

Exhibit D

SECTION 705 OBJECT MARKERS AND DELINEATORS

705-1 Description.

Furnish and install object markers to mark obstructions within or adjacent to the roadway of the types and at the locations called for in the Standard Plans or in the Plans.

Furnish and install delineators along the side of the roadway to indicate the alignment of the roadway as indicated in the Standard Plans or in the Plans.

705-2 Materials.

705-2.1 General: Meet the following requirements:

Object Markers and DelineatorsSection 993

Retroreflective and Nonreflective

Sign SheetingSection 994

705-2.2 Product Acceptance on the Project: Ensure that delineators and delineator posts are listed on the Department's Approved Product List (APL).

705-3 Installation Requirements.

Install delineators and object markers in accordance with the MUTCD, Standard Plans and Plans.

Place barrier delineators at a spacing of 25 feet for the first 100 feet of barrier and at 100 feet spacing thereafter. Orient barrier delineators as detailed in the Standard Plans or APL drawings.

705-4 Method of Measurement.

The quantity to be paid will be the number of delineators or object markers furnished, installed and accepted, with the exception of barrier delineators on new barriers, which are included in the cost of the barrier.

705-5 Basis of Payment.

Prices and payments will be full compensation for work specified in this Section, including the cost of labor, materials, and incidental items required to complete the work.

Payment will be made under:

Line Item Exhibit "E"

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SECTION 706 RAISED PAVEMENT MARKERS AND BITUMINOUS ADHESIVE

706-1 Description.

Place raised pavement markers (RPMs) and adhesive, which upon installation produces a positive guidance system to supplement other reflective pavement markings.

706-2 Materials.

Use only Class B markers unless otherwise shown in the Plans.

Meet the requirements of Section 970.

706-2.1 Product Acceptance on the Project. Use only RPMs and bituminous adhesive that are listed on the Department's Approved Product List (APL). For Class F RPMs, provide a warranty assigned to the Department in accordance with Section 970.

706-3 Equipment.

Use equipment having either thermostatically controlled double boiler type units utilizing heat transfer oil or thermostatically controlled electric heating pots to install hot applied bituminous adhesive. Use a melter/applicator unit suited for both melting and pumping the bituminous adhesive through heated applicator hoses.

Heat the bituminous adhesive to between 375°F and 425°F and apply directly to the bonding surface from the melter/applicator by either pumping or pouring. Maintain the application temperature between 375°F and 425°F. The bituminous adhesive may be reheated. However, do not exceed the manufacturer's recommendations for pot life at application temperatures.

706-4 Application.

Install RPMs in accordance with the Plans and Standard Plans.

Apply RPMs to the bonding surface using bituminous or epoxy adhesives in accordance with the manufacturer's instructions.

For Class F RPMs, installation may include the removal of roadway surface material to recess a portion of the RPM housing.

Prior to application of adhesive, clean the portion of the bonding surface of any material which would adversely affect the adhesive.

Apply the adhesive to the bonding surface (not the RPM) so that 100% of the bonding area of the RPM will be covered, in accordance with adhesive manufacturer's recommendations. Apply sufficient adhesive to ensure that when the marker is pressed downward into the adhesive, adhesive will be forced out around the entire perimeter of the RPM.

Immediately remove excess adhesive from the bonding surface and exposed surfaces of the RPMs. Soft rags moistened with mineral spirits meeting Federal Specifications TT-T-291 or kerosene may be used to remove adhesive from exposed faces of the RPMs. Do not use any other solvent. If any adhesive, pavement marking materials or other foreign matter adheres to the traffic face of the RPM, replace the RPM at no cost to the Department.

Restore any areas impacted by the installation of Class F RPMs to original condition.

Ensure that all final RPMs are in place prior to opening the road to traffic.

If more than 2% of the RPMs fail in adhesion or alignment within the first 45 days under traffic, replace all failed RPMs at no expense to the Department. If more than 5% of the RPMs

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fail in adhesion and or alignment during the initial 45 day period, the Engineer will extend the replacement period an additional 45 days from the date that all replacement RPMs have been installed. If, at the end of the additional 45 day period, more than 2% of all RPMs (initial installation and 45 day replacements combined) fail in adhesion or alignment, replace all failed RPMs at no expense to the Department.

706-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of RPMs. At the time of notification, submit the APL number and the batch or Lot numbers of RPMs and bituminous adhesive to be used.

706-6 Method of Measurement.

The quantities to be paid for will be the number of RPMs, furnished and installed, completed and accepted.

