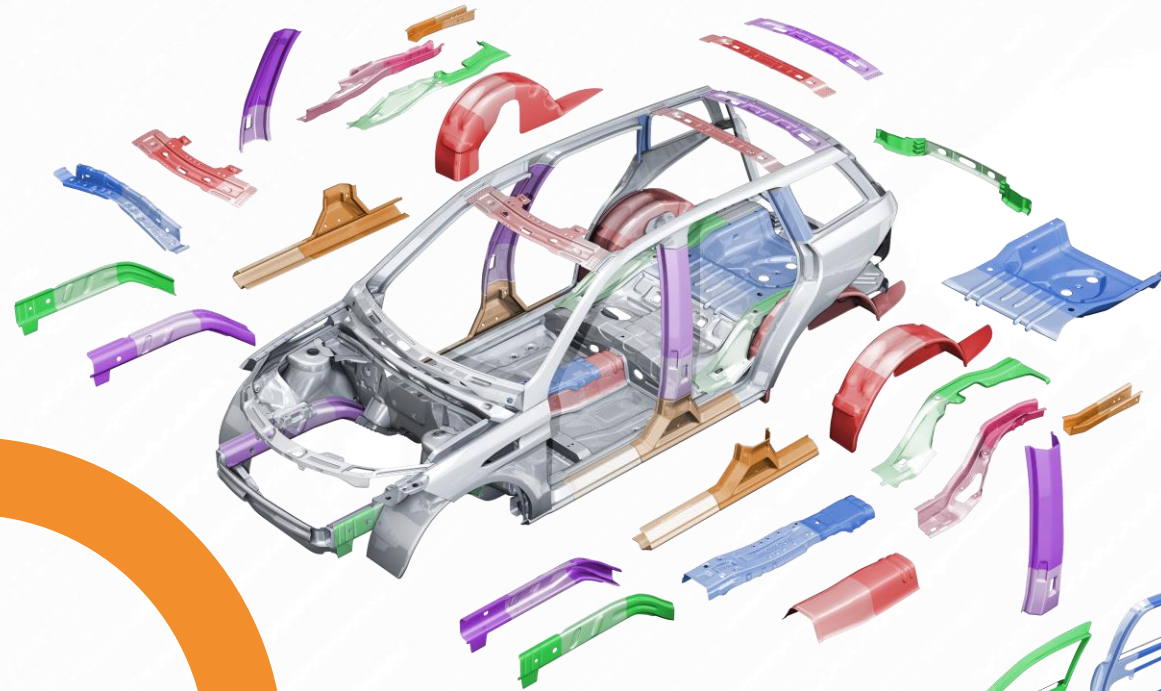


MATERIAL USAGE

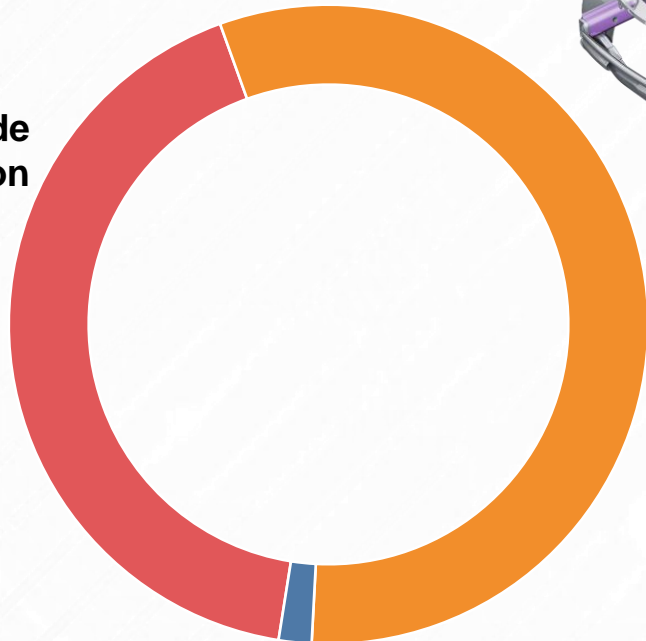
Frame



INNOVATIONS IN BIW + CLOSURES



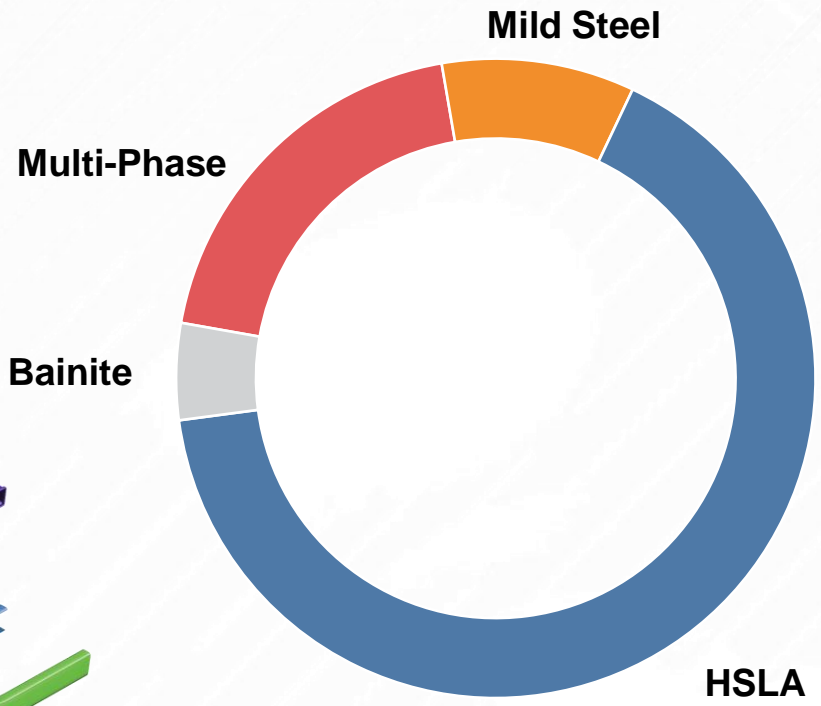
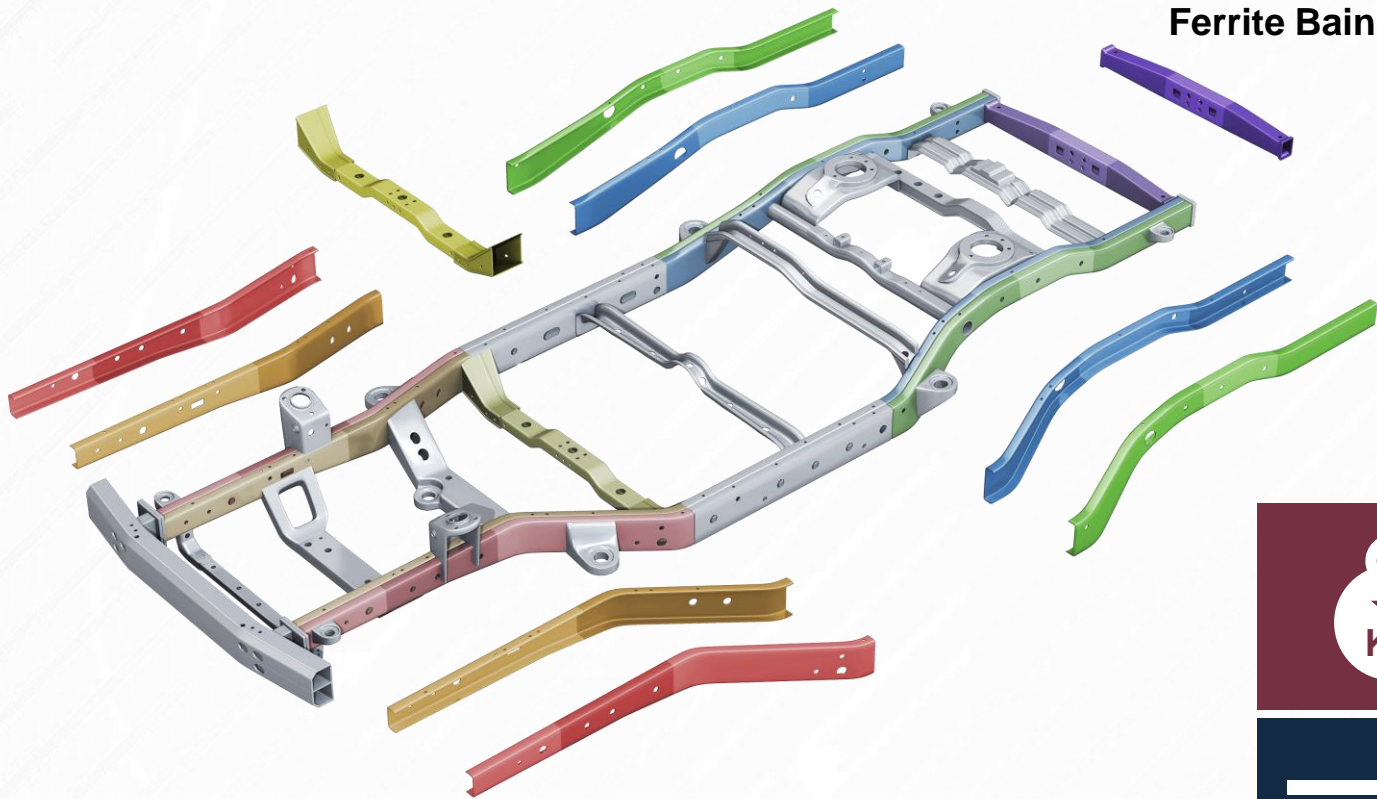
**Grade
Optimization**




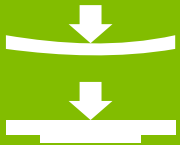


Material Savings

**Thickness
Optimization**

FRAME APPLICATIONS



 <p>Reduce vehicle weight</p>	 <p>Improve material utilization</p>
