

IFB # 1174910  
SECTION D – SPECIFICATIONS/SCOPE OF WORK

**1. DESCRIPTION AND SCOPE:**

Scope of services includes furnishing and installing pavement markings using extruded and/or sprayed thermoplastic materials, heat applied permanent preformed thermoplastic material, removable preformed materials, permanent preformed pavement marking material, permanent preformed patterned reflective pavement marking material, nontoxic lead-free waterborne paint, and the removal of existing markings - all on a work order basis. The Contractor must furnish all equipment, materials, services, labor, and all miscellaneous items necessary for the required pavement preparation, layout and completion of the pavement marking installation.

The pavement markings to be applied will generally consist of, but are not limited to, crosswalk lines, stop lines, crosshatch lines, symbols, legends, arrows, channelizing lines, and sections of centerline, lane lines, and edge lines.

The pavement markings will be applied primarily on asphalt. Some asphalt pavements may have been rejuvenated by means of “slurry seal” surface treatment. There may also be limited application of thermoplastic markings with the use of primer on Portland Cement Concrete.

**2. GENERAL REQUIREMENTS:**

**STANDARDS:** All markings shall be installed in accordance with the following:

1. The latest edition of the Maryland Manual on Uniform Traffic Control Devices for Streets and Highways (MdMUTCD) – available online at <http://www.roads.maryland.gov/index.aspx?PageId=835>
2. These specifications and special provisions
3. Work orders issued by the County Engineer, which will include appropriate drawings from the County’s Intersection Marking Program.
4. The latest edition of the Maryland State Highway Administration (MDSHA) Specifications for Construction and Materials

In the event of conflict between the above standards, the work orders and the drawings attached thereto shall take precedence. For the purpose of this solicitation and any resulting Contract, the County Engineer is the authorized representative of the Contract Administrator.

- 2.1 CONTRACTOR QUALIFICATIONS:** The Contractor must be experienced in the application of extruded, sprayed and heat-applied thermoplastic retro-reflective pavement markings at intersections, streets and highways that are open to traffic. Bidders that cannot demonstrate successful previous experience in the type of work described in this solicitation will be considered not responsible and will not be considered for award. The Contractor must possess (own or rent) and/or assure the availability of sufficient equipment, meeting the specifications that follow, to successfully pursue the work in the resulting Contracts. Personnel employed by the Contractor for work on the resulting Contracts must be experienced in operating the pavement marking equipment, requiring little or no training necessary to expeditiously commence the work and pursue it to completion. Before the County will authorize the Contractor to start work, the Contractor must inform the County of the names of the Contractor’s employees being assigned to the Contract and what specific jobs they will be responsible for doing. Any personnel replacements or job assignment changes by the Contractor during the Contract period must be reported to the County, and any of the Contractor’s replacement personnel must meet the qualifications stated above. If, at any time, the County believes that inexperienced personnel assigned by the Contractor are working on a project under this contract, to the detriment of workmanship on the contract, the County can halt the work until experienced personnel are provided.
- 2.2 CONTRACTOR’S FACILITIES:** The Contractor shall provide and maintain their own quarters and facilities to store the equipment and material for the duration of the contract. Such operating quarters should preferably be within Montgomery County. The Contractor must be able to arrive on project site, anywhere within Montgomery County, prepared to start work at 9:00 AM. Such quarters must be of sufficient size and capacity to adequately carry out the work and Contractor responsibilities specified under the resulting Contract.

- 2.3 WORK PERIOD:** Subsequent to the award of a Contract, at the commencement of weather conducive to installing pavement markings, the County will issue a Notice to Proceed, accompanied by initial work orders. The County will not issue Notice to Proceeds prior to March 20 of the work year. The Contractor must commence work as soon as possible thereafter, but no later than 7 calendar days following receipt of the work order. The last work order will be issued by the County no later than November 30 of the work year.
- 2.4 METHOD OF ASSIGNMENT AND LOCATION OF WORK:** Work orders will be issued Monday mornings, or Tuesday morning following a County holiday on Monday. The sum of the cost estimates of all work orders to be issued to the Contractor at any one time will typically be approximately \$30,000. However, the sum may vary by as much as 50% at the County's sole discretion. Please see Section C, Provision 46 for the method of issuance of work to the Primary and Secondary Contractors. Both the Primary and Secondary Contractors are independently subject to the Liquidated Damages clause (See item 2.6 for details).

The specific locations of work are not listed herein but will be assigned via written work orders issued by the County over the course of the contract term. Each work order will specify the locations, items, and estimated quantities of work to be performed. The County may change the work locations with a minimum prior notice to the Contractor of two working days and/or may change the marking details at any time during the work period. Work orders will be sent to the Contractor via email. Alternatively, the Contractor may coordinate with the County's Sign & Marking (S&M) Shop Supervisor to pick up the work orders. The Shop is located at 1283 Seven Locks Road, Building E, Rockville, MD, 20854. The phone number for the S&M Shop is (240) 773-7330.

- 2.5 RATE OF PURSUING THE WORK:** The Contractor must commence work as soon as possible but not later than 7 calendar days after the Notice to Proceed, the initial work order(s), and the Purchase Order has been received. The Contractor must complete the work required by each work order thereafter as soon as practicable, but in any event not later than 14 calendar days after the receipt of the work order, the Notice To Proceed, and the Purchase Order, unless the County Engineer has specified a later due date on the work order. Exceptions to this requirement may only occur if the County accepts extenuating circumstances. Requests for exceptions due to extenuating circumstances must be made in writing to the County within 48 hours of the occurrence. The County Engineer's decision on extenuating circumstances will be final. Lost workdays due to holidays, weather, equipment breakdown or non-availability of materials will not be considered an extenuating circumstance for not meeting the required schedule. The Contractor must assure that the necessary materials and equipment are available for use on this contract. Each day that a work order is not completed after the 14 days (or a later due date, if any specified on the work order by the County Engineer) allowed window, will result in a possible pursuit of liquidated damages as described below.
- 2.6 LIQUIDATED DAMAGES:** Liquidated Damages (L/D) at the rate of \$50 per work order per working day for a maximum sum of \$500.00 per working day may be assessed by the County in the event any of the following occurs:
- a. Failure of the Contractor to complete each work order to the satisfaction of the County Engineer within 14 calendar days (or by a later due date, if any specified on the work order by the County Engineer) of receipt of the work order, Notice to Proceed (NTP), and Purchase Order (PO).
  - b. Should it be necessary for the County to halt the work because of incorrectly or unsatisfactorily installed pavement markings under the terms of this contract, as determined by the County.

Unless a written extension of time has been granted by the County, liquidated damages will be assessed for each and every working day of delay. Due to the difficulty in computing the actual material loss and disadvantage to the County caused by delay, it is determined in advance and agreed by the Parties hereto that liquidated damages will be set at \$50 per work order per working day. In the event, multiple work orders are concurrently delayed, liquidated damages will be assessed for each work order independently, for a maximum sum of \$500/working day. The County and Contractor agree that this is a fair and reasonable measurement of the damages to the County for Contractor's failure to perform on time and within the requirements of the contract and that it does not constitute a penalty. The County will withhold said liquidated damages from any payments then due, or to become due, to the Contractor. Nothing herein precludes the County from pursuing claims with the Contractor for errors, omissions or negligence unrelated to delay.

