

Acronal NX4627 in Tack/Bond Coat Emulsions

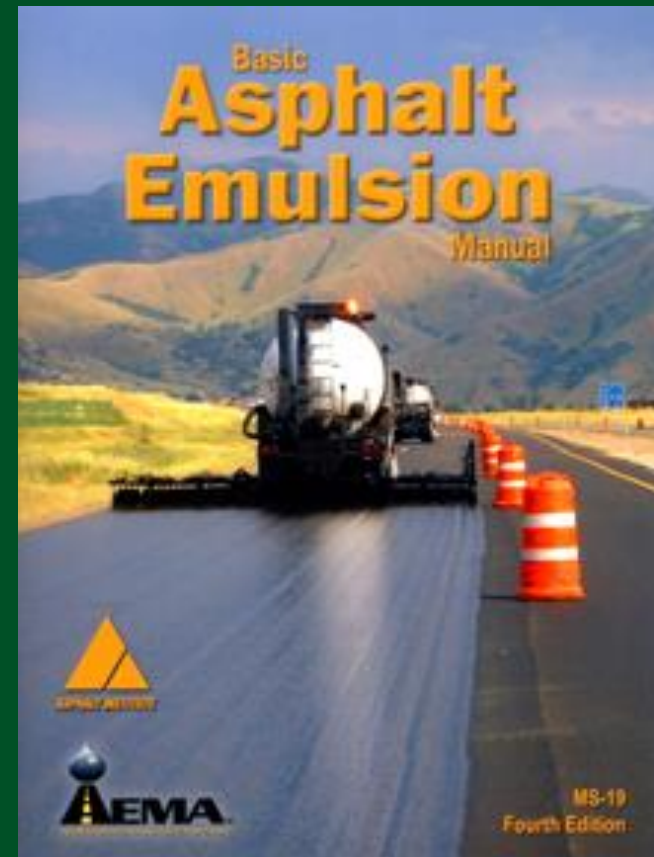
 **BASF**
We create chemistry



Tack/Bond Coat Definition

■ Basic Asphalt Emulsion Manual (Fourth Edition)

- A bond coat is a very light spray application of diluted asphalt emulsion. It is used to promote a bond between the existing surface and the new asphalt application.



Types of emulsions used

■ CSS-1h, CSS-1, SS-1h, SS-1

- These emulsions chosen for their stability and miscibility with dilution to water.
- The base asphalt are chosen for the climate conditions and are usually similar, to slightly harder (more viscous) than the paving grade.
- Polymers traditionally not used do to the lack of understanding as to what they could provide for the application
 - Cost/benefit
 - Polymers too sticky and create tracking scenarios

Tack/Bond Coat

What to look for – rates and precautions



■ Typical Rates

- Application rate (emulsion) is usually 0.05-0.10 Gal/yd² of a 30-50% residue emulsion (diluted just prior to application)

■ Precautions

- Dry/clean pavement
- Application rate for a thin uniform coating of emulsion
- Dilution of emulsion to aid in the uniform distribution
- Emulsion should be broken (brown to black in color), usually determined by application rate and environmental conditions.

Tack/Bond Coat Application

Proper Spraying - Even



Uneven or “Stripped”



Illinois Tack Coat Study - 2009

- SS-1hP, RC-70, & PG64-22
- Application rates (residual)
 - 0.02, 0.04, and 0.09 gal/yd²
- Highlighted Findings:
 - Recommended 0.04 gal/yd² residual application rate
 - SS-1hP and PG64-22 showed better rut resistance than RC-70
 - Uneven tack coat showed worse rut resistance



TACK COAT OPTIMIZATION FOR HMA OVERLAYS: ACCELERATED PAVEMENT TEST REPORT

Tack/Bond Coat

Why utilize Acronal NX4627?

■ Reduced Tracking

- The acrylic gives a very good resistance to tracking by forming a very thin layer of acrylic on the surface of the broken bond coat emulsion.
- The acrylic allows this to be accomplished with the customer using normal asphalt base materials (no hard pen necessary)

■ Better bond performance

- Use of polymers is starting to be noticed as improving the bonding of the new pavement to existing old pavement

Tack Coat Residue Testing

Traditional

ASTM Evaporation or Distillation Procedures

Test	Emulsion Type		
	CSS-1	CSS-1h	Modified
Penetration @ 25°C, dmm	100 - 250	40 - 90	40 - 90
Ductility @ 25°C, cm	40 min.	40 min.	
Softening point, °C			60 min.
Elastic Recovery @ 10°C, %			50 min.

