

State: Minnesota	Materials: Sections 3151.2, S-142, S144
Date: 6/4/13	Web Address: www.dot.state.mn.us
Contact: John Garrity	Contact Info: Jim McGraw, Chemical Lab Director; James.McGraw@dot.state.mn.us

Minnesota		Table 1: Requirements for Anionic Emulsified Asphalts (1)								
Property	Test Method AASHTO (T), ASTM (D), or Other	Rapid-Setting		Medium-Setting			Slow-Setting		Quick-Setting	
		RS-1	RS-2	MS-1	MS-2	MS-2h	SS-1	SS-1h	QS-1H	
EMULSIONS:										
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	20-100	-	20-100	100 min.	100 min.	20-100	20-100	20-100
	50 °C (122 °F)		-	75-400	-	-	-	-	-	-
Settlement, 5 days, %			-	-	-	-	-	-	-	-
Storage Stability Test, 24 hours, % (2)			1 max.	1 max.	1 max.	1 max.	1 max.	1 max.	1 max.	1 max.
Sieve Test, % (2,3)			0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.
Demulsibility, % (4)			60 min.	60 min.	-	-	-	-	-	-
Cement Mixing Test, %			-	-	-	-	-	2.0 max.	2.0 max.	-
Coating Ability and Water Resistance	Dry Aggregate		-	-	Good	Good	Good	-	-	-
	After Spraying		-	-	Fair	Fair	Fair	-	-	-
	Wet Aggregate		-	-	Fair	Fair	Fair	-	-	-
	After Spraying	-	-	Fair	Fair	Fair	-	-	-	
Residue, %		55 min.	63 min.	55 min.	65 min.	65 min.	57 min.	57 min.	57 min.	
DISTILLATION RESIDUE:										
Penetration, 25 °C (77 °F), tenths of mm		T49	100-200	100-200	100-200	100-200	40-90	100-200	40-90	40-90
Ductility, 25 °C (77 °F), cm		T51	40 min.	40 min.	40 min.	40 min.	40 min.	40 min.	40 min.	40 min.
Solubility in trichloroethylene or n-propyl bromide, %		T44	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.
NOTES:		<ol style="list-style-type: none"> 1. Refer to R5 for typical applications. 2. This test requirement on representative samples is waived if successful application of the material has been achieved in the field. 3. A maximum percentage of 0.30 is acceptable for samples taken at the point of use. 4. The demulsibility test shall be performed within 30 days from the date of shipment. Use 35 ml, 0.02 N CaCl₂ solution. 								

Table 2: Requirements for Cationic Emulsified Asphalts (1)

Property	Test Method AASHTO (T), ASTM (D), or Other	Rapid-Setting		Medium-Setting		Slow-Setting		Quick-Setting	
		CRS-1	CRS-2	CMS-2	CMS-2h	CSS-1	CSS-1h	CQS-1h	
EMULSIONS:									
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	-	-	-	-	20-100	20-100	20-100
	50 °C (122 °F)		20-100	100-400	50-450	50-450	-	-	-
Settlement, 5 days, %	-		-	-	-	-	-	-	
Storage Stability Test, 24 hours, % (2)	1 max.		1 max.	1 max.	1 max.	1 max.	1 max.	1 max.	
Sieve Test, % (2)	0.30 max.		0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	
Particle Charge	Positive		Positive	Positive	Positive	Positive	Positive	Positive	
Demulsibility, % (3)	40 min.		40 min.	-	-	-	-	-	
Cement Mixing Test, %	-		-	-	-	2.0 max.	2.0 max.	-	
Coating Ability and Water Resistance	Dry Aggregate		-	-	Good	Good	-	-	-
	After Spraying		-	-	Fair	Fair	-	-	-
	Wet Aggregate		-	-	Fair	Fair	-	-	-
	After Spraying		-	-	Fair	Fair	-	-	-
Residue, %	60 min.		65 min.	65 min.	65 min.	57 min.	57 min.	57 min.	
Oil Distillate, volume of emulsion, %	3 max.		3 max.	12 max.	12 max.	-	-	-	
pH	T200	-	-	-	-	-	-	-	
DISTILLATION RESIDUE:									
Penetration, 25 °C (77 °F), tenths of mm	T49	100-250	100-250	100-250	40-90	100-250	40-90	40-90	
Ductility, 25 °C (77 °F), cm	T51	40 min.	40 min.	40 min.	40 min.	40 min.	40 min.	40 min.	
Solubility in trichloroethylene, %	T44	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	
NOTES:	<ol style="list-style-type: none"> 1. Refer to R5 for typical applications. 2. This test requirement on representative samples is waived if successful application of the material has been achieved in the field. 3. Use 35 ml of 0.8% sodium dioctyl sulfosuccinate solution. 								

