Local Calibration of the MEPDG for HMA Pavements in Missouri

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MEPDG Implementation

- Decision made in 2004 by MoDOT Pavement Team members, including FHWA, MAPA, and ACPA to fully incorporate the MEPDG into new pavement design activities
- MoDOT contracted with ARA to calibrate the national distress models for local conditions

HMA Distresses of Interest

- Fatigue cracking
- Rutting
- Thermal cracking

Local Calibration Data Collection

- Data collection, testing, and analysis efforts split into two tasks
  - In-service pavement performance data for local calibration of distress models
    - Collected through field testing and (if necessary) project records for each identified MoDOT section
    - Imported from LTPP database for LTPP sections
  - Material testing data for MEPDG input libraries, local calibration defaults, and design guidance
    - Obtained through sampling and testing typical HMAs from active projects
    - Obtained through testing field sample cores from in-service pavements

In-Service Data Collection

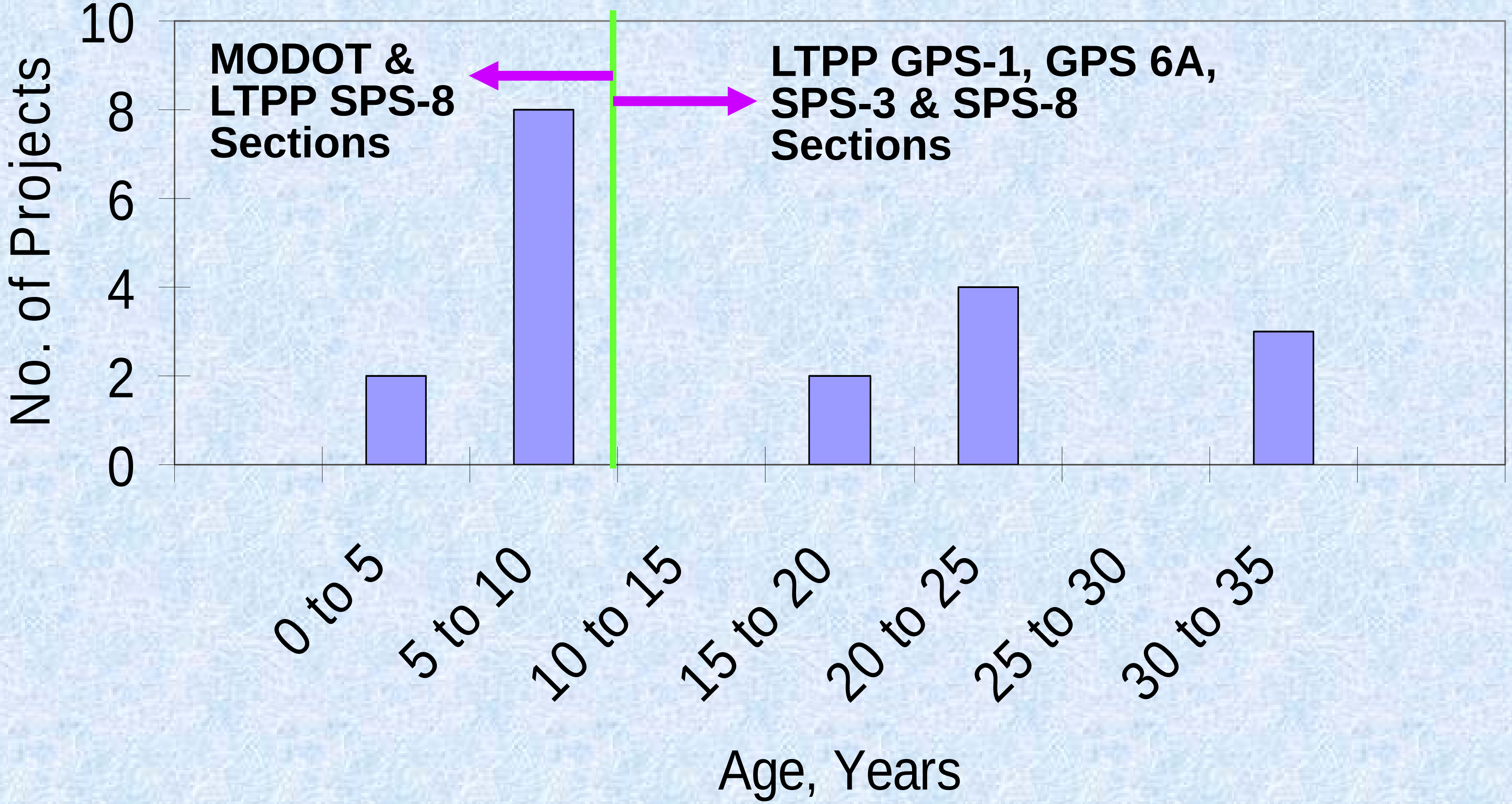
- 500-ft section units
- 3 - 4 cores sampled from each section
  - Asphalt lift thicknesses
  - Bulk and maximum specific gravities
  - Air voids
  - Gradations
  - Asphalt contents
- FWD testing performed on all sections
- Manual cracking (2 obs./unit) & rutting (1 obs./unit)
- Historical IRI

In-Service (Deep Strength) HMA Factorial

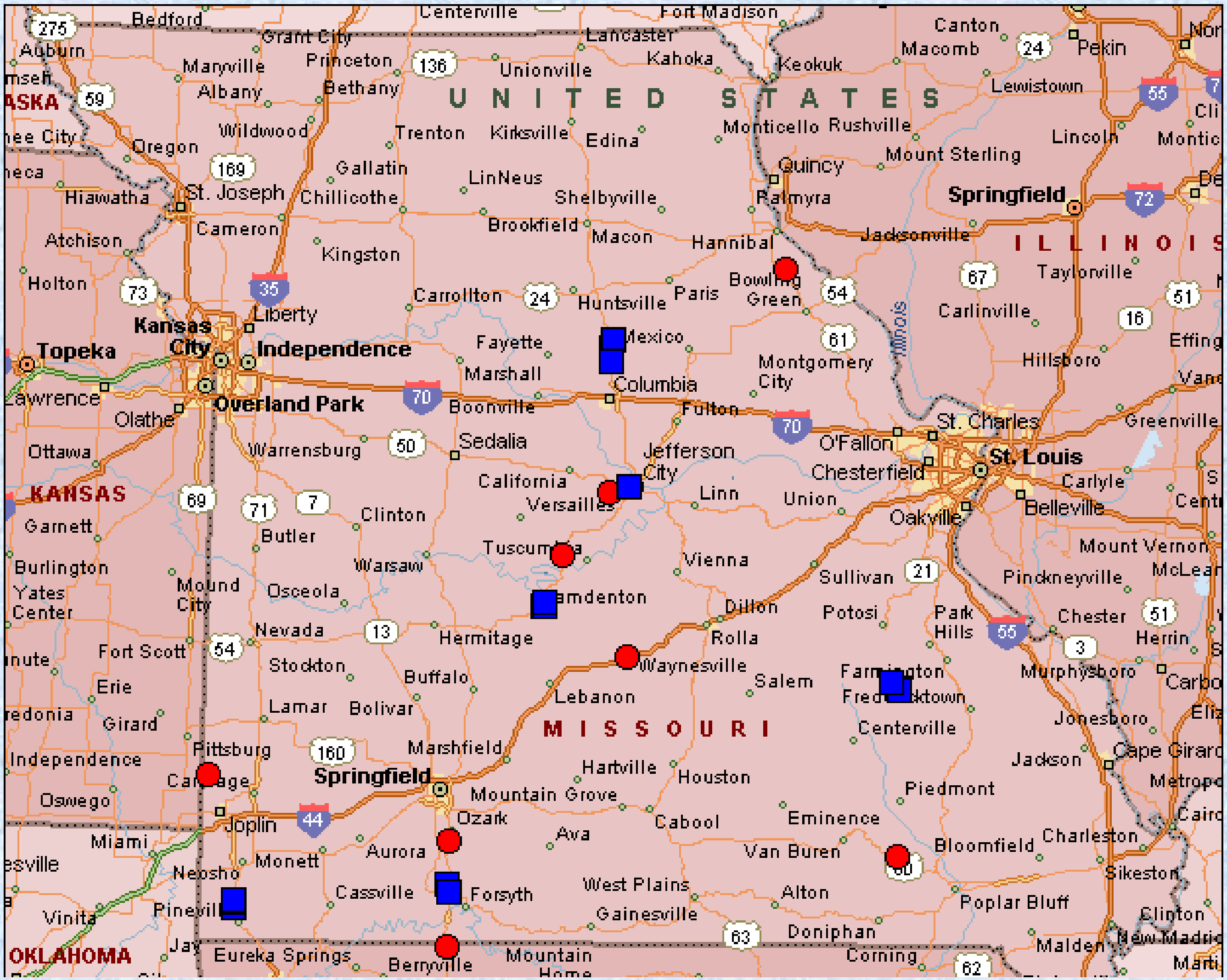
HMA Thickness		4-8 inches		> 8 inches	
Design Method		Dir. Comp./ Marshall	Superpave	Dir. Comp./ Marshall	Superpave
Base Type	4" Crushed Stone	0 7		0 7	10 0
	24" Rock Base				12 0

