

Subsection 4.23 Asphalts, Oils, and Emulsions

I. Description: Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as specified on the plans.

II. Materials: Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced Department, AASHTO, and ASTM test methods. Provide asphalt materials that have been preapproved for use by TxDOT's Construction Division in accordance with Tex-545-C, "Asphalt Binder Quality Program."

A. Acronyms used in this Item are defined in Table 1.

**Table 1
Acronyms**

Acronyms	Definition
Test Procedure Designations	
Tex T or R D	Texas Department of Transportation AASHTO ASTM
Polymer Modifier Designations	
P SBR or L SBS TR	Polymer-modified Styrene-butadiene rubber (latex) Styrene-butadiene-styrene block co-polymer Tire rubber (ground tire rubber)
AC	Asphalt cement
AE	Asphalt emulsion
AE-P	Asphalt emulsion prime
A-R	Asphalt-rubber
C	Cationic
EAP&T	Emulsified asphalt prime and tack
h-suffix	Emulsified residue
HF	High float
MC	Medium curing
MS	Medium setting
PCE	Prime, cure, and erosion control
PG	Performance grade
RC	Rapid curing
RS	Rapid setting
S-suffix	Stockpile usage
SCM	Special cutback material
SS	Slow-setting

B. Asphalt Cement: Asphalt cement must be homogeneous, water-free, and nonfoaming when heated to 347°F, and must meet Table 2 requirements.

**Table2
Asphalt Cement**

Property	Test Procedure	AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity 140°F, poise 275°F, poise	T 202										
		40	80	100	200	250	350	400	600	800	1200
		0.4	-	0.7	-	1.1	-	1.4	-	1.9	-
Penetration, 77°F, 100g, 5 sec.	T49	350	-	250	-	210	-	135	-	85	-
Flash point, C.O.C., °F	T48	425	-	425	-	425	-	425	-	450	-
Solubility in Trichloroethylene, %	T44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot Test	Tex-509-C	Negative									
Tests on RTFOT: Viscosity 140° poise	T179										
Ductility ¹ , 77°F 5 cm/min., cm	T202	-	180	-	450	-	900	-	1500	-	3000
	T51	100	-	100	-	100	-	100	-	100	-

¹ If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

C. Polymer-Modified Asphalt Cement: Polymer-modified asphalt cement must be smooth and homogeneous, and comply with the requirements of Table 3. If requested, supply samples of the base asphalt cement and polymer additives.

**Polymer-Modified Asphalt
Cement**

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-5 w/ 2% SBR		AC-10 w/ 2% SBR		AC15-P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		SBR		SBR		SBS		SBS		TR		TR	
Polymer Content % solids basis	Tex-533-C	2.0	-	2.0	-	3.0	-	-	-	2.0	-	5.0	-
Dynamic shear, G*/sin δ, 64°C, 10 rad/s, kPa	T 315	-	-	-	-	-	-	1.0	-	-	-	1.0	-
Dynamic shear, G*/sin δ, 58°C, 10 rad/s, kPa	T 315	-	-	-	-	-	-	-	-	1.0	-	-	-
Viscosity 140°F, Poise	T 202	700	-	1300	-	1500	-	2000	-	1000	-	2000	-
275°F poise	T 202	-	7.0	-	8.0	-	8.0	-	-	-	8.0	-	10.0
Penetration, 77°F, 100g, 5 sec.	T 49	120	-	80	-	100	150	75	115	95	130	75	115
Ductility, 5cm/min.,39.2°F, cm	T 51	70	60	-	-	-	-	-	-	-	-	-	-
Elastic Recovery, 50°F, %	Tex-539-C	-	-	-	-	55	-	55	-	30	-	55	-
Softening point, °F	T 53	-	-	-	-	-	-	120	-	110	-	120	-
Polymer separation, 48 hr.	Tex-540-C	None		None		None		None		None		None	
Flash point, C.O.C., °F	T 48	425	-	425	-	425	-	425	-	425	-	425	-
Test on residue from RTFOT aging and pressure aging: Creep Stiffness S,-18°C, MPa m-value, -18°C	Tex-541-C and R 28, T 313	-	-	-	-	-	300	-	300	-	300	-	300
		-	-	-	-	0.30	-	0.30	-	0.30	-	0.30	-

D. Cutback Asphalt: Cutback asphalt must meet the requirements of Tables 4, 5, and 6 for the specified type and grade. If requested, supply samples of the base asphalt cement and polymer additives.

