

**DIVISION 12  
PAVEMENT MARKINGS, MARKERS AND DELINEATION**

**SECTION 1205  
PAVEMENT MARKING GENERAL REQUIREMENTS**

**1205-1 DESCRIPTION:**

Furnish, install and remove pavement markings in accordance with the plans and specifications.

**1205-2 MATERIALS.**

**(A) General:**

Refer to Division 10:

Pavement Markings.....Section 1087

**(B) Material Qualifications:**

Use pavement markings, which are on the North Carolina Department of Transportation's Approved Products List or are Traffic-qualified by the Traffic Control Section. For more information on the Traffic-qualification process, contact the Traffic Control Section at Century Center Building B, 1020 Birch Ridge Dr., Raleigh, N.C., 27610, (919)-250-4151, or see the approved product list on the NCDOT web site at: "[www.doh.dot.state.nc.us/preconstruct/traffic/congestion/TC/products.htm](http://www.doh.dot.state.nc.us/preconstruct/traffic/congestion/TC/products.htm)"

**(C) Historical Performance:**

Historical performance of the pavement marking material will be used in determining future use of the material by the NCDOT, even if the material has been traffic-qualified. Poor past or poor current performance of pavement marking materials at any site, whether or not related to a specific contract may be grounds for non-acceptance of a product on any project under contract.

**1205-3 CONSTRUCTION METHODS.**

**(A) Testing Procedures:**

All pavement marking materials and placement will be measured according to Materials and Test Unit Testing Procedure PM-1.0 as shown in the NCDOT Construction Manual.

**(B) Application Equipment:**

**(1) General for all Application Equipment:**

Use pavement marking application equipment such that all parts that come in contact with pavement marking material are constructed for easy accessibility during cleaning and maintenance.

Keep the marking guns of the application device in full view of the operators at all times. Use applicators which are mobile and maneuverable to the extent that straight lines can be followed and all standard curves can be made in true arcs.

**(2) Glass Bead Dispensing Equipment:**

Apply drop-on beads to the surface of pavement long line markings using an automatic high pressurized bead dispenser or a pressurized mechanical feed, attached to the marking equipment. Hand-liner type equipments are exempt from this requirement. Locate the bead applicator at the proper distance behind the application of pavement marking material to provide the proper amount of retroreflectivity. Equip the bead applicator with an automatic cut-off control synchronized with the cut-off of the

marking material. Spread the beads uniformly over the entire surface of the pavement marking material such that they are partially embedded in the pavement marking. 60% bead embedment depth provides optimum retroreflectivity.

**(3) Paint Application Equipment:**

The equipment to apply paint to pavements must be a truck-mounted pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified markings. The machine must be capable of applying the desired stripe widths with uniform thickness and clear-cut edges at the paint coverage rate specified in Subarticle 1205-3(G)(3). Equipment used for application of paint pavement marking must be capable of placing double solid lines, single solid lines, intermittent skip lines or a combination of solid and intermittent skip lines in a single pass. Equipment must also have an internal timing mechanism for measurement and controlled output of required line lengths.

The paint applicator must have at least two (2) paint tanks with a minimum sixty (60) gallon (227 liter) capacity each and one (1) tank for glass beads with a minimum of 500 lb. (226 Kg) Capacity. The pneumatic spray guns used for hand held paint pavement marking application should be operable from the application truck. All metal parts that hold or transfer paint pavement marking material should be stainless steel. The paint tanks must be equipped with air-driven or mechanical agitators. The tanks and the spray mechanism must also be equipped with quick-action valves. The required gauges and pressure regulators must be conveniently located and in full view and reach of the operator. Paint strainers are required in paint supply lines.

The paint applicator must be equipped with a dispenser for the glass beads as described in Subarticle 1205-3(B)(2). The glass bead dispenser should operate automatically and simultaneously with the paint applicator through the same control mechanism. The glass bead dispenser should be capable of adjustment and designed to provide uniform flow over the full length and width of the stripe at the rate of coverage specified in Subarticle 1205(G)(2).

Pneumatic spray guns must be provided for hand application of detail markings, symbols and legends. A hand-operated push type applicator with a glass bead dispenser may be used for radii and/or parking spaces.

**(4) Removable Tape Application Equipment:**

Mechanical application equipment, defined as a mobile pavement marking machine specifically designed for use in applying pressure-sensitive pavement marking tape of varying widths up to 12 inches (300 mm) must be used for the placement of preformed pavement marking tape. The applicator should be equipped with rollers to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Symbols and legends may be tamped by hand but must be rolled with a weighted roller as per the manufacturer recommendations. The pavement marking material must be tamped as required by the manufacturer to complete the removable tape application.

**(5) Thermoplastic Application Equipment:**

Use equipment to install hot thermoplastic pavement marking material which includes the following features:

Pre-melting Kettle: oil-jacketed, or air-jacketed; utilized for uniform melting and heating of the thermoplastic material. Use a kettle which is equipped with an automatic thermostat control device to provide positive temperature control and continuous mixing and agitation of the thermoplastic material. Do not premelt thermoplastic material in hand-liner type equipment.

Applicator Storage Kettle: Equip long line pavement marking vehicles with an automatic thermostat control device to maintain the thermoplastic material at the application temperature and provide continuous mixing and agitation of the thermoplastic material during installation. Construct the equipment so that all mixing and conveying parts, up to and including the application apparatus, maintains the thermoplastic pavement marking material at the specified installation temperature and which has a capacity of a minimum of 1500 lbs. (680 Kg) of molten thermoplastic pavement marking material. Hand transfer is not allowed.

“Hand-Liner” type application vehicles may contain the premelting and applicator storage functions in the same kettle. Agitation and mixing can be done manually. Drag box type and bucket type application is not allowed.

Use premelting and applicator storage kettles which meet the requirements of the National Board of Fire Underwriters, the National Fire Protection Association, and State and local authorities.

Use application equipment which is constructed to assure continuous uniformity in the thickness and width of the thermoplastic pavement marking.

