

821 LINE STRIPING MATERIAL

821.01 GENERAL

The Contractor shall notify the District of the name, address, telephone number, and personal representative of the materials manufacturer(s) for materials supplied in accordance with this specification. Materials shall be sampled at the location of manufacture before their shipment. Conformance with the specifications will include the evaluation of test data of the material from a test bed of the AASHTO National Transportation Product Evaluation Program (NTPEP). A certification from the manufacturer shall be submitted to the District, at time of materials delivery, which contains test results of materials delivered, that they conform to these specification requirements, and the date of manufacture and lot or batch number(s) of material delivered. Marking material supplied for applications on project roadways shall be the identical composition as the materials submitted for testing. The material may be provided in either granular or block form, whichever is specified. Furnishing the certification does not relieve the Contractor of responsibility to furnish material in full compliance with this specification. The line striping materials shall be lead free and for the limits on VOCs within the restrictions of use as required by the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1 or current amendment to the CFR.

821.02 HOT EXTRUDED LEAD FREE THERMOPLASTIC COMPOUND

(A) White and yellow alkyd thermoplastic striping material shall conform to the requirements of AASHTO M 249, and these specifications. The total of lead, cadmium and hexavalent chromium is restricted and shall not exceed 100 ppm when tested by X-Ray Fluorescence, ICP, or comparable method capable of this level of detection. Diarylide type pigments shall only be used when the manufacturer or pavement marking material application temperature does not exceed 392 F.

(B) COMPOSITION

COMPONENT	TEST METHOD	COLOR	
		WHITE	YELLOW
Binder, % min	Certified	18.0	18.0
Premixed Reflective Beads, % min	AASHTO T250	30.0	30.0
Titanium Dioxide, % min	X-Ray Fluorescence	10.0	–
Calcium Carbonate Inert fillers, % max	D 34	42.0	–
Yellow Pigment, %	–	–	–

Note: Amount of yellow pigment, calcium carbonate and filler shall be at the option of the manufacturer, provided all other requirements are in conformance.

1. **Binders.** The binder shall be alkyd consisting of maleic modified glycerolester of resin and other plasticisers.
2. **Titanium Dioxide.** The titanium dioxide shall be rutile type.

(C) PROPERTIES

1. Physical Properties.

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Bond Strength, psi min.	AASHTO T250	180
Cracking Resistance		No Cracks
Softening Point, F	ASTM D36	215 ± 15

2. **Specific Gravity.** The specific gravity of the white and yellow pavement marking material shall be 1.7 to 2.2 when tested in conformance with D 153, Method A at 77 F.
3. **Color.** After heating for 4 ± 0.5 hours at 425 ± 3 F, the thermoplastic shall be as specified in ASTM E 1347 and the following:
 - (a) **Production.** The color of the cured thermoplastic material film of the production sample shall match the Federal Standard 595 Color chips specified when compared by instrumental measurement.
 - (b) **Control.** Control color matching determinations will be made using a Pacific Scientific Color Machine, and an observation angle of 2°, and the CIE Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured thermoplastic film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	± 0.020	± 0.020	± 0.030	± 0.030

(c) Reflectance.

COLOR	TEST METHOD	DAYLIGHT REFLECTANCE at Degree	PERCENT MIN
White	Fed Std 595 No. 17886	45 - 0	80
Yellow	Fed Std 595 No. 13538	45 - 0	50

(d) Yellowing Index. The yellowing index of the white material shall not exceed 8 prior to QUV and 15 after QUV when tested in accordance with ASTM E 313.

Glass beads for use with thermoplastic striping materials shall conform to [821.10\(A\)](#).

821.03 EPOXY LINE STRIPING MATERIAL

(A) GENERAL. The white and yellow lead free epoxy pavement marking material shall consist of a 100 percent solid two-part system with glass beads embedded homogeneously throughout the depth of the film and the surface. All of these materials shall be lead free as defined herein.

Materials shall be supplied in block form.

(B) EPOXY COMPONENTS.

(a) Composition.

COMPONENT A	PERCENT BY WEIGHT	
	WHITE	YELLOW
Epoxy Resin	75 - 82	75 - 79
Titanium Dioxide	18 - 25	14 - 17
Organic Yellow	—	7 - 8

The entirety of the pigment of Component A white shall consist of D 476, Type II Rutile Titanium Dioxide. No extender pigments are permitted. Yellow pigments and tinting colors shall be added in proportions which will produce a color equal to the yellow color depicted in the color box described herein. Any Titanium Dioxide used shall conform to D 476, Type II Rutile.

