March 29, 2016

REVISION OF SECTION 702

BITUMINOUS MATERIALS

**NOTICE**

This is a standard special provision that revises or modifies CDOT’s *Standard Specifications for Road and Bridge Construction.* It has gone through a formal review and approval process and has been issued by CDOT’s Project Development Branch with formal instructions for its use on CDOT construction projects. It is to be used as written without change. Do not use modified versions of this special provision on CDOT construction projects, and do not use this special provision on CDOT projects in a manner other than that specified in the instructions unless such use is first approved by CDOT’s Standards and Specifications Unit. The instructions for use on CDOT construction projects appear below.

Other agencies which use the *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision as appropriate and at their own risk.

**Instructions for use on CDOT construction projects:**

Use on projects having bituminous materials.

# Section 702 of the Standard Specifications is hereby deleted for this project and replaced with the following:

**702.01 Asphalt Cements.**

1. *Superpave Performance Graded Binders.* Superpave Performance Graded Binders shall conform to the requirements listed in Table 702-1. (Taken from AASHTO M 320)

Asphalt cement shall not be acid modified or alkaline modified.

Asphalt cement shall not contain any used oils that have not been re-refined. Modifiers that do not comply with environmental rules and regulations including 40 CFR Part 261.6(a) (3) (IV), and part 266/Subpart C shall not be added. Modifiers shall not be carcinogenic.

The supplier of the PG binder shall be certified in accordance with CP 11.

# Table 702-1

**SUPERPAVE PERFORMANCE GRADED BINDERS**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Property** | **Requirement for PG Binder** | | | | | | **AASHTO**  **Test No.** |
| **58-28** | **58-34** | **64-22** | **64-28** | **70-28** | **76-28** |
| Original Binder Properties |  |  |  |  |  |  |  |
| Flash Point Temp., °C, minimum | 230 | 230 | 230 | 230 | 230 | 230 | T 48 |
| Viscosity at 135 °C, Pa●s, maximum | 3 | 3 | 3 | 3 | 3 | 3 | T 316 |
| Dynamic Shear, Temp. °C, where G\*/Sin δ @ 10 rad/s ≥ 1.00 kPa | 58 | 58 | 64 | 64 | 70 | 76 | T 315 |
| Ductility, 4 °C (5 cm/min.), cm minimum | - | - | - | 50 |  | - | T 51 |
| Toughness, joules (inch-lbs) | - | - | - | 12.4 (110) |  | - | CP-L 2210 |
| Tenacity, joules (inch-lbs) | - | - | - | 8.5 (75) |  | - | CP-L 2210 |
| Acid or Alkali Modification (pass-fail) | Pass | Pass | Pass | Pass | Pass | Pass | CP-L 2214 |
| RTFO Residue Properties |  |  |  |  |  |  | CP-L 2215 |
| Mass Loss, percent maximum | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | CP-L 2215 |
| Dynamic Shear, Temp. °C, where G\*/Sin δ @ 10 rad/s ≥ 2.20 kPa | 58 | 58 | 64 | 64 | 70 | 76 | T 315 |
| Elastic Recovery, 25 °C, percent min. | - | - | - | - | 50 | 50 | T 301 |
| Ductility, 4 °C (5 cm/min.), cm minimum | - | - | - | 20 | - | - | T 51 |
| **PAV Residue Properties, Aging Temperature 100** °**C** |  |  |  |  |  |  | R 28 |
| Dynamic Shear, Temp. °C, where G\*●Sin δ @ 10 rad/s ≤ 5000 kPa | 19 | 16 | 25 | 22 | 25 | 28 | T 315 |
| Creep Stiffness, @ 60 s, Test Temperature in °C | -18 | -24 | -12 | -18 | -18 | -18 | T 315 |
| S, maximum, MPa | 300 | 300 | 300 | 300 | 300 | 300 | T 313 |
| m-value, minimum | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | T 313 |

Acceptance Samples of the PG binder will be taken on the project in accordance with the Schedule in the Field Materials Manual.

The Department will test for acid modification and alkaline modification during the binder certification process. Thereafter, the Department will randomly test for acid modification and alkaline modification.

1. *Damp proofing.* Asphalt for damp proofing shall conform to the requirements of ASTM D 449, and the asphaltic primer shall conform to the requirements of ASTM D 41.