Table 3: Requirements for High Float Emulsified Asphalt (1)

Property	Test Method AASHTO (T), ASTM (D), or Other	Rapid-Setting	Medium-Setting				
		HFRS-2	HFMS-1	HFMS-2	HFMS-2h	HFMS-2s	
EMULSIONS:							
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	-	20-100	-	-	-	
	50 °C (122 °F)	75-400	-	50 min.	50 min.	50 min.	
Storage Stability Test, 24 hours, % (2)	T59	1 max.	1 max.	1 max.	1 max.	1 max.	
Sieve Test, % (2,3)		0.30 max.	0.30 max.	0.30 max.	0.30 max.	0.30 max.	
Demulsibility, % (4)		60 min.	-	-	-	-	
Coating Ability and Water Resistance		Dry Aggregate	-	Good	Good	Good	Good
		After Spraying	-	Fair	Fair	Fair	Fair
		Wet Aggregate	-	Fair	Fair	Fair	Fair
		After Spraying	-	Fair	Fair	Fair	Fair
Residue, %		63 min.	55 min.	65 min.	65 min.	65 min.	
Oil Distillate, volume of emulsion, %		-	-	-	-	1-7	
DISTILLATION RESIDUE:							
Penetration, 25 °C (77 °F), tenths of mm	T49	100-200	100-200	100-200	40-90	200 min.	
Ductility, 25 °C (77 °F), cm	T51	40 min.	40 min.	40 min.	40 min.	40 min.	
Solubility in trichloroethylene, % (5)	T44	97.5 min.	97.5 min.	97.5 min.	97.5 min.	97.5 min.	
Float Test at 60 °C (140 °F), seconds	T50	1200 min.	1200 min.	1200 min.	1200 min.	1200 min.	
NOTES:	<ol style="list-style-type: none"> 1. Refer to R5 for typical applications. 2. This test requirement on representative samples is waived if successful application of the material has been achieved in the field. 3. A maximum percentage of 0.30 is acceptable for samples taken at the point of use. 4. The demulsibility test shall be performed within 30 days from the date of shipment. Use 35 ml, 0.02 N CaCl₂ solution. 5. N-propyl bromide may also be used for HFRS-2. 						

Minnesota		Table 4: Requirements for Polymer Modified Asphalt Emulsions		
Property		Test Method AASHTO (T), ASTM (D), or Other	CRS-2P	CRS-2L
EMULSIONS:				
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	-	-
	50 °C (122 °F)		100-400	100-400
Settlement, 5 days, %			-	-
Storage Stability Test, 24 hours, %			1 max.	1 max.
Sieve Test, %			0.10 max.	0.10 max.
Particle Charge Test			Positive	Positive
Demulsibility, % (1)			40 min.	40 min.
Residue by Evaporation, %			T59	65 min.
EVAPORATION RESIDUE:				
Penetration, 25° (77 °F)C		T49	100-175	100-175
Ductility, 5 cm/minute, cm	4 °C (39.2 °F)	T51	30 min.	30 min.
	25 °C (77 °F)		125 min.	125 min.
Force Ratio (f2/f1)		T300	0.3 min.	-
Elastic Recovery, 25° C (77 °F), %		T301	50 min.	-
Polymer Solids content, %		-	2.5 min.	2.5 min.
Solubility in Trichloroethylene, %		T44	97.5 min. (2)	97.5 min. (2)
NOTES:		1. Use 35 ml of 0.8 % sodium dioctyl sulfosuccinate solution. 2. If the solubility of the residue is less than 97.5 percent, the base asphalt binder for the emulsion shall be tested. The solubility of the base asphalt binder shall be greater than 99%.		

