

**NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH**

**STANDARD SPECIFICATIONS
FOR
ROADS AND STRUCTURES**



JANUARY 2018

FOREWORD

This publication has been prepared to provide a compilation of standard requirements used by the North Carolina Department of Transportation for construction contracts.

When this publication, entitled *Standard Specifications for Roads and Structures*, dated January 2018, is incorporated by reference into the Department's construction bid proposals or contracts; it is made a part of that document and shall be known as the *Standard Specifications*. The requirements stated herein may be revised or amended from time to time by Supplemental Specifications, by Standard Special Provisions which are unique to a select group of projects or by Project Special Provisions which are unique to the specific bid proposal or contract.

Working titles have a masculine gender, such as workman, workmen and foreman. Pronouns such as he, his, and him are used in the *Standard Specifications* for the sake of brevity and are intended to refer to persons of either sex or corporate entities.

Reference by title and date will be made to the governing provisions on plans and contract documents.

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For general questions about this publication, please contact the Contract Standards and Development Unit at specs@ncdot.gov or (919) 707-6900.

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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 contract.

1205-2 MATERIALS

(A) General

Refer to Division 10.

Item	Section
Pavement Markings	1087

(B) Material Qualifications

Use pavement marking materials that are on the NCDOT APL.

(C) Performance

Poor performance of pavement marking materials at any site, whether or not related to a specific contract may be grounds for nonacceptance of a product on any project under contract.

1205-3 CONSTRUCTION METHODS

Do not use handliners or any other non-truck mounted pavement marking machine to install pavement markings for long line applications of any one line longer than 1,000 feet.

Use heated in place thermoplastic with skid resistant media for bike lane symbols.

(A) Testing Procedures

All pavement marking materials and placement will be tested by the Department. Install pavement markings in order to meet the retroreflectivity requirements as measured by a Department approved 30 m mobile or handheld retroreflectometer.

(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 that 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 and Highly Reflective Media Dispensing Equipment

Apply glass beads and highly reflective media to the surface of pavement long line markings using an automatic high pressurized bead and media dispenser or a pressurized mechanical feed, attached to the marking equipment. Hand liner type equipment is exempt from this requirement. Locate the bead and media applicator at the proper distance behind the application of pavement marking material to provide the proper amount of retroreflectivity. Equip the bead and media applicator with an

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1 automatic cut-off control synchronized with the cut-off control of the marking
2 material.

3 Spread the beads and reflective media uniformly over the entire surface of the
4 pavement marking material such that they are partially embedded in the pavement
5 marking. A 60% bead and media embedment depth provides optimum
6 retroreflectivity.

7 (C) Weather Limitations and Seasonal Limitations for All Markings

8 Do not place pavement markings when moisture tests conducted on the pavement show
9 signs of moisture presence on the pavement or when it is anticipated that damage caused
10 by moisture may occur during the installation and drying periods.

11 (D) Time Limitations for Replacement

TABLE 1205-1 TIME LIMITATIONS FOR REPLACEMENT		
Facility Type	Marking Type	Replacement Deadline
Full-control-of-access multi-lane roadway (4 or more total lanes) and ramps, including Interstates	All markings	By the end of each workday's operation if the lane is opened to traffic
Multi-lane roadways (3 or more lanes) and ramps	Center Line, Lane Line, Railroad symbols, Stop bars, and school symbols	By the end of each workday's operation if the lane is opened to traffic (temporary paint with beads may be used)
	Edge Lines, gore lines and all other symbols	By the end of the 3rd calendar day after obliteration
Two-lane, two-way roadways	All centerline markings, railroad, Stop bars and school symbols	By the end of the 5th calendar day after obliteration
	Edge Lines and all other symbols	By the end of the 15th calendar day after obliteration

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

14 (E) Premarking/Interim/Temporary Markings

15 Premarking (or layout markings) are small paint spots used by striping contractors to
16 establish locations of pavement markings. Premark each installation of the final
17 pavement marking materials before application on new pavement and when required to
18 replace existing pavement marking, except when existing markings are visible. Get the
19 premarking inspected and approved by the Engineer before placing the pavement
20 marking materials.

21 Interim paint is a thin layer of pavement marking paint applied at the striping contractor's
22 option to maintain traffic, instead of durable pavement markings. Apply interim paint to
23 comply with time limitations for placement if final pavement markings cannot be placed.
24 Interim markings shall be no more than 1/4 inch less than the specified line width of the
25 existing markings.

26 Place temporary paint markings for detours, lane shifts, milled surfaces and lifts of
27 asphalt other than the final pavement surface.

1 Review and record the existing pavement markings before resurfacing and reestablish the
 2 new pavement markings using the record of existing markings in conjunction with the
 3 *Roadway Standard Drawings*, unless otherwise directed. Submit the record of the
 4 existing pavement markings 7 calendar days before the obliteration of any pavement
 5 markings.

6 (F) Surface Preparation and Curing Compound Removal

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

11 Pavements shall be free of grease, oil, mud, dust, dirt, grass, loose gravel, winter surface
 12 treatments and other deleterious material, before applying pavement markings.

13 Prepare the pavement surface, including removal of curing compound, at least 2 inches
 14 wider than the pavement markings to be placed, such that, an additional 1 inch of
 15 prepared area is on all sides of the pavement markings after they are applied.

