
Item 8010

Asphalts, Oils, and Emulsions (Materials Only)



1. DESCRIPTION

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

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced Department, AASHTO, and ASTM test methods. Use asphalt containing recycled materials only if the recycled components meet the requirements of Article 6.9, "Recycled Materials." Provide asphalt materials that the Department has preapproved for use in accordance with Tex-545-C, "Asphalt Binder Quality Program."

Inform the Department of all additives or modifiers included in the asphalt binder as part of the facility quality plan, as required by Tex-545-C, "Asphalt Binder Quality Program," and provide that information to Department personnel. The Department reserves the right to prohibit the use of any asphalt additive or modifier.

Limit the use of polyphosphoric acid to no more than 0.5% by weight of the asphalt binder.

Limit the use of re-refined engine oil bottoms to no more than 5.0% by weight of the asphalt binder.

Acronyms used in this Item are defined in Table 1.

**Table 1
Acronyms**

Acronym	Definition
Test Procedure Designations	
Tex	Department
T or R	AASHTO
D	ASTM
Polymer Modifier Designations	
P	polymer-modified styrene-butadiene rubber (latex) styrene-butadiene-styrene block co-polymer tire rubber (from ambient temperature grinding of truck and passenger tires)
SBR or L	
SBS	
TR	
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	harder residue (lower penetration)
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

- 4.1. **Asphalt Cement.** Provide asphalt cement that is homogeneous, water-free, and nonfoaming when heated to 347°F, and meets the requirements in Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		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 0.4	80 -	100 0.7	200 -	250 1.1	350 -	400 1.4	600 -	800 1.9	1,200 -
Penetration, 77°F, 100g, 5 sec.	T 49	350	-	250	-	210	-	135	-	85	-
Flash point, C.O.C., °F	T 48	425	-	425	-	425	-	425	-	450	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from Thin-Film Oven Test: Viscosity, 140°F, poise Ductility, ¹ 77°F 5 cm/min., cm	T 179 T 202 T 51	- 180 100	- - -	- 450 100	- - -	- 900 100	- - -	- 1,500 100	- - -	- 3,000 100	- - -

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.

- 4.2. **Polymer-Modified Asphalt Cement.** Provide polymer-modified asphalt cement that is smooth, homogeneous, and meets the requirements of Table 3. Supply samples of the base asphalt cement and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-5 w/2% SBR		AC-10 w/2% SBR		AC-15P		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 275°F, poise	T 202 T 202	700 -	- 7.0	1,300 -	- 8.0	1,500 -	- 8.0	2,000 -	- -	1,000 -	- 8.0	2,000 -	- 10.0
Penetration, 77°F, 100 g, 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	-
Tests 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
		-	-	-	-	0.300	-	0.300	-	0.300	-	0.300	-

- 4.3. **Cutback Asphalt.** Provide cutback asphalt that meets the requirements of Tables 4, 5, and 6 for the specified type and grade. Supply samples of the base asphalt cement and polymer additives if requested.

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	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	80	–	80	–	80	–
Distillation test:	T 78						
Distillate, percentage 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, 5 cm/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		Neg.		Neg.		Neg.

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	1,600	3,000	6,000
Water, %	D95	–	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, percentage 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, 5 cm/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		Neg.		Neg.		Neg.		Neg.

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	2,400	4,800	500	1,000	1,000	2,000
Water, %	D95	-	0.2	-	0.2	-	0.2
Flash point, T.O.C., °F	T 79	150	-	175	-	175	-
Distillation test:	T 78						
Distillate, percentage 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					
Polymer content, % (solids basis)	Tex-533-C	2.0	-	-	-	-	-
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	-	180	-
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	-	-	-	-	-
Solubility in trichloroethylene, %	T 44	99.0	-	99.0	-	99.0	-

- 4.4. **Emulsified Asphalt.** Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets 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	-	-	-	-	75	400	20	100	20	100
		150	400	100	300	-	-	-	-	-	-
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 wt. 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	100	140	120	160	300	-	120	160	70	100
	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
	T 51	100	-	100	-	-	-	100	-	80	-
	T 50	1,200	-	-	-	1,200	-	-	-	-	-

