Implementation of the MSCR Test and Specification: Questions, Clarifications, and Emphasis

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• Acknowledgments
  • Federal Highway Administration
      • Michael Arasteh, AOTR
      • John Bukowski, Tom Harman, Matt Corrigan, Jeff Withee, Tim Aschenbrener, Jason Dietz
  • Member Companies of the Asphalt Institute
    • Technical Advisory Committee
• MSCR Test
  • AASHTO T350

• Performance-Graded (PG) Specification using MSCR
  • AASHTO M332

• Practice for Evaluating the Elastic Behavior of Asphalt Binders Using the MSCR Test
  • Draft practice submitted to AASHTO SOM
Implementation of the MSCR Test and Specification

• Concerns/Questions/Challenges
  • Inconsistent implementation by specifying agencies
  • Grade names in AASHTO M332
  • Variability of MSCR test
  • Selection of appropriate test temperature
  • Leadership/champion
  • Use of recovery-Jnr curve for evaluating elastic response
• Concerns/Questions/Challenges
  • Use and relevance of Jnr-Diff as a specification requirement
  • Use and criterion for intermediate temperature binder parameter (G*sin δ)
  • Criterion for unmodified asphalt binders (“S” grades)
  • Original DSR criterion
  • Quick QC testing on original binder
• Use of recovery-Jnr curve for evaluating elastic response
  • Some agencies are using the curve as-is
  • Some agencies are specifying a minimum Rec-3.2 value
    • Kentucky has a requirement of Rec-3.2 \(\geq 60\%\) for their PG 76-22 asphalt binders (M320) when tested at 64°C
      • Replaces ER
  • Rec-3.2 is determining factor
  • Is curve even needed?
    • Replacement for PG Plus Tests
    • Maximum phase angle
• Use of recovery-Jnr curve for evaluating elastic response
  • D’Angelo Thesis
    • “A minimum MSCR %Recovery of somewhere between 20% and 40% would be a good indication of an effective polymer network in the binder. This range is based on the large increase in %Recovery seen between 2% SBS blend without cross-linker to 2% SBS blend with cross-linker.”
    • “The %Recovery should also be tied to the Jnr value for the binder.”
      • “To assure the %Recovery response is primarily from the polymer network and not from just a stiffening of the base binder, the minimum %Recovery should be increased as the Jnr value of the binder decreases.”
Implementation of the MSCR Test and Specification

- Use of recovery-Jnr curve for evaluating elastic response
  - D’Angelo Thesis

Figure 5.7: Plot of MSCR $J_{wr}$ @ 3.2 kPa$^{-1}$ and MSCR % Recovery for Six Typical Polymer Modified Binders Over Multiple Temperatures From the MTE Polymer Study.
• Use of recovery-Jnr curve for evaluating elastic response

\[ y = -64.872x^2 + 194.09x - 59.72 \]

\[ R^2 = 0.9946 \]
Implementation of the MSCR Test and Specification

- Use of recovery-Jnr curve for evaluating elastic response
• Use of recovery-Jnr curve for evaluating elastic response
• Selection of appropriate test temperature
  • “Standard” environmental temperature
    • Selection of environmental temperature based on LTPPBind 3.1
    • Guidance on the appropriate assumptions needed
      • Similar to AMPT Flow Number
    • Locations that choose “standard” temperature that is different than environmental temperature
      • e.g., choosing 64°C when LTPPBind would suggest that the climate is 58°C
  • Southeastern states that use 67°C as standard temperature
• Selection of appropriate test temperature
  • Standard environmental temperature with grade bumping (higher traffic)

• Standard environmental temperature with grade dumping (RAP and RAS use)
  • Use of a softer grade due to RAP and/or RAS use
  • What temperature for testing?
    • i.e., PG 58-28 is used in a RAP-RAS mix in a 64°C climate
    • Test the PG 58-28 at environmental temperature (64°C)? If so what grade would this be (“R”?) Or test as PG 58S-28 (at 58°C)?
• Original DSR Criterion
  • Testing at environmental temperature with no change in criterion
  • H, V, and E grades will easily meet criterion at environmental grade
    • $G^*/\sin \delta \geq 1.00 \text{ kPa}$
Implementation of the MSCR Test and Specification