**2.7** **DEFAULT ON CONTRACT:** Default on the contract may result in termination of the contract and forfeiture of the performance bond for any and all uncompleted work. In the event of any of the following conditions, the County will consider the Contractor to have defaulted on the contract:

- a. Failure of the Contractor to start work within 7 calendar days after the receipt of NTP, PO, and initial work order(s).
- b. Failure of the Contractor to pursue the work at an adequate rate such that L/D are eligible to be assessed in excess of 14 working days total, be it consecutive days or otherwise.

**2.8** **SCHEDULING AND RECORD KEEPING:** The Contractor shall designate a foreman in charge of the daily pavement marking work activity. Each Monday morning (or Tuesday morning following a County holiday), the Contractor must submit to the County Engineer a weekly written schedule of work for all outstanding work assignments. The schedule may be emailed. The email address will be provided to the Contractor by the County. The schedule must be verbally updated each working day (i.e. progress report on accomplishments and/or schedule changes) by the Contractor's foreman to the Signing and Marking Shop supervisor at (240) 773-7330.

The Contractor must report a thorough written log of each day's work activities at the end of the day. For this purpose, the Contractor must use the Montgomery County Department of Transportation titled Daily Log for Striping Quantities (Form), included in Appendix A of this solicitation to completely and accurately report each day's activities. As the form requires, the daily log must include the name and exact segment of the roadway or intersection where the work occurred, the work order number that was provided in the Notice To Proceed, the date and approximate time of day the work occurred, a description of the type of markings installed, the quantity (L.F., Sq. Ft., or each) of each bid item installed at the location, number of crosswalks installed, and any other comments as appropriate. If the Contractor works on multiple roads on the same day, a separate Form must be provided for each road that thoroughly captures all of the work that was performed on that road. Alternatively, a single Form may be provided for that day as long as supporting documentation is provided that breaks down the quantities, describes the scope of work performed at each location, and provides accurate quantities of all work that was performed at each location. Preparation and submission of accurate and complete daily logs as described above is required. Failure to meet this requirement may result in default of contract by the Contractor.

If there are locations where the Contractor desires to accomplish work during other than normal working hours **9:00 AM - 3:00 PM, Monday through Friday**, the Contractor must submit a request in writing to the County a minimum of two working days in advance of such work and shall not undertake such work without the approval of the County. For pre-approved night work, provisions must be made, at the Contractor's expense for adequate lighting of the marking operation and additional traffic controls specified by the County. Night work is defined as any work occurring between one-half (1/2) hour after sunset and one-half (1/2) hour before sunrise. The County will not compensate the Contractor for nighttime work at any rate other than what is bid on the quotation sheet. There are no overtime or special rates allowed under this contract.

**2.9** **DOCUMENTS TO BE CARRIED BY MARKING CREW:** A copy of the executed Contract, an up-to-date Alexandria Drafting Company's Montgomery County Street Map Book and Montgomery County's Work Zone Traffic Control Standards Manual must be carried by the Contractor's marking crew(s) at all times when performing work under the resulting Contract. Failure to have any of these items will be considered sufficient reason for the County to suspend all work until the required documents are produced by the crew(s).

**2.10** **GUARANTEE:** The Contractor must keep in good order and repair during the Contract Work Period and the subsequent 90-day Observation Period all markings installed per this contract. If, at any time, in the judgment of the County, repairs, renewals, or replacements become necessary, due to incorrectly applied, improperly located, or inferior materials said actions must be promptly made by the Contractor, with any inferior materials, or defective work replaced by good work and acceptable materials, and all necessary actions taken to render the improvement in first class condition. See Extended Warranty requirements, Section 12.

Following completion of all work associated with a specified assignment (work order); there will be a 90-day Observation Period of the pavement markings before final acceptance. During the 90-day Observation Period, the

pavement marking material furnished and installed under this contract must be warranted by the Contractor against failure due to blistering, bleeding, excessive cracking, staining, discoloration, oil content of the pavement material, smearing or spreading under heat, deterioration due to contact with oil, diesel fuel, grease deposits, chipping, spoiling, poor adhesion resulting from defective materials or methods of application, loss of retro-reflectivity, or damage from traffic and wear.

During the 90-day Observation Period, the Contractor, at no expense to the County, must replace any pavement markings that do not perform satisfactorily under traffic due to defective materials and/or workmanship in manufacturing and/or application. Installation of both initial and replacement markings are subject to the seasonal temperature limitations specified in Section D, Item 4.2 of the solicitation.

Marking replacement must be performed in accordance with the requirements specified herein for the initial application, including but not limited to surface cleaning, sealer application, etc. Replacement must commence within 45 days' notice or as soon as weather permits and be continuously performed until completed.

Traffic will be operated on the facility during the 90-day Observation Period. If the Contractor does not complete such necessary work as stipulated above, then the County may proceed to complete the work and deduct the full cost thereof (including materials) from the money retained on account of the contract, as provided above.

- 2.11 INVOICES:** Any work order that has not been fully completed, or that contains defective work not corrected by the Contractor to the satisfaction of the County, will not be accepted for payment by the County until all pavement markings work specified on the work order is 100% satisfactorily completed. Until the required corrections are made and accepted, the Contractor will not receive any payment for installing any markings that were included in such a work order, even if only a small portion of the work specified on the work order is incomplete or defective. Invoices must be as described on page B (Bid Cover Sheet) and Page 10 (Section C, Provision 22).
- 2.12 FINAL PAYMENT:** Upon expiration of the 90-day Observation Period for each completed work order and upon final acceptance for the work performed, the County will pay to the Contractor any and all sums reserved or retained, less such amount as the County is entitled to retain under the provisions of this contract.
- 2.13 IMPLIED WORK:** All incidental work required by the work orders, drawings or specifications, for which no payment is specifically provided, any work or materials not therein specified which are required to complete the work and which may fairly be implied as included, must be done or furnished by the Contractor without extra compensation.
- 2.14 DECISIONS AND EXPLANATIONS BY THE COUNTY ENGINEER:** The County Engineer will decide any and all questions which may arise as to the quality and acceptability of materials furnished and work performed, the manner of performance and rate of progress of the work, the interpretations of any or all plans relating to the work and specifications, and the contract on the part of the Contractor. The County Engineer will determine the amount and quantity of the several kinds of work performed and materials which are to be paid for under the contract, and such decision and estimate will be final and conclusive, and such estimate, in any case questions arise, will be a condition precedent to the right of the Contractor to receive any monies due under the contract. Any doubt as to the meaning of, or any obscurity as to, the wording of the specifications and contract or the intent of the plans, and all directions and explanations requisite or necessary to complete, explain or made definite any of the provisions of the specifications, contract, or plans and to give them due effect, will be interpreted by the County Engineer. The decision of the County will be final.

**3. Thermoplastic Pavement Markings**

**GENERAL:** The thermoplastic pavement marking materials used in this contract must meet the following specifications. These specifications cover retro-reflectorized, oil and grease impervious, lead free thermoplastic pavement marking materials which are (1) hot extrusion applied with a surface application of glass spheres and (2) heat fused applied. The properly applied markings must be retro-reflectorized and able to durably resist degradation and deformation by traffic. The thermoplastic materials must be homogeneously composed of pigment, filler, resins,

and glass beads, and must be available in both white and yellow.

