

STATE

OF

TENNESSEE

(Rev. 09-01-09)
(Rev. 02-06-10)
(Rev. 12-13-10)
(Rev. 02-13-12)

March 1, 2006

Supplemental Specifications - Section 900
of the
Standard Specifications for Road and Bridge Construction
March 1, 2006

Subsection 903.03 Coarse Aggregate for Concrete, Revise the fourth paragraph to the following:

Coarse aggregate for prestressed concrete shall be Size No. 57 or Size No. 67, **Subsection 903.22**, as may be specified or directed. Coarse aggregates for precast concrete shall include any size fractions of **Subsection 903.22**, as may be specified or directed.

Subsection 903.12 (b) - Replace with the following:

(b) Aggregate for Micro-Surface. A minimum of 50% of ~~The~~ aggregate shall be crushed slag, crushed granite or crushed stone (crushed stone as specified for the types listed for Grading D in **Subsection 903.11(c)**) meeting the gradation limits below and the physical properties of ASTM D 692 except the percent of fractured pieces shall be 100. The aggregate shall have a minimum sand equivalent (AASHTO T 176) of 65. Blends of more than one aggregate source shall be mixed by means of pug mill only. Blending aggregates with a front end loader will not be permitted. The aggregate shall be proportioned to produce a uniform gradation meeting the following requirements:

**GRADATION LIMITS FOR AGGREGATE
BASED ON WASH GRADATION**

Design Master Range Mixture Control

Sieve	(Total Percent Passing)	Tolerances
3/8 in.(9.5 mm)	100	
No. 4(4.75 mm)	70- 98	±6.0
No. 8(2.36 mm)	45-70	±5.0
No. 16(1.18 mm)	28-50	±5.0
No. 30(600 µm)	19-34	±4.0
No. 50(300 µm)	12-25	±4.0
No. 100(150 µm)	7-18	±2.0
No. 200(75 µm)	4-15	±2.0

Subsection 904.03 Emulsified Asphalts. Replace Entire subsection with the following:

904.03-Emulsified Asphalts. Emulsified asphalts used on TDOT projects shall only be from Certified Emulsified Asphalt Suppliers that have an approved Quality Control Plan in accordance with TDOT Standard Operating Procedures.

Two types of emulsified asphalts shall be used under these specifications, both, anionic and cationic. The manufacturer shall furnish samples of base asphalt used in the manufacture of asphalt emulsion, as directed by the Engineer.

All emulsified asphalts shall be homogeneous, and shall adhere firmly to the surface of the mineral aggregate. Failure of the emulsified asphalt to perform satisfactorily on the job shall be deemed cause for rejection, notwithstanding its ability to pass laboratory tests.

A. Anionic Emulsified Asphalts.

In general, anionic emulsified asphalts shall conform to all the requirements of AASHTO M 140, for the type and grade specified.

In addition to the classes provided for in AASHTO M 140, a special mixing material (AE-3), a special priming material (AE-P) or a special tack (TST-1P) may be specified. These special materials shall conform to the following requirements:

TYPE GRADE	Special Mixing AE-3		Special Prime AE-P		Special Tack TST-1P	
	Min.	Max.	Min.	Max.	Min.	Max.
TEST REQUIREMENTS:						
Viscosity, Saybolt-Furol, 77° F(25° C), Sec.	-	-	10	50	10	75
Viscosity, Saybolt-Furol, 122° F(50° C), Sec.	50+ & Pumpable		-	-	-	-
Settlement, 5 days, %	-	5	-	5	-	5
Sieve Test, %	-	-	-	0.10	-	0.10
Stone Coating, %	90	-	-	-	-	-
Residue by distillation*, %	70	-	45	-	55	60
Oil portion of distillate, % by vol.	-	6	-	12	-	-
Tests on residue from distillation:						
Float Test, 140° F (60°C),	20	-	20	-	-	-
Ductility, 77° F (25°C), cm	40	-	40	-	-	-
Ductility, 40° F (4°C), cm	-	-	-	-	10	35
Ash, by ignition, %	-	2	-	-	-	-
Demulsibility, 35 ml, 0.02 N CaCl ₂ , %	-	-	-	-	5	-
Elastic Recovery @ 50°F (10°C)	-	-	-	-	25	-
Penetration	-	-	-	-	75	150

*TST-1p shall be distilled at 400°F (205°C). AE-3 and AE-P shall be distilled at 500°F (260°C).