• Criterion for unmodified asphalt binders ("S" grades)
  • Original criterion was $J_{nr}$ at 3.2 kPa shear stress ($J_{nr}$-3.2) ≤ 4.0 kPa$^{-1}$
  • Changed to ≤ 4.5 kPa$^{-1}$ based on recommendation from Asphalt Binder ETG
    • Asphalt Institute report dated 26 April 2013
    • Presentation at Asphalt Binder ETG Meeting in May 2013 (Raleigh, NC)
  • Concern that change still allows some currently acceptable unmodified asphalt binders (M320) to fail M332.
Implementation of the MSCR Test and Specification

- Criterion for unmodified asphalt binders ("S" grades)

Table 15: Calculated Values of Jnr-3.2 at AASHTO T315 $T_c$ and G*/sin $\delta$ at AASHTO TP70 $T_c$

<table>
<thead>
<tr>
<th>Jnr-3.2 at AASHTO T315 $T_c$ (where G*/sin $\delta$ = 2.20 kPa)</th>
<th>Figure 1 (Source A, PG 64-22)</th>
<th>Figure 2 (AI Miscellaneous)</th>
<th>Figure 4 (SHRP MRL)</th>
<th>Figure 31 (SHRP MRL, Multiple Labs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.70 kPa$^{-1}$</td>
<td>4.65 kPa$^{-1}$</td>
<td>4.52 kPa$^{-1}$</td>
<td>4.65 kPa$^{-1}$</td>
</tr>
<tr>
<td>G*/sin $\delta$ at AASHTO TP70 $T_c$ (where Jnr-3.2 = 4.00 kPa$^{-1}$)</td>
<td>2.53 kPa</td>
<td>2.52 kPa</td>
<td>2.46 kPa</td>
<td>2.52 kPa</td>
</tr>
<tr>
<td>G*/sin $\delta$ at T350 $T_c$ (where Jnr-3.2 = 4.50 kPa$^{-1}$)</td>
<td>2.285 kPa</td>
<td>2.267 kPa</td>
<td>2.209 kPa</td>
<td>2.267 kPa</td>
</tr>
</tbody>
</table>
Implementation of the MSCR Test and Specification

• Use and relevance of Jnr-Diff as a specification requirement
  • Indicative of stress-sensitive binders
  • Problem for some current formulations
  • Not a problem for the majority of modified binders
  • Is it needed?
Implementation of the MSCR Test and Specification

- Use and relevance of Jnr-Diff as a specification requirement

<table>
<thead>
<tr>
<th>ID</th>
<th>Grade</th>
<th>Temp. (°C)</th>
<th>Jnr-3.2 (kPa⁻¹)</th>
<th>Rec-3.2 (%)</th>
<th>Jnr-Diff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>PG 76-28</td>
<td>64</td>
<td>0.748</td>
<td>32.6</td>
<td>1157</td>
</tr>
<tr>
<td>B</td>
<td>PG 70-22ER</td>
<td>64</td>
<td>0.311</td>
<td>59.7</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>PG 64-28NV</td>
<td>58</td>
<td>0.448</td>
<td>57.2</td>
<td>42</td>
</tr>
<tr>
<td>D</td>
<td>PG 64-28PM</td>
<td>58</td>
<td>0.227</td>
<td>73.1</td>
<td>14</td>
</tr>
<tr>
<td>E</td>
<td>PG 58-34PM</td>
<td>58</td>
<td>0.532</td>
<td>79.0</td>
<td>38</td>
</tr>
</tbody>
</table>
• Use and relevance of Jnr-Diff as a specification requirement

The curve stops at Jnr-3.2 = 2.00 kPa⁻¹ and 0.1 kPa⁻¹. Jnr-3.2 values greater than 2.00 kPa⁻¹ are not required to have any minimum Rec-3.2 value. Jnr-3.2 values less than 0.10 kPa⁻¹ are required to have a minimum Rec-3.2 value of 55%.
• Use and relevance of Jnr-Diff as a specification requirement