- 3.1 COMPOSITION:** The combined total of lead, cadmium, mercury and hexavalent chromium must not exceed 100 ppm when tested by X-Ray Fluorescence, ICP, or comparable method capable of this level of detection. Diarylide type pigments must only be used when the manufacturer or pavement marking material application temperature does not exceed 392° F.

COMPONENT	TEST METHOD	COLOR	
		WHITE	YELLOW
Binder, % min	Certified	25.0	25.0
Premixed Reflective Beads, % min	MSMT 614	25.0	25-40 MIL
Titanium Dioxide, % min	X-Ray Fluorescence	10.0	N/A
Calcium Carbonate Inert fillers, % max	D 34	42.0	*
Yellow Pigment, %	—	N/A	*

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

- a) **BINDERS:** The binder must be alkyd consisting of maleic modified glycerolester of resin and other plasticizers.
- b) **TITANIUM DIOXIDE:** The titanium dioxide must be rutile type

**3.2 PHYSICAL PROPERTIES OF THERMOPLASTIC PAVEMENT MARKINGS:**

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Bond Strength, psi min.	T250	180
Softening Point, F		215 ± 15
Low Temperature Stress Resistance	T 250	No Cracks
Abrasion Resistance	MSMT 614 ( <a href="http://www.sha.maryland.gov/OMT/msmt614.pdf">http://www.sha.maryland.gov/OMT/msmt614.pdf</a> )	0.5 g. Loss, max

- 3.2.1 SPECIFIC GRAVITY:** The specific gravity of the white and yellow thermoplastic pavement marking material must be 1.7 to 2.2 when tested in conformance with D 153, Method A at 77 F.
- 3.2.2 COLOR:** After heating for 4 ± 0.5 hours at 425 ± 3° F, the thermoplastic must be as specified in E 1347 and the following:
  - a. **PRODUCTION:** The color of the cured thermoplastic material film of the production sample must 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. 37925		YELLOW Color No. 38907	
	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. 37925	45 - 0	80
Yellow	Fed Std 595 No. 38907	45 - 0	50

**d. YELLOWING INDEX:** The yellowing index of the white material must not exceed 8 prior to QUV and 15 after QUV when tested in accordance with E 313.

**3.3 GLASS BEADS PHYSICAL REQUIREMENTS:** The glass beads must conform to M 247, Type I, and the following:

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 must be colorless, clean, transparent, and free of milkiness, excessive air bubbles, and essentially free of sharp angular scarring or scratching. The beads must be spherical in shape and must contain a minimum of 60 percent silica. Roundness must be 75 percent minimum when tested as specified in D 1155, Procedure A. Glass beads must have a 1.50 minimum refractive index when tested in conformance with MSMT 211. Glass beads must not absorb moisture in storage and must remain free of clusters or lumps.

**3.4 APPLICATION DETAILS**

1. The molten applied thermoplastic material must readily screed/extrude at temperatures between 400°F and 440°F from the approved equipment to produce a line which shall be continuous and uniform in shape having clean sharp dimensions at .090” - .125” cross section of line.
2. The application of additional glass beads by drop-on methods shall be at a minimum rate of 8 lbs. per 100 sq. ft. of marking.

3. The temperature-viscosity characteristics shall remain constant up to 4 hours when heated to the application temperature and shall show like characteristics from batch to batch. The color shall not degrade below the reflectance limitations on the specifications after 4 hours at 218.3° C (425°F), nor shall it change from batch to batch.

**3.5 QUALITY ASSURANCE PROVISIONS: Methods of Sampling and Testing:** The County reserves the right to perform any quality assurance testing necessary to determine compliance with this specification. Bidders must submit sources supplying thermoplastic material and glass beads including a certificate of compliance with the bid certifying that the materials bid are in full compliance with these specifications.

**3.6 WARRANTIES:** The thermoplastic pavement marking materials and glass beads furnished under this contract must assume the manufacturer's warranty for these materials and must be guaranteed by the supplier against failure due to traffic oil degradation. The contractor must assume all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the work and agree to indemnify and hold harmless the purchaser and its duly authorized representatives from all suits at law or action of every nature for, or on account of, the use of any patented materials, equipment, devices or processes. See Section 11 for extended warranty requirements.

**4.0 CONSTRUCTION REQUIREMENTS – THERMOPLASTIC MARKINGS**

**APPLICATION DETAILS:** The Contractor must furnish and install machine-applied extruded and/or sprayed hot thermoplastic with glass spheres (pre-mixed and drop-on) in the proper ratio to immediately produce a highly retro-reflective marking as described elsewhere in these specifications, in accordance with the details in the work orders and following provisions.

Longitudinal lines must be offset at least 2" from longitudinal construction joints of pavement. The bead distribution must be uniform throughout the width and thickness. No transverse markings shall be installed in the concrete gutter pan of any asphalt roadway; such markings shall terminate at the edge of the asphalt pavement. There must be neither measurement nor payment for any transverse markings in the concrete gutter pans of asphalt roadways.

Broken lane lines must be installed at 10' segments separated by 30' breaks. Dotted lines must be installed as 3' segments separated by 9' breaks. Double centerlines must be installed as two five-inch wide lines separated by a five-inch space.

Marking material must be applied at the specific widths and at a rate to result in a thickness of .090" for longitudinal lines and gore markings and .125" for all other markings. Application tolerances of no more than .005" will be acceptable. Engineer may, at his discretion, require Contractor to replace or correct thin application. No marking shall be less in width than the dimensions specified, nor more than ¼" wider than the dimensions specified. The markings must be straight or of uniform curvature and must conform uniformly to tangents, curves, and transitions. The finished lines must have well defined edges and be free from waviness. The lateral deviation of the finished lines must not exceed ½" from the proposed location alignment at any point. Any greater deviation will be sufficient cause for requiring the Contractor to remove and correct such markings at no additional expense to the County.

Glass beads, conforming to the material specifications for "drop-on" beads, must be uniformly applied to the surface of the marking material by means of a pressurized bead applicator or other mechanical method, immediately after the material is applied to the pavement surface, and while the marking material is still molten so that the beads will be held uniformly imbedded in the surface of the marking and must be applied at a minimum rate of 8lbs. per 100 square feet of marking.

All pavement marking lines must be applied with one pass of the pavement marking equipment, except pavement markings that exceed 12" in width. The various letters and symbols must conform to the size and shape outlined in the MdmUTCD, latest edition.

The Contractor must protect the markings until track free, by placing guarding or warning devices as necessary. In the event any vehicle should cross the molten marking, such marking must be replaced, and any marking made by the moving vehicle must be removed by the Contractor at no additional cost to the County. The Contractor must be responsible for removing all material spilled upon the road surface in a manner acceptable to the County Engineer. To avoid blistering and poor adhesion, the thermoplastic material must be applied to dry pavements in a melted state at a temperature of 400 degrees to 440 degrees Fahrenheit. Minimum pavement temperature and weather limitations as previously specified must be observed. The material must be heated throughout and must have uniform disbursement of binder, pigment, and glass beads when applied to the surface of the pavement.

The County Engineer may require the Contractor to provide openings of 6" lengths at 20-foot intervals in edge-line placed on the inside of super elevated curves to prevent the ponding of water on the pavement surface. Such openings shall not be provided unless specifically directed by the County Engineer.

