NORTH CENTRAL ASPHALT USER PRODUCER GROUP

FEBRUARY 4-5, 2009

MADISON, WI

PANEL DISCUSSION

ALTERNATE BINDER MODIFIERS

BACKGROUND

- I figured all of us would be reduced to discussing similar materials
- Decided to take a different approach
- I am going to discuss alternate methodologies for evaluating how to evaluate these alternate modification techniques affect mix behavior and how we might be better able to ascertain mix performance
- After all just throwing something into asphalt doesn't mean that we have beneficiated the mix

SOME ALTERNATE TYPES OF MODIFIERS

1. POLYMERS OR OTHER ADDITIVES OTHER THAN SBS OR SB
   a) PPA in addition to SBS or SB modification
   b) Elvaloy + PPA
   c) PPA
2. CRUMB RUBBER MIXES
3. SULFUR CONTAINING MIXES

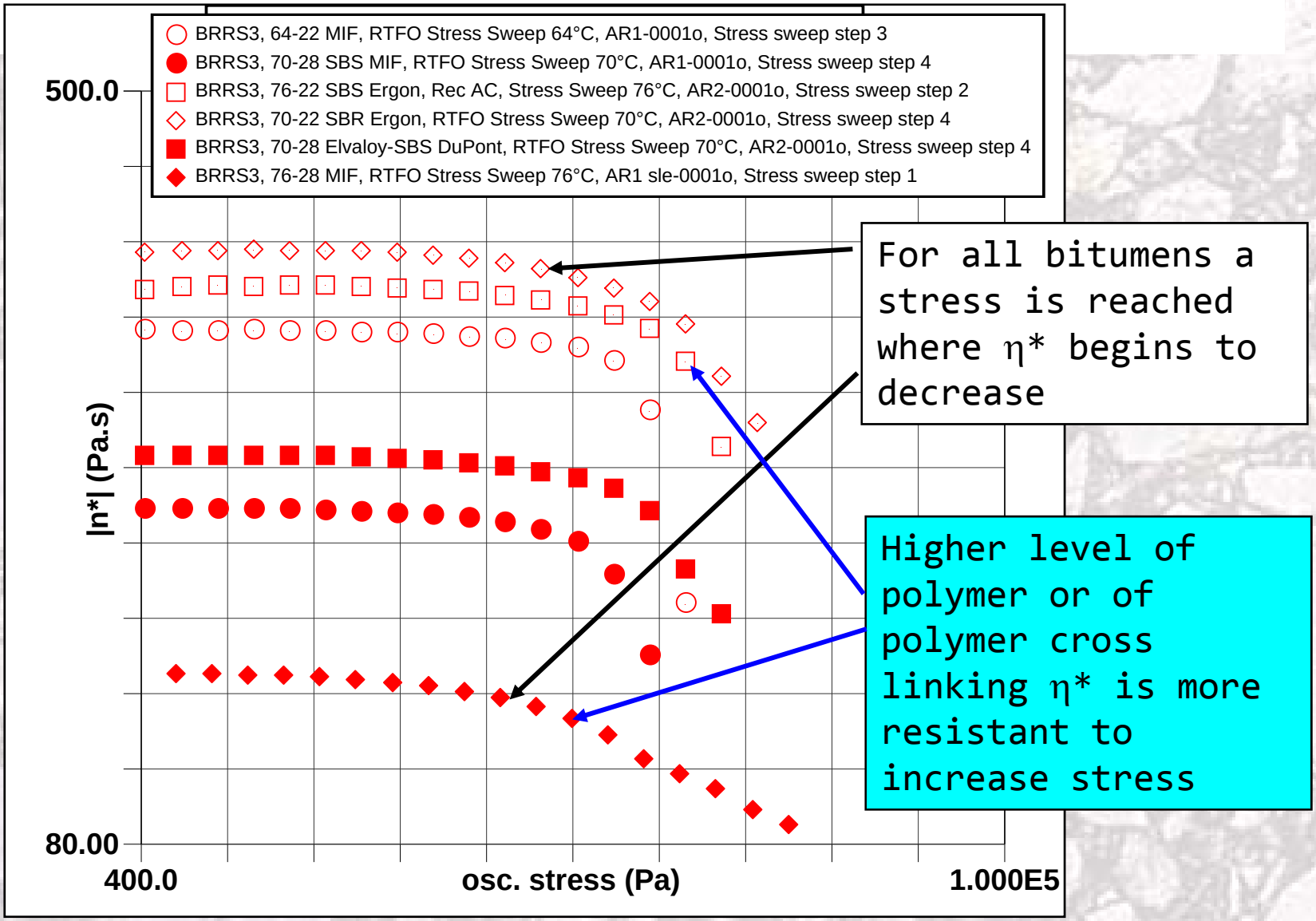
SOME ALTERNATE TYPES OF MODIFIERS

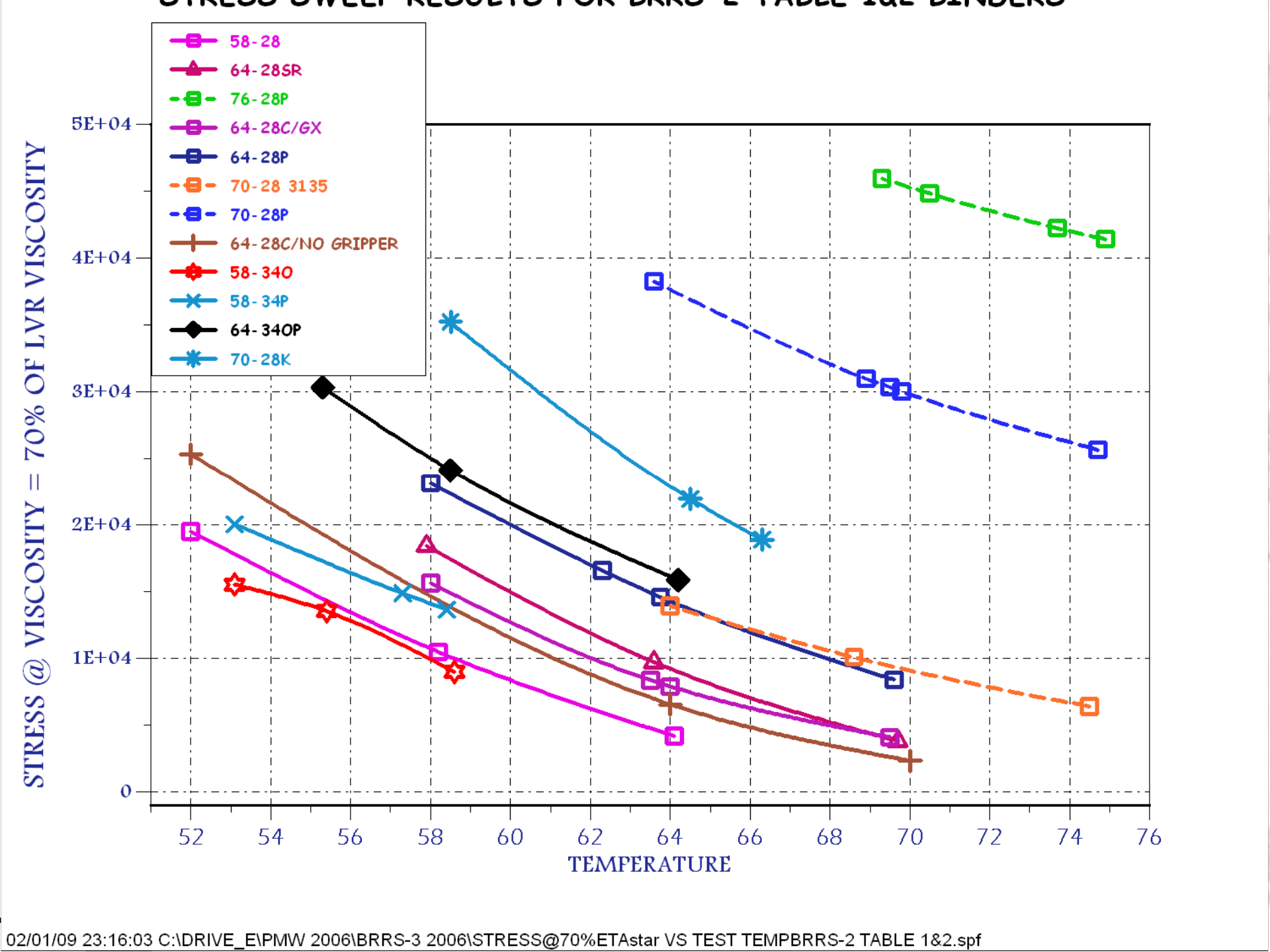
4. HIGH RAP CONTENT MIXES
   a) When the RAP content reaches 30+% I submit the RAP binder is a modifier to both the binder and the mix
5. SHINGLE CONTAINING MIXES
   a) Virgin Shingle scrap
   b) Tear off Shingle material
6. WARM MIXES
   a) Reduced Temperatures effectively modify binder & mix performance
   b) High RAP levels (40% and higher) in warm mixes

