GREAT DESIGNS IN STEEL

Presentations will be available for download on SMDI's website on Wednesday, May 22

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RECENT ADVANCEMENTS IN COMPLEX HOT STAMPED LASER WELDED BLANKS

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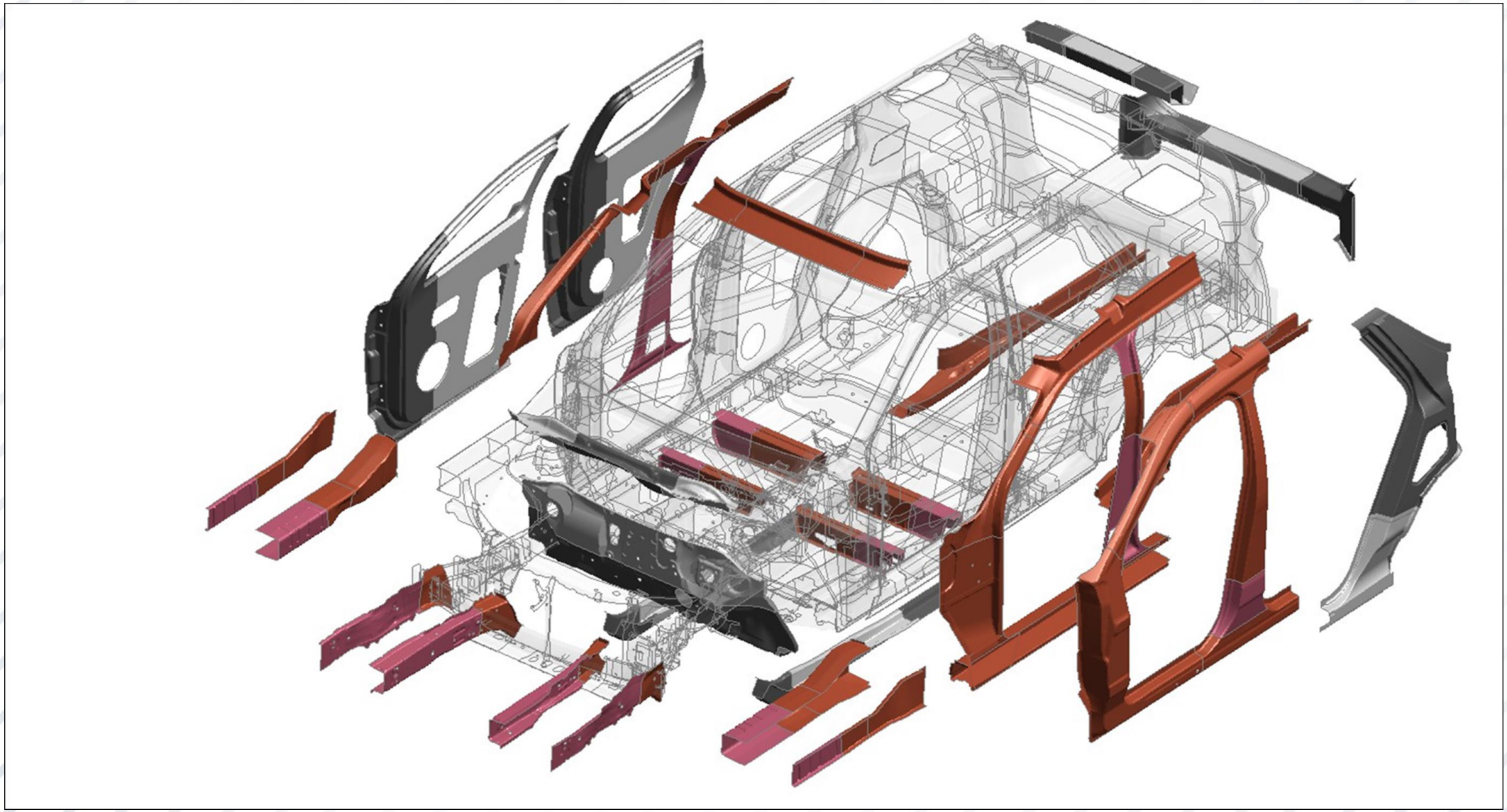
ArcelorMittal Tailored Blanks uses advanced manufacturing technologies to improve vehicle crash performance while reducing weight, fuel consumption and emissions.

AGENDA

- Current Application Map of Laser Welded Blanks
- Why apply Hot Stamped (HS) LWB door ring solution?
- Cost optimization strategies
  - 2nd generation of hot stamped steel grades
  - Ablation and welding process enhancements
  - Dedicated new generation of ablation and welding equipment
  - Common weld tooling for low volume production
  - Optimization of Hot Stamping process cost
  - Development cost reduction through global solution execution
- Summary