The test requirement for settlement may be waived when the emulsified asphalt (special tack coat excepted) is used in less than 5 days' time; or the Engineer may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.

3. Be suitable for nighttime placement.

The latex shall be combined with the asphalt emulsion at the emulsion mill to produce a homogeneous mixture.

The latex modified emulsion upon standing undisturbed for a period of 24 hours shall show no color striations, but shall be a uniform color throughout.

The latex or polymer modified emulsified asphalt shall be accepted by certification from the manufacturer.

Subsection 908.03-Permanent Steel Bridge Deck Forms; Delete ASTM A446 and A525, and **Replace** with A653

Subsection 908.03(C) First paragraph. Change to read as follows:

All high strength bolts, nuts and washers shall be certified to have met the specified tests identified in their individual ASTM Specification designations, both as individual components, and as assemblies (Bolts, Nuts, and Washers).

Subsection 908.07-Gray Iron Castings. Reviseentire subsection to the following:

908.07-Gray Iron Castings. All castings shall be of the type specified and shall be within reasonably close conformity with the dimensions shown on the Plans. The castings shall conform to AASHTO M105, with the additional requirements herein, and unless otherwise specified all castings shall be Class 30.

Test bars for tension testing shall be cast in accordance with AASHTO M 105, Table 2, Test Bar B.

All castings shall be cleaned of sand and scale by sand blasting or other effective methods so as to present a smooth, clean, and uniform surface.

Gray iron castings shall have the date of manufacture cast into each unit.

Manhole castings shall have the lid and lid seat of the rim machined to form a true bearing.

All castings shall weigh at least 95% of the theoretical weight shown on the Plans.

Subsection 914.09 Polyvinyl Chloride Pipe (PVC). Revise entire subsection to the following:

914.09-Polyvinyl Chloride Pipe(PVC) . Pressurized pipe accepted under this Specification shall conform to the requirements of ASTM D 1785. Pipe Culverts accepted under this Specification shall conform to the requirements of ASTM D 1784.

Subsection 914.10-High Density Polyethylene Plastic Pipe. Revise entire subsection to the following:

914.10, High Density Polyethylene Plastic Pipe. Pipe Culverts accepted under this specification shall conform to the requirements of AASHTO M 294, Type S. Slope Drains accepted under this specification shall conform to the requirements of AASHTO M 294, Type C or Type S.

Subsection 916.02 (a) Aluminum flat Sheet; **Revise** as shown below:

- (a). Aluminum flat sheet (sign blanks) and plates (permanent and temporary) shall meet ASTM B 209, Alloy 6061 T6 or 5052-H38. Recycled aluminum flat sheet (sign blanks) meeting ASTM

B209, Alloy 6061 T6, or 5052-H38 may be used for temporary signing only. Composite material sign blanks (temporary signing only) shall be selected from the Department’s QPL. The sign blanks shall be flat and shall contain no visible lateral bow.

Subsection 918.08: Replace entire section, with the following:

The marking material shall be prefabricated plastic consisting of white or yellow pigmented plastic with reflective glass spheres uniformly distributed throughout the entire cross sectional area and shall be capable of being affixed to bituminous or Portland cement concrete pavement by either a pressure sensitive pre-coated adhesive or liquid contact cement. The material shall be provided complete in a form that will facilitate rapid application and protection during shipment and storage. Solvents, adhesives and necessary equipment for proper application for life shall be in accordance with manufacturer's instructions. The material shall be manufactured and packaged in such a manner to permit storage at normal shelf temperatures for periods of up to one year after purchase. Contact cements, where used, shall have a shelf life of 6 months. The material shall mold itself to pavement contours, breaks, faults, and the like by action of traffic at normal pavement temperatures. The material shall have resealing characteristics so that it will fuse with itself and with previously applied marking materials of the same composition under normal conditions of use.