Table 4

Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1600	3000	6000
Water, %	D 95	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F	T 79	80	-	80	-	80	-
Distillation test:	T 78						
Distillate, % by volume of total Distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	-	80	-	70	-
Residue from distillation, volume%		70	-	75	-	82	-
Tests on distillation residue:							
Viscosity, 140°F poise	T 202	600	2400	600	2400	600	2400
Ductility, 5cm/min., 77°F, cm	T 51	100	-	100	-	100	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-
Spot test	Tex-509-C	Negative		Negative		Negative	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type-Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1600	3000	6000
Water, %	D 95	-	0.2	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F	T 79	95	-	122	-	140	-	149	-
Distillation test:	T 78								
Distillate, % by volume of total Distillate to 680°F									
to 437°F		-	35	-	20	-	-	-	-
to 500°F		30	75	5	55	-	40	-	15
to 600°F		75	95	60	90	45	85	15	75
Residue from distillation, volume%		50	-	67	-	75	-	80	-
Tests on distillation residue:									
Viscosity, 140°F poise	T 202	300	1200	300	1200	300	1200	300	1200
Ductility, 5cm/min., 77°F, cm	T 51	100	-	100	-	100	-	100	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-	99.0	-
Spot test	Tex-509-C	Negative		Negative		Negative		Negative	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type-Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2400	4800	500	1000	1000	2000
Water, %	D 95	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F	T 79	150	-	175	-	175	-
Distillation test:	T 78						
Distillate, % by volume of total							
Distillate to 680°F							
to 437°F		-	-	-	-	-	-
to 500°F		-	35	-	0.5	-	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume%		78	-	76	-	82	-
Tests on distillation residue:							
Polymer		SBR	SBR	-	-	-	-
Polymer content, % solids basis	Tex-533-C	2.0	-	-	-	-	-
Penetration, 100 g 5 sec., 77°F	T 49	150	300	180	-	180	-
Ductility, 5cm/min., 39.2°F, cm	T 50	50	-	-	-	-	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-

E. Emulsified Asphalt: Emulsified asphalt must be homogeneous, not separate after thorough mixing, and meet the requirements for the specified type and grade in Tables 7, 8, 9, and 10.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type-Grade									
		Rapid-Setting		Medium Setting				Slow Setting			
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	- 150	- 400	- 100	- 300	75	400	20	100	20	100
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-	-	-	-	-	-	Pass		Pass	
Cement Mixing, %	T 59	-	-	-	-	-	-	-	2.0	-	2.0
Coating ability and water resistance: Dry aggregate/ after spray Wet aggregate/ after spray	T 59	-	-	-	-	Good /Fair Fair /Fair		-	-	-	-
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	50	-	-	30	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1
Freezing Test, 3 cycles ¹	T 59	-		Pass		-		Pass		Pass	
Distillation test: Residue by distillation, % By weight Oil distillate, % by volume Of emulsion	T 59	65	-	65	-	65	-	60	-	60	-
		-	0.5	-	0.5	-	5	-	0.5	-	0.5
Tests on residue from distillation: Penetration, 77°F, 100 g, 5 sec. Solubility in trichloroethylene, % Ductility, 77°F 5 cm/min., cm Float test, 140°F, sec	T 49 T 44 T 51 T 50	100 97.5 100 1200	140 - - -	120 97.5 100 -	160 - - -	300 97.5 - 1200	- - - -	120 97.5 100 -	160 - - -	70 97.5 80 -	100 - - -