1. Applies only when the Engineer designates material 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: Dry aggregate/after spray Wet aggregate/after spray	T 59	-	-	-	-	Good/Fair	Good/Fair	Good/Fair	Good/Fair	-	-	-	-
		-	-	-	-	Fair/Fair	Fair/Fair	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: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59	65	-	65	-	65	-	65	-	60	-	60	-
		-	0.5	-	0.5	-	7	-	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	T 49	120	160	70	110	120	200	300	-	120	160	70	110
	T 44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
	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	-	-	-	-	75	400	75	400	75	400	30	100
		50	200	150	400	-	-	-	-	-	-	-	-
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	Good/Fair	Good/Fair	Good/Fair	Good/Fair	Good/Fair	-	-
		-	-	-	-	Fair/Fair	Fair/Fair	Fair/Fair	Fair/Fair	Fair/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	-	65	-	65	-	65	-	65	-	60	-
		-	3	-	0.5	-	3	-	5	-	7	-	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	-	-	3.0	-	-	-	-	-	-	-	3.0	-
	T 49	225	300	90	140	150	300	300	-	300	-	100	140
	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
	T 202	-	-	1,500	-	-	-	-	-	-	-	1,300	-
	T 50	-	-	1,200	-	1,200	-	1,200	-	1,200	-	-	-
	T 51	-	-	50	-	-	-	-	-	-	-	50	-
	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO curing of distillation residue	Tex-541-C	-	-	-	-	50	-	50	-	30	-	-	-
	Tex-539-C	-	-	-	-	-	-	-	-	-	-	-	-

Property	Test	Type-Grade
1.	Exception to T 59:	Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) 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		CRS-2TR		CMS-1P ³		CMS-2P ³		CSS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77°F, sec. 122°F, sec.	T 72	-	-	-	-	-	-	--	--	10	100	-	-	20	100
		50	150	150	400	100	400	150	500	-	-	50	400	-	-
Sieve test, %	T 59	-	0.1	-	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	-	40	--	-	-	-	-	-	-
Storage stability, 1 day, %	T 59	-	1	-	1	-	1	--	1	-	1	-	1	-	1
Breaking index, g	Tex-542-C	-	80	-	-	-	-	--	--	-	-	-	-	-	-
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test ¹ :	T 59														
Residue by distillation, % by weight		65	-	65	-	65	-	65	--	30	-	60	-	62	-
Oil distillate, % by volume of emulsion		-	3	-	0.5	-	0.5	--	3	-	0.5	-	0.5	-	0.5
Tests on residue from distillation:															
Polymer content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-	5.0 ⁷	--	-	-	-	-	3.0	-
Penetration, 77°F, 100 g, 5 sec.	T 49	225	300	90	150	80	130	90	150	30	-	30	-	55	90
Viscosity, 140°F, poise	T 202	-	-	1,300	-	1,300	-	1,000	--	-	-	-	-	-	-
Solubility in trichloroethylene, %	T 44	97.0	-	97.0	-	95.0	-	98	--	-	-	-	-	97.0	-
Softening point, °F	T 53	-	-	-	-	130	-	--	--	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm	T 51	-	-	-	-	-	-	40	--	-	-	-	-	70	-
Float test, 140°F, sec.	T 50	-	-	-	-	1,800	-	--	--	-	-	-	-	-	-
Ductility, ² 39.2°F, 5 cm/min., cm	T 51	-	-	50	-	-	-	--	--	-	-	-	-	-	-
Elastic recovery, ² 50°F, %	Tex-539-C	45	-	55	-	55	-	--	--	-	-	-	-	-	-
Tests on residue from evaporative recovery:	R 78, Procedure B														
Nonrecoverable creep compliance of residue, 3.2 kPa, 52°C, kPa ⁻¹	T 350									-	2.0	-	4.0		
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	-	-	-	-	-	-	--	--	800	-	800	-	-	-
Change in mass after immersion in rejuvenating agent, %	D 471	-	-	-	-	-	-	--	--	-	40 ⁶	-	40 ⁶	-	-

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1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ($\pm 0^\circ\text{F}$). Maintain at this temperature for 20 min. Complete total distillation in 60 min. (± 5 min.) from the first application of heat.
 2. CRS-2P must meet one of either the ductility or elastic recovery requirements.
 3. With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that the rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the Engineer.
 4. Preparation of latex specimens: Use any substrate and recovery method which produces specimens of uniform dimensions and which delivers enough material to achieve desired residual thickness.
 5. Cut samples for tensile strength determination using a crosshead speed of 20 in./min.
 6. Specimen must remain intact after exposure and removal of excess rejuvenating agent.
 7. Modifier type is tire rubber.

