

LAB REPORT# 01

Bryan CAM Mix-Design: FM 158

CAM MIX, SPEC ITEM 3131

Aggregate type: Capitol limestone
Aggregate-blend: 21% Gr5 (Delta pit) + 18% D-rock (Marble Falls pit)
+ 60% screenings (Marble Falls pit)
RAP: None
Anti-strip: 1.0% hydrated lime (Austin White Lime)

Asphalt-binder: Jebro, Valero, and Martin PG 76-22

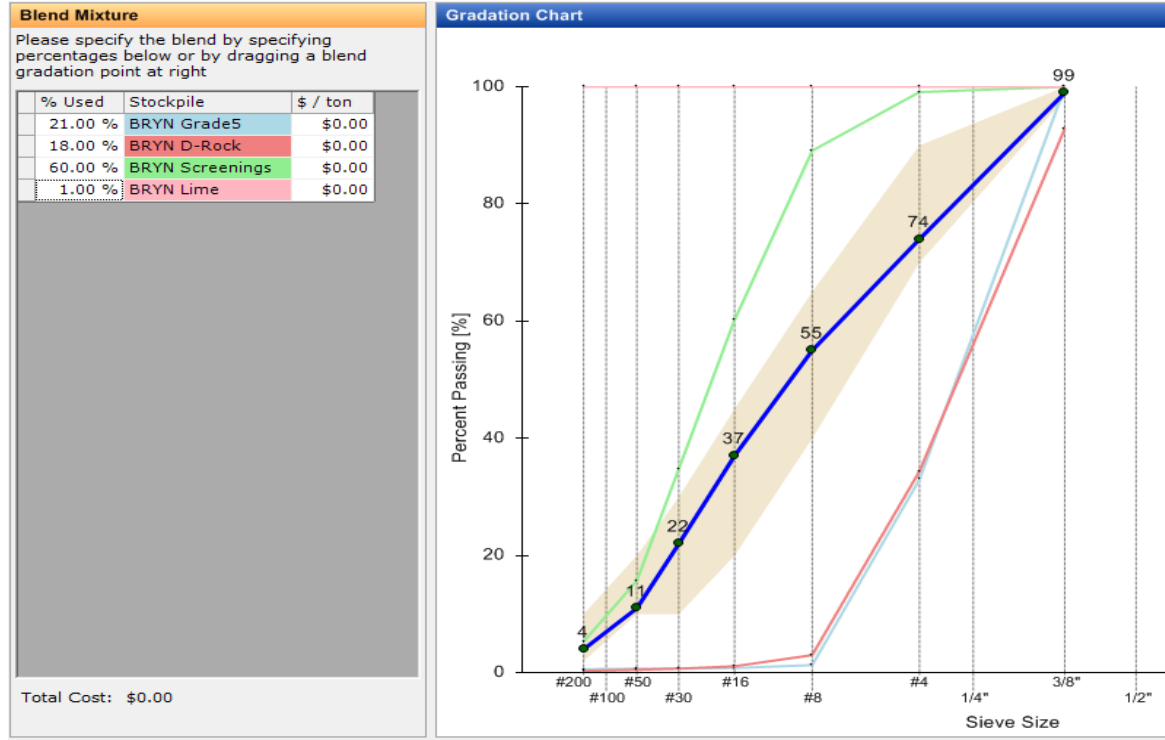


Fig 1. Aggregate Gradation

SUMMARY OF LAB TEST RESULTS

Table 1. Asphalt-Binder DSR and BBR Results

#	Source	Actual Tested Grade	DSR (High Temp)		BBR (Lower Temp)	
			G* (kPa)	G*/Sin δ (kPa) (> 1.00)	S (MPa) (< 300)	m-value (> 0.300)
1	Jebro PG 76-22	PG 76-22	1.41	1.54	174	0.325
2	Valero PG 76-22	PG 76-22	1.55	1.61	132	0.316
3	Martin PG 76-22	PG 82-22	1.03	1.05	77	0.317

Table 2. Hamburg and Overlay Results – Jebro PG 76-22

#	Asphalt-Binder Content	Corresponding Lab Density	VMA (>17)	Hamburg @ 20 k (< 12.5)	Overlay Cycles (Average) (> 750)	Average OT Peak Loads (lb)
1	6.5%	96.5%	18.7	3.2 mm	861	600
2	6.7%	97.0%	18.7	4.3 mm	1 000	774
3	6.9%	97.5%	18.7	5.0 mm	938	640
4	7.1%	98.0%	18.7	5.4 mm	1 000	612

