1084 - PATTERNED COLD PLASTIC PAVEMENT MARKINGS

1084.1 DESCRIPTION

The Contractor shall furnish and install white and yellow permanent retro-reflectorized pavement marking materials at the locations shown on the plans, in conformance with the details, and the material specifications included herein.

The permanent pavement markings shall be installed immediately after surface treatment unless prior approval is received by the Engineer or City Inspector. The installation of the yellow markings (as required) is the first priority. If the permanent markings cannot be installed and thus the roadway would be unmarked overnight, interim removable markings shall be installed and remain until the permanent markings can be installed. The contractor shall make every possible effort to remove the interim pavement markings and install permanent pavement markings within 48 hours. Only under extreme circumstances and at the approval of the pavement marking inspector or the engineer, will the duration of the interim pavement markings be extended. Under no circumstance should the interim pavement markings be in place for more than 2 weeks. The interim removable markings shall be removed prior to installation of the permanent markings. If permanent markings cannot be installed within the specified time then temporary markings shall be installed following the guide lines as set forth in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) Part VI, Sections 6F.78 and 6G.02.

1084.2 MATERIALS

This specification shall consist of furnishing and installing retroreflective preformed, patterned cold plastic pavement markings, which can be adhered to concrete pavements in accordance with this provision and in conformance to the dimensions and lines shown on the plans or established by the engineer. The applied markings shall be very durable, oil and grease impervious and provide immediate and continuing retroreflectivity. The material for permanent pavement markings shall be in accordance with this specification.

a. Approved Materials List

All material for permanent pavement marking material used by the Contractor shall be from the City's approved list of vendors. It is important that users be completely knowledgeable of all application requirements and procedures prior to product application. It is the responsibility of the installer to contact the supplier of all permanent pavement marking materials if questions regarding application procedures or conditions arise. Manufacturers interested in pre-qualifying material under this specification shall submit a sample of the material along with a complete materials specification for each color of marking material to be considered. The sample will be reviewed for compliance with all requirements of this specification. No material shall be used unless the material has been pre-qualified. A complete list of pre-qualified materials is maintained by the Traffic Engineering Division of the Department of Public Works.

b. Pavement Types

(1) Concrete Pavement or Polymer Bridge Overlays

On concrete pavements or polymer bridge overlays, pavement marking tape shall be used and installed in a groove.

(2) Chip Seal Surfaces

On chip seal wearing surfaces, the pavement markings shall not be inlaid.

c. Characteristics

(1) The markings shall consist of white or yellow films with clear and/or yellow-tinted microcrystalline ceramic beads incorporated to provide immediate and continuing retroreflection. These films shall be manufactured without the use of lead chromate pigments or other similar, lead-containing chemicals.

(2) Preformed words and symbols shall conform to the applicable shapes and sizes as outlined in the "Manual on Uniform Traffic Control Devices for Streets and Highways."

The markings shall be capable of being adhered to pavement by a pre-coated pressure sensitive adhesive and a surface preparation adhesive applied at the time of application to precondition the

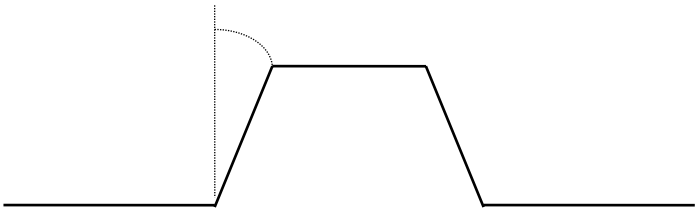
pavement. The contractor shall provide all equipment necessary for proper application, and recommendations for application that will assure effective product performance. The preformed markings shall conform to pavement contours by the action of traffic in accordance with the manufacturer's instructions. After application, the markings shall be immediately ready for traffic. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

d. Requirements

The markings shall be highly durable, retroreflective, pliant polymer materials. The material shall be designed for longitudinal, transverse, and symbol/legend markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment on typical longitudinal configurations such as edge lines and lane lines and typical transverse configurations such as stop bars and crosswalks. On concrete pavement, tape shall be installed in a groove

e. Composition

The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, and an embedded reinforcing net, and a reflective layer of microcrystalline ceramic beads bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately 50% + or - 15% of the surface area raised and presenting a near vertical face (ß angle of 0° to 60°) to traffic from any direction. (See diagram below.) The channels between the raised areas shall be substantially free of exposed beads or particles.



f. Color

The daytime color of the white film shall conform to highway colors as provided below for both daylight and nighttime conditions.