 <p>Consolidate components</p>	 <p>Optimize crash energy management</p>

FRAME APPLICATIONS

Benchmarking



2016:



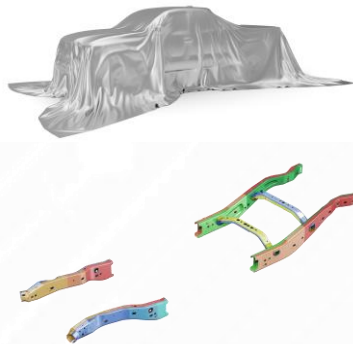
Front rails
4 TWBs
HSLA grades

2018:



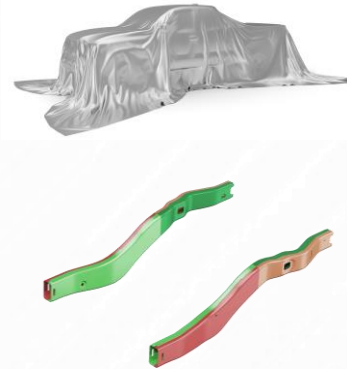
Rear rail inners
2 TWBs
Mild grades

2018:



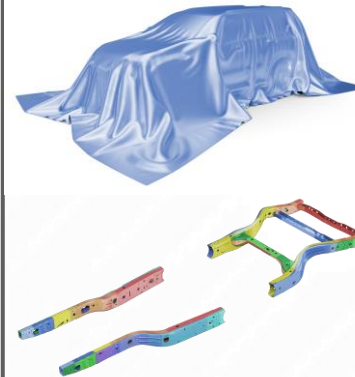
Front/rear rails +
crossmembers
12 TWBs
AHSS grades

2019:



Rear rails
4 TWBs
HSLA grades

2021:



Front/rear rails +
crossmembers
12 TWBs
HSLA grades

2022:



Front/rear rails +
crossmembers
10 TWBs
AHSS grades

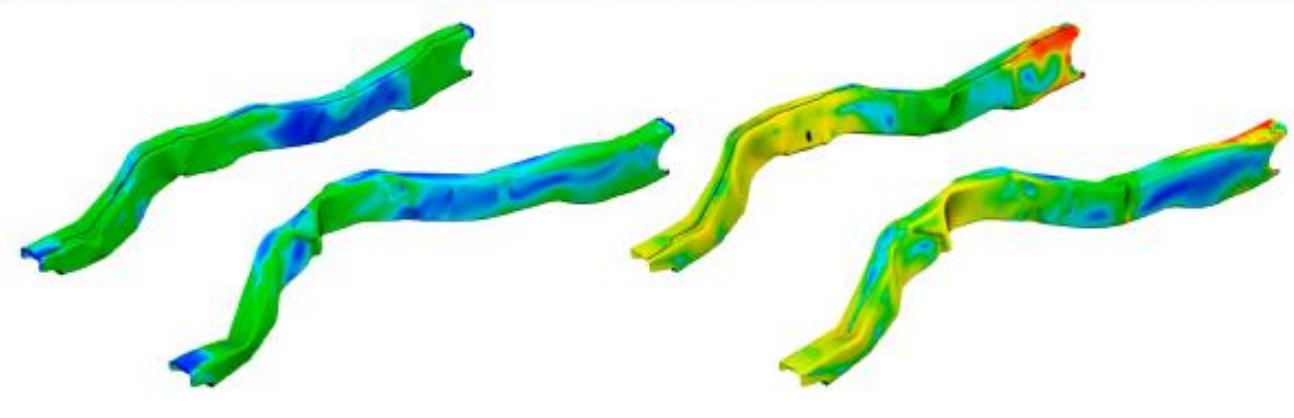
FRAME APPLICATIONS

Front Rails



Monolithic

Welded Blank

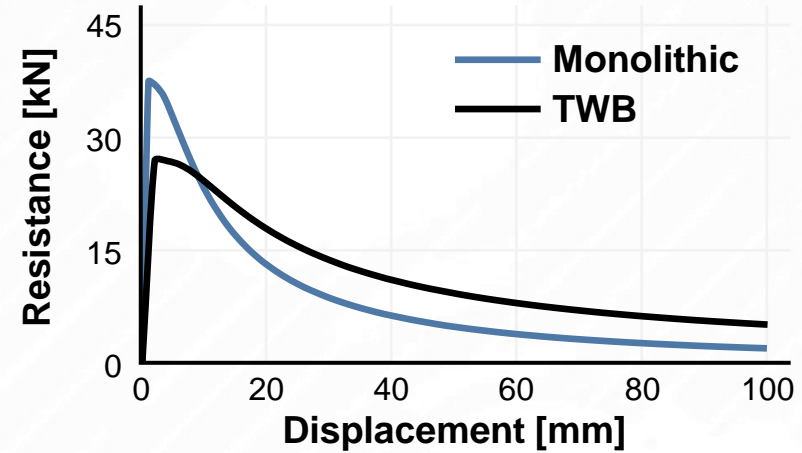


- Two-piece inner/outer design
- 4mm thick 410MPa HSLA

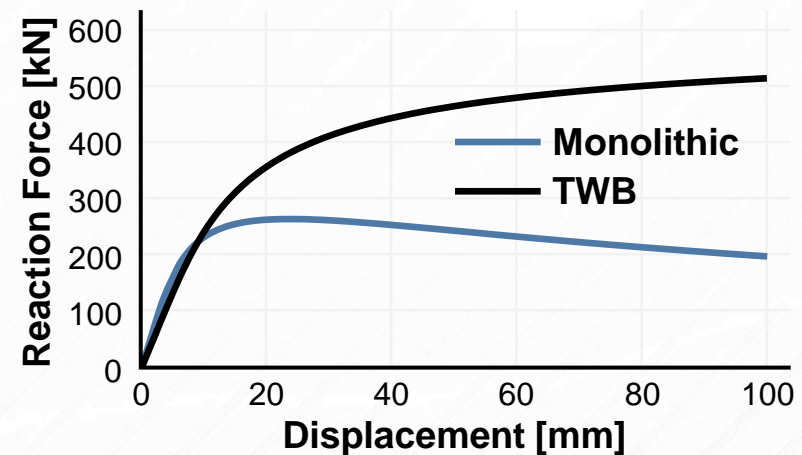
- 4mm thick 410MPa HSLA front + rear sections – 2.6mm/2.8mm 310MPa mild steel center
- Improved reaction force and crush resistance
- Optimized crumple zone in front rail structure



Crush Resistance



Reaction Force



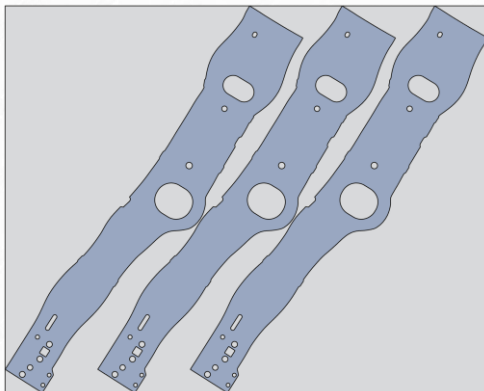
FRAME APPLICATIONS

Rear Inner Rails

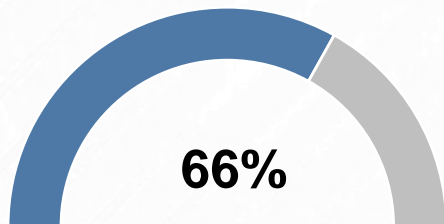
Thickness optimization – weight and cost savings



