FDOT PG BINDER SPECIFICATION

FLEXIBLE PAVEMENT COMMITTEE MEETING

APRIL 17, 2019

GAINESVILLE, FLORIDA

ATS
Asphalt Testing Solutions
&
Engineering

Overview

PG Binder Specification

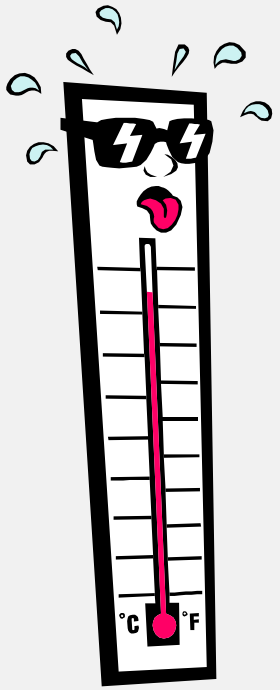
Certificate of Anlaysis

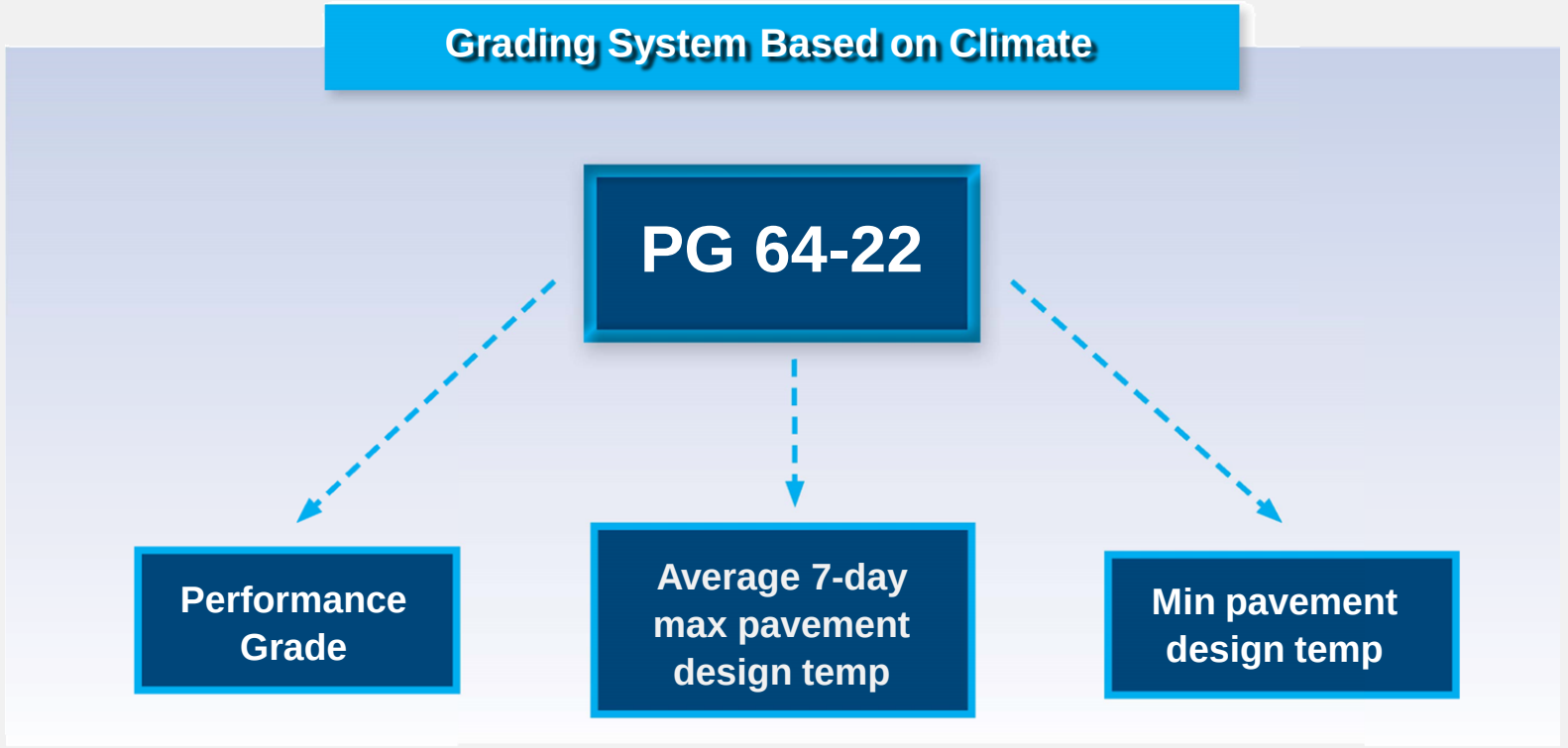
FDOT Specification

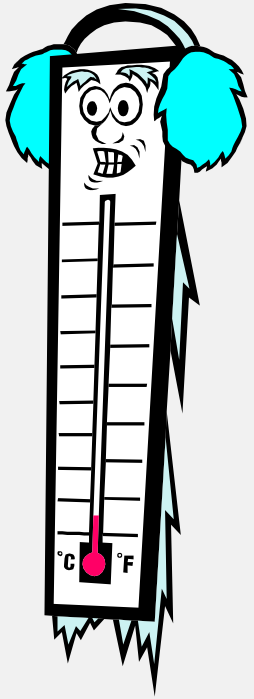
Binder Tests

- What are they
- What does they mean
- What do I need to know

Superpave Performance Grades







Performance Grades

PG 67-22

Max. Design Temp.	PG 46	PG 52	PG 58	PG 64	PG 70	PG 76	PG 82
Min. Design Temp.	-34 -40 -46	-10 -16 -22 -28 -34 -40 -46	-16 -22 -28 -34 -40	-10 -16 -22 -28 -34 -40	-10 -16 -22 -28 -34 -40	-10 -16 -22 -28 -34	-10 -16 -22 -28 -34

Original

≥230 °C	**Flash Point**						
≤ 3 Pa-s @ 135 °C	**Rotational Viscosity**						
≥ 1.00 kPa	**DSR G*/sin δ** (Dynamic Shear Rheometer)						
	46	52	58	64	70	76	82

(Rolling Thin Film Oven) RTFO, Mass Change ≤ 1.00%

≥ 2.20 kPa	**DSR G*/sin δ** (Dynamic Shear Rheometer)						
	46	52	58	64	70	76	82