Prefabricated legends and symbols must conform to the applicable shapes and sizes as outlined in the Manual on Uniform Traffic Control Devices for Streets and Highways. These pavement markings shall be on the Department’s QPL.

Materials: The marking material shall be a 60 mil (1.50 mm) retroreflective pliant polymer conforming to the following requirements. The retroreflective pliant polymer pavement marking film shall consist of a mixture of high quality polymeric materials and pigments with 1.50 minimum refractive index glass spheres uniformly distributed throughout its cross sectional area, and with a reflective layer of beads bonded to the top surface. Composition shall be as follows:

Material	Min. % by Weight
Resins & Plasticizers	20
Pigments	30
Graded Glass Beads	33

This material shall be capable of adhering to asphaltic or Portland cement concrete, by means of a pressure sensitive, pre-coated adhesive, or by a liquid contact cement applied at the time of installation.

Tensile Strength. The film shall have a minimum tensile strength of 40 psi (275 kPa) of cross section when tested according to ASTM D 638. A sample 6 x 1 x 0.06 in.(150 x 25 x 1.5 mm) shall be tested at a temperature between 70° and 80° F(21 to 27° C) using a jaw speed of ¼ in.(6 mm) per minute.

Elongation. The film shall have a minimum elongation of 75% when tested according to ASTM D 638.

Plastic Pull Test. A test specimen made the same size as described under “Tensile Strength” above shall support a dead weight of 4 lbs. (1.8 kgs.) for not less than 5 minutes at a temperature between 70 and 80° F (21 to 27° C).

Pigmentation. The pigments shall be selected and blended to provide a marking film that is white or yellow conforming to standard highway colors through the expected life of the film.

Pigments. Sufficient titanium dioxide pigment meeting Federal Specification TT-P-442 shall be used in white markings to insure a dense opaque marking. Pigments shall include titanium dioxide for white plastic and C. P. medium chrome yellow for yellow plastic.

Sufficient medium chrome yellow pigment meeting Federal Specification TT-P-346b, Type 111, shall be used to insure a durable finished color that complies with

Highway Yellow Color Tolerance Chart and matches Chip 33538 of Federal Standard 595. The yellow plastic shall have a minimum of 18% pigment as chrome yellow.

Glass Beads. The glass beads shall be American made, colorless and have a minimum index of refraction of 1.50 when tested using the liquid oil immersion method. The size and quality of the beads will be such that performance requirements for the retroreflective pliant polymer film shall be met.

The film shall have a glass bead retention quality such that when a 2 x 6 in. (50 x 150 mm) sample is bent over a 1/2 in. (13 mm) diameter mandrel, with the 2 in. (50 mm) dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

Skid Resistance. The surface of the retroreflective pliant polymer shall provide a minimum skid resistance value of 35 BPN when tested according to ASTM E 303.

Color: The color of the white thermoplastic material shall be pure white and conform to Federal standard 595-17778. The color of the yellow thermoplastic material shall conform to Federal Standard 595-33538 and meet the following chromaticity specifications.

X and Y coordinates shall fall in an area bordered by these coordinates:

X	0.470	0.510	0.490	0.537
Y	0.455	0.489	0.432	0.462

Reflectance. The white and yellow markings shall have the following minimum initial retroreflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be specific luminance (SL) and shall be expressed as millicandelas per square foot per footcandle.

	<u>White</u>		<u>Yellow</u>	
Entrance Angle	86.0	86.5	86.0	86.5
Observation Angle	0.2	1.0	0.2	1.0
Specific Luminance	500	300	400	175

Thickness. The retroreflective pliant polymer film without adhesive shall be supplied in a standard thickness of 60 mils (1.5 mm).