The material, when formed into traffic symbols and stripes, must be readily renewable by placing a thin overlay of new material directly over an old line of thermoplastic material. The new material must bond itself to the old line in such a manner that no splitting or separation takes place. At the time of the application and final acceptance, the color of the white material must be pure white; and the color of the yellow material must be reasonably close to 38907 of the Federal Standard Color No. 595a dated January 21, 1968, and must fall within the limits of the F.H.W.A. Highway Yellow Color Tolerance Chart, PR Color No. 1, dated December, 1972.

In the interest of public safety, it is necessary that no uncompleted marking work be left at the end of any workday at any given location. Therefore, the Contractor must schedule the work such that all work called for on any one work order (including removal of existing markings, if any) for an intersection or road location will be completed on the same day that it is started. Partial completion shall not be allowed and will be subject to L/D at a rate of \$50 per location per day, whenever such partial completion may occur.

- 4.1 SURFACE PREPARATION:** In order to insure maximum possible adhesion, the pavement surface upon which the pavement markings are to be placed must be properly cleaned from grease, oil, mud, dust, dirt, grass, loose gravel, and other deleterious material prior to the application of the thermoplastic pavement markings, and/or primer-sealer. Cleaning is required on all surfaces which are to receive new pavement markings and must be considered incidental to the application of the markings.
- 4.1.1 PRIMER-SEALER:** It is the responsibility of the Contractor to recommend to the County Engineer and obtain the County Engineer's concurrences as to whether primer-sealer is required on a given pavement in order to meet the material manufacturer's warranty conditions. Generally, on all Portland cement concrete pavement surfaces and aged asphaltic-concrete pavements having less than eight percent (8%) bituminous concrete, primer/sealer must be applied to the area where the thermoplastic pavement markings are to be placed. Also, the County reserves the right to direct the Contractor to apply primer/sealer for any given markings. The primer/sealer must be recommended by the manufacturer of the thermoplastic material and approved by the County Engineer. The material must form a continuous film which must dry rapidly and adhere to the pavement. The material must not discolor nor cause any noticeable change in the appearance of the pavement outside of the finished pavement markings. All solvents must have evaporated from the primer/sealer prior to the application of the molten thermoplastic materials. A sample of the primer/sealer and the recommended method of application must be submitted to the County Engineer and must be approved by the County Engineer and the manufacturer of the material before application. The County Engineer has the authority to require the Contractor to apply the primer/sealer using a separate vehicle which may require additional traffic control. Application equipment must be so constructed as to assure continuous uniformity in the width and thickness of the primer, which must be applied (when required) at least 1" wider than the thermoplastic material application. Payment for application of primer/sealer will be at the contract unit price (Item #30 on Page E-2) per square foot for "Primer/Sealer Application."
- 4.1.2 REMOVAL OF EXISTING THERMOPLASTIC OR PAINTED MARKINGS:** When called for on the work order or otherwise as directed by the County Engineer, removal of existing painted or thermoplastic pavement markings must be accomplished by the Contractor using equipment and methods specifically



approved by the County Engineer. Marking removal shall not be by “painting out” with black paint nor shall it result in excessive scarring of the pavement. No more than 1/8-inch depth of scarred pavement will be allowed. At least 90 percent of painted markings must be removed. As directed by the County, the Contractor must be responsible for sweeping or otherwise adequately cleaning up debris after completion of markings removal. One hundred percent (100%) of any thermoplastic markings required to be removed by the County because they are improperly located or otherwise incorrect or improper, as well as any of the thermoplastic plastic pavement markings that fall within the Contract Work Period or in the subsequent 90-day observation period and warranty periods, must be removed. Unless permitted otherwise by the County Engineer, where old markings are removed, the new markings must be applied the same day as the old markings are removed. Failure to meet this requirement will result in assessment of one day of Liquidated Damages at the daily rate specified in this document for each day that the new markings are not installed after the removal of the existing markings. Whenever grinding, scraping, sandblasting, or other operations are performed, the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorists. When these operations are completed, the pavement markings must be cleaned to remove residue and debris resulting from the removal. Where cleaning and/or removing pavement markings within ten (10) feet of a lane occupied by public traffic, the residue, including dust, shall be removed immediately from the surface being treated. Such removal must be by methods approved by the County Engineer. Any damage to the pavement or pavement joint materials caused by pavement marking removal must be repaired by the Contractor at no cost to the County by methods acceptable to the County. The removal of pavement markings will be measured and paid for at the contract unit price. No direct payment will be made for the removal of existing pavement markings which have not been authorized by the County Engineer.

**4.1.3 PRE-MARKING OF LINES:** Pre-marking is not required when restriping visible markings in the same location and dimensions. However, if the existing markings are to be removed or are not visible, or if new roadway surface has been placed before marking installation occurs, or if the work order requires a line to be installed where none currently exists, the Contractor will be required to pre-mark as directed by the County Engineer and subsequently must install the required markings in accordance with the requirements of other sections of the specifications. The actual placement of the pavement markings at any such site must not be performed until the pre-marking has been inspected and approved by the County Engineer. Pre-marking is incidental to the pavement marking installation work and there will be no separate payment for pre-marking.

**4.2 SEASONAL AND WEATHER LIMITATIONS:** Thermoplastic pavement markings must not be applied by the extrusion means when pavement temperatures are below 50 degrees Fahrenheit and by the spray means when the pavement temperatures are below 55 degrees Fahrenheit or by ribbon gun means when the pavement temperatures are below 65 degrees Fahrenheit. Thermoplastic markings must not be applied by any means when the surface of the pavement contains evidence of moisture, regardless of temperature.

**4.3 EQUIPMENT:** Application equipment must be so constructed as to assure continuous uniformity in the thickness and width of the marking and must be equipped with a cut-off device remotely controlled, to provide clean stripe ends. The equipment used to melt and install the hot thermoplastic materials must be constructed to provide continuous mixing and agitation of the materials. All parts of the equipment shall evenly heat the material to its temperature without overheating. The primary melting system must be equipped with automatic thermostatic control devices for positive temperature and safety controls. Heating must be by means of controlled heat transfer liquid or controlled flame heating, whereby flame does not touch underside or walls of thermoplastic melting vessel. Application equipment, including discharge apparatus, must be constructed to maintain recommended temperature of material until it is deposited on the pavement. The County Engineer can reject equipment or procedures that may cause damage to the quality of the materials by overheating, scorching, or poor agitation. The County Engineer may reject materials due to excessively long periods of heating and reheating.

If an Extrusion Die (Shoe) system is used, the front and both sides of the extrusion shaping system must, at all times while dispensing material, remain in full contact with the pavement. The heating kettle and applicator must meet the requirements of The National Board of Fire Underwriters, of the National Fire Protection Association of the State and of the local authorities.

**4.4 INSPECTION:** During and after material application, both daylight and nighttime inspections of the markings will be made by an authorized representative of the Contract Administrator. The Contractor must cooperate with the County to facilitate inspection. For example, the Contractor may be required at any time to apply markings onto an aluminum sheet as a sample for measurement of material thickness. If markings are found to be defective or if they fail in any way to meet the specifications in this Contract, such markings will be rejected and must be replaced within the time limit specified.