Table 10B
Non-Tracking Tack Coat Emulsion

Property	Test Procedure	Quick Setting	
		QS-1HH	
		Min	Max
Viscosity, Saybolt Furol, 77° F, sec	T 72	15	--
Storage stability, 1 Day, %	T 59	--	1
Settlement, 5-day, %	T 59	2	5
Sieve test, %	T 59	--	0.30
Distillation test: ¹	T 59		
Residue by distillation, % by wt.		50	--
Oil distillate, by volume of emulsion		--	1.0
Test on residue from distillation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	--	20
Solubility in trichloroethylene, %	T 44	97.5	--
Softening point, °F	T 53	150	
Dynamic shear, $G^*/\sin(\delta)$, 82°C, 10 rad/s, kPa	T 315	1.0	--

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

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

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.	T 72	-	-	-	-	10	100
122°F, sec.		15	150	-	-	-	-
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:	T 59 & T 78						
Residue after both distillations, % by wt.		40	-	-	-	-	-
Total oil distillate from both distillations, % by volume of emulsion		25	40	-	-	-	-
Residue by distillation, % by wt.	T 59	-	-	60	-	-	-
Residue by evaporation, ⁴ % by wt.	T 59	-	-	-	-	60	-
Tests on residue after all distillation(s):							
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	-	-	-	-

Supply with each shipment of PCE:

- 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;
- a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or Polychlorinated Biphenyls (PCBs) have been mixed with the product; and
- a Safety Data Sheet.

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

Use [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.

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

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

Table 11A
Hard Residue Surface Sealant

Property	Test Procedure	Min	Max
Viscosity, Krebs unit, 77°F, Krebs units	D 562	45	75
Softening point, °F	T 53 ¹	250	--
Uniformity	D 2939	Pass ²	
Resistance to heat	D 2939	Pass ³	
Resistance to water	D 2939	Pass ⁴	
Wet flow, mm	D 2939	--	0
Resistance to Kerosene (optional) ⁵	D 2939	Pass ⁶	
Ultraviolet exposure, UVA-340, 0.77 W/m ² , 50°C chamber, 8 hr. UV lamp, 5 min spray, 3 hr. 55 min. condensation, 1000 hr total exposure ⁷	G 154	Pass ⁸	
Abrasion loss, 1.6 mm thickness, liquid only, %	ISSA TB-100	--	1.0
Residue by evaporation, % by weight	D 2939	33	--
Tests on residue from evaporation: Penetration, 77°F, 100 g, 5 sec.	T 49	15	30
Flash point, Cleveland open cup, °F	T 48	500	
Tests on base asphalt before emulsification Solubility in trichloroethylene, %	T 44	98	--

1. Cure the emulsion in the softening point ring in a 200°F ± 5°F oven for 2 hr.

2. Product will be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.

3. No sagging or slippage of film beyond the initial reference line.

4. No blistering or re-emulsification.

5. Recommended for airport applications or where fuel resistance is desired.

6. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.

7. Other exposure cycles with similar levels of irradiation and conditions may be used with Department approval.

8. No cracking, chipping, surface distortion, or loss of adhesion. No color fading or lightening.

- 4.6. **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
Miscibility 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	T 48	400	–	400	–
Kinematic viscosity,	T 201				
140°F, cSt		75	200	75	200
275°F, cSt		–	10.0	–	10.0

2. Exception to T 59: Use 0.02 N CaCl₂ solution in place of water.

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

- 4.7. **Crumb Rubber Modifier.** Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free from contaminants including fabric, metal, and mineral and other nonrubber substances;
- free-flowing; and
- nonfoaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades in Table 13 when tested in accordance with [Tex-200-F](#), Part I, using a 50-g sample.