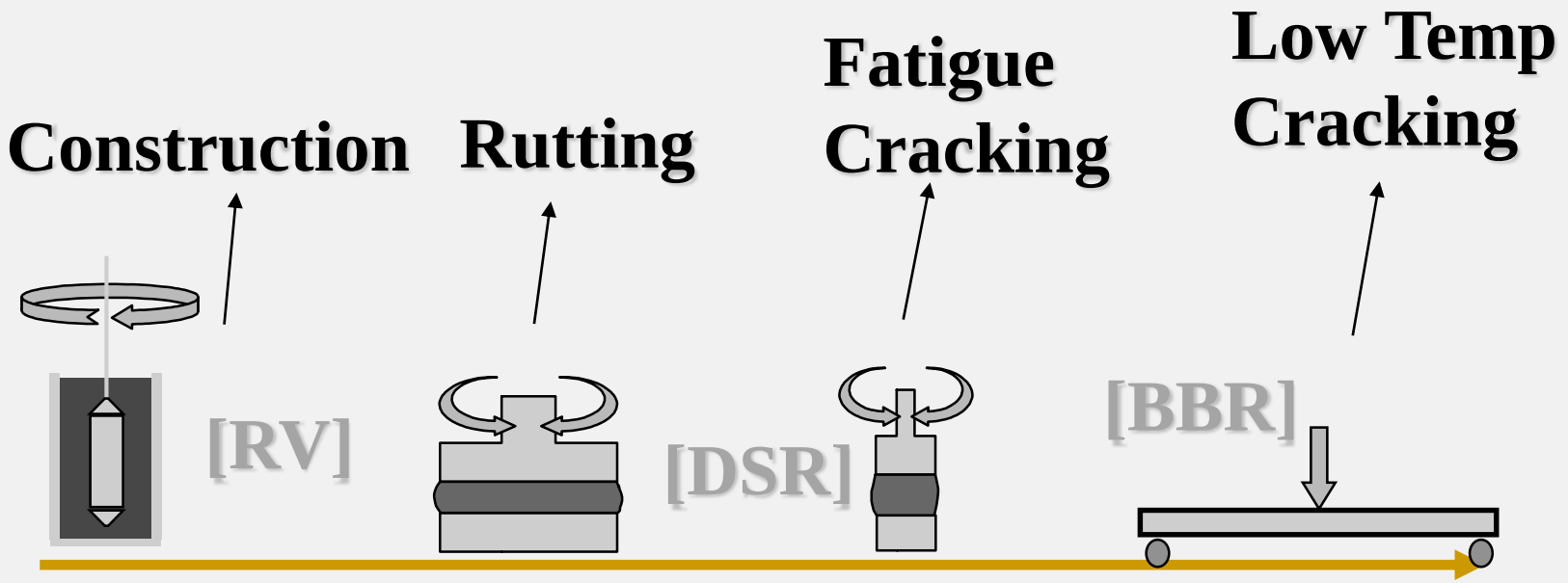
(Pressure Aging Vessel) PAV

20 hours, 2.10 MPa	90	90	100	100	100(110)	100(110)	100(110)
≤ 5000 kPa	**DSR G*sin δ** (Dynamic Shear Rheometer)						
	Intermediate Temp. = [(Max. + Min.)/2] + 4						
	10 7 4	25 22 19 16 13 10 7	25 22 19 16 13	31 28 25 22 19 16	34 31 28 25 22 19	37 34 31 28 25	40 37 34 31 28
S ≤ 300 MPa m ≥ 0.300	**BBR S (creep stiffness) & m-value** (Bending Beam Rheometer)						
	-24 -30 -36	0 -6 -12 -18 -24 -30 -36	-6 -12 -18 -24 -30	0 -6 -12 -18 -24 -30	0 -6 -12 -18 -24 -30	0 -6 -12 -18 -24	0 -6 -12 -18 -24

If BBR m-value ≥ 0.300 and creep stiffness is between 300 and 600, the Direct Tension failure strain requirement can be used in lieu of the creep stiffness requirement.

ε_f ≥ 1.00%	**DTT** (Direct Tension Tester)						
	-24 -30 -36	0 -6 -12 -18 -24 -30 -36	-6 -12 -18 -24 -30	0 -6 -12 -18 -24 -30	0 -6 -12 -18 -24 -30	0 -6 -12 -18 -24	0 -6 -12 -18 -24

SUPERPAVE™ Binder Equipment



Pavement Age

← *No aging (Original)* →

← *PAV - aging* →

RTFO (Short-Term)

Certificate of Analysis

Definition:

Document issued by QA that confirms that a regulated product meets it product specification.

- Asphalt Binder Grade
- APL Number
- Batch / Lot Number
- Date Sampled & Tested
- Test Results

Source: Tank 8
APL Number 916-002-055
Lot Number: 222
PG Grade: PG 76-22 (PMA)
Date Sampled: 06/22/2017

