GREAT DESIGNS IN STEEL

INNOVATIVE SIDE STRUCTURE ASSEMBLY USING ARCELORMITTAL MULTI PART INTEGRATION™ CONCEPTS

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AGENDA

• Auto Industry Trends
• Evolution of BEV Design Concepts
• ArcelorMittal Multi Part Integrated™ (MPI) Concepts
• AMTB NBEV Performance
• Case Study: Double Door Ring Inner (DDRI) & Double Door Ring Outer (DDRO)
  • Mass Comparison
  • Assembly benefits
  • Sustainability
  • Design Feasibility
  • Material Utilization Study
  • Cost Comparison
• Conclusions
• Coming soon! New Product
AUTO INDUSTRY TRENDS

Electrification Challenges

- Fleet CO₂ targets
- Assembly line upgrades
- Stricter safety targets
- BEV Production Volume

Cost increase
+40-50%

Heavy vehicles
+20-30%

Battery Pack Logistics

Ongoing Development & Implementation

- Tailored Steel Blanks
- Additive Manufacturing
- Die Castings
- Modular Platforms
- Flexible Cell Manufacturing
- Supply Chain Sustainability
- Mix Material Light-weighting

BEV Production Volume

- 2022: 6%
- 2030 (5x increase): 40%

Source: S&P Forecast – March 2023

ICE
BEV
EVOLUTION OF BEV DESIGN CONCEPTS

AMTB BEV
- Door rings – the first MPI
- Battery rings introduced
- PHS 1500 – PHS 1000 LWBs
- Linear PHS Laser Welded Blanks (LWB)

AMTB BEV2.0
- Rear H-frame
- Front U-frame
- Door Rings
- Battery Rings
- PHS 2000 introduced (2nd gen. PHS)
- Part weight reduced = ~16 kg
- Part count improved = 14 less components

AMTB NBEV
- Double Door Rings
- Floor Integrated Battery Enclosure
- Rear H-frame
- Front U-frame
- Roof Ring
- Part weight reduced = ~39 kg (vs AMTB BEV)
- Part count reduced = 38 less components
**ARCELORMITTAL MULTI PART INTEGRATION™ (MPI) CONCEPTS**

- **Key Enablers**
  - Laser Welded Blanks
  - Press Hardening

- **Core Benefits**
  - Weight Reduction
  - Cost Optimization
  - Performance Improvement

- **BEV Era Benefits**
  - Assembly Simplification
  - Assembly Floor Space
  - Complexity Reduction
  - Assembly Plant Investment

- **Double Door Rings**
- **Rear O-frame MPI**
- **Roof Ring MPI**
- **Front U-frame MPI**
- **Floor reinforcement MPI**
- **Battery cover upper MPI**
- **Battery tub lower MPI**

**Weight Reduction**
**Carbon Foot-Print Reduction**
**Cost Optimization**
**Performance Improvement**

**Presented at GDIS 2022**
**Presented at IABC 2022**
**Presented at CarBody Xperience 2023**

- PHS 2000
- PHS 1500
- PHS 1000
DOUBLE DOOR RING INNER AND OUTER CRASH LOAD PATHS

MPIs create a safety structure for occupant and battery protection
MPIs (Double door rings) help manage all crash load cases for occupant and battery protection.
Enhanced protection for battery and occupant achieved using the double door rings.

- Multipart Design
- MPI Design

10ms Sill starts crushing
75ms midway through crush
150ms end of crush

Weight saving per vehicle: 22 kgs
DOUBLE DOOR RING INNER AND OUTER CRASH PERFORMANCE

MPIs help manage critical pole impact load cases with no contact to battery modules.

20 ms: Sill start crushing
35 ms: Midway through crush
65 ms: Max. deformation, no contact with battery modules

FMVSS 214 5th Pole

FMVSS 214 50th Pole

Weight saving per vehicle: 22 kgs
DOUBLE DOOR RING INNER AND OUTER
POLE CRASH COMPARISON – ICE VS BEV CHALLENGES

NBEV: 40% higher kinetic energy, 20% lower cabin intrusions → 230% resultant contact force
The double door ring inner and outer structure is integral for safety in all load cases.
BENEFITS CASE STUDY: DOUBLE DOOR RING INNER AND OUTER

DOUBLE DOOR RING INNER AND OUTER
MASS COMPARISON

- Inner Door Assembly
  - IR Design
  - OR Design
- Outer Door Assembly
  - OR Design
  - IR Design

Double door ring inner and outer reduces 28 parts in the side structure to 4 parts per vehicle.