706-7 Basis of Payment.

706-7.1 Class B RPMs: Price and payment for Class B RPMs will not be measured or paid for separately when the item for painted pavement markings (Final Surface) is included in the proposal. Price and payment for all work and materials in this Section will be made in accordance with 710-11.2.

For projects without Final Surface Pavement Markings, price and payment for Class B RPMs will be full compensation for all work and materials in this Section.

706-7.2 Class F RPMs: Price and payment for Class F RPMs will be full compensation for all work and materials in this Section.

706-7.3 Payment Items: Line Item Exhibit "E"

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SECTION 709 TWO REACTIVE COMPONENTS PAVEMENT MARKINGS

709-1 Description.

Apply two reactive components pavement markings in accordance with the Contract Documents.

709-2 Materials.

Use only materials listed on the Department's Approved Product List (APL) as an approved system and meeting the following requirements:

Two Reactive Components 971-1 and 971-8

Retroreflective Elements* 971-1.7

Glass Spheres* 971-1 and 971-2

*Use only retroreflective elements or glass spheres recommended by the manufacturer.

The Engineer will take random samples of the materials in accordance with the Department's Sampling, Testing and Reporting Guide schedule.

709-3 Equipment.

Use equipment that will produce continuous uniform dimensions of pavement markings of varying widths and meets the following requirements:

1. Capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, to produce a uniform application of the two reactive components material and capable of following straight lines and making normal curves in true arcs.
2. Capable of applying retroreflective elements or glass spheres to the surface of the completed line by an automatic retroreflective element dispenser attached to the pavement marking machine such that the retroreflective elements or glass spheres are dispensed closely behind the installed line. Use a retroreflective element or glass sphere dispenser equipped with an automatic cut-off control that is synchronized with the cut-off of the material and applies the retroreflective elements or glass spheres in a manner such that the retroreflective elements or glass spheres appear uniform on the entire pavement markings surface.
3. Capable of providing the manufacturer's recommended mixing ratio between the components in a thorough and consistent manner.

709-4 Application.

709-4.1 General: Remove existing pavement markings, such that scars or traces of removed markings will not conflict with new pavement markings by a method approved by the Engineer. Before applying pavement markings, remove any material by a method approved by the Engineer that would adversely affect the bond of the pavement markings.

Offset longitudinal lines at least 2 inches from construction joints of portland cement concrete pavement.

Apply pavement markings to dry surfaces only, and when the ambient air and surface temperature is at least 40°F and rising.

Do not apply two reactive components pavement markings when winds are sufficient to cause spray dust.

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Apply two reactive components pavement markings to the same tolerances in dimensions and in alignment specified in 710-5. When applying two reactive components pavement marking over existing markings, ensure that not more than 2 inches on either end and not more than 1 inch on either side of the existing line is visible.

Apply the two reactive components pavement markings to the pavement in accordance with the manufacturer's instructions or as directed by the Engineer.

Conduct field tests in accordance with FM 5-541. Take test readings representative of the pavement marking performance. Remove and replace two reactive components pavement markings not meeting the requirements of this Section at no additional cost to the Department.

Apply all final pavement markings prior to opening the road to traffic.

709-4.2 Thickness: Apply two reactive components pavement markings to attain a minimum wet film thickness in accordance with the manufacturer's recommendations as identified on the APL. Measure, record and certify on a Department approved form and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

709-4.3 Retroreflectivity: Apply white and yellow two reactive components pavement markings that will attain an initial retroreflectivity of not less than $450 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $350 \text{ mcd/lx}\cdot\text{m}^2$, respectively for all longitudinal lines.

Measure, record and certify on the Department approved form and submit to the Engineer, the retroreflectivity of white and yellow two reactive components pavement markings in accordance with FM 5-541.

709-4.4 Color: Use materials that meet the requirements of 971-1.

709-4.5 Retroreflective Elements or Glass Spheres: Apply retroreflective elements or glass spheres to all white and yellow two reactive components pavement markings, at the rates determined by the manufacturer's recommendations as identified on the APL.

709-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the materials. At the time of notification, submit a certification to the Engineer with the APL number and the batch or Lot numbers of the materials and retroreflective elements or glass spheres to be used. Packaging labels that contain the information required by 971-1.1 will be accepted in lieu of a certification.

709-6 Protection of Newly Applied Pavement Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

709-7 Observation Period.