16 Remove the groves caused by concrete grinders before installing the polyurea pavement
 17 marking.

18 Remove all curing compound and surface laitance on Portland cement concrete
 19 pavements where long-life pavement markings will be placed. Perform curing compound
 20 removal by high-pressure water blasting or grinding methods. Ensure that the surface is
 21 free of all residue, laitance and debris before applying the pavement marking. When
 22 surface preparation and curing compound removal operations are completed, blow the
 23 pavement surface clean by compressed air immediately before installing the pavement
 24 markings.

25 If required, apply a primer sealer to pavement surfaces before applying pavement
 26 marking material as recommended by the manufacturer. Apply primer sealer in
 27 a continuous film at least 2 inches wider than the pavement markings in such a way as
 28 not to cause any noticeable change in the appearance of the pavement markings.

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

34 Surface preparation and removal of bridge laitance shall be considered incidental to the
 35 installation of pavement marking with the exception of curing compound removal.

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

39 (G) Application of Pavement Markings

40 (1) General for all types of Pavement Markings

41 Install pavement marking material that has a uniform thickness, smooth surfaced
 42 cross section throughout its entire length, width and length not less than the
 43 dimensions specified in the plans and that does not exceed the dimension by more
 44 than 1/2 inch.

45 Do not apply pavement marking materials over a longitudinal joint. Mask all bridge
 46 joints for removal of surface laitance, existing markings and application of new
 47 markings as directed by the Engineer. This work will be incidental to the installation
 48 of the pavement markings.

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1 Install pavement marking lines that are straight or have uniform curvature and
2 conform to the tangents, curves and transitions as specified in the plans.

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

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

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

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

16 Protect the pavement markings until they are track free. Repair any markings
17 tracked by a vehicle by acceptable methods.

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

20 Use yellow, white and black pavement markings, without glass beads and reflective
21 media that visually match the color chips that correspond to the Federal Test
22 Standard No. 595a for the following colors. Use markings that when subjected to
23 accelerated weathering as described in U.S. Federal Specification No. TTP-1952F
24 are within the tolerance limits of the color chips listed below:

White: Color No. 17886

Yellow: Color No. 13538

Black: Color No. 37038

25 (2) Highly Reflective Media Application

26 "Drop-on" is the method where glass beads and highly reflective media are
27 dispensed by a pressurized mechanical feed or high pressure means onto the
28 pavement marking as it is applied to the pavement. Drop-on bead and media
29 dispensing for symbols stop bars and characters may be accomplished by
30 gravitational methods.

31 (H) Observation Period

32 Maintain responsibility for debonding and color of the pavement markings during
33 a 12 month observation period beginning upon final acceptance of the project as defined
34 under Article 105-17. Guarantee the markings under the payment and performance bond
35 in accordance with Article 105-17.

36 During the 12 month observation period, provide pavement marking material that shows
37 no signs of failure due to blistering, chipping, bleeding, discoloration, smearing or
38 spreading under heat or poor adhesion to the pavement materials. Pavement markings
39 that bonded during application and were approved, but debond due to snowplowing will
40 not be considered a failed marking. Replace, at no additional expense to the Department,
41 any pavement markings that do not perform satisfactorily under traffic during the
42 12 month observation period.

(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. Provide the equipment necessary to control dust and the accumulation of debris resulting from the removal process. The removal equipment shall provide dust control and the capture of the removed material shall be done using a separate vacuum equipped vehicle or other approved system. Perform the recovery process within the same operation as the removal. Do not let traffic use the lane where the removal is taking place until the recovery system is finished. Should the recovery system fail, cease removal operations until the recovery system is properly operating. The Contractor is responsible for all cleanup and proper disposal of all removed debris from the project site.

When using a grinding method for pavement marking removal, the equipment shall have multiple heads working in tandem or have a removal head with operator dialed controls to result in a planed surface and provide adequate preparation of the surface to accept the new marking material.

Do not use high pressure water blasting on asphalt.

Application of polyurea over existing pavement marking materials will require at least 95% of the existing pavement marking material to be removed; however, if one 15 mil application of paint was placed on asphalt pavement less than 6 months old, do not remove the existing paint pavement markings.

Thermoplastic may be installed over existing thermoplastic on asphalt. Application over existing pavement marking materials other than thermoplastic will require the existing pavement marking material to be removed so that at least 85% of the existing pavement marking surface is removed. Before applying thermoplastic pavement markings over the existing thermoplastic pavement markings, remove at least 25% of the oxidized existing thermoplastic. On newly installed failed thermoplastic that is to be removed and replaced, remove a minimum of 85% of the existing thermoplastic. However, if one 15 mil application of paint was placed on asphalt pavement less than 6 months old, 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.

(J) Pavement Marking Installer Qualifications

Ensure at least one member of every pavement marking crew is certified through the NCDOT Pavement Marking Technician Certification Process. Keep the certification current throughout the life of the project. A certified crewmember shall be present anytime this work is being performed. The certified crewmember is not required to be the same person throughout the life of the contract.

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1 **1205-4 THERMOPLASTIC (ALKYD/MALEIC)**

2 **(A) Application Equipment**

3 (1) General

4 Use application equipment constructed to assure continuous uniformity in the
5 thickness and width of the thermoplastic pavement marking. Use application
6 equipment that provides multiple width settings ranging from 4 inches to 12 inches
7 and multiple thickness settings to achieve the pavement marking thickness ranging
8 from 0.090 inch to 0.120 inch. Special thickness equipment may be required for in
9 lane or shoulder transverse rumble strip pavement markings.

