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ArcelorMittal Dofasco, ArcelorMittal USA, Nucor Corporation, Severstal North America, Inc. and United States Steel Corporation
Tailored Steel Products — A Smart Investment for Future Vehicles

by:
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Powerlasers, Inc.
and
Peter R. Mould
Tailored Steel Product Alliance (TSPA)
• What are tailored steel products?
• What is the Tailored Steel Product Alliance (TSPA?)
  – Growth and applications
• Automotive Needs
• Tailored steel products – a smart investment to meet automotive’s needs:
  – Mass reduction
  – Cost reduction
  – Environmental benefits
• Summary/Conclusions
DEFINITION OF TSPs

- Pre-welded structures for subsequent forming (i.e. stamping, hydro-forming, etc.)
  - Laser welded blanks or tubes
  - Mash seam welded blanks
  - Patch welded structures
  - Tailor rolled structures

- Allow use of different:
  - Steels (Mild Steel, HSS & AHSS)
  - Thicknesses

- Provide engineering flexibility for locating high strengths at critical locations
  - Cost effective
  - Minimize mass


**Alliance:** Tailored Steel Blank Manufacturers, Equipment Suppliers, North American Steel Companies.

**Purpose:** To promote the use of tailored steel products in automotive applications.
Tailored Blank Manufacturers

- Powerlasers, Inc.
- Shiloh Industries, Inc.
- TWB Company, LLC

Equipment Suppliers

- Soutec
- Soudronic

North American Steel Companies

- ArcelorMittal
- Nucor Corporation
- Severstal North America, Inc
- United States Steel Corporation
• Market Analysis
  – Applications
  – Materials

• Communications
  – Benefits

• Development Programs
  – Cost Model
  – Applications Database
AUTOMOTIVE NEEDS

Engineering Performance
- Crash/Safety
- Mass reduction
- Durability

Cost Minimization
- Materials
- Manufacturing & Assembly

Customer Acceptance
- Value
- Ride
- Environmental Impact

Tailored Steel Products
Enablers to meet automotive needs

A smart investment for future vehicles.
AUTOMOTIVE NEEDS

Engineering Performance
- Crash/Safety
- Mass reduction
- Durability

Cost Minimization
- Materials
- Manufacturing /Assembly

Customer Acceptance
- Value
- Ride
- Environmental Impact

Review examples where TSPs positively impact these issues
Front Door Inners — 3-pc. LWB Concept – Integrated Belt Reinf.

Door Inner Plus Hinge Reinforcement

Conventional Laser Welded Door Inner

Future Laser Welded Door Inner with Integrated Belt Reinforcement

Mass Savings Potential: 4-9 pounds per vehicle
Side Intrusion Beam — Hot stamped 3-piece LWB

Tailor Welded Door Beams

22MnB5 (boron)

Mass Reduction
1.1#/ door
2.2#/ 2 door veh.
4.0#/ 4 door veh.
Sunroof Structure — Concept

Potential Part Mass Savings ~ 9 pounds
Potential Material Savings ~ 22 pounds

Side Reinforcements LH/RH
1.2 mm DQSK
~ 10 kg / Veh

Center Reinforcement
1.2 mm DQSK
~ 3 kg / Veh

1.6 mm DQSK
~ 15 kg

1.0 mm DQSK
~ 7 kg

Sunroof Ring
1.0 mm DQSK
~ 19 kg / Veh
Body Side Inner — Concept

- Part reduction: 17 to 7
- Multiple steel grades
- **Mass reduction 13 to 15#**
- Improved roof crush and side impact performance
- Lower variable cost and investment cost
- Manageable press loads compared with a single LWB inner
Body Side Outer — Ford F-150 Door Opening Panel

FORD F-150 DOP
- 1.1mm EG coating & 2mm HD coating
- Class 2 exposed

BENEFITS
- Eliminated 8 reinforcements, 20 stampings and 88 stamping dies
- Improved stiffness
- Improved material utilization
- Mass savings

- Part reduction
- Mass savings/vehicle = 59 pounds
- Reduced cost
- Good surface appearance of weld seam in semi-exposed door location
**B-Pillar Rein.** — 2-pc. LWB Hot stamped Boron-HSLA Steel – Audi A5

Mass savings = 4 pounds/vehicle
TSPA 2008 Study of BIW and Closures Estimated:

99 - 155 pounds of Primary Mass Savings

Additional Secondary Mass Savings

- No Resizing of Power Train
  - 0.5x Primary*
- Resizing of Power Train
  - 1.5x Primary*

*Recent study by Auto / Steel Partnership - Future Generation Passenger Compartment Team
MASS REDUCTION POTENTIAL

- Total estimated **primary** mass savings
- Additional **secondary** mass savings

<table>
<thead>
<tr>
<th>Est. Pounds/vehicle</th>
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<tr>
<td><strong>99-155</strong></td>
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</table>

No Power Train Resizing

- (0.5 x Primary) *
  - 69 - 107

With Power Train Resizing

- (1.5 x Primary) *
  - 207 - 320

**Total mass savings**

- 207 – 320
- 345 - 533

*Based on a recent study by the A/SP Future Generation Passenger Compartment Team*
COST REDUCTION

