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Multiple Stress Creep Recovery (MSCR) Binder Specification Implementation

SEAUPG Annual Meeting
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Oklahoma City, Oklahoma

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Washington DC Circa 1900

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Our visit today

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- What is MSCR (*pronounced massacre*) test?
- PG binder grading system for SE states
- What are advantages of MSCR?
- What is the status of the AASHTO specifications for MSCR?
- What role will SEAUPG play in evaluation and/or implementation of MSCR?

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What is MSCR?

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The MSCR test is a new test for measuring high temperature properties of an asphalt binder which:

- can replace the existing high temp. test for short term aged binder in M 320 ($G^*/\sin\delta$)
- can better relate predicted laboratory polymer-modified binders' high temp properties to actual rutting performance of in-service pavements
- allows for a much more economic use of polymers to improve performance

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What is MSCR?

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- It is the Asphalt Institute's opinion that MSCR represents a technical advancement over the current PG specification
- AI recommends that agencies move toward implementing MSCR
- It is recommended that this implementation be accomplished regionally or through the User Producer Groups

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What is MSCR?

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- The test method is detailed in AASHTO TP 70
- The test uses the same Dynamic Shear Rheometer (DSR) as required in the original M 320
- Only minor software changes are needed to run the MSCR test
- The test uses the creep and recovery method to measure the *percent recovery* and *non-recoverable creep compliance* (J_{nr})

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MSCR Advantages

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- Jnr is better correlated with rutting potential than $G^*/\sin\delta$
 - Lab research
 - Field Studies
- MSCR can be used effectively for both modified and unmodified binders
- May eliminate the need for "PG Plus" tests



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History of SEAUPG

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- Formed in 1993
- Regional forum for discussion and exchange of asphalt pavement technology
- Original focus was on implementation of Superpave binder and mix technologies
- Performance Grade (PG) binder grading system was adopted by SEAUPG states in mid 1990s



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AI State DOT Binder Database

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State: VIRGINIA	Materials: PMA: Section 210 - Asphalt Materials	
Date Last Reviewed: 8-19-2010	Web Address: www.dot.state.va.us	
Materials Engineer: Todd Romer	Contact Info: Todd.Romer@dot.virginia.gov	
ASPHALT BINDER:		
Description: Asphalt materials shall conform to the requirements of Section 210 except asphalt cement materials shall be Performance Graded conforming to the requirements of AASHTO Provisional Specification M320.		
Section 210 PMA's:	Type 'E' and 'H' asphalt mixtures shall consist of mixes incorporating a neat asphalt material with polymer modification meeting the requirements of a PG 76-22 and have a Rolling Thin Overlaid Test residue Elastic Recovery @ 77°F of a minimum of 70%.	
Exclusions: None stated		
PROPERTY	Test Method AASHTO or Other	Requirements by Performance Grade, PG (Common Grades)
		64-22 70-22 76-22
ORIGINAL:		
Specific Gravity	15.6°C ASTM D 70	Report
Flash Point, °C	T 48	230 min
Rotational Viscosity, Pa·s @ 136°C	T 316	3.0 max.
Dynamic Shear, kPa (2" dia x 10 rad/sec)	T 315	1.0 min.



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PG Binder Grading System

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- PG Binders for SE states
 - Most Common "Neat" Binder Grades
 - PG 64-22
 - PG 67-22
 - Most Common "Modified" Binder Grade
 - PG 76-22



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Why Do We Need New Binder Test?

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- PG Binders for SE states
 - Most Common "Neat" Binder Grades
 - PG 64-22 ← Current PG spec. works OK for neat binders
 - PG 67-22 ← Current PG spec. works OK for neat binders
 - Most Common "Modified" Binder Grade
 - PG 76-22 ← Current PG spec. doesn't work as well for modified binders



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Why Do We Need New Binder Test?

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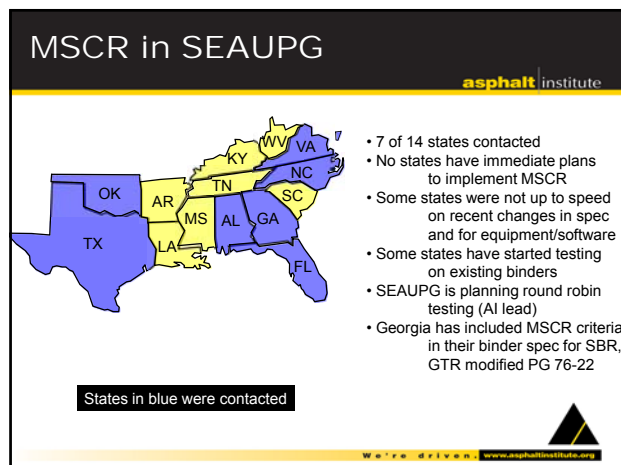
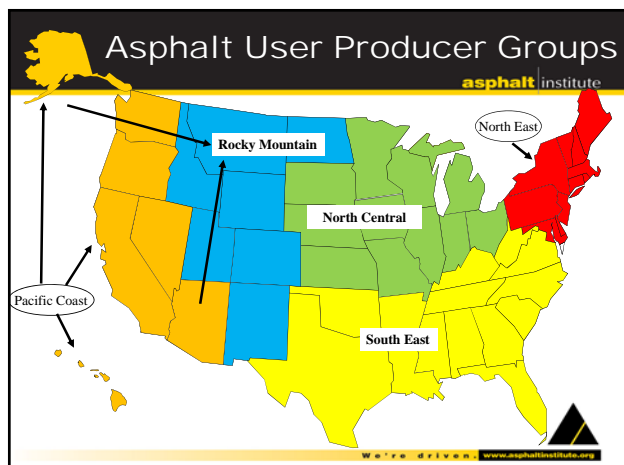