Table 3. Hamburg and Overlay Results – Valero PG 76-22

#	Asphalt-Binder Content	Corresponding Lab Density	VMA (>17)	Hamburg @ 20 k (< 12.5)	Overlay Cycles (Average) (> 750)	Average OT Peak Loads (lb)
1	6.5%	96.5%	19.0	4.5 mm	736	580
2	6.7%	97.5%	18.1	4.9 mm	951	630
3	6.9%	98.0%	18.1	5.7 mm	956	553
4	7.1%	98.4%	18.4	7.4 mm	1 000	563

Table 4. Hamburg and Overlay Results – Martin PG 76-22

#	Asphalt-Binder Content	Corresponding Lab Density	VMA (>17)	Hamburg @ 20 k (< 12.5)	Overlay Cycles (Average) (> 750)	Average OT Peak Loads (lb)
1	6.5%	96.7%	18.4	2.9 mm	132	815
2	6.7%	98.5%	17.2	3.6 mm	169	770
3	6.9%	98.9%	17.4	4.1 mm	173	696
4	7.1%	99.0%	17.6	4.4 mm	173	835

***All Hamburg and OT samples were molded and tested at 7±1% AV.**

GRAPHS – HAMBURG AND OT RESULTS

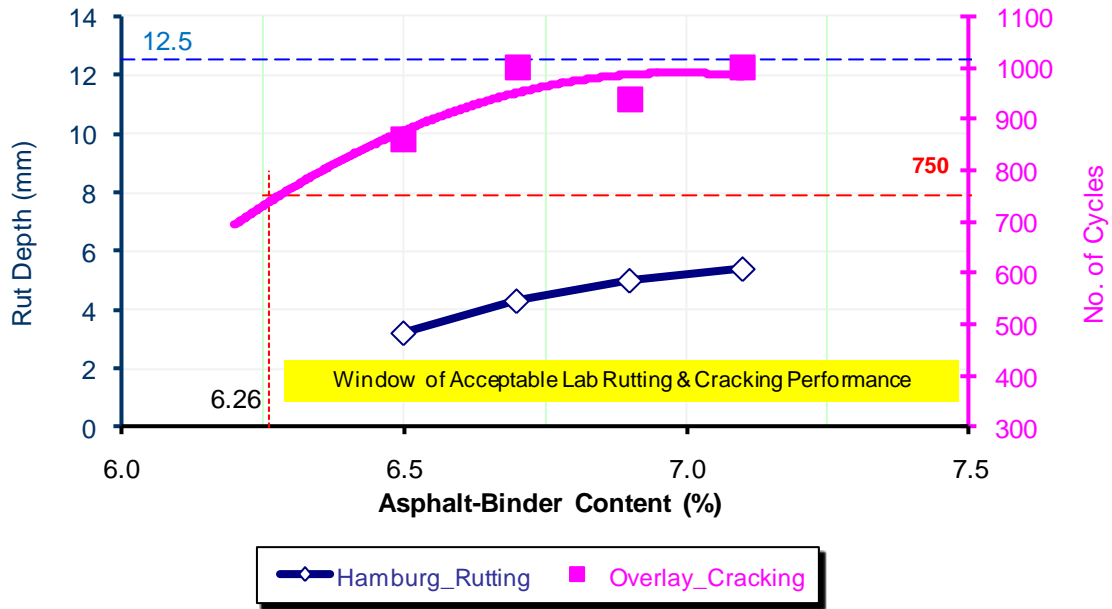


Fig 2. Hamburg and OT Results for Jebro PG 76-22

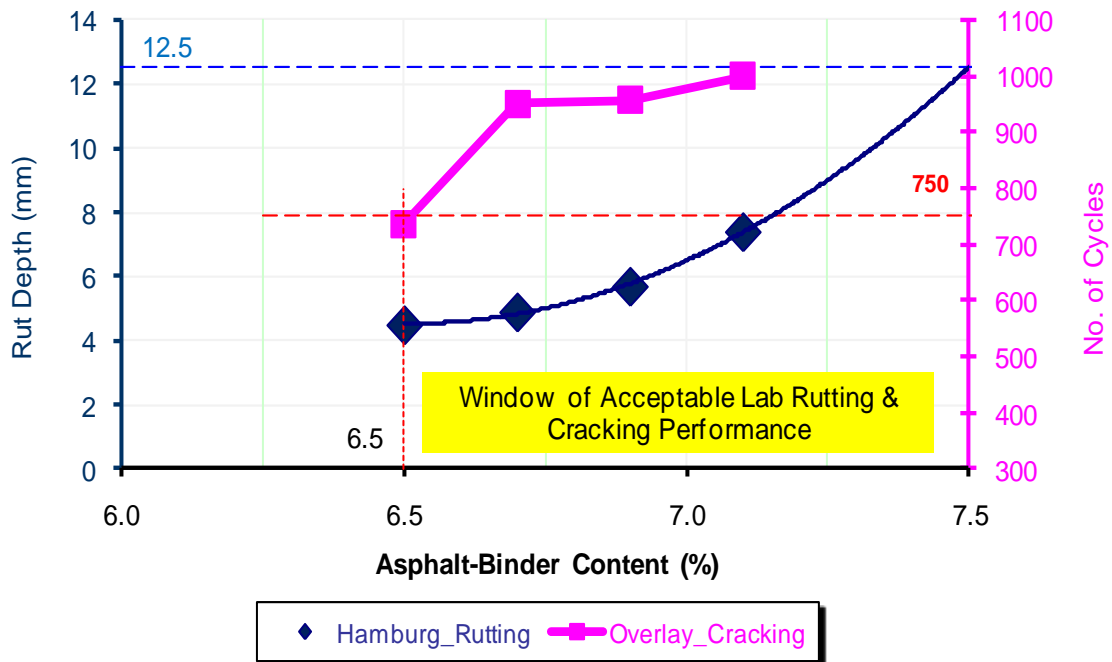


Fig 3. Hamburg and OT Results for Valero PG 76-22

GRAPHS – HAMBURG AND OT RESULTS

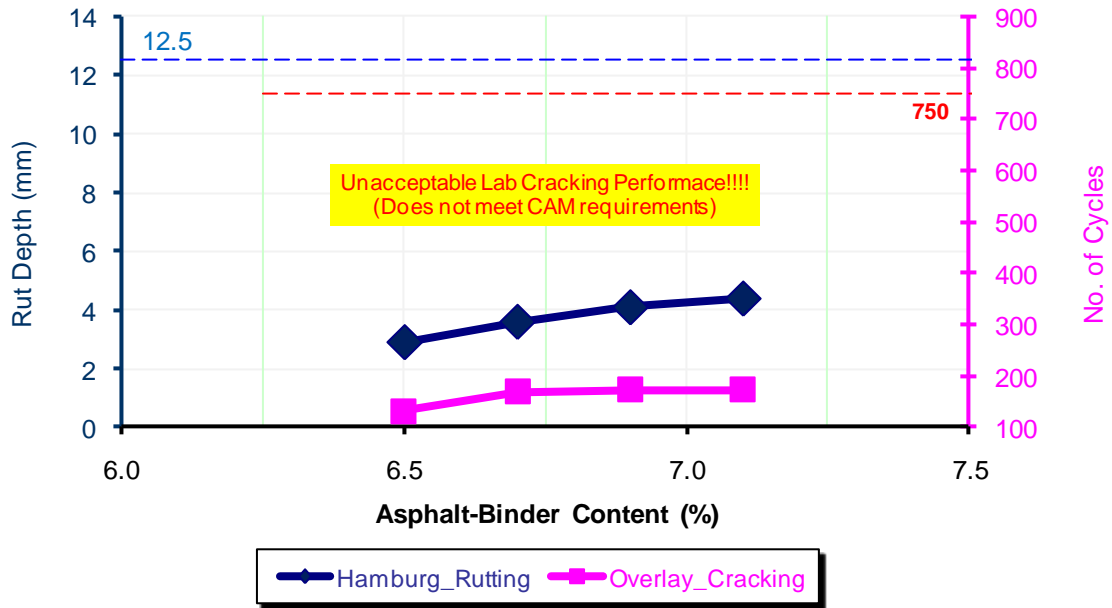


Fig 4. Hamburg and OT Results for Martin PG 76-22

PICTURES – OT SAMPLES



Fig 5. OT Pictures

MIX-DESIGN SHEET: COMBINED GRADATION

SAMPLED BY:	TTI	SPEC ITEM:	3131
SAMPLE LOCATION:	TTI	SPECIAL PROVISION:	
MATERIAL CODE:	TTI	MIX TYPE:	CAM
MATERIAL NAME:	CRACK ATTENUATING MIXTURE		
PRODUCER:	KNIFE RIVER - BRYAN PLANT(TTI)		
AREA ENGINEER:		PROJECT MANAGER:	
COURSE\LIFT:		STATION:	
		DIST. FROM CL:	
		CONTRACTOR DESIGN # :	KRC 205