Same Gauge LW Blanks

Improved nesting of pieces

Maximizes material utilization by reducing engineered scrap

2 Options

– In product LW blanks

– In process LW blanks
Definitions:

- **In-product laser welded blanks:**
  - Designed into product at the early stages
  - Laser line design in a neutral area of the part

- **In-process laser welded blanks:**
  - 2 blanks attached by laser weld
  - Laser weld removed in stamping process.
COST REDUCTION

In Product: B-Pillar – Monolithic Blank

Finished Component

Offal – 35%

Blank Nesting
In Product: B-Pillar – LWB Same Gauge

Efficient Blank Nestings

Assembly

Individual Blanks

Savings: $1.70

OFFAL — ? %
In Product: Heavy Gauge — Frame Rails — Monolithic Blank

Engineered Scrap – 48%
In Product: Heavy Gauge – Frame Rails

Savings: $3.00
Body Side Inner — Baseline Design

Five Parts:

FBHP, Rocker, Center Pillar, Wheelhouse, Roof Rail
Body Side Inner — LWB Design

Six Welded Pieces:
FBHP, Rocker, Center Pillar, Wheelhouse, Front Roof Rail, Rear Roof Rail
## COST COMPARISON

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<th>LWB</th>
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<tbody>
<tr>
<td></td>
<td># of Parts</td>
<td>Weight (kg)</td>
<td></td>
<td># of Parts</td>
<td>Weight (kg)</td>
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<td>Stampings</td>
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<td>50.6</td>
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<td>Tailored Blanks</td>
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<td>2</td>
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<td>Rollformings</td>
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<td>TOTAL</td>
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<td>60.1</td>
<td></td>
<td>2</td>
<td>43.8</td>
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<tr>
<td># of Spot Welds</td>
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Includes left & right assemblies. / Same materials in both designs
Unit Cost (275k vehicles/year)

Total Unit Cost $, (L & R assemblies)

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<th></th>
<th>Base</th>
<th>LWB</th>
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<tr>
<td>Total</td>
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<tr>
<td>Labor &amp; Equipment</td>
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<td>Variable &amp; Fixed*</td>
<td>8.77</td>
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<td>10.80</td>
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<td>Blank</td>
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<td>Blanking</td>
<td>1.25</td>
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<td>Welding</td>
<td>0.00</td>
<td>16.72</td>
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*Variable: Energy, Process material costs
Fixed: Building, Maintenance, Overhead
Fixed Tooling Investment

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<th>LWB</th>
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<td>$ millions</td>
<td>16.3</td>
<td>12.0</td>
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LWB saves $4.3 million or 26%
Tailored Steel Products enable:

**Mass Reduction**
- Lighter weight parts
- Lighter vehicles

**Cost Reduction**
- High material utilization
- Reduced material manufacturing

**100% Recycling at EOL**
- No landfill
- Demand on raw materials minimized

**Improved Vehicle Efficiency**
- Higher mileage
- Reduced CO₂

*For each 10kg mass reduction*
- 0.04 L/100km fuel saving
- 1g/CO₂/km reduction

Tailored Steel Products
- Green Products
- Green Vehicles
Think Green

- Reduced steel content = Reduced steel energy usage
- Reduced parts in assembly = Reduced manufacturing energy cost
- Reduced vehicle mass = Reduced fuel consumption and emissions

www.autosteel.org
### Tailored Steel Products Offer:

#### Mass Reduction
- Enabled by design and HSS/AHSS
- Mass compounding allows savings up to 230#/vehicle or 380# vehicle (depending on power-train choices)

#### Achievement of Crash/Safety Targets
- Use of lightweight HSS/AHSS
- Engineering design/flexibility

#### Cost Reduction/Minimization
- Blank/part design and efficient nesting optimizes material utilization

#### Achievement of Environmental Targets
- Fuel efficiency standards
- Control of GHG
- Benign EOL through recycling

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**A smart investment for future vehicles**
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Back up Slides
Volume Sensitivity

Total Unit Cost (L&R Assemblies)

Annual Production Volume (x 1,000)
Suggested Omitted Slides
In Product: Double Attached Front Rail — Monolithic Blank

Eng. Scrap: 47.6%
In Process: Double Attached Front Rail  
Same Gauge LWB

Laser welded in neutral area

Savings: $0.65
Eng. Scrap: 8%
92% Efficient
In Process: Heavy Gauge Developed Spring Hangar — Monolithic

Engineer Scrap: 28%
In Process: Heavy Gauge Developed Spring Hangar

Monolithic Blanking Process

1085.4 [42.73]

631.9 [24.88]

Engineer Scrap: 28%

Same Gauge LWB

www.autosteel.org
Front Door Inners — A/SP Lightweight Closures Project – 2002

Several Concepts — LWB’s and/or Patches

Mass Reduction
2.5 – 4.5# / 2 door
4.0 - 8.0# / 4 door
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