Nighttime Visibility of Wet Reflective Pavement Markings
What Do You Prefer When Driving Home Tonight?
Figure 3.8
Scores for ‘visibility of markings on the road surface’
Role of Pavement Markings

- Visual Guidance
- Traffic Regulation
- Traffic Management
Good Day & Nighttime Performance
Good Day & Nighttime Performance
Durability  Germany BASt Turntable
Durability

Testdeck France
Benefit of High Performing and Durable PM over Time: *Cost Saving & Safety Improvement*
Human Factors Study: Wet Night Retroreflectivity

- **Objective**
  - Evaluate nighttime visibility of different pavement markings
  - Dynamic driving and under different weather conditions
  - Aging population: 30 participants (aging 55 to 80 – Av 69)

- **Project Partners**
    [http://www.fhwa.dot.gov/hfl/partnerships/3m.cfm](http://www.fhwa.dot.gov/hfl/partnerships/3m.cfm)
  - Texas Transportation Institute
  - 3M USA, TSS, StPaul, MN
Human Factors Study : Wet Night Retroreflectivity

Approach :

1. **Pre-screening of 22 prototype all-weather pavement markings systems** (New Orleans test deck)
   - Formulations:
     - Paint (wet) thickness (15-20-25 mils)
     - Glass beads R.I. 1.5 (12 g/lin ft)
     - 3M™ All-Weather elements (size, ratio, drop rate: 4-8-12 g/lin ft)
   - Performance characteristics in dry, wet and rainy conditions
   - Durability

2. **Human Factors study at Texas Transportation Institute Riverside track**
   - 3 best prototypes + 2 controls (1 X standard beads, 1 X All Weather Tape)
   - Different weather conditions: dry, wet (ASTM E2177) and rain.(EN 1436)
Liquid Pavement Marking Systems Tested

Ceramic Elements with 1.9 & 2.4 Index

Traditional Glass Beads
Human Factors Study: Wet Night Retroreflectivity
Human Factors Study: Wet Night Retroreflectivity

Figure 5. View of completed New Orleans test deck installation
Human Factors Study: Wet Night Retroreflectivity

Figure 6. EN 1436 rain simulator
Human Factors Study: Wet Night Retroreflectivity

<table>
<thead>
<tr>
<th>Marking</th>
<th>Binder</th>
<th>Wet Film thickness</th>
<th>Optics</th>
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</thead>
<tbody>
<tr>
<td>Prototype A</td>
<td>high-build waterborne paint</td>
<td>20</td>
<td>3M Series 90S high refractive index dual-optics drop-on elements (4g/lineal ft drop rate) in combination with MODOT Type P Drop-on 1.5 index Glass Beads (12g/lineal ft)</td>
</tr>
<tr>
<td>Prototype B</td>
<td>high-build waterborne paint</td>
<td>20</td>
<td>3M Series 90S high refractive index dual-optics drop-on elements (8g/lineal ft drop rate) in combination with MODOT Type P Drop-on 1.5 Glass Beads (12g/lineal ft)</td>
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<tr>
<td>Prototype C</td>
<td>high-build waterborne paint</td>
<td>25</td>
<td>3M Series 90 high refractive index dual-optics drop-on elements (8g/lineal ft drop rate) in combination AASHTO M247 Type 1 Drop-on 1.5 index Glass Beads (12g/lineal ft)</td>
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<tr>
<td>Benchmark 1</td>
<td>high-build waterborne paint</td>
<td>15 mil</td>
<td>AASHTO M247 Type 1 Drop-on 1.5 index Glass Beads (12g/lineal ft)</td>
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<tr>
<td>Benchmark 2</td>
<td>Removable Preformed wet-reflective structured tape</td>
<td>NA</td>
<td>Specially designed optics to provide high retroreflective efficiency in dry and wet conditions</td>
</tr>
</tbody>
</table>
Human Factors Study: Wet Night Retroreflectivity
Human Factors Study: Wet Night Retroreflectivity

Coefficient of Retroreflected Luminance (mcd.lux\(^{-1}\).m\(^{-2}\))

<table>
<thead>
<tr>
<th>Weather Condition</th>
<th>Statistic</th>
<th>Prototypes</th>
<th>Benchmarks</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Dry (per ASTM E1710)</td>
<td>Mean</td>
<td>520</td>
<td>547</td>
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<tr>
<td></td>
<td>Stdev</td>
<td>67</td>
<td>44</td>
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<tr>
<td>(average change from 4/28/2008 to 5/20/2008)</td>
<td></td>
<td>0%</td>
<td>-4%</td>
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<tr>
<td>Wet recovery (per ASTM E2177; 45 sec recovery)</td>
<td>Avg</td>
<td>628</td>
<td>545</td>
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<tr>
<td></td>
<td>Stdev</td>
<td>178</td>
<td>139</td>
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<tr>
<td>Rain (per EN 1436; 5 min rain @ 0.8 in/hr)</td>
<td>Avg</td>
<td>520</td>
<td>433</td>
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<tr>
<td></td>
<td>Stdev</td>
<td>198</td>
<td>94</td>
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Human Factors Study: Wet Night Retroreflectivity
# Human Factors Study: Wet Night Retroreflectivity

<table>
<thead>
<tr>
<th>Environmental Condition</th>
<th>Marking System</th>
<th>No Response</th>
<th>Belated Response (after vehicle had passed marking)</th>
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<tbody>
<tr>
<td>Wet recovery</td>
<td>C</td>
<td>1</td>
<td>1</td>
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<tr>
<td></td>
<td>Benchmark 1 (conventional paint and beads)</td>
<td>15</td>
<td>7</td>
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<tr>
<td>Rain</td>
<td>A</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Benchmark 1</td>
<td>38</td>
<td>16</td>
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</tbody>
</table>
Practical Solutions with “Wet Reflective” Pavement Marking
Practical Solutions with “Wet Reflective” Pavement Marking
Practical Solutions with “Wet Reflective” Pavement Marking
Construction Work Zones with Temporary Markings

- Fast and easily applicable
- Conspicuous (safe guidance)
- Daytime visibility
- Nighttime visibility
- Durable up to several months for high traffic loads
- Removable without leaving traces
Construction Work Zones with Temporary Markings
Thank You

Nighttime Visibility of Wet Reflective Pavement Markings

www.irf2010.com