¹ Applies only when the Engineer or ODR designates for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting				Medium-Setting				Slow-Setting			
		CRS-2		CRS-2H		CMS-2		CMS-2S		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec.	T 72	-	-	-	-	-	-	-	-	20	100	20	100
		150	400	150	400	100	300	100	300	-	-	-	-
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Cement mixing, %	T 59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Coating ability and water resistance:	T 59												
Dry aggregate/after spray		-		-		Good/ Fair		Good/ Fair		-		-	
Wet aggregate/after spray		-		-		Fair/ Fair		Fair/ Fair		-		-	
Demulsibility, 35 ml of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	-	70	-	-	-	-	-	-	-	-	-
Storage stability, 1 day %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test:	T 59												
Residue by distillation, % by weight		65	-	65	-	65	-	65	-	60	-	60	-
Oil distillate, % by volume of emulsion		-	0.5	-	0.5	-	7	-	5	-	0.5	-	0.5
Tests on residue from distillation:													
Penetration, 77°F, 100g, 5 sec	T 49	120	160	70	110	120	200	300	-	120	160	70	110
Solubility in trichloroethylene, %	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
Ductility, 77°F, 5 cm/min., cm	T 51	100	-	80	-	100	-	-	-	100	-	80	-

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting				Medium Setting				Slow-Setting			
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	- 150	- 200	- 150	- 400	75	400	75	400	75	400	30	100
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-		-		-		-		-		Pass	
Coating ability and water resistance: Dry aggregate/after spray Wet aggregate/after spray	T 59	-		-		Good/Fair Fair/Fair		Good/Fair Fair/Fair		Good/Fair Fair/Fair		-	
Demulsibility, 35 ml of 0.02 N CaCl ₂ , &	T 59	60	-	50	-	-	-	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation test ¹ : Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65 -	- 3	65 -	- 0.5	65 -	- 3	65 -	- 5	65 -	- 7	60 -	- 0.5
Tests on residue from distillation: Polymer content, wt. % solids basis Penetration, 77°F, 100 g, 5 sec Solubility in trichloroethylene, % Viscosity, 140°F, poise Float test, 140°F, sec. Ductility ² , 39.2°F, 5 cm/min., cm Elastic recovery ² , 50°F, %	Tex-533-C T 49 T 44 T 202 T 50 T 51 Tex-539-C	- 225 97. 0 - - 55	- 300 - - - - -	3.0 90 97.0 150 0 120 0 50 55	- 140 - - - - - -	- 150 97.0 - 1200 - -	- 300 - - - - -	- 300 97.0 - 1200 - -	- - - - - - -	300 97.0 - 120 0 -	- - - - - -	3.0 100 97.0 1300 - 50 -	- 140 - - - - -
Tests on RTFO curing of distillation residue Elastic recovery, 50°F, %	Tex-541-C Tex-539-C	-	-	-	-	50	-	50	-	30	-	-	-

¹Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ± 10°F. Maintain at this temperature for 20 minutes. Complete total distillation in 60 minutes (± 5 minutes) from the first application of heat.

² HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type-Grade											
		Rapid-Setting						Medium-Setting				Slow-Setting	
		CRS-1P		CRS-2P		CHFRS-2P		CMS-1P ³		CMS-2P ³		CSS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	- 50	- 150	- 150	- 400	- 100	- 400	20 -	100 -	- 50	- 400	20 -	100 -
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Demulsibility, 35 ml of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	60	-	70	-	60	-	-	-	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1	-	-	-	-	-	1
Breaking index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Particle Charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test ¹ :	T 59												
Residue by distillation, % by weight		65	-	65	-	65	-	65	-	65	-	62	-
Oil distillate, % by volume of emulsion		-	3	-	0.5	-	0.5	-	0.5	-	0.5	-	0.5
Tests on residue from distillation:													
Polymer content, wt. % solids basis	Tex-533-C	-	-	3.0	-	3.0	-	-	-	-	-	30	-
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	150	80	130	40	-	40	-	55	90
Viscosity, 140°F, poise	T 202	-	-	130	-	130	-	-	500	-	500	-	-
Solubility in trichloroethylene, %	T 44	97.	-	0	-	0	-	-	0	-	0	97.	-
Softening point, °F	T 53	0	-	97.	-	95.	-	-	-	-	-	0	-
Ductility ² , 39.2°F, 5 cm/min., cm	T 51	-	-	0	-	0	-	-	-	-	-	135	-
Float test, 140°F, sec.	T 51	-	-	-	-	130	-	-	-	-	-	70	-
Ductility ² , 392°F, 5 cm/min., cm	T 50	-	-	-	-	-	-	-	-	-	-	-	-
Elastic recovery ² , 50°F, %	T 51	-	-	-	-	180	-	-	-	-	-	-	-
	Tex-539-C	45	-	50	-	0	-	45	-	45	-	-	-
				55		55							
Tests on rejuvenating agent:													
Viscosity, 140°F, cSt	T 201	-	-	-	-	-	-	50	175	50	175	-	-
Flash point, C.O.C., °F	T 48	-	-	-	-	-	-	380	-	380	-	-	-
Saturates, % by weight	D 2007	-	-	-	-	-	-	-	30	-	30	-	-
Solubility in n-pentane, % by weight	D 2007	-	-	-	-	-	-	99	-	99	-	-	-
Tests on rejuvenating agent after TFO or RTFO:	T 240 or T 179												
Weight change, %		-	-	-	-	-	-	-	6.5	-	6.5	-	-
Viscosity ratio		-	-	-	-	-	-	-	3.0	-	3.0	-	-
Tests on latex ⁴ :													
Tensile strength, die C dumbbell, psi	D 412 ⁵	-	-	-	-	-	-	500	-	500	-	-	-
Change in mass after immersion in rejuvenating agent, %	D 471	-	-	-	-	-	-	-	40 ⁶	-	40 ⁶	-	-