Longitudinal pavement markings are subject to a 180 day observation period under normal traffic. The observation period shall begin with the satisfactory completion and acceptance of the work. The longitudinal pavement markings shall show no signs of failure due to blistering, excessive cracking, chipping, discoloration, poor adhesion to the pavement, loss of retroreflectivity or vehicular damage. The retroreflectivity shall meet the initial requirements of 709-4.3. The Department reserves the right to check the retroreflectivity any time prior to the end of the observation period.

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

709-8 Corrections for Deficiencies.

Correct all deficiencies by removal and reapplication of a one mile section centered around the deficiency, as determined by the Engineer, at no additional cost to the Department.

709-9 Submittals.

709-9.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

709-9.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consists of the following:

1. Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
2. The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

709-10 Method of Measurement.

The quantities, authorized and acceptably applied, under this Section will be paid as follows:

1. The length, in gross miles, of solid, 10'-30' skip, and 3'-9' dotted, 6'-10' dotted, 2'-2' dotted, and 2'-4' dotted lines.
2. The area, in square feet, for removal of existing markings acceptably removed. Payment for removal of conflicting markings will be in accordance with 102-5.8. Payment for removal of non-conflicting markings will be paid separately.

The gross mile measurement will be taken as the distance from the beginning of the two reactive component line to the end of the two reactive component line and will include the unmarked gaps for skip and dotted lines. The gross mile measurement will not include designated unmarked lengths at intersections, turn lanes, etc. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

709-11 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

Payment will be made under:

Line Item Exhibit "E"

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SECTION 710 PAINTED PAVEMENT MARKINGS

710-1 Description.

Apply painted pavement markings, in accordance with the Contract Documents.

710-2 Materials.

Use only materials listed on the Department's Approved Product List (APL) meeting the following requirements:

Materials for Raised Pavement Markers (RPMs) and Bituminous Adhesive	Section 970
Standard Paint	971-1 and 971-3
Durable Paint	971-1 and 971-4
Glass Spheres	971-1 and 971-2

The Engineer will take random samples of all material in accordance with the Department's Sampling, Testing and Reporting Guide schedule.

710-3 Equipment.

Use equipment that will produce continuous uniform dimensions of pavement markings of varying widths and meet the following requirements:

1. Capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, in order to produce a uniform application of paint and capable of following straight lines and making normal curves in a true arc.
2. Capable of applying glass spheres to the surface of the completed line by an automatic sphere dispenser attached to the pavement marking machine such that the glass spheres are dispensed closely behind the installed line. Use a glass spheres dispenser equipped with an automatic cut-off control that is synchronized with the cut-off of the paint and applies the glass spheres in a manner such that the spheres appear uniform on the entire pavement markings surface.
3. Capable of spraying the paint to the required thickness and width without thinning of the paint. Equip the paint tank with nozzles equipped with cut-off valves, which will apply broken or skip lines automatically.

710-4 Application.

710-4.1 General: Remove existing pavement markings, such that scars or traces of removed markings will not conflict with new pavement markings, by a method approved by the Engineer. Before applying pavement markings, remove any material that would adversely affect the bond of the pavement markings by a method approved by the Engineer.

Apply standard paint to dry surfaces only, and when the ambient air and surface temperature is at least 40°F and rising.

Apply durable paint to dry surfaces only. Do not apply durable paint when the ambient air and surface temperature is below 50°F, relative humidity is above 80% or when the dew point is within 5°F of the ambient air temperature.

Do not apply painted pavement markings when winds are sufficient to cause spray dust.

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Apply painted pavement markings, having well defined edges, over existing pavement markings such that not more than 2 inches on either end and not more than 1 inch on either side is visible. When stencils are used to apply symbols and messages, the areas covered by the stencil reinforcing will not be required to be painted.

Mix the paint thoroughly prior to pouring into the painting machine. Apply paint to the pavement by spray or other means approved by the Engineer.

Conduct field testing in accordance with FM 5-541. Remove and replace painted pavement markings not meeting the requirements of this Section at no additional cost to the Department.

Apply all pavement markings prior to opening the road to traffic.

710-4.1.1 Painted Pavement Markings (Final Surface): On concrete surfaces or newly constructed asphalt, the painted pavement markings (final surface) will include one application of standard paint and one application of Class B RPMs applied to the final surface.

For center line and edge line rumble strip installations where the pavement marking is placed within the grinding, apply a second application of standard paint within 24 hours of each day's grinding operation.