Use application equipment which provides multiple width settings ranging from 4" (100 mm) to 12" (300 mm) and multiple thickness settings to achieve above the pavement thickness ranging from 0.090" (90mils) (2.3 mm) to 0.120" (120mils) (3.1 mm). Special thickness equipment may be required for in lane or shoulder transverse rumble strip pavement markings.

**(6) Epoxy Application Equipment:**

Use epoxy application equipment which is equipped with or capable of the following:

- Precisely metering the two components in the ratio of proportion recommended by the manufacturer,
- Producing the required amount of heat at the mixing head and gun tip,
- Maintaining temperatures within the tolerances recommended,
- Gauges for each proportioning pump so that any pressure difference can be easily monitored,
- A minimum 24" (610 mm) long static mixer unit for proper mixing of the two components of the epoxy marking material,
- Each component of the epoxy pavement marking must be in a homogeneous state prior to mixing,
- Have the capability to totally mix component A with component B immediately prior to the marking application,
- Have the capability to spray both yellow and white pavement marking material and have the equipment mounted on a truck of sufficient size and stability with an adequate power source to produce uniform lines of the specified dimension,
- A metering device to register the accumulated installed footage for each gun.

**(7) Cold Applied Plastic Application Equipment:**

Refer to Subarticle 1205-3(B)(4)

Do not tamp Cold Applied Plastic pavement markings with truck tires unless specifically recommended in writing by the manufacturer of the cold applied plastic pavement markings.

**(8) Heated In Place Thermoplastic Application Equipment:**

Apply Heated-In Place Thermoplastic Application Equipment using a propane blow torch and other material such as infra-red temperature gauge as recommended by the manufacturer.

**(9) Maintenance:**

See Construction Manual, Section 12, for details.

**(10) Compensation:**

There will be no direct payment for the items covered by this section.

Payment at the contract unit price for the various items in the contract will be full compensation for all items covered by this section.

**(C) Weather Limitations and Seasonal Limitations:**

Do not place pavement markings when moisture tests conducted on the pavement show signs of moisture presence on the pavement, or it is anticipated that damage-causing moisture may occur during the installation and drying periods. See Section 12 of the Construction Manual for details.

**(1) Paint:**

Apply paint only when the ambient air temperature and pavement surface temperature is a minimum of 40°F (5°C) and rising and a maximum of 160°F (71°C).

**(2) Removable Tape:**

Install removable tape pavement markings at ambient air temperature and pavement surface temperature per manufacturer specifications.

**(3) Thermoplastic:**

Do not apply thermoplastic pavement markings on existing or new pavements unless the ambient air temperature and the temperature of the pavement is 50°F (10° C) or higher.

Do not apply thermoplastic pavement markings between the dates specified below:

East of I-95	December 15 and the following March 16
East of I-77 to and including I-95	November 30 and the following April 1
West of and including I-77	November 15 and the following April 16

As an exception to the above, when traffic is to be maintained on a portion of roadway and thermoplastic pavement marking will not be placed within 30 calendar days due to seasonal limitations, place pavement marking paint and beads in accordance with subarticle 1205-3(G)(3) and payment will be made at the contract unit prices for the various items of work.

**(4) Epoxy:**

Apply epoxy pavement marking only when the ambient air temperature and the pavement surface temperature is a minimum of 35°F (2°C) and rising.

**(5) Cold Applied Plastic:**

Install cold applied plastic pavement marking at ambient air temperature and pavement surface temperature per manufacturer's specifications.

**(6) Heated In Place Thermoplastic:**

Apply Heated-In Place Thermoplastic only when ambient air temperature and pavement surface temperature is 32 °F (0°C) and rising.

**(D) Time Limitations for Placement and Replacement:**

For all interstate highways and access ramps, place all lane line and edge line markings by the end of each workday's operation. Place gore lines markings and symbols on these facilities within 3 days after they have been obliterated.

For all other divided and multi-lane facilities place all center line and lane line markings, railroad symbols, and school symbols by the end of each workday's operation. Place edge line markings and other symbols on these facilities within 3 days after they have been obliterated.

**A multi-lane facility is defined as any roadway having more than two lanes to include a two-lane / two-way roadway with a center two-way left turn lane.**

For all two-lane, two-way facilities, place all centerline markings, railroad and school symbols within 2 days after they have been obliterated by the operation. Place all edge line markings and other symbols on these facilities within 15 days after they have been obliterated by the operation.

**(E) Premarking:**

Premark each installation of pavement marking materials prior to application on new pavement and when required to replace pavement marking, except when existing markings are visible. Use premarking to guide in the placement of pavement markings. Get the premarking inspected and approved before placing the pavement marking materials.

Review and record the existing pavement markings prior to resurfacing and re-establish the new pavement markings using the record of existing markings in conjunction with the North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings, unless otherwise directed. In order to assure compliance with this specification, submit a pavement marking plan seven (7) calendar days before any pavement is placed.

**(F) Surface Preparation and Curing Compound Removal:**

Prepare the pavement to accept new pavement markings to insure maximum possible adhesion. Clean, seal and remove curing compound as necessary to insure that the markings adhere to the pavement. Obtain approval for all surface preparation methods prior to implementing.

Make sure that all pavements are free of grease, oil, mud, dust, dirt, grass, loose gravel and other deleterious material, prior to applying pavement markings.

Prepare the pavement surface, including removal of curing compound, a minimum of 2 inches (51 mm) wider than the pavement markings to be placed, such that, an additional 1 inch (25.4 mm) of prepared area is on all sides of the pavement markings after they are applied.

Remove all curing compound and surface laitance on portland cement concrete pavements where long-life pavement markings will be placed. Perform curing compound removal by high-pressure water, sand or shot blasting methods.

Apply a primer sealer to pavement surfaces before applying pavement marking material as recommended by the manufacturer. Apply primer sealer in a continuous film in such a way as to not cause any noticeable change in the appearance of the pavement markings. Submit a sample of the primer sealer to the Engineer, prior to application.

