Move to lightweight designs

NDT Challenges

T. Gethin Davies
Introduction

• Background
• Drivers for lightweighting
• Where we currently are
• Where we could be going
• The need for NDT technology
• Challenges in adopting NDT
• Summary
Background

End of Year Sales

<table>
<thead>
<tr>
<th>Year</th>
<th>Jaguar</th>
<th>Land Rover</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>54,039</td>
<td>260,394</td>
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<tr>
<td>2013</td>
<td>76,668</td>
<td>348,338</td>
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<tr>
<td>2014</td>
<td>81,570</td>
<td>381,108</td>
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<tr>
<td>2015</td>
<td>83,986</td>
<td>403,079</td>
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<tr>
<td>2016</td>
<td>148,730</td>
<td>434,583</td>
</tr>
</tbody>
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Environmental Improvement

Vehicle Downsizing
Environmental Improvement

- **Vehicle Downsizing**
- **Ingenium Engine**
- **Aluminium Body**

Graph showing CO₂ emissions from 2010 to 2020 with a trend towards lower emissions. A 99g/Km is highlighted.

Legend:
- A <100
- B 101-120
- C 121-150
- D 151-165
- E 166-185
- F 186-225
- G 226+
Currently

Mixed Metal
• D7a

Steel
• D8

Aluminium
• D7u
Currently

Mixed Material

- Mixture of Steel, Aluminium and Composite materials
- Right material – Right place
The main challenges

**Cost**
- Possibly greatest hurdle
- Very high

**Volume**
- Cycle times
- Investment in infrastructure

**Knowledge**
- Education
- Design
- Nature of Damage

60% Weight Save  
\(x8 \sim x20\) Cost

40% Weight Save  
\(x2\) Cost

30% Weight Save  
\(x4 \sim x10\) Cost
Damage in composites and avoidance in Automotive Structures
Damage in composites and avoidance in Automotive Structures
Core, Transition and Periphery

Core
- Elastic deformation only
- Heavily protected
- Difficult to repair

Transition
- Sacrificial/Energy absorbing
- Protect as necessary

Periphery
- Non or minimally structural
- Not possible to protect

Note: This is not a JLR strategy, rather an alternative conceptual approach for discussion on the topic of NDT.
Protection of Composites in a Production environment

Composite Structure delivered by Supplier

OEM randomly checks to ensure integrity (?)

Accept/Reject
Protection of Composites in a Production environment

Event

Fast scanning, quick analysis

Rapid decision on continue/replace part(s)
Protection of Composites in an After market environment

Event

Cue to Customer

Certified Body Shop assessment

Decision on Repair / Replace / No Action
Protection of Composites in an After market environment
Possible methods of assessing damage

Passive methods for notifying driver of possible damage event

- Bruising Laminates
- Embedded Sensors
- Statistical Analysis
- Self-healing Laminates

Active methods used by Certified body shops to identify and locate damage

- Woodpeckers
- UT
- Thermography
- Shearography
What the industry needs

Technology
- Fast
- Reliable
- Adaptable
- Tangible

Engagement
- Insurance industry
- Certified body shops

Training & Education
- Shifting the paradigm
- Minimum training requirements
Summary

• Where we currently are
• Where we could be going
• How we could protect composites using NDT in:
  o Manufacturing environments
  o Aftermarket environments
• What the automotive industry will need to develop
Lightweighting means incorporating composites – how do we effectively find damage?
THANK YOU

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