¹Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F. Maintain at this temperature for 20 minutes. Complete total distillation in 60 minutes (±5 minutes) from the first application of heat.

²CRS-2P must meet one of either the ductility or elastic recovery requirements.

³With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the ODR.

⁴Preparation of latex films: Use any substrate which produces a film of uniform cross-section. Apply latex using a drawdown tool that will deliver enough material to achieve desired residual thickness. Cure films for 14 days at 75°F and 50% relative humidity.

⁵Cut samples for tensile strength determination using a crosshead speed of 20 inches/minute.

⁶Specimen must remain intact after exposure and removal of excess rejuvenating agent.

F. Specialty Emulsions: Specialty emulsions may be either asphalt-based or resin-based and must meet the requirements of Table 11.

Table 11
Specialty Emulsions

Property	Test Procedure	Type-Grade					
		Medium-Setting				Slow-Setting	
		AE-P		EAP&T		PCE ¹	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	- 15	- 150	- -	- -	10 -	100 -
Sieve test, %	T 59	-	0.1	-	0.1	-	0.1
Miscibility ²	T 59	-	-	Pass	-	Pass	-
Demulsibility, 35 ml of 0.10 N CaCl ₂ , %	T 59	-	70	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	-
Particle size ⁵ , % by volume <2.5 μm	Tex-238-F ³	-	-	90	-	90	-
Asphalt emulsion distillation to 500°F Followed by cutback asphalt distillation of residue to 680°F: Residue after both distillations, % by wt. Total oil distillate from both distillations, % by volume of emulsion	T 59 & T 78	40 25	- 40	- -	- -	- -	- -
Residue by distillation, % by wt.	T 59	-	-	60	-	-	-
Residue by evaporation ⁴ , % by wt.	T 59	-	-	-	-	60	-
Tests on residue after all distillations:							
Viscosity, 140°F, poise	T 202	-	-	800	-	-	-
Kinematic viscosity ⁵ , 140°F, cSt	T 201	-	-	-	-	100	350
Flash point C.O.C., °F	T 48	-	-	-	-	400	-
Solubility in trichloroethylene, %	T 44	97.5	-	-	-	-	-
Float test, 122°F, sec.	T 50	50	200	-	-	-	-

¹Supply with each shipment of PCE:

- a) A copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- b) A certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCBs have been mixed with the product; and
- c) A Material Safety Data Sheet.

²Exception to T 59: In dilution, use 350 ml of distilled or deionized water and a 1,000-ml beaker.

³Use Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.

⁴Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

⁵PCE must meet either the kinematic viscosity requirement or the particle size requirement.

G. Recycling Agent: Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

**Table 12
Recycling Agent and Emulsified Recycling Agent**

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	-	-	15	100
Sieve test, %	T 59	-	-	-	0.1
Misibility ¹	T 59	-		No coagulation	
Residue by evaporation ² , % by wt.	T 59	-	-	60	-
Tests on recycling agent or residue from evaporation: Flash point, C.O.C., °F Kinematic viscosity, 140°F, cSt 275°F, cSt	T 48	400	-	400	-
		T 201			
		75	200	75	200
		-	10.0	-	10.0

¹Exception to T 59: use 0.02 N CaCl₂ solution in place of water

²Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

H. Crumb Rubber Modifier: Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding. CRM must be:

1. Free from contaminants including fabric, metal, and mineral and other nonrubber substances;
2. Free-flowing; and
3. Nonfoaming when added to hot asphalt binder.