Conduct all pavement surface preparation including curing compound removal in such a manner that the pavement or joint material is not damaged or left in a condition that will mislead or misdirect the motorist. Repair any damage caused to the pavement, or joint materials caused by surface preparation or the removal of curing compound by acceptable methods and at no additional cost to the Department.

Where pavement surface preparation results in obscuring existing pavement markings of a lane occupied by traffic, remove immediately the residue, including dust by approved methods.

When surface preparation and curing compound removal operations are completed, blow the pavement surface clean by compressed air to remove residue or debris.

Curing compound removal will be paid for at the applicable contract unit price. All other surface preparation will be considered incidental to the work covered by this specification.

**(G) Application of Pavement Markings:**

**(1) General for all types of Pavement Markings:**

Install pavement marking material which has a uniform thickness, a smooth surfaced cross-section throughout its entire length, and which has widths and lengths not less than the dimensions specified in the plans and which do not exceed the dimension by more than 1/2 inch (12.7 mm).

Do not apply pavement marking materials over a longitudinal joint. See Roadway Standard Drawing No. 1205.01 sheet 2 of 2 for details.

Install pavement marking lines which are straight or of uniform curvature and conform with the tangents, curves, and transitions as specified in the plans.

Produce finished lines which have well defined edges and are free of horizontal fluctuations. Do not exceed 1/2 inch (12.7 mm) in lateral deviation from the proposed location alignment at any point. Any greater deviations may be cause for requiring the material to be removed and replaced at no additional cost.

Apply all longitudinal pavement marking lines 8 inches (203 mm) or less in width with one pass of the pavement marking equipment. Pavement marking lines greater than 8 inches (203 mm) in width and pavement marking symbols may be applied with multiple passes of the pavement marking equipment

The stem portion of straight arrows is to be applied in a single pass and the stem portion of turn arrows is to be applied in a maximum of 2 passes of the application equipment. Arrow heads may be applied by multiple passes of the application equipment, not to exceed three passes.

Install all pavement marking lines, characters, and symbols which require multiple passes of the application equipment such that there are no gaps separating the application passes.

Install characters and symbols so that they conform to the sizes and shapes shown in the plans.

Use pavement marking material which is capable of accepting an overlay of compatible material.

Protect the pavement markings until they are track free. Remove any markings tracked by a vehicle by acceptable methods and at no additional expense to the Department.

Reapply any molten pavement marking which is crossed by a vehicle.

Remove all pavement marking materials spilled on the road surface by acceptable methods.

Use yellow, white, and black pavement markings, without drop-on glass beads, that visually match the color chips that correspond to the Federal Test Standard Number 595a for the following colors. Use markings that when subjected

to accelerated weathering as described in U.S. Federal Specification No. (TT-P-115F) are within the tolerance limits of the color chips listed below:

WHITE:	Color 17886
YELLOW:	Color 13538
BLACK:	Color 37038

**(2) Glass Bead Application:**

Drop-On: Method where glass beads are dispensed by a pressurized mechanical feed or high pressure means onto the pavement marking as it is applied to the pavement. Drop-On bead dispensing for symbols and characters may be accomplished by gravitational methods such as hand scattering.

**(3) Paint Application:**

Apply paint with drop-on glass beads at the rate necessary to produce a minimum wet film thickness of 15 mils (.38 mm).

**(4) Removable Tape Application:**

Apply removable tape pavement marking per manufacturer's instructions.

**(5) Thermoplastic Application (Alkyd/Maleic):**

Use only thermoplastic markings which are of the hot, machine applied type. Apply Alkyd/Maleic thermoplastic pavement markings by extrusion methods only. Extrusion may be accomplished using either conventional extrusion equipment or "ribbon gun" extrusion devices.

Apply "Drop-on Beads" uniformly to the surface of the molten thermoplastic material so that the beads are partially embedded and at a rate to obtain immediately the minimum reflectance values. At the time of installation, produce in-place markings with the minimum reflectance values shown below, as obtained with a LTL 2000 Retroreflectometer. Maintain the retroreflectance values shown below for a minimum of 30 days from the time of placement of the marking material.

**White: 375 mcd/lux/m<sup>2</sup>**

**Yellow: 250 mcd/lux/m<sup>2</sup>**

Make sure that the marking is uniformly retroreflectorized upon cooling and has the ability to resist deformation caused by traffic throughout its entire length.

The Contractor, at his option, may place a thin layer of pavement marking paint at the proper width prior to applying the thermoplastic markings. If this option is chosen, when not specified in the plans or by the Engineer, direct payment for the paint will not be made. Cover any such thin layer of pavement marking paint with thermoplastic pavement marking within 30 calendar days of placement. Apply the thin layer of pavement marking paint and beads at the rate necessary to produce a dry film thickness of 5 - 8 mils (0.12 - 0.20 mm). Apply drop-on glass beads at a rate of 1-3 pounds (0.45 - 1.36 kg) per gallon (3.787 L) of paint.

Provide drainage openings at intervals of 250 feet (76 m) in edge lines placed on the inside of curves and in edge lines on the low side of tangents. Provide openings that are a maximum of 12 inches (304 mm) and a minimum of 6 inches (152 mm) in length.

Produce a crosssectional thickness of the thermoplastic markings above the surface of the pavement as follows:

240 mils (6.1 mm)- In lane and shoulder transverse pavement markings (rumble strips) may be placed in 2 passes.

120 mils (3.1 mm)-	center lines, skip lines, transverse bands, mini-skip lines, characters, and crosswalk lines.
90 mils (2.3 mm)-	edge lines, gore lines, diagonals, and arrow symbols.

## (6) Epoxy Application

Produce epoxy pavement marking lines which have a minimum dry thickness of 15 mils (0.38 mm) when placed on concrete pavements, and 20 mils (0.50 mm) when placed on asphalt pavements.