*MODOT Sections
LTPP Sections

Age of New HMA Pavement Sections



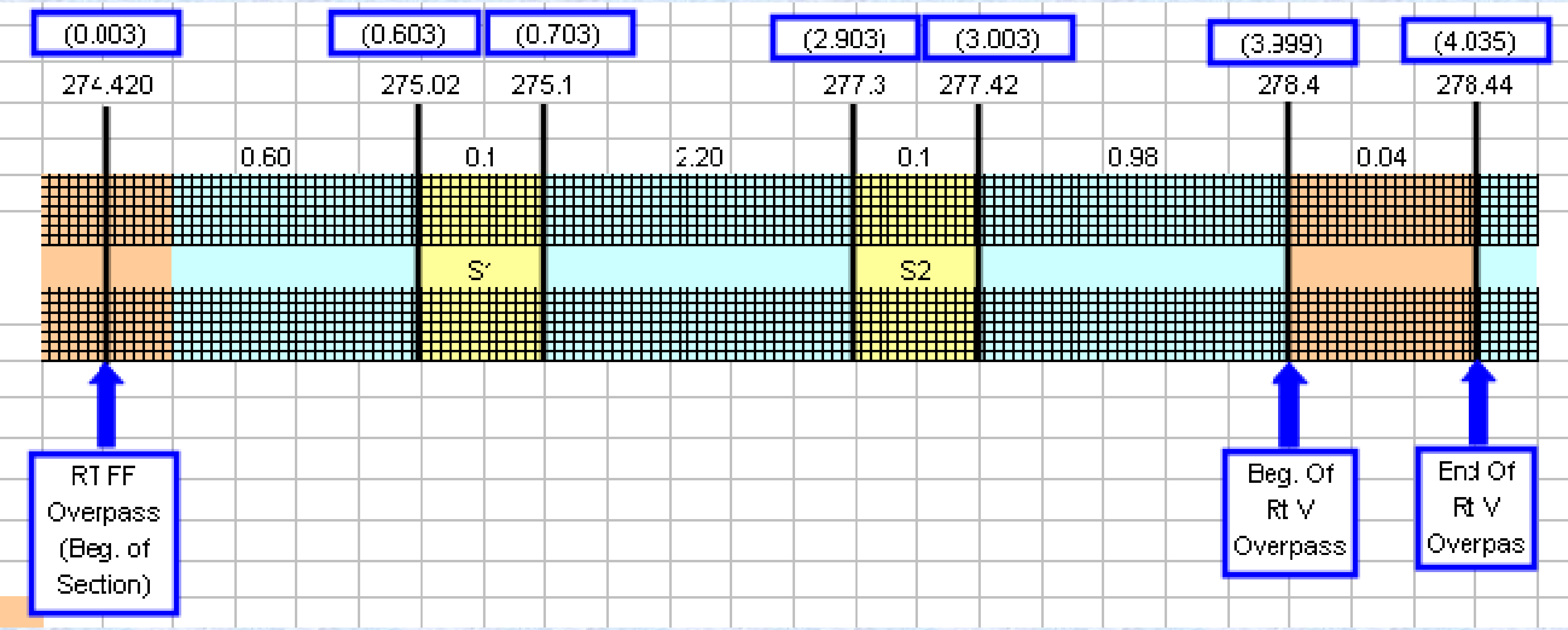
Geographic Distribution of New HMA Sections Selected for Local Calibration