![Graph showing AMRL PSP with Rec-3.2, % on the y-axis and ER, % on the x-axis.](image-url)
• Use and relevance of Jnr-Diff as a specification requirement

![Graph showing AMRL PSP with data points labeled Jnr-Diff = 22%, Jnr-Diff = 51%, Jnr-Diff = 164%]
• Use and relevance of Jnr-Diff as a specification requirement
  • Experiment using PCCAS ILS Binders
    • Binder A
      • PG 76-28
      • Jnr-3.2 = 0.748 kPa$^{-1}$ at 64°C
      • Rec-3.2 = 32.6% at 64°C
      • Jnr-Diff = 1157% at 64°C
    • Binder C
      • PG 64-28NV
      • Jnr-3.2 = 0.448 kPa$^{-1}$ at 58°C
      • Rec-3.2 = 57.2% at 58°C
      • Jnr-Diff = 42% at 58°C
• Use and relevance of Jnr-Diff as a specification requirement
  • Experiment using PCCAS ILS Binders
    • AI lab standard 9.5mm NMAS mixture
    • 5.4% AC using asphalt binders "A" and "C"
    • Loose mix conditioning for 4 hours at 135°C
    • Compacted using SGC to achieve a final air voids content of 7.0 ± 0.5 percent.
  • Tested using AMPT Flow Number test
    • Temperature of 54 and 58°C
    • Deviator stress of 600kPa
    • Seating load (contact stress) of 30kPa
    • Flow Number reported using a Franken Model fit
• Use and relevance of Jnr-Diff as a specification requirement
Implementation of the MSCR Test and Specification

- Use and relevance of Jnr-Diff as a specification requirement
• Variability of MSCR test
  • Continued expressed concerns about variability in Jnr and Rec
• WCTG Data Set
  • Higher test temperature
  • Higher applied shear stress
• Variability of MSCR test
• WCTG Data Set

<table>
<thead>
<tr>
<th>Test</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Average</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductility, Unaged</td>
<td>21.8%</td>
<td>6.3%</td>
<td>11.8%</td>
<td>10.8%</td>
</tr>
<tr>
<td>Ductility, RTFO</td>
<td>17.4%</td>
<td>8.2%</td>
<td>13.9%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Toughness, Unaged</td>
<td>23.6%</td>
<td>4.6%</td>
<td>14.9%</td>
<td>14.9%</td>
</tr>
<tr>
<td>Tenacity, Unaged</td>
<td>49.0%</td>
<td>8.9%</td>
<td>21.9%</td>
<td>17.9%</td>
</tr>
<tr>
<td>Jnr, 3.2 kPa @ PG Temp.</td>
<td>57.0%</td>
<td>5.2%</td>
<td>27.5%</td>
<td>29.1%</td>
</tr>
<tr>
<td>Jnr, 3.2 kPa @ PG - 6 °C Temp.</td>
<td>51.1%</td>
<td>6.9%</td>
<td>24.3%</td>
<td>23.9%</td>
</tr>
<tr>
<td>Jnr, 10 kPa @ PG Temp.</td>
<td>878.4%</td>
<td>52.0%</td>
<td>137.1%</td>
<td>78.7%</td>
</tr>
<tr>
<td>Jnr, 10 kPa @ PG - 6 °C Temp.</td>
<td>237.3%</td>
<td>54.0%</td>
<td>92.8%</td>
<td>77.6%</td>
</tr>
<tr>
<td>% Rec, 3.2 kPa @ PG Temp.</td>
<td>58.4%</td>
<td>2.7%</td>
<td>13.8%</td>
<td>6.7%</td>
</tr>
<tr>
<td>% Rec, 3.2 kPa @ PG - 6 °C Temp.</td>
<td>18.8%</td>
<td>0.8%</td>
<td>7.2%</td>
<td>3.9%</td>
</tr>
<tr>
<td>% Rec, 10 kPa @ PG Temp.</td>
<td>86.5%</td>
<td>12.1%</td>
<td>39.1%</td>
<td>35.1%</td>
</tr>
<tr>
<td>% Rec, 10 kPa @ PG - 6 °C Temp.</td>
<td>55.4%</td>
<td>5.6%</td>
<td>22.1%</td>
<td>20.6%</td>
</tr>
<tr>
<td>% Elastic Recovery, 25 °C</td>
<td>5.9%</td>
<td>1.0%</td>
<td>2.5%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Maximum</td>
<td>878.4%</td>
<td>54.0%</td>
<td>137.1%</td>
<td>78.7%</td>
</tr>
<tr>
<td>Minimum</td>
<td>5.9%</td>
<td>0.8%</td>
<td>2.5%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>
Implementation of the MSCR Test and Specification