The epoxy system shall contain no volatile solvents. The cured film shall be no less than 99.5 percent of the wet film thickness of the panel at the time it was prepared for test.

Restrictions. The manufacturer shall certify that the combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, Atomic Absorption Spectroscopy, or a comparable method capable of this level of detection.

- (b) **Epoxide Number.** The weight per epoxy equivalent (WPE) as determined by D 1652 for both white and yellow of Component A, on a pigment free basis, shall conform to a target value ± 50 provided by the manufacturer and approved by the Chief Engineer.
- (c) **Amine Number.** The amine value of the curing agent (component B) shall consist entirely of stable amines and shall be determined as specified in D 2074. The total amine value shall conform to a target value ± 50 provided by the manufacturer and approved by the Chief Engineer.

(C) MIXED COMPOSITION

- (a) **Mixing Ratio.** The mixing ratio for the epoxy pavement marking material shall be proportioned according to the manufacturer’s recommendations. The ratio shall not vary more than 2.5 percent during any operation conducted in conjunction with these materials.
- (b) **Color (White and Yellow).**
 - (1) **Production.** The color of the cured epoxy material film of the production sample shall essentially match the specified color chips conforming to Federal Standard 595 when visually compared or by instrumental measurement.
 - (2) **Control.** Control color matching determinations will be made using a Pacific Scientific Color Machine at an observation angle of 2 degrees, and the C.I.E. Chromatically Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the cured epoxy film sample:

	WHITE Color No. 17886		YELLOW Color No. 13538	
	X	Y	X	Y
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	± 0.020	± 0.020	± 0.030	± 0.030

- (c) **Yellowing Index.** After curing for 72 hours, the yellowing index of the white material when tested in conformance with E 313, using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall not exceed 8.0 preceding QUV, and shall not exceed 15.0 after 72 hours in QUV.
- (d) **Toxicity.** After heating to the application temperature, the material shall not exude fumes which are toxic or injurious to persons or property.

- (e) **Directional Reflectance.** The directional reflectance when tested in conformance with E 1347 after QUV using the C.I.E. Scale Illuminate C and 45/2 degrees geometry, shall be minimums of 80 for white and 50 for yellow.
- (f) **Abrasion Resistance.** Abrasion Resistance of the mixed material without glass beads shall be 80 mg maximum loss when tested as specified in C 501 with a 1000 g load, 1000 cycles, CS-17 wheel and a 15 ± 0.5 mil wet film thickness on a S-16 plain steel plate.

Hardness. The Type D Durometer Hardness of the material shall be a minimum of 75 when tested in conformance with D 2240. Test films shall be cast on a suitable substrate at 20 ± 1 mil wet film thickness. The film shall be cured 24 to 72 hours at 75 ± 2 F prior to testing.
- (h) **Tensile Strength.** The average tensile strength shall be a minimum of 6000 psi when tested in conformance with D 638, Type IV molded specimens. Specimens shall be cured 24 to 72 hours at 75 ± 2 F with a relative humidity of 50 ± 3 percent prior to testing.
- (i) **Compressive Strength.** The compressive strength of the catalyzed epoxy marking material shall be a minimum of 12 000 psi when tested in conformance with D 695. The test specimen shall be cured 72 hours at 75 ± 2 F with a relative humidity of 50 ± 3 percent prior to testing.
- (j) **Adhesion to Concrete.** The catalyzed epoxy paint pavement marking materials, when tested in conformance with ACI Method 503, shall have a 4000 psi minimum adhesion to the specified concrete surface with 100 percent concrete failure in the performance of this test. The prepared specimens shall be conditioned for 24 to 72 hours at 75 ± 2 F prior to the performance of the tests.
- (k) **Infrared Spectroscopy.** Both component A and component B shall be analyzed to verify for control purposes that materials submitted for use are of an identical formulation as originally approved. Deviations as determined by comparison with the original sample shall be cause for rejection.
- (l) **Curing.** The epoxy material shall be fully cured at a surface temperature of 35 F or above. The pavement marking material shall exhibit a no-tracking time of less than 10 minutes, when mixed in the proper ratio and applied at 20 ± 1.0 mil film thickness at 75 ± 2 F and with the proper saturation of beads when tested in conformance with D 711. The manufacturer shall furnish a table depicting typical no-track time versus various temperatures in the recommended application temperature range.