Tack/Bond Coat Emulsion Testing

With and Without Acronal NX4627



SHRP TEST REPORT FORM						
			D7497 Low Temperature Recovery Residue			
Base Asphalt			NuStar	NuStar	NuStar	NuStar
Grade			PG58-28	PG58-28	PG64-22	PG64-22
% Acronal NX 4627 X			0	5	0	5
% Emulsifier (CRS Type)			0.35	0.35	0.35	0.35
Tests on unaged material:	°C	Spec Limit				
Phase Angle (delta)	58		80.0		76.8	
G*/sin delta @ 10 rad/sec,kPa	58	1.0 min.	3.15		7.98	
Phase Angle (delta)	64		82.4		79.4	
G*/sin delta @ 10 rad/sec,kPa	64	1.0 min.	1.69		3.77	
Phase Angle (delta)	70		84.5	68.3	81.9	
G*/sin delta @ 10 rad/sec,kPa	70	1.0 min.	0.88	1.33	1.88	
Phase Angle (delta)	76			65.6	84.1	70.1
G*/sin delta @ 10 rad/sec,kPa	76	1.0 min.		0.82	1.00	1.45
Phase Angle (delta)	82					68.5
G*/sin delta @ 10 rad/sec,kPa	82	1.0 min.				0.88

ASTM D7497 Procedure

Tracking Test Procedures

What is being looked at?

■ Variation on ASTM D711

- Information regarding Virginia DOT procedure

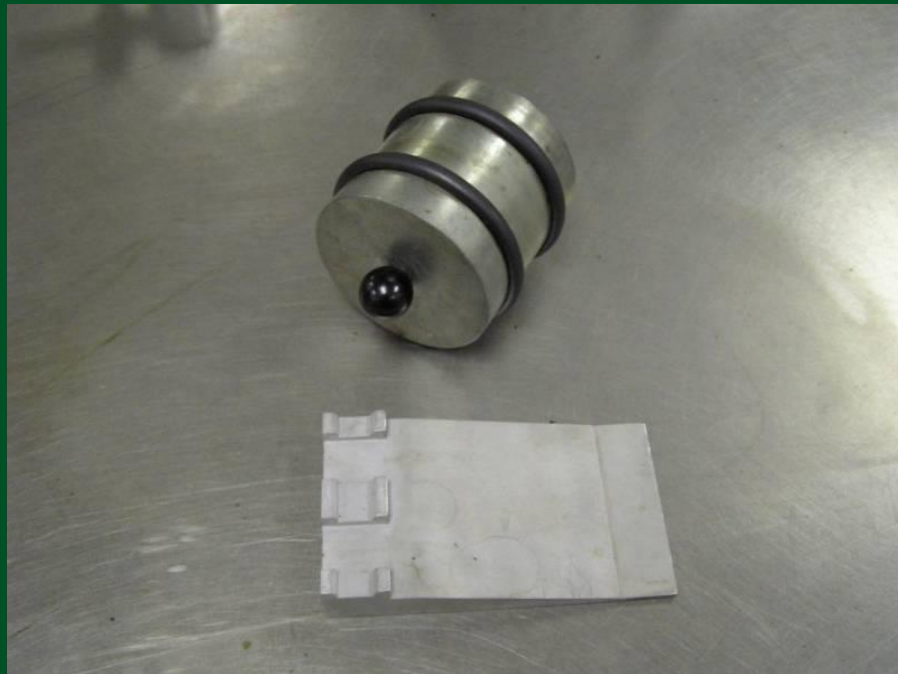
■ BASF Modifications to improve the procedure

