

**Loop detector cable and lead-in cable** will be measured and paid for in accordance with the requirements of Section 700.05.

**Cleaning, painting, and grouting of existing equipment retained in signal modifications** will not be measured for separate payment but will be considered incidental to other items of work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Master controller	Each
Controller	Each
Traffic signal head section (Size and type)	Each
Pedestrian signal head (Standard)	Each
Detector amplifier (Type)	Each
Magnetic detector sensing element (Standard)	Each
Pedestrian pushbutton	Each
Flasher	Each
Saw cut	Linear foot
Hanger assembly (Standard, [ ]-way)	Each
Illuminated traffic control sign	Each
Tether wire (Size)	Linear foot
Span wire (Size)	Linear foot
Cable terminal enclosure (Standard)	Each

## **SECTION 704—PAVEMENT MARKINGS AND MARKERS**

### **704.01—Description.**

This work shall consist of establishing the location of pavement markings and installing pavement markings, pavement markers, and reflectorized material on specified pavements in accordance with these specifications, the *MUTCD* and as directed by the Engineer.

### **704.02—Materials.**

The Contractor shall use an approved inventory tracking system for all materials received from the manufacturer. Shipment of materials from such inventory shall be accompanied by the following certification:

Material shipped under this certification has been tested and approved by VDOT as indicated by laboratory test numbers listed hereon.

Signature and Title \_\_\_\_\_ Date \_\_\_\_\_

A copy of the certified delivery ticket shall be given to the Engineer upon delivery of the material.

- (a) **Pavement markings** shall conform to the requirements of Section 246.
- (b) **Glass beads** shall conform to the requirements of Section 234.
- (c) **Pavement markers** shall conform to the requirements of Section 235.

#### **704.03—Procedures.**

The Contractor shall have a certified Pavement Marking Technician present during pavement marking operations.

Pavement markings shall be installed on new roadways prior to opening the roadway to traffic. Pavement marking installation shall be completed within the time limits herein on roadways where the pavement markings have been removed or obscured and the roadway is open to traffic unless otherwise directed by the Engineer. Installation of Type B, Class VI pavement markings on asphalt roadways are not applicable to these requirements if they are inlaid with the last pass of the asphalt roller or directly after the asphalt roller utilizing a separate roller. Installation of edge lines on roadways where the existing pavement markings have been removed or obscured are also required within these time limits unless otherwise indicated by the Engineer. Exceptions to the below time limits will be granted only for weather restrictions, and installation of epoxy resin pavement markings on new pavement shall not commence until after 24 hours of final surface placement.

Pavement marking installation on roads having traffic volumes of 10,000 ADT or more shall be completed within 24 hours after the end of the workday where the pavement markings were removed or obscured.

Pavement marking installation on roads having traffic volumes between 3,000 and 10,000 ADT shall be completed within 48 hours after the end of the workday where the pavement markings were removed or obscured.

Pavement marking installation on roads having traffic volumes of less than 3,000 ADT shall be completed within 72 hours after the end of the workday where the pavement markings were removed or obscured.

If the Contractor will not have pavement markings installed within the time limits set above, the Contractor shall install Type D construction pavement markings within the same time limits and maintain such until the final pavement markings can be installed. The cost of installing, maintaining and removing the Type D construction pavement markings shall be borne by the Contractor with no cost to the Department.

When establishing the location of pavement markings, the Contractor may mark the locations on the roadway by installing premarkings. Premarkings shall be accom-

plished using Type D (removable—any class) tape, chalk, or lumber crayons except special pavement markings such as stop lines, crosswalks, messages, hatching, etc. shall be accomplished using chalk or lumber crayons. All premarkings shall be of the same general color as the pavement markings being premarked. When tape is used as premarking, premarking shall consist of 4-inch x 4-inch maximum squares or 4-inch maximum diameter circles spaced at 100-foot minimum intervals in tangent sections and 50-foot minimum intervals in curved sections. At locations where the pavement marking will switch colors, e.g. gore marking, the ends of the markings may be premarked regardless of the spacing. When chalk or lumber crayon are used as premarking, the entire length of the pavement marking may be premarked. All premarkings shall be installed whereby its installation shall not affect the adhesion of the pavement markings. When Type D tape is used as the premarking and the lateral location of such premarkings to the final pavement markings exceeds 6 inches, the premarkings shall be removed at no cost to the Department.