When tested in accordance with Tex-200-F, Part I, using a 50-g sample, the rubber gradation must meet the requirements of the grades in Table 13.

**Table 13
CRM Gradations**

Sieve Size % Passing	Grade A		Grade B		Grade C		Grade D
	Min	Max	Min	Max	Min	Max	
#8	100	-	-	-	-	-	As shown on the plans
#10	95	100	100	-	-	-	
#16	-	-	70	100	100	-	
#30	-	-	25	60	90	100	
#40	-	-	-	-	45	100	
#50	0	10	-	-	-	-	
#200	-	-	0	5	-	-	

I. Crack Sealer: Polymer modified asphalt-emulsion crack sealer must meet the requirements of Table 14. Rubber-asphalt crack sealer must meet the requirements of Table 15.

Table 14
Polymer-Modified Asphalt Emulsion Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D 2196, Method A	10,000	25,000
Sieve test, %	T 59	-	0.1
Storage stability, 1 day, %	T 59	-	1
Evaporation Residue by evaporation, % by wt.	Tex-543-C	65	-
Tests on residue from evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening point, °F	T 53	140	-
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	-

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or B, % by wt.	Tex-544-C	22	26	-	-
CRM content, Grade B, % by weight	Tex-544-C	-	-	13	17
Virgin rubber content ¹ , % by weight		-	-	2	-
Flash point ² , C.O.C., °F	T 48	400	-	400	-
Penetration ³ , 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration ³ , 32°F, 200 g, 60 sec.	T 49	12	-	12	-
Softening point, °F	T 53	-	-	170	-
Bond test, non-immersed, 0.5 in specimen, 50% extension, 20°F ⁴	D 5329	-		Pass	

¹Provide certification that the minimum % virgin rubber was added.

²Agitate the sealing compound with a 3/8 to 1/2 inch wide, square end metal spatula to bring the material on the bottom of the cup to the surface (i.e., turn the material over) before passing the test flame over the cup. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 seconds. Pass the test flame over the cup immediately after stirring is completed.

³Exception to T 49: Substitute the cone specified in D 217 for the penetration needle.

⁴Allow no crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 inch deep for any specimen after completion of the test.

J. Asphalt-Rubber Binders: Asphalt-rubber (A-R) binders are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. The A-R binders meet D 6114 and contain a minimum of 15% CRM by weight. Types I or II, containing CRM Grade C, are used for hot mixed aggregate mixtures. Types II or III, containing CRM Grade B, are used for surface treatment binder. Ensure binder properties meet the requirements of Table 16.

**Table 16
A-R Binders**

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D 2196, Method A	1500	5000	1500	5000	1500	5000
Penetration, 77°F, 100g, 60 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200g, 60 sec.	T 49	10	-	15	-	25	-
Softening point, °F	T 53	135	-	130	-	125	-
Resilience, 77°F, %	D 5329	25	-	20	-	10	-
Flash point, C.O.C., °F	T 48	450	-	450	-	450	-
Test on residue from Thin-Film Oven Test:	T 179						
Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 49	75	-	75	-	75	-

K. Performance-Graded Binders: PG binders must be smooth and homogeneous, show no separation when tested in accordance with Tex-540-C, and meet Table 17 requirements. Separation testing is not required if:

- A.** A modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- B.** The binder is blended on site in continuously agitated tanks, or
- C.** Binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