Daytime Color Requirements								
Color	1		2		3		4	
	x	y	X	y	X	y	x	y
White	.355	.355	.305	.305	.285	.325	.335	.375
Yellow	.560	.440	.490	.510	.420	.440	.460	.400

Nighttime Color Requirements								
Color	1		2		3		4	
	x	y	X	y	X	y	x	y
White	.480	.410	.430	.380	.405	.405	.455	.435
Yellow	.575	.425	.508	.415	.473	.453	.510	.490

g. Reflectance

The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be coefficient of retroreflected luminance (R_L) and shall be expressed as millicandelas per square meter per lux (mcd-m^{-2}-lux^{-1}) (millicandelas per square foot per foot-candle (mcd-ft^{-2}-fc^{-1})).

Minimum Initial Reflectance, Dry		
Color	White	Yellow

Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance RL (mcd-ft^{-2}-fc^{-1})	500	300

Minimum Initial Reflectance, Wet		
Color	White	Yellow
Entrance Angle	88.76º	88.76º
Observation Angle	1.05º	1.05º
Retroreflected Luminance RL (mcd-ft^{-2}-fc^{-1})	250	200

*These retroreflectance values are based on dark room photometric readings per ASTM D4061. Note: The test instrument shall use an Entrance Angle of 88.76° and Observation Angle of 1.05° which represent a simulated driver viewing geometry at a 30 meter distance.

h. Skid Resistance

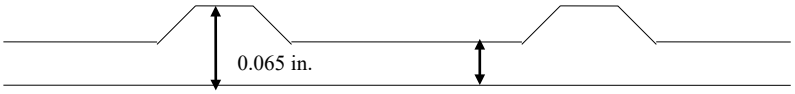
The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E303 except values shall be taken in one direction and then at a 45° angle from that direction. These two values shall then be averaged to find the skid resistance of the patterned surface.

i. Patchability

The pavement marking material shall be capable of use for patching worn areas of the same type in accordance with manufacturer's instructions.

j. Thickness

The patterned material without adhesive shall have a minimum caliper of 65 mil (0.065") at the thickest portion of the patterned cross-section and a minimum caliper of 20 mil (0.02") at the thinnest portion of the cross-section.



k. Bead Index of Refraction

All microcrystalline ceramic beads bonded to the polyurethane-coated, patterned surface of the material shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method. The glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.5 when tested by the liquid oil immersion method.

(1) Testing Procedure for Refractive Index of the Beads by Liquid Immersion

(a) Equipment Required

Microscope (minimum 100X magnification)

Light source - preferably sodium light or other monochromatic source

Refractive index liquids, available from R.P. Cargille Laboratories, Inc., Cedar Grove, NJ.

Microscope slide and slide cover

Mortar and pestle

(b) Procedure

Using the mortar and pestle, crush a few representative beads and place a few of these crushed particles on a microscope slide.

Place a drop of a refractive index liquid, with an index as close to that of the glass as can be estimated, on the particles.

Cover the slide with a microscope slide cover and view the crushed particles by transmitted light normal to the slide surface (illuminated from the bottom).

Adjust the microscope mirror to allow a minimum light intensity for viewing. This is particularly important if sodium light is not used.

Bring a relatively flat and transparent particle into focus.

By slightly raising and lowering the objective (microscope tube), look for one or both of the following:

- Becke Line - This light line will appear to move either into the particle or away from it. In general, if the objective is raised, the line will move toward the material of higher refractive index; if the objective is lowered, the line will move toward the material of lower index.
- Variation in Particle Brightness - When raising the object from a sharp focus, the particle will appear to get brighter or darker than the surrounding field. If it becomes brighter, the glass has a higher refractive index than the liquid. If it becomes darker, the glass has a lower refractive index than the liquid. In both cases, the opposite will be true if the object is lowered.
- This test can be used to confirm that the beads are above or below a specified index. It can also be used to give an accurate determination of the index (+ or - 0.001). This is done by using several refractive index liquids until a match or near match of indices occurs. The index of the glass will equal that of the liquid when no Becke line and no variation in bead brightness can be observed.

The size and quality of the beads shall be such that the performance requirements for the retroreflective pliant polymer shall be met.

