



## SECTION 1015

### BITUMINOUS MATERIAL

**1015.1 Scope.** This specification covers bituminous material to be used in highway construction.

#### **1015.2 General.**

**1015.2.1 Approval of Source.** The contractor shall obtain approval of the source of bituminous material from the engineer before any shipments to the work site are made.

**1015.2.2 Sampling, Testing and Acceptance Procedures.** The supplier shall certify that the bituminous material complies with the specification requirements.

**1015.2.2.1 Certification.** The supplier shall furnish the truck driver a copy of the bill of lading, manifest or truck ticket to be available to MoDOT at the destination prior to unloading. The engineer at the source shall be furnished a copy. The bill of lading, manifest or truck ticket shall provide the following information regarding the shipment: type and grade of material, specific gravity at 60 F (15.6 C), net gallons (L), consignee, truck number, identification number, weight (mass) of truck before and after loading, destination, date loaded, name and location of the source, and a certification statement. The certification statement shall be signed by an authorized representative of the supplier and shall be substantially as follows:

"This certifies that the bituminous material in this shipment is in accordance with MoDOT specifications for the grade specified and the weights (masses) shown hereon were obtained on MoDOT approved scales and are correct within the specified scale requirements."

**1015.2.2.2 Sampling.** The engineer will at random observe the sampling and testing of truck shipments and tanks, and will select representative samples of the material being supplied for testing in the field or in the Central Laboratory. When test results certified by the supplier are not representative of the material being shipped, the source approval will be withdrawn. A source may be reinstated when proof is furnished that the deficiency has been corrected and adequate controls are in effect to guarantee delivery of material meeting specifications.

**1015.2.2.3 Sampling Equipment.** The supplier shall furnish the required sampling equipment and shall sample the contents of the truck under the direction of the engineer. The supplier shall keep all sampling equipment clean and in good condition. Sampling devices on truck transports will be approved provided an adequately insulated valve is used with a pipe or nipple inserted a suitable distance into the tank.

**1015.2.2.4 Truck Log.** Each truck transport shall carry a log showing types of material and the dates hauled with respect to previous shipments, or the supplier shall furnish to the engineer such information with respect to the previous load.

**1015.2.2.5 Intermediate Storage.** Intermediate storage tanks for storage and transfer of material between the refinery or terminal and the point of acceptance shall be equipped for

sealing and shall be reserved exclusively for MoDOT work. Use of any material from unsealed tanks will be subject to delay until material can be sampled, tested and approved.

**1015.2.2.6 Other Transportation.** At sources from which liquid bituminous material is being accepted by certification, the applicable requirements of the foregoing sections shall be followed for shipments of material in transportation units other than trucks. The certification and all information regarding each shipment shall be furnished to the engineer at the source.

**1015.2.2.7 Railroad Shipments.** For railroad shipments from refineries where inspection is not maintained by MoDOT, the supplier shall sample each car load at the source and submit the sample promptly to the Central Laboratory. A bill of lading or identification sheet shall accompany each sample and contain the following information: car number, type and grade of material, quantity represented, including gross gallons (L), temperature and net gallons (L) at 60 F (15.6 C), destination of shipment, project number and consignee. A certification statement as specified in [Sec 1015.2.2.1](#) shall accompany each sample. Approval of the source may be withdrawn if samples submitted are not representative of the material shipped in the car.

**1015.2.3 Proportioning and Blending Bituminous Material Constituents.** All material shall be properly proportioned and thoroughly blended in suitable tanks prior to delivery to transportation equipment, or material may be proportioned and blended by use of automatic proportioning equipment. All automatic-proportioning blenders shall meet the approval of the engineer and shall be equipped with precision instruments, including electrically interlocked motors and automatic meters. Blending quantities of less than 8000 gallons (30,000 L) in tanks or in tank trucks will not be permitted.

**1015.3 Performance Graded Asphalt Binder.** The grade shall be as specified in the contract.

**1015.3.1 Description.** Performance graded asphalt binder shall be an asphalt-based binder produced from petroleum residue either with or without the addition of non-particulate organic modifiers.