10 Do not use spray thermoplastic unless approved by NCDOT's Signing and
11 Delineation Unit.

12 (2) Premelting Kettle

13 Use equipment to install hot thermoplastic pavement marking material that includes
14 an oil-jacketed or air-jacketed premelt kettle for uniform heating and melting of the
15 thermoplastic material. Use a kettle that is equipped with an automatic thermostat
16 control device to provide positive temperature control and continuous mixing and
17 agitation of the thermoplastic material. Do not premelt thermoplastic material in
18 handliner type equipment.

19 (3) Applicator Storage Kettle

20 Equip long line pavement marking vehicles with an automatic thermostat control
21 device to maintain the thermoplastic material at the application temperature and
22 provide continuous mixing and agitation of the thermoplastic material during
23 installation. Construct the equipment so that all mixing and conveying parts, up to
24 and including the application apparatus, maintains the thermoplastic pavement
25 marking material at the specified installation temperature and which has a capacity
26 of at least 1,500 lbs. of molten thermoplastic pavement marking material. Hand
27 transfer is not allowed.

28 Handliner type application vehicles may contain the premelting and applicator
29 storage functions in the same kettle. Agitation and mixing can be done manually.
30 Drag box type and bucket type application is not allowed.

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

34 **(B) Weather Limitations and Seasonal Limitations**

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

37 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

38 Exception to the above: When traffic is maintained on a portion of roadway and
39 thermoplastic pavement marking will not be placed within 30 calendar days due to
40 seasonal limitations, place pavement marking paint and beads in accordance with
41 Subarticle 1205-8(C).

1 (C) Application

2 Use only thermoplastic markings that are of the hot, machine applied type. Apply
 3 alkyd/maleic thermoplastic pavement markings by extrusion methods only. Extrusion
 4 may be accomplished using either conventional extrusion equipment or ribbon gun
 5 extrusion devices.

6 The stem portion of straight arrows shall be applied in a single pass and the stem portion
 7 of turn arrows is to be applied in no more than 2 passes of the application equipment.
 8 Arrowheads may be applied by multiple passes of the application equipment, not to
 9 exceed 3 passes.

10 Apply drop-on beads and/or highly reflective media uniformly to the surface of the
 11 molten thermoplastic material so the beads and highly reflective media are partially
 12 embedded and at a rate recommended by the manufacturer to obtain the minimum
 13 reflectance values. For highly reflective markings, a double drop system consisting of
 14 glass beads and highly reflective media is required. Produce in place markings with
 15 minimum retroreflective values shown in Table 1205-2, as obtained with a Department
 16 approved 30 m mobile or handheld retroreflectometer. Retroreflective measurements
 17 will be taken within 30 days after final placement of the pavement marking.

Item	Color	Reflectivity
Standard Glass Beads	White	375 mcd/lux/m ²
	Yellow	250 mcd/lux/m ²
Highly Reflective Media	White	800 mcd/lux/m ²
	Yellow	600 mcd/lux/m ²

18 Ensure that the marking is uniformly retroreflective upon cooling and has the ability to
 19 resist deformation caused by traffic throughout its entire length.

20 A thin layer of interim pavement marking paint at the proper width may be placed before
 21 installing the thermoplastic markings. If this option is chosen, when not specified in the
 22 plans or by the Engineer, direct payment for the paint will not be made. Cover any such
 23 thin layer of pavement marking paint with thermoplastic pavement marking within
 24 30 calendar days of placement. Apply the thin layer of pavement marking paint and
 25 beads at the rate necessary to produce a dry film thickness of 5 to 8 mils. Apply drop-on
 26 glass beads at a rate of 1 to 3 lbs/gal of paint.

27 Provide drainage openings at intervals of 250 feet in edge lines placed on the inside of
 28 curves and in edge lines on the low side of tangents. Provide openings that are no more
 29 than 12 inches and at least 6 inches in length.

30 Produce a cross-sectional thickness of the thermoplastic markings above the surface of
 31 the pavement in accordance with Table 1205-3.

Thickness	Location
240 mils	In-lane and shoulder-transverse pavement markings (rumble strips) may be placed in 2 passes.
120 mils	Center lines, skip lines, transverse bands, mini-skip lines, characters, bike lane symbols and crosswalk lines.
90 mils	Edge lines, gore lines, diagonals and arrow symbols.

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1 (D) Observation Period

2 In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for
3 minimum retroreflective values for a 30-day period beginning upon the Engineer's
4 acceptance of all markings on the project. Guarantee retroreflective values of the
5 markings during the 30-day period under the payment and performance bond in
6 accordance with Article 105-17.

7 1205-5 POLYUREA

8 (A) Weather Limitations and Seasonal Limitations

9 Do not apply polyurea pavement markings on existing or new pavements unless the
10 ambient air temperature and the temperature of the pavement is 40°F or higher.

11 Do not apply polyurea pavement marking between November 15 and the following
12 February 28 unless the surface is free from winter surface treatment applications.

13 (B) Application

14 Produce polyurea pavement marking lines that have a minimum dry thickness of 20 mils
15 when placed on concrete and asphalt pavements. Apply 30 mils on textured surfaces
16 such as OGFC.

17 Using the polyurea application equipment, apply the pavement marking materials
18 simultaneously. Apply the polyurea resin, mixed at the proper ratio according to the
19 manufacturer's recommendations, to the pavement surfaces within the proper application
20 temperatures as determined by the material manufacturer. Inject reflective glass beads
21 and highly reflective media into the molten (liquid) polyurea pavement markings. For
22 highly reflective markings, a double drop system consisting of glass beads and highly
23 reflective media is required.