(2) Acid Resistance

The beads shall show resistance to corrosion of their surface after exposure to a 1% solution (by weight) of sulfuric acid. The 1% acid solution shall be made by adding 5.7cc of concentrated acid into 1000cc of distilled water. CAUTION: Always add the concentrated acid into the water, not the reverse. The test shall be performed as follows:

Take a 1" x 2" sample, adhere it to the bottom of a glass tray and place just enough acid solution to completely immerse the sample. Cover the tray with a piece of glass to prevent evaporation and allow the sample to be exposed for 24 hours under these conditions. Then decant the acid solution (do not rinse, touch or otherwise disturb the bead surfaces) and dry the sample while adhered to the glass tray in a 150° F oven for approximately 15 minutes. Microscopic examination (20X) shall show no more than 15% of the beads having a formation of a very distinct opaque white (corroded) layer on their entire surface.

1084.3 CONSTRUCTION REQUIREMENTS

The proposed permanent markings shall be laid out by the contractor in advance of the marking installation. Markings shall not be applied until the layout and conditions of the surface have been approved by the City Inspector. If a paint line is used for layout purposes (in lieu of a chalk line or string line) the paint line shall not be wider than ½ inch) in width. If wider, the paint shall be removed following the application of the final permanent marking. New markings shall match existing markings as applicable in areas abutting existing road surfaces. The surface shall be dry and all dust, debris, oil, grease, dirt, temporary markings, existing markings, and other foreign matter shall be removed from the road surface prior to the application of the permanent marking material.

The Contractor shall be responsible for keeping traffic off freshly applied markings until they have set sufficiently to bear traffic. Traffic control is the responsibility of the Contractor and shall conform to the City of Overland Park Traffic Control Handbook. Failure to comply with traffic control guidelines will result in the Pavement Marking Contractor being directed to stop operations and leave the site until proper and approved traffic control has arrived and put in place on site.

a. General

The Contractor shall furnish and install white and yellow permanent retro-reflectorized preformed, patterned cold plastic pavement marking material, at the location shown on the plans, in conformance with the details and material specifications included herein

b. Procedure

The markings shall be applied in accordance with the manufacturer's installation instructions.

c. Road Surface Conditions

(1) Concrete Surfaces

Grooving the pavement surface of a concrete street is the preferred method of installation. All weather conditions for the specific pavement marking product must be met before application into the groove. For longitudinal markings, the typical groove width shall be two inches wider than the pavement marking with one inch on each side of the tape. Groove depths shall be a minimum of 80 mils and a maximum of 90 mils per manufacturer's recommendations. On polymer bridge deck overlays, the groove depth should be shallow, just sufficient to remove the sharp rock surface.

Transverse markings such as crosswalks and stop bars can be grooved into the pavement and recessed by making multiple side-by-side passes with grooving equipment typically used for lone line pavement markings. Cutting grooves with multiple passes should not result in a ridge between each pass. All ridges shall be ground off prior to placing the pavement marking in the recessed groove.

Legends and symbols shall be grooved and recessed by grooving a large square or rectangular shaped area that will fit the pavement marking. Wider cutting blades and more blades gang stacked on the saw auger should be used to reduce the number of ridges formed by multiple passes with the cutting head.

Groove equipment with a free-floating, independent head is recommended. The use of gang stacked cutting blades is strongly recommended for concrete pavement surfaces, especially for older surfaces that show visible signs of deterioration. Diamond cutting blades produce an optimal groove surface.

A single large diameter (12-18 inch saw blades) cutting head, with gang-stacked, 1/8-inch to ¼-inch wide carbide or diamond tipped cutting blades can also be used for grooving the concrete pavement in lieu of grooving equipment. Spacers shall be placed between the blades to provide a gap for the wider cutting head tips and to decrease the number of blades required for the cutting head. Wider spacing of the blades may result in a heavily "ribbed" or "ridged" pattern that is not recommended for pavement marking applications. Thinner spacers may be used between the blades to prevent an irregular raised pattern in the groove. This will result in a groove with a smoother surface. The height of the ridges shall be no greater than 15 mil above the base of the groove. Grinder-type cutting heads should only be used on newer concrete pavement surfaces in good repair. A slow moving shot blaster, grinder, or sand blaster shall be used to knock down any ridges and create a textured surface after cutting the initial groove with the saw blade cutting head. The textured surface should have an irregular pattern without a ribbed or corduroy pattern. Hydroblasting can also be used, but the groove shall be allowed to dry (24-hour minimum) prior to application of the pavement markings.