Use **Type I** epoxy material (fast dry) for epoxy pavement markings except when otherwise specified in the special provisions.

**Type II** epoxy material may be used with lane closures as approved by the Engineer to allow for curing time.

Do not place epoxy markings on fresh asphalt pavements until 15 days have elapsed after the last asphalt is placed.

Using the Epoxy application equipment, apply the pavement marking materials simultaneously. Hot-spray the Epoxy Resin, mixed in accordance with the manufacturer's recommendations, onto the pavement surface within an application temperature range recommended by the manufacturer. Inject retroreflective glass beads into the molten (liquid) Epoxy Marking.

**Individual Components:** Before mixing, heat the individual components to within the temperature range of 100°F (37°C) to 170°F (77°C). Do not exceed the upper limit of the manufacturer's recommended heating temperature at any time under any circumstances.

**Mixed Material:** After mixing, make sure that the application temperatures for the combined materials at the gun tip are within the temperature range recommended by the manufacturer for the particular product used.

Apply glass beads in the proper ratio to immediately produce a highly reflective marking. Apply "Drop-on Beads" uniformly to the surface of the epoxy pavement marking so that the beads are partially embedded and at a rate to obtain the minimum reflectance values. At the time of installation, produce in-place marking with the minimum reflectance values shown below, as obtained with LTL 2000 retroreflectometer. Maintain the retroreflectance values shown below for a minimum of 30 days from the time of placement of marking material.

**White: 375 mcd/lux/m<sup>2</sup>**

**Yellow: 250mcd/lux/m<sup>2</sup>**

Produce marking, which upon cooling, is uniformly reflectorized and has the ability to resist deformation caused by traffic throughout its entire length.

## (7) Cold Applied Plastic Application:

Apply Cold Applied Plastic pavement markings per manufacturers' specifications.

Use Cold Applied Plastic pavement markings which are 90 mils (2.3 mm) thick.

## (8) Heated In Place Thermoplastic Application:

Apply Heated-In Place Thermoplastic per manufacturer's specifications. The manufacturer must certify the Installer of Heated-In Place Thermoplastic. See the Construction Manual for details.

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The contractor may choose to use Heated-In Place Thermoplastic symbols, characters, and transverse lines in lieu of molten thermoplastics pavement markings at no additional cost to the Department.

Produce a cross-sectional thickness of the Heated-In Place thermoplastic markings above the surface of the pavement as follows:

- |                    |   |
|--------------------|---|
| 240 mils (6.1 mm)- | In lane and shoulder transverse pavement markings (rumble strips) may be placed in 2 passes   |
| 120 mils (3.5 mm)- | center lines, skip lines, transverse bands, mini-skip lines, characters, and crosswalk lines. |
| 90 mils (2.3 mm)-  | edge lines, gore lines, diagonals, and arrow symbols.   |

### **(H) Observation Period for Thermoplastic, Heated In Place Thermoplastic, Cold Applied Plastic, and Epoxy Pavement Markings :**

Thermoplastic and epoxy pavement markings are subject to a 180 day observation period.

Maintain responsibility for the pavement markings for a 180 day observation period beginning upon the satisfactory completion of all work required in the plans. Guarantee the markings under the payment and performance bond, refer to Article 109-10.

Have traffic operating on the facility during the entire 180 day observation period unless otherwise directed.

Provide pavement marking material which during the 180 day observation period, shows no signs of failure due to blistering, excessive cracking, chipping, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, spilling, poor adhesion to the pavement materials, loss of reflectivity, vehicular damage, and normal wear.

Replace, at no additional expense to the Department, any pavement markings that do not perform satisfactorily under traffic during the 180 day observation.

Provide thermoplastic and epoxy marking materials that maintain minimum retroreflectance values of **325 mcd/lux/m<sup>2</sup>** for white material and **200 mcd/lux/m<sup>2</sup>** for yellow material throughout the observation period. These measurements will be taken within 30 days prior to the end of the Observation Period. The reflectance values will be taken using a LTL 2000 retroreflectometer.

At the end of the Observation Period, the thermoplastic pavement marking material must be within 10 mils of the initial above the pavement thickness as required in the plan. Take the thickness measurements as specified by Materials and Tests Unit Procedure PM-1.0. See the Construction Manual for details.

### **(I) Removal of Pavement Markings:**

This work includes the removal of all types of pavement marking lines, symbols, and characters including removal for long life marking preparation. This work does not include removal of removable tape pavement markings.

Remove pavement marking lines, characters, and symbols by acceptable methods to the Engineer that will not materially or structurally damage the surface or the texture of the pavement. Leave the pavement surface in a condition that will not mislead or misdirect the motorist.

Where existing pavement markings are to be removed and replaced by other pavement markings, do not begin removal until adequate provisions have been made to complete the installation of the replacement markings. Remove pavement markings such that the surface is in proper condition for adequate bonding of the new markings.

Promptly remove any material deposited on the pavement as a result of removing pavement markings as the work progresses by acceptable methods. When these operations are completed, clean the pavement surfaces with broom or forced air to remove residue and debris.

Do not apply Epoxy pavement markings over existing pavement marking materials having less adherence than the Epoxy. Application over existing pavement marking materials other than epoxy will require the existing pavement marking material to be removed, so that a minimum of 85 percent of the existing pavement marking is removed. However, if pavement is less than 6 month old and one 15 mils (.38 mm) application of paint was placed on the pavement initially, do not remove the existing paint pavement markings.

Do not apply Thermoplastic pavement markings over existing pavement marking materials having less adherence than the Thermoplastic. Application over existing pavement marking materials other than thermoplastic will require the existing pavement marking material to be removed so that a minimum of 85 percent of the existing pavement marking surface is removed. Before applying thermoplastic pavement markings over the existing thermoplastic pavement markings, remove a minimum of 25 percent of the oxidized existing thermoplastic. However, if pavement is less than 6 month old and one 15 mil (.38 mm) application of paint was placed on the pavement initially, do not remove the existing paint pavement markings.