**5.0 NONTOXIC LEAD-FREE WATERBORNE PAVEMENT MARKINGS**

**SCOPE:** This work must consist of furnishing and applying nontoxic lead-free waterborne pavement markings (fast-dry, 60 second no-track) to pavement surfaces as specified in the work orders or as directed by the County Engineer.

**5.1 PAINT MATERIAL:** Paint material must be a ready-mixed, pigmented binder emulsified in water and capable of anchoring reflective beads that are applied separately. Paint material shall be on MSHA’s Qualified Product List. The paint shall not contain any hazardous material listed in the Environmental Protection Agency Code of Federal Regulations (CFR) 40, Section 261.24, and Table 1. Paint shall conform to the manufacturer’s formulations and must be controlled from batch to batch. Unless otherwise noted, paint must be tested in conformance with Federal Test Method Standard No. 141 and must conform to the requirements listed below. The combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm, when tested by X-ray fluorescence spectroscopy, or other method capable of detection at this level. The Contractor must provide the County with the manufacturer’s certified analysis in conformance with TC-1.02 of the Standard Specifications. The paint shall meet the following physical requirements:

- i. **VISCOSITY:** Viscosity must be  $85 \pm 10$  KU when tested in conformance with D 562.
- ii. **PIGMENT -** The colorants used to attain the color of the yellow product shall be one or more of the following, along with titanium dioxide: Pigment Yellow 65, Pigment Yellow 75, and opaque Pigment Yellow 74.
- iii. **REFERENCE:** Reflectance without beads, and using CIE XYZ Yxy, must be a minimum Y of 80 percent for white and a minimum of 50 percent Y for yellow when tested in conformance with E 97.
- iv. **PRODUCTION:** The color of the dry paint film of the production sample must essentially match Federal Standard 595, color chips Nos. 37886 (white) or 33538 (yellow), when compared instrumentally.
- v. **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:

	<b>WHITE Color No. 37925</b>		<b>YELLOW Color No. 38907</b>	
	<b>X</b>	<b>Y</b>	<b>X</b>	<b>Y</b>
Standard Chip	0.310	0.330	0.480	0.450
Delta Tolerance	$\pm 0.020$	$\pm 0.020$	$\pm 0.030$	$\pm 0.030$

**a.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.

**b.BLEEDING RATIO:** Bleeding ratio must be a minimum of 0.95 when tested in conformance with Federal Specification TT-P-85, Modified. The asphalt saturated felt shall conform to Federal Specification HH-R-590 or HH-R-595.

- c. **FLEXIBILITY:** The pigmented binder shall not display cracking or flaking when subjected to the flexibility test of TT-P 1952D, with the exception that the panels must 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.
- d. **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).
- e. **SETTLING RATE:** Settlement rating shall not be less than 8 when tested in conformance with D 869 and D 1309.
- f. **WEIGHT PER GALLON:** The weight per gallon must be within  $\pm 0.3$  lb/gal of the value obtained by the National Transportation Product Evaluation Program (NTPEP).

**5.2 GLASS BEAD PHYSICAL REQUIREMENTS:** Reflective glass beads must conform to M 247, except that the gradation must conform to the following:

PERCENT PASSING			
SIEVE SIZE	Standard Beads	Large Beads	Maryland Blend
12 (1.70 mm)		100	100
14 (1.40 mm)		95 – 100	98 – 100
16 (1.18 mm)		80 – 95	88 – 97
18 (1.00 mm)		10 – 40	48 – 70
20 (0.85 mm)	100	0 – 5	28 – 50
30 (0.60 mm)	75 – 95		
50 (0.30 mm)	15 – 35		5 – 25
80 (0.18 mm)			0 – 5
100 (0.15 mm)	0 – 5		

Moisture resistance and flotation tests are not required.

- **REFRACTIVE INDEX:** Glass beads must be colorless, clean, transparent, and free of milkiness or excessive air bubbles. The refractive index must be 1.50 to 1.52 when tested in conformance with MSMT 211.
- **ROUNDNESS:** Glass beads shall be smooth, spherical in shape, free of sharp angular scars, scratches, or pits, and shall contain a minimum of 60 percent silica. Beads shall have a minimum average roundness of 75 percent when tested in conformance with ASTM D-1155.

**5.3 MATERIAL ACCEPTANCE:** Only Laboratory approved materials conforming to this Specification must be used. Paints shall be compatible with cleaning solvents used in equipment cleaning. Paint must not skin, curdle, settle or be unusable or difficult to apply within 12 months of the date of manufacture. Paint shall not be used beyond 12 months after the date of manufacture.

**5.4 CERTIFICATION:** The Contractor must supply to the County all the manufacture’s certification before using any material for line striping. The Contractor or the manufacturer must also provide the following:

- Certification in conformance with TC-1.02.
- Material Safety Data Sheets for all materials to be used.
- The name or the type of colorant material used to make the nonleaded yellow color to indicate compliance with this Specification. The County will keep the paint composition and chemical analysis information confidential.
- Application temperature ranges and optimum temperatures of paints for fast drying when measured at the spray gun nozzle.

**5.5 APPLICATION:** The location, width, and type of marking, must be as specified in the work orders or as directed by the County Engineer. Applying pavement markings over longitudinal joints is prohibited; they must preferably be offset 2 in. from them. Nontoxic lead-free waterborne pavement markings must conform to the following:

- a. **FORMULATION SELECTION:** The Contractor must apply paint conforming to these Specifications.
- b. **TEMPERATURE:** The markings must be applied when the paint, ambient, and surface temperature and relative humidity conform to the manufacturer's recommendations.
- c. **GLASS BEADS:** The Contractor must apply the beads uniformly across the surface of the stripe, at the rate of 6 to 7 lb/gal of paint. When large type glass beads are specified, they must be applied uniformly across the surface of the stripe at the rate of 12 lb/gal of paint, by special gravity fed bead guns conforming to the manufacturer's recommendations.
- d. **THICKNESS:** The paint must be applied at a wet film thickness of  $14 \pm 1$  mils.
- e. **COLOR:** The color of the dry markings must match Federal Standard 595 (33538 - yellow or 37886 - white). The Contractor must supply the specified color chips for the County Engineer's use to visually determine that the waterborne material matches the specified color.
- f. **DRY TIME:** The applied paint shall dry to a no-track condition within 60 seconds. The no-track time shall not be exceeded when the pavement temperature is between 40 and 120 F and under all humidity conditions, providing the pavement is dry. The no-track time must be determined by passing over the applied line at approximately 30 degrees with a standard passenger car or pickup truck. When viewed from a distance of 50 ft, the pavement surface must show no evidence of the paint being picked up and re-deposited on the pavement by the vehicle.
- g. **RETRO-REFLECTANCE:** At the time of the paint application, the minimum retro-reflectance values must be 250 and 150 mcd/L/m<sup>2</sup> for white and yellow, respectively.
- h. **APPLICATION EQUIPMENT:** The equipment used for application of the paint must be approved by the County Engineer prior to start of work and must be capable of applying waterborne traffic paint that has been approved by the County. The Contractor must provide access to the paint application equipment for inspection by the County Engineer. The paint carriage on the left side of the paint truck must have three paint and bead guns. The paint carriage on the right side of the paint truck must have two paint and bead guns. All 10 in. lines must be applied using two paint and bead guns. Raising the paint carriage in order to paint these lines with one type of paint and one bead gun is prohibited.
- i. The footage counter used to measure pavement markings must be calibrated and a notarized certification must be submitted to the County Engineer prior to application.
- j. **OBSERVATION PERIOD:** The Contractor must not be responsible for pavement markings when the County Engineer determines that they have been damaged by plowing. The full Observation Period only applies to those pavement marking materials used as permanent pavement markings for a project.