BIN FRACTIONS																					
	Bin No.1		Bin No.2		Bin No.3		Bin No.4		Bin No.5		Bin No.6		Bin No.7								
Aggregate Source:	CAPITOL		CAPITOL		CAPITOL		AUSTIN														
Aggregate Pit:	DELTA		MARBLE FALLS		MARBLE FALLS		WHITE LIME														
Aggregate Number:																					
Sample ID:	GRADE 5		D ROCK		SCREENINGS		LIME								Combined Gradation						
Rap?:																					
																Total Bin					
Individual Bin (%):	21.0	Percent	18.0	Percent	60.0	Percent	1.0	Percent		Percent		Percent		Percent	100.0%	Lower & Upper Specification Limits		Restricted Zone			
Sieve Size:	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum.% Passing	Wtd Cum. %	Cum. % Passing	Lower	Upper	Within Spec's	Lower	Upper	Within Spec's
3/8"	99.9	21.0	92.9	16.7	100.0	60.0	100.0	1.0							98.7	98.0	100.0	Yes			
No. 4	33.0	6.9	34.4	6.2	99.1	59.5	100.0	1.0							73.6	70.0	90.0	Yes			
No. 8	1.3	0.3	3.0	0.5	89.1	53.5	100.0	1.0							55.3	40.0	65.0	Yes			
No. 16	0.8	0.2	1.1	0.2	60.2	36.1	100.0	1.0							37.5	20.0	45.0	Yes			
No. 30	0.7	0.1	0.7	0.1	34.8	20.9	100.0	1.0							22.2	10.0	30.0	Yes			
No. 50	0.7	0.1	0.5	0.1	15.7	9.4	100.0	1.0							10.7	10.0	20.0	Yes			
No. 200	0.6	0.1	0.3	0.1	5.3	3.2	100.0	1.0							4.4	2.0	10.0	Yes			

MIX-DESIGN SHEET: SUMMARY – JEBRO PG 76-22

Target Density, %:	98.0
Number of Gyration:	50

GRM Content	
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TEST SPECIMENS							Mixture Evaluation @ Optimum Asphalt Content			
Asphalt Content (%)	Specific Gravity Of Specimen (Ga)	Maximum Specific Gravity (Gr)	Effective Gravity (Ge)	Theo. Max. Specific Gravity (Gt)	Density from Gt (Percent)	VMA (Percent)	Indirect Tensile Strength (psi)	Hamburg Wheel Tracking Test		Overlay Tester Min. Number of Cycles
								Number of cycles	Rut depth (mm)	
6.5	2.412	2.492	2.763	2.501	96.4	18.7		See Table 2 & Fig. 2	See Table 2 & Fig. 2	See Table 2 & Fig. 2
7.5	2.442	2.475	2.791	2.464	99.1	18.6				
8.5	2.462	2.425	2.772	2.427	101.4	18.8				

Effective Specific Gravity:	2.775
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Estimated Percent of Stripping, %:	
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Optimum Asphalt Content :	7.1
VMA @ Optimum AC:	18.7

Interpolated Values	
Specific Gravity (Ga):	2.430
Max. Specific Gravity (Gr):	2.482
Theo. Max. Specific Gravity (Gt):	2.479

Remarks:

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MIX-DESIGN SHEET: SUMMARY – VALERO PG 76-22

Target Density, %:	98.0
Number of Gyration:	50

CRM* Content	
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TEST SPECIMENS							Mixture Evaluation @ Optimum Asphalt Content			
Asphalt Content (%)	Specific Gravity Of Specimen (Ga)	Maximum Specific Gravity (Gr)	Effective Gravity (Ge)	Theo. Max. Specific Gravity (Gt)	Density from Gt (Percent)	VMA (Percent)	Indirect Tensile Strength (psi)	Hamburg Wheel Tracking Test		Overlay Tester Min. Number of Cycles
								Number of cycles	Rut depth (mm)	
6.5	2.380	2.480	2.748	2.479	96.0	19.0		See Table 3 & Fig. 3	See Table 3 & Fig. 3	See Table 3 & Fig. 3
6.7	2.409	2.472	2.747	2.471	97.5	18.1				
6.9	2.416	2.465	2.747	2.464	98.1	18.1				
7.1	2.418	2.454	2.742	2.457	98.4	18.2				

Effective Specific Gravity:	2.746
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Estimated Percent of Stripping, %:	
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Optimum Asphalt Content :	6.9
VMA @ Optimum AC:	18.1

Interpolated Values	
Specific Gravity (Ga):	2.415
Max. Specific Gravity (Gr):	2.466
Theo. Max. Specific Gravity (Gt):	2.465

Remarks:

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MIX-DESIGN SHEET: SUMMARY – MARTIN PG 76-22