Sampled By: ME
Date Testing Completed: 06/23/2017
Date Received: 06/22/2017

Test	Test Method	Specification	Test Results	Units
		Original Binder		
Dynamic Shear, kPa (G*/sin δ, 10 rad/sec)	T315	1.0 Min @ 76C	1.20	kPa
Density @ 15.6 C	T228	Report	1.0361	kg/L
Specific Gravity @ 15.6 C			1.0370	------
Density, lbs/gal	T228	Report	8.646	lbs/gal
API	T228	Report	4.950	API
Rotational Viscosity, Pa.s.				
@ 135C, 20rpm spindle# 27	T316	3.0 Max	1.438	Pa.s.
@ 165C, 20rpm spindle# 27			0.400	Pa.s.
Flash Point COC, C	T48	230C Minimum	363	C
Solubility, % Soluble	T44	99.0% Minimum	99.94	%
Penetration @ 77 F, dmm	T49	Report	56	dmm

Sample Meets current FDOT requirements for PG 76-22 (PMA)

FDOT Original Binder Testing

Original Binder		
Solubility, AASHTO T44-14	in Trichloroethylene	Minimum 99.0% (Not applicable for PG 76-22 (ARB))
Flash Point, AASHTO T48-17	Cleveland Open Cup	Minimum 450°F
Rotational Viscosity, AASHTO T316-13 (2017)	275°F	Maximum 3 Pa·s[a]
Dynamic Shear Rheometer [b], AASHTO T315-12 (2016)	$G^*/\sin\delta$ Phase Angle, δ[c] PG 76-22 (PMA) and PG 76-22 (ARB)[d]	Minimum 1.00 kPa Maximum 75 degrees
Separation Test, ASTM D7173-14 and Softening Point, AASHTO T53-09 (2013)	163±5°C 48 hours	Maximum 15°F (PG 76-22 (ARB) only)

January 2019 FDOT Section 916-2.3 (AASHTO M 320 & M 332)

Solubility (AASHTO T 44)

FDOT Specification:

Min. 99.0% in Trichloroethylene

Purpose:

Detect contamination of asphalt; ensuring that binder is substantially free of mineral matter

Effect of Filler Content to the Contractor:

- Accurate estimate of dust/asphalt ratio when the mix design is complete
- Impact on performance, particularly with respect to moisture damage
- Fillers are a cheap extender to increase PG grades

Flash Point (AASHTO T 48)

FDOT Specification:

Min. 450°F

Purpose:

Measure tendency of asphalt to produce flammable mixture when heated under controlled lab conditions

Contractor:

SAFETY

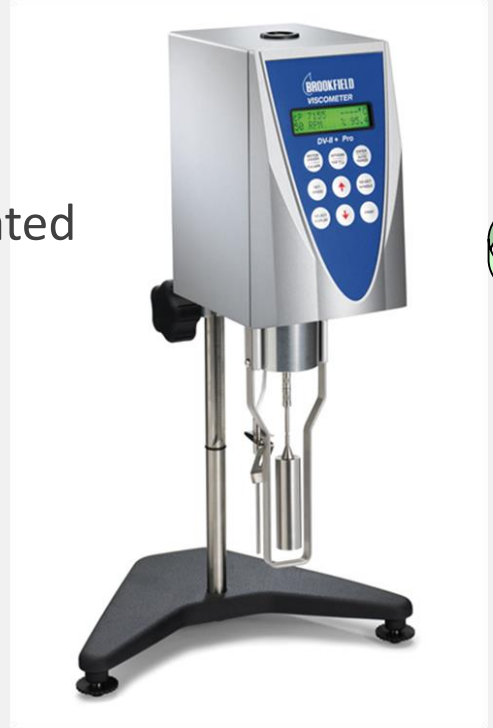
Rotational Viscosity (AASHTO T 316)