24 Wait at least 15 days before applying polyurea on new asphalt. Place a thin layer of
25 pavement marking paint at the proper width before applying the polyurea markings
26 during the 15 day waiting period. Apply the thin layer of pavement marking paint and
27 beads at the rate necessary to produce a dry film thickness of 5 to 8 mils. Apply drop-on
28 beads at a rate of 1 to 3 lbs/gal of paint. Direct payment for the pavement marking paint
29 will not be made. Cover any such thin layer of paint with polyurea pavement marking
30 within 30 calendar days of placement. If paint is placed on concrete before applying
31 polyurea, remove 100% of the paint before installing polyurea. Payment for the paint and
32 removal shall be made under Article 1205-10.

33 Apply drop-on beads and/or highly reflective media uniformly to the surface of the
34 polyurea material so that the beads and reflective media are partially embedded and at a
35 rate recommended by the manufacturer to obtain the minimum reflectance values.
36 Produce in place markings with minimum retroreflective values shown in Table 1205-4,
37 as obtained with a Department approved 30 m mobile or handheld retroreflectometer.
38 Retroreflective measurements will be taken within 30 days after final placement of the
39 pavement marking.

40 Produce marking that, upon curing, is uniformly reflectorized and has the ability to resist
41 deformation caused by traffic throughout its entire length.

42 (C) Observation Period

43 In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for
44 minimum retroreflective values for a 30-day period beginning upon the Engineer's
45 acceptance of all markings on the project. Guarantee retroreflective values of the
46 markings during the 30-day period under the payment and performance bond in
47 accordance with Article 105-17.

**TABLE 1205-4
MINIMUM REFLECTOMETER REQUIREMENTS
FOR POLYUREA**

Item	Color	Reflectivity
Highly Reflective Media	White	800 mcd/lux/m ²
	Yellow	600 mcd/lux/m ²

1 **1205-6 COLD APPLIED PLASTIC**

2 **(A) Application Equipment**

3 Use mechanical application equipment, defined as a mobile pavement marking machine
4 specifically designed for use in applying pressure sensitive pavement marking tape of
5 varying widths up to 12 inches. Use an applicator equipped with rollers to provide initial
6 adhesion of the preformed, pressure sensitive marking tape with the pavement surface.
7 Symbols and legends may be tamped by hand but shall be rolled with a weighted roller as
8 per the manufacturer's recommendations. Tamp the cold applied plastic pavement
9 marking material with a 200 lb. weighted roller as per the manufacturer
10 recommendations.

11 Surface preparation adhesive may be required depending on the type of cold applied
12 plastic. Refer to the manufacturers' specifications before applying cold applied plastic.

13 Most overlay tape installations should be conducted at an ambient air temperature of
14 60°F and rising and a surface temperature of 70° F with an overnight temperature at
15 least 40°F the night before application. Check the manufacturer's specifications for
16 actual requirements. Install cold applied plastic pavement markings at ambient air
17 temperature and pavement surface temperature per manufacturer's specifications. Wait
18 at least 24 hours after a rain before applying cold applied plastic pavement marking.

19 Cold applied plastic pavement markings shall be between 15 to 90 mils thick.

20 **(B) Types of Cold Applied Plastic**

21 At the time of installation, cold applied plastic pavement markings shall meet
22 Table 1205-5.

**TABLE 1205-5
REFLECTOMETER REQUIREMENTS FOR COLD APPLIED PLASTIC TAPE**

Type	Color	Reflectivity
Type 1 - Permanent Standard Tape	White	400 mcd/lux/m ²
	Yellow	300 mcd/lux/m ²
Type 2 - Permanent High Performance Tape	White	500 mcd/lux/m ²
	Yellow	300 mcd/lux/m ²
Type 3 - Permanent Wet Reflective High Performance Tape (Wet)	White	250 mcd/lux/m ²
	Yellow	200 mcd/lux/m ²
Type 3 - Permanent Wet Reflective High Performance Tape (Dry)	White	500 mcd/lux/m ²
	Yellow	300 mcd/lux/m ²
Type 4 - Removable Tape	White	700 mcd/lux/m ²
	Yellow	400 mcd/lux/m ²

23 Type 1 is typically a 2 year life cycle permanent tape used on roadways with an ADT
24 of 5,000 or less.

25 Type 2 material may come as one piece with a black border with yellow or white in the
26 center. Type 2 is typically a 5 year permanent tape used on roadways with an ADT
27 greater than 5,000.

28 Type 3 wet reflective tape shall meet Table 1205-5 retroreflective values, both wet and
29 dry. The value measured under wet conditions shall be measured in accordance with

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1 ASTM E1710 when using a portable retroreflectometer and in accordance with
2 ASTM E2177.

3 **(C) Observation Period**

4 In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for
5 minimum retroreflective values for a 30-day period beginning upon the Engineer's
6 acceptance of all markings on the project. Guarantee retroreflective values of the
7 markings during the 30-day period under the payment and performance bond in
8 accordance with Article 105-17.

9 **1205-7 HEATED-IN-PLACE THERMOPLASTIC**

10 **(A) Application Equipment**

11 Apply heated-in-place thermoplastic using a propane blow torch and other material as
12 recommended by the manufacturer.

13 **(B) Weather Limitations**

14 Apply heated-in-place thermoplastic only when ambient air temperature and pavement
15 surface temperature is 40°F and rising.

