

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 mobile or handheld retroreflectometer that is on the NCDOT APL.

(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) Reflective Media Dispensing Equipment

Apply 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 reflective media applicator at the proper distance behind the application of pavement marking material to provide the proper amount

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1 of retroreflectivity. Equip the reflective media applicator with an automatic cut-off
 2 control synchronized with the cut-off control of the marking material.

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

6 **(C) Weather Limitations and Seasonal Limitations for All Markings**

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

10 **(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

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

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 by the Engineer. Submit the
4 record of the existing pavement markings 7 calendar days before the obliteration of any
5 pavement markings.

6 (F) Surface Preparation and Curing Compound Removal

7 Prepare the pavement to accept pavement markings to ensure maximum possible
8 adhesion. Clean, seal and remove curing compound as necessary to ensure that the
9 markings adhere to the pavement. Obtain approval from the Engineer for all surface
10 preparation methods 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 grooves 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. If required by the Engineer,
17 repair any markings 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 reflective media that
21 visually match the color chips that correspond to the AMS-STD-595 for these colors.
22 Use markings that when subjected to accelerated weathering as described in U.S.
23 Federal Specification No. TTP-1952 are within the tolerance limits of the color chips
24 listed below:

White: Color No. 17886

Yellow: Color No. 13538

Black: Color No. 37038

25 (2) Reflective Media Application

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

30 (H) Observation Period

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

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

42 (I) Removal of Pavement Markings

43 This work includes the removal of all types of pavement marking lines, symbols and
44 characters including removal for long life marking preparation. This work does not

1 include removal of removable tape pavement markings.

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

6 Where existing pavement markings are to be removed and replaced by other pavement
7 markings, do not begin removal until adequate provisions have been made to complete
8 the installation of the replacement markings. Remove pavement markings such that the
9 surface is in proper condition for adequate bonding of the new markings.
10 Promptly remove any material deposited on the pavement as a result of
11 removing pavement markings as the work progresses by acceptable methods.
12 Provide the equipment necessary to control dust and the accumulation of debris resulting
13 from the removal process. The removal equipment shall provide dust control and the
14 capture of the removed material shall be done using a separate vacuum equipped vehicle
15 or other approved system. Perform the recovery process within the same operation as the
16 removal. Do not let traffic use the lane where the removal is taking place until the
17 recovery system is finished. Should the recovery system fail, cease removal operations
18 until the recovery system is properly operating. The Contractor is responsible for all
19 cleanup and proper disposal of all removed debris from the project site.

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

24 Do not use high pressure water blasting on asphalt.

25 Application of polyurea over existing pavement marking materials will require at least
26 95% of the existing pavement marking material to be removed; however, if one 15 mil
27 application of paint was placed on asphalt pavement less than 6 months old, do not
28 remove the existing paint pavement markings.

29 Thermoplastic may be installed over existing thermoplastic on asphalt. Application over
30 existing pavement marking materials other than thermoplastic will require the existing
31 pavement marking material to be removed so that at least 85% of the existing pavement
32 marking surface is removed. Before applying thermoplastic pavement markings over the
33 existing thermoplastic pavement markings, remove at least 25% of the oxidized existing
34 thermoplastic. On newly installed failed thermoplastic that is to be removed and replaced,
35 remove a minimum of 85% of the existing thermoplastic. However, if one 15 mil
36 application of paint was placed on asphalt pavement less than 6 months old, do not
37 remove the existing paint pavement markings.

38 Use black color #37038 in paint or tape, as determined by Contractor, to cover any
39 remaining conflicting pavement marking after removal from asphalt pavement surfaces.
40 Do not use black paint or tape on concrete pavement surfaces. The black paint will not
41 have a defined shape or edges with a width not exceeding double of the existing lines.

42 When traffic patterns are changed in work zones due to construction or reconstruction,
43 remove all conflicting pavement markings, symbols, and characters that conflict with the
44 new traffic pattern before switching traffic to the new traffic pattern. Unless behind
45 barrier, any pavement marking, symbol, or character not used for the new traffic pattern
46 which is within 6 feet of the new traffic pattern markings shall be considered conflicting.

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

48 Ensure at least one member of every pavement marking crew is certified through the
49 NCDOT Pavement Marking Technician Certification Process. Keep the certification
50 current throughout the life of the project. A certified crew member shall be present

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1 anytime this work is being performed. The certified crew member is not required to be
2 the same person throughout the life of the contract.