**1015.3.2 Characteristics.** Performance graded asphalt binder shall be in accordance with AASHTO M 320 for the grade specified, except as follows. AASHTO T 111, *Inorganic Matter or Ash in Bituminous Materials*, may be substituted for AASHTO T 44, *Solubility of Bituminous Materials*, at the specification value indicated. The direct tension test will be waived. The following additional requirements will apply:

Binder Characteristics		
Absolute Temperature Spread Between Upper and Lower Temperature for PG Binder Grade <sup>a</sup>	Elastic Recovery <sup>b</sup> , Percent, Minimum, AASHTO T 301	Separation Test <sup>c</sup> , Percent Difference, Maximum, ASTM D 5976
86 C	-	-
92 C	55	10
98 C	65	10
104 C	75	10

<sup>a</sup>Temperature Spread = Upper PG Temperature minus Lower PG Temperature.

<sup>b</sup>Elastic recovery test to be performed on the residue from the Rolling Thin Film Oven Test at 25 C and 10 cm elongation.

<sup>c</sup>Separation test to be performed in accordance with ASTM D 5976, except test upper and lower portions as original binder for G\* value according to AASHTO T 315.

**1015.3.3 Storage.** Performance graded asphalt binder shall be furnished as a uniform mixture shipped directly to the project site from the asphalt binder supplier's permanent plant address or intermediate storage facility, suitable for direct use. Asphalt binder shall be capable of being stored at the project site without separation or settling. Automatic blending will be allowed, except no intermediate blending of asphalt binder and any other modifiers will be allowed at the project site.

**1015.4 Certification and Acceptance.** Suppliers electing to furnish liquid bituminous material to MoDOT projects by QC/QA certification shall furnish material in accordance with [Sec 1015.4.1](#). To become pre-qualified to furnish material, a written request shall be submitted to Construction and Materials, along with a copy of the supplier's QC plan. For source approval for any supplier of liquid bituminous material, split samples and an on-site laboratory inspection may be required. A manufacturer may forgo a formal QC plan and elect to perform full compliance testing, and certify each batch of material. If a manufacturer elects to forgo a formal QC Plan, all truck shipments shall be loaded from approved storage tanks that have been sampled, tested and certified by the supplier. If a manufacturer so elects, and automatic blending equipment is used, blender material will be approved for use provided the finished product is in accordance with this specification. At least one complete specification compliance test shall be conducted every two weeks on each grade of material furnished for MoDOT work from the blender. A certified copy of the test results shall be furnished to the engineer. For all liquid bituminous material, AASHTO T 111, *Inorganic Matter or Ash in Bituminous Materials*, may be substituted for AASHTO T 44, *Solubility of Bituminous Materials*, at the specification value indicated.

**1015.4.1 Quality Control Plan Requirements.** The QC plan shall be in accordance with the following:

(a) The plan may be written to cover multiple terminals, shipping facilities, blending or manufacturing facilities.

(b) The plan shall state the location, organization and responsible personnel for each facility, including the physical address and telephone contact information. In general, following the guidelines in AASHTO R 26 will be acceptable.

(c) The plan shall state the minimum testing frequency for all material supplied. At a minimum, each grade of material supplied to MoDOT shall have complete specification compliance testing conducted monthly. Polymer modified material shall have complete specification compliance testing conducted every two weeks. The manufacturer's internal QC testing frequency shall be approved by MoDOT prior to implementation. The manufacturer shall perform sufficient tests and at a frequency to ensure specification compliant material is being supplied to MoDOT at all times. For emulsified asphalt, QC testing on each batch, at a minimum, shall consist of viscosity, sieve test, determination of residue by either distillation or evaporation and an identifier test, if applicable, for that particular grade, either cement mixing, particle charge or demulsibility. The manufacturer may elect to perform additional QC tests. For cutback material, QC testing shall be a minimum of the viscosity on a daily basis when material is being shipped to MoDOT work.