821.04 TRAFFIC PAINT

- (A) **DESCRIPTION** White and yellow paint material shall be a fast drying water based, nonleaded, acrylic resin paint suitable for use on both asphalt and portland cement concrete surfaces. The paint shall not contain any hazardous material listed in the

Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, Table 1.

(B) PROPERTIES

1. **Hiding Power:** Paint shall show a dry hiding quality that will give a contrast ratio of at least 0.96 at 0.38 mm (15 mil) wet film thickness.
2. **Settling Properties:** Settling shall be no less than a rating of 8 when tested in accordance with ASTM D869.
3. **Freeze-Thaw and Heat Stability:** Paint shall show no coagulation or change in viscosity greater than +/- 5 KU.
4. **Water Resistance:** Paint shall show no blistering, peeling or wrinkling, softening or loss of adhesion.
5. **VOC: The Volatile Organic Compound** content shall be no greater than 150 grams/liter when tested in accordance with EPA Method 24.
6. **Flash Point:** Paint shall have a flash point of at least 140 degrees F when tested in accordance with ASTM D93, Pensky-Martens Closed Cup.
7. **No-Track Time:** Paint shall have a 60-second maximum vehicle no-track time when measured in accordance with the NTPEP Field Test Procedures.
8. **Maintained Retroreflectivity and Durability:** Maintained retroreflectivity and durability shall conform to the following requirements after being installed on the test deck for 1 year:
 - (a). **Maintained Retroreflectivity:** Photometric quantity to be measured is coefficient of retroreflected luminance (RL) in accordance with the requirements of ASTM E 1743 for 15 meter geometry and ASTM E1710 for 30 meter geometry. RL shall be expressed in millicandelas per square foot per foot-candle and shall be at least either 150 for 15 meter or 100 for 30 meter when measured in the skip line or centerline areas.
 - (b). **Durability:** Paint shall have a durability rating of at least 4 when determined in the wheel path area.
9. **Flexibility.** The pigmented binder shall not display cracking or flaking when subjected to the flexibility test of TT-P-85, with the exception that the panels shall be 35 to 31 gauge 0.0078 to 0.0112 in.) tin plate approximately 3 x 6 in. The tin plates shall be lightly buffed with steel wool and thoroughly cleaned with solvent and dried before being used for the test.
10. **Total Solids.** Total solids shall be a minimum of 70 percent by weight when tested in conformance with Federal Test Method 4041.1, Volatile and Nonvolatile Content (ordinary lab oven).
11. **Weight/Gallon.** The paint shall be 12.0 pounds/gallon minimum and be within 0.2 pounds/gallon of the original qualification sample approved hereunder.
12. **Viscosity.** Viscosity shall be 80 ± 10 KU when tested in conformance with D 562 at 77°F.

13. Dry Opacity. Dry opacity shall have a minimum contrast ratio of 0.98 when tested in conformance with Federal Test Method 4121, Procedure B using a 0.015 in. Bird Applicator or 0.030 Doctor Blade.

14. Color.

(a) **Production.** The color of the dry paint film of the production sample shall essentially match Federal Standard 595, color chips Nos. 37886 (white) or 33538 (yellow), when compared instrumentally.

(b) **Control.** Control sample color matching determinations will be made using a color machine and the C.I.E. Chromaticity Coordinate Color Matching System under light source Illuminate C, with the following tolerances permitted between the standard chip and the dry paint film sample:

	WHITE Color No. 37886		YELLOW Color No. 33538	
	X	Y	X	Y
Standard Chip	0.32	0.33	0.49	0.44
Delta Tolerance	± 0.02	± 0.02	± 0.03	± 0.03

15. Glass Bead Adhesion. The paint with drop-on type beads, applied at the rate of six pounds-per- gallon of binder shall require not less than 550 liters of sand for removal of the beaded film. The test for bead adhesion shall be conducted in accordance with the Abrasion Resistance Test (10 above) and differing therefrom only in that the glass spheres shall be uniformly applied by gravity flow so as to obtain six pounds glass spheres per gallon of binder. The application of the glass spheres is to be a separate operation, but applied at the same time as the paint. Glass beads shall conform to [821.10](#).