• Variability of MSCR test
• WCTG Data Set

<table>
<thead>
<tr>
<th>COV Comparison of Superpave PG Plus Tests, 2010-2011 samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
</tr>
<tr>
<td>Ductility, Unaged</td>
</tr>
<tr>
<td>Ductility, RTFO</td>
</tr>
<tr>
<td>Toughness, Unaged</td>
</tr>
<tr>
<td>Tenacity, Unaged</td>
</tr>
<tr>
<td>Jnr, 3.2 kPa @ PG Temp.</td>
</tr>
<tr>
<td>Jnr, 3.2 kPa @ PG - 6 °C Temp.</td>
</tr>
<tr>
<td>Jnr, 10 kPa @ PG Temp.</td>
</tr>
<tr>
<td>Jnr, 10 kPa @ PG - 6 °C Temp.</td>
</tr>
<tr>
<td>% Rec, 3.2 kPa @ PG Temp.</td>
</tr>
<tr>
<td>% Rec, 3.2 kPa @ PG - 6 °C Temp.</td>
</tr>
<tr>
<td>% Rec, 10 kPa @ PG Temp.</td>
</tr>
<tr>
<td>% Rec, 10 kPa @ PG - 6 °C Temp.</td>
</tr>
<tr>
<td>% Elastic Recovery, 25 °C</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
<tr>
<td>Minimum</td>
</tr>
</tbody>
</table>
• Variability of MSCR test
  • AI-Coordinated ILS
    • d2s% shown for between lab (reproducibility)

<table>
<thead>
<tr>
<th>ILS</th>
<th>Multi-Lab Rec-3.2</th>
<th>Multi-Lab Jnr-3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETG 2009</td>
<td>18.1%</td>
<td>22.0-42.6%</td>
</tr>
<tr>
<td>NEAUPG 2010</td>
<td>18.7%</td>
<td>33.7%</td>
</tr>
<tr>
<td>SEAUPG 2011</td>
<td>9.8%</td>
<td>28.0%</td>
</tr>
<tr>
<td>NEAUPG 2012</td>
<td>7.6%</td>
<td>33.0%</td>
</tr>
<tr>
<td>PCCAS 2013</td>
<td>13.8%</td>
<td>36.8%</td>
</tr>
</tbody>
</table>
• Variability of MSCR test
  • AMRL PSP
• Variability of MSCR test
• AMRL PSP
• Variability of MSCR test
  • AMRL PSP
Implementation of the MSCR Test and Specification

- Variability of MSCR test
  - PCCAS ILS (2013)

### Table 20: Estimated Repeatability and Reproducibility from ILS

<table>
<thead>
<tr>
<th>Test</th>
<th>Acceptable Range of Two Test Results (d25%)</th>
<th>2013 PCCAS ILS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Operator Precision</td>
<td>Multilaboratory Precision</td>
</tr>
<tr>
<td>Elastic Recovery (RTFO) at 25°C</td>
<td>5.6%</td>
<td>9.2%</td>
</tr>
<tr>
<td>R&amp;B Softening Point</td>
<td>2.8%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Ductility (Original) at 4°C</td>
<td>17.9%</td>
<td>75.0%</td>
</tr>
<tr>
<td>Ductility (RTFO) at 4°C</td>
<td>19.5%</td>
<td>95.1%</td>
</tr>
<tr>
<td>Toughness at 25°C</td>
<td>15.3%</td>
<td>29.1%</td>
</tr>
<tr>
<td>Tenacity at 25°C</td>
<td>17.9%</td>
<td>30.0%</td>
</tr>
</tbody>
</table>

