Remote Laser Welding of Automotive Components

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Agenda

- Van Rob Inc.
- Growth of laser welded components
- Products in production
- Manufacturing Equipment
- Dimensional stability
- Design to be stronger
- Quality systems
- Conclusions
Growth of Laser Welded Products in Van - Rob
These following slides are showing how the laser process can increase sales of different components.

Using laser welding cells to achieve very high dimensional accuracy in larger welded modules.

Weight saving is on everyone's mind.

The latest contracts have been won in tight competition against other concepts and manufacturers.
Manufacturing location Aurora
Canada started 2006
Products in Manufacturing at Present Time
Pick-up Steel Radiator Support

- GM steel Rad-Support production started in 2006
- Volume 600,000 to 1,000,000
- 6 cells with Co2 laser welding sources were used in the manufacturing systems for welding of the profiles
Laser-welded steel profiles

Inner and outer post
Upper and lower tie-bar
Inner post and outer post welding

- Uncoated material
- Material 1.0mm thick.
- HSLA material 420 mpa
Butt Welding of inner and outer post.
Seatback Manufacturing

- Seatback panels
- Volume 500,000 / year
Installations of Cross Car Beams

- Instrument panel beams
- Volume Total 580,000
Process Equipment
Layout for Current MIG Weld Program
Current Process

- Different types of mig welding cells with 2-3 robots
- Weld speeds are around 1meter / minute

1. High heat input to the part resulting in high distortion
2. Multiple fixtures
3. High amount of people
4. Based on weld access of weld torch, part has to be made in multiple steps
5. Fasteners have to be welded in sub assembly's before final welding of beam
REMOTE LASER SOURCE

- One laser source used with beam switching to service multiple weld cells
- Beam switching increases the laser utilization without significantly impacting the cycle time depending on the part
- We are using 6 kW disk lasers
- Programmable focus optic (PFO) welding head (3-D)
- Laser transmitted to head through fiber optics from laser source
- Elliptical weld envelope dictated by the offset distance from the work piece (for example: a 450 mm offset creates a 320 mm by 190 mm elliptical envelope)
Less tooling due to faster welding (each tool has more clamping units)
Less operators??
Flexible
Simple operator stations
High mobility, easy to move within the plant or to other plants
Lower capital cost
Dimensional Stability
Laser Welding Experimental Setup

Laser Welding Cell

- 10mm Gap
- Vertical Sensor
- Horizontal Sensor
- IP Tube
Experimental Sample-1

Laser welding Sample

MIG welding Sample
Laser vs. MIG Welding – Heat Distortion Comparisons

Welding Heat Distortion:
Laser: Vertical 1.3mm vs. Horizontal 0.5mm
MIG: Vertical: 3.7mm. Horizontal 0.5mm
Design to Make Stronger
A new method is developed to test real CCB weld strength quantitatively

Instron Machine Peel Test Setup
# Peel Test Comparison of Brkt I/Pnl to cowl top RH

## Welding Comparison

<table>
<thead>
<tr>
<th></th>
<th>Failure mode</th>
<th>Peel Test Force (KN)</th>
<th>Welding length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser welding</td>
<td>Raw material</td>
<td>13.68</td>
<td>2 C ( 28 mm/each )</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 U ( 21.5 mm/each )</td>
</tr>
<tr>
<td>MIG welding</td>
<td>HAZ</td>
<td>8.678</td>
<td>3 x 20mm</td>
</tr>
</tbody>
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**Laser Welding Shape:**

- 1.8 mm
Laser Welding / MIG Welding Peel Test Comparison of G/B Side Frame

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<td>5.55</td>
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**Laser Welding / MIG Welding Peel Test Comparison of G/B frame Brkt**

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<td>6.86</td>
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<td>MIG welding</td>
<td>HAZ</td>
<td>4.87</td>
<td>2 X 20mm</td>
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</table>
Lap Joints Configurations

U shape  C shape  S shape
Quality systems
QUALITY OVERVIEW:
Laser Welding Quality Analysis

Weld Watcher 4D Laser Welding Monitor

Weld watcher 4D system overview (left)

4D operator interface screen (below)
Weld Cross Section

3 key dimensions for lap joint weld:
- Penetration
- Concavity
- Width at interface

Weld strength is determined by weld width at interface of two sheets.
Conclusions
Why we are designing with laser welding

- Less weight (no weld-wire, use of thinner material possible)
- Less tooling due to faster welding
- Less operators
- Higher dimensional quality, less weld distortion
- Flexible
- Quick-change
- Simple operator stations
- High mobility, easy to move to other plants
- Lower energy consumption with higher efficiency lasers
- Lower capital cost
Designing with Laser Welding

- Weld from thin to thick
- Understand your weld joint
- Understand your GD&T
- Know your materials
- Stamping dies have to produce higher quality parts
- Ventilation
- Redundancy
- Laser lab
- Quality inspection systems
Thank You for your attention
Questions