16 **(C) Applications**

17 Apply heated-in-place thermoplastic on asphalt or concrete per manufacturer's
18 specifications. The manufacturer shall certify the installer of heated-in-place
19 thermoplastic.

20 Use a one part primer sealer when installing heated-in-place thermoplastic on concrete.

21 The Contractor may choose to use heated-in-place thermoplastic symbols, characters and
22 transverse lines instead of molten thermoplastics pavement markings.

23 Produce a cross sectional thickness of installed heated-in-place thermoplastic markings
24 above the surface of the pavement after installation and upon cooling in accordance with
25 Table 1205-3.

26 For initial minimum retroreflective value requirements, see Subarticle 1205-4(C).

27 **(D) Observation Period**

28 In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for
29 minimum retroreflective values for a 30-day period beginning upon the Engineer's
30 acceptance of all markings on the project. Guarantee retroreflective values of the
31 markings during the 30-day period under the payment and performance bond in
32 accordance with Article 105-17.

33 **1205-8 PAINT**

34 **(A) Application Equipment**

35 The equipment to apply paint to pavements shall be a truck mounted pneumatic or airless
36 spray machine with suitable arrangements of atomizing nozzles and controls to obtain the
37 specified markings. Paint pavement markings application equipment shall be capable of
38 placing double solid lines, single solid lines, intermittent skip lines or a combination of
39 solid and intermittent skip lines in a single pass. This equipment shall also have
40 an internal timing mechanism for measurement and controlled output of required line
41 lengths.

42 The paint applicator equipment shall have at least two paint tanks with a minimum 60 gal
43 capacity and one tank for glass beads with at least 500 lb. capacity. The spray guns used
44 for hand held paint pavement marking application shall be operable from the application
45 truck. All metal parts that hold or transfer paint pavement marking material shall be

1 stainless steel. The paint trucks shall be equipped with quick action valves. The required
 2 gauges and pressure regulators shall be conveniently located and in full view and reach of
 3 the operator. Paint strainers are required in paint supply lines.

4 The paint applicator shall be equipped with a dispenser for the glass beads as described in
 5 Subarticle 1205-3(B)(2). Provide a glass bead dispenser that operates automatically and
 6 simultaneously with the paint applicator through the same mechanism and that is capable
 7 of adjustment and designed to provide uniform flow over the full length and width of the
 8 stripe as specified in Subarticle 1205-3(G)(2).

9 Provide spray guns for hand application of detail markings, symbols and legends. A hand
 10 operated push type applicator with a glass bead dispenser may be used for radii and/or
 11 parking spaces.

12 **(B) Weather Limitations**

13 Apply paint only when the ambient air temperature and pavement surface temperatures
 14 are at least 40°F and rising and no more than 160°F.

15 **(C) Application**

16 Final pavement marking applications of paint shall be placed in 2 applications of 15 mils
 17 wet each. Apply the second application of paint upon sufficient drying time of the first.
 18 Each application of paint shall consist of drop-on beads applied at a rate to immediately
 19 obtain the minimum retroreflective values.

20 When paint is required by the Engineer or Traffic Control Plan for temporary pavement
 21 markings during temporary traffic patterns, apply one application of paint at 15 mils wet.
 22 If the temporary traffic pattern will last longer than 6 months, apply a second application
 23 of paint 6 months after the initial application. Additional applications of paint at 15 mils
 24 wet may be applied every 6 months as directed by the Engineer or Traffic Control Plan.

25 For each 15 mil application of paint, apply drop-on beads uniformly to the surface of the
 26 paint material at a rate to immediately obtain the minimum retroreflective values. At the
 27 time of installation, produce in-place markings with the minimum retroreflective values
 28 shown in Table 1205-6, as obtained with a Department approved 30 m mobile or
 29 handheld retroreflectometer. Maintain the retroreflective values shown in Table 1205-6
 30 for at least 30 days from the time of placement of the marking material.

TABLE 1205-6 REFLECTOMETER REQUIREMENTS FOR PAINT		
Item	Color	Reflectivity
Standard Glass Beads	White	225 mcd/lux/m ²
	Yellow	200 mcd/lux/m ²

31 Make sure that the marking is uniformly retroreflectorized upon drying.

32 **(D) Observation Period**

33 In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for
 34 minimum retroreflective values for a 30-day period beginning upon the Engineer's
 35 acceptance of all markings on the project. Guarantee retroreflective values of the
 36 markings during the 30-day period under the payment and performance bond in
 37 accordance with Article 105-17.

38 **1205-9 MAINTENANCE**

39 Replace pavement markings that prematurely deteriorate, fail to adhere to the pavement, lack
 40 reflectorization or are otherwise unsatisfactory during the life of the project or during the
 41 12 month observation period as determined by the Engineer.

Section 1205

1 Upon notification from the Engineer, winterize the project by placing an initial or additional
2 application of paint pavement marking lines in accordance with Article 1205-8.

3 **1205-10 MEASUREMENT AND PAYMENT**

4 _____ *Pavement Marking Lines* will be measured and paid as the actual number of linear feet
5 of pavement marking lines satisfactorily placed and accepted by the Engineer. In addition,
6 *Paint Pavement Marking Lines* will be paid per linear foot for each 15 mil application placed
7 in accordance with Subarticle 1205-8(C). The quantity of solid lines will be the summation of
8 the linear feet of solid line measured end-to-end of the line. The quantity of skip or broken
9 lines will be the summation of the linear feet derived by multiplying the nominal length of
10 a line by the number of marking lines satisfactorily placed.