Target Density, %:	98.0
Number of Gyration:	50

CRM Content

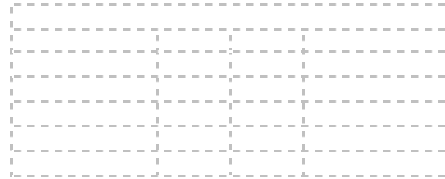
TEST SPECIMENS							Mixture Evaluation @ Optimum Asphalt Content			
Asphalt Content (%)	Specific Gravity Of Specimen (Ga)	Maximum Specific Gravity (Gr)	Effective Gravity (Ge)	Theo. Max. Specific Gravity (Gt)	Density from Gt (Percent)	VMA (Percent)	Indirect Tensile Strength (psi)	Hamburg Wheel Tracking Test		Overlay Tester Min. Number of Cycles
								Number of cycles	Rut depth (mm)	
6.5	2.397	2.484	2.753	2.481	96.6	18.5		See Fig. Table 4 & Fig. 4	See Table 4 & Fig. 4	See Table 4 & Fig. 4
6.7	2.444	2.477	2.753	2.473	98.8	17.0				
6.9	2.439	2.463	2.745	2.466	98.9	17.4				
7.1	2.435	2.455	2.744	2.459	99.0	17.7				

Effective Specific Gravity:	2.749
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Estimated Percent of Stripping, %:	
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Optimum Asphalt Content :	6.6
VMA @ Optimum AC:	17.6

Interpolated Values	
Specific Gravity (Ga):	2.427
Max. Specific Gravity (Gr):	2.480
Theo. Max. Specific Gravity (Gt):	2.476



Remarks:

ASPHALT-BINDER HIGH TEMPERATURE DSR TEST RESULTS

Jebro PG 76-



Performance Grade Asphalt Analysis

Test Mode : Grade Determination (Auto-stress)
Instrument Serial Number : MAL1027321
Temperature Control : Digital TCU
Software Version : TruGrade 1.1.0.0
File Name : Jebro 76-22_20101015_155133.gdp
File Location : C:\Documents and Settings\All Users\Application
Temperature Calibration Date : 4/15/2010 3:07:42 PM
Temperature Verification Date : 4/15/2010 3:43:03 PM
Result : Final Grade : PG76
TruGrade Temperature (°C) : 80.95

Ancillary Information :

Sample : Jebro 76-22
User Id : SUPERVISOR
Test Number : 0
Project Number :
Grade :
Emulsion :
Batch Number :
Enter Plate Diameter : 25.0

Parameters :

Measurement Type : High Temperature Range
Initial Temperature (°C) : 76.00
Strain Amplitude (%) : 12.00
Measuring System : PP 25 DSR
Plate Diameter (mm) : 25
Plate Gap (mm) : 1.000
Thermal Equilibrium Time (min) : 10
Sample Type : Original Binder (High)

Grade Run 1 Results :

10/15/2010 2:50:48 PM
Complex Modulus (kPa) : 1.41
Phase Angle (°) : 65.6
G*Sin(Delta) (kPa) : 1.54
Strain (%) : 12.05
Shear Stress (Pa) : 168.138
Temperature (°C) : 76.03
Frequency (rad/s) : 10.03
Result : Pass

PG 76-

ASPHALT-BINDER HIGH TEMPERATURE DSR TEST RESULTS

Valero PG 76-



Performance Grade Asphalt Analysis

Test Mode : Grade Determination (Auto-stress)
Instrument Serial Number : MAL1027321
Temperature Control : Digital TCU
Software Version : TruGrade 1.1.0.0
File Name : New Valero_20101101_105251.gdp
File Location : C:\Documents and Settings\All Users\Application
Temperature Calibration Date : 4/15/2010 3:07:42 PM
Temperature Verification Date : 4/15/2010 3:43:03 PM
Result : Final Grade : PG76
TruGrade Temperature (°C) : 80.56

Ancillary Information :

Sample : New Valero
User Id : SUPERVISOR
Test Number : 0
Project Number :
Grade :
Emulsion :
Batch Number :
Enter Plate Diameter : 25.0

Parameters :

Measurement Type : High Temperature Range
Initial Temperature (°C) : 70.00
Strain Amplitude (%) : 12.00
Measuring System : PP 25 DSR
Plate Diameter (mm) : 25
Plate Gap (mm) : 1.000
Thermal Equilibrium Time (min) : 10
Sample Type : Original Binder (High)
Grade Run 1 Results : 11/1/2010 10:06:02 AM
Complex Modulus (kPa) : 1.55
Phase Angle (°) : 75.0
G*Sin(Delta) (kPa) : 1.61
Strain (%) : 11.93
Shear Stress (Pa) : 184.008
Temperature (°C) : 76.03
Frequency (rad/s) : 10.03
Result : Pass