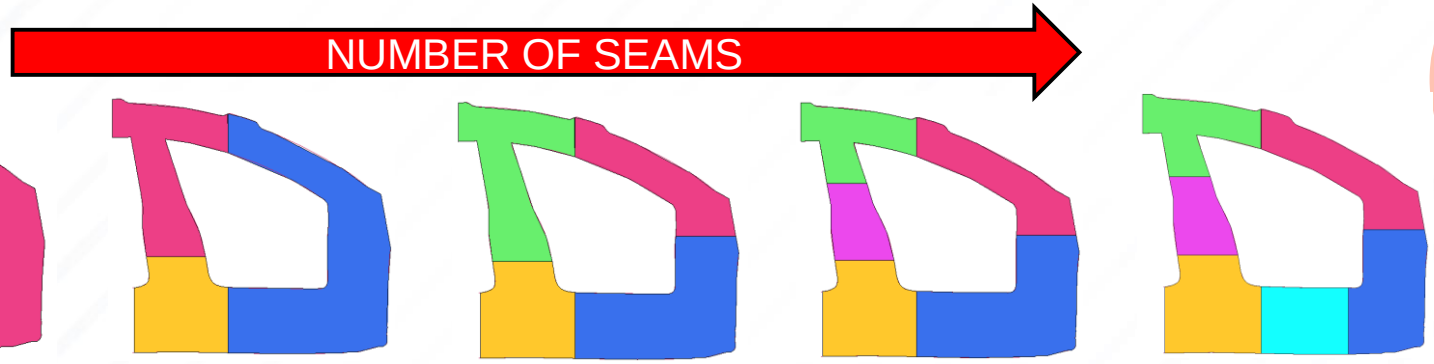
CURRENT APPLICATION MAP OF LASER WELDED BLANKS



*Source: S-in motion®

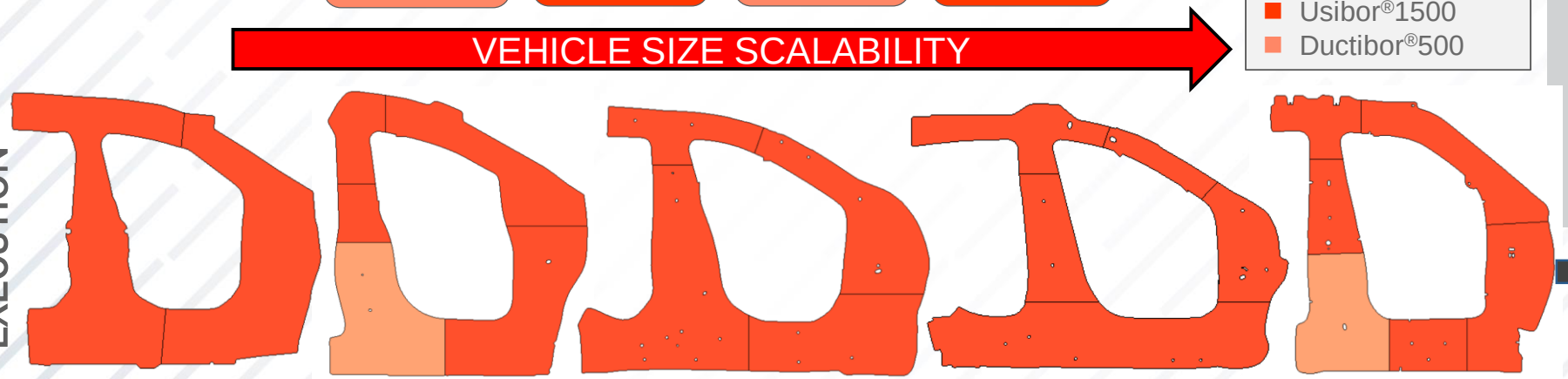
WHY APPLY HOT STAMPED (HS) LWB DOOR RING SOLUTION?

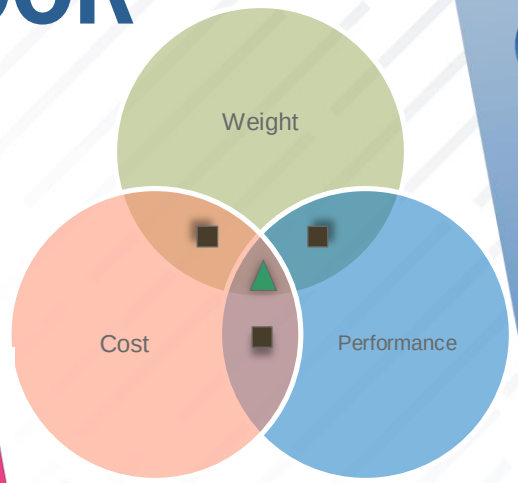
Different designs and PHS material grade and gauge combinations are possible depending on customer requirements:



1st Gen PHS: Ductibor® 500 | Usibor® 1500

2nd Gen PHS: Ductibor® 1000 | Usibor® 2000





- Laser welded blank technology
- Competing technologies

1 part instead of 2/3/4/5/6

- ✓ One stamping tool
- ✓ One stamping operation
- ✓ No post assembly operations

Lightweight concept

- ✓ Hot stamping steel grades
- ✓ Optimized thickness distribution
- ✓ Laser weld continuous links (no overlap)
- ✓ Hot-stamping geometry accuracy

2020+

WHY APPLY HOT STAMPED (HS) LWB DOOR RING SOLUTION?

2014 Acura MDX	2017 Chrysler Pacifica	2019 Acura RDX	2019 RAM1500
			
Weight saved = 4.0kg/vehicle	Weight saved = 9.0kg/vehicle	Weight saved = 14.0kg/vehicle	Weight saved = 10.0kg/vehicle
2014 IIHS TOP SAFETY PICK+	2017 IIHS TOP SAFETY PICK+	2019 IIHS TOP SAFETY PICK+	2019 IIHS GOOD
Lifecycle savings: 37,044,000 kg CO_2eq = 8 wind turbines = 4,436 households electricity = 43,598 acres	Lifecycle savings: 322,000,000 kg CO_2eq = 68 wind turbines = 56,152 households electricity = 378,969 acres	Lifecycle savings: 168,268,000 kg CO_2eq = 36 wind turbines = 29,344 households electricity (e.g. Livonia) = 198,038 acres	Lifecycle savings: 746,900,000 kg CO_2eq = 158 wind turbines = 130,249 households electricity = 879,043 acres