Table 13
CRM Gradations

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

- 4.8. **Crack Sealer.** Provide polymer-modified asphalt-emulsion crack sealer meeting the requirements of Table 14. Provide rubber-asphalt crack sealer meeting 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	Tex-543-C		
Residue by evaporation, % by wt.		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 wt.	Tex-544-C	–	–	13	17
Virgin rubber content, ¹ % by wt.		–	–	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	D5329	–		Pass	

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound with a 3/8- to 1/2-in. (9.5- to 12.7-mm) 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 sec. Pass the test flame over the cup immediately after stirring is completed.
3. Exception to T 49: Substitute the cone specified in D 217 for the penetration needle.
4. Allow no crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.

- 4.9. **Asphalt-Rubber Binders.** Provide asphalt-rubber (A-R) binders that are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing a minimum of 15% CRM by weight. Provide Types I or II, containing CRM Grade C, for use in hot-mixed aggregate mixtures. Provide Types II or III, containing CRM Grade B, for use in 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	D2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	–	15	–	25	–
Softening point, °F	T 53	135	–	130	–	125	–
Resilience, 77°F, %	D5329	25	–	20	–	10	–
Flash point, C.O.C., °F	T 48	450	–	450	–	450	–
Tests 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	–

- 4.10. **Performance-Graded Binders.** Provide PG binders that are smooth and homogeneous, show no separation when tested in accordance with [Tex-540-C](#), and meet the requirements of Table 17.

Separation testing is not required if:

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

Table 17
Performance-Graded Binders

Property and Test Method	Performance Grade																	
	PG 58			PG 64				PG 70				PG 76				PG 82		
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day max pavement design temperature, °C ¹	< 58			< 64				< 70				< 76				< 82		
Min pavement design temperature, °C ¹	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28	>-34	>-16	>-22	>-28
Original Binder																		
Flash point, T 48, Min, °C	230																	
Viscosity, T 316: ^{2,3} Max, 3.0 Pa-s, test temperature, °C	135																	
Dynamic shear, T 315: ⁴ G*/sin(δ), Min, 1.00 kPa, Max, 2.00 kPa, ⁷ Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
Elastic recovery, D 6084, 50°F, % Min	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
Rolling Thin-Film Oven (Tex-541-C)																		
Mass loss, Tex-541-C, Max, %	1.0																	
Dynamic shear, T 315: G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa, ⁷ Test temperature @ 10 rad/sec., °C	58			64				70				76				82		
Pressure Aging Vessel (PAV) Residue (R 28)																		
PAV aging temperature, °C	100																	
Dynamic shear, T 315: G* sin(δ), Max, 5,000 kPa Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep stiffness, T 313: ^{5,6} S, max, 300 MPa, m-value, Min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct tension, T 314: ⁶ Failure strain, Min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

- Pavement temperatures are estimated from air temperatures using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
- This requirement may be waived at the Department'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).
- Viscosity 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 any constructability issues that may arise.
- For 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).
- Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
- If 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.
- Maximum values for unaged and RTFO aged dynamic shear apply only to materials used as substitute binders, as described in specification Items 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)," 341, "Dense-Graded Hot-Mix Asphalt," and 344, "Superpave Mixtures."

5. EQUIPMENT

Provide all equipment necessary to transport and heat asphalts, oils, and emulsions.

- 5.1. **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 Allowable (°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 w/2% 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, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50-130	140	140
PG binders	275-350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350-375	400	-
A-R binders Types I, II, and III	325-425	425	425

6. MEASUREMENT

- 6.1. **Asphalt Material.** Unless otherwise shown on the plans, asphalt material will be measured by one of the following methods:
- 6.1.1. **Volume.** Asphalt material, including all components, will be measured in gallons.
- 6.1.2. **Weight.** Asphalt material will be measured in tons using certified scales meeting the requirements of Item 520, "Weighing and Measuring Equipment," unless otherwise approved. The transporting truck must have a seal attached to the draining device and other openings. Random checking on public scales at the Contractor's expense may be required to verify weight accuracy.

7. PAYMENT

Material (Pick up). Payment will be made at the unit prices bid for "Asphalts, Oils, and Emulsions" for the type specified. This price is full compensation for furnishing materials, assistance provided in sampling, loading provided vehicles, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.

Material (Delivery). Payment will be made at the unit prices bid for "Asphalts, Oils, and Emulsions" for the type specified. This price is full compensation for furnishing materials, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.