Table 5: Requirements for Polymer Modified High Float Emulsified Asphalt (1)

Property		Test Method AASHTO (T), ASTM (D), or Other	Polymer Modified High Float Emulsified Asphalt
EMULSIONS:			
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	-
	50 °C (122 °F)		50-450
Storage Stability Test, 24 hours, %			1 max.
Sieve Test, %			0.10 max.
Residue, %			65 min.
Oil Distillate, volume of emulsion, %			3.0 max.
DISTILLATION RESIDUE:			
Penetration, 25 °C (77 °F), tenths of mm		T49	100-200
Elastic Recovery, 25 °C (77 °F) , %		T301	58 min.
Float Test at 60 °C (140 °F), seconds		T50	1200 min.
NOTES:		None.	

Minnesota		Table 6: Requirements for Bituminous Seal Coats	
Property		Test Method AASHTO (T), ASTM (D), or Other	CRS-2P
EMULSIONS:			
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	-
	50 °C (122 °F)		100-400
Settlement, 5 days, %			-
Storage Stability Test, 24 hours, %			1 max.
Sieve Test, %			0.10 max.
Particle Charge Test			Positive
Demulsibility, %			40 min.
Residue by Evaporation, %			T59
EVAPORATION RESIDUE:			
Penetration, 25° (77 °F) C		T49	100-175
Ductility, 5 cm/minute, cm	4 °C (39.2 °F)	T51	30 min.
	25 °C (77 °F)		125 min.
Force Ratio (f2/f1)		T300	0.3 min.
Elastic Recovery, 25 °C (77 °F), %		T301	50 min.
Polymer Solids content, %		-	2.5 min.
Solubility in Trichloroethylene, %		T44	97.5 min. (1)
NOTES:		1. If the solubility of the residue is less than 97.5 percent, the base asphalt binder for the emulsion shall be tested. The solubility of the base asphalt binder shall be greater than 99%.	

Minnesota		Table 7: Requirements for Seal Coat-Micro-surfacing (1)	
Property	Test Method AASHTO (T), ASTM (D), or Other	CSS-1h	
EMULSIONS:			
Viscosity, Saybolt Furol seconds	25 °C (77 °F)	T59	20-100
	50 °C (122 °F)		-
Settlement, 5 days, %			-
Storage Stability Test, 24 hours, % (2)			1 max.
Sieve Test, % (2)			0.30 max.
Particle Charge			Positive
Demulsibility, % (3)			-
Cement Mixing Test, %			2.0 max.
Residue, % (4)			62 min.
Oil Distillate, volume of emulsion, %			-
DISTILLATION RESIDUE:			
Penetration, 25 °C (77 °F), tenths of mm	T49		40-90
Ductility, 25 °C (77 °F), cm	T51		40 min.
Solubility in trichloroethylene, %	T44		97.5 min.
Softening Point (Ring and Ball), °C (°F)	T53		57 (135) min.
Absolute Viscosity, 60 °C (140 °F), Pa·s	D2171		800 min.
NOTES:	<ol style="list-style-type: none"> 1. Refer to R5 for typical applications. 2. This test requirement on representative samples is waived if successful application of the material has been achieved in the field. 3. Use 35 ml of 0.8% sodium dioctyl sulfosuccinate solution. 4. The temperature for the distillation procedure shall be held at 177 ± 5 °C (350 ± 9 °F) for 20 minutes. Complete the entire distillation procedure within 60 minutes from the first application of heat. The cement mixing test shall be waived. 		