Asphalt Expert Task Group Update

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U.S. DOT | Federal Highway Administration
Asset Management, Pavement, and Construction
October 2014
Asphalt Expert Task Groups

- Forum for Government, Industry, and Academia
- Discussion of ongoing asphalt binder and mixture technology
- Provide technical input for current and future research, development, and specifications.
Asphalt Expert Task Groups

• Asphalt Mixture & Construction ETG
  • LTRC Baton Rouge, September 17-19, 2014

• Asphalt Binder ETG
  • LTRC Baton Rouge, September 16-17, 2014

• Warm Mix Asphalt TWG (complete)

• High RAP/RAS ETG (complete)

• Pavement Sustainability TWG
Asphalt Mixture ETG - Activities

- Asphalt Mixture Performance Tester (AMPT)
  — FHWA Transportation Pooled Fund (TPF)
- RAP & RAS
  Asphalt Binder Replacement
- WMA
- Provide technical input to AASHTO Subcommittee on Materials (SOM) Revise and Update AASHTO Standards
- GTR
- REOB
- Hamburg Wheel Track Testing
Asphalt Mix Performance Tester (AMPT)

- Refined under NCHRP 9-29
- Results used for PavementME Design inputs
- Dynamic Modulus $|E^*|$ and Flow (Fn)
- AASHTO Standards: PP 60, TP 79, PP 61
- TP 79 Flow number standardization
- Specimen air void tolerance
- New: Fatigue testing protocols

www fhwa dot gov pavement asphalt tester cfm
Implementation of the Asphalt Mixture Performance Tester (AMPT) for Superpave Validation

- Nationally procure AMPT equipment
- Provide training for technicians and engineers
- Support national implementation

www.pooledfund.org/Details/Study/405
AMPT Equipment

• AMPTs Delivered
  o 2010: 4
  o 2011: 9
  o 2012: 12
  o 2013: 2

• AMPTs on Order
  o 2014: 1

• Supplemental Equipment List
  o NHI 131118 Participant Workbook Appendix F
AMPT Operator Training

- NHI #131118
  Asphalt Mixture Performance Tester (AMPT)
- Classroom Instruction
  - Theory
  - Data Evaluation
- Sample Preparation Video
- Hands-on Experience
  - Sample Evaluation
  - Test Procedures
  - Equipment Operation
Interlaboratory Study (ILS)

- Compare results
- Build testing proficiency
  - 22 participating labs
- Compare to NCHRP 9-29 ILS precision
- Build dataset for evaluating a larger specimen air void tolerance of > ±0.5%
- Dynamic Modulus
- Flow Number
- Final Report – NCAT 14-01
Specimen Preparation Study

- NCHRP 9-29 ILS Finding
  - Specimen preparation → significant test variability
- Ruggedness on Specimen Fabrication - PP60
- Example Factors
  - Mixture conditioning
  - Mixing time / temperature
  - Gyratory specimen height
  - Air voids
- Evaluation by Dynamic Modulus Testing
- Asphalt Institute (AI) & Advanced Asphalt Technologies (AAT)
Silicone Friction Reducer Study

- **TP 79 – Annex A**
  - Required for Flow Number testing
  - Paste silicone grease

- **Study Parameters**
  - Flow Number testing
  - Silicone spray/grease types (3)
  - Application rates (2)
  - Dynamic Modulus checks

- **Evaluation of:**
  - Test result variability
  - Fabrication practicality

- **NCAT**
AMPT Flow Number standardization

Published as Appendix within AASHTO TP 79-13

X1. EVALUATE RUTTING RESISTANCE USING THE FLOW NUMBER TEST

X1.1 Scope:

X1.1.1 This procedure establishes a method to evaluate the rutting resistance of asphalt paving mixtures using the TP 79, Flow Number test in the AMPT.

X1.2 Procedure:

X1.2.1 Input the test parameters listed in Table X1.2.1 into the AMPT control software for the Flow Number test.