Monolithic

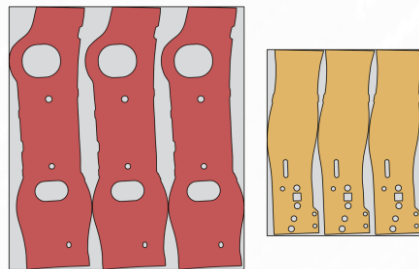


Gross Weight : 21.9kg
Net Weight : 14.5kg

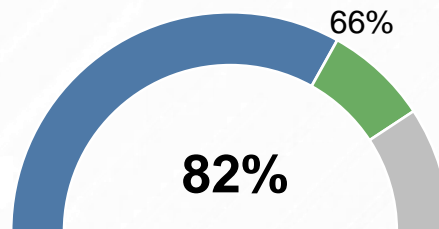


Material Utilization

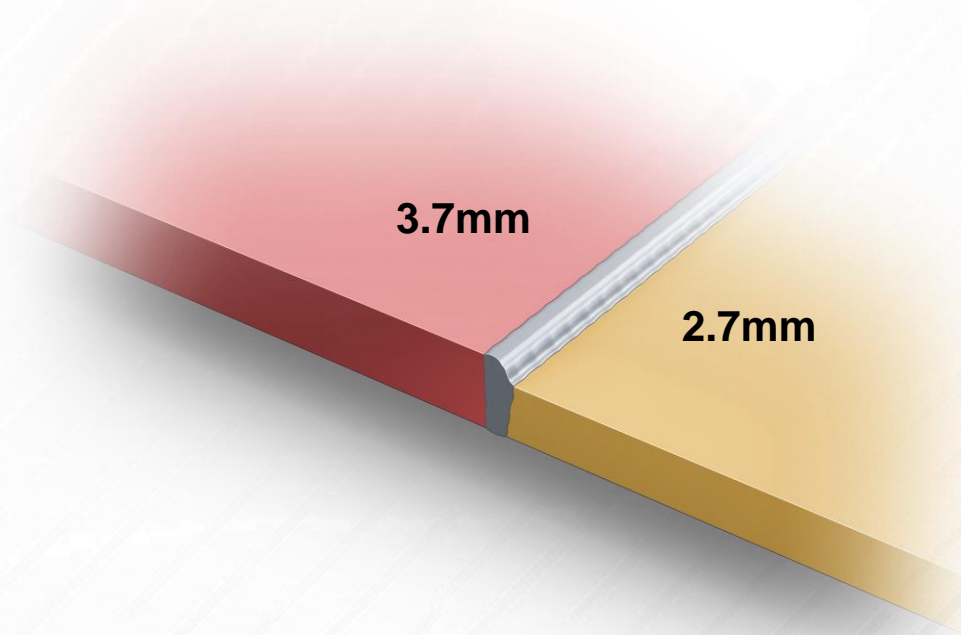
Welded Blank



Gross Weight : 14.6kg
Net Weight : 11.9kg

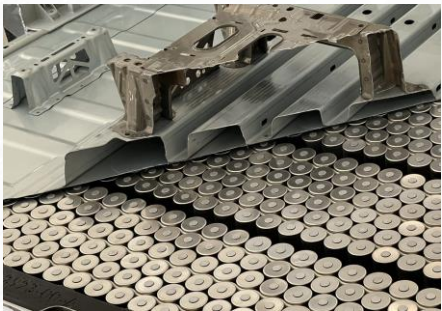


Material Utilization

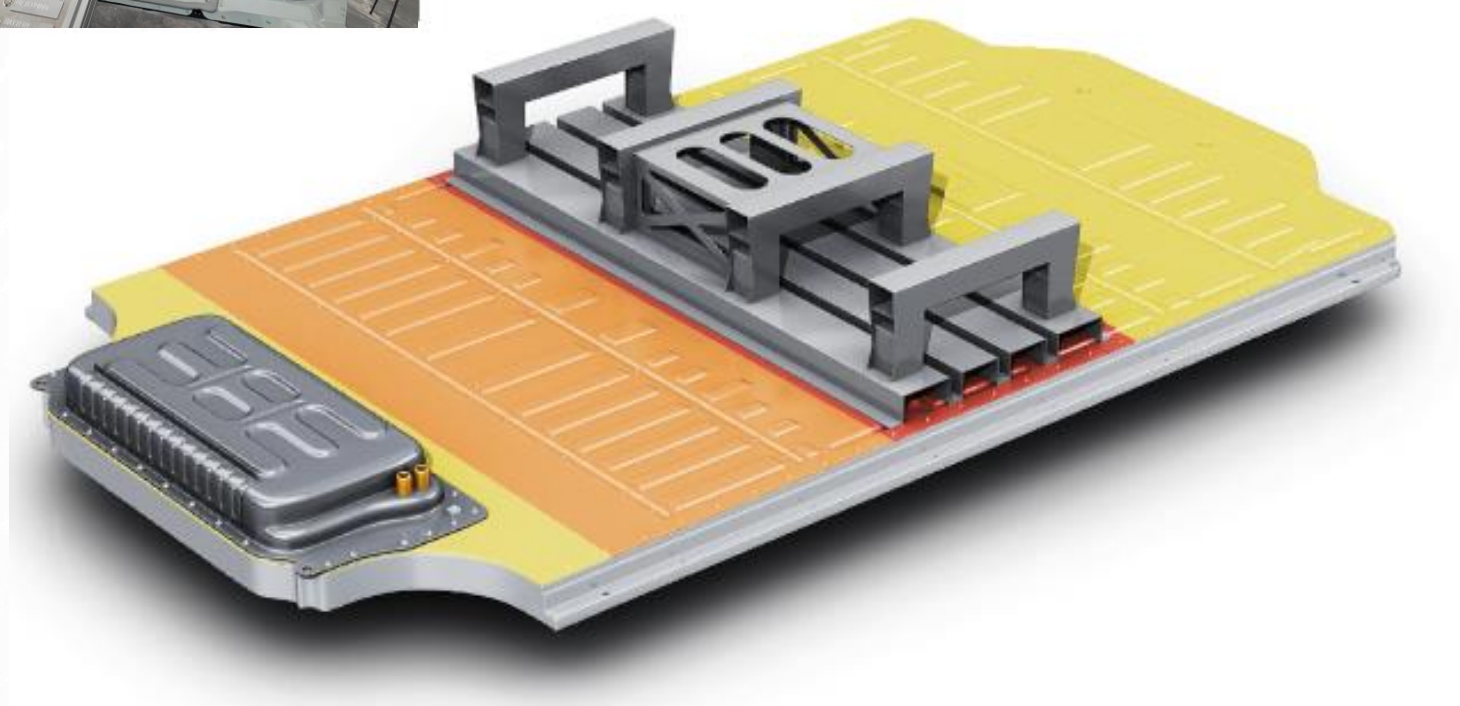


BEV APPLICATIONS

Structural Top Covers

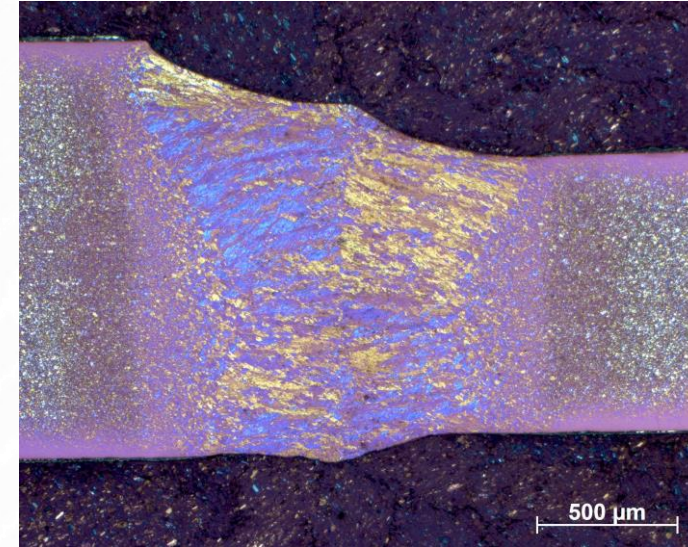
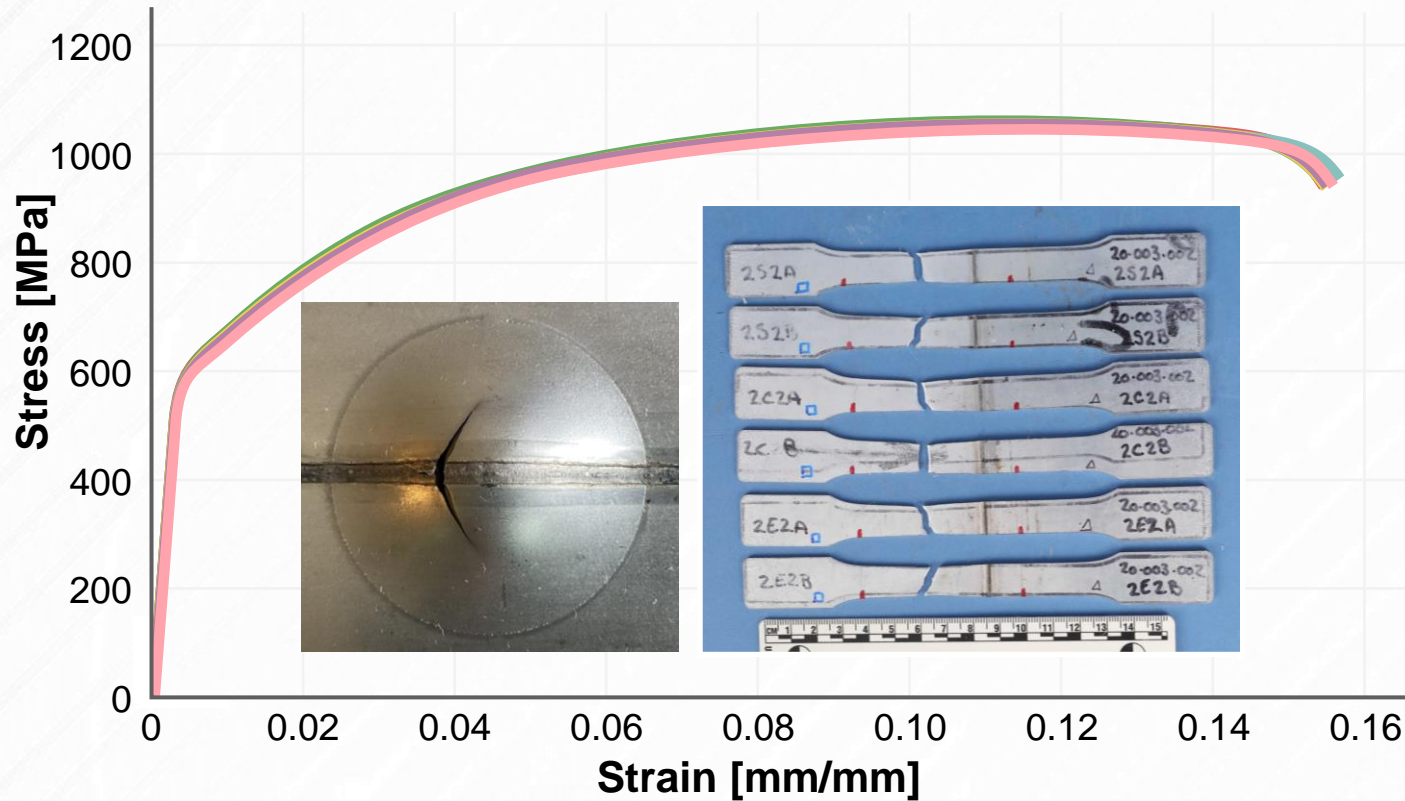