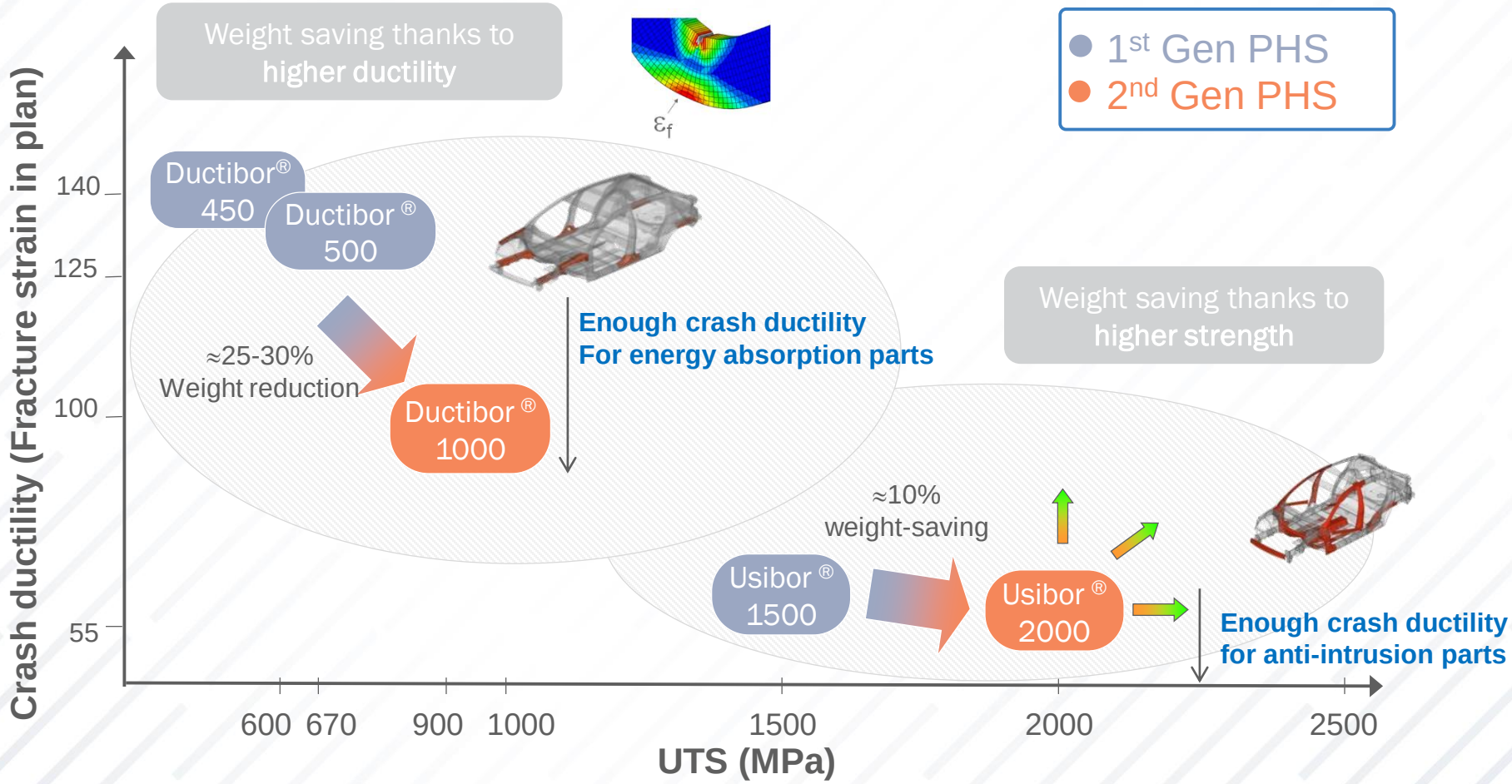
OPPORTUNITIES FOR COST OPTIMIZATION

Where are these opportunities?

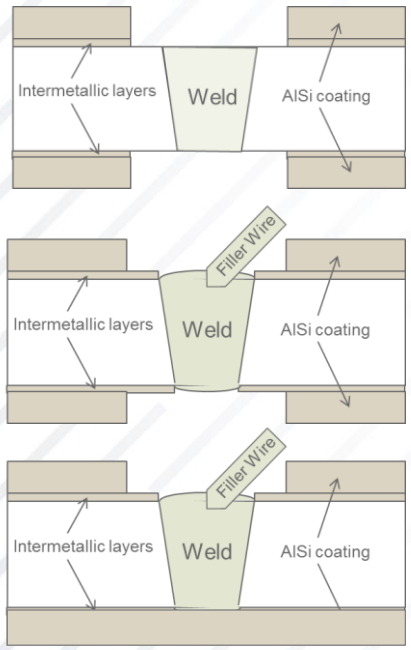
- Applying second generation of PHS
- Ablation and welding process enhancements
- New types of dedicated ablation and welding equipment
- Common weld tooling – Low Volume and Platform Approach
- Optimization of Hot Stamping process cost

SECOND GENERATION OF PHS PRODUCTS

ARCELORMITTAL 2ND GENERATION OF ALSI-COATED USIBOR® AND DUCTIBOR®



ARCELORMITTAL TECHNICAL PROCESSING GUIDELINE FOR THE ALSI COATED HS LWB



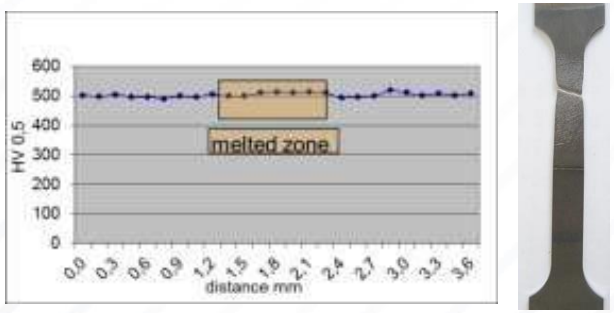
Homogeneous combinations:
Usibor®-Usibor®
Ductibor®-Ductibor®