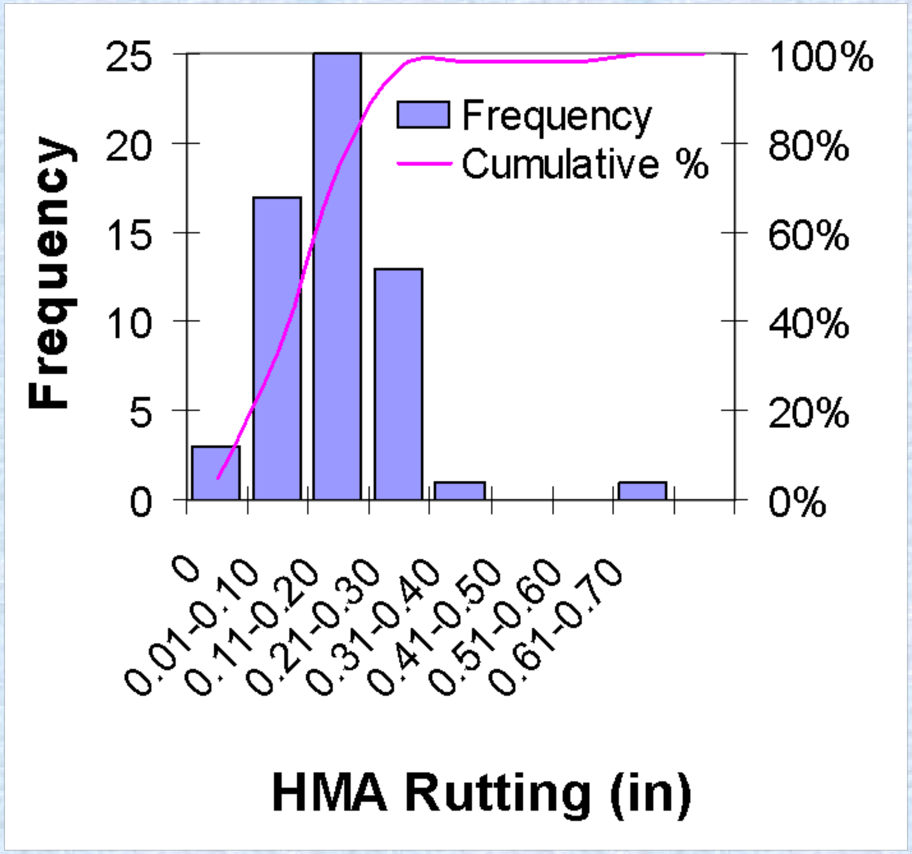
LTPP

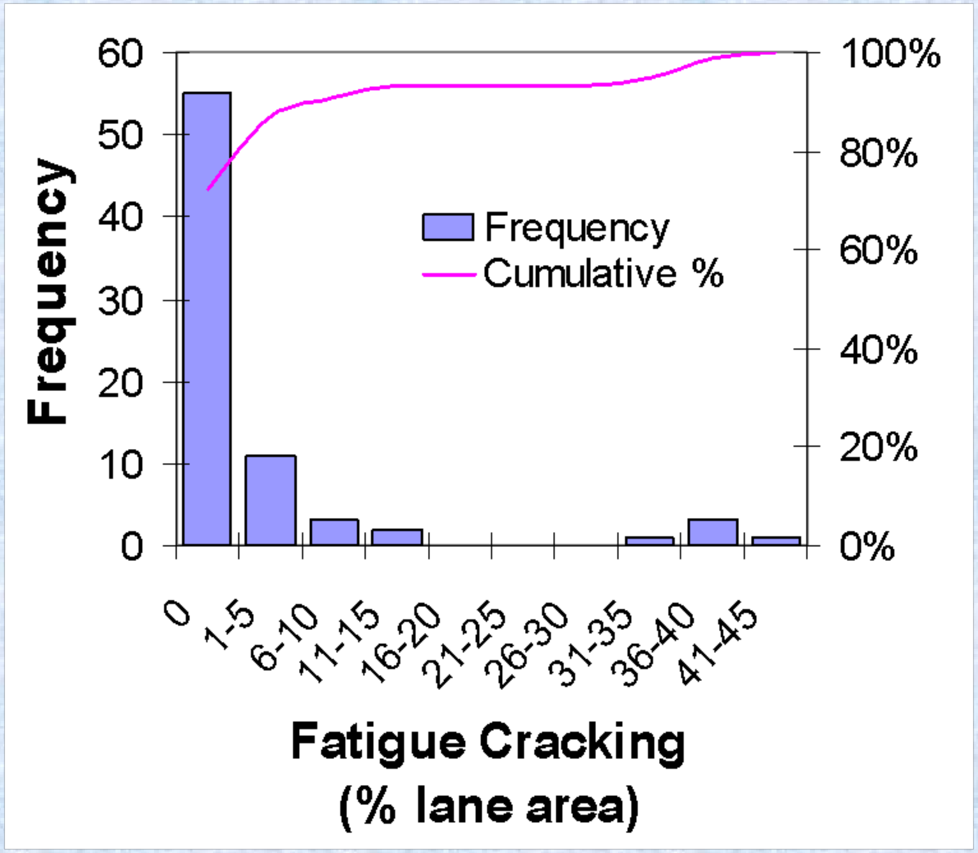
MODOT

Illustration of a Typical Section and 500-ft Sample Units



Magnitudes of Measured Distress – MoDOT and MO LTPP HMA Pavements





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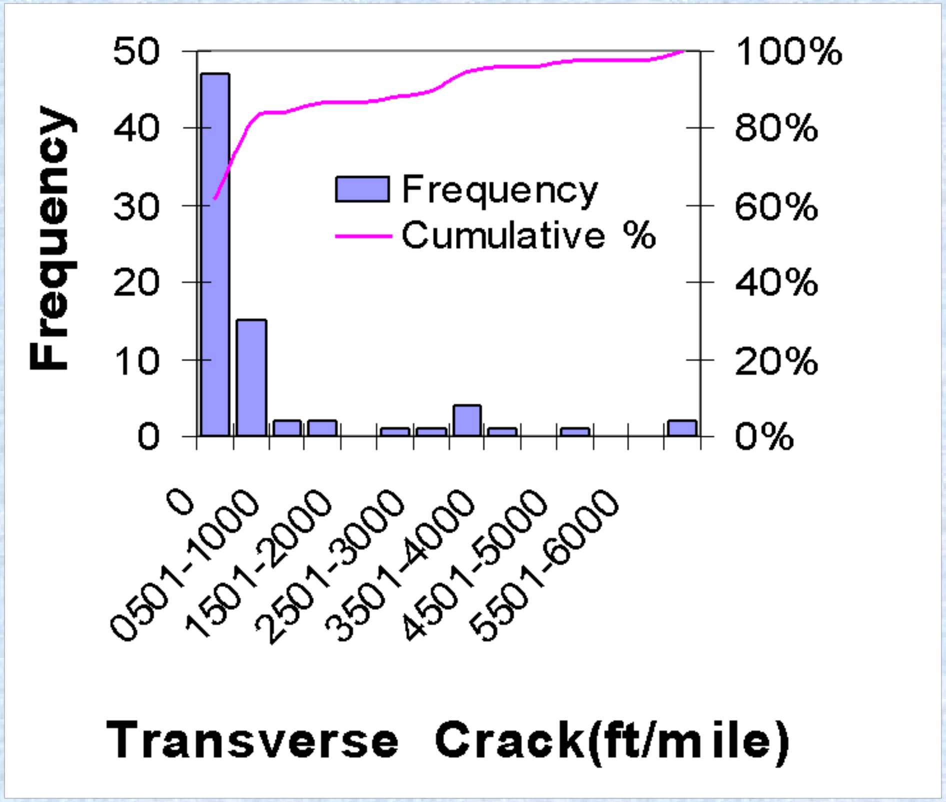
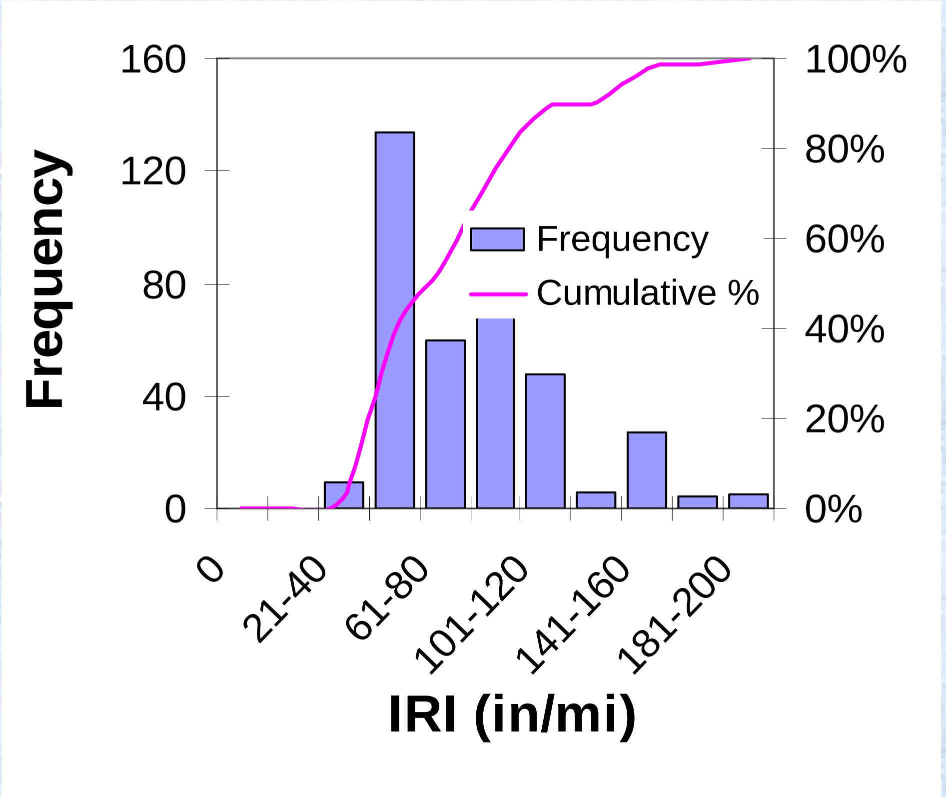




Material Testing (Level 1)

- Fatigue cracking
  - Dynamic modulus
- Rutting
  - Dynamic modulus
- Thermal cracking
  - Creep compliance
  - Tensile strength

Dynamic Modulus

- Testing performed with in-house AMPT
- Three replicate gyratory-compacted samples of each mix type
- Air voids – 4%, 6.5%, and 9%
- Polymer-modified and neat (dependent on PG grade)

Dynamic Modulus

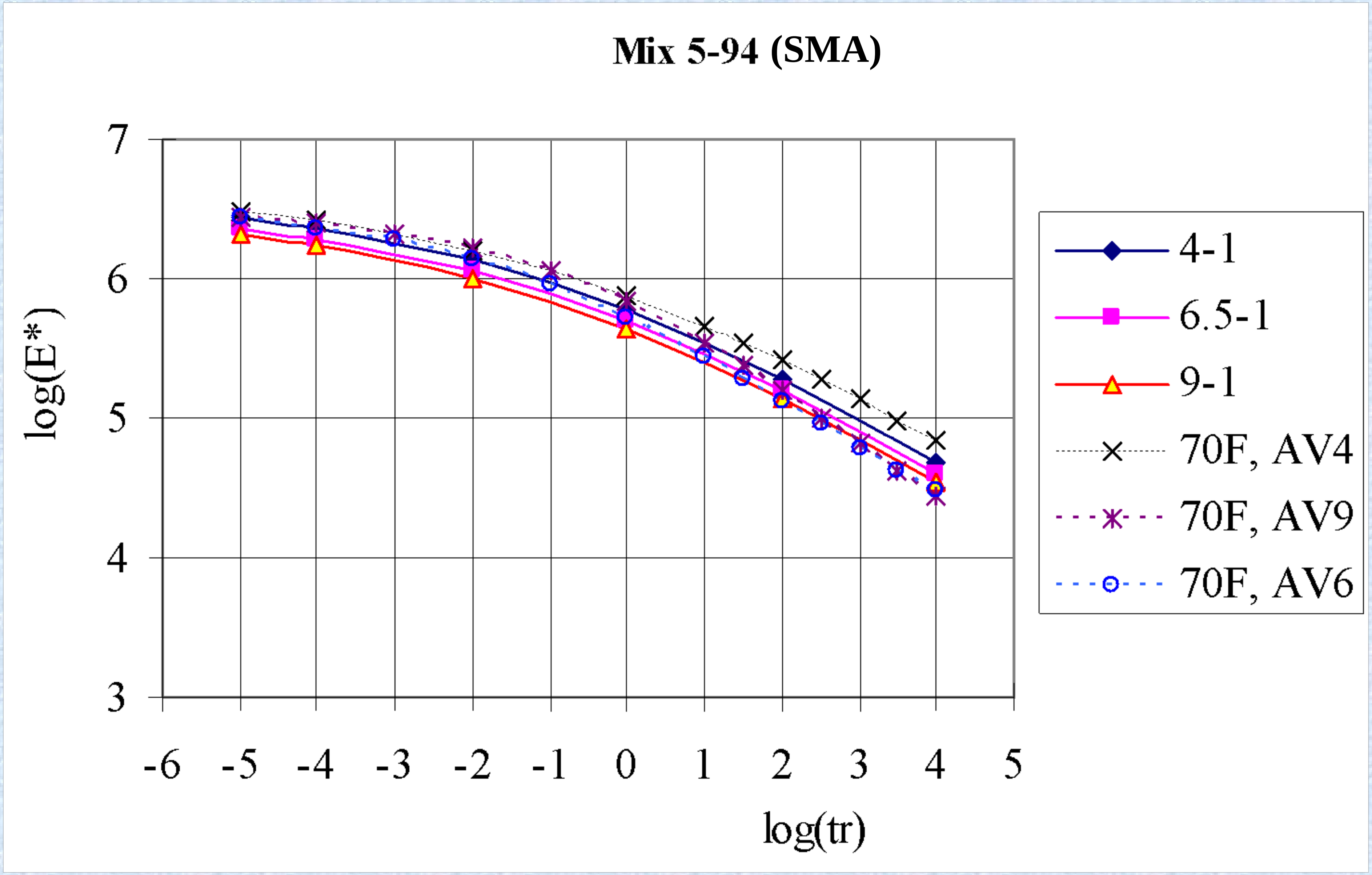
- Test frequencies – 25, 10, 5, 1, 0.5, and 0.1 Hz
- Test temperatures – (14)*, 40, 70, 100, and 130 ºF