- Consolidated battery top cover and vehicle floor
- Seats are mounted onto the battery and installed into the vehicle

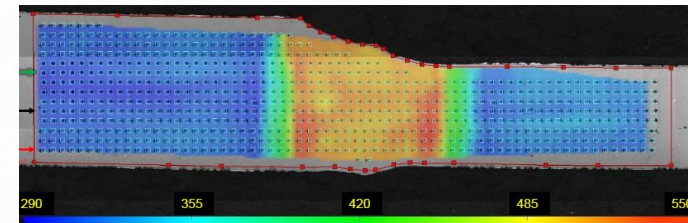


JOINING – 3RD GEN STEELS

3rd Gen 980 GI / 3rd Gen 980 GI



1.5mm 3rd Gen 980 / 1.0mm 3rd Gen 980



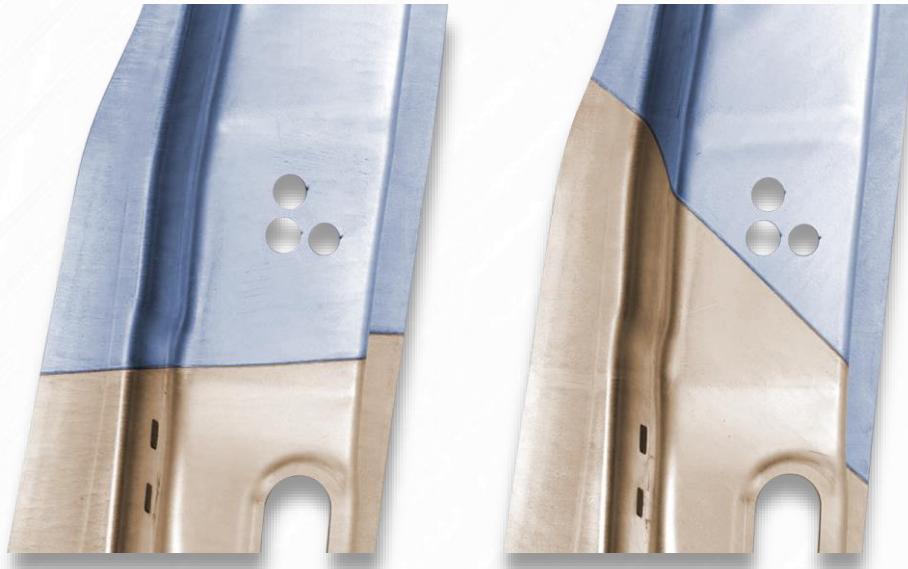
1.5mm 3rd Gen 980 / 1.0mm 3rd Gen 980

- No HAZ softening observed
- Tensile fractures occurred in parent metal
- Olsen cup fractures occurred perpendicular to the weld