- Wheel changes
- Drawdown adjustment
- Felt paper consistency issues

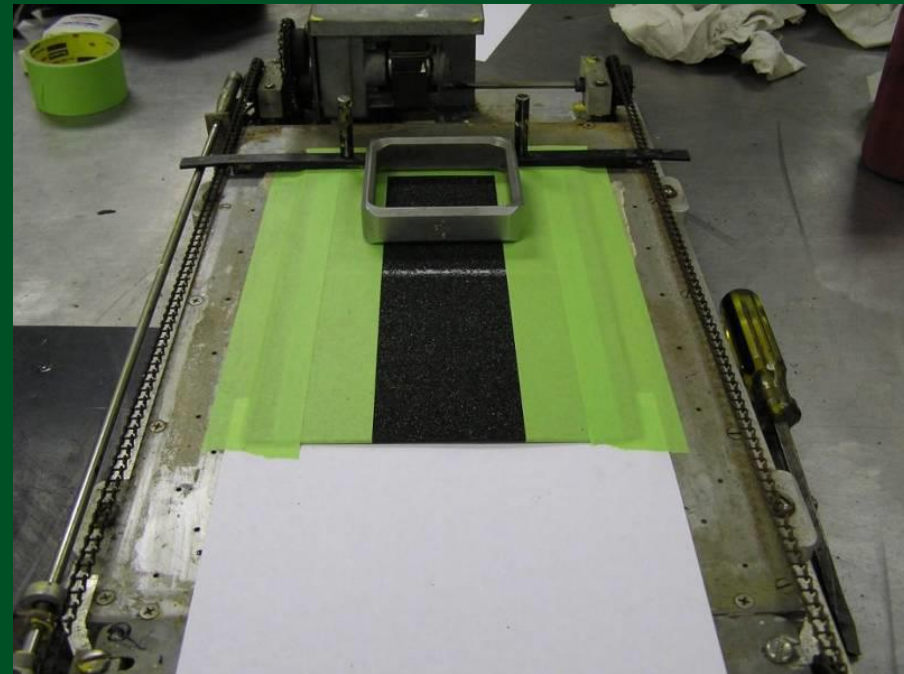
Tracking Testing

Example of ASTM D711 Equipment

Tracking Wheel



Drawdown Apparatus



Information from VADOT TRB Paper: Clark, Rorrer & McGhee

Tracking Test Procedure

Modified to reduce variability

■ Procedure

- 30 lb roofing felt is glued to a particle board using a spray adhesive
- 0.015" thickness of emulsion is drawn down on the felt paper – wide enough for three test times
- Sample is cured at a specific temperature and time intervals prior to testing
- At testing interval, 10 lb wheel with 4" diameter rubber (cam-lock) rings are rolled across the tack coat onto poster board paper placed on the same thickness of particle board

■ Measurement

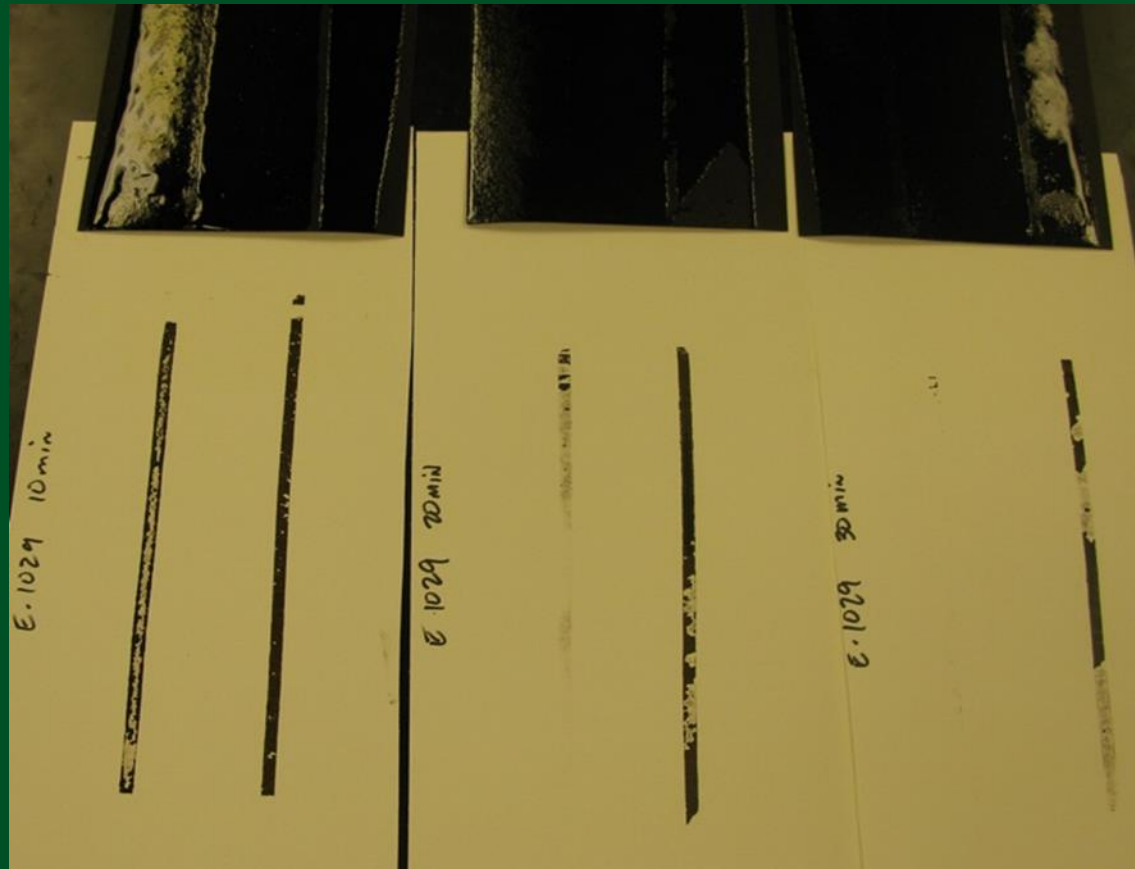
- Visually determine the degree of tracking at each time interval and the time that no tracking appears