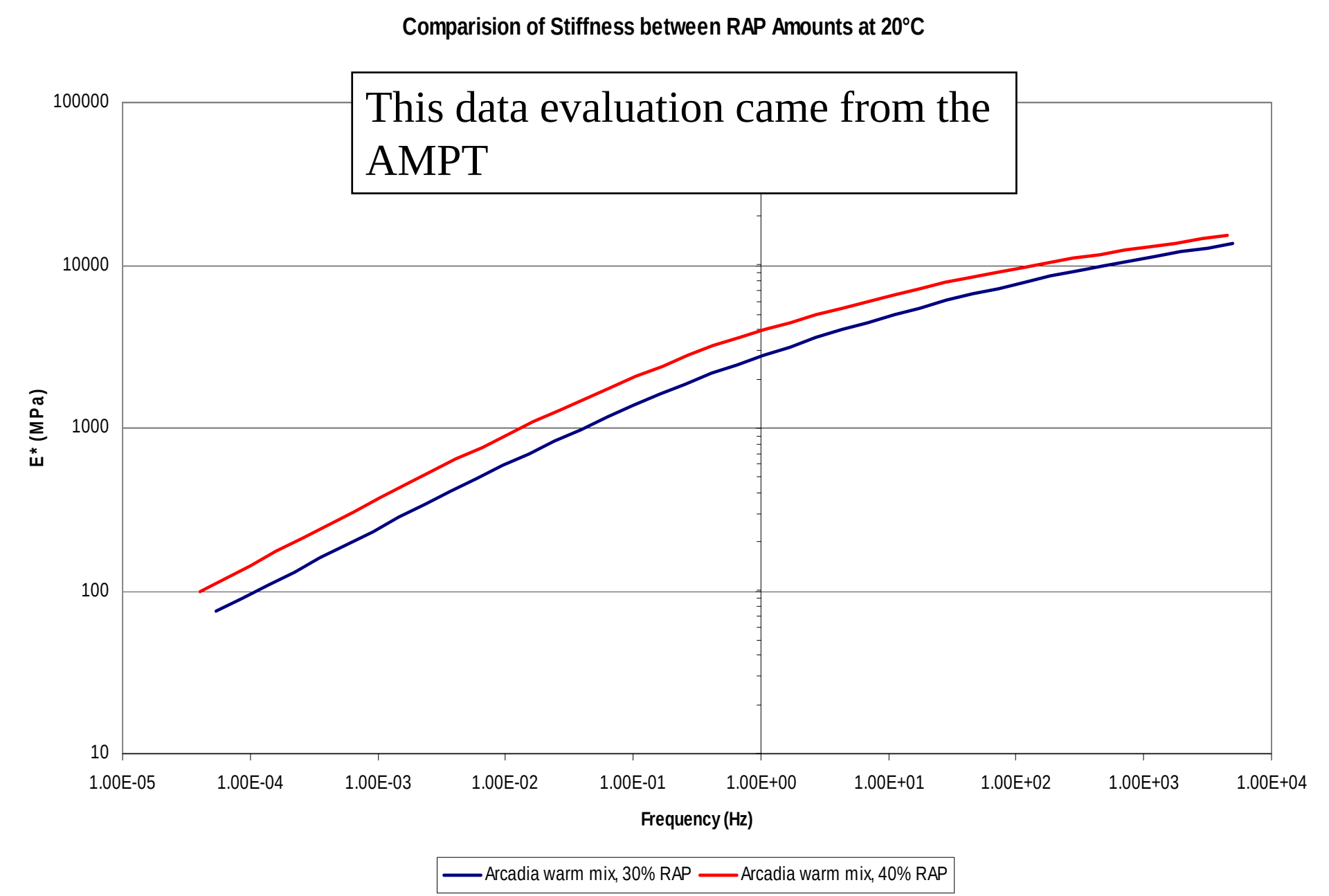
SOME TYPES OF TESTS

1. STRESS TESTS ON BINDER
   a) Mix performance appears to be directly related to the stress sensitivity of the binder, especially for high temperature performance.
2. ASPHALT MIX PERFORMANCE TESTER TO DETERMINE STRENGTH & FLOWNUMBER PROPERTIES OF MIXTURES
3. Mix repeated creep tests at varying temperatures and stress levels
   a) We use torsion bars in DSR—advantage is that many tests can be performed quickly to get an idea of mix performance
4. Mix cylinder tests to evaluate mix modulus and fatigue performance
   a) Sieve mix on #4 sieve and fabricate small cylindrical samples of mix that we then can evaluate for modulus and fatigue performance.
   b) We are finding this useful to evaluate RAP mixes and warm mixes without having to extract binders

BINDER STRESS SWEEP RESULT




STRESS SWEEP RESULTS FOR BRRS-2 TABLE 1&2 BINDERS
58-28
64-28SR
76-28P
64-28C/GX
64-28P
70-28 3135
70-28P
64-28C/NO GRIPPER
58-34O
58-34P
64-34OP
70-28K
STRESS @ VISCOSITY = 70% OF LVR VISCOSITY
5E+04
4E+04
3E+04
2E+04
1E+04
0
52
54
56
58
60
62
64
66
68
70
72
74
76
TEMPERATURE
02/01/09 23:16:03 C:\DRIVE_E\PMW 2006\BRRS-3 2006\STRESS@70%ETAstar VS TEST TEMPBRRS-2 TABLE 1&2.spf