Performance. The retroreflective pliant polymer, when applied according to the recommendations of the manufacturer, shall provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The pliant polymer shall provide a cushioned resilient substrate that

reduces bead crushing and loss. The film shall be weather resistant, and through normal traffic wear shall show no appreciable fading, lifting or shrinkage throughout the useful life of the marking. It shall also show no significant tearing, roll back or other signs of poor adhesion.

Subsection 918.09 B 3 Chemical Additives, Add the following as Subsection B-3:

- 3 Warm Mix Asphalt (WMA) additives. Organic wax or foaming additives may be added to bituminous plant mix to reduce placement temperatures in accordance with subsection 407.11. WMA additives should be introduced into the mixture at a constant rate satisfactory to produce mix temperatures as per subsection 407.11. If the proportions of the additive change during the course of mix production, these changes shall be noted and recorded. The manner in which the additive is introduced into the mixture shall be approved by the Department. The Department will maintain a list of qualified WMA additives. No product shall be used unless it appears on this list.

Subsection 918.18-Mulch Material, Add the following as the last sentence:

“An approved tackifier from the QPL shall be used to hold mulch in place.”

Subsection 918.23; Remove and Replace entire subsection with the following:

918.23- Thermoplastic Pavement Marking Material. This material shall conform to AASHTO M-249 with the following changes. The material requirements are as follows.

Composition: The retroreflective pavement marking material shall be an Alkyd / Maleic based thermoplastic material consisting of homogeneously mixed pigments, filler, resins and glass beads. The pigment, beads, and filler shall be uniformly dispersed in the resin. The material shall be manufactured from virgin material using no reprocessed components.

The material shall be free from all skins, dirt, and foreign objects and shall comply with requirements from the following table.

TABLE 1

Component	White	Yellow
% Binder Content	19.0 min	19.0 min
% TiO ₂ Pigment,	10.0 min	N/A
% Intermix Glass Beads	35 min	35 min
% Calcium Carbonate \ Fillers	36 max*	46 max*

*The amount of Calcium Carbonate and inert fillers shall be as opted by the manufacturer, providing all other specifications are met.

The Titanium Dioxide shall be Rutile Type II in accordance with ASTM D 476 with a minimum purity of 93%.

Use white thermoplastic which does not contain anatase titanium dioxide pigment.

The total silica content used in the formulation of the thermoplastic shall be the premixed beads. Uniformly disperse the pigment, beads and filler in the binder.

The Alkyd / Maleic binder shall consist of a mixture of synthetic resins and high boiling point plasticizers one of, which shall be solid at room temperature. At least one-half of the binder composition shall be 100% Maleic modified glycerol ester of resin and shall be no less than 15% of the entire material formulation. The binder shall contain no petroleum, hydrocarbon resins, tall oil resins or rosins.

The thermoplastic material shall be free of contaminates and shall be dry blended or hot mixed from 100% virgin stock using no reprocessed materials.

The Thermoplastic material shall be formulated such that when it is on the roadway surface at any natural temperature it exists in a hard, solid state with cold ductility that permits normal movement with the road surface without chipping, or cracking.

The thermoplastic shall not deteriorate or discolor when held at the application temperature for periods of time up to 4 hours or upon repeated reheating (a minimum of 4 times).

The color, viscosity, and chemical properties versus temperature characteristics of the thermoplastic material shall remain constant for up to 4 hours at the application temperature and shall be the same from batch to batch.

The thermoplastic material shall be readily applicable at temperatures between 400°F and 440°F from the approved equipment to produce lines and symbols of the specified thickness above the pavement surface.

Physical Requirements: After 4 hours @ 425°F

The thermoplastic material after heating for 4 hours \pm 5 minutes at $218 \pm 2^{\circ}\text{C}$ ($425 \pm 3^{\circ}\text{F}$) and cooled to $25 \pm 2^{\circ}\text{C}$ ($77 \pm 3^{\circ}\text{F}$) shall meet the physical requirements set forth in AASHTO M-249 with the following changes.