New concrete surfaces may contain more fine cement dust after cutting. This dust and any cement residue shall be removed and blown clean from the groove prior to application of the pavement marking. The groove shall be cleaned prior to the pavement marking application using an air compressor with at least 185 cfm air flow and 120 psi air pressure. There should be no more than 50 feet of ¾-inch (inner diameter) hose from the compressor to the air nozzle and the air nozzle shall be equipped with a moisture and oil trap. When cleaning the groove the air nozzle shall be no more than two feet from the ground. A street sweeper or pick-up broom may also be used, but shall require a pass with the air compressor to completely clean the bottom of the groove.

If cooling water is necessary during the grooving process or rainfall occurs during the grooving process, the groove shall be flushed immediately with a high pressure power washer to remove any build-up of cement dust/water slurry to prevent the slurry from hardening in the groove. Allow the groove to dry for a minimum of 24 hours after cleaning the groove, for removal of excess water prior to pavement marking application. The groove shall be clean and dry for proper application of the pavement marking.

If markings already exist on the roadway, remove markings from the surface by sandblasting, shotblasting, hydroblasting or grinding. At a minimum, 90 percent of the road surface under the existing markings must be exposed prior to tape application.

If existing markings have been removed, the road surface must be blown clean using an air compressor with at least 185 cubic feet per minute air flow and 90 psi air pressure. All road surfaces where tape will be applied should be swept with a broom and cleaned with a high pressure blower. The road surface must also be dry.

(2) Chip Seal Surfaces

The surface shall be clean, dry and free of loose material. The markings shall not be installed until after the second sweeping. All remaining loose material shall be cleaned off the area to be striped using an air compressor with at least 185 cfm air flow and 120 psi air pressure. There should be no more than 50 feet of ¾-inch (inner diameter) hose from the compressor to the air nozzle and the air nozzle shall be equipped with a moisture and oil trap. When cleaning, the air nozzle shall be no more than two feet from the ground. A street sweeper or pick-up broom may also be used, but shall require a pass with the air compressor to completely clean the bottom of the groove.

d. Adhesive Application

Surface Preparation Adhesive P-50 is required on all tape applications regardless of temperature, date or season. Read and become familiar with all health and safety information and directions for use regarding the P-50 preparation adhesive. Refer to manufacturer MSDS sheets.

Adhesive should be applied according to the following methods for transverse and longitudinal markings. Allow the P-50 adhesive to dry until it feels tacky but is no longer in liquid form and has a matte finish rather than a glossy wet appearance. P-50 adhesive dries quickly under most circumstances. Typical time for P-50 adhesive to dry is 2 to 3 minutes under optimal conditions of 70 degrees F and medium to low humidity levels. Coverage of the adhesive is approximately 450 lineal ft/gal spraying a 6 inch wide pattern.

(1) Transverse Markings

Evenly apply one coat of P-50 adhesive to the road surface using a solvent-resistant roller with a 3/8-inch nap roller. The coating on the pavement must extend at least 1-inch beyond the premarked area. Allow the adhesive to set to prevent the tape from sliding after application. If the adhesive is not allowed to set, it will not bond properly to the adhesive on the tape and adhesion failure will likely occur. The P-50 adhesive is set when it feels tacky but will not lift or string when touched with fingertips protected with gloves.

(2) Longitudinal Markings

Using a manufacturer approved spray applicator, apply a thin, uniform coat of P-50 adhesive to the pavement. The adhesive should extend at least 1-inch beyond the premarked area where the edges of the tape will be applied. The applicator shall be designed to spray a 6-wide pattern for application of 4-inch wide tape using a size 8004 spray tip nozzle. Adjust the arm of the applicator up or down so that the spray pattern is 6 inches wide. For tape wider than 4 inches, spray multiple passes, overlapping the previous pattern by 1/2-inch. Allow additional time for the overlapped areas to dry.

e. Tape Application

When splicing is required, use butt splices only. Do no overlap the material. If there is a crack in the pavement, or if the tape is to be applied over a bridge expansion joint, manhole or utility box, lay the tape over the crack joint or fitting, then cut the tape one inch away from the crack or joint on each side. Apply the required surface preparation adhesive and allow to dry completely (5-10 minutes at 70 degrees F), but not over 30 minutes. Apply material by hand for transverse markings and apply longitudinal markings using a manual highway tape applicator as approved by the manufacturer.