11 _____ *Pavement Marking Symbols* will be measured and paid as the actual number of
12 pavement marking symbols satisfactorily placed and accepted by the Engineer. In addition,
13 *Paint Pavement Marking Symbols* will be paid for each 15 mil application placed in
14 accordance with Subarticle 1205-8(C).

15 _____ *Pavement Marking Characters* will be measured and paid as the actual number of
16 characters satisfactorily placed and accepted by the Engineer. A character is considered to be
17 one letter or one number of a word message. In addition, *Paint Pavement Marking*
18 *Characters* will be paid for each 15 mil application placed in accordance with Subarticle
19 1205-8(C).

20 *Removal of Pavement Marking Lines* will be measured and paid as the actual number of linear
21 feet of pavement marking lines satisfactorily removed and accepted by the Engineer. The
22 quantity of solid lines will be the summation of the linear feet of solid line measured end-to-
23 end of the line. The quantity of skip or broken lines will be the summation of the linear feet
24 derived by multiplying the nominal length of a line by the number of marking lines
25 satisfactorily removed. No payment will be made for the removal of removable pavement
26 marking tape.

27 *Removal of Pavement Marking Symbols & Characters* will be measured and paid as the actual
28 number of pavement marking symbols and characters satisfactorily removed and accepted by
29 the Engineer.

30 *Curing Compound Removal, Lines* will be measured and paid as the actual number of linear
31 feet of pavement surface from which the curing compounds are satisfactorily removed. All
32 other surface preparation will be incidental to the work covered by this section. Measurement
33 will be made along the surface of the pavement.

34 *Curing Compound Removal, Symbols & Characters* will be measured and paid as the actual
35 number of symbols and characters for which the curing compound has been satisfactorily
36 removed. All other surface preparation will be incidental to the work covered by this section.

37 Payment at the contract unit price for the various items in the contract will be full
38 compensation for all the items covered by this section. No direct payment will be made for:
39 the work involved in applying the lines, including surface preparation; reapplication of molten
40 pavement marking crossed by a vehicle; removal of all pavement marking materials spilled on
41 the roadway surface; and repair of markings tracked by a vehicle.

42 Premarking will be incidental to other items in the contract. Unless directed by the Engineer,
43 there will be no direct payment for interim paint. No direct payment will be made for black
44 paint or tape.

45 The 5 to 8 mils of paint installed before placing the polyurea will be incidental to the work of
46 this section.

47 The Contractor may choose to use heated-in-place thermoplastic symbols, characters and
48 transverse lines instead of molten thermoplastics pavement markings and cold applied plastic
49 at no additional cost to the Department.

Section 1250

1 Replacement of pavement markings that prematurely deteriorated, failed to adhere to the
2 pavement, lacked reflectorization or were otherwise unsatisfactory during the life of the
3 project or during the 12 month observation period as determined by the Engineer will be at no
4 cost to the Department.

5 Payment for Paint Pavement Marking Lines required to winterize the project will be made in
6 accordance with Article 1205-10 except that no payment will be made on resurfacing projects
7 where paving is completed more than 30 days before the written notification by the
8 Department that winterization is required.

9 Payment will be made under:

Pay Item	Pay Unit
Paint Pavement Marking Lines, __"	Linear Foot
Thermoplastic Pavement Marking Lines, __", __ mils	Linear Foot
Polyurea Pavement Marking Lines; __", __ mils	Linear Foot
Cold Applied Plastic Pavement Marking Lines, Type ____ (__")	Linear Foot
Heated-In-Place Thermoplastic Pavement Marking Lines, __", __ mils	Linear Foot
Paint Pavement Marking Symbols	Each
Thermoplastic Pavement Marking Symbols, __ mils:	Each
Cold Applied Plastic Pavement Marking Symbols, Type ____	Each
Heated-In-Place Thermoplastic Pavement Marking Symbols, __ mils	Each
Paint Pavement Marking Characters	Each
Thermoplastic Pavement Marking Characters, __ mils	Each
Cold Applied Plastic Pavement Marking Characters, Type ____	Each
Heated-In-Place Pavement Marking Characters __ mils	Each
Removal of Pavement Marking Lines, __"	Linear Foot
Removal of Pavement Marking Symbols & Characters	Each
Curing Compound Removal, Lines	Linear Foot
Curing Compound Removal, Symbols & Characters	Each

10

SECTION 1250

11

PAVEMENT MARKERS GENERAL REQUIREMENTS

12

1250-1 DESCRIPTION

13

Furnish and place pavement markers in accordance with the contract.

14

1250-2 MATERIALS

15

(A) General

16

Refer to Division 10.

Item

Pavement Markers

Section

1086

17

(B) Material Qualifications

18

Use pavement markers that are on the NCDOT APL.

Section 1250

1 (C) Historical Performance

2 Historical performance of the pavement markers will be used in determining future use of
3 the pavement markers by the Department, even if the pavement markers have been traffic
4 qualified. Poor performance of pavement markers at any site, whether or not related to
5 a specific contract may be grounds for nonacceptance of a product on any project under
6 contract.

7 1250-3 CONSTRUCTION METHODS

8 (A) Weather Limitations

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

13 (B) Preparing for installation

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

18 (C) Removal of Existing Pavement Markers

19 Remove the existing raised pavement markers or the snowplowable pavement markers
20 including the castings, before overlaying an existing roadway with pavement. Repair the
21 pavement by filling holes as directed by the Engineer.