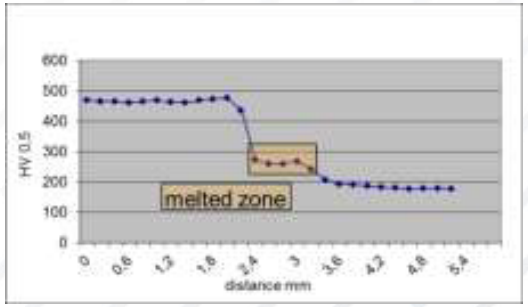
- Offline two-side partial coating ablation
- Offline/Inline two-side partial coating ablation + FEEDIBOR® Filler wires

Heterogeneous combinations:
Usibor®- Ductibor®

- Offline two-side partial coating ablation
- Offline/Inline two-side partial coating ablation + FEEDIBOR® Filler wires
- One-side partial coating ablation + welding with FEEDIBOR® Filler wires

NEW



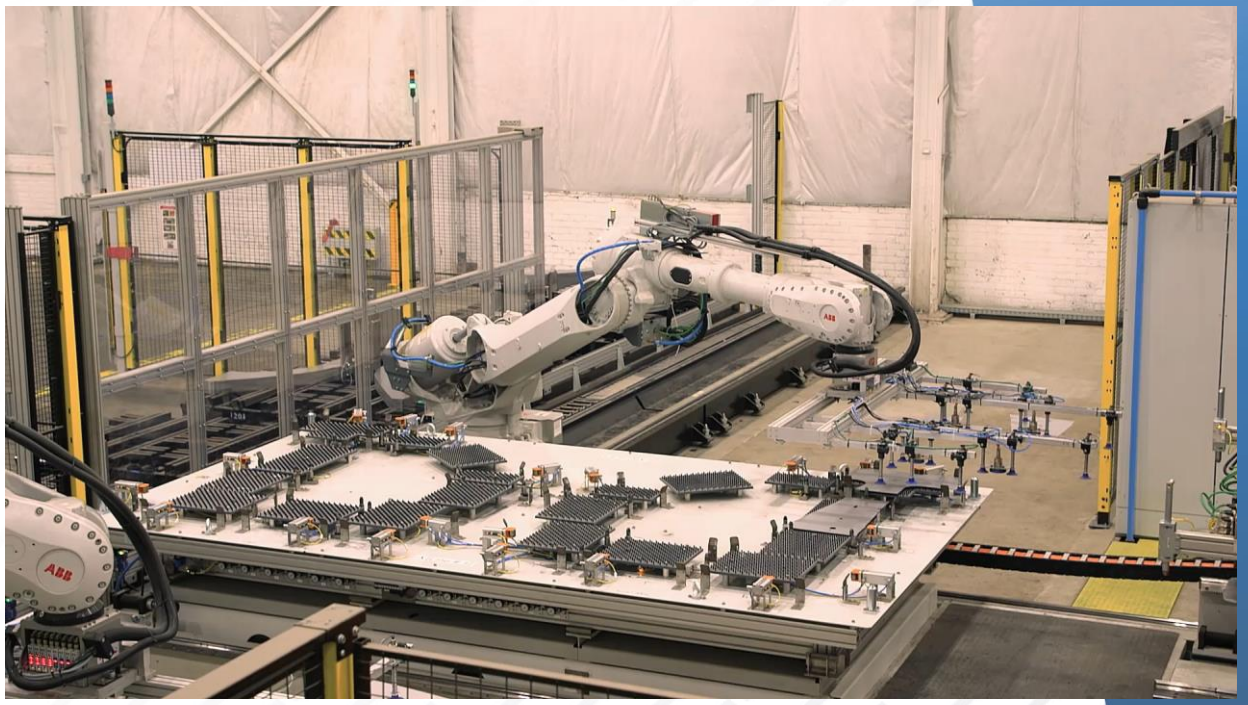


EQUIPMENT INNOVATIONS & STRATEGY

Dedicated ablation and welding lines to increase efficiency and throughput

Continuous ablation line

Multi-seam curvilinear welding line



Ablation throughput is improved by 5x

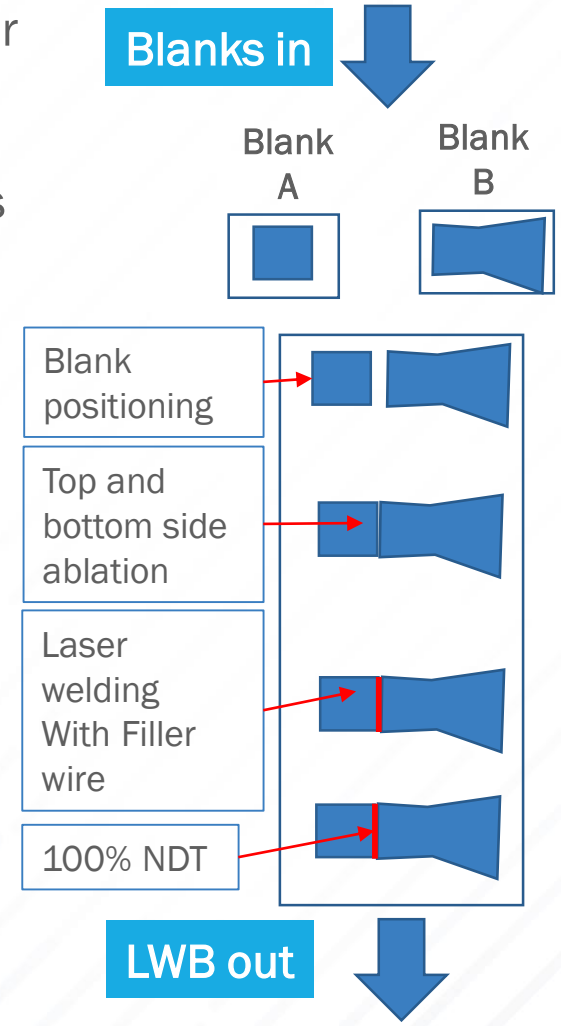
Welding throughput is improved by 4.5x

NEW SHORT WELD SYSTEM