Traffic must be kept off of pavement surfaces coated with a surface preparation adhesive prior to tape application (follow manufacturer's instruction regarding the use of surface preparation adhesive).

f. Tamping

Tamp the tape thoroughly with a tamping cart with a minimum 200 pound load, three times back and forth (six passes) over each part of the tape. For transverse markings, start in the center of the marking and work out to the edges removing any trapped air. Do not twist or turn the tamper cart on the tape. Make six passes (three passes back and forth) over each part of the tape (tamping is very important). For longitudinal markings, the contractor may slowly drive over the tape three times with a vehicle. The

vehicle must be equipped with a pointing device to aid in keeping the vehicle on the tape, making three passes forward over the tape. Use a vehicle tire on long line markings only. Make sure all edges are firmly adhered.

g. Application Temperatures

The air temperature shall be 40 degrees F and rising with a surface temperature of 40 degrees F and rising. The overnight air temperature shall not have been below 40 degrees F the night before tape application.

h. Surface Moisture

The pavement surface must be clean and dry. Cold preformed plastic tapes will not adhere if moisture is present. No rainfall should occur within 24 hours prior to application. Should rainfall occur within 24 hours prior to application, a surface moisture test (plastic wrap or roofing paper method as approved by the inspector) must be performed and approval obtained from the inspector. The groove must be visibly dry for a minimum of two hours prior to application. A moisture test shall be completed after the two-hour drying time to ensure no presence of moisture.

1084.4 INSTALLATION PERFORMANCE MEASURES

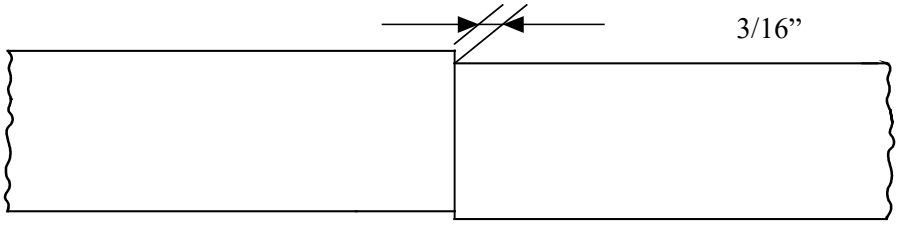
To ensure total understanding of what is expected in the application of any permanent pavement marking material on new pavement surfaces in the City of Overland Park, the following guidelines shall be followed. Applied material must be from an approved manufacturer, of proper dimensions and composition. Material must be applied per manufacturer's instructions. No substitutions of materials will be allowed without prior approval of the Engineer. Manufacturer-approved adhesive must be used and applied per instructions. No substitutions of materials will be allowed without prior approval of the Engineer.

The contractor is responsible for accurate layout and measurement. Applied material must adhere fully and completely to road surface, with straight edges and squared ends; lay smooth on surface with no warps, folds, creases, waves, bubbles or rips.

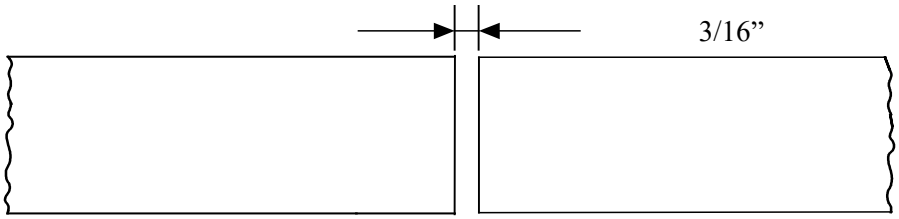
No overlap of materials. Ends or sides matched to existing markings must not exceed 1/8" in separation. Applied material to be in alignment with existing markings and of consistent size..

Lack of adhesion: The full unit price bid per foot shall be withheld for one foot for each occurrence if found more than three (3) times per 1 mile, or project if less than 1 mile in length.

Line Deviation: A line that in the judgment of the Engineer deviates from the specified layout by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.