16. Field Application. The paint shall not be applied at surface temperatures and air temperatures under 60°F.

821.05 POLYESTER LINE STRIPING MATERIAL

(A) DESCRIPTION

Polyester-resin is a two-component pavement marking material suitable for use on portland cement concrete surfaces.

(B) COMPOSITION

**Composition (uncatalyzed material):
Min. Max.**

- Pigment 36.0 40.0
- Acrylic monomer 8.5
- Polyester resin 55.5

(C) REQUIREMENTS

1. **Viscosity:** Viscosity (25 degrees C), ASTM D562, shall be 80 to 90 Krieb units.
2. **Weight per gallon:** Weight per gallon shall be at least 11.5 pounds.
3. **Drying time:** The catalyst/resin ratio shall be adjusted by the operator so that the applied line shall dry to a no-tracking condition in 15 minutes or less when applied at an application temperature of 77 degrees F to 100 degrees F, a substrate temperature of at least 60 degrees F, a wet thickness of 15 to 25 mils, and with 10 to 15 pounds of glass beads, conforming to the requirements of Section 234, applied per gallon. No-track time shall be determined by passing over the line with a passenger car or pickup truck at a speed of 25 to 35 miles per hour (mph) in a simulated passing maneuver. A line showing no visual deposition of the material to the pavement surface when viewed from a distance of 50 feet shall be considered as showing "no track" and conforming for time to "no-track".
4. **Catalyst:** The catalytic component of the system shall be commercially available type recommended by the manufacturer of the polyester. The peroxide shall not be exposed to any form of heat, such as direct sunlight, radiators, open flame, or sparks. Heat may cause the organic peroxide to decompose violently or burn if ignited. The peroxide shall not come into contact with easily oxidized metals, such as copper, brass, or mild steel or galvanized steel as this can also initiate a violent reaction.
5. **Weight loss:** Beaded catalyzed material shall not have a weight loss of more than 125 milligrams after 1,000 revolutions when abraded according to Federal Test Method Standard No. 141b, Method 6192, using CS-17 wheels with a 1,000-gram load on each wheel.
6. **Shelf life:** The shelf life of uncatalyzed material shall be at least 6 months when stored in a cool area below 85 degrees F.
7. **Durability and wear resistance:** Material shall be designed to provide a life expectancy of at least 3 years under an average daily traffic count per lane of approximately 9,000 vehicles.
8. **Hiding:** The marking shall show a dry hiding quality that will give a contrast ratio of at least 0.96 with the Merest Black and White Power Chart, Form 03B when drawn down at a fifteen (15) mil wet film thickness. Readings will be determined in accordance with the requirements of ASTM E 1349 using CIE1931 2 degree standard observer and CIE standard Illuminant D65.

821.06 PERMANENT PREFORMED LINE STRIPING MATERIAL**(A) GENERAL**

The materials shall remain in place on the asphaltic concrete or Portland Cement concrete pavement surfaces without being displaced by traffic, and shall not be affected by weather conditions.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three

splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

(B) DESCRIPTION

Permanent preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and the following:

1. **Composition.** The marking material shall consist of a mixture of polymeric materials, pigment and glass or ceramic beads distributed uniformly throughout the surface. The material, without adhesive, shall be a minimum of 60 mils thick.
2. **Color.** The color of the marking materials shall match Federal Test Standard Number 595 for the following:
White - 17886
Yellow - 13538
3. **Tensile Strength.** The tensile strength of the material shall be at least 175 psi when tested as specified in D 638 using a 1 x 6 in. specimen.
4. **Elongation.** The elongation of the material at break shall be 15 to 90 percent when tested as specified in D 638 using a 1 x 6 in. specimen.
5. **Flexibility.** When the material is bent 180 degrees around a 1/4 in. mandrel, it shall show no signs of cracking or loss of surface dressing beads.
6. **Skid Resistance.** The British Pendulum Number shall be a minimum of 45 BPN when tested as specified in E 303.
7. **Patchability.** The material shall be capable of patching worn areas of the same material type in accordance with the manufacturer's instructions.
8. **Freeze-thaw.** The adhesive quality of the material will be considered satisfactory if it has a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw action when tested as specified in C 666, Method B.