22 When traffic patterns are changed in work zones due to construction or reconstruction,
23 remove all raised pavement markers or snowplowable markers including castings that
24 conflict with the new traffic pattern before switching traffic to the new traffic pattern.
25 Lens removal in lieu of total casting removal is not an acceptable practice for
26 snowplowable markers.

27 Properly dispose of the removed pavement markers. No direct payment will be made for
28 removal or disposal of existing pavement markers or repair of pavement, as such work
29 will be incidental to other items in the contract.

30 (D) Installation

31 (1) General

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

33 (2) Color

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

38 (3) Appearance

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

42 (4) Spacing

43 Space pavement markers as shown in the plans. Position pavement marker lenses
44 perpendicular to the flow of traffic as shown in the *Roadway Standard Drawings*.
45 Adjust marker longitudinal spacing up to 1 foot in either direction and/or adjust

marker lateral spacing up to 3 inches to avoid installation of the marker at a pavement construction joint or surface defect. If a marker cannot be relocated as described above, do not install the affected marker.

(E) Pavement Marker Installer Qualifications

Ensure at least one member of every pavement marker crew is certified through the NCDOT Pavement Marking Technician Certification Process. Keep the certification current throughout the life of the project. A certified crewmember shall be present anytime this work is being performed. The certified crewmember is not required to be the same person throughout the life of the contract.

**SECTION 1251
RAISED PAVEMENT MARKERS**

1251-1 DESCRIPTION

Furnish, install, maintain and remove temporary and permanent raised pavement markers in accordance with the contract.

1251-2 MATERIALS

Refer to Division 10.

Item	Section
Temporary Raised Pavement Markers	1086-1
Permanent Raised Pavement Markers	1086-2

Use pavement markers that are on the NCDOT APL.

1251-3 CONSTRUCTION METHODS

Install temporary raised pavement markers on the nonfinal pavement surfaces with epoxy, pressure sensitive adhesives or hot bitumen adhesives.

Install permanent raised pavement markers using a hot bitumen adhesive in accordance with Article 1081-3.

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

1251-4 MAINTENANCE

Maintain all installed temporary raised pavement markers. Replace all damaged or missing temporary raised pavement markers if any of the following occurs:

(A) Three segment failures occur in any roadway section. Three consecutive damaged or missing markers in any group of 7 represents a segment failure.

(B) Twenty percent of the markers in any roadway section are damaged or missing.

(C) Engineer determines replacement is necessary.

Maintain all installed permanent raised pavement markers until final acceptance of the project.

1251-5 MEASUREMENT AND PAYMENT

Temporary Raised Pavement Markers will be measured and paid as the actual number of temporary raised pavement markers satisfactorily placed and accepted by the Engineer.

Permanent Raised Pavement Markers will be measured and paid as the actual number of permanent raised pavement markers satisfactorily placed and accepted by the Engineer.

Payment will be made under:

Section 1253

Pay Item	Pay Unit
Temporary Raised Pavement Markers	Each
Permanent Raised Pavement Markers	Each

1 **SECTION 1253**
2 **SNOWPLOWABLE PAVEMENT MARKERS**

3 **1253-1 DESCRIPTION**

4 Furnish, install and maintain snowplowable pavement markers in accordance with the
5 contract.

6 **1253-2 MATERIALS.**

7 Refer to Division 10.

Item	Section
Snowplowable Pavement Markers	1086-3
Epoxy	1081

8 Use snowplowable pavement markers that are on the NCDOT APL.

9 **1253-3 CONSTRUCTION METHODS**

10 **(A) General**

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

14 Install snowplowable pavement marker castings into slots sawcut into the pavement.
15 Make slots in the pavement to exactly duplicate the shape of the casting of the
16 snowplowable pavement markers.

17 Promptly remove all debris resulting from the saw cutting operation from the pavement
18 surface. Install the marker castings within 7 calendar days after sawcutting slots in the
19 pavement. Remove and dispose of loose material from the slots by brushing, blow
20 cleaning or vacuuming. Dry the slots before applying the epoxy adhesive. Fill the
21 cleaned slots totally with epoxy adhesive flush with the surface of the existing pavement.
22 Install snowplowable pavement markers according to the manufacturer's
23 recommendations.

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

26 **(B) Reflector Replacement**

27 In the event that a reflector is damaged, replace the damaged reflector by using adhesives
28 and methods recommended by the manufacturer of the markers and approved by the
29 Engineer. This work is considered incidental if damage occurs during the initial
30 installation of the marker castings and maintenance of initial snowplowable markers
31 specified in this section. This work will be paid for under the pay item for the type of
32 reflector replacement if the damage occurred after the initial installation of the
33 snowplowable pavement marker.

34 Missing castings shall be replaced. Broken castings shall be removed and replaced. In
35 both cases the slot for the castings shall be properly prepared prior to installing the new
36 casting. Removal of broken castings and preparation of slots will be considered
37 incidental to the work of replacing castings.

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

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

4 **1253-4 MAINTENANCE**

5 Maintain all installed snowplowable raised pavement markers before acceptance.

6 **1253-5 MEASUREMENT AND PAYMENT**

7 *Snowplowable Pavement Markers* will be measured and paid as the actual number of
8 snowplowable pavement markers satisfactorily placed and accepted by the Engineer.

9 *Replace Snowplowable Pavement Marker Reflector* will be measured and paid for in units of
10 each that have been satisfactorily placed and accepted.