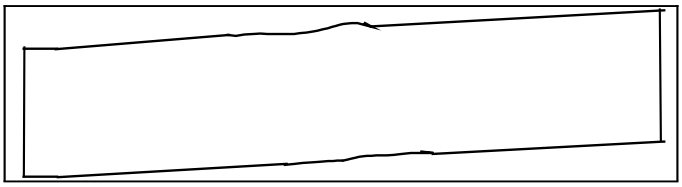


Gaps Between Successive Lines: Successively placed lines that contain gaps as specified by an unreasonable amount shall be replaced. The Contractor shall be responsible for removal of the deviated marking material/repair of the pavement as designated by, and to the satisfaction of, the Engineer at no additional compensation.



Inlaid Groove Quality: The full unit price bid per foot shall be withheld for the entire length of line that does not meet the requirements for depth of the inlaid material or for a groove that displays a coarse tooth pattern bottom that is not conducive to complete adhesion of the marking material. Penalty shall be imposed from the first occurrence.

Wavy or Misaligned Line: The full unit price bid per foot shall be withheld for the entire length of waviness caused by poor operation by the driver/operator of the grooving/installation equipment or for any misalignment in the material installed within the inlaid groove. Penalty shall be imposed from the first occurrence.



Work Outside the Scope/Limits of Project: Payment for all pavement marking work performed shall be withheld in full until the Contractor (a) removes all pavement marking material placed outside the scope/limits of the project, and (b) repairs the pavement surface as directed by and to the satisfaction of the Engineer and the local entity, if different from the Engineer.

Timeliness: All pre-formed patterned cold plastic material shall be completely installed within two (2) calendar weeks of the road surface material being laid. Failure to install markings on schedule shall result in liquidated damages of $1500 per day, separate from the project liquidated damages as stated elsewhere in the Contract Documents, until pavement markings are installed on schedule, or completion of the markings completes the project. These liquidated damages shall be imposed each time the Contractor fails to install pavement markings within the two-week window as described above.

1084.5 MEASUREMENT AND PAYMENT

a. Lump Sum

The Engineer will measure the pavement markings, as indicated on the plans, complete- in-place and accepted, as a unit lump sum quantity for all work necessary.

Payment for “Permanent Pavement Markings” at the contract lump sum price bid is full compensation for the specified work, which shall include all materials, labor, equipment and incidentals necessary to complete the work. The removal of existing pavement markings prior to installing new markings in the same location shall be considered subsidiary to the bid item “Permanent Pavement Markings”.

b. Unit Bid Prices

Measurement for ”Patterned Cold Plastic Pavement Markings” shall be as listed in the bid proposal, which includes all labor, materials, tools and equipment necessary to fully complete the installation according to the plans and specifications. No measurement will be made for the removal of existing pavement markings prior to installing new markings in the same location.

The Engineer will measure the various widths, type and color of pavement marking material along the marking centerline by the linear foot complete in place. Each line of double median approach

lines, double centerlines, solid and broken centerline or other parallel lines will be measured separately. Crosshatch lines, chevron lines, crosswalk lines, solid lane lines, stop lines and edge lines, etc. will be measured by the linear foot, measured along the centerline of all markings for each length of the various widths, type and color of material complete in place.

The Engineer will measure broken lines, composed of short line segments separated by a specified gap, by the linear foot of the various widths, type of material and color for the actual marked line only complete in place.

The Engineer will measure each symbol marking, consisting of left and right turn arrows, "ONLY" markings, handicap parking symbols, etc. Each isosceles triangle within a yield line will be measured separately. The "X" and "RR" symbols of a railroad crossing markings will be measured as one combined railroad crossing symbol. Parking space markings will be measured per each whether they consist of the full "+" symbols or "T" symbols used at the outer ends of an on-street parking section. No distinction will be made whether it is a full "+" or whether it is a "T". Bicycle lane symbol markings, comprised of a bicycle lane rider symbol and a bicycle lane arrow, will be measured per each for each bicycle lane rider symbol and per each for each bicycle lane arrow. Shared bicycle lane markings (sharrows), comprised of a bicycle lane rider symbol and two chevrons, will be measured per each for each bicycle lane rider symbol and per each for the pair of chevrons.

Payment for "Patterned Cold Plastic Pavement Markings" as listed in the proposal, at the contract unit price bid is full compensation for the specified work.

All traffic control necessary for installation of the Patterned Cold Plastic Pavement Markings shall be subsidiary to other bid items. The removal of existing pavement markings prior to installing new markings in the same location shall be considered subsidiary to other bid items.