3 **1205-4 THERMOPLASTIC**

4 **(A) Application Equipment**

5 (1) General

6 Use application equipment constructed to assure continuous uniformity in the
7 thickness and width of the thermoplastic pavement marking. Use application
8 equipment that provides multiple width settings ranging from 4 inches to 12 inches
9 and multiple thickness settings to achieve the required thickness above the surface of
10 the pavement as shown in Table 1205-3 of the *Standard Specifications*. Special
11 thickness equipment may be required for in lane or shoulder transverse rumble strip
12 pavement markings.

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

15 (2) Premelting Kettle

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

22 (3) Applicator Storage Kettle

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

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

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

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

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

40 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

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

(C) Application

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

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

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

**TABLE 1205-2
MINIMUM REFLECTOMETER REQUIREMENTS
FOR THERMOPLASTIC**

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

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

A thin layer of interim pavement marking paint at the proper width may be placed before installing 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 to 8 mils. Apply reflective media at a rate per manufacturer's recommendation in order to obtain required retroreflectivity shown in Table 1205-6.

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

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

**TABLE 1205-3
THICKNESS REQUIREMENTS FOR THERMOPLASTIC**

Thickness	Location
240 mils	In-lane and shoulder-transverse pavement markings (rumble strips). These markings may be placed in 2 passes.
90 mils	Center lines, skip lines, transverse bands, mini-skip lines, characters, bike lane symbols, crosswalk lines, 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 Install polyurea pavement marking lines that have a minimum dry thickness of 30 mils.

15 Using the polyurea application equipment, apply the pavement marking materials
16 simultaneously. Apply the polyurea resin, mixed at the proper ratio according to the
17 manufacturer's recommendations, to the pavement surfaces within the proper application
18 temperatures as determined by the material manufacturer. Inject reflective media into the
19 molten (liquid) polyurea pavement markings. For double drop systems the two reflective
20 media shall be dropped separately.

21 Wait at least 15 days before applying polyurea on new asphalt. Place a thin layer of
22 pavement marking paint at the proper width before applying the polyurea markings
23 during the 15 day waiting period. Apply the thin layer of pavement marking paint and
24 beads at the rate necessary to produce a dry film thickness of 5 to 8 mils. Apply
25 reflective media at a rate per manufacturer's recommendation in order to obtain required
26 retroreflectivity shown in Table 1205-6. Direct payment for the pavement marking paint
27 will not be made. Cover any such thin layer of paint with polyurea pavement marking
28 within 30 calendar days of placement. If paint is placed on concrete before applying
29 polyurea, remove 100% of the paint before installing polyurea.

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

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

38 (C) Observation Period

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

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

Item	Color	Reflectivity
Reflective Media	White	375 mcd/lux/m ²
	Yellow	250 mcd/lux/m ²

1 The installer may choose to use an AASHTO Type 4/Type 1 or AASHTO Type 3/Type 1
2 double drop system, but no price adjustment will be made, and these systems will be
3 incidental to the polyurea pavement marking.

4 **1205-6 COLD APPLIED PLASTIC**

5 **(A) Application Equipment**

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

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

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

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

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

24 At the time of installation, cold applied plastic pavement markings shall meet
25 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

26 Type 3 wet reflective tape shall meet Table 1205-5 retroreflective values, both wet and
27 dry. The value measured under wet conditions shall be measured in accordance with
28 ASTM E1710 when using a portable retroreflectometer and in accordance with
29 ASTM E2177. If the Contractor elects to use Type 3, Type 3 will be paid for as Type 2.

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1 (C) 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 1205-7 HEATED-IN-PLACE THERMOPLASTIC

8 (A) Application Equipment

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

11 (B) Weather Limitations

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

14 (C) Applications

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

18 Install heated-in-place thermoplastic in lane route shields that are capable of adhering to
19 both asphalt and concrete pavements. Installation shall be in accordance with
20 manufacturer's specifications.

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

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

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

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

28 (D) Observation Period

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

34 1205-8 PAINT

35 (A) Application Equipment

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

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

1 truck. All metal parts that hold or transfer paint pavement marking material shall be
 2 stainless steel. The paint trucks shall be equipped with quick action valves. The required
 3 gauges and pressure regulators shall be conveniently located and in full view and reach of
 4 the operator. Paint strainers are required in paint supply lines.