(d) In the event of a failing sample, the manufacturer shall follow the steps outlined in AASHTO R 26, Sec. 9.2. If a sample fails to comply with any specification requirement at the Central Laboratory, the manufacturer may only ship new material of that grade after full specification compliance testing. After the manufacturer has certified through specification compliance testing that three consecutive batches are in accordance with the material specification, the manufacturer may return to the testing frequency outlined in the QC/QA plan. If a second sample of the same grade from the same facility fails to comply with any specification requirement within the same calendar year, approval of that facility to supply that

grade under QC/QA may be withdrawn. If approval for a grade is withdrawn, that material may only be supplied to MoDOT work after full certification compliance testing has been performed at the Central Laboratory. Re-approval to supply under the supplier's QC/QA Plan will occur only after three consecutive batches meet specifications after testing at the Central Laboratory. Failure of multiple grades from a single facility tested at the Central Laboratory may result in that facility being removed from approval to supply material to MoDOT. Reinstatement will occur only after all materials in question have been tested at the Central Laboratory and have met all specifications, and documentation from the supplier outlining the reason for the failures and what corrective measures have been taken are to the satisfaction of MoDOT.

(e) The shipping facility shall document that each transport vessel was inspected prior to loading and was found to be acceptable for the material shipped. The inspection shall be documented by a statement on the bill of lading or truck ticket, or by maintaining a record of transport vessel inspections at the shipping facility, which shall be available for review by MoDOT.

The results of QC/QA testing shall be retained by the supplier for a period of three years. A report containing all test results for any material shall be available to MoDOT upon request.

**1015.4.2 Type RC Liquid Asphalt.** Type RC liquid asphalt shall be produced by fluxing an asphaltic base with suitable petroleum distillates. The material shall show no separation or curdling prior to use and shall not foam when heated to the application temperature. The material shall be in accordance with AASHTO M 81, invoking Note 3 using penetration in lieu of viscosity for the grade specified in the contract.

**1015.4.3 Type MC Liquid Asphalt.** Type MC liquid asphalt shall be produced by fluxing an asphaltic base with suitable petroleum distillates. The material shall show no separation or curdling prior to use and shall not foam when heated to the application temperature. The material shall be in accordance with AASHTO M 82, invoking Note 4 using penetration in lieu of viscosity for the grade specified in the contract.

**1015.4.4 Emulsified Asphalt.** Emulsified asphalt shall be in accordance with AASHTO M 140 or AASHTO M 208, for the type and grade specified in the contract.

**1015.4.4.1 Polymer Modified Asphalt Emulsion.** Bituminous material for polymer modified asphalt shall be in accordance with the following:

Polymer Modified Asphalt Emulsion				
Test <sup>a</sup>	CRS-2P		EA-90P	
	Min	Max	Min	Max
Viscosity, SSF @ 50 C	100	400	100	400
Storage Stability Test <sup>b</sup> , 24 hour, percent	----	1	----	1
Classification Test	Pass	----	----	----
Particle Charge Test	Positive	----	----	----
Sieve Test, 850 µm mesh, percent	----	0.3	----	0.3
Demulsibility, 0.02 N CaCl <sub>2</sub> , percent	----	----	30	----
Distillation:				
Oil distillate by volume of emulsion, percent	----	3	----	3
Residue from distillation <sup>c</sup> , percent	65	----	65	----
Tests on Residue from Distillation:				
Penetration, 25 C, 100 g, 5 sec	100	200	100	200
Ductility, 4 C, 5 cm/minute, cm	30	----	25	----
Ash <sup>d</sup> , percent	----	1	----	1
Float Test at 60 C, sec	----	----	1200	----
Elastic Recovery <sup>e</sup> , percent	58	----	58	----

<sup>a</sup>All tests shall be performed in accordance with AASHTO T 59 except as noted.

<sup>b</sup>In addition to AASHTO T 59, upon examination of the test cylinder, and after standing undisturbed for 24 hours, the surface shall show no appreciable white, milky colored substance and shall be a homogeneous brown color throughout.

<sup>c</sup>AASHTO T 59 shall be modified to maintain a 204 C ± 5 C maximum temperature for 15 minutes.

<sup>d</sup>Percent ash shall be determined in accordance with AASHTO T 111, *Ash in Bituminous Material*.