The material shall be tested in accordance with AASHTO T-250 and or with the appropriate method in Federal Test Method Standard #141 or ASTM Designation.

Safety – No toxic fumes.

Bond Strength – (ASTM-D4796), 180 p.s.i. min.

Specific Gravity – Not to exceed 2.30

Yellowness Index – The white thermoplastic shall not exceed a yellowness index of 0.15.

Glass Beads

General: All beads used for Thermoplastic Pavement Markings shall be clear, transparent, colorless glass, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles and conform to the following specific requirements.

Silica content of the glass beads shall be no less than 60%.

Color and Clarity: Beads shall be colorless, clear and free from carbon residues.

Roundness: Minimum true spheres overall shall be 80% when tested in accordance with ASTM-D-1155, for larger beads use visual inspection.

Index of Refraction: Minimum of 1.50, when tested by the liquid emersion method @ 77°F

Air Inclusions: Maximum of 3% overall

Intermix Glass Beads

Glass Beads used for intermix shall be premixed into the thermoplastic mixture and shall consist of 35% of the overall thermoplastic formulation. Intermix beads shall be uncoated and defined by two distinct gradations and meet the following requirements.

Type 1 Intermix glass beads shall comprise 50 % minimum of the 35% of the overall thermoplastic formulation (Intermix Glass Beads) and shall conform to AASHTO M-247-09, Type 1 with the exception of minimum true spheres overall shall be 80% as stated above, when tested in accordance with ASTM D-1155.

Type 3 Intermix glass beads shall comprise 50 % minimum of 35% of the overall thermoplastic formulation (Intermix Glass Beads) and shall conform to AASHTO M-247-09, Type 3 with the exception of minimum true spheres overall shall be 80% as stated above, when tested in accordance with ASTM D-1155.

Specification for Double Drop System

Double Drop on Glass Beads

General: All beads used for the **Double Drop system** for Thermoplastic Pavement Markings shall be clear, transparent, colorless glass, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles and conform to the following specific requirements.

Silica content of the glass beads shall be no less than 60%.

Color and Clarity: Beads shall be colorless, clear and free from carbon residues.

Roundness: Minimum true spheres overall shall be 80% when tested in accordance with ASTM-D-1155, for larger beads use visual inspection.

Index of Refraction: Minimum of 1.50, when tested by the liquid emersion method @ 77°F

Air Inclusions: Maximum of 3% overall

Drop on glass beads shall consist of a double drop system meeting the requirements specified herein. The double drop system shall be capable of applying glass beads at the specified application rates. Beads shall be applied across the entire line width assuring uniform application and embedment of the beads to 50 to 60% of the bead diameter.

Type 1 drop on beads shall be dual coated for moisture resistance and adhesion , Also meet the requirements of AASHTO M-247-09 Type 1 with the exception that the beads shall be 80% round overall.

Type 4 drop on beads shall be dual coated for moisture resistance and adhesion , Also shall meet the requirements of AASHTO M-247-09 Type 4 with the exception that the beads shall be 80% round overall.

918.26-Raised Reflective Pavement Markers with Adhesive. Remove “with Adhesive” from the subsection title.

Subsection 918.27-Geotextile. Add “and Geosynthetics” to subsection title. **Replace** entire subsection with the following:

Geotextile and Geosynthetic materials and their types shall be on the Departments Qualified Products List. Geotextile and Geosynthetic material used shall meet the material requirements of the Standard Drawing.

The contractor shall furnish a certified laboratory test report from an approved testing laboratory and a certified letter stating the product is the same as on the Department’s Qualified Products List with each shipment of materials. Laboratory test reports shall include the actual numerical test data obtained. All rolls shall be clearly labeled as being part of the same production run from which the test date was derived. Fabric shall be protected to prevent damage during transportation, storage, and installation. Geotextile and Geosynthetic rolls shall be covered during storage to protect against UV degradation and shall be stored with rolls elevated up off of the ground. Fabric that is torn, punctured, or otherwise damaged shall not be installed.