- (a) **Pavement Markings:** Pavement markings shall be white or yellow markings as required by the *MUTCD* for the specific location or as specified by the Engineer and shall be installed in accordance with Table VII-1 unless otherwise recommended by the manufacturer and approved by the Engineer. The Contractor shall furnish a copy of the manufacturer's installation recommendations to the Engineer.

The Contractor shall perform quality control testing for application thickness and glass bead rate in accordance with VTM-94 at the beginning of each workday and every 3 hours thereafter. The Contractor shall be responsible for providing the apparatus indicated in VTM-94 that are needed to perform the quality control testing. Testing shall be performed in the presence of the Engineer.

The Contractor shall maintain a daily log (Form C-85) for both temporary and permanent pavement markings and markers. Entries in the log shall be made in ink, shall be legible, and the log shall be signed by the Contractor and delivered to the Engineer by the end of each workday.

Pavement line markings shall consist of stop lines, crosswalks, and solid or skip lines used for, but not limited to, dividing lanes, marking edges, channelizing, outlining and marking safety zones around objects, and forming islands and parking lot stalls.

1. **Crosswalks and stop lines** shall be installed using Type B, Class I or IV markings.
2. **Solid lines or skip lines** shall be installed using Type A or Type B markings as specified.

Pavement message markings shall be installed using Type B, Class I, IV or VI markings and shall include, but not be limited to, school zone markings, railroad crossing markings, disabled parking symbols, elongated

TABLE VII-1  
Pavement Markings

Type	Class	Name	Surface Temp. at Time of Application	Film Thickness (mils)	Pavement Surface	Application Limitations
A		Traffic paint	50°F+	15 ± 1 when wet	AC HCC	May be applied directly after paving operations
B	I	Thermoplastic Alkyd	50°F+	90 ± 5 when set	AC	May be applied directly after paving operations
	I	Thermoplastic Hydrocarbon	50°F+	90 ± 5 when set	AC	Do not apply less than 30 days after paving operations
	II	Polyester resin	50°F+	15 ± 1 when wet	HCC	Needs to be coned
	III	Epoxy resin	50°F+	20 ± 1 when wet	AC HCC	Pavement surface needs to be at least 1 day old
	IV	Plastic-backed preformed Tape	Manufacturer's Recommendation	60-90	AC HCC	Manufacturer's recommendations
	VI	Patterned preformed Tape	Manufacturer's Recommendation	20 min* 65 min**	AC HCC	Manufacturer's recommendations
D	I & II	Removable tape	Manufacturer's*** Recommendation	Recommendation	AC HCC	Construction zone pavement marking
E		Removable black tape (Non-Reflective)	Manufacturer's*** Recommendation	Recommendation	AC	Construction zone pavement marking for covering existing markings
F	I & II	Temporary markings	Manufacturer's*** Recommendation (Film Thickness = 40 mils max)	Recommendation	AC HCC	Construction zone pavement marking

\*Thinnest portion of the tapes cross-section

\*\*Thickest portion of the tapes cross-section

\*\*\*In the event the manufacturer's recommendation for film thickness is less than utilized when the material was tested by the National Transportation Product Evaluation Program (NTPEP) or other Department approved test facility, the minimum values used during installation shall conform to the test values which are indicated on the approved list for the specific marking.

arrows, word messages, etc. The word SCHOOL shall be formed with characters that are 10 feet in height where permitted by the normal roadway width. School zone markings shall extend transversely across both lanes of two-lane roadways and across two or more approach lanes of roadways of three or more lanes. Disabled parking symbols shall be 41 inches in height, 36 inches in width and shall use a 4-inch stroke width for the lines.

The Contractor shall protect the public from damage attributable to pavement marking operations. The Contractor shall be responsible for the complete preparation of the pavement surface, including, but not limited to, removing dust, dirt, loose particles, oily residues, curing compounds, concrete laitance, residues from eradication, and other foreign matter immediately prior to installing pavement markings. The pavement surface shall be dry at the time of installation when tested in accordance with VTM-94. The Contractor shall be responsible for providing the apparatus indicated in VTM-94 that are needed to perform the moisture test. Marking material shall not be applied within 24 hours following rain or other inclement weather.