Tracking Testing – Original Procedure

Bond Coat Emulsion with CRS Chemistry

25°C Curing – 10, 20 and 30 Minutes

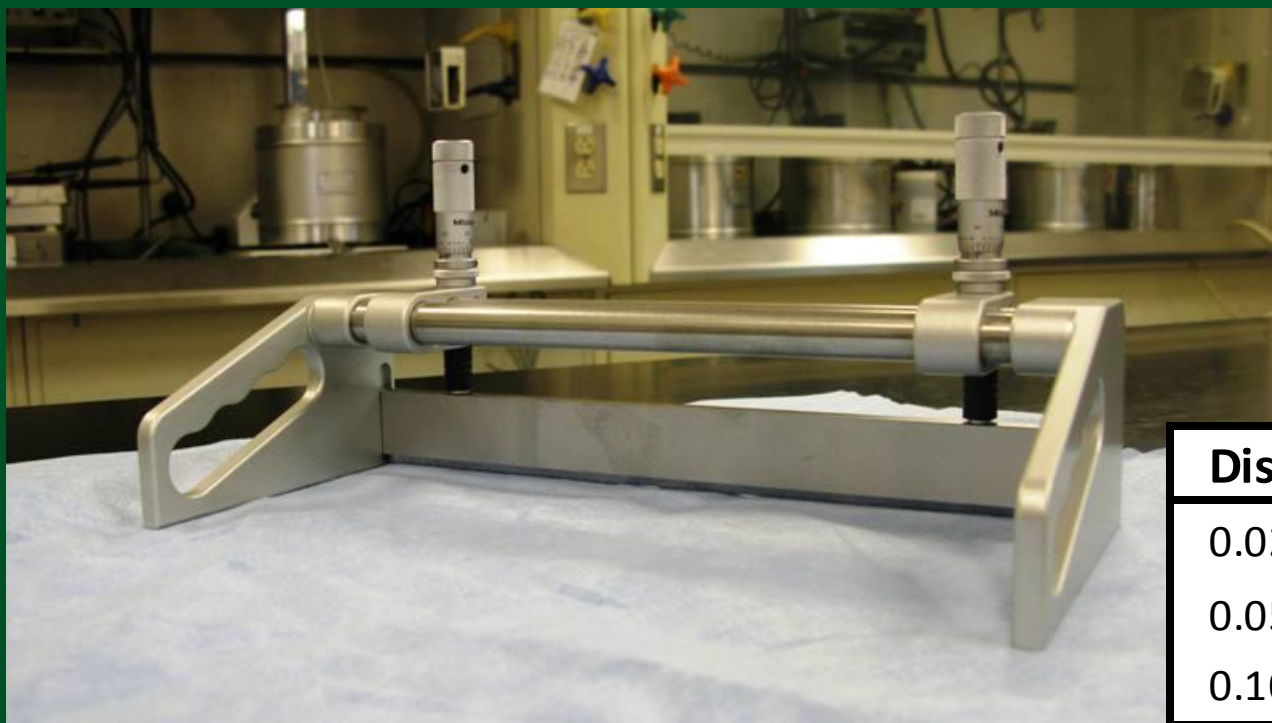
Prior to modification of felt paper to particle board and wider drawdown



Tracking Test Procedure

■ Draw Down Apparatus

- Can be adjusted easily for varying thicknesses, and wide enough for at least three measurements with the wheel.



