LASD Coatings Optimized for Damping of Aluminum Intensive Vehicle Bodies

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LASD Acoustical Coatings Technology

- **Liquid Applied Sound Damper**
- **Vehicle sound package component**
  - Mitigates structure-borne NVH issues
- **Fully automated application process**
  - Fully integrated with the paint shop cure processes
High Aluminum Vehicle Body Content - Implications

- Noise-vibration-harshness (NVH):  Sources → Paths → Receivers
  - Aluminum intensive vehicle bodies can be more than 3 dB noisier than steel bodies, with the same sound package (e.g. SAE papers 2015-01-2343, 2015-01-2302)
- Reduced weight leads to increased NVH issues at higher frequencies
- Preserved stiffness/strength at lower modulus leads to increased gage
- Sound package - mitigate NVH issues efficiently without adding weight
Aluminum vs. Steel - Substrates

Center Point Modal Testing – 1D beam (ISO 16940:2008)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Units</th>
<th>ST</th>
<th>AL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulus</td>
<td>$E$</td>
<td>GPa</td>
<td>200</td>
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<tr>
<td>Thickness</td>
<td>$t$</td>
<td>mm</td>
<td>0.8</td>
</tr>
<tr>
<td>Bending Stiffness</td>
<td>$\frac{E \cdot t^3}{12 \cdot (1 - \vartheta^2)}$</td>
<td>N•m</td>
<td>9.4</td>
</tr>
</tbody>
</table>

- Stiffness of Aluminum & steel substrates are statically matched
- Aluminum emphasizes stiffness vs. mass dynamic participations

FRF Plots

Blank Beams

Coated Beams
Stiffness ratios of AL & ST coated substrates are highly differentiated at frequencies > 300Hz

Noise & vibration transmission through Aluminum structures expected to shift at higher frequencies
Damping Performance Designed for Aluminum

- Most damping treatments designed for steel do not perform at optimum level on Aluminum at similar weight/area
- Coating optimized for Aluminum - increased damping performance
Most damping treatments designed for steel show lower damping performance at higher modal frequencies.

Coating optimized for Aluminum: increased damping above 300Hz
Panels exhibit higher modal densities vs. beams …
- BIW is a complex multi-panels & multi-beams assembled structure, and ….

Resonance frequencies of Aluminum structures are shifted higher, while …
- Coincidence frequencies for Aluminum panels < 8-9 kHz
LASD coated panels show high damping above 500Hz vs. CLD steel

LASD performs optimally in higher modal densities structures (i.e. BIW) and at frequencies >500Hz
Panels with higher damping consistently produce lower noise
Concluding Remarks

- **Aluminum BIW changes NVH transmission path significantly**
  - Aluminum substrates shift structural resonances at higher frequencies vs. steel substrates at similar stiffness

- **Damping treatment products designed for steel substrates do not perform optimally on Aluminum**

- **LASD optimized for Aluminum:**
  - Higher damping performance on Aluminum compared to steel
  - Higher damping at higher frequencies (>300 Hz)
  - Good damping performance in high modal densities structures (e.g. panels, BIW)
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