Liquid markings shall be applied so as to prevent splattering and overspray and shall be protected from traffic until track free by the use of guarding or warning devices as necessary. If a vehicle crosses a marking and tracks it or if splattering or overspray occurs, the affected marking and resultant tracking shall be removed and new markings applied at the Contractor's expense.

Equipment shall also be thoroughly cleaned between changes in colors of materials.

Pavement markings shall have clean and well-defined edges without running or deformation; shall be uniform, free of waviness; shall be straight on tangent alignment; and shall be on a true arc on curved alignment. The widths of pavement markings shall not deviate more than 1/4 inch on tangent nor more than 1/2 inch on curves from the required width. The length of the gap and the length of the individual stripes that form skip lines shall not deviate more than two inches. The length of the gap and individual skip line shall be of such uniformity throughout the entire length of each that a normal striping machine will be able to repeat the pattern and superimpose additional striping upon the existing marking. Glass beads shall be applied at the rate specified herein and shall be evenly distributed over the entire surface of the marking. Beads shall be applied to the surface of liquid markings by a bead dispenser attached to the applicator that shall dispense beads simultaneously on and in the just-applied marking. The bead dispenser shall be equipped with a cut-off control synchronized with the cut off of the applied marking material so that the beads are applied totally to the completed line. Beads shall be applied while the liquid marking is still fluid. Approximately 70 percent of beads shall be buried

in the marking, and the remaining 30 percent shall be 50-60 percent embedded in the surface. Beads installed on crosswalks and stop lines on roadways with curbs only (no gutter) may be hand applied for two feet at the end of each line next to the curb with 100 percent of the beads embedded 50-60 percent in the surface.

Markings found to be unacceptable shall be removed, and new markings applied at the Contractor's expense.

1. **Type A markings:** Paint may be applied to asphalt concrete and hydraulic cement concrete pavements. Paint shall not be applied over existing pavement markings of other materials unless the existing marking is 90 percent removed. Paint may be applied over existing paint markings.

Paint shall be applied with a line painting machine that is capable of hot spraying paint directly onto the pavement surface with a uniformity of feed through its nozzles for widths of 4 through 8 inches. The machine shall be capable of applying two pavement stripes, either solid or skip, at the same time when double line markings are required. Paint tanks on the equipment shall be equipped with a mechanical agitator and paint shall be thoroughly mixed and heated such that it will not track within 60 seconds after its application.

Non-truck mounted equipment shall be self-propelled and regulated to allow for calibration of the amount of material applied.

Glass beads shall be applied to the surface of the paint at the rate of 6 pounds per gallon of paint.

2. **Type B markings:**

Equipment shall be capable of providing mixing, heating and agitation of material. Material shall be uniformly heated throughout the system in accordance with the manufacturer's recommendations. Thermoplastic material shall be maintained in the heating kettle and applied to the road surface at a minimum temperature of 400 degrees F. Heating kettles shall be equipped with an automatic thermostatic control device. The Contractor shall furnish a properly calibrated infrared instrument for the purpose of measuring the actual temperature of molten thermoplastic material. Multi-component material shall be applied using internally injected guns for the mixing of catalyst and hardener.

Non-truck mounted equipment for application of thermoplastic material shall be of the screed extrude type with a screw drive or shall be self propelled and regulated to allow for calibration of the amount of material applied. Non-truck mounted equipment for

application of polyester and epoxy resin material shall be self propelled and regulated to allow for calibration of the amount of material applied.

- a. **Thermoplastic (Class I)** material shall only be applied on asphalt concrete pavements and shall be applied by screed extrude, ribbon gun or spray equipment. Alkyd thermoplastic may be applied directly after the paving operations, however hydrocarbon thermoplastic shall not be applied less than 30 days after the paving operations.

Alkyd and hydrocarbon materials shall not be mixed together. Equipment shall be thoroughly cleaned before types of material are changed.

Thermoplastic shall not be applied over existing pavement markings of other materials unless the existing marking is 90 percent removed. Thermoplastic may be applied over existing thermoplastic markings. For concrete bridge decks that occur in asphalt roadways, Type B, Class VI tape shall be used.