MSCR Rec-3.2  8.0%  17.3%
• Use and criterion for intermediate temperature binder parameter \((G\times\sin\delta)\)
  • Not specifically a concern with MSCR
    • Use of \(G\times\sin\delta\) as intermediate parameter
    • Change to environmental temperature makes matters worse
      • PG 76-22 would be tested at 31°C and \(G\times\sin\delta\) would have to be \(\leq 5000\) kPa
      • PG 64V-22 would be tested at 25°C and \(G\times\sin\delta\) would have to be \(\leq 6000\) kPa
  • Shouldn’t criterion change for each grade (H,V, and E)?
• Use and criterion for intermediate temperature binder parameter (G*\sin \delta)

For PG 76-22 Grades

- Maximum slope = -0.066
- Maximum slope = -0.075
- 2.2 kPa
- 5000 kPa
- 76°C
- 31°C
- 25°C
Effect of Intermediate Temperature on Temp. Susceptibility: PG xx-22 Binders

![Graph showing the relationship between temperature and G*sin δ (G''), kPa. The graph includes three lines with maximum slopes of -0.075, -0.080, and -0.086. The temperatures at 31, 28, and 25 degrees Celsius are indicated with vertical lines.](image)
Effect of Intermediate Temperature on Temp. Susceptibility: M320 and M332

PG 70-22 and PG 64H-22

\[ G' + \sin \delta \] (kPa)

\[ \text{Temperature, } ^\circ\text{C} \]

Maximum slope = -0.08

Maximum slope = -0.078
Effect of Intermediate Temperature on Temperature Susceptibility

PG 70-22 and PG 64H-22

G* sin δ (G''), kPa

Temperature, C

Maximum slope = -0.080

Maximum slope = -0.080
Effect of Intermediate Temperature on Temperature Susceptibility

PG 76-22 and PG 64V-22

\[ G'\sin\delta (G''), \text{ kPa} \]

Temperature, C

\[ G'\sin\delta (G''), \text{ kPa} \]

Temperature, C

Maximum slope = -0.075

Maximum slope = -0.071
Effect of Intermediate Temperature on Temperature Susceptibility

PG 76-22 and PG 64V-22

G*\sin \delta (G''), kPa

<table>
<thead>
<tr>
<th>Temperature, C</th>
<th>G*\sin \delta (G''), kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>2.2</td>
</tr>
<tr>
<td>70</td>
<td>4.4</td>
</tr>
<tr>
<td>64</td>
<td>8.8</td>
</tr>
<tr>
<td>31</td>
<td>Maximum slope = -0.075</td>
</tr>
<tr>
<td>28</td>
<td>Maximum slope = -0.073</td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>
Effect of Intermediate Temperature on Temperature Susceptibility

PG 76-22 and PG 64V-22

Temperature, C

G* sin δ (G''), kPa

76 70 64 31 28 25

7136 6000 5000 76 64 28

2.2 4.4 8.8

Maximum slope = -0.075  Maximum slope = -0.075
Effect of Intermediate Temperature on Temperature Susceptibility

**PG 76-22 and PG 64V-22**

- Assumes $\delta=60$ degrees

**Graph Details:**
- **$G\sin\delta (G'')$, kPa**
  - 7136
  - 6000
  - 5000
  - 8.8
  - 4.4
  - 2.2

**Temperature, C**
- 76
- 70
- 64
- 31
- 28
- 25

**Slopes:**
- Maximum slope = -0.075
- Maximum slope = 0.076

**Equations:**
- $PG_{76-22} - 22$
- $PG_{64V-22} - 22$
Effect of Intermediate Temperature on Temperature Susceptibility

PG 82-22 and PG 64E-22

Temperature, C

G*sin δ (G''), kPa

Maximum slope = -0.070

Maximum slope = -0.063
Effect of Intermediate Temperature on Temperature Susceptibility