Table X1.2.1 – TP 79 Flow Number Test Conditions

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>HMA</th>
<th>WMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Temperature</td>
<td>1-</td>
<td>1-</td>
</tr>
<tr>
<td>Deviator Stress</td>
<td>87 psi (600 kPa)</td>
<td>87 psi (600 kPa)</td>
</tr>
<tr>
<td>Contact Stress</td>
<td>5% of deviator stress</td>
<td>5% of deviator stress</td>
</tr>
<tr>
<td>Confining Stress</td>
<td>0 psi (0 kPa)</td>
<td>0 psi (0 kPa)</td>
</tr>
</tbody>
</table>

1- Determine the project design temperature using LTPPBind version 3.1; computed using 50% reliability, at a 20 mm depth for surface courses and the top of the pavement layer for intermediate and base courses.

X1.2.2 Determine the flow number for each specimen, and average the results. Compare the average flow number with the criteria in Table X1.2.2.

Table X1.2.2 – Minimum Flow Number Requirements

<table>
<thead>
<tr>
<th>Traffic Level, million ESAL’s</th>
<th>HMA, minimum Flow Number</th>
<th>WMA, minimum Flow Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3 to &lt; 10</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>10 to &lt; 30</td>
<td>190</td>
<td>105</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>740</td>
<td>415</td>
</tr>
</tbody>
</table>
## NCHRP 9-47A - HMA Flow Number Results

<table>
<thead>
<tr>
<th>Project</th>
<th>Route</th>
<th>Mix Heating</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker, MT</td>
<td>Route 322</td>
<td>Reheated</td>
<td>98</td>
</tr>
<tr>
<td>Rapid River, MI</td>
<td>CR-513</td>
<td>Reheated</td>
<td>199</td>
</tr>
<tr>
<td>Casa Grande, AZ</td>
<td>SR 84</td>
<td>No</td>
<td>61</td>
</tr>
<tr>
<td>Jefferson Co., FL</td>
<td>SR 30</td>
<td>No</td>
<td>414</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reheated</td>
<td>231</td>
</tr>
<tr>
<td>Queens, NY</td>
<td>Little Neck Pkwy</td>
<td>No</td>
<td>291</td>
</tr>
<tr>
<td>Munster, IN</td>
<td>Calumet Ave.</td>
<td>No</td>
<td>561</td>
</tr>
<tr>
<td>Walla Walla, WA</td>
<td>US-12</td>
<td>No</td>
<td>332</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reheated</td>
<td>426</td>
</tr>
<tr>
<td>Centreville, VA</td>
<td>I-66</td>
<td>Reheated</td>
<td>1855</td>
</tr>
</tbody>
</table>

**HMA Fn Criteria**  
AASHTO TP-79 Appendix 2

<table>
<thead>
<tr>
<th>Traffic, MESALs</th>
<th>Min. Flow No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3</td>
<td>NA</td>
</tr>
<tr>
<td>3 to &lt;10</td>
<td>50</td>
</tr>
<tr>
<td>10 to &lt;30</td>
<td>190</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>740</td>
</tr>
</tbody>
</table>
# NCHRP 9-47A - WMA Flow Number Results

<table>
<thead>
<tr>
<th>Project</th>
<th>Route</th>
<th>Mix Heating</th>
<th>WMA Additive</th>
<th>FN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker, MT</td>
<td>Route 322</td>
<td>RH</td>
<td>Evotherm DAT</td>
<td>58</td>
</tr>
<tr>
<td>Rapid River, MI</td>
<td>CR-513</td>
<td>RH</td>
<td>Advera</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RH</td>
<td>Evotherm 3G</td>
<td>65</td>
</tr>
<tr>
<td>Casa Grande, AZ</td>
<td>SR 84</td>
<td>No</td>
<td>Sasobit</td>
<td>46</td>
</tr>
<tr>
<td>Jefferson Co., FL</td>
<td>SR 30</td>
<td>RH</td>
<td>Terex Foam</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Terex Foam</td>
<td>157</td>
</tr>
<tr>
<td>Queens, NY</td>
<td>Little Neck Pkwy</td>
<td>No</td>
<td>Cecabase</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>SonneWarmix</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>BituTech PER</td>
<td>128</td>
</tr>
<tr>
<td>Munster, IN</td>
<td>Calumet Ave.</td>
<td>No</td>
<td>Evotherm 3G</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Gencor Foam</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Heritage Wax</td>
<td>314</td>
</tr>
<tr>
<td>Walla Walla, WA</td>
<td>US-12</td>
<td>No</td>
<td>Maxam Aquablack</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RH</td>
<td>Maxam Aquablack</td>
<td>227</td>
</tr>
<tr>
<td>Centreville, VA</td>
<td>I-66</td>
<td>RH</td>
<td>Astec DBG</td>
<td>439</td>
</tr>
</tbody>
</table>