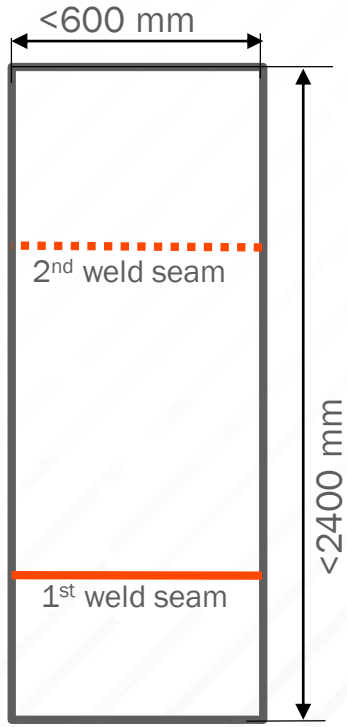
- New short weld system for laser welded blanks can produce (except door rings)
  - Hot Stamped LWBs
  - Cold Stamped LWBs

Key advantages
- Continuous blank feeding
- Short changeover times
- Inline ablation capability for AlSi coated PHS grade
- Filler wire capable laser welding
- Integrated quality control system

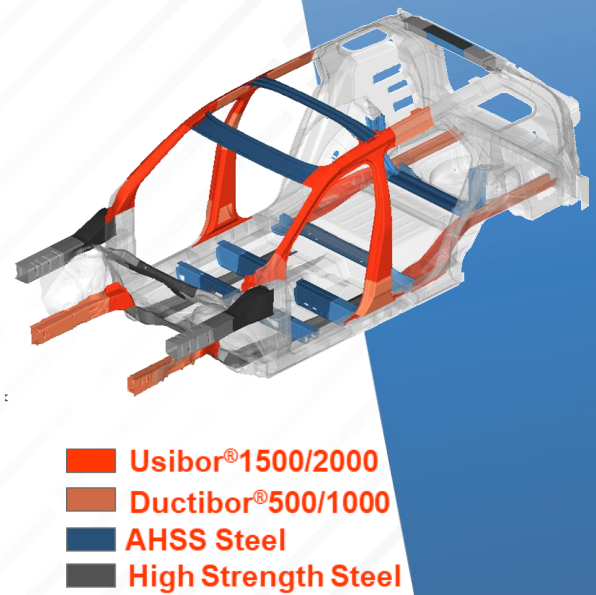
Inline Process



Ideally suited for 1-2 seams



Over 98 BIW applications

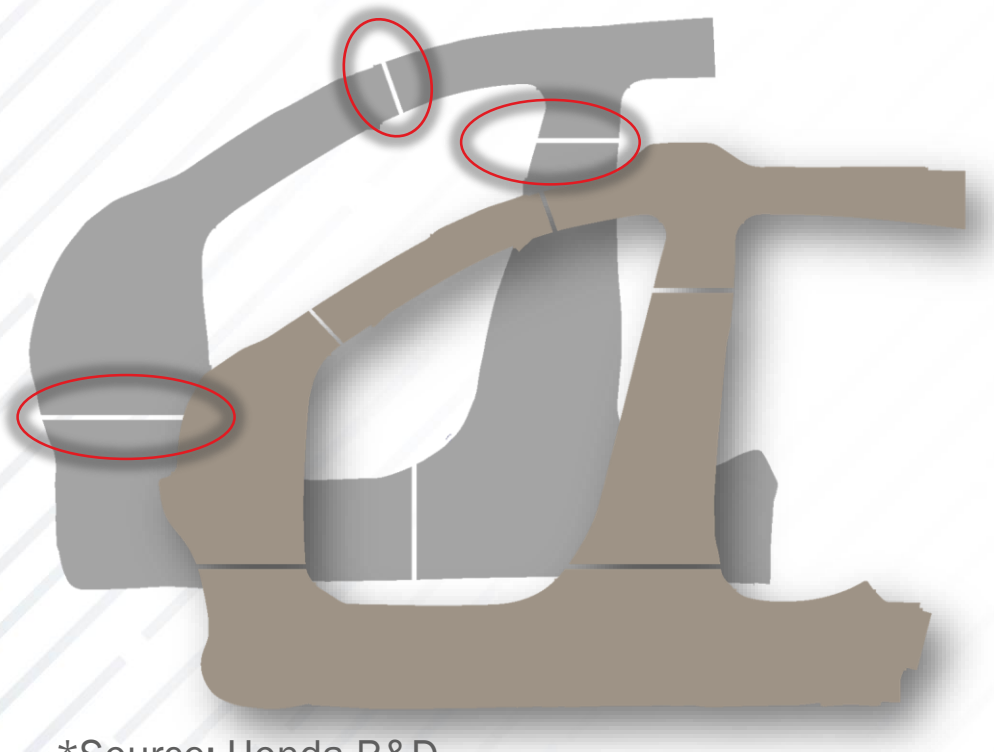


Material Type	Material Combination	Gauge (mm)	Max. Gauge Ratios
Cold Stamped	Homogeneous or Heterogeneous	0.5 (min) 3.0 (max)	1: (2.5-3) (Forming limit)
Hot Stamped	Homogeneous or Heterogeneous	0.6 (min) 3.0 (max)	T_{max}= T_{min}+(1.3)mm (Current capability)*