Use black color #37038 in paint or tape, as determined by Contractor, to cover any remaining conflicting pavement marking after removal from asphalt pavement surfaces. Do not use black paint or tape on concrete pavement surfaces. The black paint will not have a defined shape or edges with a width not exceeding double of the existing lines. No direct payment will be made for black paint or tape.

**(J) Pavement Marking Installer Qualifications:**

Have at least one member of every pavement marking crew working on a project certified as specialist or technician by the American Traffic Safety Services Association (ATSSA) Pavement Marking Division. Keep the certification current throughout the crew members work on the project. The certified crewmember is not required to be the same person throughout the life of the contract.

**1205-4 MAINTENANCE.**

Replace pavement markings which prematurely deteriorate, fail to adhere to the pavement, lack reflectorization, or are otherwise unsatisfactory, during the life of the project as determined by the engineer at no cost to the Department.

Upon notification from the Engineer, winterize the existing pavement markings on the project by placing an additional application of markings. The markings are to be suitable for use in winter periods whether in a temporary or final pattern. Payment will be made under the pay item for the type of marking placed.

**1205-5 METHOD OF MEASUREMENT:**

**(A) Pavement Marking Lines:**

The quantity of pavement marking lines to be paid for will be the actual number of linear feet (linear meters) of pavement marking lines which have been satisfactorily placed and accepted by the Engineer. The quantity of solid lines shall be the summation of the linear feet (linear meters) of solid line measured end-to-end of the line. The quantity of skip or broken lines will be the summation of the linear feet (linear meters) derived by multiplying the nominal length of a line by the number of marking lines satisfactorily placed.

**(B) Pavement Marking Symbols:**

The quantity of pavement marking symbols to be paid for will be the actual number of pavement marking symbols satisfactorily placed.

**(C) Pavement Marking Characters:**

The quantity of pavement marking characters to be paid for will be the actual number of pavement marking characters satisfactorily placed. A character is considered one letter or one number of a word message.

**(D) Curing Compound Removal, Lines:**

The quantity of curing compound removal, lines to be paid for will be the actual number of linear feet (linear meter) of pavement surface from which the curing compounds are satisfactorily removed. Measurement will be made along the surface of the pavement.

**(E) Curing Compound Removal, Symbols & Characters:**

The quantity of curing compound removal, symbols and characters to be paid for will be the actual number of symbols and characters for which the curing compound has been satisfactorily removed.

**(F) Removal of Pavement Marking Lines:**

The quantity of removal of pavement marking lines to be paid for will be the actual number of linear feet (linear meters) of pavement marking lines which have been satisfactorily removed and accepted by the Engineer. The quantity of solid lines will be the summation of the linear feet (linear meters) of solid line measured end-to-end of the line. The quantity of skip or broken lines will be the summation of the linear feet (linear meters) of lines derived by multiplying the nominal length of a line by the number of lines satisfactorily removed. No payment will be made for removal of removable pavement marking tape.

**(G) Removal of Pavement Marking, Symbols & Characters:**

The quantity of removal of pavement marking symbols and characters to be paid for will be the actual number of pavement marking symbols and characters which have been satisfactorily removed and accepted.

**1205-6 BASIS OF PAYMENT**

The quantity of pavement marking lines, measured as provided in Article 1205-5, will be paid for at the contract unit price per linear foot (linear meter) for "(Type) Pavement Marking Lines, (width)" and "Thermoplastic Pavement Marking Lines, \_\_\_ Inch (mm), \_\_\_ mils".

The quantity of pavement marking symbols, measured as provided in Article 1205-5, will be paid for at the contract unit price each for "(Type) Pavement Marking Symbols" and "Thermoplastic Pavement Marking Symbols, (\_\_\_ mils)".

The quantity of pavement marking characters, measures as provided in Article 1205-5, will be paid for at the contract unit price each for "(Type) Pavement Marking Characters" and "Thermoplastic Pavement Marking Characters, (\_\_\_ mils)".

The quantity of removal of pavement marking lines, measures as provided in Article 1205-5, will be paid for at the contract unit price per linear foot (linear meter) for "Removal of Pavement Marking Lines, (width)".

The quantity of removal of pavement marking symbols and characters, measured as provided in Article 1205-5, will be paid for at the contract unit price each for "Removal of Pavement Markings, Symbols and Characters".

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The quantity of curing compound removal (lines), measured as provided in Article 1205-5, will be paid for at the contract unit price per linear foot for "Curing Compound Removal, Lines".

The quantity of curing compound removal, symbols and characters, measures as provide in Article 1205-5, will be paid for at the contract unit price each for "Curing Compound Removal, Symbols and Characters".

Payment will be made under:

_____ Pavement Marking Lines, __" (mm).....	Linear Foot (Linear Meter)
Thermoplastic Pavement Marking Lines, __" (mm),__mils.....	Linear Foot (Linear Meter)
_____ Pavement Marking Symbols .....	Each
Thermoplastic Pavement Marking Symbols, (___ mils) .....	Each
_____ Pavement Marking Characters .....	Each
Thermoplastic Pavement Marking Characters, (___ mils) .....	Each
Removal of Pavement Marking Lines, __" (mm).....	Linear Foot (Linear Meter)
Removal of Pavement Marking, Symbols & Characters .....	Each
Curing Compound Removal, Lines .....	Linear Foot (Linear Meter)
Curing Compound Removal, Symbols & Characters .....	Each.

**SECTION 1250**

**GENERAL REQUIREMENTS FOR PAVEMENT MARKERS**

**1250-1 DESCRIPTION:**

Furnish and place pavement markers in accordance with the plans and specifications.

