

## SECTION 916 BITUMINOUS MATERIALS

### 916-1 General.

All products supplied under this Specification shall be one of the products included on the Approved Product List (APL). Producers seeking evaluation of a product for inclusion on the APL shall submit an application in accordance with Section 6.

Any marked variation from the original test values for a material below the established limits or evidence of inadequate quality control or field performance of a material will be considered sufficient evidence that the properties of the material have changed, and the material will be removed from the APL.

### 916-2 Superpave PG Asphalt Binder:

**916-2.1 Requirements:** Superpave Performance Graded (PG) asphalt binders, identified as PG 52-28, PG 58-22, PG 67-22, polymer modified asphalt (PMA) binders, PG 76-22 (PMA) and High Polymer, and asphalt rubber binders (ARB), PG 76-22 (ARB), shall meet the requirements of 916-2 and AASHTO M332-14. When the Contract Documents specify either a PG 76-22 (PMA), PG 76-22 (ARB), or PG 76-22 binder, either binder can be used interchangeably at no additional cost to the Department. All PG asphalt binders shall meet the following additional requirements:

1. The intermediate test temperature at 10 rad/sec. for the Dynamic Shear Rheometer (DSR) test (AASHTO T315-12 (2016)) shall be 26.5°C for PG grades PG 67 and higher.
2. An additional high temperature grade of PG 67 is added for which the high test temperature at 10 rad/sec for the DSR test (AASHTO T315-12 (2016)) shall be 67°C.
3. All PG asphalt binders having a high temperature designation of PG 67 or lower shall be prepared without modification.
4. All PMA binders having a high temperature designation higher than PG 67 shall only be produced with a styrene-butadiene-styrene (SBS) or styrene-butadiene (SB) elastomeric polymer modifier and the resultant binder shall meet all requirements of this Section.
5. Polyphosphoric acid may be used as a modifier not exceeding 0.75% by weight of asphalt binder for PG 76-22 (PMA) and PG 76-22 (ARB) binders. Polyphosphoric acid may not be used in High Polymer binder.
6. PG 76-22 (ARB) shall meet the additional requirements of 916-2.1.1.
7. All PG asphalt binders having a high temperature designation of PG 67 or lower shall not have a high temperature true grade more than 5.9°C higher than the specified PG grade, (for example, if a PG 58-22 is specified, do not supply a PG 64-22 or higher).
8. The use of waste oil is prohibited in the modification of any PG binder grade. Waste oil shall be defined as recycled oil products that have not been processed through a vacuum tower and have an initial boiling point of 385°C (725°F) or lower when tested in accordance with ASTM D6352-15.
9. Re-refined engine oil bottoms (REOB)/vacuum tower asphalt extenders (VTAE) may be used as a modifier not exceeding 8.0% by weight of asphalt binder. REOB/VTAE are materials as defined in Asphalt Institute document IS-235.

For all PG binder used in all hot mix asphalt, silicone may be added to the PG binder at the rate of 25 cubic centimeters of silicone mixed to each 5,000 gallons of PG binder. If a

disbursing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters of silicone shall be added in accordance with the manufacturer's recommendation. The blending of the silicone with the PG binder shall be done by the supplier prior to the shipment. When the asphalt binder will be used with a foaming warm mix technology, refer to the technology supplier's guidance on the addition of silicone.

Where an anti-strip additive is required, the anti-strip additive shall meet the requirements of 916-4. The anti-strip additive shall be introduced into the PG binder by the supplier during loading.

**916-2.1.1 Additional Requirements for PG 76-22 (ARB):** The following additional requirements apply only to PG 76-22 (ARB):

1. The asphalt binder shall contain a minimum of 7.0% ground tire rubber (GTR) by weight of asphalt binder.
2. The GTR shall meet the requirements of Section 919.
3. Polymer modification is optional for PG 76-22 (ARB).

**916-2.2 Compliance with Materials Manual:** Producers of Superpave PG binders shall meet the requirements of Section 3.5, Volume II of the Department's Material Manual, which may be viewed at the following URL:

<http://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section35V2.shtm>.

**916-2.3 Reporting:** Specification compliance testing results shall be reported for the tests in the table below, unless noted otherwise. Quality control (QC) testing results shall be reported for original binder DSR ( $G/\sin \delta$  and phase angle, as applicable).