### WMA Fn criteria

- AASHTO TP-79
- Appendix 2

<table>
<thead>
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<td>105</td>
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<tr>
<td>&gt; 30</td>
<td>415</td>
</tr>
</tbody>
</table>
S-VECD Fatigue using AMPT

- Simplified Viscoelastic Continuum Damage (S-VECD) Model
- AASHTO TP 107-14 *Determining the Damage Characteristic Curve of Asphalt Mixtures from Direct Tension Cyclic Fatigue Tests*
  - $|E^*|$ Linear Viscoelastic (LVE) Test
  - $|E^*|$ Dynamic Modulus (Finger Print) Test
  - Pull-Pull Fatigue Test
  - Predicted Endurance Limit
Recycled/Reclaimed Asphalt Pavement (RAP)

- NCHRP 9-46 “Mix Design and Evaluation Procedure for High Reclaimed Asphalt Pavement Content in HMA”
- published as NCHRP Report No. 752
- Report recommendations are under review by ETG Task Force
  - potential changes to M323 and R35
  - new terminology: Asphalt Binder Ratio
Recycled/Reclaimed Asphalt Shingles (RAS)

• New AASHTO Provisional Standards
  – MP 23-14 Reclaimed Asphalt Shingles for use in Asphalt Mixtures
  – PP 78-14 Design Considerations when using RAS in Asphalt Mixtures

• Ongoing NCHRP research projects
  – 09-58 RAS in Asphalt Mixtures with WMA
  – 09-59 Relating Asphalt Binder Fatigue Properties to Asphalt Mixture Fatigue Performance
Recycled/Reclaimed Asphalt Shingles (RAS)

- FHWA Accelerated Loading Facility (ALF) is currently evaluating test sections with various amounts of RAP and RAS
- NCAT and Asphalt Institute (AI) are investigating laboratory tests to predict optimal fatigue performance
by Walter C. Waidelich, Associate Administrator for Infrastructure sent 20 October 2014

Increasing number of state highway agencies reporting pre-mature cracking in relatively new asphalt pavements with high content of recycled asphalt binder

Increased concerns with high levels of RAS use especially when RAP is already used
  – Potential increased cracking due to low temperatures, thin pavement sections, and increased asphalt ageing

Reminder to follow sound engineering design and construction practices
(released Oct 2014)

Product of FHWA & NAPA Cooperative Agreement Contract

www.asphaltpavement.org/recycling
**RAP Usage in HMA/WMA**

*Percentage of **Total** Mix Production in USA*

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Asphalt Mix (million tons)</th>
<th>RAP Usage (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>56.0 million tons</td>
<td>16%</td>
</tr>
<tr>
<td>2010</td>
<td>62.1 million tons</td>
<td>18%</td>
</tr>
<tr>
<td>2011</td>
<td>66.7 million tons</td>
<td>19%</td>
</tr>
<tr>
<td>2012</td>
<td>68.3 million tons</td>
<td>20%</td>
</tr>
<tr>
<td>2013</td>
<td>67.8 million tons</td>
<td>20%</td>
</tr>
</tbody>
</table>

*Percentages are based on RAP utilized for new asphalt mixtures only*
**RAS Usage in HMA/WMA**

*Total RAS tons used for mix production in USA*

<table>
<thead>
<tr>
<th>Year</th>
<th>Total asphalt mix: (million tons)</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>702 thousand tons</td>
<td>1,100 thousand tons</td>
<td>1,192 thousand tons</td>
<td>1,863 thousand tons</td>
<td>1,647 thousand tons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>358.4</td>
<td>359.8</td>
<td>366.0</td>
<td>360.3</td>
<td>350.7</td>
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</tbody>
</table>
NCHRP Projects funded as a result of WMA TWG efforts:

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Cost</th>
<th>Status</th>
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<tbody>
<tr>
<td>9-43</td>
<td>-Mix Design Practices for WMA</td>
<td>$522,501</td>
<td>completed</td>
</tr>
<tr>
<td>9-47</td>
<td>-Engineering Properties, Emissions, and Field Performance of WMA Technologies</td>
<td>$79,000</td>
<td>completed</td>
</tr>
<tr>
<td>9-47A</td>
<td>-Properties and Performance of WMA Technologies</td>
<td>$1,121,000</td>
<td>completed</td>
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<tr>
<td>9-49</td>
<td>-Performance of WMA Technologies:</td>
<td>$450,000</td>
<td>completed</td>
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<tr>
<td></td>
<td>Stage I--Moisture Susceptibility</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Stage II--Long-Term Field Performance</td>
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<td></td>
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<tr>
<td>9-52</td>
<td>-Short-Term Laboratory Conditioning of Asphalt Mixtures</td>
<td>$800,000</td>
<td>Nov 2014</td>
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<tr>
<td>9-53</td>
<td>-Properties of Foamed Asphalt for Warm Mix Asphalt Applications</td>
<td>$700,000</td>
<td>Dec 2014</td>
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<td>9-54</td>
<td>-Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction</td>
<td>$800,000</td>
<td>May 2016</td>
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<td>9-55</td>
<td>-Recycled Asphalt Shingles in Asphalt Mixtures with WMA Technologies</td>
<td>$600,000</td>
<td>Sept 2016</td>
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<td>9-58</td>
<td>-Effects of Recycling Agents on Asphalt Mixtures w/High RAS &amp; RAP Binder Ratios</td>
<td>$1,500,000</td>
<td>July 2017 est.</td>
</tr>
<tr>
<td>20-07 (311)</td>
<td>-Development of a WMA Tech. Evaluation Program</td>
<td>$50,000</td>
<td>completed</td>
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NCHRP Projects funded as a result of WMA TWG efforts:

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Description</th>
<th>Cost</th>
<th>Completion Date</th>
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<tbody>
<tr>
<td>9-43</td>
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<td>$50,000</td>
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Total: $7,522,501
WMA Usage in HMA/WMA

Percentage of Total Mix Production in USA

<table>
<thead>
<tr>
<th>Year</th>
<th>Total asphalt mix: (million tons)</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>16.8</td>
<td>41.1</td>
<td>68.7</td>
<td>86.7</td>
<td>106.4</td>
</tr>
<tr>
<td>2006</td>
<td>WMA trials begin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2006 WMA trials begin
WMA Usage by Technology

Percent of market for WMA production in USA
Expansion of NCHRP 9-43 Mix Design Study to Higher Absorption Mixtures

• Original Project 9-43
  – Binder Absorption limited to 0.5 - 1.0 %
• ETG Work Item: Expansion to Higher Absorption Mixtures ≥ 2.0%
  – Includes High Absorption Lab Foamed Mix
• Completed by Dr. Ray Bonaquist, AAT
• Confirmed impact of WMA on mixture volumetrics and performance during design and AASHTO R 35 WMA Appendix
NCHRP 9-47A Field Performance of Warm Mix Asphalt Technologies


- Two TRB Webinars:
  - Engineering Properties and Field Performance of Warm Mix Asphalt (14 Oct 2014)
  - Effects of Warm Mix Asphalt on Plant Energy & Emissions and Worker Exposures to Respirable Fumes (27 Oct 2014)
Asphalt Binder ETG - Activities

- Multiple Stress Creep Recovery
  - T350-14 *MSCR Test of Asphalt Binder Using a DSR* (formerly TP 70)
  - M332-14 *Performance-Graded Asphalt Binder Using MSCR* (formerly MP 19)
- Ground Tire Rubber (GTR)
- Recycled Engine Oil Bottoms (REOB)
- Provide technical input to AASHTO Subcommittee on Materials (SOM)
- Revise & update AASHTO standards
FHWA is working with the Asphalt Institute to assist States to effectively understand and implement MSCR & also better understand successful GTR utilization.