For center line rumble strip installations where RPMs are in conflict with the grinding, install Class D RPMs with the first application of standard paint. Remove Class D RPMs prior to grinding, then install Class B RPMs in an unground area after grinding.

Do not apply final surface paint for bicycle arrows or bicycle messages, 24 inch longitudinal bars in special emphasis crosswalks, or route shields where preformed thermoplastic will be applied.

Install all RPMs in accordance with Standard Plans, Indexes 706-001 and 711-003, prior to opening the road to traffic.

Temporary RPMs must meet the requirements of Section 102.

Permanent RPMs must meet the requirements of Section 706.

710-4.2 Thickness: Apply standard paint to attain a minimum wet film thickness in accordance with the manufacturer's recommendations. Apply durable paint to attain a minimum wet film thickness of 0.025 inches or 25 mils. Measure, record, and certify on a Department approved form and submit to the Engineer, the thickness of white and yellow durable paint pavement markings in accordance with FM 5-541.

710-4.3 Retroreflectivity: Apply white and yellow standard paint that will attain an initial retroreflectance of not less than $300 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $250 \text{ mcd/lx}\cdot\text{m}^2$, respectively. Apply white and yellow durable paint that will attain an initial retroreflectance of not less than $450 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $300 \text{ mcd/lx}\cdot\text{m}^2$, respectively.

Measure, record and certify on a Department approved form and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with FM 5-541.

The Department reserves the right to test the markings within three days of receipt of the Contractor's certification. Failure to afford the Department opportunity to test the markings will result in non-payment. The test readings should be representative of the Contractor's pavement marking performance. If the retroreflectivity values measure below values shown above, reapply the pavement marking at no additional cost to the Department.

For standard paint, ensure that the minimum retroreflectance of white and yellow pavement markings are not less than 150 mcd/lx m^2 . If the retroreflectivity values for standard paint fall below the 150 mcd/lx m^2 value within 180 days of initial application, the pavement

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marking will be reapplied at the Contractor's expense. If the retroreflectivity values for durable paint fall below the initial values of 450 mcd/lx m² value for white and 300 mcd/lx m² for yellow within 180 days of initial application, the pavement marking will be reapplied at the Contractor's expense.

710-4.4 Color: Use paint material that meets the requirements of 971-1.

710-4.5 Glass Spheres: Apply glass spheres on all pavement markings immediately and uniformly following the paint application. The rate of application shall be based on the manufacturer's recommendation.

For longitudinal durable paint markings, apply a double drop of Type 1 and Type 3 glass spheres. For transverse durable paint markings, apply a single drop of Type 3 glass spheres.

The rate of application shall be based on the manufacturer's recommendation.

710-5 Tolerances in Dimensions and in Alignment.

Establish tack points at appropriate intervals for use in aligning pavement markings, and set a stringline from such points to achieve accuracy.

710-5.1 Dimensions:

710-5.1.1 Longitudinal Lines: Apply painted skip line segments with no more than plus or minus 12 inches variance, so that over-tolerance and under-tolerance lengths between skip line and the gap will approximately balance. Apply longitudinal lines at least 2 inches from construction joints of portland cement concrete pavement.

710-5.1.2 Transverse Markings, Gore Markings, Arrows, and Messages: Apply paint in multiple passes when the marking cannot be completed in one pass, with an overall line width allowable tolerance of plus or minus 1 inch.

710-5.1.3 Contrast Lines: Use black paint to provide contrast on concrete or light asphalt pavement, when specified by the Engineer. Apply black paint in 10 foot segments following each longitudinal skip line.

710-5.2 Alignment: Apply painted pavement markings that will not deviate more than 1 inch from the stringline on tangents and curves one degree or less. Apply painted pavement markings that will not deviate more than 2 inches from the stringline on curves greater than one degree. Apply painted edge markings uniformly, not less than 2 inches or more than 4 inches from the edge of pavement, without noticeable breaks or deviations in alignment or width.

Remove and replace at no additional cost to the Department, pavement markings that deviate more than the above stated requirements.

710-5.3 Correction Rates: Make corrections of variations in width at a maximum rate of 10 feet for each 0.5 inch of correction. Make corrections of variations in alignment at a maximum rate of 25 feet for each 1 inch of correction, to return to the stringline.

710-6 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the materials. At the time of notification, submit a certification to the Engineer with the APL number and the batch or Lot numbers of the paint and glass spheres to be used.

710-7 Protection of Newly Applied Pavement Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

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710-8 Corrections for Deficiencies to Applied Painted Pavement Markings.