Distributor	Film Thickness
0.02 gal/yd ²	0.0036 in.
0.05 gal/yd ²	0.0089 in.
0.10 gal/yd ²	0.0180 in.

Tracking Test Procedure

■ Tracking Wheel

- Ten pound stainless wheel that can accommodate two four inch square (cam-lock) o-rings



Tracking Testing at various temperatures

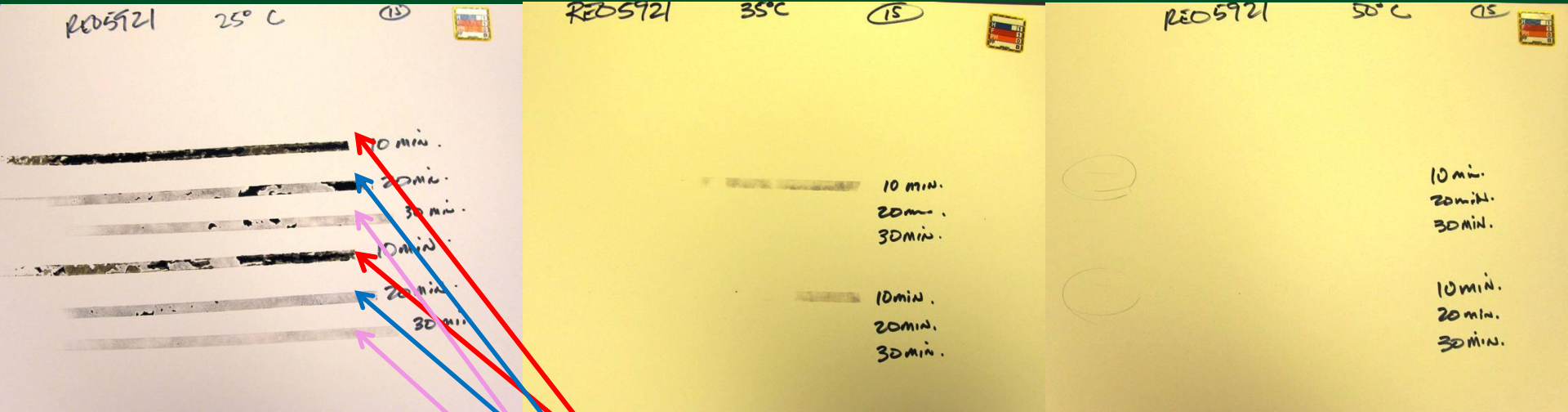
Bond Coat Emulsion with CRS Chemistry



Ambient – 25°C

35°C

50°C

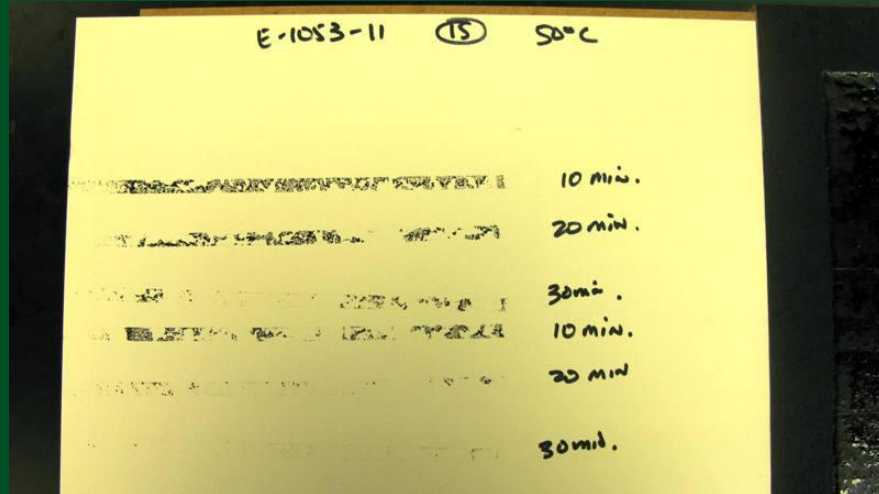


10 Minute
20 Minute
30 Minute

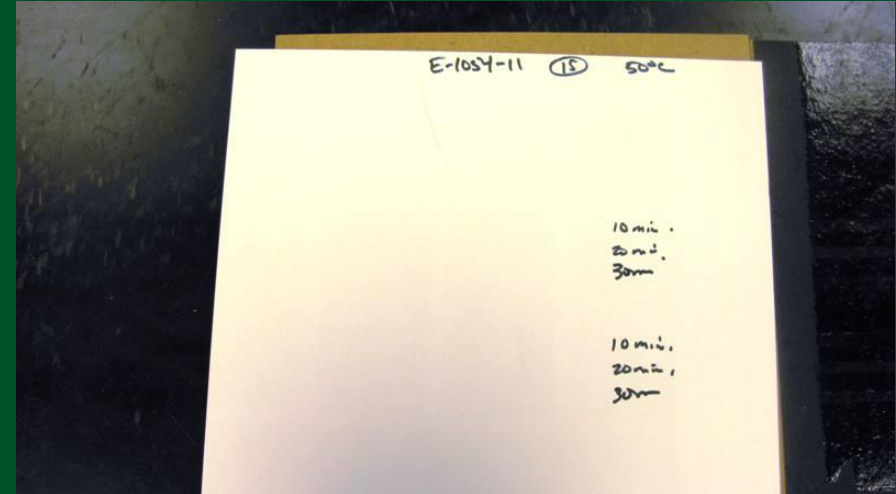
Tracking Testing at 50°C (122°F)

PG58-28 Base – CRS Chemistry

Without Modification



With 5% Acronal NX4627



Tracking Testing at 60°C (140°F)

PG58-28 Base – CRS Chemistry

Bond Coat on felt and paper



Bond Strength Testing

■ Types of Bond strength testing

■ Shear or tensile