  *estimated

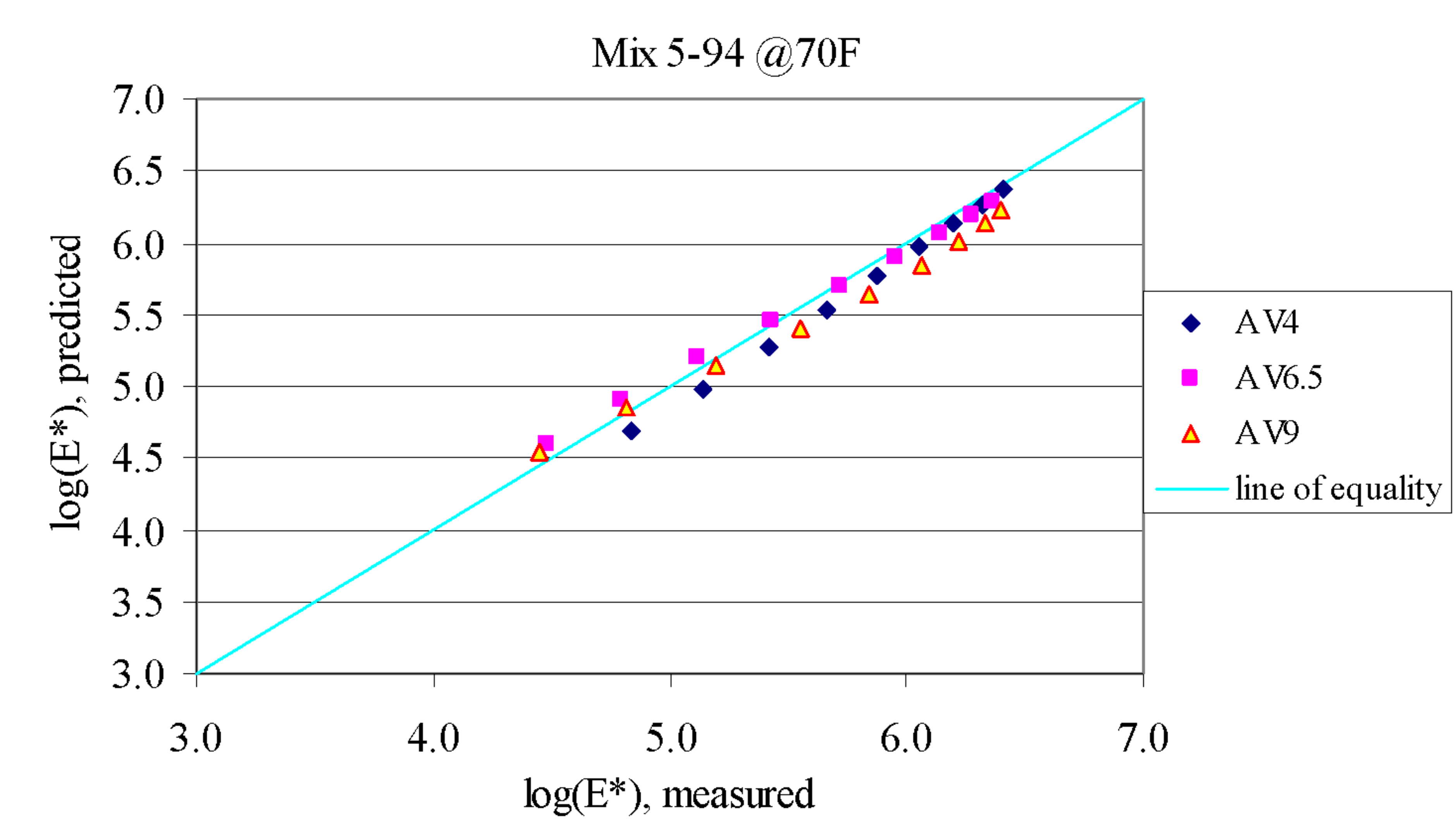
- Mixes completed included
  - SP125 PG76-22 (2)
  - SP190 PG76-22
  - SP190 PG70-22
  - SP190 PG64-22
  - SP250 PG70-22
  - SP250 PG64-22
  - BP1 PG64-22