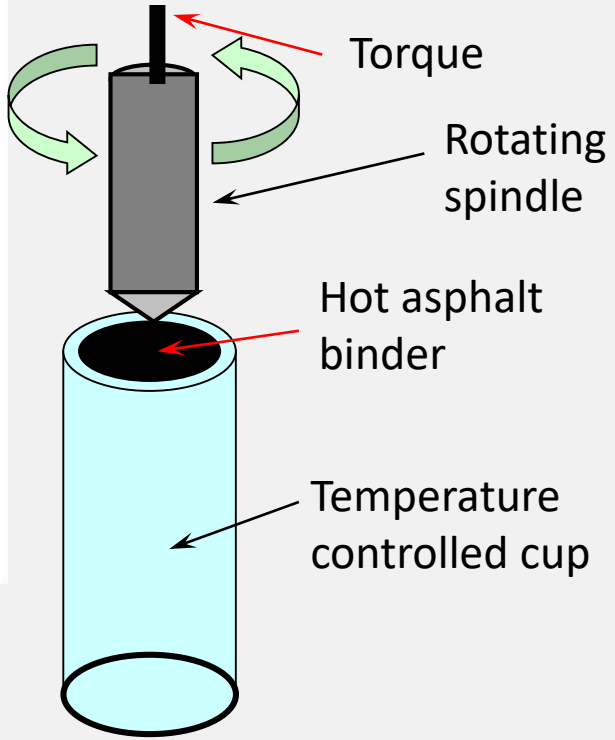
FDOT Specification:
Max. 3 Pa· s @ 275°F

Purpose:
Measures the viscosity of an asphalt at a designated temperature

Contractor:

- Viscosity at pumping and handling temperatures
- Mixing and compaction temperatures
- Not designed for modified asphalts – consult your supplier





Dynamic Shear Rheometer (AAHTO T 315)

FDOT Specification:

G* / sin δ = Min. 1.00 kPa at PG HT

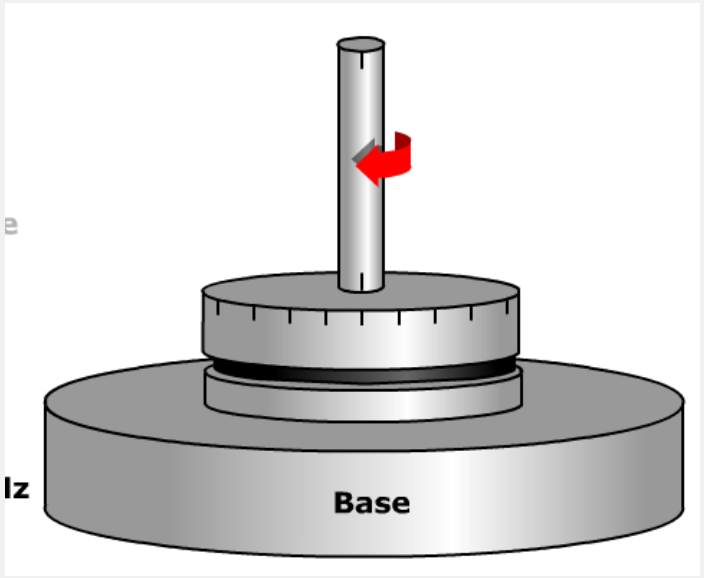
Phase Angle (δ) = Max. 75° at 76°C

Purpose:

Characterizing the viscous (G*) and elastic (δ) behavior of binders at medium to high temperatures

Contractor:

- Predictors of rutting and fatigue cracking susceptibility
- G* should decrease with temperature
- Phase angle should increase with increase in temp.
- To stay in grade – 2.00 kPa



Separation Test (ASTM D7173)

FDOT Specification:

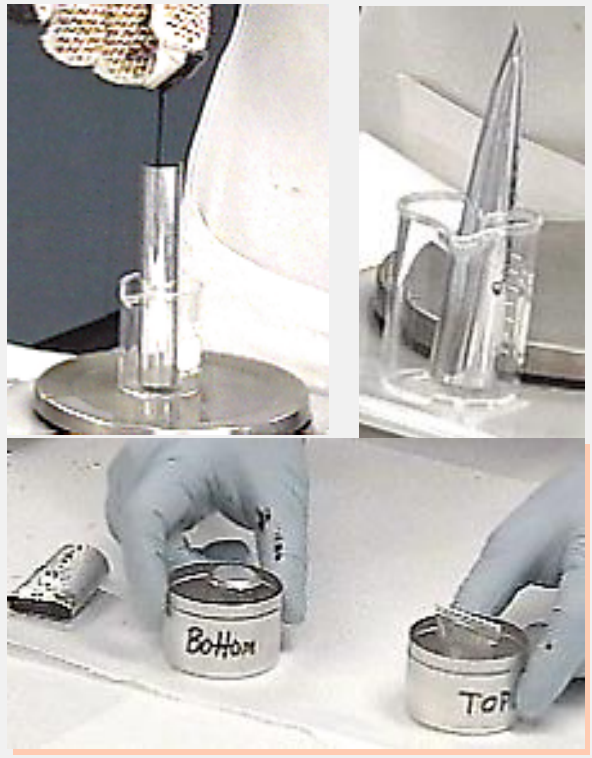
Max. 15°F

Purpose:

Measure the tendency of the CRM to separate from binder

Contractor:

- Handling and Settlement Issue



Softening Point (AASHTO T 53)

FDOT RTFO Binder Testing

Rolling Thin Film Oven Test Residue (AASHTO T240-13 (2017))		
Rolling Thin Film Oven, AASHTO T240-13 (2017)	Mass Change %	Maximum 1.00
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$ AASHTO T350-14	Grade Temperature (Unmodified binders only)	"S" = 4.50 kPa^{-1} max
Multiple Stress Creep Recovery, $J_{nr,\ 3.2}$[d, e, f] AASHTO T350-14	67°C (Modified binders only)	"V" = 1.00 kPa^{-1} max Maximum $J_{nr,diff}$ = 75%
	76°C (High Polymer binder only)	0.10 kPa^{-1} max
Multiple Stress Creep Recovery, %Recovery[d, e] AASHTO T350-14	67°C (Modified binders only)	$\%R_{3.2} \geq 29.37\ (J_{nr,\ 3.2})^{-0.2633}$
	76°C (High Polymer binder only)	$\%R_{3.2} \geq 90.0$

January 2019 FDOT Section 916-2.3 (AASHTO M 332)

Rolling Thin Film Oven (AASHTO T 240)

FDOT Specification:

Mass Change = Max. 1.00%

Purpose:

Measures the changes in PG properties that occur in a batch plant operating at approx. 150°C

Contractor:

- Simulated STOA
- Should be under 1.00%
- Monitors the excessive aging through the plant and the presence of possible light ends
  - If does not show up in flash – typically a refinery
  - Fuming in plant

Multiple Stress Creep Recovery (MSCR) (AASHTO T 350)

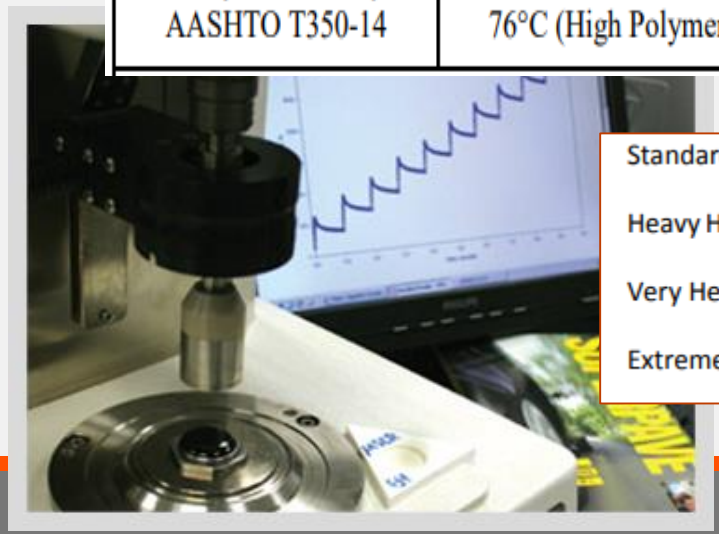
Purpose:
Characterizes neat & polymer modified binders at their temperatures in which they are used