PG 82-22 and PG 64E-22

Temperature, C

G*sin δ (G''), kPa

Maximum slope = -0.070

Maximum slope = -0.070
### Effect of Intermediate Temperature on Temperature Susceptibility

**Table:**

<table>
<thead>
<tr>
<th>G*δ (G''), kPa</th>
<th>Temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>82</td>
</tr>
<tr>
<td>4.4</td>
<td>76</td>
</tr>
<tr>
<td>8.8</td>
<td>70</td>
</tr>
<tr>
<td>17.6</td>
<td>64</td>
</tr>
<tr>
<td>5000</td>
<td>34</td>
</tr>
<tr>
<td>8200</td>
<td>31</td>
</tr>
<tr>
<td>10.3</td>
<td>28</td>
</tr>
<tr>
<td>9391</td>
<td>25</td>
</tr>
</tbody>
</table>

**Graph:**

- **PG 82-22 and PG 64E-22**
- Assumes δ = 50 degrees
- Maximum slope = -0.070
- Maximum slope = -0.071

**Notes:**

- Assumes δ = 50 degrees
- PG 82-22 and PG 64E-22 are asphalt pavement grades.
## Effect of Intermediate Temperature on Temperature Susceptibility

<table>
<thead>
<tr>
<th>M332 Grade</th>
<th>M332 Spec</th>
<th>Equal G-T Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>5000 kPa</td>
<td>5000 kPa</td>
</tr>
<tr>
<td>H</td>
<td>6000 kPa</td>
<td>5758 kPa</td>
</tr>
<tr>
<td>V</td>
<td>6000 kPa</td>
<td>7136 kPa</td>
</tr>
<tr>
<td>E</td>
<td>6000 kPa</td>
<td>9391 kPa</td>
</tr>
</tbody>
</table>
## Effect of Intermediate Temperature on Temperature Susceptibility

<table>
<thead>
<tr>
<th>M332 Grade</th>
<th>Assume $\delta \approx 90^\circ$ at HT</th>
<th>w/ consideration of $\delta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>5000 kPa</td>
<td>5000 kPa</td>
</tr>
<tr>
<td>H</td>
<td>5758 kPa</td>
<td>5084 kPa</td>
</tr>
<tr>
<td>V</td>
<td>7136 kPa</td>
<td>5352 kPa</td>
</tr>
<tr>
<td>E</td>
<td>9391 kPa</td>
<td>5510 kPa</td>
</tr>
</tbody>
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## Effect of Intermediate Temperature on Temperature Susceptibility

<table>
<thead>
<tr>
<th>M332 Grade</th>
<th>Assume $\delta \approx 90^\circ$ at HT</th>
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<td>5000 kPa</td>
</tr>
<tr>
<td>H</td>
<td>5758 kPa</td>
<td>5084 kPa $70^\circ$</td>
</tr>
<tr>
<td>V</td>
<td>7136 kPa</td>
<td>5352 kPa $60^\circ$</td>
</tr>
<tr>
<td>E</td>
<td>9391 kPa</td>
<td>5510 kPa $50^\circ$</td>
</tr>
</tbody>
</table>
• Use and criterion for intermediate temperature binder parameter \((G\sin \delta)\)
  • Not specifically a concern with MSCR
    • Change to environmental temperature makes matters worse
      • PG 76-22 would be tested at 31°C and \(G\sin \delta\) would have to be \(\leq 5000\) kPa
      • PG 64V-22 would be tested at 25°C and \(G\sin \delta\) would have to be \(\leq 6000\) kPa
    • Shouldn’t criterion change for each grade (H, V, and E)?