Comparision of Stiffness between RAP Amounts at 20°C
This data evaluation came from the AMPT
100000
10000
1000
100
10
E* (MPa)
1.00E-05
1.00E-04
1.00E-03
1.00E-02
1.00E-01
1.00E+00
1.00E+01
1.00E+02
1.00E+03
1.00E+04
Frequency (Hz)
Arcadia warm mix, 30% RAP
Arcadia warm mix, 40% RAP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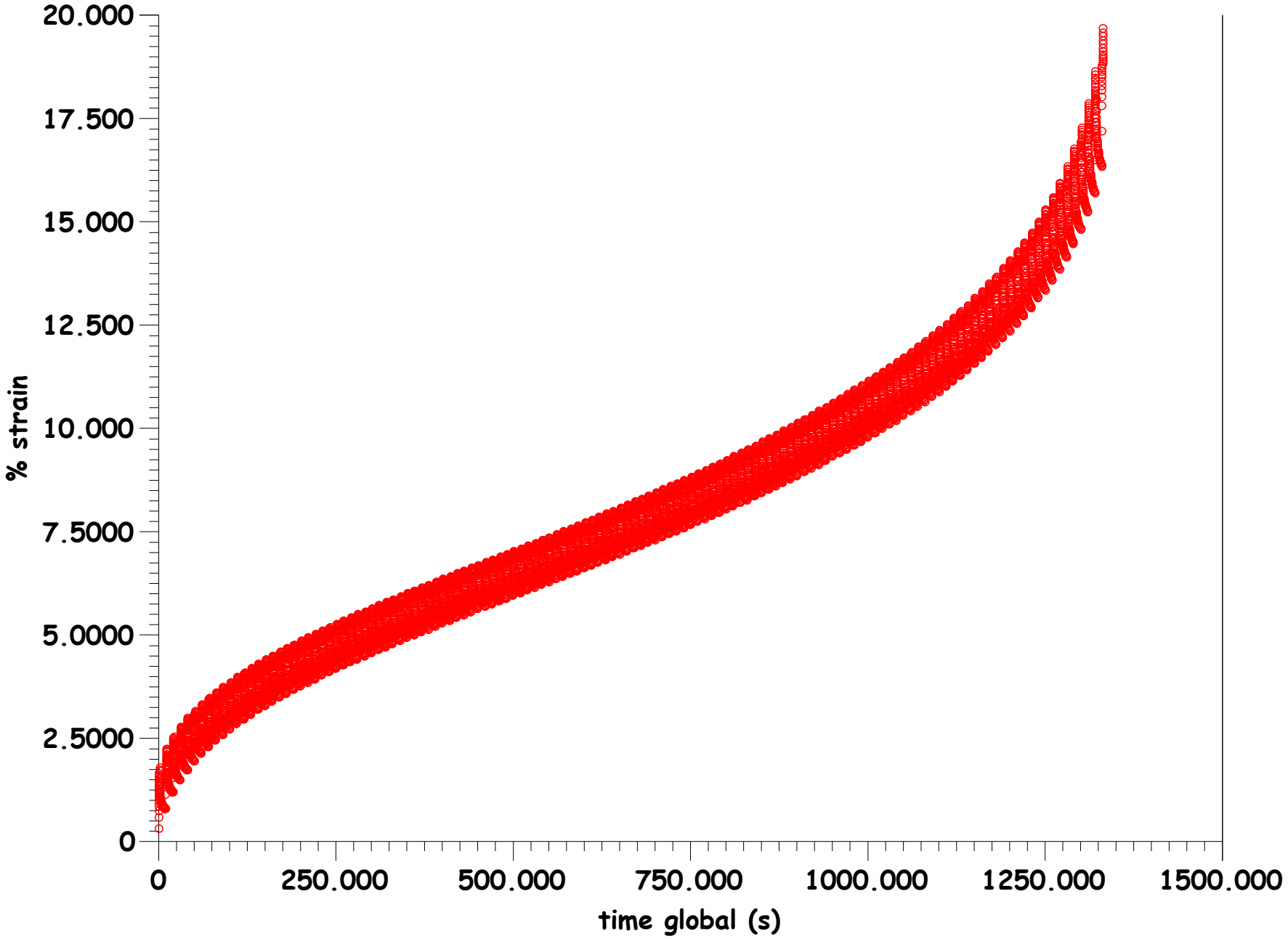
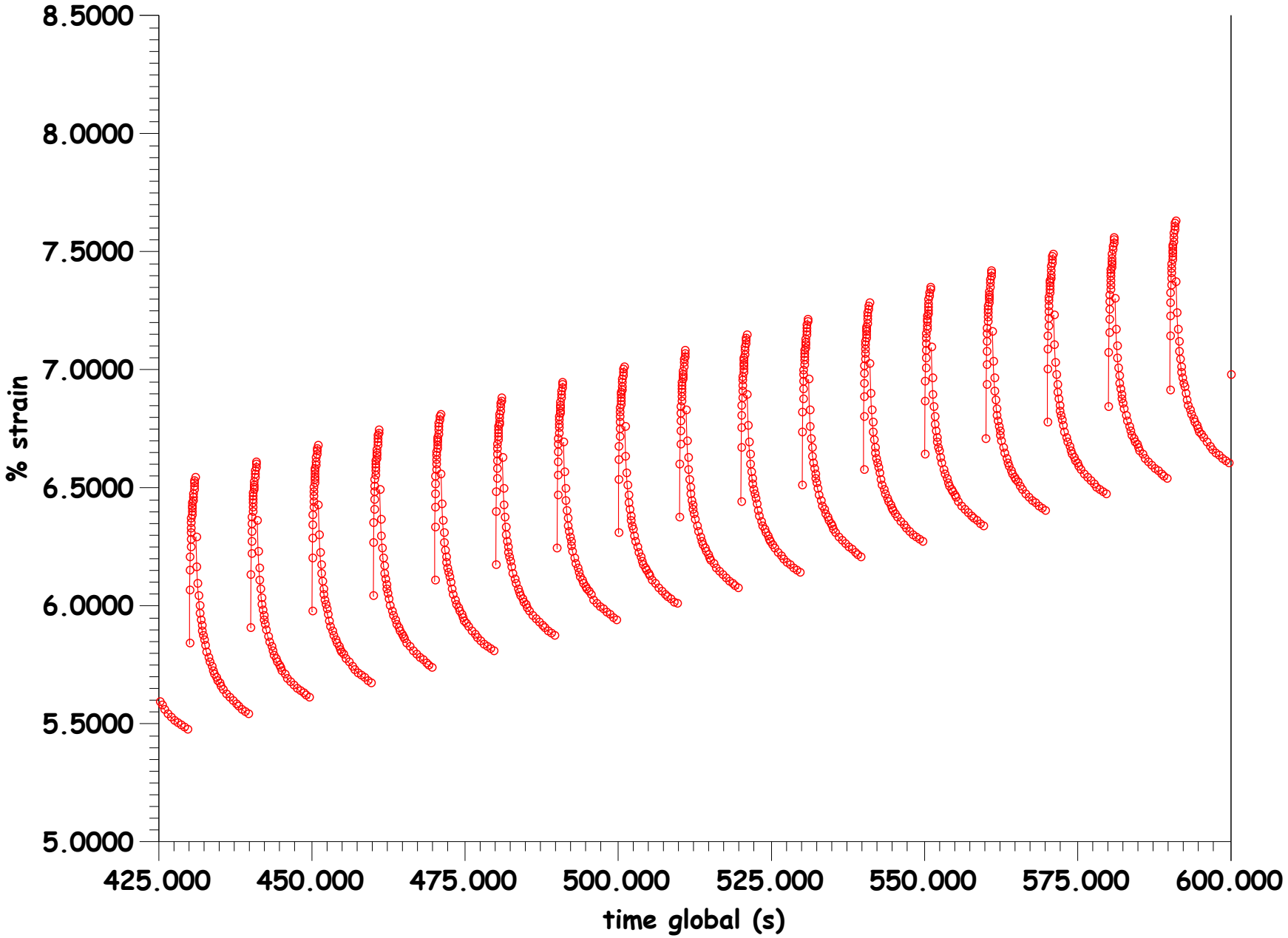
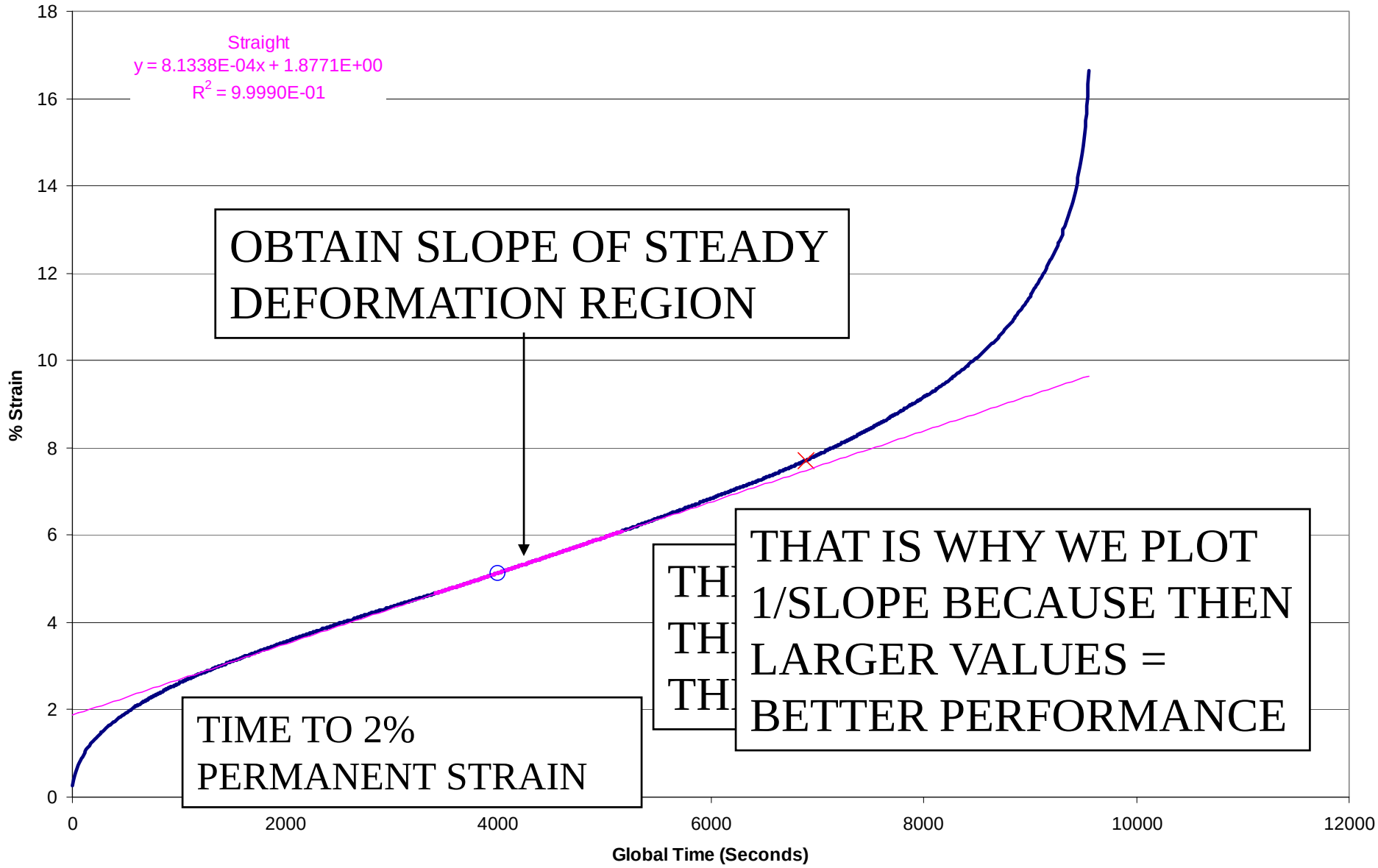
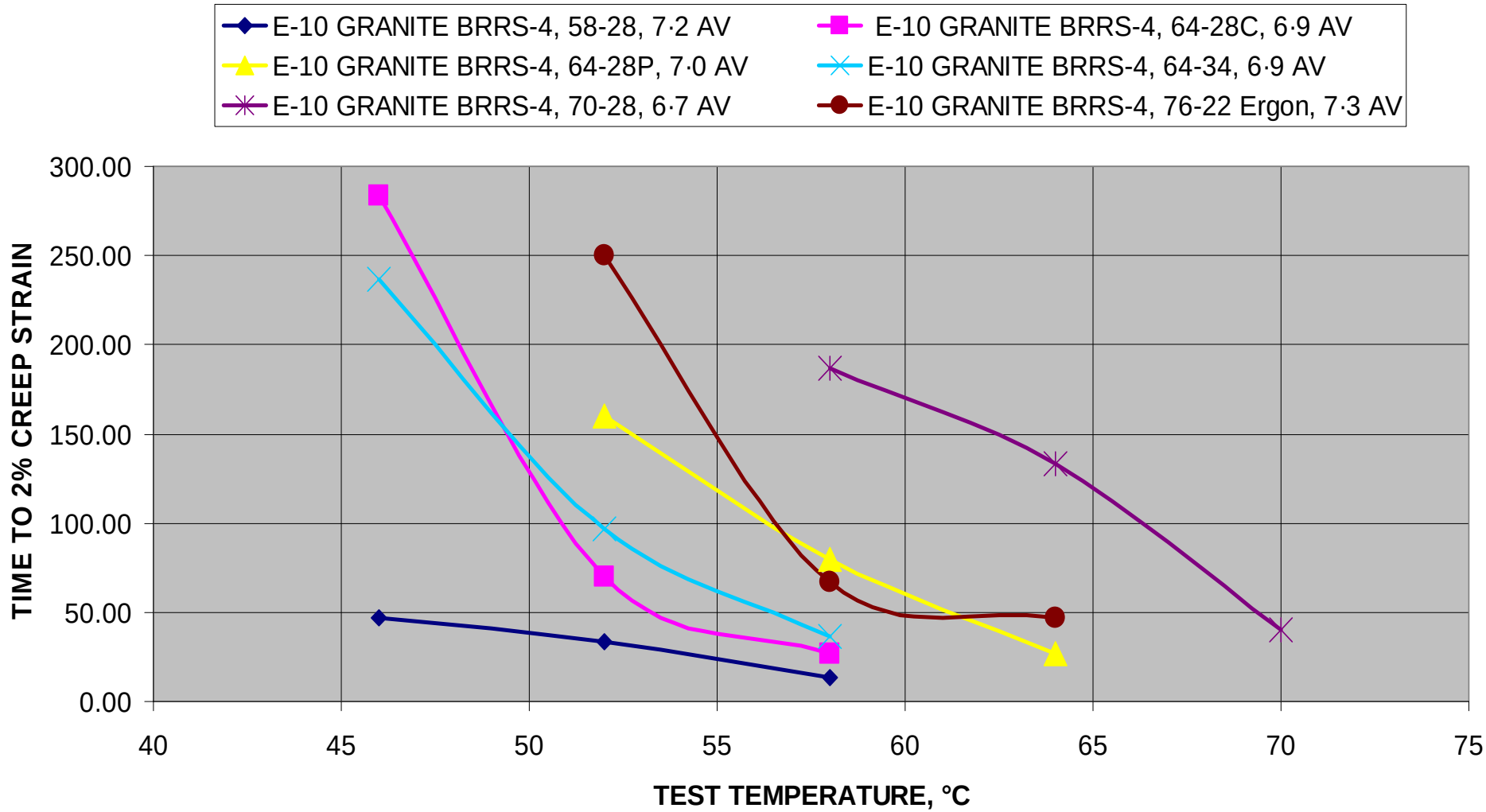