11 Payment will be made under:

Pay Item	Pay Unit
Snowplowable Pavement Marker	Each
Replace Snowplowable Pavement Marker Reflector	Each

12 **SECTION 1264**
13 **OBJECT MARKERS**

14 **1264-1 DESCRIPTION**

15 Furnish and install object markers in accordance with the contract.

16 **1264-2 MATERIALS**

17 Refer to Division 10.

Item	Section
Object markers	1088-4
U-channel posts	1094-1(B), 1094-1(C)
Joint Sealer	1028-2

18 Use object markers that are on the NCDOT APL.

19 **1264-3 CONSTRUCTION METHODS**

20 Use Type 1 object markers to mark obstructions within the roadway. Mount on sign supports
21 to supplement a sign, or mount individually on 7 foot U-channel posts, or mount on the actual
22 obstruction.

23 Use Type 2 object markers to mark obstructions that are not in the roadway. Mount
24 Type 2 object markers on the back of sign supports located in the median of divided
25 roadways, and the outside of two-lane, two-way roadways where the sign is facing the
26 opposing traffic direction. Place Type 2 object markers on the side nearest the traffic
27 approaching the back of the sign supports. If guardrail is used to protect the sign supports, or
28 where 2 signs are mounted back to back, Type 2 object markers are not required.

29 Use Type 3 object markers to mark larger obstructions within or outside the roadway, such as
30 bridge piers, abutments, rails, culvert headwalls or narrow shoulder drop-offs. Ensure the
31 stripes slope downward toward the side of the obstruction on which traffic is to pass. They
32 may be required to be mounted on the actual obstruction or individually on 7 foot U-channel
33 posts.

34 Mount end of road object markers on 7 foot U-channel posts at the end of a roadway where
35 there is no alternate vehicular path.

Section 1266

1 **1264-4 MEASUREMENT AND PAYMENT**

2 *Object Markers (Type ____)* will be measured and paid as the actual number of object
3 markers satisfactorily placed and accepted by the Engineer

4 *7' U-Channel Posts* will be measured and paid as the actual number of 7 foot U-channel posts
5 satisfactorily placed and accepted by the Engineer.

6 Payment will be made under:

Pay Item	Pay Unit
Object Markers (Type 1)	Each
Object Markers (Type 2)	Each
Object Markers (Type 3)	Each
Object Markers (End of Road)	Each
7' U-Channel Posts	Each

7 **SECTION 1266**
8 **TUBULAR MARKERS (FIXED)**

9 **1266-1 DESCRIPTION**

10 Furnish, install, relocate, maintain and remove tubular markers in accordance with the
11 contract.

12 **1266-2 MATERIALS**

13 Refer to Division 10.

Item	Section
Tubular Markers	1088-5

14 Use tubular markers that are on the NCDOT APL.

15 **1266-3 CONSTRUCTION METHODS**

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

18 Use tubular markers affixed to pavement surfaces as a supplement to pavement markings to
19 channelize traffic. Use tubular marker such that the color of the tubular marker and
20 retroreflective sheeting would match the color of the pavement markings they supplement,
21 except as noted below:

22 (A) Use yellow tubular markers with white and crystal retroreflective sheeting on top of
23 asphalt islands as shown in the plans.

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

27 (C) Gray tubular markers with white/crystal retroreflective sheeting may be used to
28 supplement white pavement markings.

29 **1266-4 MAINTENANCE**

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

31 Inspect and replace all damaged or missing tubular markers if any of the following occurs in
32 accordance with Article 1266-5:

33 (A) Three segment failures occur in any roadway section. Two consecutive damaged or
34 missing tubular markers in any group of 7 represents a segment failure

1 **(B)** Twenty percent of the total numbers of tubular markers in any roadway section are
 2 damaged or missing.

3 **(C)** Engineer determines replacement is necessary.

4 **1266-5 MEASUREMENT AND PAYMENT**

5 *Tubular Markers (Fixed)* will be measured and paid as the maximum number of tubular
 6 markers satisfactorily placed and accepted by the Engineer at any one time during the life of
 7 the project.

8 Payment will be made under:

Pay Item	Pay Unit
Tubular Markers (Fixed)	Each

9 **SECTION 1267**
 10 **FLEXIBLE DELINEATORS**

11 **1267-1 DESCRIPTION**

12 Furnish and install flexible delineators in accordance with the contract.

13 **1267-2 MATERIALS**

14 Refer to Division 10.

Item	Section
Flexible Delineators	1088-6

15 Use flexible delineators that are on the NCDOT APL.

16 **1267-3 CONSTRUCTION METHODS**

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

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

21 Install the delineator post so the top of the reflective sheeting is 48 inches above the near edge
 22 of roadway surface.

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

24 Install the flexible delineators plumb on all sides.

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

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

29 Attach the flexible delineator post to the base support using 2 hex head bolts, flat washers,
 30 lock washers and deformed thread hex nuts. Tighten the bolts to at least 20 foot-pound
 31 torque.

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

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

Section 1267

1 **1267-4 MAINTENANCE**

2 Maintain all installed flexible delineators before acceptance.

3 **1267-5 MEASUREMENT AND PAYMENT**

4 *Flexible Delineators (color)* will be measured and paid as the actual number of flexible
5 delineators satisfactorily installed and accepted by the Engineer.

6 Payment will be made under:

Pay Item

Flexible Delineator (Crystal)

Flexible Delineator (Yellow)

Flexible Delineator (Crystal and Red)

Flexible Delineator (Yellow and Red)

Pay Unit

Each

Each

Each

Each