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

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

13 **(B) Weather Limitations**

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

16 **(C) Application**

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

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

26 For each 15 mil application of paint, apply reflective media uniformly to the surface of
 27 the paint material at a rate to immediately obtain the minimum retroreflective values. At
 28 the time of installation, produce in-place markings with the minimum retroreflective
 29 values shown in Table 1205-6, as obtained with a Department approved 30 m mobile or
 30 handheld retroreflectometer. Maintain the retroreflective values shown in Table 1205-6
 31 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

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

33 **(D) Observation Period**

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

39 **1205-9 MAINTENANCE**

40 Replace pavement markings that prematurely deteriorate, fail to adhere to the pavement, lack
 41 reflectorization or are otherwise unsatisfactory during the life of the project or during the
 42 12 month observation period as determined by the Engineer.

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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 *In Lane Route Shields* will be measured and paid for in units of each that have been
21 satisfactorily placed and accepted by the Engineer.

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

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

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

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

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

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

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

- 1 The Contractor may choose to use heated-in-place thermoplastic symbols, characters and
- 2 transverse lines instead of molten thermoplastics pavement markings and cold applied plastic
- 3 at no additional cost to the Department.
- 4 Replacement of pavement markings that prematurely deteriorated, failed to adhere to the
- 5 pavement, lacked reflectorization or were otherwise unsatisfactory during the life of the
- 6 project or during the 12 month observation period as determined by the Engineer will be at no
- 7 cost to the Department.
- 8 Payment for *Paint Pavement Marking Lines* required to winterize the project will be made in
- 9 accordance with Article 1205-10 except that no payment will be made on resurfacing projects
- 10 where paving is completed more than 30 days before the written notification by the
- 11 Department that winterization is required.
- 12 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 Thermoplastic Pavement Marking Characters __ mils	Each
In Lane Route Shields	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

13 **SECTION 1250**

14 **PAVEMENT MARKERS GENERAL REQUIREMENTS**

15 **1250-1 DESCRIPTION**

16 Furnish and place pavement markers in accordance with the contract.

17 **1250-2 MATERIALS**

18 **(A) General**

19 Refer to Division 10.

Item	Section
Pavement Markers	1086

20 **(B) Material Qualifications**

21 Use pavement markers that are on the NCDOT APL.

Section 1250

1 1250-3 CONSTRUCTION METHODS

2 (A) Weather Limitations

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

7 (B) Preparing for installation

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

12 (C) Removal of Existing Pavement Markers

13 Remove the existing raised pavement markers or the snowplowable pavement markers
14 including the housings, before overlaying an existing roadway with pavement. Repair the
15 pavement by filling holes as directed by the Engineer.

16 When traffic patterns are changed in work zones due to construction or reconstruction,
17 remove all raised pavement markers or snowplowable markers including housings that
18 conflict with the new traffic pattern before switching traffic to the new traffic pattern.
19 Unless behind barrier, any pavement marker or snowplowable marker within 6 feet of the
20 new traffic pattern markings shall be considered conflicting. Total housing removal shall
21 occur for snowplowable markers inside or within 2 feet of a travel lane.

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

25 (D) Installation

26 (1) General

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

28 (2) Color

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

33 (3) Appearance

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

37 (4) Spacing

38 Space pavement markers as shown in the plans. Position pavement marker lenses
39 perpendicular to the flow of traffic as shown in the *Roadway Standard Drawings*.
40 Adjust marker longitudinal spacing up to 1 foot in either direction and/or adjust
41 marker lateral spacing up to 3 inches to avoid installation of the marker at a
42 pavement construction joint or surface defect. If a marker cannot be relocated as
43 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 per 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:

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

SECTION 1253
SNOWPLOWABLE PAVEMENT MARKERS

1253-1 DESCRIPTION

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

1253-2 MATERIALS

Refer to Division 10.

Item	Section
Snowplowable Pavement Markers	1086-3
Epoxy	1081

Use snowplowable pavement markers that are on the NCDOT APL.

1253-3 CONSTRUCTION METHODS

(A) General

Bond marker housings 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 sawcut into the pavement. Make slots in the pavement to exactly duplicate the shape of the casting of the snowplowable pavement markers.