JOINING – 3RD GEN STEELS

B-Pillar Stamping Trial

1.5mm 3rd Gen 980 GI / 1.5mm 3rd Gen 980 GI
1.5mm 3rd Gen 980 GI / 1.5mm DP600 GI



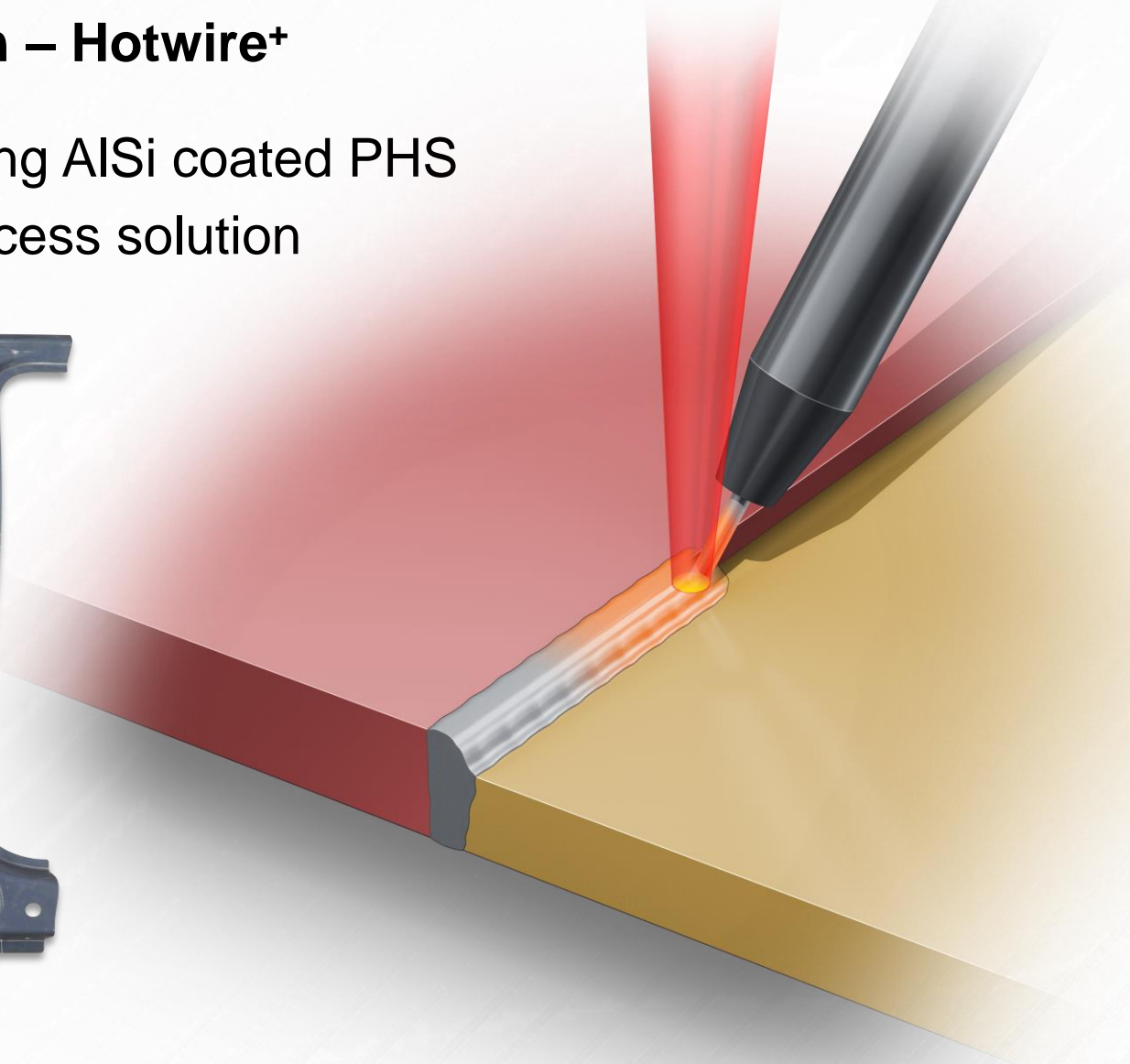
**3rd Gen welded blanks formed successfully
with good weld seam ductility**