Current M332 specification appears reasonable. Could still make an argument that a sliding scale is needed...

\[
H=5500 \text{ kPa} \quad V=6000 \text{ kPa} \quad E=6500 \text{ kPa}
\]
• Quick QC Testing on Original Binder
  • Terminal labs may not have RTFO oven
  • Need to validate presence of modifier and verify grade before shipping
  • MSCR testing on original binder?
  • Use of phase angle as surrogate?
Implementation of the MSCR Test and Specification

• Grade names in AASHTO M332
  • Acceptance of letter designation for traffic
  • Need high temperature (environmental) as part of the grade name to know appropriate test temperature
• PG designation is still appropriate
  • Still a Performance Graded asphalt binder
    • Even more so since Jnr is better correlated to rutting distress than $G^*/\sin \delta$ for both modified and unmodified binders
• Education for Designers, truck drivers
• Confusion of E and V (similar sounds) when ordering
  • Consider “X” instead of “E”?
• Inconsistent implementation by specifying agencies
  • We don’t have a rutting problem so why do we need a better high temperature parameter?
  • Every M320 grade may not equate to a distinct M332 grade
    • the current polymer loading in a PG 70-22 and PG 76-22 may be high enough that both grade to a PG 64V-22
• MTE Rutting Study: Hamburg WI E10 Fine Mix

<table>
<thead>
<tr>
<th>PG Grade (M320)</th>
<th>PG Grade (MP19)</th>
<th>Test Temp, C</th>
<th>Jnr-3.2 at Test Temp, kPa⁻¹</th>
<th>Rec-3.2, %</th>
<th>HWT Rut Depth at 10,000 Passes, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-22</td>
<td>n/a</td>
<td>75</td>
<td>5.74</td>
<td>0.5</td>
<td>13.2</td>
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<tr>
<td>64-22</td>
<td>64-22S</td>
<td>64</td>
<td>3.40</td>
<td>3.4</td>
<td>7.1</td>
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<td>70-22</td>
<td>70-22S</td>
<td>70</td>
<td>2.92</td>
<td>1.5</td>
<td>5.1</td>
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<tr>
<td>70-22</td>
<td>64-22H</td>
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<td>1.35</td>
<td>4.4</td>
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<tr>
<td>76-22</td>
<td>64-22E</td>
<td>64</td>
<td>0.24</td>
<td>55.8</td>
<td>1.7</td>
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<tr>
<td>82-22</td>
<td>64-22E</td>
<td>64</td>
<td>0.08</td>
<td>78.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Leadership/champion

Implementation belongs to everyone

PG system had leaders in all areas

Researchers

Dr. Tom Kennedy, A-001 Research Program Leader

Users

FHWA (implementation funding and technology transfer)

Lead States

Industry

Expert Task Group

Suppliers

Need leaders in user agencies, industry
• Suggestions for Path Forward
  • Need to repackage message
    • What should have been done as PG system was implemented was to change high temperature criterion as grade was bumped (due to traffic)
    • Need to change criterion rather than test temperature
    • Recognize that this is a major specification change instead of just focusing on MSCR as a new test
      • Truer to concept of a performance-based specification
      • Next step in evolution of specification
92nd AAPT Annual Meeting and Technical Sessions

The 2017 Annual Meeting will be held March 19-22, 2017
The Island Hotel, Newport Beach, California USA

2017 Call for Papers

The Association of Asphalt Paving Technologists is actively soliciting paper offers for its 2017 Annual Meeting and Technical Sessions. Papers reporting on studies concerning any aspect of asphalt paving technology or related fields are considered. These can include research, design, construction and maintenance issues dealing with all types of asphalt binders, asphalt mixtures, and pavement applications – including innovative ideas and improvements to current practice. Papers will be considered for presentation at the Annual Meeting which is attended by specialists from academia, research organizations, material producers, contractors, national and state authorities, and consultants from around the world. Papers offered for the 2017 Annual Meeting must be submitted through the AAPT website.

Important dates

May 1, 2016 web site open for paper submission
August 15, 2016 - deadline for submitting papers
November 4, 2016 - notification of paper acceptance
December 2016 - registration open
March 19 to 22, 2017 - annual meeting and technical sessions

For current information please check our web site at: http://www.asphalttechnology.org
Thanks!