**702.02 Emulsified Asphalts.** Emulsified asphalts shall conform to AASHTO M 140 or M 208 for the designated types and grades. Emulsified asphalt andaggregate used for surface seals shall be sampled and will be tested for information only in accordance with CP-L 2213.

Emulsified asphalt (HFMS-2S) with a residual penetration greater than 300 dmm shall conform to all properties listed in AASHTO M 140, Table 1 except that ductility shall be reported for information only.

1. *Emulsion for Tack and Fog Coats.* Emulsions for tack and fog coats shall conform to the requirements listed in Table 702-2 or 702-3, prior to dilution.

**Table 702-2**

**TACK AND FOG COAT EMULSIONS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Property | | CSS-1h | **SS-1h** | AASHTO Test No. |
| Tests on Emulsion: | |  |  |  |
| Viscosity, at 25 ºC, Saybolt- Furol, s | min | 20 | 20 | T 59 |
| max | 100 | 100 |
| Storage stability, 24 hr, % max1 | | 1.0 | 1.0 | T 59 |
| Particle charge test | | Positive |  | T 59 |
| Sieve test, % max | | 0.10 | 0.10 | T 59 |
| Oil Distillate by volume, % max | | 3.0 | 3.0 | T-59 |
| Residue by distillation/ evaporation, % min3 | | 573 | 573 | T 59/  CP-L 22122 |
| Tests on residue: | |  |  |  |
| Penetration, 25 ºC, 100g, 5s, min, dmm | | 40 | 40 | T 49 |
| Penetration, 25 ºC, 100g, 5s, max, dmm | | 120 | 120 |
| Ductility, 25 ºC, 5 cm/min, cm, min | | 40 | 40 | T 51 |
| Solubility, in trichloroethylene% min | | 97.5 | 97.5 | T 44 |
| 1If successful application is achieved in the field, the Engineer may wave this requirement.  2 CP-L 2212 is a rapid evaporation test for determining percent residue of an emulsion and providing material for tests on residue. CP-L 2212 is for acceptance only. If the percent residue or any test on the residue fails to meet specifications, the tests will be repeated using the distillation test in conformance with AASHTO T-59 to determine acceptability.  3 For polymerized emulsions the distillation and evaporation tests will in be in conformance with AASHTO T-59 or CP-L 2212 respectively with modifications to include 205 ± 5 ºC (400 ± 10 ºF) maximum temperature to be held for 15 minutes. | | | | | |

1. *Emulsion for Chip Seals*  Polymerized emulsions for chip seals shall conform to the requirements listed in Table 702-3. Emulsion for chip seals shall be an emulsified blend of polymerized asphalt, water, and emulsifiers. The asphalt cement shall be polymerized prior to emulsification and shall contain at least 3 percent polymer by weight of asphalt cement. The emulsion standing undisturbed for a minimum of 24 hours shall show no white, milky separation but shall be smooth and homogeneous throughout. The emulsion shall be pumpable and suitable for application through a distributor.