20.000
17.500
15.000
12.500
10.000
7.5000
5.0000
2.5000
0
% strain
0
250.000
500.000
750.000
1000.000
1250.000
1500.000
time global (s)

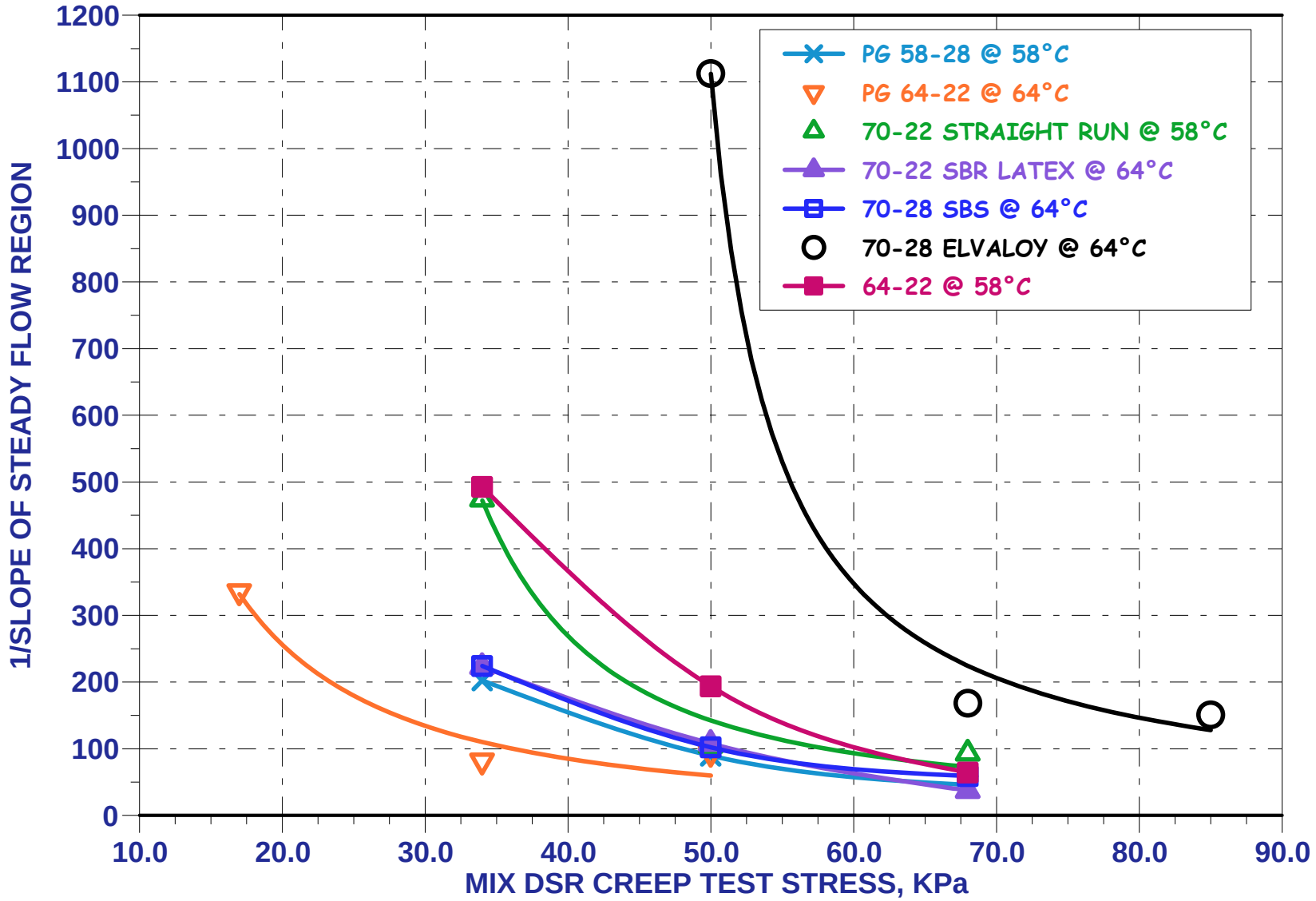

8.5000
8.0000
7.5000
7.0000
6.5000
6.0000
5.5000
5.0000
% strain
425.000
450.000
475.000
500.000
525.000
550.000
575.000
600.000
time global (s)