PG 76-

ASPHALT-BINDER HIGH TEMPERATURE DSR TEST RESULTS

Martin PG 76-



Performance Grade Asphalt Analysis

Test Mode : Grade Determination (Auto-stress)
Instrument Serial Number : MAL1027321
Temperature Control : Digital TCU
Software Version : TruGrade 1.1.0.0
File Name : Martin 76-22 20101015_132523.gdp
File Location : C:\Documents and Settings\All Users\Application
Temperature Calibration Date : 4/15/2010 3:07:42 PM
Temperature Verification Date : 4/15/2010 3:43:03 PM
Result : Final Grade : PG82
TruGrade Temperature (°C) : 82.41

Ancillary Information :

Sample : ~~XXXXXX~~ Martin 76-22
User Id : SUPERVISOR
Test Number : 0
Project Number :
Grade :
Emulsion :
Batch Number :
Enter Plate Diameter : 25.0

Parameters :

Measurement Type : High Temperature Range
Initial Temperature (°C) : 70.00
Strain Amplitude (%) : 12.00
Measuring System : PP 25 DSR
Plate Diameter (mm) : 25
Plate Gap (mm) : 1.000
Thermal Equilibrium Time (min) : 10
Sample Type : Original Binder(High)
Grade Run 1 Results : 10/15/2010 10:19:06 AM
Complex Modulus (kPa) : 1.03
Phase Angle (°) : 76.7
G*/Sin(Delta) (kPa) : 1.05
Strain (%) : 11.96
Shear Stress (Pa) : 121.511
Temperature (°C) : 81.97
Frequency (rad/s) : 10.03
Result : Pass

PG 82-

ASPHALT-BINDER LOW TEMPERATURE BBR TESTING: JEBRO PG 76-22

CANNON® Instrument Company, USA 1.23 12/06/2010 02:25:08 PM

CANNON® Instrument Company, USA 1.23 12/06/2010 04:07:06 PM

Project : 6132 Target Temp (°C) : -12.0 Conf Test (GPa) : 207
 Operator : rc Min. Temp (°C) : -12.1 Conf Date : 12/06/2010
 Specimen : jebro Max. Temp (°C) : -12.0 Force Const (mN/bit) : 0.149
 Test Time : 02:18:58 PM Temp Cal Date : 09/28/2010 Defl Const (µm/bit) : 0.161
 Test Date : 12/06/2010 Soak Time (min) : 60.0 Cmpl (µm/N) : 4.71
 File Name : lubinda Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID : temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

Project : 6132 Target Temp (°C) : -18.0 Conf Test (GPa) : 207
 Operator : rc Min. Temp (°C) : -18.0 Conf Date : 12/06/2010
 Specimen : jebro Max. Temp (°C) : -18.0 Force Const (mN/bit) : 0.149
 Test Time : 04:01:09 PM Temp Cal Date : 12/01/2010 Defl Const (µm/bit) : 0.161
 Test Date : 12/06/2010 Soak Time (min) : 60.0 Cmpl (µm/N) : 4.71
 File Name : 10120601 Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID : temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	995	0.259	310	309	-0.323	0.243
15.0	993	0.305	263	263	0.000	0.269
30.0	992	0.370	216	216	0.000	0.297
60.0	992	0.458	175	174	-0.571	0.325
120.0	995	0.581	138	138	0.000	0.353
240.0	1002	0.757	107	107	0.000	0.381

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	981	0.154	514	513	-0.195	0.207
15.0	979	0.177	446	448	0.448	0.222
30.0	977	0.206	382	382	0.000	0.239
60.0	974	0.244	322	322	0.000	0.256
120.0	973	0.293	268	268	0.000	0.273
240.0	977	0.358	220	220	0.000	0.290

A = 2.67 B = -0.159 C = -0.0468 R² = 0.999978

Force (t=0.0s) = 39 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 999 mN Deflection (t=0.5s) = 0.132 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +6 mN
 Max Force Deviation (t=5.0 - 240.0s) = -5, +7 mN

Average Force (t=0.5 - 240.0s) = 996 mN
 Maximum Force (t=0.5 - 240.0s) = 1003 mN
 Minimum Force (t=0.5 - 240.0s) = 991 mN