The use of polymer modified binders has grown tremendously in recent years

However, AASHTO M 320 was based on a study of neat (unmodified) binders, and may not properly characterize polymer modified binders



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Status of AASHTO MSCR Spec

- Originally, proposal was to add MSCR spec as Table 3 in standard specification M 320 – PG Binders
- However, suggestions to consider making this a provisional spec to allow more study
- **Ballot at recent SOM meeting was passed that created a new Provisional MSCR Specification (MP 19)**

Guidance Documents

- AI Guidance Document: “Implementation of the MSCR Test and Specification”
- AI Guidance Document: “Guidance on the Use of MSCR Test with AASHTO M320 Specifications”
- FHWA TechBrief

AI Guidance Document

- Become Familiar with MSCR Test / Specs.
- Conduct Transitional Testing as Needed
- Transition Regionally and Uniformly
- Use MSCR Recovery if there is a Need to Identify Elastomeric Modification in an Asphalt Binder...
- ...And Eliminate the Use of Other “PG Plus” Tests

Two Ways to Implement MSCR

- Partial Implementation
 - Use in conjunction with M 320
 - MSCR test used as PG Plus
- Full implementation
 - Adopt MP 19
 - Revised grading system based strictly on climate and loading
 - Eliminate graded bumping
 - Eliminate “PG Plus” tests

New PG Grading System (MSCR)

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- Environmental grade plus traffic level designation; i.e. PG 64-22E
 - Four traffic levels
 - S = Standard: < 10 million ESALs and standard traffic loading
 - H = Heavy: 10 – 30 million ESALs or slow moving traffic loading
 - V = Very Heavy: > 30 million ESALs or standing traffic loading
 - E = Extr. Heavy: > 30 million ESALs and standing traffic loading



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What's Next?

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- Nationally
 - Consensus that MSCR has been validated
 - MSCR testing by individual states and UPGs
 - Likely that MSCR will be adopted in the future by states / UPGs
- SEAUPG
 - Binder Task Group taking a look
 - MSCR Task Force formed
 - Round Robin testing planned



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Conclusion

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- MSCR looks like a very promising tool to improve current PG binder specification
- SEAUPG Binder Task Group has decided to focus on evaluating MSCR for possible implementation through round robin testing, parallel testing of existing binders, etc.
- Look for annual updates from the MSCR Task Force at future meetings



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MSCR Implementation-DOT Perspective

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Questions?



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What is MSCR?

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Definitions:

Creep and recovery – a standard test protocol whereby a specimen is subjected to a constant load for a fixed time period and then allowed to relax (recover) at a zero load for a fixed time period

Percent Recovery – A measure of how much the sample returns to its previous shape after being repeatedly stretched and then relaxed

Non-Recoverable Creep Compliance (J_{nr}) – a measure of the amount of residual strain left in the specimen after repeated creep and recovery, relative to the amount of stress applied



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PG Plus Tests

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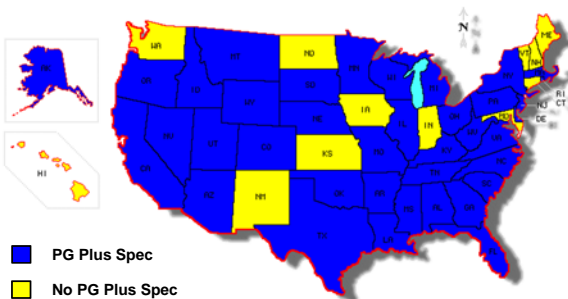
- Most states have added “PG Plus” tests to PG testing (M 320) to ensure presence of polymers and improved elastic properties



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States with a “PG Plus” Specification

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PG Plus Tests

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- PG Plus tests (elastic recovery) have issues:
 - Time consuming
 - Good at confirming the presence of polymers
 - Don't predict field performance well
- MSCR seems to be better than PG Plus:
 - Quicker/easier to run with existing DSR
 - Better at predicting performance



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