PHS WELDING SOLUTIONS

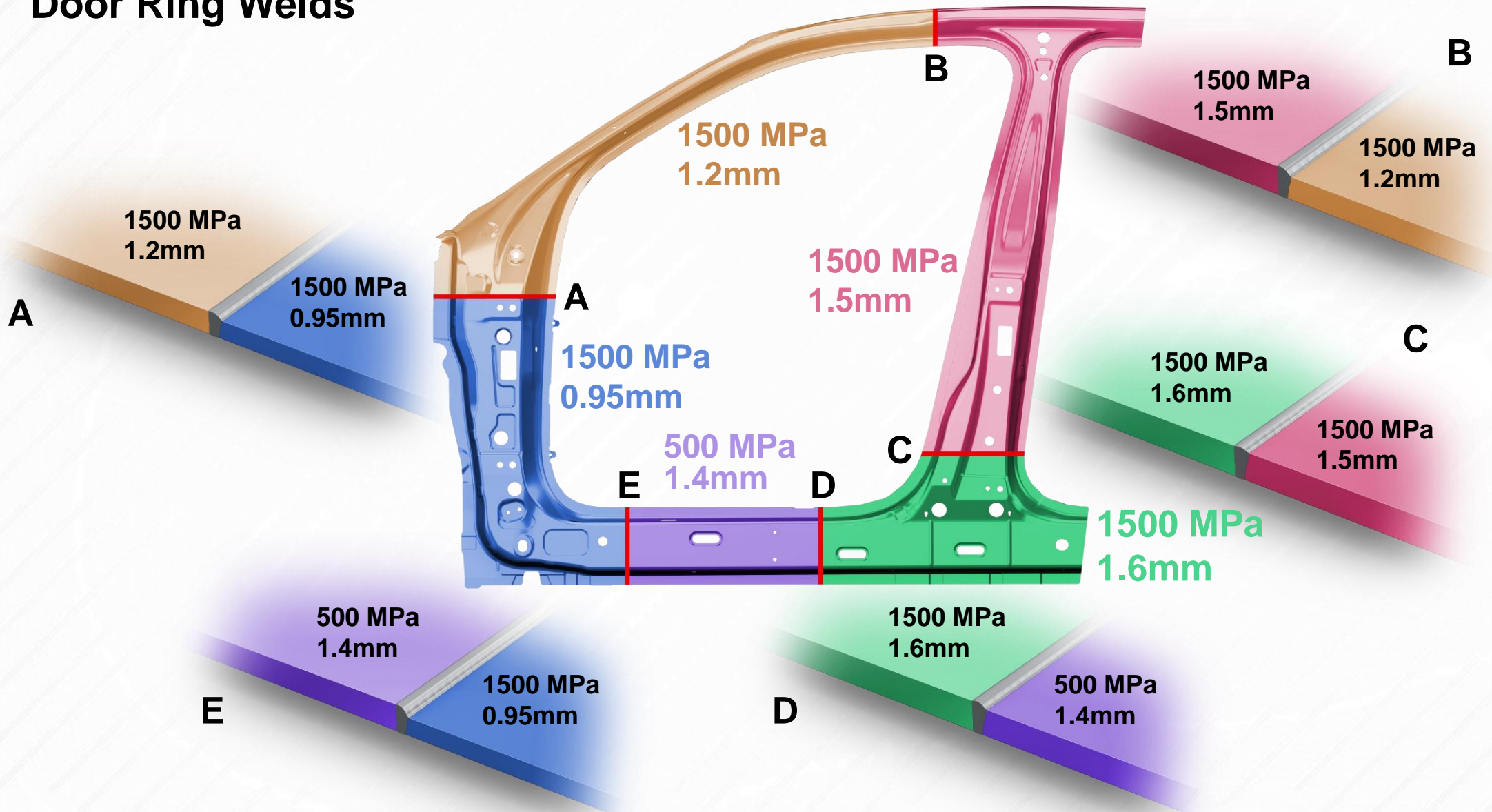
PHS + PQS Without Ablation – Hotwire⁺

- Ablation alternative for welding AlSi coated PHS
- Filler metal + proprietary process solution



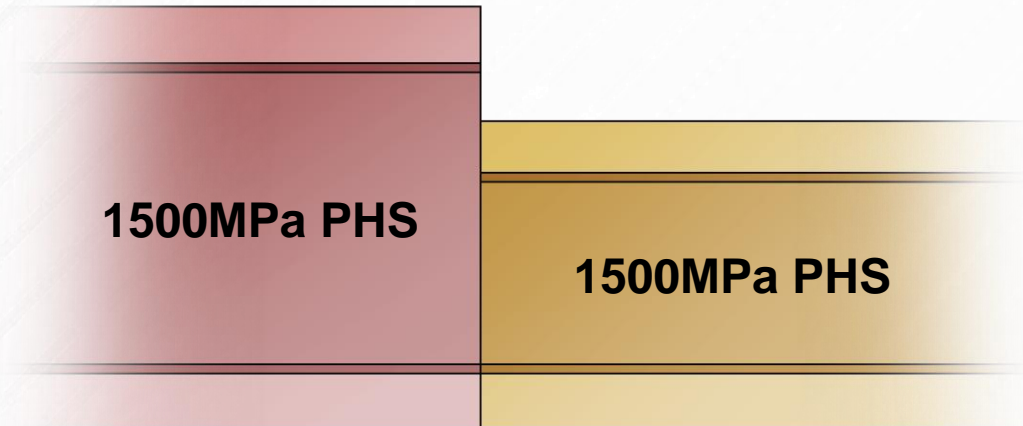
PHS WELDING SOLUTIONS

Door Ring Welds

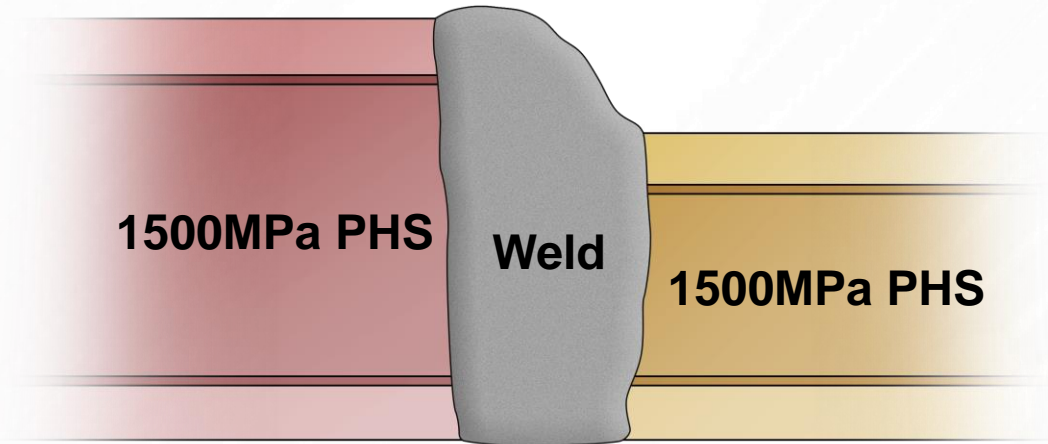


PHS WELDING SOLUTIONS

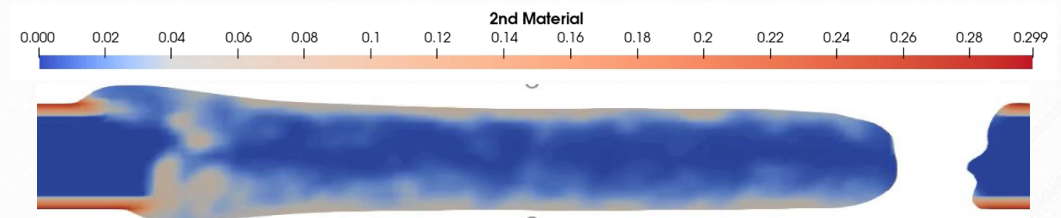
Prior to welding



Following welding



- Ferrite formation is suppressed during laser welding
- Aluminum remains distributed in weld metal