821.07 PERMANENT PREFORMED PATTERNED LINE STRIPING MATERIAL

(A) GENERAL

The material shall be capable of adhering to asphaltic concrete and portland cement concrete surfaces, and to any existing pavement markings in accordance with manufacturer's recommendations by a pre-coated pressure sensitive adhesive. A primer shall be used to precondition the surface if recommended by the manufacturer. The markings shall be capable of being inlaid in new hot mix asphalt surfaces during the paving operation.

The material shall be highly durable and retro-reflective and shall be fabricated of a polymeric material designed for longitudinal and legend/symbol markings subjected to high traffic volumes and severe wear conditions, such as shear action from crossover or encroachment on typical longitudinal configurations, and where high levels of reflectivity are required to ensure the safety of the motoring public.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

The material shall remain in place on the pavement surface without being displaced by traffic, and shall not be affected by weather conditions.

(B) DESCRIPTION

1. **Composition.** The material shall consist of a mixture of polymeric materials, pigments and reflective spheres distributed throughout the base cross-sectional area and reflective spheres bonded to the topcoat surface to provide immediate and continuing retro-reflection. The marking material may include a black perform patterned film border.
2. **Restrictions.** The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm. Diarylide based pigments and non-leachable lead pigmentation are not acceptable. The presence of these compounds shall be tested for compliance to the specification by X-ray diffraction, ICP, or another comparable method, capable of this level of detection.
3. **Reflectance.** The manufacturer shall certify that the white and yellow materials shall have the minimum initial retroreflectance values of 350 mcd/L/m² for white and 250 mcd/L/m² for yellow markings in any 528 ft section. Reflectance shall be measured using a reflectometer with CEN 30-meter geometry (88.76 degree entrance angle and 1.05 degree observation angle).
4. **Color.** The color of preformed markings shall essentially match the 37886, 33538 or 37038 color chips for white, yellow or black respectively as shown in Federal Standard 595A.
5. **Skid Resistance.** The British Pendulum Number shall be a minimum of 45 BPN when tested as specified in E 303.
6. **Thickness.** The material, without adhesive, shall be a minimum of 65 mils thick.

821.08 PERMANENT PREFORMED LINE STRIPING MATERIAL – HEAT APPLIED

(A) GENERAL

The material shall be highly durable retro-reflective polymeric materials designed for use as transverse lines, numbers, legends, symbols and arrow markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment.

The applied material shall adhere to asphaltic concrete pavement, portland cement concrete (PCC), and any existing pavement markings when applied using normal heat from a propane fueled heat gun in conformance with manufacturer's recommendations.

The applied material shall be capable of conforming to pavement contours, breaks and faults, shall not be affected by weather conditions, and shall remain in place on pavement surfaces without being displaced by traffic.

The material shall have a minimum shelf life of one year.

(B) DESCRIPTION

The material shall conform to the requirements of the MUTCD and the following:

1. **Composition.** The material shall consist of polymeric materials, pigments, binders and glass beads distributed throughout the entire cross-sectional area. The thermoplastic material shall conform to M 249 with the exception of the relevant differences for the material being supplied in the preformed state.
2. **Restrictions.** The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm when tested by X-ray diffraction, ICP, or comparable method capable of this level of detection. Nonleachable lead based pigments will not be permitted. Diarylide type pigments shall only be used when the manufacture or pavement marking material application temperature does not exceed 392 F.
3. **Color.** Preformed markings shall consist of film with pigments selected and blended to match Federal Standard 595 color chip Nos. 17886 and 13538 for white and yellow respectively.
4. **Skid Resistance.** The surface of the applied material shall provide a minimum average skid resistance value of 50 BPN when tested in conformance with E 303.
5. **Patchability.** The material shall be capable of use for patching worn areas of the same type in conformance with manufacturer's recommendations.
6. **Thickness.** The minimum thickness, without adhesive, shall be 120 mils.
7. **Adhesion.** The material shall retain a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw when tested in conformance with C 666, Method B.

821.09 REMOVABLE PREFORMED LINE STRIPING MATERIAL

(A) GENERAL

Removable preformed pavement marking material shall remain in place on the pavement surface without being displaced by traffic or affected by weather conditions. The material shall be capable of being removed without the use of heat, solvents, grinding or sand blasting, and shall not leave an objectionable residue.

The material shall be of good appearance and free from cracks. Edges shall be true, straight and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. All marking materials shall be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year.

(B) DESCRIPTION

White and Yellow. Removable preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) latest edition and the following:

1. **Composition.** The marking material shall consist of a mixture of polymeric materials, pigment and glass beads distributed uniformly throughout the surface.