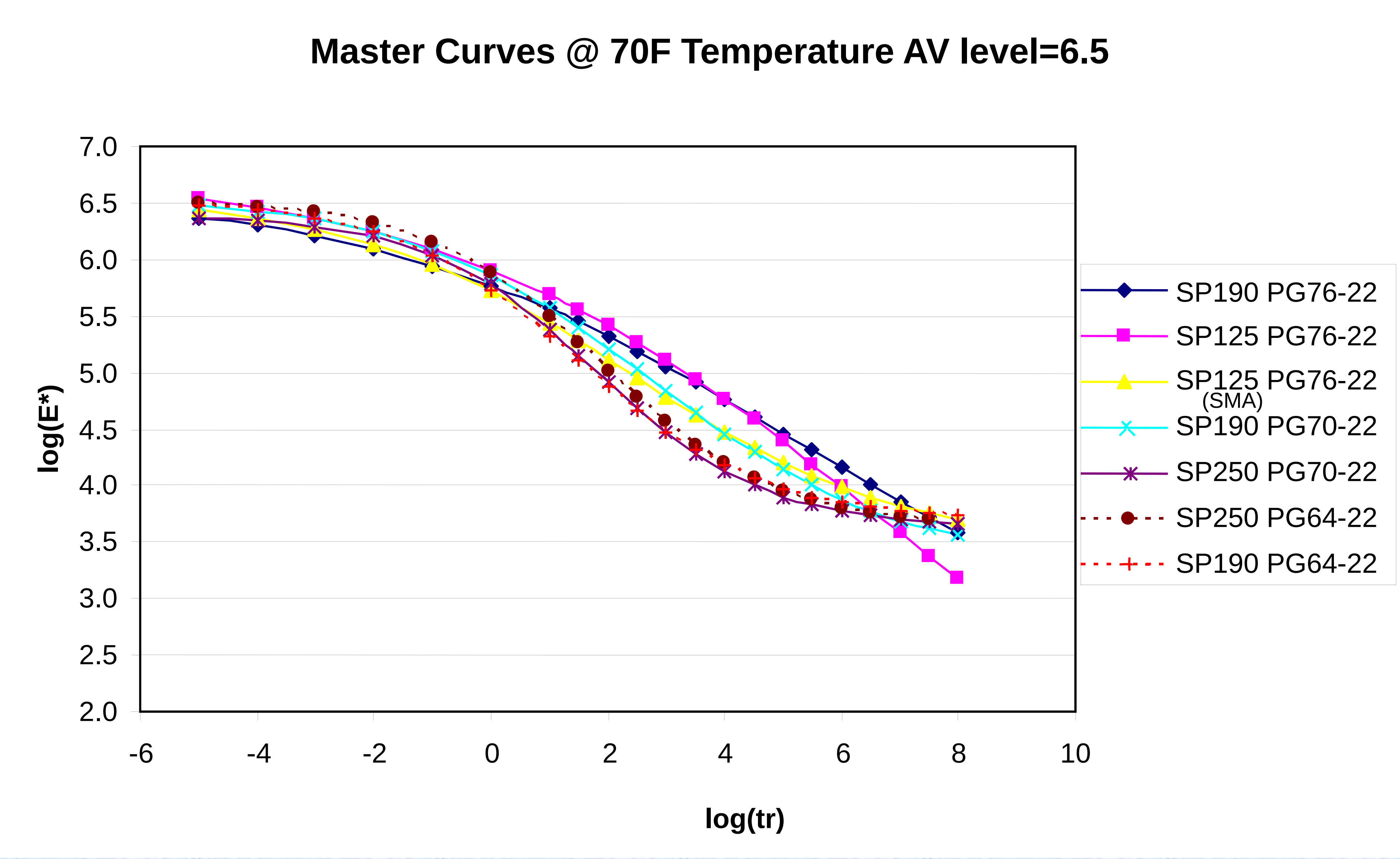
AMPT

Predicted (with Witczak model in MEPDG) and Measured Dynamic Modulus Master Curves for SP125 PG76-22



Predicted vs. Measured Dynamic Modulus for SP125 PG76-22





Master Curves @ 70F Temperature AV level=6.5
log(E*)
log(tr)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
-6
-4
-2
0
2
4
6
8
10
SP190 PG76-22
SP125 PG76-22
SP125 PG76-22 (SMA)
SP190 PG70-22
SP250 PG70-22
SP250 PG64-22
SP190 PG64-22

Dynamic Modulus Findings

- MEPDG dynamic modulus equation provides a reasonable prediction
- Air void range between 4 and 9 percent has minimal affect on dynamic modulus

Creep Compliance and IDT

- Testing performed under contract with Missouri University of Science and Technology (MS&T)
- AASHTO T-322
- Wearing course mixes only
  - SP125 @ PG64-22, 70-22, and 76-22
  - SMA @ PG76-22
  - BP-1 @ PG64-22

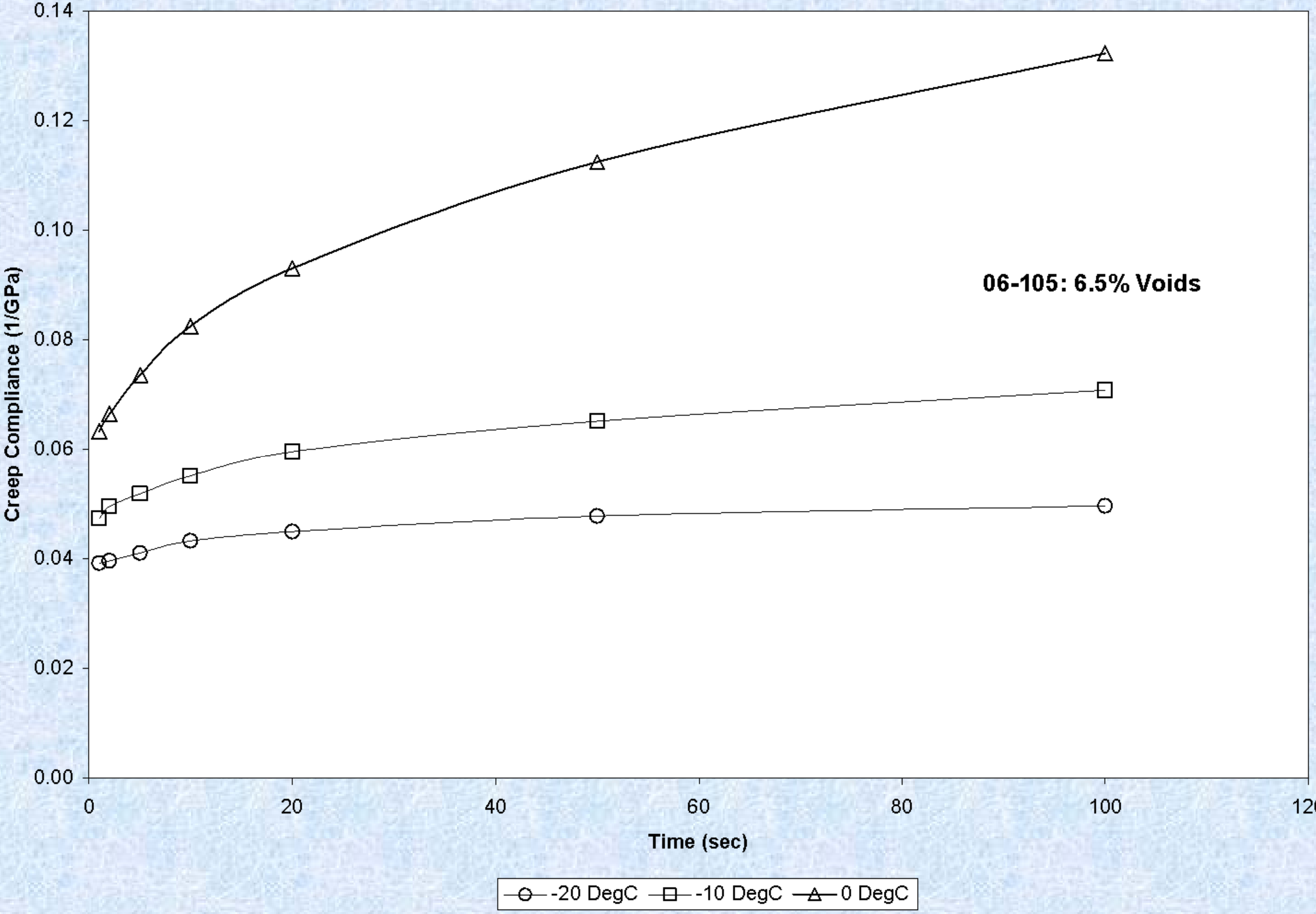
Creep Compliance and IDT

- Creep compliance -
  - Test loading times – 1, 2, 5, 10, 20, 50, and 100 s
  - Test temperatures– -20, -10, and 0 ºC
- Indirect Tensile Strength tested at -10 ºC