<sup>e</sup>Elastic recovery shall be determined as follows. Condition the ductilometer and samples to be treated at 10 C. Prepare the brass plate, mold and briquet specimen in accordance with AASHTO T 51. Keep the specimen at the specified test temperature of 10 C for 85 to 95 minutes. Immediately after conditioning, place the specimen in the ductilometer and proceed to elongate the sample to 20 cm at a rate of pull of 5 cm/min. After the 20 cm elongation has been reached, stop the ductilometer and hold the sample in the elongated position for 5 minutes. After 5 minutes, clip the sample approximately in half by means of scissors or other suitable cutting devices. Let the sample remain in the ductilometer in an undisturbed condition for one hour. At the end of this time period, retract the half sample specimen until the two broken ends touch. At this point note the elongation (x) in cm. Calculate the percent recovery by the following formula:

$$\% \text{ Recovery} = \frac{20 - X}{20} \times 100$$

**1015.4.4.2 Asphalt Emulsion for Micro-Surfacing.** Bituminous material for micro-surfacing shall be a polymer modified asphalt emulsion, grade CSS-1h, in accordance with the following table. The bituminous material shall show no separation after mixing. A minimum of 3.0 percent polymer content, by mass, of an approved polymer shall be milled into the asphalt emulsion at the time of manufacture of the emulsion. The emulsion shall be sampled in accordance with AASHTO T 40.

<b>Micro-Surfacing Emulsion (MSE-1)</b>			
	<b>Min.</b>	<b>Max.</b>	<b>Test Method</b>
Viscosity, Saybolt Furol at 25 C, s	20	100	AASHTO T 59
Storage stability test, 24 hr, percent	--	1 <sup>a</sup>	AASHTO T 59
Particle charge test positive <sup>b</sup>			AASHTO T 59
Sieve test, percent	--	0.50	AASHTO T 59
Residue, percent	62	--	AASHTO T 59
<b>Tests on Residue from Distillation</b>	<b>Min.</b>	<b>Max.</b>	<b>Test Method</b>
Penetration, 25 C, 100 g, 5 s,	40	90	AASHTO T49
Ductility, 25 C, 5cm/min, cm,	40	--	AASHTO T 51
Solubility in Trichloroethylene, %	97.50	--	AASHTO T 44

<sup>a</sup>The storage stability test may be waived provided the asphalt emulsion storage tank at the project site has adequate provisions for circulating the entire contents of the tank, and provided satisfactory field results are obtained.

<sup>b</sup>If the particle charge test is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

**1015.4.4.3 Scrub Seal Emulsion.** Scrub seal emulsion shall be smooth and homogeneous, polymer modified, shall contain an asphalt rejuvenator and shall be in accordance with the following:

<b>Scrub Seal Emulsion (SSE-1)</b>			
	<b>Min.</b>	<b>Max.</b>	<b>Test Method</b>
Saybolt Furol Viscosity, SFS @ 25 C	30	100	AASHTO T 59
Storage Stability Test <sup>a</sup> , 24 hr., %	--	1 <sup>a</sup>	AASHTO T 59
Demulsibility, 35 ml of 0.02N, CaCl <sub>2</sub> , %	--	60	AASHTO T 59
Sieve Test <sup>b</sup> , percent	--	0.3	AASHTO T 59
Residue by Distillation <sup>(c)</sup> @ 205 ± 5 C, %	60	--	AASHTO T 59
Oil Distillate by Volume, percent	--	3	AASHTO T 59
<b>Tests on Residue from Distillation</b>	<b>Min.</b>	<b>Max.</b>	<b>Test Method</b>
Penetration @ 25 C, 5 s, 100 g, dmm	100	300	AASHTO T 49
Float Test @ 60 C, s	1200	--	AASHTO T 50
Ash, percent	--	1	AASHTO T 111
Elastic Recovery, 10 C, 200 mm elongation, 60 min. recovery, percent	30	--	ASTM D 5976
Saturates <sup>d</sup> , percent	--	20	ASTM D 4124

Upon examination of the test cylinder after standing undisturbed for 24 hours, the surface shall show no white, milky colored substance and shall be a homogeneous brown color throughout.