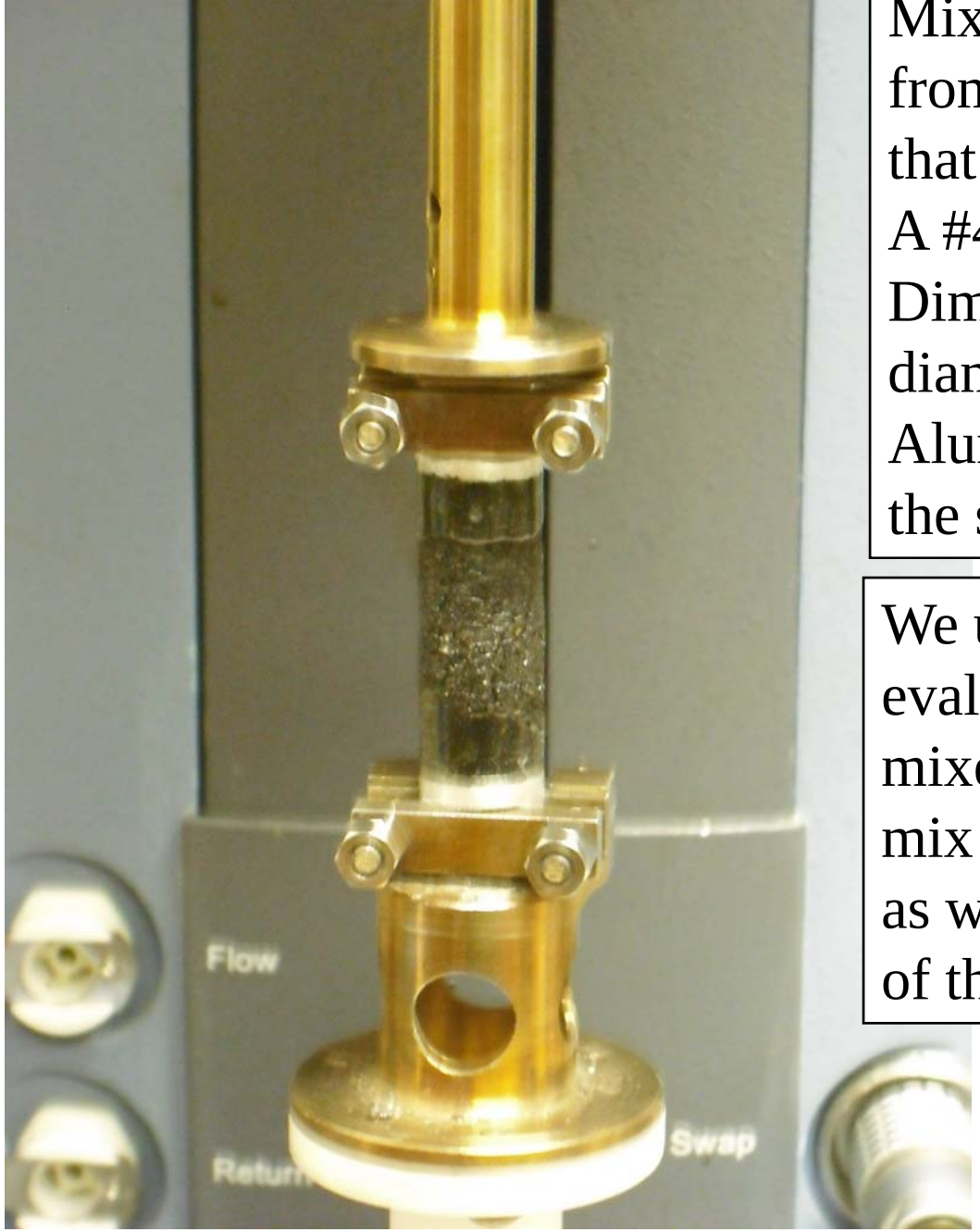

Straight
y = 8.1338E-04x + 1.8771E+00
R2 = 9.9990E-01
OBTAIN SLOPE OF STEADY DEFORMATION REGION
THAT IS WHY WE PLOT 1/SLOPE BECAUSE THEN LARGER VALUES = BETTER PERFORMANCE
TIME TO 2% PERMANENT STRAIN
% Strain
Global Time (Seconds)
0
2
4
6
8
10
12
14
16
18
0
2000
4000
6000
8000
10000
12000

MIX TEMP SENSITIVITY ~7% VOIDS



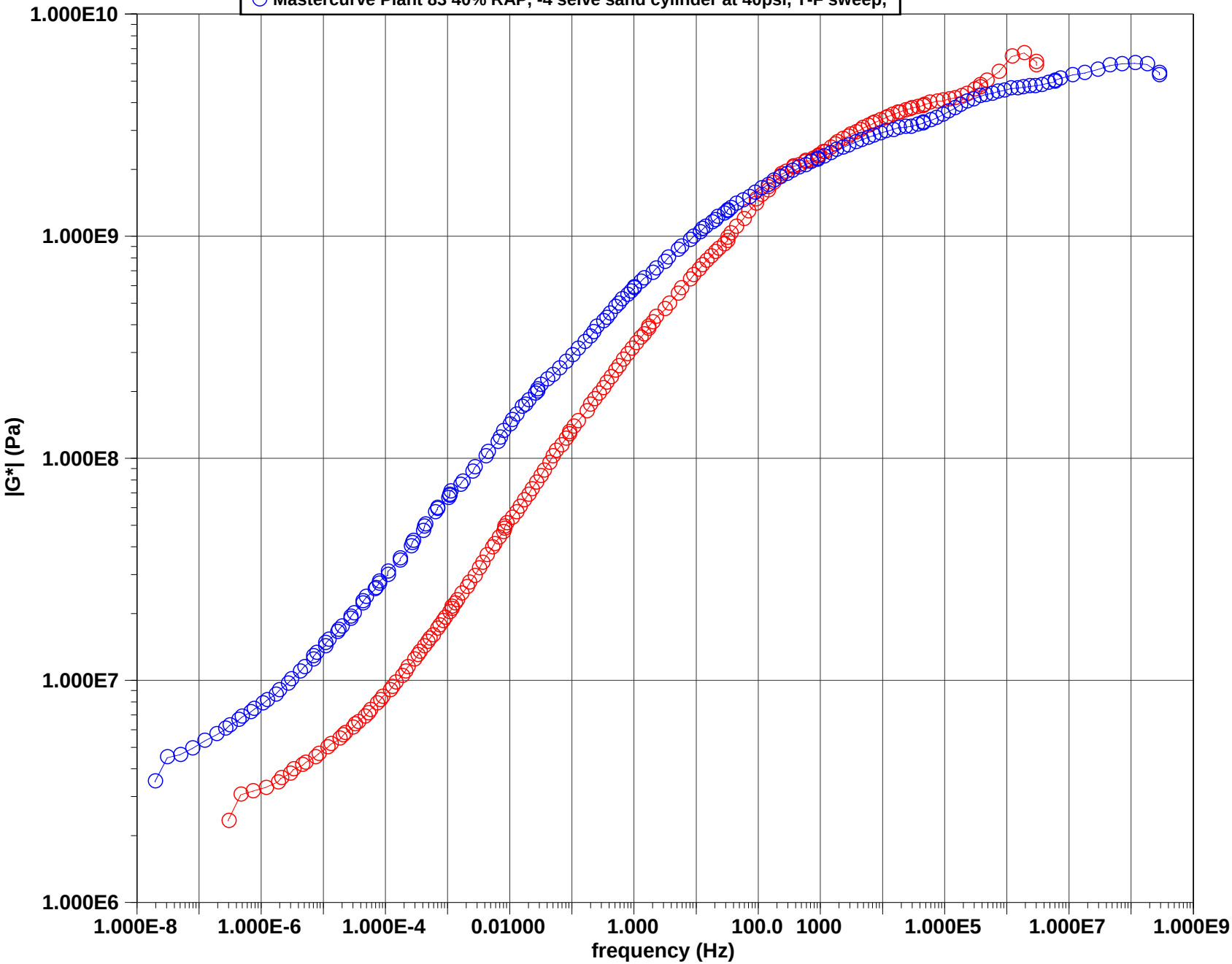
1/SLOPE OF DSR CREEP TEST IN STEADY FLOW REGION