**1250-2 MATERIALS**

**(A) General:**

Refer to Division 10:

Pavement Markers.....Section 1086

**(B) Material Qualifications:**

Use pavement markers which are on the North Carolina Department of Transportation's Approved Products List or are Traffic-qualified by the Traffic Control Section. For more information on the Traffic-qualification process, contact the Traffic Control Section at Century Center Building B, 1020 Birch Ridge Dr., Raleigh, NC, 27610, (919) 250-4151, or see the approved product list on the NCDOT web site at:

["www.doh.dot.state.nc.us/preconstruct/traffic/congestion/TC/products.htm"](http://www.doh.dot.state.nc.us/preconstruct/traffic/congestion/TC/products.htm)

**(C) Historical Performance:**

Historical performance of the pavement markers will be used in determining future use of the pavement markers by the NCDOT, even if the pavement markers have been traffic-qualified. Poor past or poor current performance of pavement markers at any site, whether or not related to a specific contract may be grounds for non-acceptance of a product on any project under contract.

**1250-3 CONSTRUCTION METHODS.**

**(A) Weather Limitations:**

Do not install pavement markers or replacement reflectors if moisture tests performed on the pavement indicate the presence of moisture on the pavement surface or on the pavement marker. Install all pavement marker adhesives as required by the manufacturer's specifications for weather and temperature limitations.

**(B) Preparing for installation:**

Insure that the roadway pavement, pavement markers, and replacement lens are free of dirt, dust, oil, grease, moisture, curing compound, loose or unsound layers, or any other material which would interfere with proper bonding of the marker to the pavement or the lens to the marker. Use methods for this preparation as approved by the Engineer.

**(C) Removal of Existing Pavement Markers:**

Remove existing pavement markers prior to overlaying an existing roadway with pavement. Repair the pavement by filling holes as directed. When traffic patterns are changed, remove pavement markers that conflict with the new traffic pattern removed prior to switching traffic to the new traffic pattern.

The removed pavement markers become the property of the Contractor. No direct payment will be made for removal of existing pavement markers or repair of pavement, as such work will be considered incidental to other items in the contract.

**(D) Installation:**

**(1) General:**

Install all pavement markers and adhesives per manufacturer's specifications.

**(2) Color:**

Insure that the color of the reflector corresponds to the pavement marking that the marker supplements. Red reflectors may be required in combination with crystal or yellow reflectors to indicate wrong-way movement when viewed in the direction opposing the flow of traffic.

**(3) Appearance:**

Remove any adhesive from the reflective lens of the marker, otherwise, replace the reflector lenses of a snowplowable pavement marker or the entire raised pavement marker.

**(4) Spacing:**

Space pavement markers as shown in the plans. Position pavement marker lenses perpendicularly to the flow of traffic as shown in the NCDOT Roadway standard Drawings. Adjust marker longitudinal spacing up to 1 foot (0.3 m) in either direction and/or adjust marker lateral spacing up to 3 inches (76.2 mm) to avoid installation of the marker at a pavement construction joint or surface defect. If marker can not be relocated as described above, delete the affected marker.

**SECTION 1251  
TEMPORARY RAISED PAVEMENT MARKERS**

**1251-1 DESCRIPTION.**

Furnish, install, maintain and remove temporary raised pavement markers in accordance with the plans and specification.

**1251-2 MATERIALS.**

Apply the provisions of Article 1250-2 to the work covered by this section.

Refer to Division 10:

Temporary Raised Pavement Markers..... Article 1086-1

**1251-3 CONSTRUCTION METHODS.**

Apply the provisions of Article 1250-3 to the work covered by this section.

Install temporary raised pavement markers on the non-final pavement surfaces with either epoxy, pressure sensitive adhesives or hot bitumen adhesives.

On final pavement surfaces, install temporary raised pavement markers using a pressure sensitive adhesive or hot bitumen adhesives. When using a pressure sensitive adhesive, install a primer/sealer when required by the manufacturer's specifications.

**1251-4 MAINTENANCE.**

Be responsible for maintenance of temporary raised pavement. Replace all damaged or missing temporary raised pavement markers if any of the following occurs:

- Three segment failures occur in any roadway section. **Three consecutive damaged or missing markers in any group of seven represents a segment failure.**
- Twenty percent of total number of markers in any roadway section are damaged or missing.
- Engineer determines replacement is necessary.

Replace markers from the time of the initial installation up to 180 days at no cost to the Department. After 180 days, any marker replacement will be paid for as described under section 1251-6.

**1251-5 METHOD OF MEASUREMENT.**

The quantity of temporary pavement markers to be paid for will be the actual number of pavement markers which have been satisfactorily installed and accepted.

**1251-6 BASIS OF PAYMENT.**

The quantity of temporary raised pavement markers, measured as provided in Article 1251-5, will be paid for at the contract unit price each for "Temporary Raised Pavement Markers (color)".

Payment will be made under:

Temporary Raised Pavement Markers .....Each

**SECTION 1252  
PERMANENT RAISED PAVEMENT MARKERS**

**1252-1 DESCRIPTION.**

Furnish, install and maintain permanent raised pavement markers in accordance with the plans and specifications.

**1252-2 MATERIALS.**

Apply the provisions of Article 1250-2 to the work covered by this section.

Refer to Division 10:

Permanent Raised Pavement Markers..... Article 1086-2

**1252-3 CONSTRUCTION METHODS.**

Apply the provisions of Article 1250-3 to the work covered by this section.

Install permanent raised pavement markers using a hot bitumen adhesive in accordance with Article 1081-7.

**1252-4 MAINTENANCE.**

Be responsible for maintenance of the permanent pavement markers prior to acceptance.

**1252-5 METHOD OF MEASUREMENT.**

The quantity of permanent pavement markers to be paid for will be the actual number of pavement markers which have been satisfactorily installed and accepted.

**1252-6 BASIS OF PAYMENT.**

The quantity of permanent raised pavement markers, measured as provided in Article 1252-5, will be paid for at the contract unit price each for "Permanent Raised Pavement Markers (color)".

Payment will be made under:

Permanent Raised Pavement Markers.....Each

**SECTION 1253  
SNOWPLOWABLE PAVEMENT MARKERS**

**1253-1 DESCRIPTION.**

Furnish, install and maintain snowplowable pavement markers in accordance with the plans and specifications.