**Hot Stamping limitation depending on OEM spec. and hot stamper*

COMMON WELD TOOLING - EXECUTION

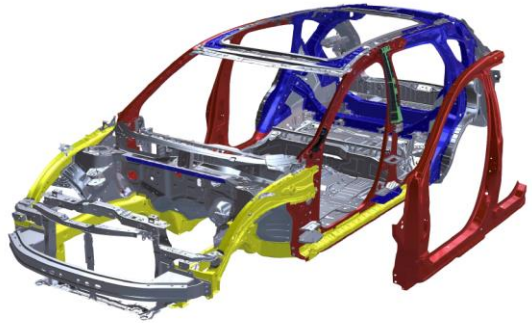
2019 Acura RDX Inner and Outer Door Rings



*Source: Honda R&D

Inner & Outer Door Ring System Concept

In a world first, Acura has created an inner and outer door ring system that takes full advantage of this technology and frees-up tremendous design possibilities

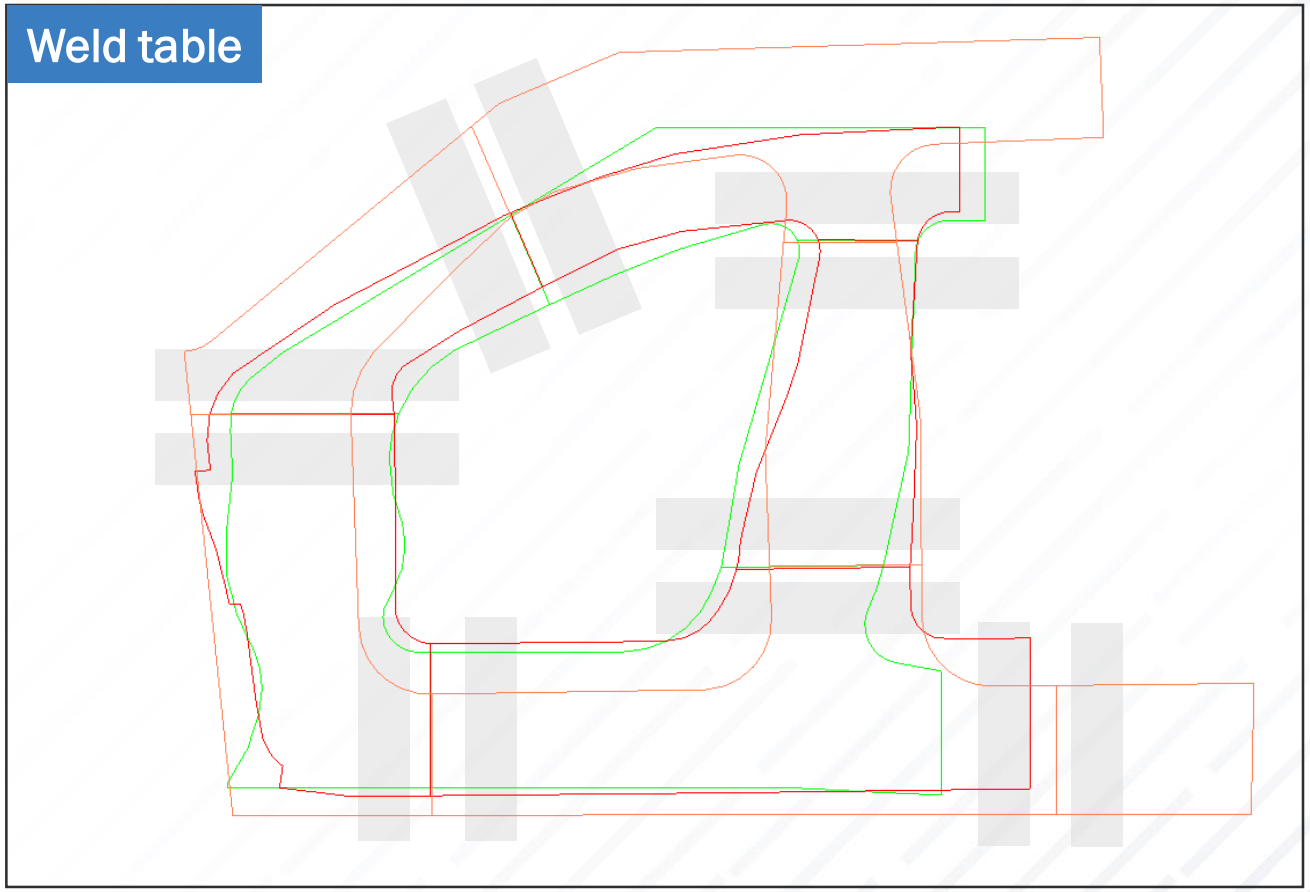


2018 GDIS

#GDIS | #SteelMatters

COMMON WELD TOOLING - CONCEPT

- Welding system requires dedicated weld tooling for positioning, crowding, and welding the door ring with very tight tolerance
- To improve tooling cost efficiency, 2 or more door rings can be design to use common weld tools
- Key advantage on low volume and global programs