**6.0 HEAT APPLIED PERMANENT PREFORMED THERMOPLASTIC PAVEMENT MARKINGS**

This work must consist of furnishing and installing heat applied permanent preformed thermoplastic pavement markings as specified in the Contract Documents or as directed by the County Engineer of the County. The material must 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 must adhere to hot mix asphalt (HMA), open-grade friction courses (OGFC), stone matrix asphalt (SMA), 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 must be capable of conforming to pavement contours, breaks and faults, shall not be affected by weather conditions, and must remain in place on pavement surfaces without being displaced by traffic. The material must have a minimum shelf life of one year. The material must conform to the requirements of the latest edition of the MdMUTCD and the following:

- i. **COMPOSITION:** The material must consist of polymeric materials, pigments, binders and glass

beads distributed throughout the entire cross-sectional area. The thermoplastic material must conform to M 249 with the exception of the relevant differences for the material being supplied in the preformed state.

- ii. **RESTRICTIONS:** The combined total of lead, cadmium, mercury and hexavalent chromium must not exceed 100 ppm when tested by X-ray diffraction, ICP, or comparable method capable of this level of detection. Non-leachable lead-based pigments will not be permitted. Diarylide type pigments must only be used when the manufacture or pavement marking material application temperature does not exceed 392 F.
- iii. **COLOR:** Preformed markings must consist of film with pigments selected and blended to match Federal Standard 595 color chip Nos. 37925 and 38907 for white and yellow respectively.
- iv. **FRICTIONAL RESISTANCE:** The surface of the applied material must provide a minimum average skid resistance value of 50 BPN when tested in conformance with E 303.
- v. **PATCHABILITY:** The material must be capable of use for patching worn areas of the same type in conformance with manufacturer's recommendations.
- vi. **THICKNESS:** The minimum thickness, without adhesive, must be 120 mils.
- vii. **ADHESION:** The material must retain a minimum of 65 percent adhesive bond after 100 cycles of freeze-thaw when tested in conformance with C 666, Method B.
- viii. **BEADS**
  - 1. **INDEX OF REFRACTION:** All beads must meet the general requirements of M 247, Type I, and must have a refraction index of 1.50 to 1.52 when tested using the liquid oil immersion method specified in MSMT 211.
  - 2. **ACID RESISTANCE:** A maximum of 15 percent of the beads must show a formation of a distinct opaque white layer on the entire surface after exposure to a 1 percent solution (by weight) of sulfuric acid in conformance with MSMT 211.
  - 3. **APPLICATION:** Permanent preformed thermoplastic pavement markings must be applied to clean and dry hot mix asphalt or Portland Cement Concrete pavements using a propane fueled heat gun in conformance with the manufacturer's recommendations. The markings must be capable of being applied at a minimum pavement and ambient temperature of 32° F.
- ix. **RETRO-REFLECTANCE**

MINIMUM INITIAL REFLECTANCE

SPECIFICATION	WHITE	YELLOW
Entrance Angle, Degrees	88.76	88.76
Observation Angle, Degrees	1.05	1.05
Specific Luminance, mcd/lux/m <sup>2</sup>	350	250

**7.0 PERMANENT PREFORMED PAVEMENT MARKING MATERIAL**

This work must consist of furnishing and installing permanent preformed reflective pavement markings on pavement surfaces. These materials include line marking tape and preformed letters, numbers, arrows, and symbols. The materials must remain in place on the pavement surface without being displaced by traffic and shall not be affected by weather conditions. The material must be of good appearance and free from cracks. Edges must be true, straight and unbroken. Line marking material must be in rolls having no more than three splices per 150 ft of length. All marking materials must be packaged in conformance with accepted commercial standards and must have a minimum shelf life of one year. Permanent preformed pavement marking materials must conform to the requirements of the latest edition of the MdmUTCD and the following:

- 1. **COMPOSITION:** The marking material must consist of a mixture of polymeric materials, pigment and glass beads distributed uniformly throughout the surface. The material, without adhesive, must be a minimum of 60 mils thick.
- 2. **Color:** The color of the marking materials must match Federal Test Standard Number 595 for the following:
  - i. White - 37925

- ii. Yellow – 38907
- 3. TENSILE STRENGTH: The tensile strength of the material must 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 must 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 must show no signs of cracking or loss of surface dressing beads.
- 6. FRICTIONAL RESISTANCE: The British Pendulum Number must be a minimum of 45 when tested as specified in E 303. After exposure to 5000 revolutions in the Maryland Test Track at a speed of 6-1/2 RPM, the British Pendulum Number must be a minimum of 40.
- 7. WEARABILITY: Seventy-five percent of the reflective beads must remain in place after 5000 revolutions in the Maryland Test Track at a speed of 6-1/2 RPM.
- 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.
- 9. GLASS BEADS: Glass beads used for surface dressing must conform to the General Requirements of M 247 and have a refraction index of 1.50 to 1.52 when tested as specified in MSMT 211.
- 10. CERTIFICATION: Manufacturer's certified analysis in conformance with TC-1.02 must be submitted to the County. Conformity with the requirements will be determined by the County Engineer of the County.
- 11. FIELD TESTING: Line marking materials conforming to this Specification may be field tested over a 180-day period as specified in MSMT 724 for conformance with the following:
  - i. Ease of Application - satisfactory.
  - ii. Loss or Movement - minimum rating of 2.
  - iii. Performance Rating - minimum weighted rating of 4.

## 8.0 **PERMANENT PREFORMED PATTERNED REFLECTIVE PAVEMENT (PPRP) MARKING MATERIAL**

The material must be capable of adhering to hot mix asphalt 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 must be used to precondition the surface if recommended by the manufacturer. The markings must be capable of being inlaid in new hot mix asphalt surfaces during the paving operation.

The material must be highly durable and retro-reflective and must 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 must be of good appearance and free from cracks. Edges must be smooth, straight and unbroken. Line marking material must be in rolls having no more than three splices per 150 ft of length. All marking materials must be packaged in conformance with accepted commercial standards and shall have a minimum shelf life of one year. The material must remain in place on the pavement surface without being displaced by traffic and must not be affected by weather conditions. The material must meet the following chemical and physical requirements:

- COMPOSITION: The material must 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.
- RESTRICTIONS: The combined total of lead, cadmium, mercury and hexavalent chromium shall not exceed 100 ppm. Diarylde based pigments and non-leachable lead pigmentation are not acceptable. The presence of these compounds must be tested for compliance to the specification by X-ray diffraction, ICP, or another comparable method, capable of this level of detection.
- REFLECTANCE: The manufacturer must certify that the white and yellow materials will have the minimum initial retro-reflectance values of 350 mcd/L/m<sup>2</sup> for white and 250 mcd/L/m<sup>2</sup> 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).

