Multiple Stress Creep Recovery (MSCR): New Binder Grade Testing and Terminology

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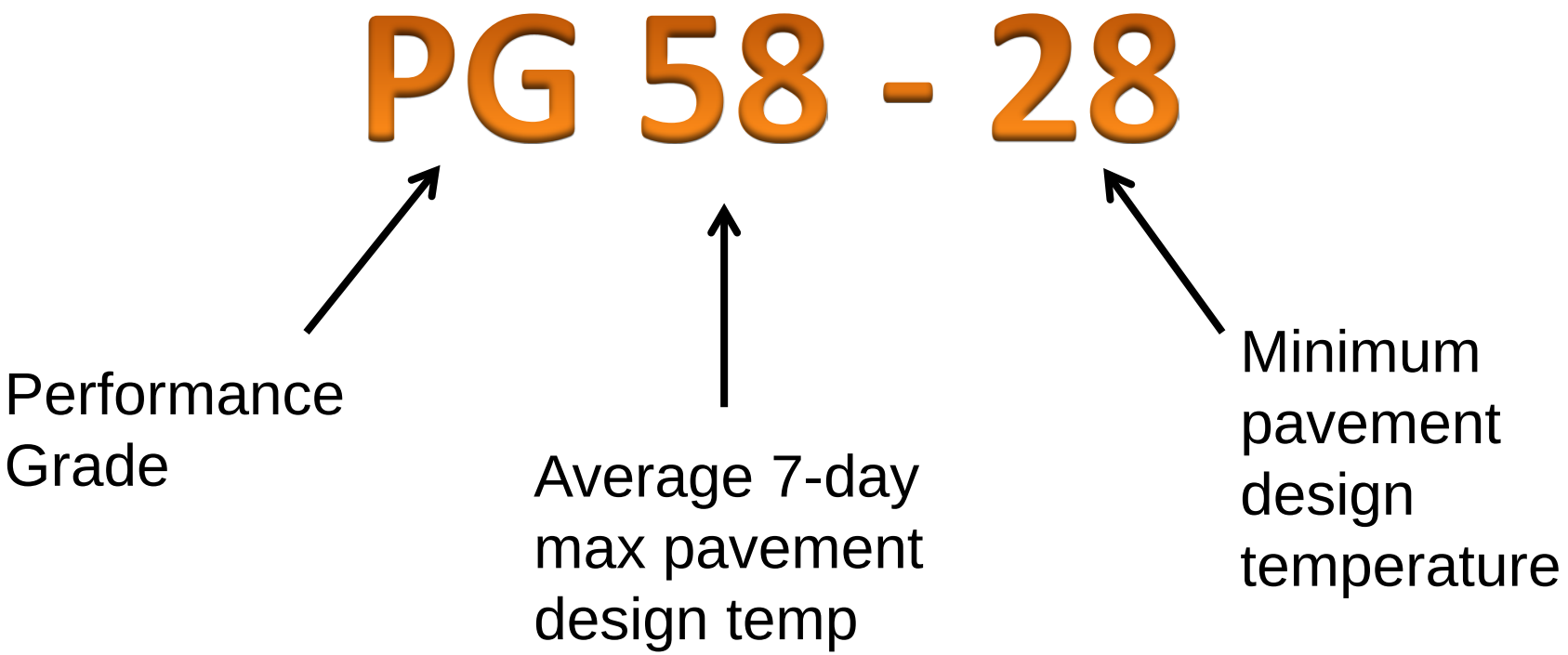
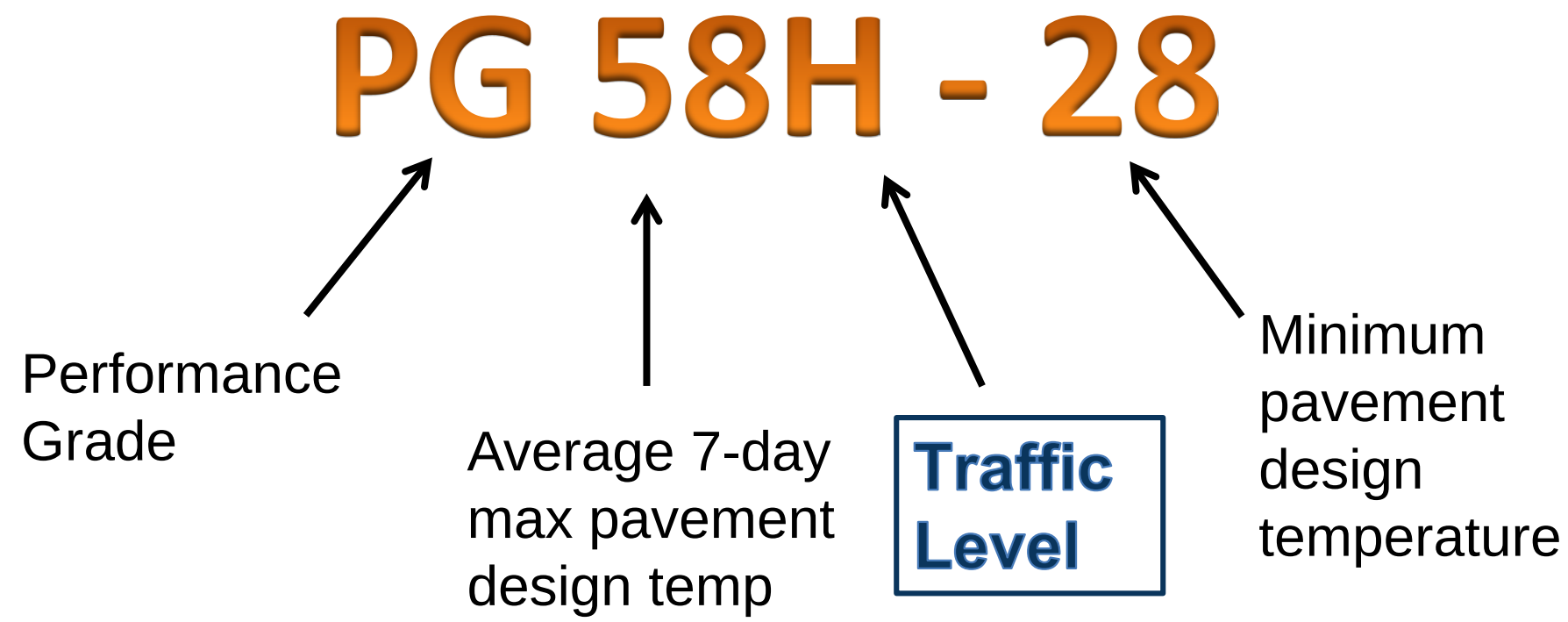
Current Superpave Specification

