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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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Intelligent Hauling Units?



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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  |  |
| <b>ASPHALT BINDER:</b>   |  |  |
| 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  |  |  |
| <b>PROPERTY</b>  | <b>Test Method AASHTO or Other</b>   | <b>Requirements by Performance Grade, PG (Common Grades)</b> |
|  |  | 64-22 70-22 76-22  |
| <b>ORIGINAL:</b>   |  |  |
| 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.   |



## 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
      - PG 67-22
    - Most Common “Modified” Binder Grade
      - PG 76-22
- Current PG spec. works OK for neat binders
- 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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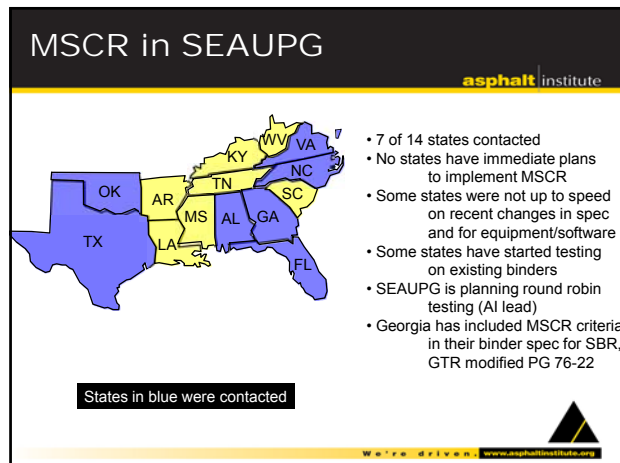
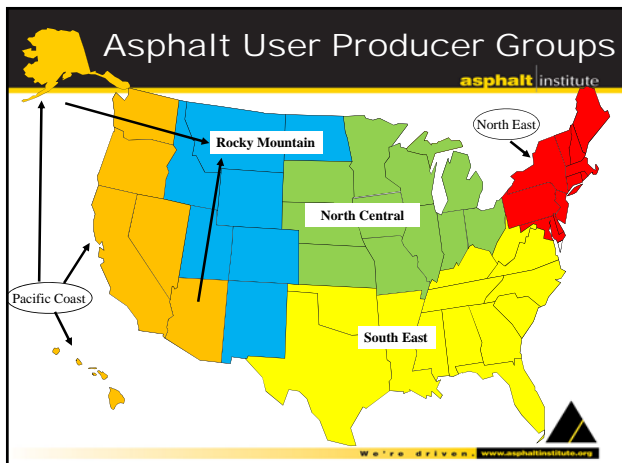


The use of polymer modified binders has grown tremendously in recent years

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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### MEMBER COMPANIES



### AFFILIATE MEMBERS



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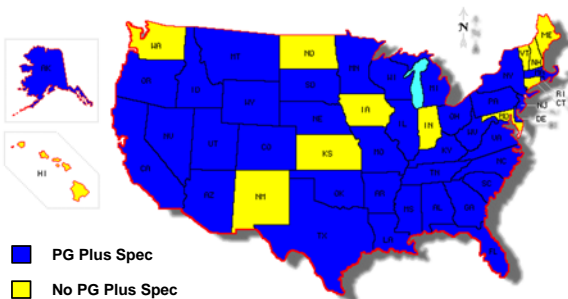
- Most states have added “PG Plus” tests to PG testing (M 320) to ensure presence of polymers and improved elastic properties



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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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