- Technical Brief FHWA-HIF-11-038
  - www.fhwa.dot.gov/pavement/asphalt/index.cfm
- Resources posted on AI’s website
  - www.asphaltinstitute.org/public/engineering/mscr-information.dot
ETG Draft Standard Practice

• Proposed new standard: Standard Practice for *Evaluating the Elastic Behavior of Asphalt Binders Using the Multiple Stress Creep Recovery (MSKR) Test*

• Planned submission of draft to AASHTO SOM with recommendations
  – early 2015
Comparison of MSCR Jnr-3.2 and Rec-3.2 to Assess Elastic Response

FIGURE 1a: Comparison of MSCR Jnr-3.2 and Rec-3.2 to Assess Elastic Response

FIGURE 1b: Comparison of MSCR Jnr-3.2 and Rec-3.2 to Assess Elastic Response (Semi-Log)
Can it fit within existing PG grading system?

- **Solubility limitations**
  - Current AASHTO M 320 requires the asphalt binder shall be at least 99.0 percent soluble as determined by T 44 or ASTM D 5546.

- **Handling/re-heating of AR binders**
  - Impact on test results due to additional reaction or additional degradation of GTR
Ground Tire Rubber

Can it fit within existing PG grading system?

- RTFO limitations
  - Can not achieve coating at higher GTR concentrations
  - In order to mainstream GTR in PG system, we may need to use softer base binders or target a lower percent GTR needed in order to achieve a reacted PG 70, 76 or 82?
Videos of Reheating Procedure

5 Gallon Container

Gallon Container
PG 64-22 + 0.5% Evotherm + 15.9% GTR

Sample Before Mixing

Sample Poured in Silicone Mold

Stirring with Mechanical Mixer

Asphalt Being Poured
PG 64-22 + 0.5% Evotherm + 15.9% GTR
PG 64-22 + 0.5% Evotherm + 15.9% GTR

RTFO samples crawled out of the bottles:

Asphalt binder dripping out during test

Asphalt Binder dripped onto Heating Elements inside RTFO Oven
PG 64-22 + 0.5% Evotherm + 15.9% GTR

Attempted levelness deviation from standard by tilting RTFO by +1 degree (allows ± 1.0 degree)
PG 64-22 + 0.5% Evotherm + 15.9% GTR

Resulted in bottles not completely coated

RTFO bottles after aging
PG 64-22 + 0.5% Evotherm + 15.9% GTR

Difficult to prepare test specimens for BBR, DTT and ABCD testing

PG 64-22 + GTR (Original) BBR Beams
No RTFO or PAV conditioning
Can it fit within existing PG grading system?

- Impact of binder crude source compatibility with GTR source?
  - Some binder/GTR source combinations react well, while others do not react
  - Impact on percent GTR required/allowed to meet PG grade or rotational viscosity requirements
Can it fit within existing PG grading system?

• DSR Testing Geometry
  — Parallel Plate (PP) vs Concentric Cylinder (CC)
  — GTR particle size & concentration limitations
    • DSR currently limited to a max. of 25% of PP gap size
    • Size of non-reacted GTR vs reacted GTR in binder
      — GTR particle size increases with reaction (it can double)
    • Particle influence with increased concentrations
      — Non-homogenous or mastic behavior?
    • Sample Trimming and Edge Effects
Can it fit within existing PG grading system?