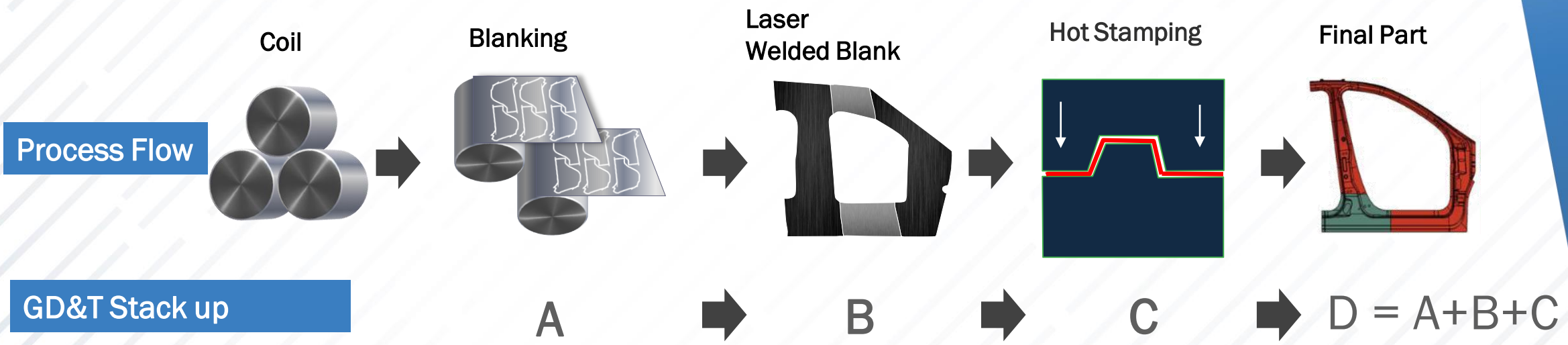
Mid size CUV Mid size Truck/SUV Full size Truck/SUV

*Source: S-in motion® Door Ring

OPTIMIZATION OF HOT STAMPING PROCESS COST

Tight tolerance of Laser Welded Blanks - Concept

- Tight tolerances on blanks provides opportunity to achieve near net shape for hot stamped parts and reduces laser trimming cost
- Total stack up can be improved through common datum scheme



Developed trim when D<= OEM tolerance for final part

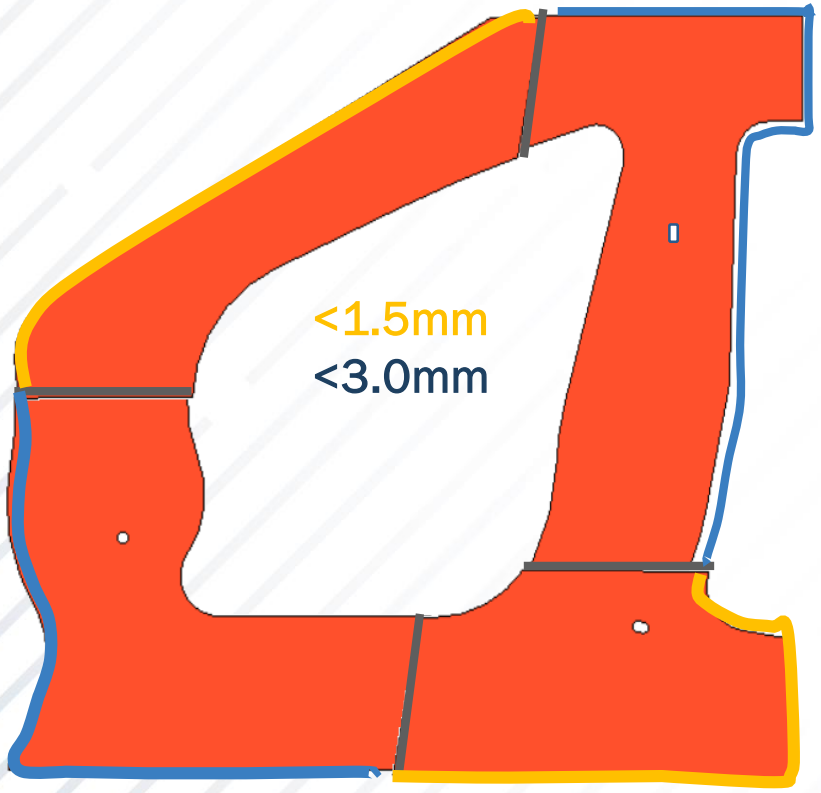
Laser trim when D> OEM tolerance for final part

OPTIMIZATION OF HOT STAMPING PROCESS COST

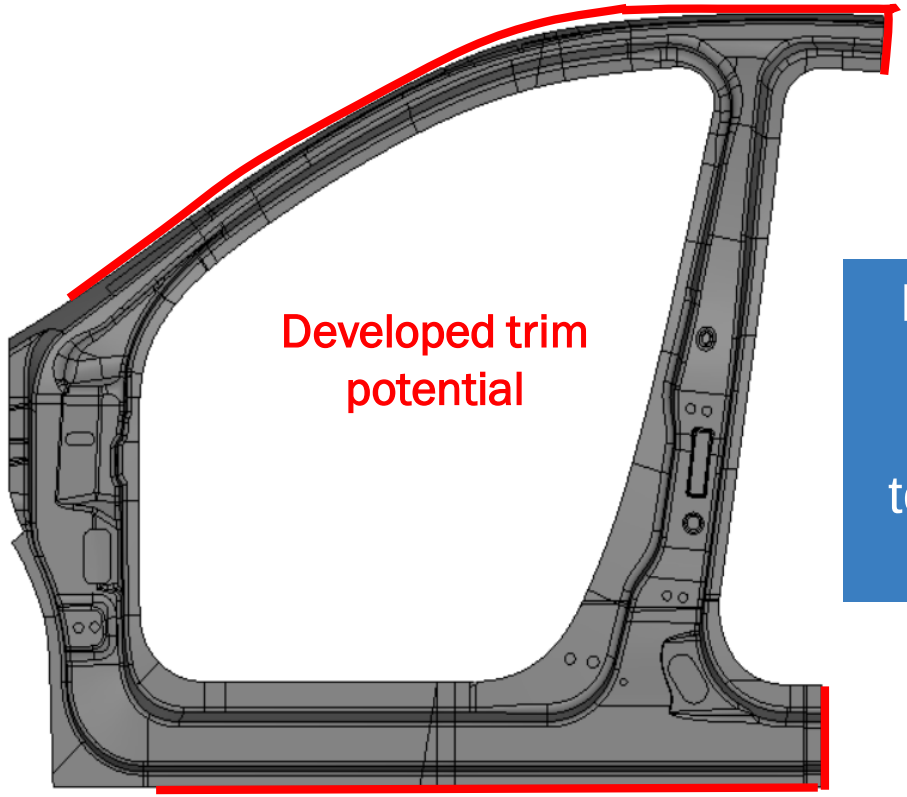
Tight tolerance of Laser Welded Blanks – Concept