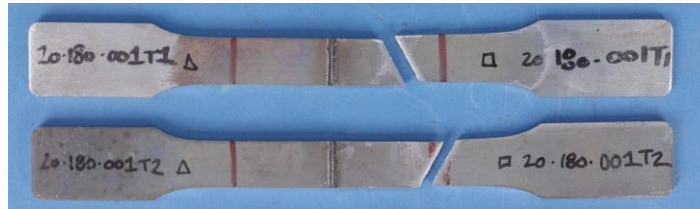


CFD simulation showing distribution of AlSi coating into weld

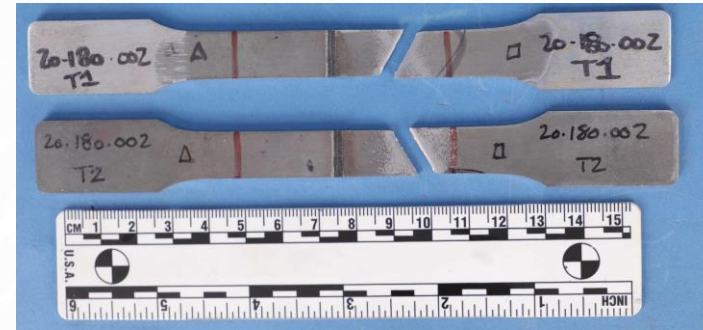
PHS WELDING SOLUTIONS



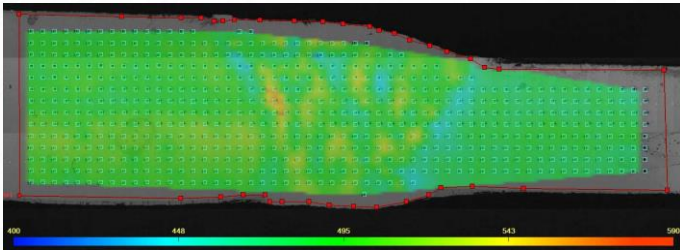
1.8mm PHS1500 / 1.2mm PHS1500 – Hot Stamped



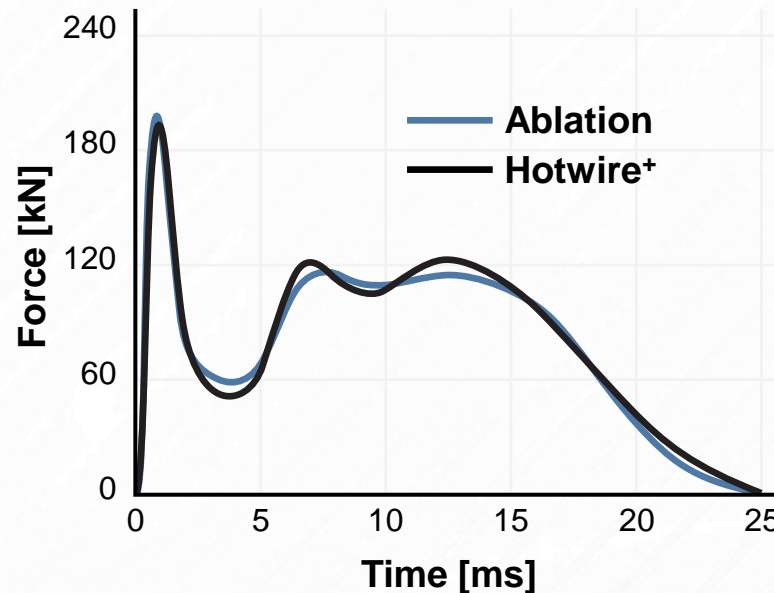
Tensile fractures of differential thickness welds occur in the parent metal



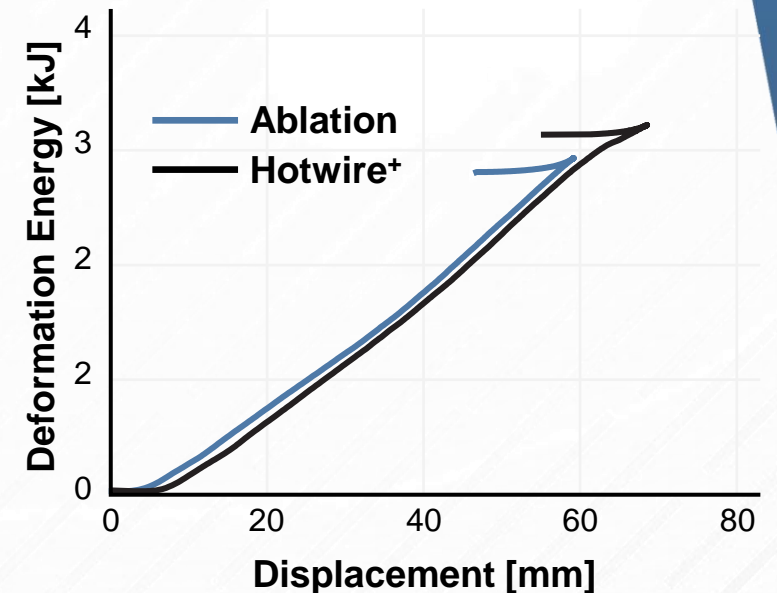
Weld performance is comparable to ablation



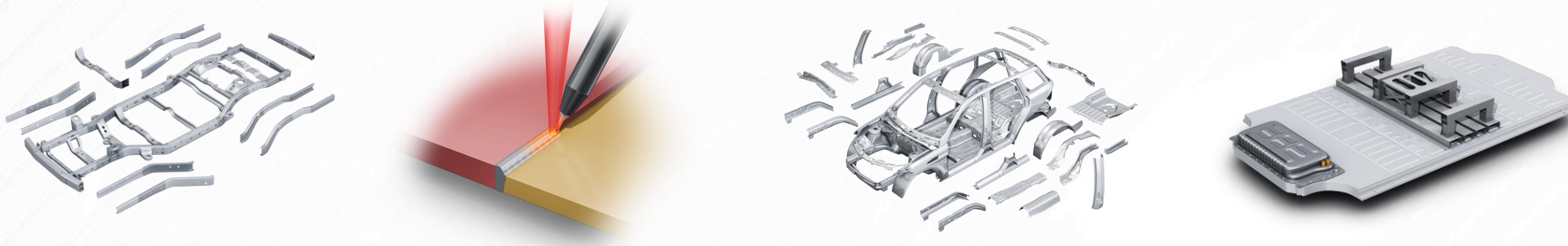
Axial Crash



3-Point Bending



FUTURE OF WELDED BLANKS



Enabling optimized steel designs – the right material in the right place

- Advanced steel applications
 - 0.5mm – 4mm thicknesses in production
 - PHS + PQS in production without ablation
 - Cold stamped grades up to DP1180 in production
 - 3rd Gen steel production ready
- All automotive grades have a validated weld process
- Engaged with steel producers for weld development of new grades

 <p>Vehicle weight reduction</p>	 <p>Component consolidation</p>	 <p>Optimized for crash energy management</p>	 <p>Material utilization improvement</p>	 <p>Cost savings</p>
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FOR MORE INFORMATION

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