<sup>b</sup>A percentage of 0.30 will be acceptable for samples taken at the point of use or shipped to the Central Laboratory for testing.

<sup>c</sup>ASTM D 244 shall be modified to include a 205 ± 5 C maximum temperature to be held for 15 minutes.

<sup>d</sup>ASTM D 4124 shall be modified to use Alumina, CG - 20 Grade, available from Aluminum Company of America, Pittsburgh, PA.

**1015.4.5 Ultrathin Bonded Wearing Surface.** Bituminous material for ultrathin bonded wearing surface shall be in accordance with the following.

**1015.4.5.1 Asphalt Binder.** The asphalt binder shall be in accordance with [Sec 1015.3](#), and specifically as follows:

Tests	Method	Min.	Max.
Separation Test, %	AASHTO PP-5		10
Elastic Recovery Test, %	ASTM D 6084	65	

**1015.4.5.2 Polymer Modified Emulsion Membrane.** The anionic or cationic emulsion shall be polymer modified and shall be in accordance with one of the following:

<b>Anionic Polymer Modified Emulsion Membrane (PEM-1)</b>			
Tests on Emulsion	Method	Min.	Max.
Viscosity, Saybolt Furol @ 122 F (50 C), s	AASHTO T 59	25	125
Storage Stability Test <sup>a</sup> , 24 h, percent	AASHTO T 59		1
Sieve Test <sup>b</sup> , percent	AASHTO T 59		0.3
Residue by Distillation <sup>c</sup> , percent	AASHTO T 59	63	
Oil Distillate by Distillation, percent	AASHTO T 59		2
Demulsibility, %	35 ml, 0.02 N CaCl <sub>2</sub>	AASHTO T 59	60
<b>Tests on Residue From Distillation</b>			
Penetration	AASHTO T 49	90	150
Elastic Recovery, percent	AASHTO T 301	60	

<b>Cationic Polymer Modified Emulsion Membrane (CPEM-1)</b>			
Tests on Emulsion	Method	Min.	Max.
Viscosity, Saybolt Furol @ 122°F (50 C), s	AASHTO T 59	25	125
Storage Stability Test <sup>a</sup> , 24 h, percent	AASHTO T 59		1
Sieve Test <sup>b</sup> , percent	AASHTO T 59		0.3
Residue by Distillation <sup>c</sup> , percent	AASHTO T 59	63	
Oil Distillate by Distillation, percent	AASHTO T 59		2
Demulsibility, %	35 ml, 0.8% dioctyl sodium sulfosuccinate	AASHTO T 59	60
<b>Tests on Residue From Distillation</b>			
Penetration	AASHTO T 49	90	150
Elastic Recovery, %	AASHTO T 301	60	

<sup>a</sup>After standing undisturbed for 24 hours, the surface shall show no white, milky colored substance, but shall be a smooth homogeneous color throughout.

<sup>b</sup>The sieve test will be waived if successful application of the material has been achieved in the field.

<sup>c</sup>AASHTO T 59 shall be modified to include a 400 F ± 10 F (205 C ± 5 C) maximum temperature to be held for a period of 15 minutes.

**1015.5 Sampling and Test Methods for Asphalt.**

Property	Method	RC	MC	PG
Sampling	AASHTO T 40	X	X	X
Water	AASHTO T 55	X	X	X
Flash Point (Tag Open Cup)	AASHTO T 79	X	X	
Flash Point (Cleveland Open Cup)	AASHTO T 48			X
Viscosity, Centistokes	AASHTO T 201	X	X	
Distillation	AASHTO T 78	X	X	
Penetration	AASHTO T 49	X	X	
Ductility	AASHTO T 51	X	X	
Solubility in Trichlorethylene	AASHTO T 44	X	X	X
Viscosity (Rotational)	ASTM D 4402			X
Dynamic Shear	AASHTO TP 5			X
Rolling Thin Film Oven Test	AASHTO T 240			X
Pressure Aging Test	AASHTO PP 1			X
Creep Stiffness	AASHTO TP 1			X
Direct Tension	AASHTO TP 3			X