- COLOR: The color of preformed markings must essentially match the 37925, 38907 or 37038 color chips for white, yellow or black respectively as shown in Federal Standard 595A.
- FRICTIONAL RESISTANCE: The surface of the retro-reflective pliant polymer must provide a minimum average skid resistance value of 50 BPN when tested according to ASTM E 303.

**8.1 CERTIFICATION:** The Contractor must furnish notarized certification as specified in TC-1.02. The manufacturer shall certify that any reflective thermoplastic materials supplied during the Contract conforms to the above specified specifications. Reflective thermoplastic materials which fail to conform will be rejected. The manufacturer must also provide the following:

- a. Material Safety Data Sheets for all materials submitted for testing and use.
- b. A facility, presently in operation, capable of producing the reflective thermoplastic materials in the quantity and quality required by the County.
- c. A laboratory subject to the County's approval which is capable of performing the required tests.

**9.0 REMOVABLE PREFORMED PAVEMENT MARKING TAPE**

Removable preformed pavement marking material must remain in place on the pavement surface without being displaced by traffic or affected by weather conditions. The material must be capable of being removed without the use of heat, solvents, grinding or sand blasting, and must not leave an objectionable residue. The material must be of good appearance and free from cracks. Edges must be true, straight and unbroken. Line marking material must be in rolls having no more than three splices per 150 ft of length. All marking materials must be packaged in conformance with accepted commercial standards and must have a minimum shelf life of one year.

When applied in conformance with the manufacturer's recommendations, the material must provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface or underlying markings remain stable. The material must be weather resistant and, through normal traffic wear, must show no lifting or shrinkage that will significantly impair the intended usage of the tape throughout its useful life, and must show no significant tearing while in place, or other signs of poor adhesion. The material must be capable of easy removal without tearing into small pieces. Finally, the material must conform to the requirements of the latest edition of the MdMUTCD.

A. YELLOW AND WHITE: The material must meet the following requirements:

- a. COMPOSITION: The marking material must consist of a mixture of polymeric materials, pigment and glass beads distributed uniformly throughout the surface.
- b. COLOR: The color of the marking materials shall match Federal Test Standard No. 595, latest edition for the following:  
 White - 37925  
 Yellow - 38907
- c. GLASS BEADS: Glass beads shall conform to the General Requirements of M 247 and have a refractive index of 1.50 to 1.52 when tested as specified in MSMT 211.
- d. FRICTIONAL RESISTANCE: The British Pendulum Number shall be a minimum of 45 when tested as specified in E 303.
- e. Field testing: Line marking materials conforming to the contract documents may be field tested over a 180-day period as specified in MSMT 723 for conformance with the following:
  - i. Ease of application – satisfactory
  - ii. Removability – a minimum rating of 2
  - iii. Residue remaining at time of removal (day & night) – minimum rating of 2
  - iv. Durability, appearance, and night visibility – minimum weighted rating of 4
  - v. Loss or movement – minimum rating of 2

B. BLACK: The non-reflective, patterned black line masking tape shall not contain materials, pigments and inorganic fillers distributed throughout its base cross-sectional area, with a matte black non-reflective surface. For patterned materials, a minimum of 20 percent of the surface area must be raised and coated with nonskid particles. The channels between the raised areas must be substantially free of particles. The film must be pre-coated with a pressure sensitive adhesive. A nonmetallic medium must be incorporated to facilitate removal. The material must meet the following requirements:

- i. **SKID RESISTANCE:** The surface of the patterned, nonreflective black line mask must provide a minimum skid resistance value of 45 British Pendulum Number when tested in conformance with E 303.
- ii. **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.
- iii. **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.
- iv. **REMOVABILITY:** The manufacturer must show that the black line tape 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 tape must remove cleanly from existing markings that are adequately adhered to the pavement surface.
- v. **PERFORMANCE REQUIREMENTS:** When applied in accordance with the of the manufacturer’s recommendations, the black line tape must provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface, or underlying markings remain stable. The black line tape must be weather resistant and, through normal traffic wear, must show no lifting or shrinkage which will significantly impair the intended usage of the tape throughout its useful life, and must show no significant tearing or other signs of poor adhesion.

**9.1** **CERTIFICATION:** Manufacturer's certified analysis in conformance with TC-1.02 must be submitted to the County Engineer of the County.

**10.0** **GREEN COLORED PAVEMENT SPECIFICATIONS**

**DESCRIPTION:** This work shall consist of the surface preparation and application of Ennis-Flint PreMark Preformed Thermoplastic pavement markings for high volume traffic areas and intersections, Ennis-Flint CycleGrip MMA pavement markings for low vehicle traffic areas such as driveway access points or bike lanes, or approved equals, as indicated in the contract or directed by the Engineer. Refer to separate attachment, “CycleGrip MMAX Specialized Bike Lane Treatment System Product Data”.

**10.1** **MATERIALS:**

**General:** As per the manufacturer’s specifications and as follows:

The coating material shall consist of a prepared colored aggregate material manufactured in part from recycled materials, which is broadcast over an epoxy binder. The coating shall simulate a green colored pavement and shall cause no loss of traction for bicyclists or pedestrians.

**Green Color:**

The daytime chromaticity coordinates for the color used for the completed green colored pavement coating shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.266	0.500	0.367	0.500	0.444	0.555

The daytime luminance factor (Y) shall be at least 20, but no more than 35.

The nighttime chromaticity coordinates for the color used for the completed green colored pavement coating shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.336	0.540	0.450	0.500	0.479	0.520



Green Aggregate: Furnish with the following gradations or in accordance with the manufacturer’s specifications as approved by the Engineer:

Sieve Size	Retained (%)
1.00 mm (No. 18)	< 10%
850 µm (No. 20)	17-37
600 µm (No. 30)	45-65
425 µm (No. 40)	14-25

**10.2 CONSTRUCTION:**

I. Surface Preparation: Pavement shall be cleaned and prepared to ensure proper, long-term adhesion, in conformance with manufacturer’s specifications and as follows:

- 1) Clean surface to remove all dust and debris prior to installation. Prior to installing the coating on any new asphalt pavements, allow a 30-day cure period of the new asphalt surface.
- 2) Remove existing pavement markings as indicated in the contract documents or directed by the Engineer.
- 3) Cover and protect all existing pavement markings (if left in place) and utility appurtenances prior to installation.

II. Application: Installation of the binder and aggregate coating system shall be in conformance with the manufacturer’s specifications and as follows:

- 1) Conditions for application: Do not apply the colored pavement coating if the pavement and ambient temperature is forecasted /measured to be/fall below 50°F for an extended period of time thus not providing adequate drying time. Wait 24 hours from the time of the last rain or wet conditions prior to installation.
- 2) Curing Time: ranges from 1 to 5 or more hours, dependent on the ambient temperature.
- 3) Manually spread the mixed components of the binder onto the prepared surface at an application rate specified by the manufacturer. Mechanically broadcast the colored aggregate at a continuous application rate 12 lbs per square yard and at a rate consistent with the manufacturer’s specifications. Apply aggregate until saturation. No exposed wet spots of the binder surface shall be visible after the application of the aggregate.
- 4) Once the coating obtains the initial set, excess aggregate must be removed. Do not permit the use of any equipment or vehicular traffic on the installed coating until after the manufacturer’s specified curing time.
- 5) Remain on site until after the coating is cured and opened to traffic.
- 6) Do not heat over the green coating for placement of preformed or hot- applied thermoplastic markings. To place pavement markings over coating, use only epoxy or waterborne pavement markings and legends. If preformed thermoplastic is placed adjacent to pavement coating, use heat shield to protect the surface and edges of the pavement coating and submit method of application to Engineer for approval prior to placement.