- Shear testing applies a horizontal force to the pavement section to “shear” the specimen
- Tensile testing “pulls” the top section away from the existing pavement

■ How strong do you need a bond to be?

- Just like gluing or welding two materials together, the strength of the bond needs to be greater than the materials being bonded.



Shear testing

Bond Strength Testing

Florida procedure

- **PG58-28 based emulsion**
 - Tack coat at 0.1 Gallon/yd²
 - Tested at 25°C
 - Bond Strength
 - **182.1 psi (1.26 MPa)**



Bond Strength Testing

Florida procedure

■ PG64-22 – Based Emulsion

- Tack coat at 0.1 gallon/yd²
- Tested at 25°C
- Bond Strength
 - 207.9 psi (1.43MPa)

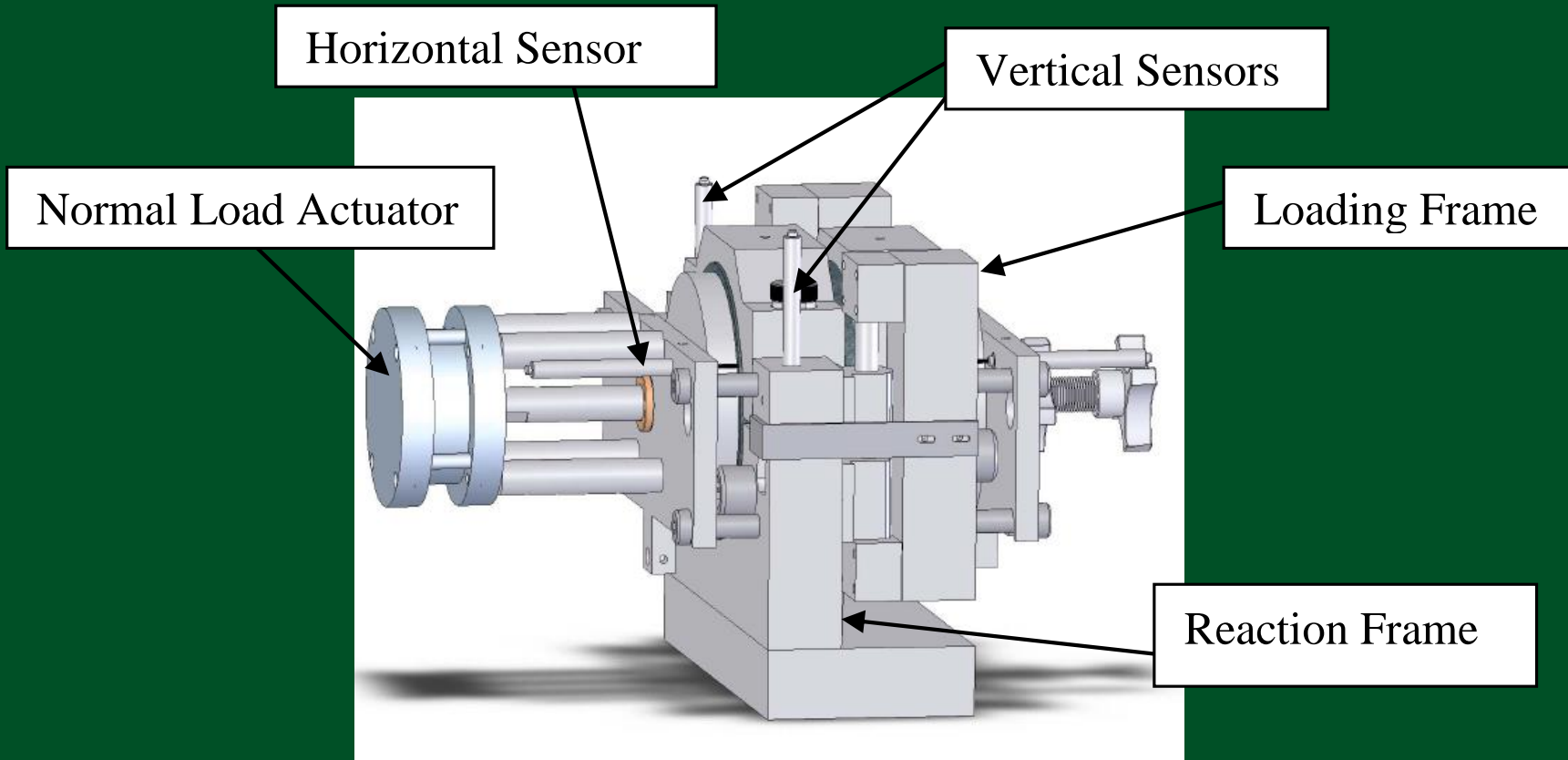
Illinois Report showed the same findings on shear strength testing between SS-1hP and SS-1h