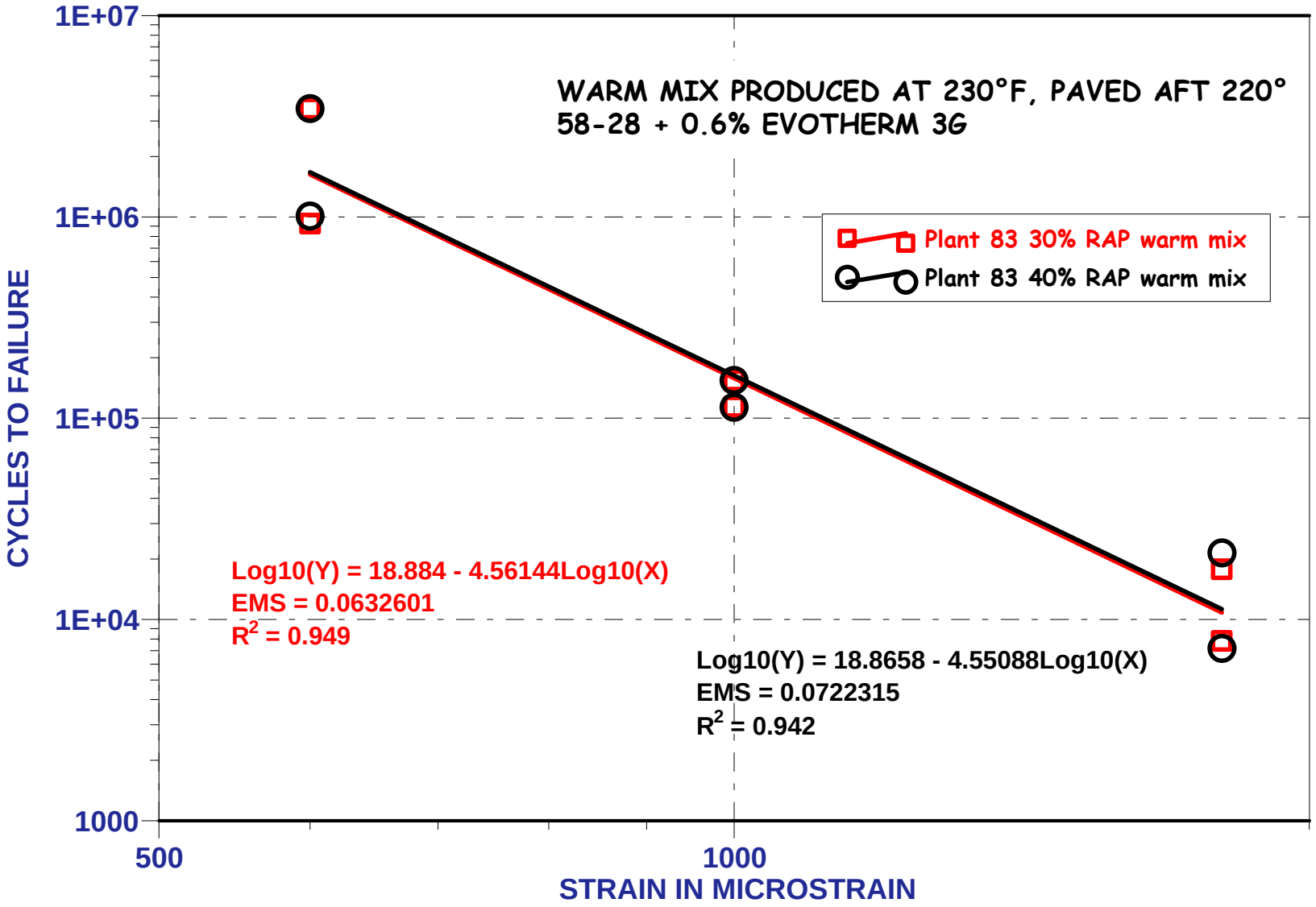


Mix cylinders are molded from plant mix material that has been sieved through A #4 (4.76 mm) sieve. Dimensions are 12 mm diameter and 30 mm in length. Aluminum ends are glued to the specimen

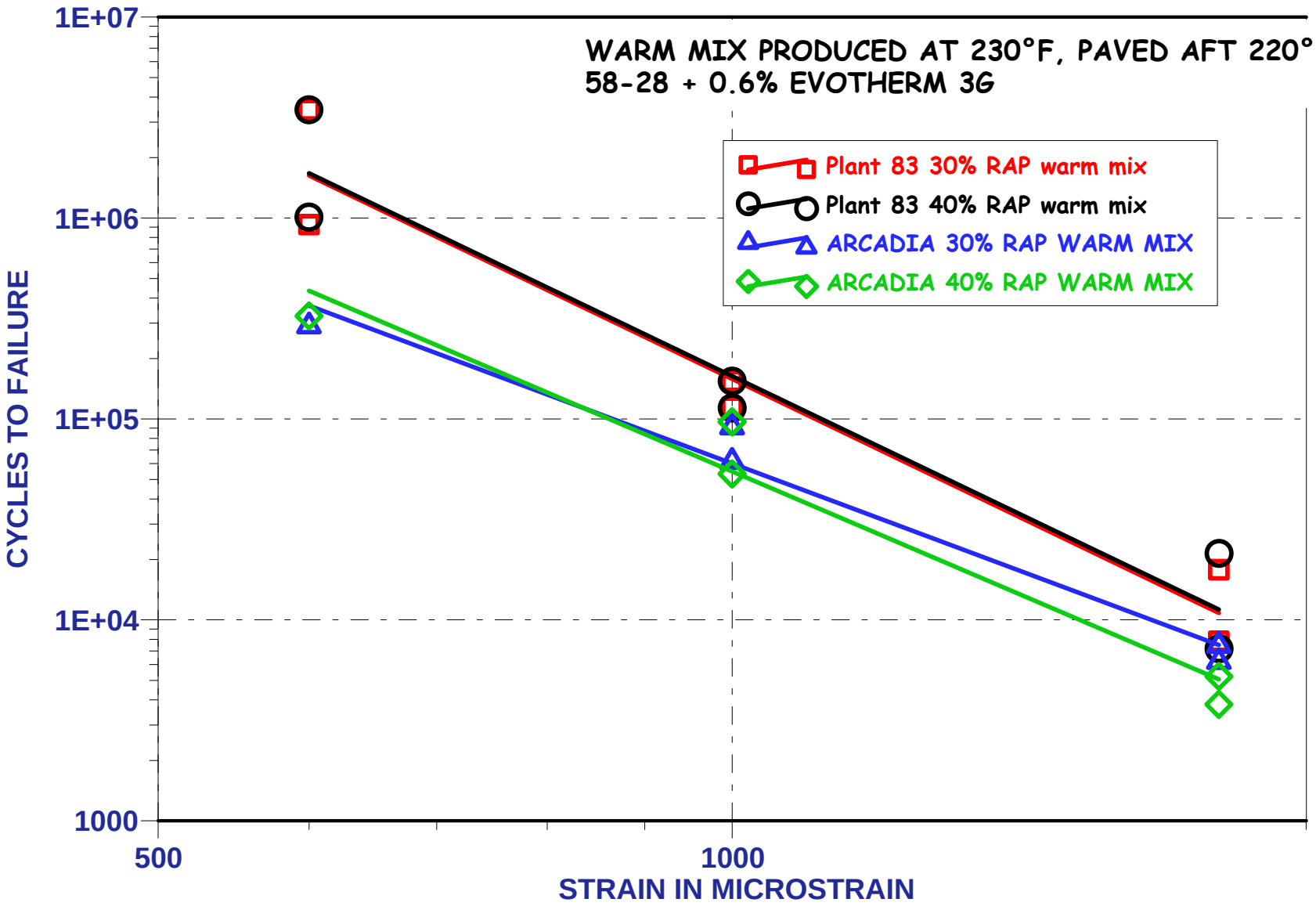
We use these samples to evaluate RAP and warm mixes to determine the mix complex shear modulus as well as fatigue analysis of the mix