III. Defective Markings: Remove and replace any markings placed incorrectly. Repair those markings, which after application and drying, the Inspector-in-Charge determines to be defective. Complete this work at no additional cost to the County. The contractor is responsible for submitting to the Engineer the method of removal/restoration.

IV. Guarantee: Guarantee 90% of the pavement marking material against failure due premature wear or poor adhesion resulting from defective materials. The Engineer will identify material to be repaired or replaced. Begin all repair or replacement work within 30 days of notification by the Engineer and perform as specified in these specifications.

V. MEASUREMENT AND PAYMENT – Square foot

The measured area is the actual area of pavement that has received the combined application of epoxy binder and colored aggregate surface, measured in place. No deduction will be made for areas occupied by manholes, inlets, drainage structures, bollards or by any public utility appurtenances within the area. All surface preparation as specified herein and within the manufacturer’s specifications and related work is incidental.

**11.0 MMAX Red Colored Bus Lane Treatment**

MMAX Colored Bus Lane Treatment conveniently combines state-of-the-art methyl methacrylate resins with hardwearing aggregate and premium pigments to deliver an extremely durable, highly visible, and color-stable lane delineation treatment that meets the non-slip requirements.

Transit Lane Red colored MMAX colored lane treatment can be used to delineate bus lanes, no stopping areas, or other specialty applications where a durable area marking is required.

<b>Product Characteristics</b>	<b>Result</b>	<b>Test</b>
<b>Binder Resin</b>		
Density	12.52 +/- .35	Lbs./Gal
Tensile	> 400 psi	ASTM D638
Elongation	> 180%	ASTM D638
Flash Point	> 10°C	ASTM D1310
<b>Aggregate</b>		
Hardness	9	Mohs Scale
<b>Preferential Lane Treatment</b>		
Density	18.5+/- .5	LBS/Gal
Skid	>60	ASTM 303
Cure time	<30	Minutes

**12.0 WORK AREA TRAFFIC CONTROL REQUIREMENTS**

GENERAL: This section provides guidance for the safe and continuous maintenance of traffic through the project site while minimizing inconvenience to the traveling public and the Contractor. All work must be performed in accordance with Montgomery County Work Zone Traffic Control Standards, the latest Maryland State Highway Administration (MSHA) Specifications, and the latest edition of the MdMUTCD. Maintenance of Traffic will not be a separate pay item but will be considered as incidental to the implementation of this contract.

Montgomery County’s Work Zone Traffic Control Standards book must be readily available at the work site during all working hours. The pavement marking crew leader must be familiar with the Traffic Control Plan Typical’s and have received training on the implementation of the MdMUTCD. Any crew member who is assigned to “FLAG” traffic in the public right-of-way during the implementation of this contract must have an AATSA Approved Flagger card on his person when performing traffic flagging functions. Traffic must be maintained at all times throughout the entire length of the work area. Road closures will not be permitted. This TCP consists of typical traffic schemes (attached) which will be employed as required to perform the pavement marking installation work. All signs may be portable and any signs not applicable to the actual situations are to be removed or covered.

The channelizing devices must be either traffic drums or traffic cones. Channelizing devices used must be thirty-six inches (36”) in height with the predominate color being orange, in accordance with the latest edition of the MdMUTCD. Channelizing devices must be placed at intervals equal to the numerical value of the posted speed limit or 85<sup>th</sup> percentile speed in areas of lane transition. On tangent sections, the channelizing devices must be placed at intervals twice the above value. When it becomes necessary to close a lane of traffic, a trailer-mounted arrow panel containing amber lamps, which when activated must achieve a flashing arrow conveying to the traveling public in which direction movement must be made. This system must be of a type as described in Section 104 of the latest edition of the MSHA Specifications.

- 12.1 LONG LINE STRIPING TRAFFIC CONTROL:** The contractor must furnish and place without extra compensation all necessary warning and direction signs to maintain traffic and must provide such protection to the uncured markings as may be needed until traffic can cross them without damage or tracking. When necessary, a pilot car and flagmen must be used to provide adequate control and direction of traffic. Traffic must be allowed to keep moving at all times and the striping equipment must be operated in a manner that will not make it necessary for traffic to cross uncured markings. Protective devices such as "cones" must be of an approved type that will not cause damage to the vehicle when accidentally struck.
- 12.2 WORK RESTRICTIONS:** With the appropriate Traffic Control and appurtenances, the contractor will only be permitted to work between 9:00 a.m. - 3:00 p.m., unless permission is granted otherwise by the County Engineer. If permission is granted, there will be no work requiring the closure of lanes between the hours of 5:30 a.m. - 9:00 a.m., and 3:00 p.m. - 7:00 p.m. No work will be permitted on a Saturday, Sunday, national holidays, or days preceding said holidays without written permission of the County (Engineer). The County reserves the right to modify or expand on the methods of traffic control specified and to restrict working hours, if, in the opinion of the Engineer, the Contractor's operations are a detriment to traffic. Any construction materials or debris dropped on the roadway surface must be removed immediately to avoid possible hazardous conditions. No overnight storage of equipment or materials will be permitted within the right-of-way. All equipment and materials must be removed from the work site during non-working hours.
- 13.0 EXTENDED WARRANTY**  
In addition to the 90-day Thermoplastic Pavement Marking Observation Period required elsewhere in the contract, the Contractor must obtain from the material manufacturer and extend to the County the following extended warranty for all thermoplastic markings installed in this contract:
- a. At least 75% of the total of the crosswalk and stop line markings on any one intersection approach must remain to perform useful service for at least one year.
  - b. At least 75% of the total of the arrows, and other legends on any one intersection approach must remain to perform useful service for at least one year.
  - c. At least 75% of the total of the channelization markings on any one intersection approach must remain to perform useful service for at least one year.
  - d. At least 80% of a unit must remain to perform useful service for at least one year, and at least 60% of a unit must remain to perform useful service for at least two years. (A "unit" is defined as the total of all lane lines, edge lines, and center lines of the specified width, in any combination or pattern, on any one intersection approach).

For non-defective pavement surfaces carrying average annual daily traffic volumes less than 50,000 vehicles per day, the Contractor must guarantee to replace or renew, at no cost to the County, the part of the pavement markings which have not remained to provide useful service due to defective materials or method of application (in the opinion of the Engineer), in accordance with the above requirements. The Contractor must also warrant that the applied material will be impervious to degradation by motor oil, diesel fuel, and grease deposits. Replacement material installed under the guarantee shall be guaranteed the same as the original material, from the date of the original installation.

**14.0 METHOD OF MEASUREMENT**

Application of longitudinal and transverse pavement markings will be measured in linear feet, complete-in-place, for the width and thickness specified, rounded to the nearest foot. For broken and dotted lines, only the actual marked segments will be measured, and not the gaps. For double lines, each single line will be measured separately. Work and symbol pavement markings will be measured in units of each complete in place. Words and symbols for which there is not a separate line item in the schedule of prices will be measured in square feet, using a one-foot-square grid.

**End of Section D – Specifications and/or Scope of Work**