A = 2.87 B = -0.155 C = -0.0284 R² = 0.999945

Force (t=0.0s) = 37 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 988 mN Deflection (t=0.5s) = 0.091 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +15 mN
 Max Force Deviation (t=5.0 - 240.0s) = -3, +8 mN

Average Force (t=0.5 - 240.0s) = 975 mN
 Maximum Force (t=0.5 - 240.0s) = 990 mN
 Minimum Force (t=0.5 - 240.0s) = 972 mN

*Jebro
-12
passed*

(~~22~~ -22)

*Jebro
-18
failed*

-22

ASPHALT-BINDER LOW TEMPERATURE BBR TESTING: VALERO PG 76-22

CANNON® Instrument Company, USA 1.23 12/06/2010 04:20:20 PM

CANNON® Instrument Company, USA 1.23 12/06/2010 02:38:31 PM

Project : 6132 Target Temp (°C) : -18.0 Conf Test (GPa) : 207
 Operator : rc Min. Temp (°C) : -18.0 Conf Date : 12/06/2010
 Specimen : valero Max. Temp (°C) : -17.9 Force Const (mN/bit) : 0.149
 Test Time : 04:14:26 PM Temp Cal Date : 12/01/2010 Defl Const (µm/bit) : 0.161
 Test Date : 12/06/2010 Soak Time (min) : 60.0 Crpl (µm/N) : 4.71
 File Name : 10120603 Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID : temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

Project : 6132 Target Temp (°C) : -12.0 Conf Test (GPa) : 207
 Operator : rc Min. Temp (°C) : -12.0 Conf Date : 12/06/2010
 Specimen : valero Max. Temp (°C) : -11.9 Force Const (mN/bit) : 0.149
 Test Time : 02:32:53 PM Temp Cal Date : 09/23/2010 Defl Const (µm/bit) : 0.161
 Test Date : 12/06/2010 Soak Time (min) : 60.0 Crpl (µm/N) : 4.71
 File Name : lubinds2 Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID : temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	982	0.203	390	390	0.000	0.206
15.0	981	0.233	339	340	0.295	0.224
30.0	980	0.273	289	289	0.000	0.244
60.0	979	0.325	243	243	0.000	0.264
120.0	979	0.394	200	201	0.500	0.284
240.0	982	0.484	164	164	0.000	0.304

A = 2.75 B = -0.147 C = -0.033 R² = 0.999981

Force (t=0.0s) = 30 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 988 mN Deflection (t=0.5s) = 0.117 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +10 mN
 Max Force Deviation (t=5.0 - 240.0s) = -2, +4 mN

Average Force (t=0.5 - 240.0s) = 980 mN
 Maximum Force (t=0.5 - 240.0s) = 990 mN
 Minimum Force (t=0.5 - 240.0s) = 978 mN

*Valero
-18
failed*

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	982	0.337	235	235	0.000	0.254
15.0	981	0.398	199	199	0.000	0.273
30.0	979	0.484	163	163	0.000	0.295
60.0	978	0.596	132	132	0.000	0.316
120.0	979	0.748	106	105	-0.943	0.338
240.0	981	0.957	82.7	82.7	0.000	0.359

A = 2.57 B = -0.189 C = -0.0358 R² = 0.999988

Force (t=0.0s) = 33 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 988 mN Deflection (t=0.5s) = 0.171 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +10 mN
 Max Force Deviation (t=5.0 - 240.0s) = -3, +3 mN

Average Force (t=0.5 - 240.0s) = 980 mN
 Maximum Force (t=0.5 - 240.0s) = 990 mN
 Minimum Force (t=0.5 - 240.0s) = 977 mN

*Valero
-12
passed
(-22)*

-22

ASPHALT-BINDER LOW TEMPERATURE BBR TESTING: MARTIN PG 76-22

CANNON® Instrument Company, USA 1.23 12/06/2010 02:32:16 PM

CANNON® Instrument Company, USA 1.23 12/06/2010 04:14:04 PM

Project: 6132 Target Temp (°C) : -18.0 Conf Test (GPa) : 207
 Operator: rc Min. Temp (°C) : -18.0 Conf Date : 12/06/2010
 Specimen: martin Max. Temp (°C) : -18.0 Force Const (mN/bit) : 0.149
 Test Time: 04:09:04 PM Temp Cal Date : 12/01/2010 Def Const (µm/bit) : 0.161
 Test Date: 12/06/2010 Soak Time (min) : 60.0 Cmpl (µm/N) : 4.71
 File Name: 10120602 Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID: temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