Table 702-3

POLYMERIZED EMULSIONS FOR CHIP SEALS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Property | | **CRS-2** | **CRS-2P** | **CRS-2R** | **HFMS-2P** | AASHTO Test No. |
| Tests on Emulsion: | |  |  |  |  |  |
| Viscosity, at 50 ºC, Saybolt- Furol, s | min | 50 | 50 | 50 | 50 | T 59 |
| max | 450 | 450 | 450 | 450 |
| Storage stability, 24 hr, % max | | 1.0 | 1.0 | 1.0 | 1.0 | T 59 |
| Particle charge test | | Positive | Positive | Positive |  | T 59 |
| Sieve test, % max | | 0.10 | 0.10 | 0.10 | 0.10 | T 59 |
| Demulsibility1, % min | | 40 | 40 | 40 |  | T 59 |
| Oil Distillate by volume, % max or range | | 3.0 | 3.0 | 3.0 | 3.0 | T-59 |
| Residue by distillation/ evaporation, % min3 | | 653 | 653 | 653 | 653 | T 59/  CP-L 22122 |
| Tests on residue: | |  |  |  |  |  |
| Penetration, 25 ºC, 100g, 5s, min, dmm | | 70 | 70 | 70 | 70 | T 49 |
| Penetration, 25 ºC, 100g, 5s, max, dmm | | 150 | 150 | 150 | 150 |
| Ductility, 25 ºC, 5 cm/min, cm, min | | 40 |  |  | 75 | T 51 |
| Ductility, 4 ºC, 5 cm/min, cm, min | |  |  | 40 |  |  |
| Solubility, in trichloroethylene% min4 | | 97.54 | 97.54 | 97.54 | 97.54 | T 44 |
| Elastic Recovery, 25 ºC min | |  |  |  | 58 | T 301 |
| Float Test, 60 ºC, s min | |  |  |  | 1200 | T 50 |
| Toughness, in-lbs, min | |  | 70 | 90 |  | CP-L 2210 |
| Tenacity, in-lbs, min | |  | 45 | 45 |  | CP-L 2210 |
| 1If successful application is achieved in the field, the Engineer may waive this requirement.  2 CP-L 2212 is a rapid evaporation test for determining percent residue of an emulsion and providing material for tests on residue. CP-L 2212 is for acceptance only. If the percent residue or any test on the residue fails to meet specifications, the tests will be repeated using the distillation test in conformance with AASHTO T-59 to determine acceptability.  3 For polymerized emulsions the distillation and evaporation tests will in be in conformance with AASHTO T-59 or CP-L 2212 respectively with modifications to include 205 ± 5 ºC (400 ± 10 ºF) maximum temperature to be held for 15 minutes.    4 Solubility may be determined on the base asphalt cement prior to polymer modification. | | | | | | |

1. *Emulsion for Slurry Seals and Micro-Surfacing.* Emulsions for slurry seals and micro-surfacing shall conform to the requirements listed in Table 702-4. The modified emulsion shall contain a minimum of 3 percent polymer, SBR latex, or natural latex by weight.

**Table 702-4**

**SLURRY SEAL AND MICRO-SURFACING EMULSIONS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Property | | **CQS-1hL** | **CQS-1hP** | AASHTO Test No. |
| Tests on Emulsion: | |  |  |  |
| Viscosity, at 25 ºC, Saybolt- Furol, s | min | 15 | 15 | T 59 |
| max | 100 | 100 |
| Storage stability, 24 hr, % max1 | | 1.0 | 1.0 | T 59 |
| Particle charge test | | Positive | Positive | T 59 |
| Sieve test, % max | | 0.10 | 0.10 | T 59 |
| Oil Distillate by volume, % max | | 0.5 | 0.5 | T-59 |
| Residue by distillation/ evaporation, % min3 | | 623 | 623 | T 59/  CP-L 22122 |
| Tests on residue: | |  |  |  |
| Penetration, 25 ºC, 100g, 5s, min, dmm | | 40 | 40 | T 49 |
| Penetration, 25 ºC, 100g, 5s, max, dmm | | 150 | 150 |
| Ductility, 25 ºC, 5 cm/min, cm, min | | 50 | 50 | T 51 |
| Solubility, in trichloroethylene% min | | 97.5 | 97.5 | T 44 |
| 1If successful application is achieved in the field, the Engineer may wave this requirement.  2 CP-L 2212 is a rapid evaporation test for determining percent residue of an emulsion and providing material for tests on residue. CP-L 2212 is for acceptance only. If the percent residue or any test on the residue fails to meet specifications, the tests will be repeated using the distillation test in conformance with AASHTO T-59 to determine acceptability.  3 For polymerized emulsions the distillation and evaporation tests will in be in conformance with AASHTO T-59 or CP-L 2212 respectively with modifications to include 205 ± 5 ºC (400 ± 10 ºF) maximum temperature to be held for 15 minutes. | | | | | |

(d) *Emulsion for Prime Coat.* Emulsion for prime coat shall conform to the requirements of Table 702-5. Circulate before use if not used within 24 hours.

|  |  |  |
| --- | --- | --- |
| **Table 702-5**  **Asphalt Emulsion FOR Prime COAT (AEP)** | | |
| **Property** | **Requirement** | **AASHTO**  **Test No.** |
| Viscosity,  Saybolt Furol, at 50 °C (122 °F), s | 20-150 | T 59 |
| % Residue | 65% min. | T 59  to 260 °C (500 °F) |
| Oil Distillate by Volume, % | 7% max. | T59 |
| **Tests on Residue from Distillation:** |  |  |
| Solubility in Trichloroethylene, % | 97.5 min. | T 44 |
|  | | |