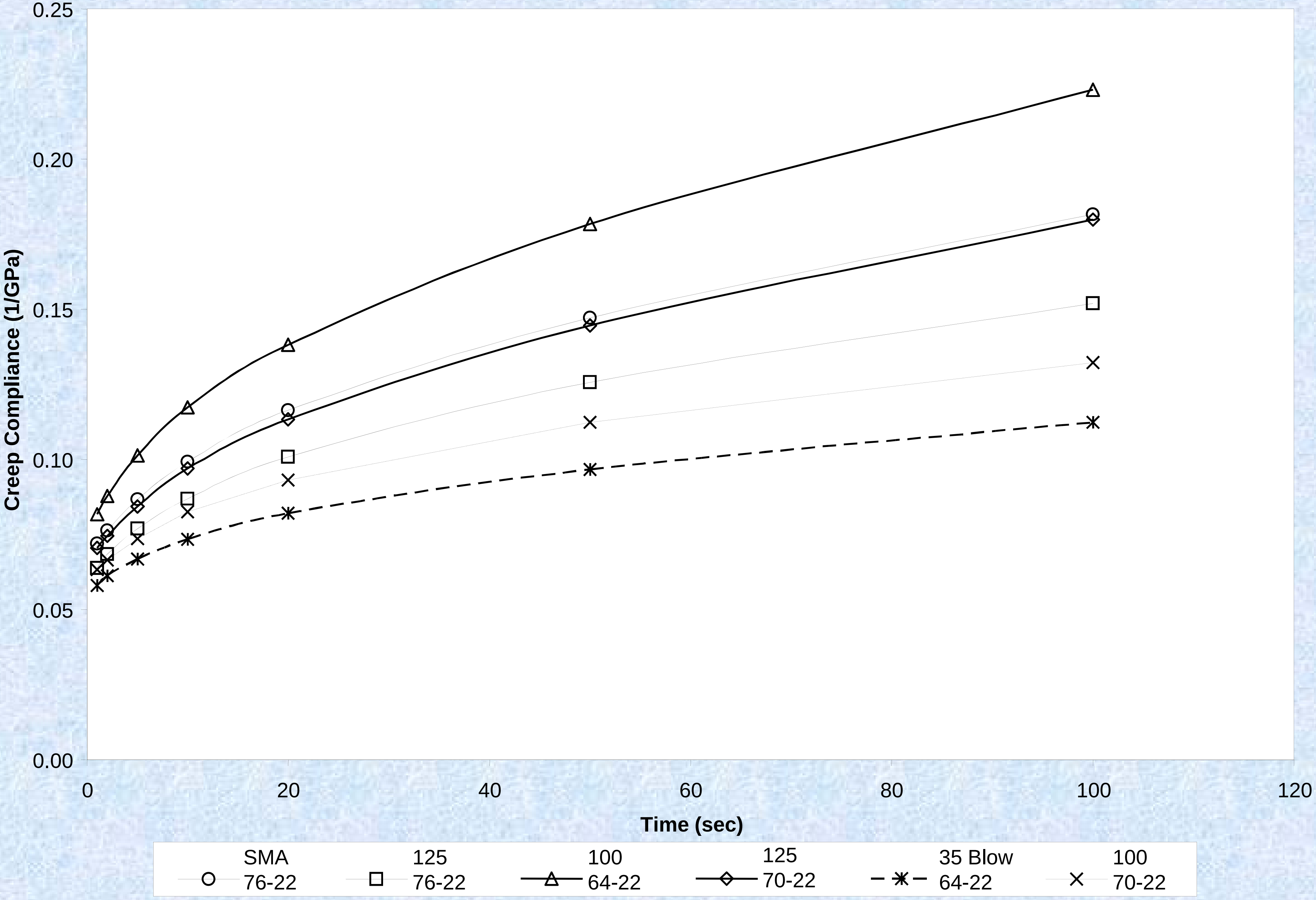
IDT and Creep Compliance Equipment

Specimen Set Up

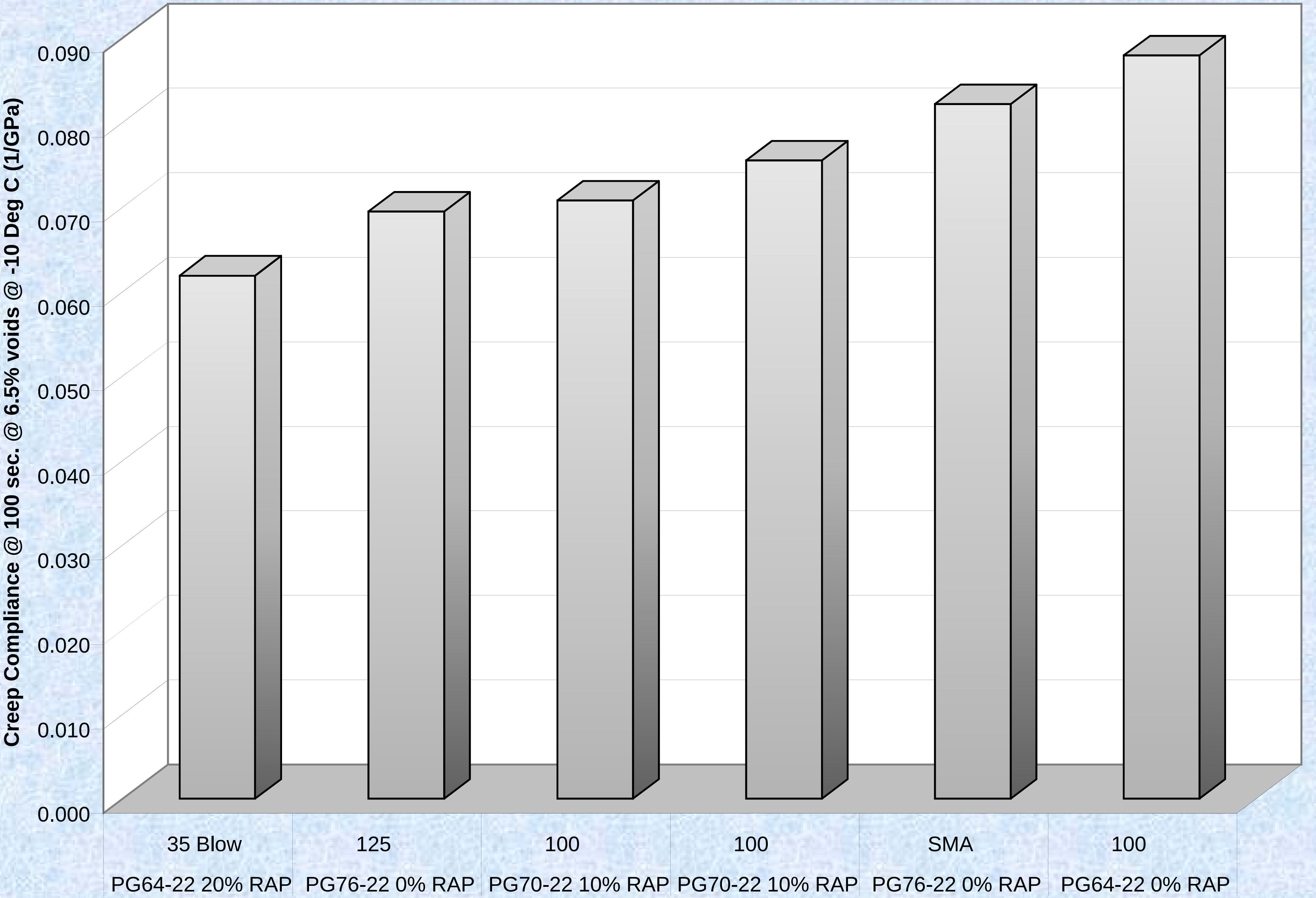
SP125 PG70-22 @ 6.5% Voids



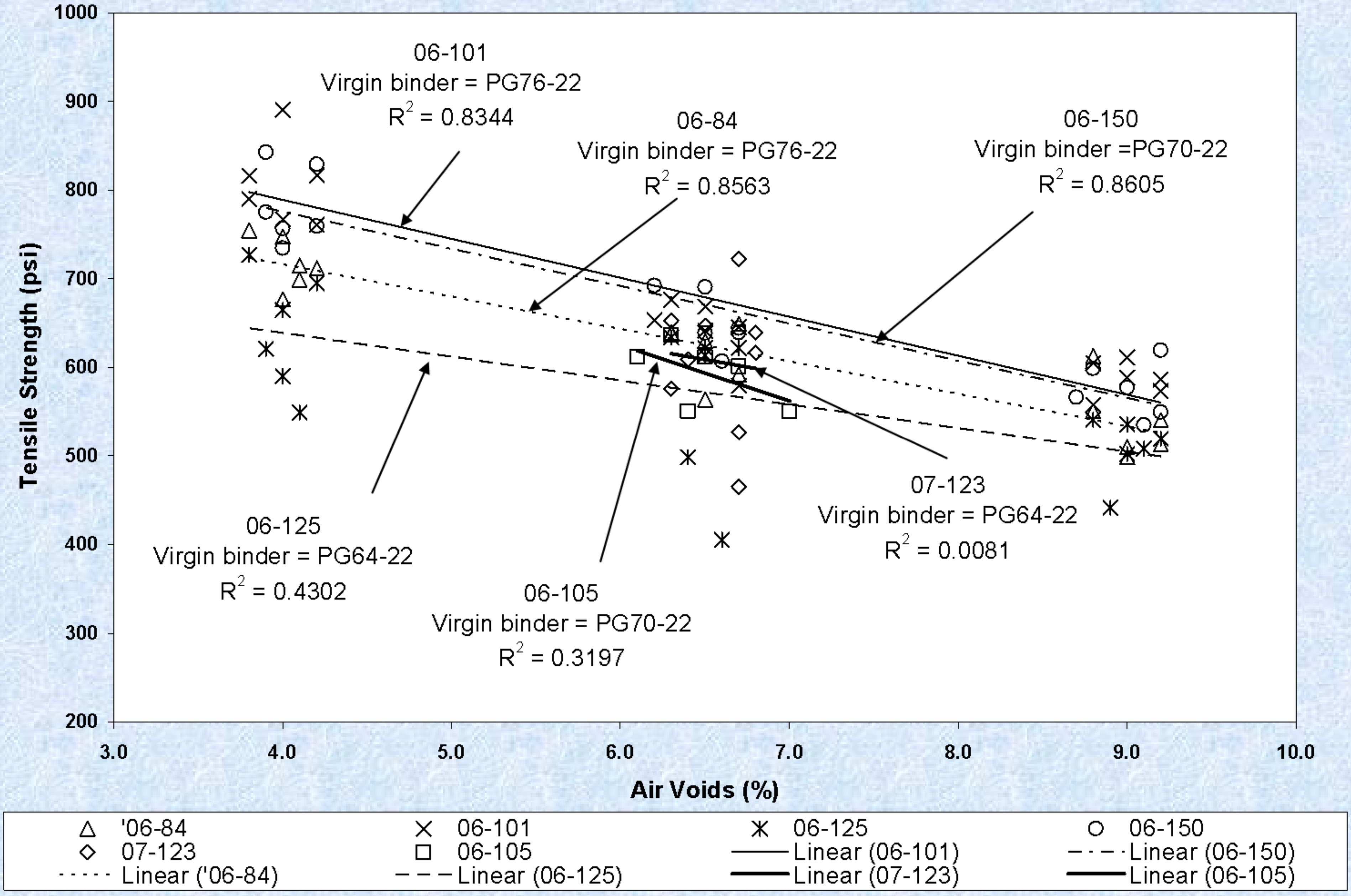
6 Mixes @ 6.5% Voids & 0°C