Project: 6132 Target Temp (°C) : -12.0 Conf Test (GPa) : 207
 Operator: rc Min. Temp (°C) : -12.0 Conf Date : 12/06/2010
 Specimen: martin Max. Temp (°C) : -12.0 Force Const (mN/bit) : 0.149
 Test Time: 02:26:11 PM Temp Cal Date : 09/28/2010 Def Const (µm/bit) : 0.161
 Test Date: 12/06/2010 Soak Time (min) : 60.0 Cmpl (µm/N) : 4.71
 File Name: lubinda1 Beam Width (mm) : 12.70 Cal Date : 12/06/2010
 BBR ID: temp prob Thickness (mm) : 6.35 Software Version : BBRw 1.23

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	981	0.304	260	260	0.000	0.230
15.0	979	0.354	223	224	0.448	0.245
30.0	977	0.420	188	188	0.000	0.261
60.0	977	0.505	156	156	0.000	0.277
120.0	977	0.616	128	128	0.000	0.293
240.0	980	0.763	104	104	0.000	0.310

A = 2.6 B = -0.182 C = -0.0268 R² = 0.999970

Force (t=0.0s) = 32 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 986 mN Deflection (t=0.5s) = 0.162 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +11 mN
 Max Force Deviation (t=5.0 - 240.0s) = -2, +4 mN

Average Force (t=0.5 - 240.0s) = 978 mN
 Maximum Force (t=0.5 - 240.0s) = 989 mN
 Minimum Force (t=0.5 - 240.0s) = 976 mN

Martin
-18
failed

t Time (s)	P Force (mN)	d Deflection (mm)	Measured Stiffness (MPa)	Estimated Stiffness (MPa)	Difference (%)	m-value
8.0	991	0.578	138	138	0.000	0.266
15.0	990	0.687	116	116	0.000	0.282
30.0	989	0.839	95	95.1	0.105	0.299
60.0	987	1.036	76.8	76.8	0.000	0.317
120.0	988	1.298	61.4	61.3	-0.163	0.335
240.0	991	1.656	48.3	48.3	0.000	0.352

A = 2.36 B = -0.212 C = -0.0294 R² = 0.999994

Force (t=0.0s) = 31 mN Deflection (t=0.0s) = 0.000 mm
 Force (t=0.5s) = 997 mN Deflection (t=0.5s) = 0.277 mm

Max Force Deviation (t=0.5 - 5.0s) = -0, +11 mN
 Max Force Deviation (t=5.0 - 240.0s) = -3, +5 mN

Average Force (t=0.5 - 240.0s) = 989 mN
 Maximum Force (t=0.5 - 240.0s) = 1000 mN
 Minimum Force (t=0.5 - 240.0s) = 986 mN

Martin
-12
passed
(-22)

-22

ASPHALT-BINDER PG SPEC REQUIREMENTS

Table 2-9. Performance Graded Asphalt Binder Specification (continued)

Performance Grade	PG 70						PG 76					PG 82				
	-10	-16	-22	-28	-34	-40	-10	-16	-22	-28	-34	-10	-16	-22	-28	-34
Average 7-day Maximum Pavement Design Temperature, °C ^a	<70						<76					<82				
Minimum Pavement Design Temperature, °C ^a	>-10	>-16	>-22	>-28	>-34	>-40	>-10	>-16	>-22	>-28	>-34	>-10	>-16	>-22	>-28	>-34
Original Binder																
Flash Point Temp, T48: Minimum °C	230															
Viscosity, ASTM D 4402: ^b Maximum, 3 Pa·s (3000 cP), Test Temp, °C	135															
Dynamic Shear, TP5: ^c G*/sin δ, Minimum, 1.00 kPa Test Temperature @ 10 rad/s, °C	70						76					82				
Rolling Thin Film Oven (T 240) or Thin Film Oven (T 179) Residue																
Mass Loss, Maximum, %	1.00															
Dynamic Shear, TP5: G*/sin δ, Minimum, 2.20 kPa Test Temp @ 10 rad/sec, °C	70						76					82				
Pressure Aging Vessel Residue (PP1)																
PAV Aging Temperature, °C ^d	100(110)						100(110)					100(110)				
Dynamic Shear, TP5: G*/sin δ, Maximum, 5000 kPa Test Temp @ 10 rad/sec, °C	34	31	28	25	22	19	37	34	31	28	22	40	37	34	31	28
Physical Hardening ^e																
Creep Stiffness, TP1: ^f S, Maximum, 300 MPa m-value, Minimum, 0.300 Test Temp, @ 60 sec, °C	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24
Direct Tension, TP3: ^f Failure Strain, Minimum, 1.0% Test Temp @ 1.0 mm/min, °C	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	0	-6	-12	-18	-24