Primer/adhesive shall be applied to asphalt concrete surfaces more than two years old and shall be from the same manufacturer as the thermoplastic.

Glass beads shall be applied to the surface of the marking at the rate of 7 pounds per 100 square feet.

- b. **Polyester resin (Class II)** material shall only be applied on hydraulic cement concrete pavements. Polyester resin shall not be applied over existing pavement markings of other materials unless the existing marking is 90 percent removed. Polyester resin may be applied over existing polyester resin markings.

Glass beads shall be applied to the surface at the rate of 8 pounds per gallon of material.

- c. **Epoxy resin (Class III)** material shall only be applied to asphalt concrete pavement more than one day old and hydraulic cement concrete pavement. Epoxy resin shall not be applied over existing pavement markings unless the existing marking is 90 percent removed.

Glass beads shall be applied by the gravity method to the surface at the rate of 25 pounds per gallon of material.

- d. **Plastic-backed preformed tape** shall be installed in accordance with the manufacturer's recommendations and as denoted

herein. Tape may be applied to asphalt concrete and hydraulic cement concrete pavements. Tape may be installed immediately following the final rolling of the new asphalt concrete surface. Tape shall not be applied over existing pavement markings of other materials unless the existing marking is 90 percent removed.

Primer/adhesive shall be used for all installations except when tape is applied immediately following the final rolling of the new asphalt concrete surface and shall be from the same manufacturer as the tape.

Tape for pavement line markings shall be applied by an application cart as recommended by the manufacturer. Tape shall be tamped into place with a tamper cart with the weight as recommended by the manufacturer. The use of a vehicle to ride over the markings for tamping will not be permitted.

(b) **Eradication:**

Eradication of pavement markings for restriping when required shall be in accordance with Section 512 except only 90 percent removal of the existing markings is required.

(c) **Pavement Markers:**

1. **Snow-plowable raised pavement markers** shall be installed by cutting two parallel grooves into the pavement at the depth and dimensions recommended by the manufacturer. Grooves shall be parallel to the adjacent pavement marking. Grooves shall be cut with saw blades having a diameter to match the curvature of the steel casting bottom and keels. Keel surfaces shall be free from scale, dirt, oil, grease, or any other contaminant that might reduce bonding.

Casting keels shall be bonded in the saw-cut grooves in the manner recommended by the manufacturer of the marker. The bonding material shall be from the Department's approved list or as recommended by the manufacturer of the marker. Noses of the casting shall be installed flush with the pavement surface. The installed height of the raised pavement marker shall be approximately 1/2 inch above the pavement surface. Ambient temperature at the time of installation of the snow-plowable raised pavement markers shall be at least 50 degrees F or higher.

The top of reflectors shall be mounted flush with the top of the casting.

2. **Raised pavement markers** shall be bonded to the pavement surface in accordance with the manufacturer's recommendations. Bonding

material shall be from the Department's approved list or as recommended by the manufacturer of the marker except epoxy shall not be used on asphalt concrete pavements.

#### **704.04—Measurement and Payment.**

**Pavement line markings** will be measured and paid for at the contract unit price per linear foot. This price shall include the pavement marking material, surface preparation, quality control tests, daily log, guarding devices, primer/adhesive, and glass beads.

**Pavement message markings** will be measured and paid for at the contract unit price per each per location. This price shall include the pavement marking material, surface preparation, quality control tests, daily log, guarding devices, primer/adhesive, and glass beads.

**Pavement markers** will be measured and paid for at the contract unit price per each. This price shall include prismatic retroreflectors, pavement cutting, adhesive, and castings.

**Eradication of pavement markings** will be measured and paid for in accordance with Section 512.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Pavement line marking (Type and/or class and width)	Linear foot
Pavement message marking (Message)	Each
Pavement marker (Type, [ ]-way, and/or type pavement)	Each

## **SECTION 705—LIGHTING SYSTEMS**

#### **705.01—Description.**

This work shall consist of furnishing, installing, and testing proposed lighting systems and modifying or relocating existing systems in accordance with these specifications and in reasonably close conformity to the lines and details shown on the plans or as established by the Engineer.

#### **705.02—Materials.**

Photoelectric controls shall conform to the requirements of Section 238.