Mastercurve Plant 83 40% RAP, -4 selve sand cylinder at 40psi, T-P sweep,
1.000E10
1.000E9
1.000E8
1.000E7
1.000E6
|G*| (Pa)
1.000E-8
1.000E-6
1.000E-4
0.01000
1.000
100.0
1000
1.000E5
1.000E7
1.000E9
frequency (Hz)

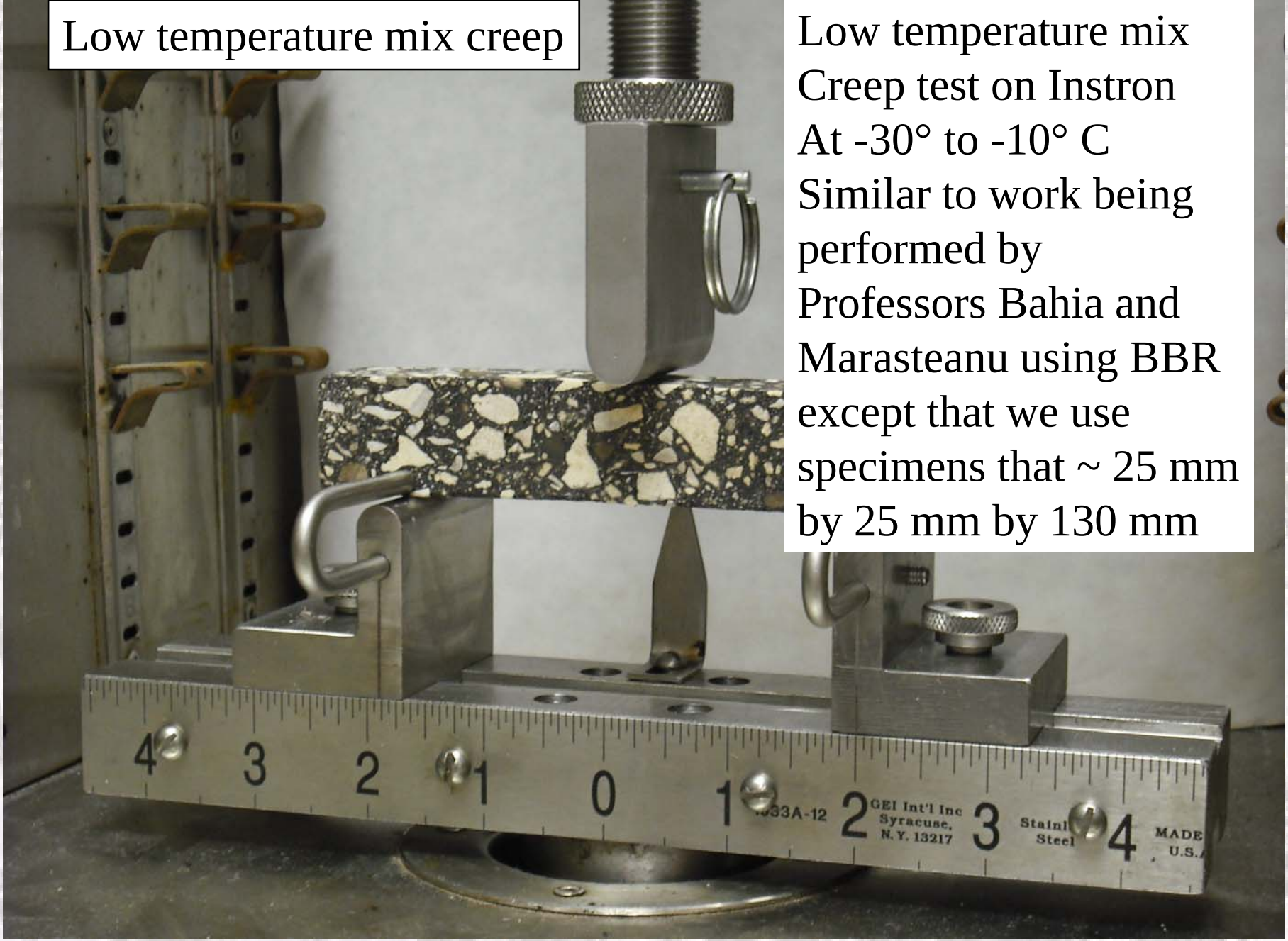
MIX CYLINDER FATIGUE TEST RESULTS
PLANT 83 WARM MIX AT 30% AND 40% RAP CONTENT



MIX CYLINDER FATIGUE TEST RESULTS
PLANT 83 & ARCADIA WARM MIX AT 30% AND 40% RAP CONTENT



Low temperature mix creep



Low temperature mix
Creep test on Instron
At -30° to -10° C
Similar to work being performed by Professors Bahia and Marasteanu using BBR except that we use specimens that ~ 25 mm by 25 mm by 130 mm

OUR GOALS

- RAPIDLY EVALUATE THE PERFORMANCE POTENTIAL OF MIXTURES BASED ON
  - KNOWLEDGE OF UNIQUE BINDER PROPERTIES
  - THE PROPERTIES OF MIXES AS CLOSE TO THE CONDITION OF MANUFACTURE AS POSSIBLE
    - TRY NOT TO ARTIFICIALLY CAUSE ANY ENHANCEMENT TO MIX PROPERTIES BY HEATING RAP MIXES OR WARM MIXES BEYOND THE ABSOLUTE MINIMUM NEEDED TO FABRICATE SPECIMENS
- ULTIMATELY WE WOULD LIKE TO ELIMINATE THE NEED TO EXTRACT AND RECOVER BINDERS FROM MIXES AND YET HAVE AN UNDERSTANDING OF THE BINDER PROPERTIES BASED ON THESE AND OTHER TESTS WE ARE DEVELOPING

THANKS

THE INFORMATION PRESENTED HERE IS THE RESULT OF A COMBINDED EFFORT OF THE ENTIRE STAFF AT THE MATHY MTE LABORATORY

SPECIFICALLY

John Jorgenson

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