A measure of modification performance within the binder (% Recovery)

Contractor:

- Stiffness (Jnr) & Elasticity (%R)
- Neat Binders Jnr= 2.00 – 4.50 kPa^{-1}
- %Recovery no mix related
- Modified Binders typically around 0.50 and below

Multiple Stress Creep Recovery, $J_{nr,3.2}$ AASHTO T350-14	Grade Temperature (Unmodified binders only)	"S" = 4.50 kPa^{-1} max
Multiple Stress Creep Recovery, $J_{nr,3.2}^{(d,e,f)}$ AASHTO T350-14	67°C (Modified binders only)	"V" = 1.00 kPa^{-1} max Maximum $J_{nr,diff}$ = 75%
	76°C (High Polymer binder only)	0.10 kPa^{-1} max
Multiple Stress Creep Recovery, %Recovery$^{(d,e)}$ AASHTO T350-14	67°C (Modified binders only)	$\%R_{3.2} \geq 29.37\ (J_{nr,3.2})^{-0.2633}$
	76°C (High Polymer binder only)	$\%R_{3.2} \geq 90.0$

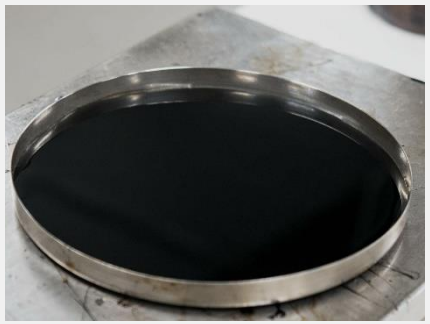


Standard S grade	traffic < 3 million ESAL's
Heavy H grade	traffic > 3 million ESAL's
Very Heavy V grade	traffic > 10 million ESAL's
Extreme E grade	traffic > 30 million ESAL's

FDOT PAV Binder Testing

Pressure Aging Vessel Residue (AASHTO R28-12)		
Dynamic Shear Rheometer, AASHTO T315-12 (2016)	$G^*\sin\delta$, 10 rad/sec.	Maximum 5000 kPa[f, g]
Creep Stiffness, AASHTO T313-12 (2016)	S (Stiffness), @ 60 sec. m-value, @ 60 sec.	Maximum 300 MPa Minimum 0.300
ΔTc, ASTM D7643-16	20 hours PAV aging S (Stiffness), @ 60 sec. m-value, @ 60 sec.	ΔTc ≥ -5.0°C

Long Term Aging = 5-7 years



January 2019 FDOT Section 916-2.3 (AASHTO M 320)

Intermediate Temperature (Fatigue / Durability)

FDOT Specification:

G* Sin δ = Max. 5,000 kPa

Purpose:

Complex Shear Modulus should be at a minimum to resist fatigue cracking

Contractor:

- There is arguments of this property's value

Intermediate Temperature = ((PG HT + PG LT) /2) + 4

Bending Beam Rheometer (AASHTO T 313)

FDOT Specification:

Stiffness = Max. 300 MPa / m-value = Min. 0.300

- **Tested at PG LT +10°C**

ΔT_c = Min. -5.0°C (ASTM D7643)

Purpose:

Determine the binder's stiffness and ability to relax at low temperatures.

Measure of ductility loss of an aged binder.

Contractor:

- Thermal Events – large temperature changes, quickly
- Looking for speed of recovery – Florida gets thermal shock with hot temp. and rain quenching.
- The more negative the Delta Tc the less relaxation capability the binder has as it ages.

QUESTIONS?


FLORIDA
DEPARTMENT
OF
TRANSPORTATION
FDOT
STANDARD SPECIFICATIONS
FOR
ROAD AND BRIDGE
CONSTRUCTION
January 2019
FLORIDA