100 Second Creep Compliance @ 6.5% Voids @ -10°C



IDT Strength vs % Air Voids: All Mixes: -10°C



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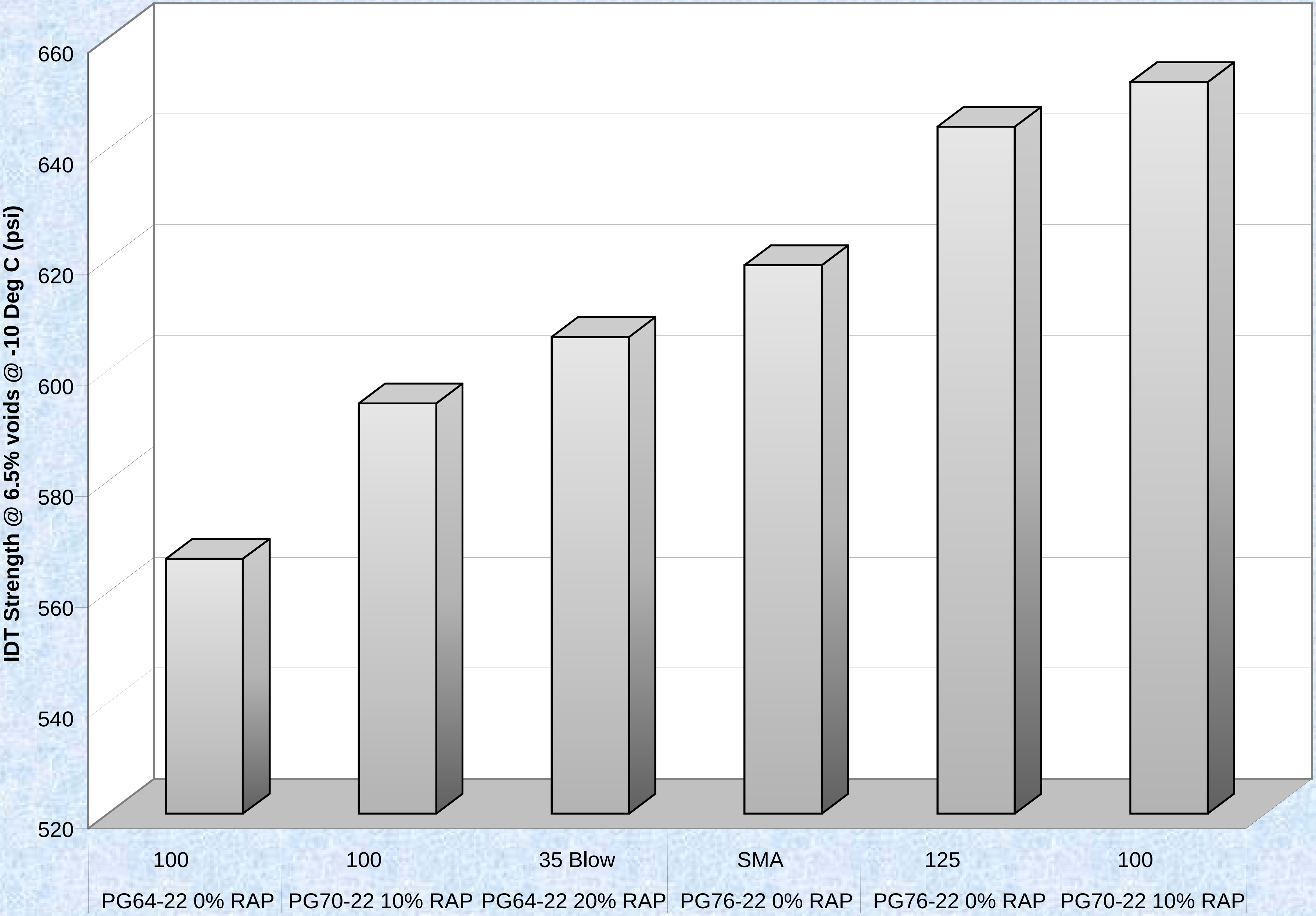
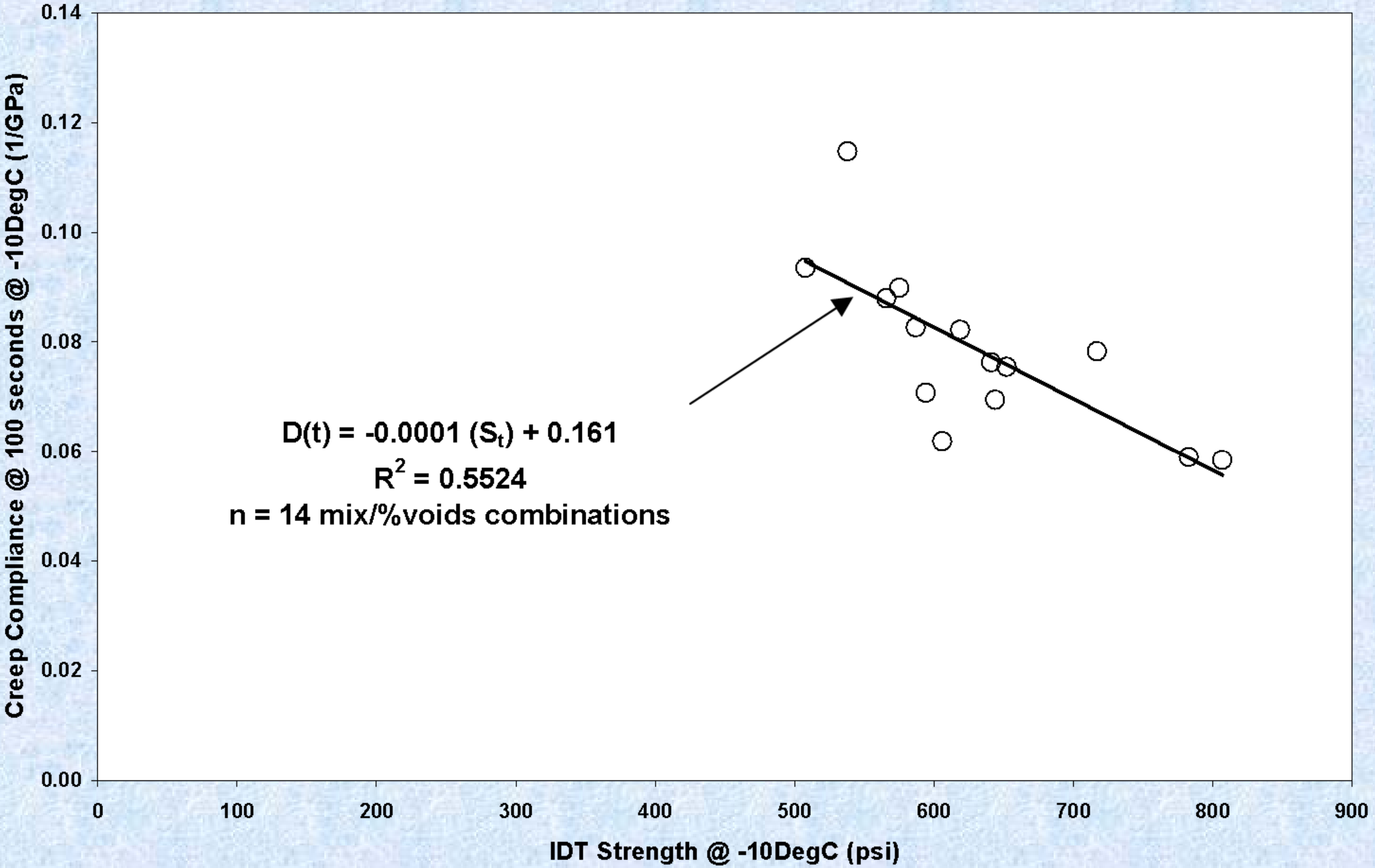