Bond Strength Testing

Louisiana Interlayer Shear Strength Tester

■ Test Apparatus

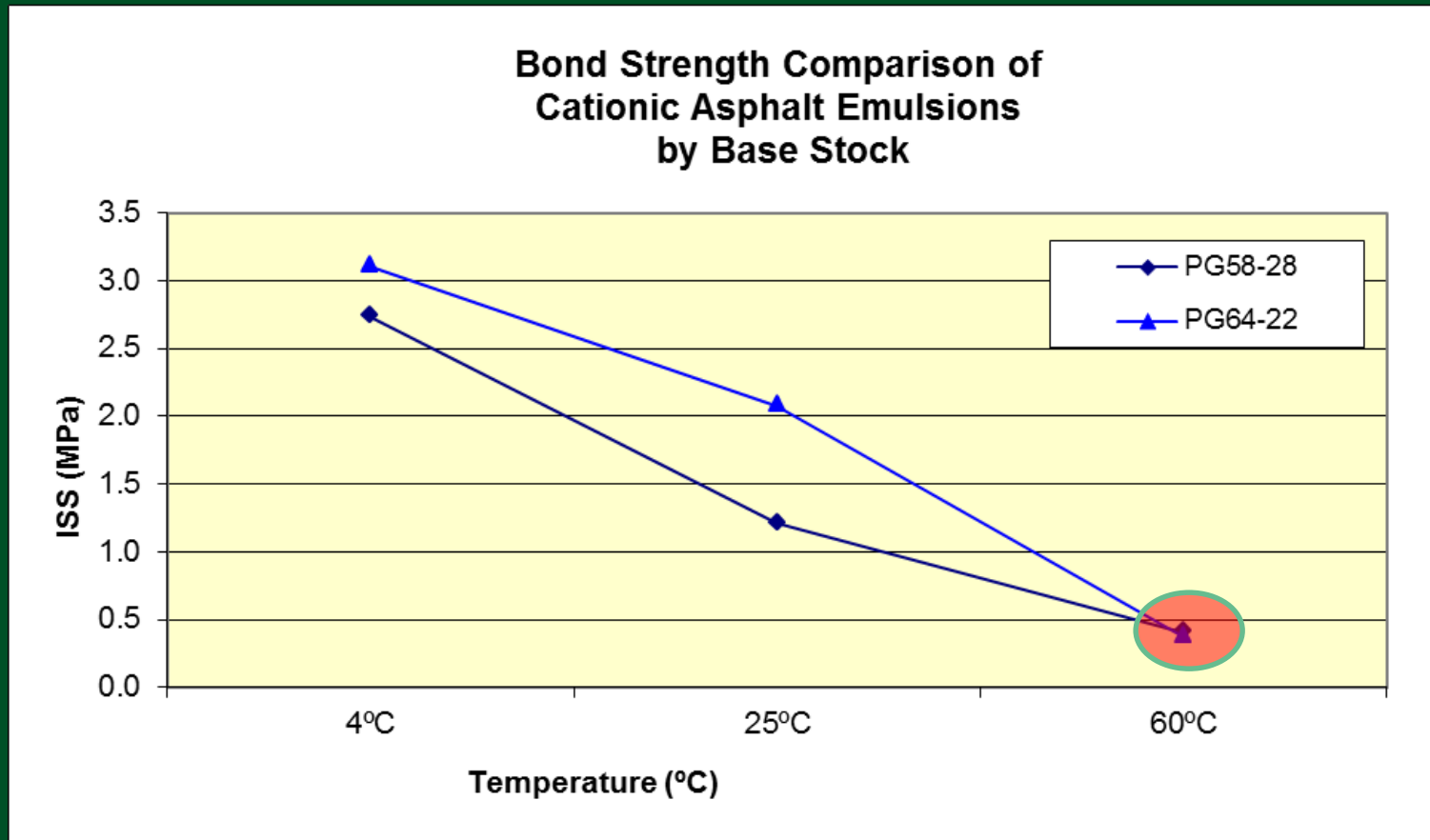


Taken from Louay Mohammad's Draft Test Procedure

Bond Strength Testing

Louisiana Interlayer Shear Strength Tester

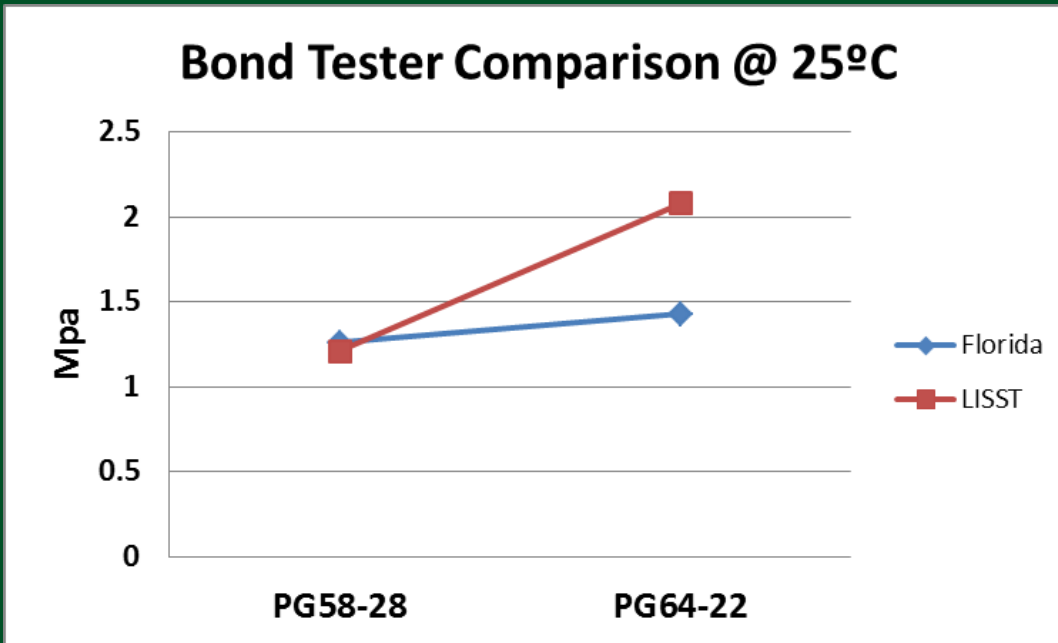
- PG58-28 and PG64-22 based cationic emulsion
- 4, 25 and 60°C Temperatures – 0.05 gal/yd²



Bond Strength Comparison

Florida vs. LISST Procedure

- Similar Emulsion Manufactured for both
 - Converted to MPa for both



Emulsion Base	
PG58-28	PG64-22
MPa	MPa
Florida	1.26
LISST	1.43
	2.08

Florida Data converted to MPa
1MPa = 145 lb/in²

Questions??

