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

- 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

NUMBER OF SEAMS

CONCEPTS

<table>
<thead>
<tr>
<th>Concept</th>
<th>VEHICLE SIZE SCALABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Gen PHS</td>
<td>Ductibor® 500</td>
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<tr>
<td>2nd Gen PHS</td>
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</table>

VEHICLE SIZE SCALABILITY

2014 MY Acura MDX
2017 MY Chrysler Pacifica
2019 MY Acura RDX Outer
2019 MY Acura RDX Inner
2019 MY RAM1500

EXECUTION

2020+

Competing technologies:

- Laser welded blank technology

1 part instead of 2/3/4/5/6
- One stamping tool
- One stamping operation
- No post assembly operations
- Hot concept
- Hot stamping steel grades
- Optimized thickness distribution
- Laser weld continuous links (no overlap)
- Hot-stamping geometry accuracy
## WHY APPLY HOT STAMPED (HS) LWB DOOR RING SOLUTION?

<table>
<thead>
<tr>
<th>Year</th>
<th>Model</th>
<th>Weight saved</th>
<th>Lifecycle savings:</th>
<th>Lifecycle savings:</th>
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<tbody>
<tr>
<td>2014</td>
<td>Acura MDX</td>
<td>4.0kg/vehicle</td>
<td>37,044,000 kg CO₂eq</td>
<td>8 wind turbines</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 4,436 households</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 43,598 acres</td>
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<tr>
<td>2017</td>
<td>Chrysler Pacifica</td>
<td>9.0kg/vehicle</td>
<td>322,000,000 kg CO₂eq</td>
<td>68 wind turbines</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>= 56,152 households</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>electricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 378,969 acres</td>
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<tr>
<td>2019</td>
<td>Acura RDX</td>
<td>14.0kg/vehicle</td>
<td>168,268,000 kg CO₂eq</td>
<td>36 wind turbines</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td>= 29,344 households</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>electricity (e.g. Livonia)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 198,038 acres</td>
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<tr>
<td>2019</td>
<td>RAM1500</td>
<td>10.0kg/vehicle</td>
<td>746,900,000 kg CO₂eq</td>
<td>158 wind turbines</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 130,249 households</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>electricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>= 879,043 acres</td>
</tr>
</tbody>
</table>
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®

- **Usibor® 1500**: 10% weight-saving
- **Ductibor® 450, 500, 1000**: 25-30% weight reduction
- **Usibor® 2000**: Enough crash ductility for anti-intrusion parts
- **Ductibor® 2000**: Enough crash ductility for energy absorption parts

Weight saving thanks to higher ductility

- **Usibor® 1500**: 10% weight-saving
- **Ductibor® 450, 500, 1000**: 25-30% weight reduction
- **Usibor® 2000**: Enough crash ductility for anti-intrusion parts
- **Ductibor® 2000**: Enough crash ductility for energy absorption parts

Weight saving thanks to higher strength
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
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
Blanks in
Blank A
Blank B
Blank positioning
Top and bottom side ablation
Laser welding
With Filler wire
100% NDT
LWB out

Ideally suited for 1-2 seams
<600 mm
<2400 mm
1st weld seam
2nd weld seam

Over 98 BIW applications

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Material Combination</th>
<th>Gauge (mm)</th>
<th>Max. Gauge Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Stamped</td>
<td>Homogeneous or Heterogeneous</td>
<td>0.5 (min)</td>
<td>1: (2.5-3) (Forming limit)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.0 (max)</td>
<td></td>
</tr>
<tr>
<td>Hot Stamped</td>
<td>Homogeneous or Heterogeneous</td>
<td>0.6 (min)</td>
<td>( T_{\text{max}} = T_{\text{min}} + (1.3)\text{mm} ) (Current capability)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.0 (max)</td>
<td></td>
</tr>
</tbody>
</table>

*Hot Stamping limitation depending on OEM spec. and hot stamper
COMMON WELD TOOLING - EXECUTION

2019 Acura RDX Inner and Outer Door Rings

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.

*Source: Honda R&D

GREAT DESIGNS IN STEEL

2019 Acura RDX
Carolyn LeBlanc
Cabin Design Engineer

*Source: Honda R&D
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.

*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

- Process Flow
  - Coil
  - Blanking
  - Laser Welded Blank
  - Hot Stamping
  - Final Part

- GD&T Stack up
  - A
  - B
  - C
  - D = A+B+C

- 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

<1.5mm
<3.0mm

Developed trim potential

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

*Source: S-in motion® Door Ring
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

Europe
- Birmingham, UK
- Bremen, Germany
- Neuwied, Germany
- Liège, Belgium
- Gent, Belgium
- Lorraine, France
- Senica, Slovakia
- Zaragoza, Spain
- Orhangazi, Turkey

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

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

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

Production Started in North America for 2019 RDX
Production Started in China six months later
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\textsuperscript{®} 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
THANK YOU
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