**1253-2 MATERIALS.**

Apply the provisions of Article 1250-2 to the work covered by this section.

Refer to Division 10:

Snowplowable Pavement Markers..... Article 1086-3

**1253-3 CONSTRUCTION METHODS.**

Apply the provisions of Article 1250-3 to the work covered by this section.

**(A) General:**

Bond marker castings to the pavement with epoxy adhesive. Mechanically mix and dispense epoxy adhesives as required by the manufacturer's specifications. Place the markers immediately after the adhesive has been mixed and dispensed.

Install snowplowable pavement marker castings into slots saw-cut into the pavement. Make slots saw-cut in the pavement to exactly duplicate the shape of the casting of the snowplowable pavement markers.

Promptly remove all debris resulting from the saw cutting operation from the pavement surface. Install the marker castings within 7 calendar days after saw cutting slots in the pavement. Brush or blow clean the slots of loose material and dry prior to applying the epoxy adhesive. Fill the cleaned slots totally with epoxy adhesive flush with the surface of the existing pavement. Hand place the keels of the pavement marker casting in to the slots in such a manner as to assure that the tips of the marker's snowplow deflecting surfaces are below the pavement surface. Make sure that the 4 lugs on the keels of the raised snowplowable pavement marker casting are in contact with the pavement surface.

Protect the snowplowable pavement markers until the epoxy has initially cured and is track free.

**(B) Reflector Replacement:**

In the event that a reflector is damaged, replace the damaged reflector by using adhesives and methods recommended by the manufacturer of the markers and approved by the Engineer. This work is considered incidental to the installation and maintenance of snowplowable markers specified in this section.

**(C) Recycled Snowplowable Pavement Marker Castings:**

Use properly refurbished snowplowable pavement marker castings as approved by the Engineer such that approved new reflectors can be installed inside the castings.

**1253-4 MAINTENANCE.**

Be responsible for maintenance of the snowplowable raised pavement markers prior to acceptance.

**1253-5 METHOD OF MEASUREMENT.**

The quantity of snowplowable pavement markers to be paid for will be the actual number of pavement markers which have been satisfactorily installed and accepted by the Engineer.

**1253-6 BASIS OF PAYMENT.**

The quantity of snowplowable pavement markers, measured as provided in Article 1253-5, will be paid for at the contract unit price each for "Snowplowable Pavement Markers (color)".

Payment will be made under:

Snowplowable Pavement Markers .....Each

**SECTION 1264  
OBJECT MARKERS**

**1264-1 DESCRIPTION.**

Furnish and install object markers, U-channel posts, and fasteners; drill holes in paved areas for U-channel posts; and furnish and place joint sealer around the U-channel post in paved areas.

**1264-2 MATERIALS.**

Refer to Division 10:

Object markers ..... Article 1088-5  
U-channel posts ..... Subarticle 1094-1(B) & (C)  
Joint Sealer ..... Article 1028-2

**1264-3 CONSTRUCTION METHODS.**

Type 1 object markers consist of nine yellow reflectors mounted in an 18 inch x 18 inch (457.2 mm X 457.2 mm) panel covered with yellow reflective sheeting; or an 18 inch X 18 inch (457.2 mm X 457.2 mm) panel covered with yellow reflective sheeting without reflectors. Type 1 object markers are used to mark obstructions within the roadway. Mount on sign supports to supplement a sign, or mount individually on 7' (2.1 m) U-channel posts, or mount on the actual obstruction.

Type 2 object markers consist of three yellow reflectors; or one 6 inch X 12 inch (152.4 mm X 304.8 mm) panel covered with yellow reflective sheeting. Type 2 object markers are used to mark obstructions that are not in the roadway. They are mounted on the back of sign supports located in the median of divided roadways, and the outside of two-lane, two-way roadways where the sign is facing the opposing traffic direction. Place Type 2 object markers on the side nearest the traffic approaching the back of the sign supports. If guardrail is used to protect the sign supports, or where two signs are mounted back to back, Type 2 object markers are not required.

Type 3 object markers consist of a 12 inch X 36 inch (304.8 mm X 457.2 mm) panel covered with alternating stripes sloping downward at an angle of 45 degrees. Type 3 object markers are used to mark larger obstructions within or outside the roadway, such as bridge piers, abutments and rails, culvert headwalls, or narrow shoulder drop-offs. Have

the stripes slope downward toward the side of the obstruction on which traffic is to pass. They may be required to be mounted on the actual obstruction or individually on 7' (2.1 m) U-channel posts.

End of Road object markers consist of nine red reflectors mounted on an 18 inch X 18inch (457.2 mm X 457.2 mm) panel covered with red reflective sheeting; or an 18 inch X 18 inch (457.2 mm X 457.2 mm) panel covered with red reflective sheeting without reflectors. Mount "End of Road" object markers on 7'(2.1 m) U-channel posts at the end of a roadway where there is no alternate vehicular path.

Mount all object markers using the proper fasteners. When required, use 7' (2.1 m) U-channel posts for supports for Type 1, Type 3 and End of Road object markers. Type 2 object markers may be secured to sign supports with epoxy adhesive or other acceptable methods.

**1264-4 METHOD OF MEASUREMENT.**

The quantity of object markers to be paid for will be the actual number of object markers which have been satisfactorily installed and accepted.

The quantity of 7' (2.1 m) U-channel posts to be paid for will be the actual number of 7' (2.1 m) U-channel posts which have been satisfactorily installed and accepted.

**1264-5 BASIS OF PAYMENT.**

The quantity of object markers, measured as provided in Article 1264-4, will be paid for at the contract unit price each for "Object Markers (Type \_\_)."

The quantity of 7' (2.1 m) U-channel posts, measured as provided in Article 1264-4, will be paid for at the contract unit price each for "7' (2.1 m) U-channel Posts."