Performance-Graded Binders

Property	Test Method	Performance Grade							
		PG 58		PG 64		PG 70		PG 76	
		-22	-28	-22	-28	-22	-28	-22	-28
Average 7 day max pavement design temperature, °C ¹		< 58		< 64		< 70		< 76	
Min pavement design temperature, °C ¹		> -22	> -28	> -22	> -28	> -22	> -28	> -22	> -28
Original Binder									
Flash point, Min, °C	T 48	230							
Viscosity ^{2,3} Max, 3.0 Pa·s, test temperature, °C	T 316	135							
Dynamic shear: G*/sin(δ), Min, 1.00 kPa, Max 2.00 kPa, ⁷ Test temperature @ 10 rad/sec., °C	T 315 ⁴	58		64		70		76	
Elastic recovery, 50°F, % min	D 6084	-	-	-	30	30	50	50	60
Rolling Thin-Film Oven (Tex-541-C)									
Mass loss, Max %	Tex-541-C	1.0							
Dynamic shear: G*/sin(δ), Min, 2.20 kPa, Max 5.00 kPa, ⁷ Test temperature @ 10 rad/sec., °C	T 315	58		64		70		76	
Pressure Aging Vessel (PAV) Residue (R28)									
PAV aging temperature, °C		100							
Dynamic shear: G*/sin(δ), Max 5,000 kPa, Test temperature @ 10 rad/sec., °C	T 315	25	22	25	22	25	22	25	22
Creep stiffness ^{5,6} S, max, 300 MPa m-value, Min 0.300 Test temperature @ 60 sec., °C	T 313	-12	-18	-12	-18	-12	-18	-12	-18
Direct tension ⁶ Failure strain, Min, 1.0% Test temperature @ 1.0 mm/min., °C	T 314	-12	-18	-12	-18	-12	-18	-12	-18

¹Pavement temperatures are estimated from air temperatures using an algorithm contained in a TxDOT computer program, or by following procedures outlined in ASSHTO MP 2 and PP 28.

²This requirement may be waived at the City’s discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).

³Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing and constructability issues that may arise.

⁴For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G*/sin(δ) at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).

⁵Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.

⁶If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

⁷Maximum values for unaged and RTFO aged dynamic shear apply to materials used as substitute binders, as described in Subsection 4.13 “Dense Graded Hot-Mix Asphalt.”

III. Equipment: The contractor will provide the required or necessary equipment in accordance with Subsection 4.25, “Equipment for Asphalt Concrete Pavement” and Subsection 4.26 “Weighing and Measuring Equipment.”

IV. Construction

A. Seasonal Restrictions: The “open” season for applying asphaltic materials and mixtures for the listed items shall be as follows, unless authorized otherwise in writing by the ODR.

<u>Items</u>	<u>Open season</u>
4.15	From April 15 th through September 30 th
4.16, 4.22	From April 15 th through October 31 st

B. Typical Material Use: Table 18 shows typical materials used for specific applications. These are typical uses only. Circumstances may require use of other material.

Table 18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot laid asphalt mixtures	PG binders, A-R binders Types I and II
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Surface treatment	AC-5, AC-10, AC-5 W/2% SBR, AC-10 W/2% SBR, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG binders, SS-1H, CSS-1H, EAP&T
Fog seal	SS-1, SS-1H, CSS-1
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P
Crack sealing	SS-1P, rubber asphalt crack sealers (Class A and Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H

C. Storage and Application Temperatures: Use storage and application temperatures in accordance with Table 19. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer’s instructions for any agitation requirements in storage. Manufacturer’s instructions regarding recommended application and storage temperatures supersede those of Table 19.

Table 19
Storage and Application Temperatures

Type-Grade	Application		Storage Maximum °F
	Recommended Range °F	Maximum Range °F	
AC-0.6, AC-1.5, AC-3	200-300	350	350
AC-5, AC-10	275-350	350	350
AC-5 w/2% SBR, AC-10 w2% SBR, AC-15P, AC-20-5TR	300-375	375	360
RC-250	125-180	200	200
RC-800	170-230	260	260
RC-3000	215-275	285	285
MC-30, AE-P	70-150	175	175
MC-250	125-210	240	240
MC-800, SCM I, SCM II	175-260	275	275
MC-3000, MC-2400L,	225-275	290	290
HFRS-2,MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120-160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agents	50-130	140	140
PG binders	275-350	350	350
Rubber asphalt crack sealers (Class A and Class B)	350-375	400	-
A-R binders Types I, II, and III	325-425	425	425

V. **Measurement and Payment:** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but is subsidiary or is included in payment for other bid Items.

LAST PAGE OF SECTION