**1015.6 Application Temperatures for Bituminous Materials.**

Bituminous Material	Temperature, Degrees Fahrenheit (Celsius)			
	Spraying		Mixing	
	Min	Max	Min	Max
<b>Asphalt Binder</b>				
PG 46-28	260 (125)	325 (165)	----	----
All Other Grades	285 (140)	350 (175)	275 (135)	350 (175)
<b>Liquid Asphalt RC-MC</b>				
Grade				
30	70 (20)	150 (65)	50 (10)	110 (45)
70	100 (40)	180 (80)	90 (30)	140 (60)
250	150 (65)	220 (105)	130 (55)	170 (75)
800	180 (80)	260 (125)	170 (75)	210 (100)
3000	210 (100)	290 (145)	200 (95)	240 (115)
<b>Asphalt Emulsions</b>				
RS-1	70 (20)	140 (60)	----	----
RS-2	125 (50)	185 (85)	----	----
SS-1	70 (20)	160 (70)	70 (20)	160 (70)
SS-1h	70 (20)	160 (70)	70 (20)	160 (70)
CRS-1	125 (50)	185 (85)	----	----
CRS-2	125 (50)	185 (85)	----	----
CSS-1	70 (20)	160 (70)	70 (20)	160 (70)
CSS-1h	70 (20)	160 (70)	70 (20)	160 (70)
EA-90P	130 (55)	180 (80)	----	----
CRS-2P	130 (55)	180 (80)	----	----

**1015.6.1** Application temperatures of other grades of emulsions shall be as specified in the contract.

**1015.6.2** The spraying temperature for non-modified PG 46-28 asphalt binder shall be 260 - 325 F (125 - 165 C), and for all other higher temperature non-modified performance grades, the spraying temperature shall be 285 - 350 F (140 - 175 C). The mixing and

compaction temperatures for performance graded asphalt binder shall be determined by rotational viscosity testing as defined in AASHTO T P4.

**1015.6.3** When material to be applied by pressure distributor is, due to refining or blending procedures, delivered at a temperature above the specified limits, the material may be applied at the higher temperature provided satisfactory application can be obtained at the specified rate and provided sufficient precaution is exercised with respect to the fire hazard.

**1015.7 Measurement of Bituminous Material.** Field weight (mass) or field volumetric determinations of the material actually incorporated into the work will be used for measurement of the quantity of bituminous material for payment. The volume of material supplied from intermediate storage tanks will be determined from the net weight (mass) of the material. The net weight (mass) will be determined from the gross weight (mass) of the loaded transport vehicle used to deliver the material to the project less the empty transport vehicle weight (mass). The volume correction methods specified below will be used for determining the volume of bituminous material. Scales for determining the weight (mass) of bituminous material shall be in accordance with [Sec 310](#).

**1015.7.1 Liquid Bituminous Material and Asphalt Binder - Volumetric Determination.** Measurement of the material will be based on the volume at 60 F (15.6 C). The volume correction factors of ASTM D 1250, Table 24b, will be used for converting the material from the volume at the observed temperature to the volume at 60 F (15.6 C). The volume of uncalibrated distributors and tank trucks will be determined from the net weight (mass) of the material. The net weight (mass) will be determined from the gross weight (mass) of the loaded delivery vehicle less the empty delivery vehicle weight (mass). For computing the volume in gallons (liters) from weight (mass), the following formula will be used:

ENGLISH

$$G = \frac{W}{SG \times 8.328}$$

where:

- G = Volume in gallons at 60 F.
- W = Weight of material in pounds.
- SG = Specific Gravity of material at 60 F.

METRIC

$$L = \frac{M}{SG \times 997.914}$$

where:

- L = Volume in liters at 15.6 C.
- M = Mass of material in kilograms
- SG = Specific Gravity of material at 15.6 C.

**1015.7.2 Emulsified Asphalt.** Measurement of the material will be based on the volume at 60 F (15.6 C) using a coefficient of expansion of 0.0003 per degree F (0.00054 per degree C) for converting the material from the volume at the observed temperature to the volume at 60 F (15.6 C).