- Grading System Based on Climate



MSCR Superpave Specification

- Grading System Based on Climate **and Traffic**



MSCR Superpave Specification

Letter Designation	Traffic Level
S	Standard
H	Heavy
V	Very Heavy
E	Extreme

Specification Differences

- Current Superpave Specification
  - The greater the temperature spread, the greater the modification level
- MSCR Superpave Specification
  - The greater the traffic level “letter”, the greater the modification level
  - No Temperature Bumping

How will you know which spec to use?

- **AASHTO M 320 –** Current PG Specification

- **AASHTO M 332 –** MSCR PG Specification
  - Nebraska DOR implementation October 2016

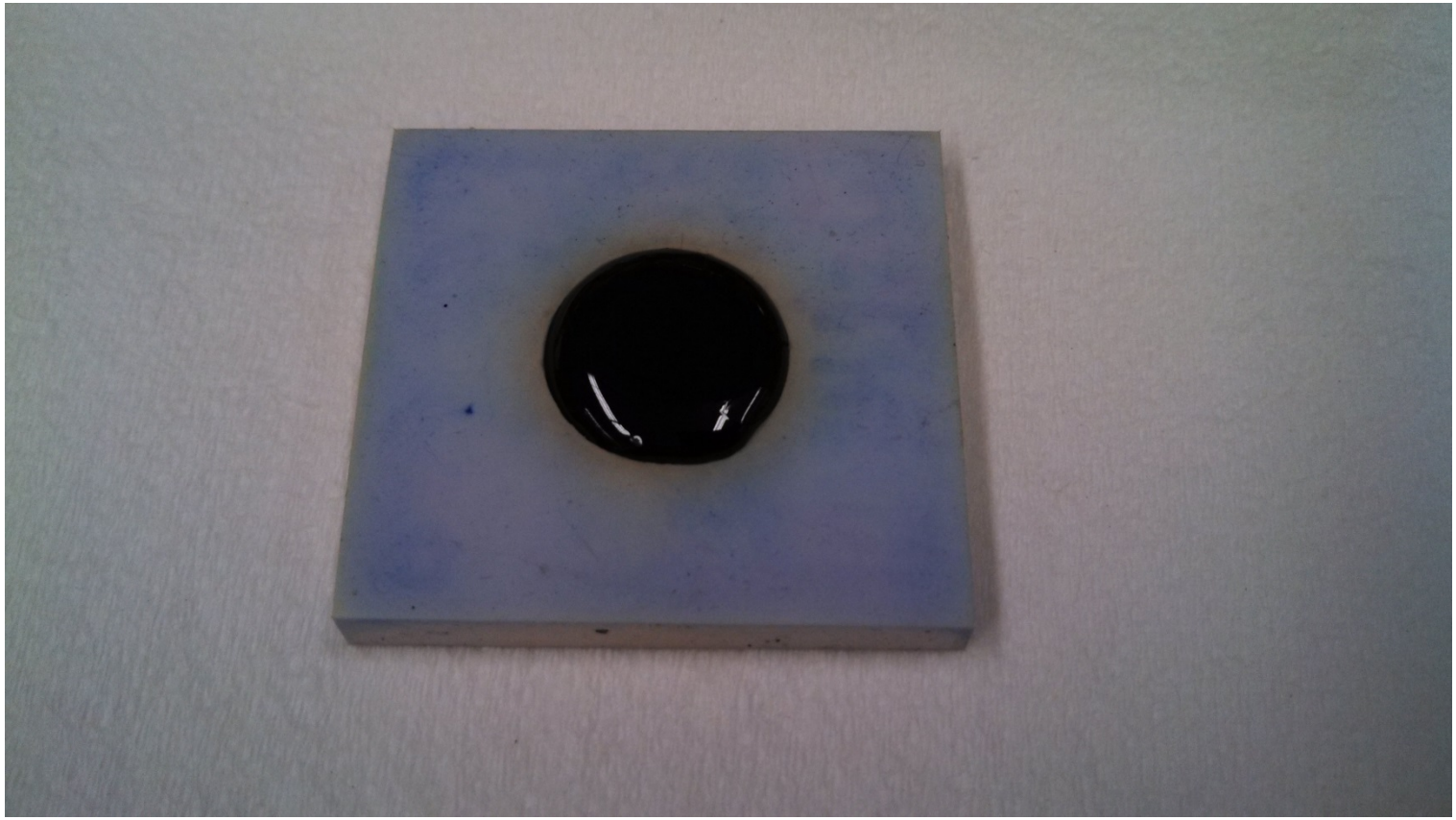
Benefits of changing to the MSCR Specification

Dynamic Shear Rheometer (DSR)

- Measures G*/Sin(δ)
  - Current Rutting Parameter
- Tested at in-service temperatures
  - 58°C, 64°C, 70°C, etc.