Potential to achieve up to 35% of near net shape by realizing tighter blank tolerance

Door ring outer LWB Blank



Door ring outer Hot Stamped Part



Developed trim when D<= OEM tolerance for the final part

*Source: S-in motion® Door Ring

OPTIMIZATION OF HOT STAMPING PROCESS COST

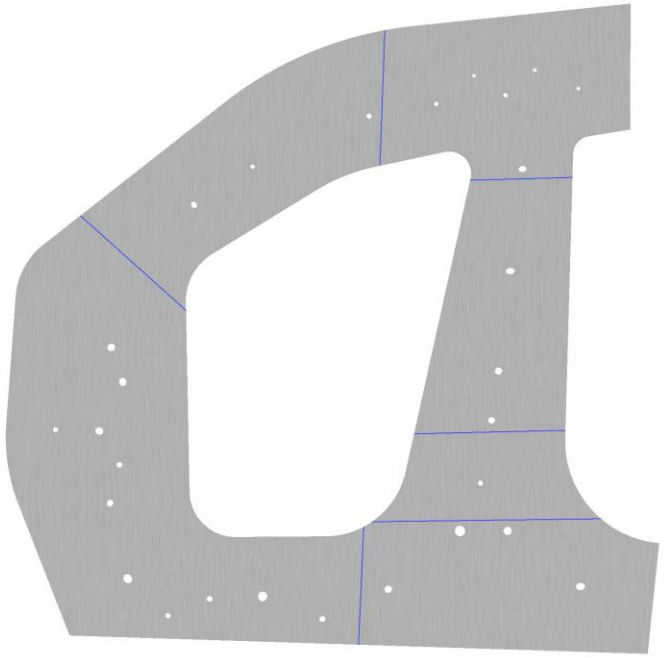
Laser trim when D> OEM tolerance for the final part

OPTIMIZATION OF HOT STAMPING PROCESS COST

Use CAE to predict profile and position of holes on 2D blank from 3D part

Reverse engineer the holes into 2D blanks

Tighter tolerance and CAE prediction helps to achieve 30% pre developed holes



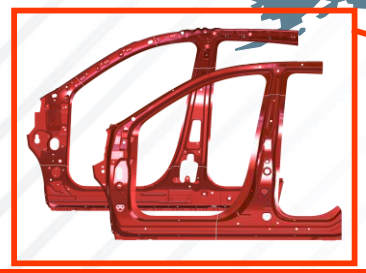
14-0738-07_01-14_holes_cuttool_bse_trim5
Time From Start / Distance To Bottom: 3.030 s / 0.00 mm
Operation Step: T-10 Cutting

*Source: S-in motion® Door Ring

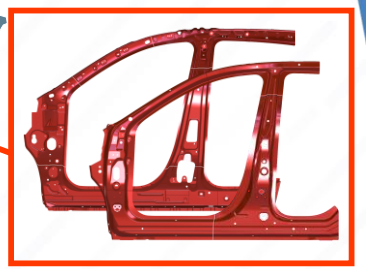
DEVELOPMENT COST REDUCTION THROUGH GLOBAL SOLUTION EXECUTION

ArcelorMittal Tailored Blanks production plants

LWB for hot stamping
installed capacity



Production Started in North America for 2019 RDX



Production Started in China six months later

North America

ArcelorMittal Tailored Blanks

- Concord, Ontario, Canada
- Woodstock, Ontario, Canada
- Pioneer, Ohio, USA
- Detroit, Michigan, USA
- Silao, Guanajuato, México

Delaco ArcelorMittal Tailored Blanks

- Tonawanda, NY, USA (JV)
- Dearborn, Michigan, USA (JV)
- Montezuma, Iowa, USA (JV)

Europe

ArcelorMittal Tailored Blanks

- Birmingham, UK
- Bremen, Germany
- Neuwied, Germany
- Liège, Belgium
- Genk, Belgium
- Gent, Belgium
- Lorraine, France
- Senica, Slovakia
- Zaragoza, Spain
- Orhangazi ,Turkey (JV)

India

- Arcelor Neel Tailored Blank Chennai (JV)
- Arcelor Neel Tailored Blank Pune (JV)

China

- Shanghai Baosteel & Arcelor Tailor Metal (JV)
- Gonvvama Loudi (JV)
- Gonvvama Changshu (JV)
- Gonvvama Chongqing (JV)
- Gonvvama Shenyang (JV)

SUMMARY

- Hot Stamped Laser Welded Blanks (HS LWBs) provide Greener, Safer and Lighter solutions

- Laser welded blanks make steel solutions more affordable for our customers

- HS LWB Door Rings provide the optimal balance of weight, cost and performance
  - Multiple OEMs have applied the door ring solution to make best-in-class vehicles

- AMTB has developed many cost optimization solutions for Door Rings
  - 2nd generation Press Hardened Steel Solutions → Higher weight savings
  - Feedibor® wires with partial Ablation→ Robust joining and process step reduction
  - Next generation welding and ablation systems → Higher throughput/efficiency
  - Weld tool commonization → Lower investment → platform and low volume program approach
  - Tight blank tolerances → Near net shape and pre-developed holes (Laser trimming cost reduction)

- Co-Engineering with our customers allows us to innovate and find new ways to cost optimize, maximize weight savings, improve material utilization

Q&A

THANK YOU

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