DOUBLE DOOR RING INNER AND OUTER
ASSEMBLY BENEFITS

MNP Design

MNP’s implementation eliminates multiple sub-assembly stages on the assembly line.

DOUBLE DOOR RING INNER AND OUTER
DESIGN FEASIBILITY

Press Hardened Steels’ superior formability is critical to achieve manufacturing feasibility.

DOUBLE DOOR RING INNER AND OUTER
MATERIAL UTILIZATION SUMMARY

Laser welded blanks provide significant improvements in material utilization versus multipart.

DOUBLE DOOR RING INNER AND OUTER
SUSTAINABILITY

- Total yearly savings for a year volume of 300,000 vehicles: 36,47 tons of CO2 eq.
- MNP Design offers CO2 eq emissions reduction of 22% compared to traditional multipart design.

DOUBLE DOOR RING INNER AND OUTER
COST COMPARISON

- Double door ring inner and outer MNP allows for 18% cost savings versus multipart solution.
DOUBLE DOOR RING INNER AND OUTER
MASS COMPARISON

Inner Sub Assembly

Total Part count: 14
Gross steel usage: 85.37 kg/side
Material Utilization: 66%
Assembly weight: 56.35 kg/side

Double Door Ring Inner

MPI Design

Outer Sub Assembly

Double Door Ring Outer

Total Part count: 2
Gross steel usage: 64.57 kg/side (-20.80 kg/side)
Material Utilization: 70% (+4.0%)
Assembly weight: 45.22 kg/side (-11.13 kg/side)

Double door ring inner and outer reduces 28 parts in the side structure to 4 parts per vehicle
DOUBLE DOOR RING INNER AND OUTER ASSEMBLY BENEFITS

MPIs implementation eliminates multiple sub-assembly stages on the assembly line.
DOUBLE DOOR RING INNER AND OUTER ASSEMBLY BENEFITS

MPIs implementation eliminates multiple sub-assembly stages on the assembly line.
MPI Design offers CO\textsubscript{2} eq emissions reduction of 22% compared to traditional multipart design.

Production phase emissions per vehicle:
- 61.38 kg CO\textsubscript{2} eq savings per vehicle (25% reduction)

Vehicle use phase emissions:
- 123.06 kg CO\textsubscript{2} eq savings per vehicle (20% reduction)

Total yearly savings for a yearly volume of 200,000 vehicles: 38.57 ktonne of CO\textsubscript{2} eq savings
Press Hardened Steels’ superior formability is critical to achieve manufacturing feasibility.
Laser welded blanks provide significant improvements in material utilization versus multipart
Double door ring inner and outer MPI allow for 8% cost savings versus multipart solution.
IT HAS ALREADY BEGUN!

Why apply Hot Stamped (HS) LWB door ring solution? - Safer, Lighter & Greener

- Evolution of Door Ring design to Double Door Ring Designs
- Incorporates 14 parts into 2 stamped parts
- Press Hardened Steel enables stamping of the complex shapes
- Excellent load transfer through continuous seams in crash events
- Acts as part of an integrated battery and occupant protection system
- Reduced manufacturing footprint
- Cheaper and lighter solution
- Validated through prototypes and production vehicle assembly

**Coming soon!**

- First of many currently in design

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**Weight Saved = 18.0 kg/vehicle**

*expecting top IIHS rating for crash and safety evaluations

- Emissions savings per year = 63,617,598 kg CO₂eq
- Wind turbines = 13
- Household electricity = 11,103
- Acres of forest = 74,844

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**Implemented door ring solutions & LWBs make the vehicles – safer, stronger, lighter and greener**

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**Door ring design variation & complexity**

- 2014 Acura MDX
- 2016 Chrysler Pacifica
- 2019 Acura RDX
- 2019 RAM 1500
- 2021 Acura MDX
- 2021 Stellantis Grand Cherokee
- 2021 Stellantis Grand Wagoneer
- 2021 EV
- 2022 EV
- 2022 Honda Pilot

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**World’s first Door Ring Inner & Outer**

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**+11 more by 2028**
Home of the most advanced Laser Welded Door Rings

ArcelorMittal Tailored Blanks

Stop by our booth for more information!

AMTB is a leading global supplier of tailored (laser welded) blanks – safer, stronger, lighter and green solution!

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14 locations in Europe and Asia