- **DSR Testing Geometry**
  - Concentric Cylinder (CC) equipment development by Anton Paar and testing evaluation looks promising
  - CC test geometry should be considered to overcome some of the PP geometry and specimen prep limitations
Newest FHWA Technical Brief

- **The Use of Recycled Tire Rubber to Modify Asphalt Binder and Mixtures**
  FHWA-HIF-14-015 (Sept 2014)

Hamburg Wheel-Track Testing

- Updated AASHTO T 324-14 “Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)”
  - General improvements to simplify, improve language, and clarity.
- TS 2c Hamburg Task Force (TF 2c-2012-01)
  - Submitted RNS which resulted in NCHRP 20-07(361)
  - Continued efforts:
    - Improve and standardize specimen fabrication requirements
    - Address additional equipment models currently available
    - Improve and standardize the data analysis for stripping and determination of stripping inflection point (SIP)
NCHRP 20-07 Task 361

• “Hamburg Wheel-Track Test Equipment Requirements and Improvements to AASHTO T 324”

• Louisiana Transportation Research Center
• Dr. Louay Mohammad
• $100,000
• Planned completion July 2015
NCHRP 20-07 Task 361

- “Hamburg Wheel-Track Test Equipment Requirements and Improvements to AASHTO T 324”

- Goals
  - (1) document the capabilities of available commercial Hamburg test equipment
  - (2) determine Hamburg test equipment capabilities, components, or design features that ensure proper testing and accurate, reproducible results, and
  - (3) provide proposed revisions with commentary to AASHTO T 324 to enable the use of a performance type specification for Hamburg test equipment
FHWA Field Support
Mobile Asphalt Testing Trailer (MATT)

- Mobile Asphalt Pavement Materials Lab
  - Site Visits
  - Field Data/Testing/Evaluation
  - Use/Demo Emerging Test Devices
  - POC: Matthew Corrigan, P.E.
Asphalt Pavements

Current Projects and Activities

- Asphalt Pavement Recycling with Reclaimed Asphalt Pavement (RAP)
- Asphalt Mixture Performance Tester (AMPT)
- Expert Task Group on Asphalt Mixtures & Construction: Asphalt Binders; and Models Technology
- Mobile Asphalt Pavement Mix Laboratory
- Foamed Recycled Asphalt Pavement The Louisiana Experience
- Slurry/Micro-Surface Mix Design Procedure Project
- Superpave Regional Centers
- Superpave Implementation Update
- Recycling Team activities
- RD&T Recycling Information
- Warm Mix Asphalt Technologies and Research
- Crumb Rubber
- NIOSH Activities

Research

- Asphalt Research

Techbriefs

- TechBrief: Asphalt Mixture Performance Tester (AMPT), FHWA-HIF-13-005 2013
The Use of Recycled Tire Rubber to Modify Asphalt Binder and Mixtures, FHWA-HIF-14-015

Asphalt Material Characterization for AASHTOWare® Pavement ME Design Using an Asphalt Mixture Performance Tester (AMPT), FHWA-HIF-13-060 2013

TechBrief: Asphalt Mixture Performance Tester (AMPT), FHWA-HIF-13-005 2013

Construction Quality Assurance for Design-Build Highway Projects, FHWA-HRT-12-039 2012

TechBrief: An Alternative Asphalt Binder, Sulfur-Extended Asphalt (SEA), FHWA-HIF-12-037 2012

The Use and Performance of Asphalt Binder Modified with Polypophosphoric Acid (PPA), FHWA-HIF-12-030 2012

Techbrief: Independent Assurance Program, FHWA-HIF-12-001 2012
• **Identifying Existing/Emerging Technologies in the Area of Intelligent Construction**, FHWA-HIF-12-014 2011
• **The Multiple Stress Creep Recovery (MSCR) Procedure**, FHWA-HIF-11-038 2011
• **A Review of Aggregate and Asphalt Mixture Specific Gravity Measurements and Their Impacts on Asphalt Mix Design Properties and Mix Acceptance**, FHWA-HIF-11-033 2011
• **Superpave Gyratory Compactors**, FHWA-HIF-11-032 2011
• **Superpave Mix Design and Gyratory Compaction Levels**, FHWA-HIF-11-031 2011
• **TechBrief: Intelligent Compaction for Asphalt Materials**, 2010
• **TechBrief: Phosphoric Acid as an Asphalt Modifier Guidelines for Use: Acid Type**, FHWA-HRT-08-061 2008

... and many more!!
Thank You

FHWA’s Mobile Asphalt Testing Trailer
Office of Asset Management, Pavement, and Construction