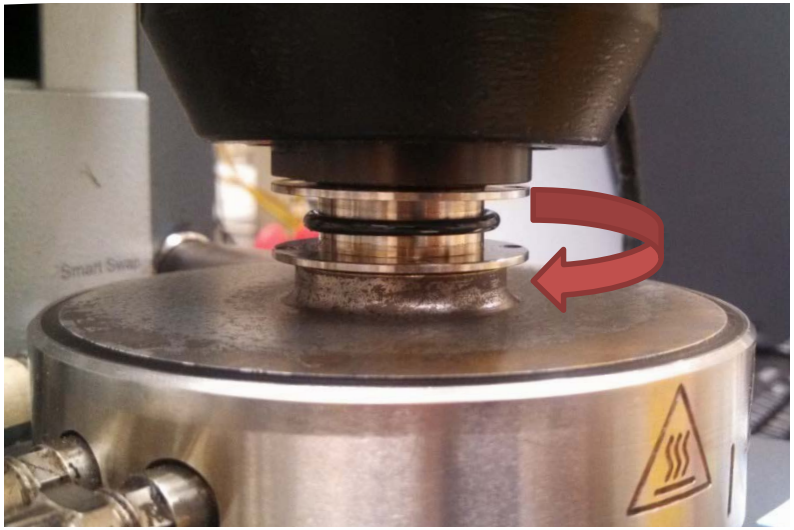
Unaged	≥ 1.0 kPa
RTFO Aged	≥ 2.2 kPa

Asphalt Binder Sample



25 mm (1 inch) Diameter

Testing for G*/Sin(δ)



Oscillation rate of 10hz ≈ 55 mph traffic speed

But what if traffic slows down or increases?

Current Superpave Specification

- Slower speeds or heavier loads require stiffer asphalt binders
- Temperature Bumping
- Example grades for PG 58 climate
  - Fast moving traffic (PG 58-28)
  - Slow or heavy traffic (PG 64-28)
  - Stationary or high volume traffic (PG 70-28)

Response to Temperature Bumping

- Suppliers began utilizing a variety of modification technologies to meet the specification including:
  - Styrene-butadiene-styrene (SBS)
  - Ethyl vinyl acetate (EVA)
  - Polyphosphoric Acid
  - Ground Tire Rubber
  - Oxidation
  - Plastomers
- G*/sinδ was found to be inadequate for characterizing different types of modifications

Response to Temperature Bumping

- Agencies adopted various PG+ test methods
  - e.g., Elastic Recovery, Ductility

- PG+ test methods do not relate well to performance

Response to PG+ Specifications

- Development of the MSCR Test
  - Uses the DSR for faster results
  - For both unmodified and modified binders
  - Identifies the presence of an elastomeric modifier
  - Excellent correlation with rutting
  - High stress level engages polymer network

New Parameters from MSCR Test

- Rutting parameter
  - $J_{nr,\ 3.2kPa}$ = compliance value
- Stress sensitivity
  - $J_{nr,\ differential}$

  (% difference between low and high stress levels)
- Elastic recovery replacement
  - % Recovery

MSCR Grading System

Letter	Traffic Level	Jnr Value	% Recovery
Standard “S”	< 3 million ESAL’s	< 4.5 kPa^{-1}	
Heavy “H”	> 3 million ESAL’s	< 2.0 kPa^{-1}	≥ 30%
Very Heavy “V”	< 10 million ESAL’s	< 1.0 kPa^{-1}	≥ 55%
Extreme “E”	> 10 million ESAL’s	< 0.5 kPa^{-1}	≥ 75%

Are H, V, E Grades Modified?

- Yes. They have an elastomeric modifier to meet the minimum % recovery.

- Example
  - PG 58V – 34

Can “S” Grade Binders be Modified?

- Yes. Rule of 90 still applies.
- PG 58S – 34 ⇨ 58 - -34 = 92 > 90
  - Probably modified
- PG 58S – 28 ⇨ 58 - -28 = 86 < 90
  - Doesn’t require a modifier

Binder Grade Comparisons

This MSCR Grade… (AASHTO M 332)	Is close to a… (AASHTO M 320)
PG 58S – 34	PG 58 – 34
PG 58H – 34	PG 58 – 34
PG 58V – 34	PG 58 – 34 / 64 – 34
PG 58E – 34	PG 64 – 34 / 70 – 34
PG 64S – 34	PG 58 – 34
PG 64H – 34	PG 64 – 34
PG 64V – 34	PG 64 – 34 / 70 – 34
PG 64E – 34	PG 70 – 34

Summary

- MSCR eliminates temperature bumping and PG+ tests
- New parameters relate better to pavement rutting
- Better Uniformity across states
- Selecting the right asphalt binder is only one part of producing long lasting roads
  - Aggregate selection, mix design, hot mix production, and application technique will remain as integral parts for project success

Thank You

Questions ?