SUPERPAVE PG ASPHALT BINDER		
Test and Method	Conditions	Specification Minimum/Maximum Value
Superpave PG Asphalt Binder Grade		Report
APL Number		Report
Modifier (name and type)	Polymer, Ground Tire Rubber with Approved Product List (APL) number, Sulfur, PPA, REOB, and any Rejuvenating Agents	Report
Original Binder		
Solubility, AASHTO T44-14	in Trichloroethylene	Minimum 99.0% (Not applicable for PG 76-22 (ARB))
Flash Point, AASHTO T48-17	Cleveland Open Cup	Minimum 450°F
Rotational Viscosity, AASHTO T316-13 (2017)	275°F	Maximum 3 Pa·s <sup>(a)</sup>
Dynamic Shear Rheometer <sup>(b)</sup> ,	$G^*/\sin \delta$	Minimum 1.00 kPa

AASHTO T315-12 (2016)	Phase Angle, $\delta^{(c)}$ PG 76-22 (PMA) and PG 76-22 (ARB) <sup>(d)</sup>	Maximum 75 degrees
Separation Test, ASTM D7173-14 and Softening Point, AASHTO T53-09 (2013)	163±5°C  48 hours	Maximum 15°F (PG 76-22 (ARB) only)
Rolling Thin Film Oven Test Residue (AASHTO T240-13 (2017))		
Rolling Thin Film Oven, AASHTO T240-13 (2017)	Mass Change %	Maximum 1.00
Multiple Stress Creep Recovery, $J_{nr, 3.2}$ AASHTO T350-14	Grade Temperature (Unmodified binders only)	“S” = 4.50 kPa <sup>-1</sup> max
Multiple Stress Creep Recovery, $J_{nr, 3.2}^{(d, e, f)}$ AASHTO T350-14	67°C (Modified binders only)	“V” = 1.00 kPa <sup>-1</sup> max Maximum $J_{nr, diff} = 75\%$
	76°C (High Polymer binder only)	0.10 kPa <sup>-1</sup> max
Multiple Stress Creep Recovery, %Recovery <sup>(d, e)</sup> AASHTO T350-14	67°C (Modified binders only)	$\%R_{3.2} \geq \frac{29.37 (J_{nr, 3.2})}{0.2633}$
	76°C (High Polymer binder only)	$\%R_{3.2} \geq 90.0$
Pressure Aging Vessel Residue (AASHTO R28-12)		
Dynamic Shear Rheometer, AASHTO T315-12 (2016)	$G^* \sin \delta$ , 10 rad/sec.	Maximum 5000 kPa <sup>(f, g)</sup>
Creep Stiffness, AASHTO T313-12 (2016)	S (Stiffness), @ 60 sec. m-value, @ 60 sec.	Maximum 300 MPa Minimum 0.300
$\Delta T_c$ , ASTM D7643-16	20 hours PAV aging S (Stiffness), @ 60 sec. m-value, @ 60 sec.	$\Delta T_c \geq -5.0^\circ\text{C}$
<p>(a) Binders with values higher than 3 Pa·s should be used with caution and only after consulting with the supplier as to any special handling procedures, including pumping capabilities.</p> <p>(b) Dynamic Shear Rheometer (AASHTO T315-12 (2016)) shall be performed on original binders for the purposes of QC testing only.</p> <p>(c) The original binder phase angle (AASHTO T315-12 (2016)) shall be performed at grade temperature.</p> <p>(d) AASHTO T315-12 (2016) and AASHTO T350-14 will be performed at a 2-mm gap for PG 76-22 (ARB).</p> <p>(e) All binders with a high temperature designation &gt;67 will be tested at 67°C. PG 76-22 (PMA) and PG 76-22 (ARB) shall pass a “V” grade per AASHTO M332-14.</p> <p>(f) A maximum <math>J_{nr, diff} = 75\%</math> does not apply for any <math>J_{nr}</math> value <math>\leq 0.50</math> kPa<sup>-1</sup>.</p> <p>(g) For all PG grades of a PG 67 or higher, perform the PAV residue testing at 26.5°C with a maximum of 5000 kPa.</p>		

### 916-3 Asphalt Emulsions.

**916-3.1 Compliance with Materials Manual:** Producers of asphalt emulsions shall meet the requirements of Section 3.4, Volume II of the Department’s Material Manual, which may be viewed at the following URL:

<http://www.fdot.gov/programmanagement/Implemented/URLinSpecs/Section34V2.shtm>.

**916-3.2 Requirements:** Use a prime coat meeting the requirements of AASHTO M140-13 for anionic emulsions, AASHTO M208-16 or AASHTO M316-16 for cationic emulsions, or as specified in the Producer's QC Plan. For anionic emulsions, the cement mixing test will be waived. For tack products, the minimum testing requirements shall include percent residue, naphtha content (as needed), one-day storage stability, sieve test, Saybolt Furol viscosity, original DSR, and solubility (on an annual basis). Residue testing shall be performed on residue obtained from distillation (AASHTO T59-16) or low- temperature evaporation (AASHTO R78-16).

**916-4 Liquid Anti-strip Agents.**

**916-4.1 Requirements:** Liquid anti-strip agents shall be tested by the Department in accordance with FM 1-T 283. A minimum tensile strength ratio of 0.80 must be obtained when testing the liquid anti-strip with various aggregate sources and two nominal maximum aggregate size mixtures for approval to be placed on the APL.

**916-4.2 Mix Design Verification:** Particular aggregate sources may require moisture susceptibility testing per FM 1-T283 for each mix design. Results from this testing may meet the Department's requirement of minimum tensile strength ratio of 0.80 or may indicate the need for a larger dosage rate of anti-strip agent (up to 0.75% maximum) or may require a different anti-strip agent to meet the specification requirements.