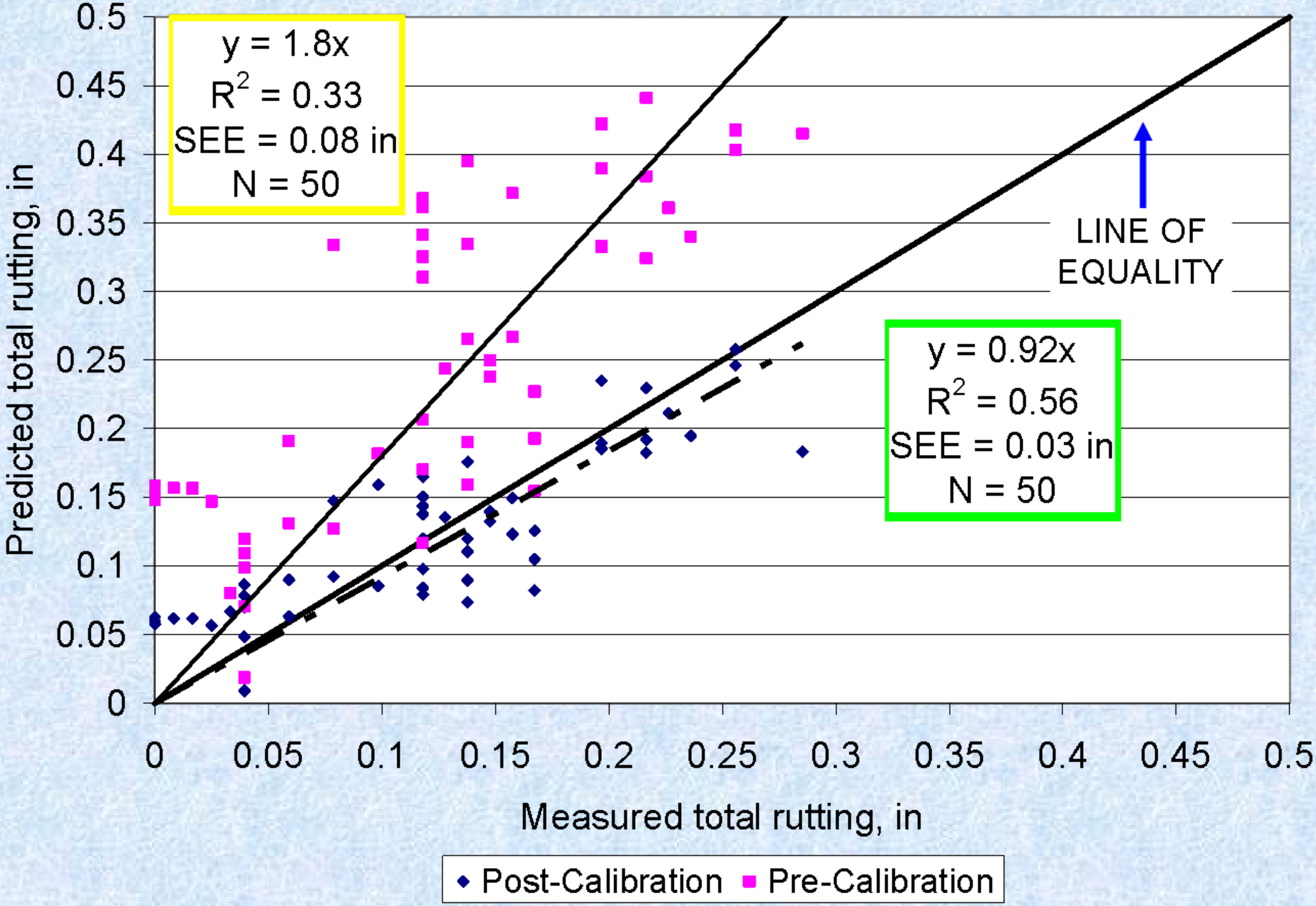
100 Second Creep Compliance vs IDT Strength: -10°C



Local Calibration/Validation Steps

1. Assemble best possible input data for each sample unit
   a) Backcast initial IRI from historical IRI data for each section
   b) Backcast initial AADTT and compute growth rate from historical traffic data
   c) Assume MODOT specific defaults where project specific data is not available
2. Execute MEPDG runs
3. Examine predicted versus measured distress plots
4. Assess bias and error
5. Make suitable engineering and statistical analyses to calibrate models and to reduce bias and error

New HMA Pavements—Measured



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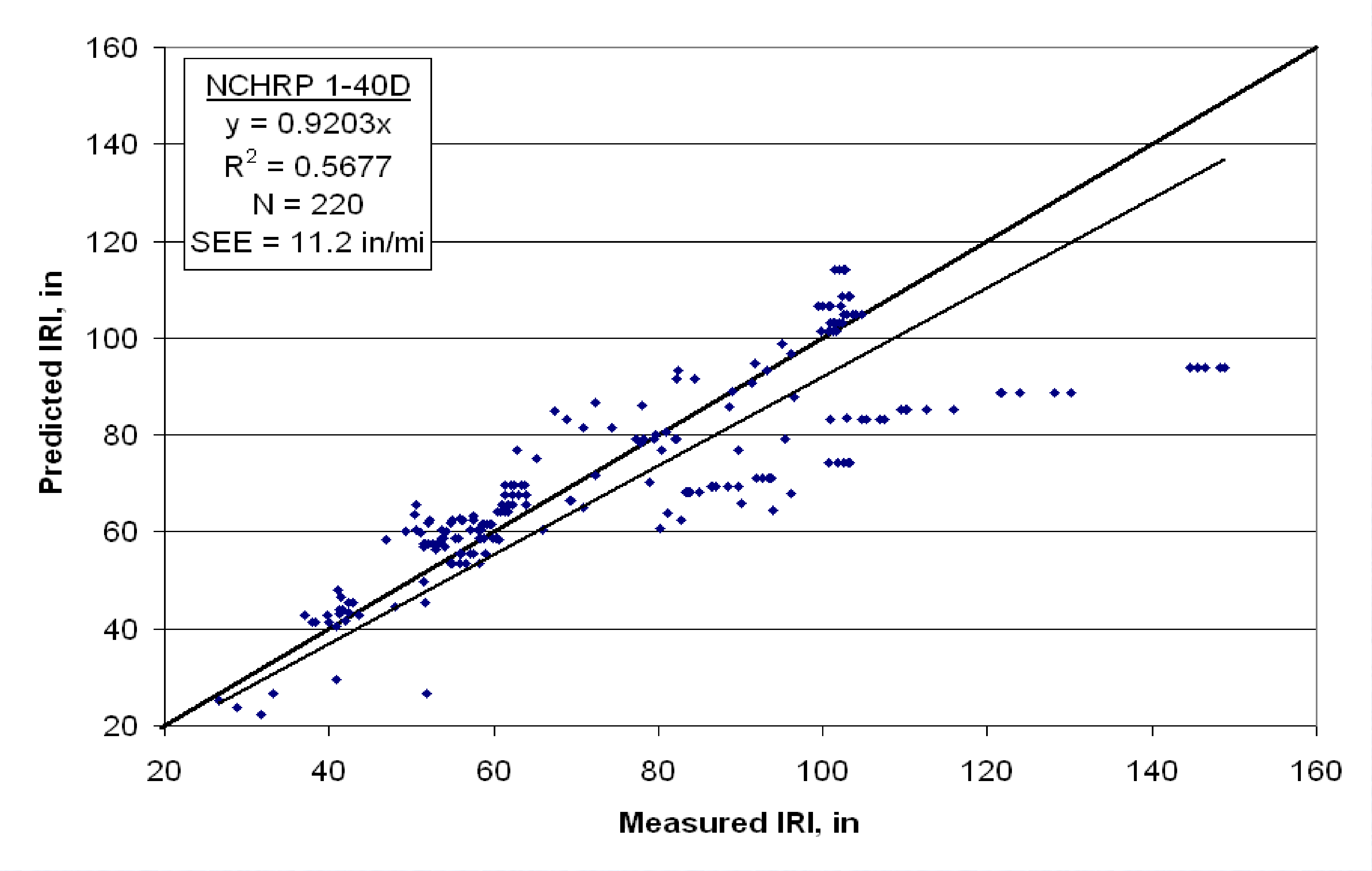

Thank You!

Questions?

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