(e) *Recycling Agent.* Recycling Agent for Item 406, Cold Bituminous Pavement (Recycle), shall be either a high float emulsified asphalt (polymerized) or an emulsified recycling agent as follows:

1. High Float Emulsified Asphalt (Polymerized). High Float Emulsified Asphalt (Polymerized) for Cold Bituminous Pavement (Recycle) shall be an emulsified blend of polymer modified asphalt, water, and emulsifiers conforming to Table 702‑6 for HFMS‑2sP. The asphalt cement shall be polymerized prior to emulsification, and shall contain at least 3 percent polymer.

The emulsion standing undisturbed for a minimum of 24 hours shall show no white, milky separation, and shall be smooth and homogeneous throughout.

The emulsion shall be pumpable and suitable for application through a pressure distributor.

**Table 702-6**

**HIGH FLOAT EMULSIFIED ASPHALT**

**(POLYMERIZED) (HFMS‑2sP)**

| **Property** | **Requirement** | | **AASHTO Test** |
| --- | --- | --- | --- |
| **Minimum** | **Maximum** |
| **Tests on Emulsion:** |  |  |  |
| Viscosity, Saybolt Furol at 50 °C (122 °F), sec | 50 | 450 | T 59 |
| Storage Stability test, 24 hours, % |  | 1 | T 59 |
| Sieve test, % |  | 0.10 | T 59 |
| % Residue1 | 65 |  | T 59 |
| Oil distillate by volume, % | 1 | 7 | T 59 |
| **Tests on Residue:** |  |  |  |
| Penetration, 25 °C (77 °F), 100g, 5 sec | 150 | 3002 | T 49 |
| Float Test, 60 °C (140 °F), sec | 1200 |  | T 50 |
| Solubility in TCE, % | 97.5 |  | T 44 |
| Elastic Recovery, 4 °C (39.2 °F), % | 50 |  | T 301 |
| 1400 ± 10° F maximum temperature to be held for 15 minutes.  2When approved by the Engineer, Emulsified Asphalt (HFMS-2sP) with a residual penetration greater than 300 dmm may be used with Cold Bituminous Pavement (Recycle) to address problems with cool weather or extremely aged existing pavement. Emulsified Asphalt (HFMS-2sP) with a residual penetration greater than 300 dmm shall meet all properties listed in Table 702-4 except that Elastic Recovery shall be reported for information only. | | | |

1. *Emulsified Recycling Agent.* Emulsified Recycling Agent for use in Cold Bituminous Pavement (Recycle) shall conform to the requirements in Table 702‑7.

**Table 702-7**

**EMULSIFIED RECYCLING AGENT**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **Requirement** | | **Test** |
| **Minimum** | **Maximum** |
| **Tests on Emulsion:** |  |  |  |
| Viscosity @ 25 °C, SFS | 20 | 200 | ASTM D 244 |
| Pumping Stability | Pass |  | GB Method1 |
| Sieve Test, %w |  | 0.1 | ASTM D 2442 |
| Cement Mixing, %w |  | 2.0 | ASTM D 244 |
| Particle Charge | Positive |  | ASTM D 244 |
| Conc. Of Oil Phase | 64 |  | ASTM D 2443 |
| **Tests on Residue:** |  |  |  |
| Viscosity @ 60 °C , CST | 2000 | 4000 | ASTM D 2170 |
| Flash Point, COC, °C (° F) | 232 |  | ASTM D 92 |
| Maltenes Dist. PC+A1  Ratio4 S+A2 | 0.3 | 0.6 | ASTM  D 2006 |
| PC/S Ratio | 0.4 |  | ASTM  D 2006 |
| Asphaltenes, % max. |  | 11.0 | ASTM  D 2006 |
| 1Pumping stability is determined by charging 450 ml of emulsion into a one liter beaker and circulating the emulsion through a gear pump (Roper 29.B22621) having a 6.3 mm (1/4 inch) inlet and outlet. The emulsion passes if there is no significant separation after circulating ten minutes.  2Test procedure identical with ASTM D 244 except that distilled water shall be used in place of 2 percent sodium oleate solution.  3ASTM D 244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149°C (300 °F) until foaming ceases, then cooling immediately and calculating results.  4In the Maltenes Distribution Ratio Test by ASTM Method D 2006.  PC = Polar Compounds S = Saturates  A1 = First Acidaffin A2 = Second Acidaffins | | | |