Payment will be made under:

Object Markers (Type 1) .....	Each
Object Markers (Type 2) .....	Each
Object Markers (Type 3) .....	Each
Object Markers (End of Road) .....	Each
7' (2.1 m) U-Channel Post .....	Each

**SECTION 1265  
DRUM-TYPE DELINEATORS**

**1265-1 DESCRIPTION.**

Furnish and install drum-type delineators in accordance with the plans and specifications.

**1265-2 MATERIALS.**

Refer to Division 10:

Drum-type delineators.....Article 1088-6.

**1265-3 CONSTRUCTION METHODS.**

Apply the provisions of Article 1105-3 to the work covered by this section. Install orange and white drum-type delineators as shown in the plans. Install drum-type delineators securely and perpendicular to the top of the temporary concrete barrier. Do not cause damage to the reflective sheeting by stacking and unstacking the drum-type delineators.

Ballast the Drum-Type Delineators, through the top, by filling both legs completely with sand to a level of 1 inch (25.4 mm) above the leg openings or by other approved methods. Do not place ballast on top of the Drum-Type Delineators. Do not exceed a filled weight of 35 pounds (15.9 kg) for the drum-Type delineator.

**1265-4 MAINTENANCE.**

Apply the provisions of Article 1105-4 to the work covered by this section.

**1265-5 METHOD OF MEASUREMENT.**

The quantity of drum-type delineators to be paid for will be the actual number of drum-type delineators which have been satisfactorily installed and accepted.

**1265-6 BASIS OF PAYMENT**

The quantity of object markers, measured as provided in Article 1265-5, will be paid for at the contract unit price each for "Drum-Type Delineators".

Payment will be made under:

Drum-Type Delineators .....Each

**SECTION 1266  
TUBULAR MARKERS (FIXED)**

**1266-1 DESCRIPTION.**

Furnish, install, relocate, maintain and remove tubular markers in accordance with the plans.

**1266-2 MATERIALS.**

Refer to Division 10

Tubular Markers..... Article 1088-7

**1266-3 CONSTRUCTION METHODS.**

Refer to Article 1105-3.

Secure tubular markers to the pavement surfaces using epoxy or other approved types of adhesives.

Use orange tubular markers with white and crystal retroreflective sheeting on top of asphalt islands as shown in the plans.

Use orange tubular markers affixed to pavement surfaces with white and crystal retroreflective sheeting to separate opposing traffic placed on one side of a 4 lane divided highway.

Use tubular markers affixed to pavement surfaces as a supplement to pavement markings to channelize traffic. Use tubular marker such that the color of the tubular marker and retroreflective sheeting would match the color of the pavement markings they supplement. Gray tubular markers may be used to supplement white pavement markings.

**1266-4 MAINTENANCE.**

Refer to Article 1105-4.

Inspect and replace any worn out tubular markers at no cost to the Department.

Inspect and replace all damaged or missing tubular markers if any of the following occurs (such replacement will be paid for under 1266-6):

- Three segment failures occur in any roadway section. **Two consecutive damaged or missing tubular markers in any group of seven represents a segment failure**
- Twenty percent of the total number of tubular markers in any roadway section are damaged or missing.
- Engineer determines replacement is necessary.

**1266-5 METHOD OF MEASUREMENT.**

The quantity of tubular markers (fixed) to be paid for will be the maximum number of tubular markers acceptably placed at any one time during the life of the project as required by the contract. Relocation of tubular markers as required by the contract will be considered as incidental to the measurement of the quantity of tubular markers.

**1266-6 BASIS OF PAYMENT.**

The quantity of tubular markers (fixed), measured as provided above, will be paid for at the contract unit price each for "Tubular Markers (Fixed)".

Payment will be made under:

Tubular Markers (Fixed) .....Each

**SECTION 1267  
FLEXIBLE DELINEATORS**

**1267-1 DESCRIPTION.**

Furnish and install flexible delineators in accordance with the plans.

Provide Flexible delineators which meet or exceed the current National Transportation Product Evaluation Program (NTPEP) evaluation criteria.

**1267-2 MATERIALS.**

Refer to division 10.

Flexible Delineators.....Article 1088-8

**1267-3 CONSTRUCTION METHODS.**

Use yellow, red, or crystal retroreflective sheeting as shown in the plans. Place the retroreflective sheeting on the front and back of the delineator post as required by the plans.

Install the delineator post so that the entire width of the retroreflective sheeting is visible to approaching traffic.

Install the delineator post so the top of the reflective sheeting is 48 inches (122 mm) above the near edge of roadway surface.

Install the delineator post and base support according to the manufacturer's specifications.

Install the flexible delineators plumb on all sides.

Provide a post such that both sides of the top of the post accepts, and holds securely, retroreflectorized sheeting. The color of the post must be gray.

Install the post such that the post length provides for adequate ground penetration for proper performance.

Attach the flexible delineator post to the base support using two (2) hex head bolts, flat washers, lock washers and deformed thread hex nuts. Tightened the bolts to a minimum 20 ft-lbs (2.77 kg-meters) torque.

Position delineators perpendicular to the centerline of the road. Use yellow delineators in median and on the left side of one-way ramps, loops, or other one-way facilities. Use crystal delineators on the right side of divided highways, ramps, loops and all other one-way or two-way facilities. In all cases, use delineators whose colored retroreflective sheeting supplements the color of the adjacent edgeline

Design the delineator post for a permanent installation to resist overturning, twisting, and displacement from wind and impact forces.

**1267-4 MAINTENANCE.**

Be responsible for maintenance of the flexible delineators prior to acceptance.

**1267-5 METHOD OF MEASUREMENT.**

The quantity of flexible delineators to be paid for will be the actual number of flexible delineators which have been satisfactorily installed and accepted by the Engineer.

**1267-6 BASIS OF PAYMENT.**

The quantity of flexible delineators, measured as provided above, will be paid for at the contract unit price each for "Flexible Delineators (color)".

Payment will be made under:

Flexible Delineators (color) .....Each

**NOTES:**