If saw cutting, milling, or grooving operations are used, promptly remove all resulting debris from the pavement surface. Install the marker housings within 7 calendar days after saw cutting, milling, or grooving the pavement. Remove and dispose of loose material from the slots by brushing, blow cleaning or vacuuming. Dry the slots before applying the epoxy adhesive. Install non-cast iron snowplowable pavement markers according to the manufacturer's recommendations.

Protect the non-cast iron 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 if damage occurs during the initial installation of the marker housings and maintenance of initial non-cast iron snowplowable markers specified in this section. This work will be paid for under the pay item for the type of reflector replacement if the damage occurred after the initial installation of the non-cast iron snowplowable pavement marker.

If during reflector replacement it is discovered that the housing is missing or broken this will be paid as *Non-Cast Iron Snowplowable Pavement Markers*. Missing housings shall be replaced. Broken housings shall be removed and replaced. In both cases the slot for the housings shall be properly prepared prior to installing the new housing; patch the existing marker slots as directed by the Engineer and install the new marker approximately one foot before or after the patch. Removal of broken housings and preparation of slots will be considered incidental to the work of replacing housings.

(C) Recycled Snowplowable Pavement Marker Housings

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

1 **1253-4 MAINTENANCE**

2 Maintain all installed non-cast iron snowplowable raised pavement markers before acceptance
3 by the Engineer.

4 **1253-5 MEASUREMENT AND PAYMENT**

5 *Non-Cast Iron Snowplowable Pavement Markers* will be measured and paid as the actual
6 number of non-cast iron snowplowable pavement markers satisfactorily placed and accepted
7 by the Engineer.

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

10 Payment will be made under:

Pay Item	Pay Unit
Non-Cast Iron Snowplowable Pavement Marker	Each
Replace Snowplowable Pavement Marker Reflector	Each

11 **SECTION 1264**
12 **OBJECT MARKERS**

13 **1264-1 DESCRIPTION**

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

15 **1264-2 MATERIALS**

16 Refer to Division 10.

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

17 Use object markers that are on the NCDOT APL.

18 **1264-3 CONSTRUCTION METHODS**

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

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

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

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

35 **1264-4 MEASUREMENT AND PAYMENT**

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

Section 1266

1 7' U-Channel Posts will be measured and paid as the actual number of 7 foot U-channel posts
2 satisfactorily placed and accepted by the Engineer.

3 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

4 **SECTION 1266**
5 **TUBULAR MARKERS (FIXED)**

6 **1266-1 DESCRIPTION**

7 Furnish, install, relocate, maintain and remove tubular markers in accordance with the
8 contract.

9 **1266-2 MATERIALS**

10 Refer to Division 10.

Item	Section
Tubular Markers	1088-5

11 Use tubular markers that are on the NCDOT APL.

12 **1266-3 CONSTRUCTION METHODS**

13 Install tubular markers to the pavement surfaces per the manufacturer's specifications.

14 Use tubular markers affixed to pavement surfaces as a supplement to pavement markings to
15 channelize traffic. Use tubular marker such that the color of the tubular marker and
16 retroreflective sheeting would match the color of the pavement markings they supplement,
17 except as noted below:

18 **(A)** Use yellow tubular markers with white retroreflective sheeting on top of asphalt islands
19 as shown in the plans.

20 **(B)** Gray or white tubular markers with white retroreflective sheeting may be used to
21 supplement white pavement markings.

22 **1266-4 MAINTENANCE**

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

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

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

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

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

31 **1266-5 MEASUREMENT AND PAYMENT**

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

1 Payment will be made under:

Pay Item	Pay Unit
Tubular Markers (Fixed)	Each

2 **SECTION 1267**
3 **FLEXIBLE DELINEATORS**

4 **1267-1 DESCRIPTION**

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

6 **1267-2 MATERIALS**

7 Refer to Division 10.

Item	Section
Flexible Delineators	1088-6

8 Use flexible delineators that are on the NCDOT APL.

9 **1267-3 CONSTRUCTION METHODS**

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

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

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

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

17 Install the flexible delineators plumb on all sides.

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

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

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

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

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

32 **1267-4 MAINTENANCE**

33 Maintain all installed flexible delineators before acceptance by the Engineer.

34 **1267-5 MEASUREMENT AND PAYMENT**

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

Section 1267

1 Payment will be made under:

Pay Item

Flexible Delineator (White)
Flexible Delineator (Yellow)
Flexible Delineator (White and Red)
Flexible Delineator (Yellow and Red)

Pay Unit

Each
Each
Each
Each