2. **Color.** The color of the marking materials shall match Federal Test Standard No. 595A, latest edition for the following:

White - 17778

Yellow - 13538

3. **Glass Beads.** Glass beads shall conform to the General Requirements of M 247.
4. **Skid Resistance.** The British Pendulum Number shall be a minimum of 50 when tested as specified in E 303.
5. **Retro-reflectance.** The marking material shall have the initially the same retro-reflectance values under wet or dry conditions. Retro-reflective Luminance shall be a minimum of 750 for white and 450 for yellow when tested under ASTM D 4061, dry conditions, and ASTM E 2176 and E 2177 for wet conditions.

Black. Removable preformed pavement marking materials shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) latest edition and the following:

1. **Composition.** The non-reflective, patterned black line masking tape shall not contain metallic foil and shall consist of a mixture of high quality polymeric materials, pigments and inorganic fillers distributed throughout its base cross-sectional area, with a matte black non-reflective top layer. The patterned surface shall have a minimum of 20 percent of the surface area raised and coated with nonskid particles. The channels between the raised areas shall be substantially free of particles. The film shall be pre-coated with a pressure sensitive adhesive. A nonmetallic medium shall be incorporated to facilitate removal.
2. **Skid Resistance.** The surface of the patterned, non-reflective black line mask shall provide an initial average skid resistance value of 60 BPN when tested in conformance with E 303.
3. **Thickness.** The patterned material, without adhesive, shall have a minimum caliper of 0.065 in. at the thickest portion of the patterned cross-section, and a minimum caliper of 0.02 in. at the thinnest portion of the cross-section.
4. **Adhesion.** The manufacturer shall demonstrate that the properly applied black line mask adheres to the roadway and existing stable roadway markings under climatic and traffic conditions normally encountered in the construction work zone.
5. **Removability.** The manufacturer shall show that the black line mask can be manually removed after its intended use, intact or in large pieces, at temperatures above 40 F without the use of heat, solvents, grinding or sand or water blasting. The black line mask shall remove cleanly from existing markings that are adequately adhered to the pavement surface.
6. **Performance Requirements.** When applied in accordance with the of the manufacturer's recommendations, the black line mask shall provide a neat, durable masking that will not flow or distort due to temperature if the

pavement surface, or underlying markings remain stable. The black line mask shall be weather resistant and, through normal traffic wear, shall show no lifting or shrinkage which will significantly impair the intended usage of the tape throughout its useful life, and shall show no significant tearing or other signs of poor adhesion.

821.10 GLASS BEADS

(A) FOR HOT EXTRUDED THERMOPLASTIC. Glass beads shall meet the requirements of AASHTO M 247, Type II . Moisture resistance coatings shall be applied.

GRADATION SIEVE SIZE	PERCENT PASSING
	UNIFORM BEADS
0.60 mm (No. 30)	100
0.425 mm (No. 40)	90-100
0.30 mm (No. 50)	50-75
0.18 mm (No. 80)	0 – 5

(B) FOR EPOXY AND POLYESTER LINE STRIPING. Glass beads shall be premixed and shall meet the requirements of AASHTO M 247, Type I, Moisture resistance does not apply.

GRADATION SIEVE SIZE	PERCENT PASSING
	UNIFORM BEADS
0.60 mm (No. 30)	100
0.425 mm (No. 40)	90-100
0.30 mm (No. 50)	50-75
0.18 mm (No. 80)	0 – 5

(C) FOR TRAFFIC PAINT. Glass beads shall be drop- on and shall meet the requirements of AASHTO M 247, Type I . Moisture resistance coatings shall be applied.

GRADATION SIEVE SIZE	PERCENT PASSING
	STANDARD BEADS
0.85 mm (No. 20)	100
0.60 mm (No. 30)	75-95
0.30 mm (No. 50)	15-35
0.15 mm (No. 100)	0 – 5

Glass beads shall be colorless, clean, transparent, and free of milkiness, excessive air bubbles, and essentially free of sharp angular scarring or scratching. The beads shall be spherical in shape and shall contain a minimum of 60 percent silica. Roundness shall be 75 percent minimum when tested as specified in ASTM D 1155, Procedure A. The glass beads shall have a refractive index of 1.50 when tested by the liquid immersion method (Becke Line Method or equal) at a temperature of $77 \pm 9^\circ$ F.