(f) Asphalt Rejuvenating Agents. Asphalt rejuvenating agents (ARA) shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the physical and chemical requirements of Table 702-8 or ASTM D 4552.

|  |  |  |
| --- | --- | --- |
| Table 702-8 **Asphalt Rejuvenating Agent** | | |
| **Property** | **Test Method** | **Requirement** |
| Viscosity, S.F., @ 25 °C (77 °F), s | ASTM D 244 | 20-40 |
| 1Residue, % min. | ASTM D 244 | 60-65 |
| 2Miscibility Test | ASTM D 244 | No  coagulation |
| 3Sieve Test, % max. | ASTM D 244 | 0.10 |
| Particle Charge Test | ASTM D 244 | Positive |
| **ASTM D244 (Mod):** |  |  |
| Viscosity, 60 °C (140 °F), mm2/s | ASTM D 445 | 100 - 200 |
| Flash Point, COC, °C, min. | ASTM D 92 | 196 |
| Asphaltenes, % max. | ASTM  D2006 | 1.0 |
| 4Maltenes Dist. PC+A1  Ratio S+A2 | ASTM  D 2006 | 0.3-0.6 |
| Saturated Hydrocarbons, % | ASTM  D 2006 | 21-28 |
| 1 ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50-gram sample to 149 °C (300 °F) until foaming ceases, then cooling immediately and calculating results.  2 Test procedure identical with ASTM D244 except that 0.02 Normal Calcium Chloride solution shall be used in place of distilled water.  3 Test procedure identical with ASTM D244 except that distilled water shall be used in place of 2% sodium oleate solution.  4 In the Maltenes Distribution Ratio Test by ASTM Method D4124:  PC = Polar Compounds S = Saturates  A1 = First Acidaffin A2 = Second Acidaffins | | |

For hot-in-place recycling ARA-1P is an acceptable alternative to ARA. ARA-1P shall meet the requirements below:

Emulsified Polymer Modified Asphalt Rejuvenating Agent (ARA-1P) for use in hot-in-place recycling of bituminous pavements shall be modified with a minimum of 1.5 percent styrene-butadiene solution polymer. The finished product shall conform to the physical requirements listed in Table 702-9 below.

# Table 702-9

**ARA-1P**

|  |  |  |  |
| --- | --- | --- | --- |
| Property | **Test Method** | **Min** | **Max** |
| Test on Emulsion |  |  |  |
| Viscosity, Saybolt-Furol @ 77 ºF, s | ASTM D 244 |  | 100 |
| Residue @ 350 ºF, % | ASTM D 244 Mod | 60 |  |
| Sieve Test, % | ASTM D 244 |  | 0.10 |
| Oil distillate, % | ASTM D 244 |  | 2.0 |
| Test on Residue |  |  |  |
| Penetration @ 39.2 ºF, 100g, 5s, dmm | ASTM D-5 Modified | 150 | 250 |
| Asphaltenes, % | ASTM D 4124 |  | 15 |

**702.03 (unused)**

**702.04 Hot Poured Joint and Crack Sealant.** Hot poured material for filling joints and cracks shall conform to the requirements of ASTM D 6690, Type II or Type IV. The concrete blocks used in the Bond Test shall be prepared in accordance with CP-L 4101.

Sealant material shall be supplied pre-blended, pre-reacted, and prepackaged. If supplied in solid form the sealant material shall be cast in a plastic or other dissolvable liner having the capability of becoming part of the crack sealing liquid. The sealant shall be delivered in the manufacturer’s original sealed container.

Each container shall be legibly marked with the manufacturer’s name, the trade name of the sealer, the manufacturer’s batch or lot number, the application temperature range, the recommended application temperature, and the safe heating temperature.

The sealant shall be listed in CDOT’s Approved Products List prior to use.