Reapply a 1.0 mile section, centered around any deficiency, at no additional cost to the Department.

710-9 Submittals.

710-9.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. For Lump Sum pay item 710-90, document the quantity as an estimated percentage (in decimal form) of the total lump sum amount on the daily worksheet. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

710-9.2 Contractor's Certification of Quantities: Request payment by submitting a certification of quantities no later than Twelve O'clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consists of the following:

1. Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
2. The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

710-10 Method of Measurement.

The quantities, authorized and acceptably applied, under this Section will be paid as follows:

1. The length, in gross miles, of solid, 10'-30' skip, 3'-9' dotted, 6'-10' dotted, 2'-2' dotted, and 2'-4' dotted lines.
2. The length, in linear feet, of transverse lines, diagonal lines, chevrons, and parking spaces.
3. The number of pavement messages, symbols, and arrows. Each arrow is paid as a complete marking, regardless of the number of "points" or directions.
4. Lump Sum, as specified in 710-4.1.1 (final surface) and 710-9.1.
5. The area, in square feet, for removal of existing markings acceptably removed. Payment for removal of conflicting markings will be in accordance with 102-5.8. Payment for removal of non-conflicting markings will be paid separately.

The gross mile measurement will be taken as the distance from the beginning of the painted line to the end of the painted line and will include the unmarked gaps for skip and dotted lines. The gross mile measurement will not include designated unmarked lengths at intersections, turn lanes, etc. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

710-11 Basis of Payment.

710-11.1 General: Price and payment will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected.

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710-11.2 Painted Pavement Markings (Final Surface): Price and payment for painted pavement markings (final surface) will be full compensation for all applications of painted pavement markings, and all applications and removal of RPMs in accordance with 710-4.1.1 and 710-9.1.

710-11.3 Payment Items: Line Item Exhibit “E”

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SECTION 711 THERMOPLASTIC PAVEMENT MARKINGS

711-1 Description.

Apply new thermoplastic pavement markings, or refurbish existing thermoplastic pavement markings, in accordance with the Contract Documents.

711-2 Materials.

Use only materials listed on the Department’s Approved Product List (APL) meeting the following requirements.

Standard and Refurbishment Thermoplastic	971-1 and 971-5
Preformed Thermoplastic	971-1 and 971-6
High Friction Thermoplastic	971-1 and 971-10
Glass Spheres	971-1 and 971-2

Use sand materials meeting the requirements of 971-5.4.

The Engineer will take random samples of all material in accordance with the Department’s Sampling, Testing and Reporting Guide schedule.

711-3 Equipment.

Use equipment capable of providing continuous, uniform heating of the pavement marking material to temperatures exceeding 390°F, mixing and agitation of the material in the reservoir to provide a homogeneous mixture without segregation. Use equipment that will maintain the pavement marking material in a plastic state, in all mixing and conveying parts, including the line dispensing device until applied. Use equipment which can produce varying width lines and which meets the following requirements:

1. Capable of traveling at a uniform, predetermined rate of speed, both uphill and downhill, to produce a uniform application of pavement marking material and capable of following straight lines and making normal curves in a true arc.
2. Capable of applying glass spheres to the surface of the completed pavement marking by a double drop application for standard thermoplastic pavement markings and a single drop application for recapping and refurbishment thermoplastic pavement markings. The bead dispenser for the first bead drop shall be attached to the pavement marking machine in such a manner that the beads are dispensed closely behind the installed line. The second bead dispenser bead shall be attached to the pavement marking machine in such a manner that the beads are dispensed immediately after the first bead drop application. Use glass spheres dispensers equipped with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material and applies the glass spheres uniformly on the entire pavement markings surface with 50 to 60% embedment.
3. Equipped with a special kettle for uniformly heating and melting the pavement marking material. The kettle must be equipped with an automatic temperature control device and material thermometer for positive temperature control and to prevent overheating or scorching of the thermoplastic material.
4. Meet the requirements of the National Fire Protection Association, state, and local authorities.

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711-4 Application.

711-4.1 General: Remove existing thermoplastic pavement markings using a method approved by the Engineer such that pavement surface scars or traces of the removed thermoplastic pavement markings will not conflict with new pavement markings. Do not use paint to blackout, hide, or disguise existing pavement markings.

Before applying pavement markings, remove any material that would adversely affect the bond of the pavement markings by a method approved by the Engineer.

Before applying pavement markings to any portland cement concrete surface, apply a primer, sealer, or surface preparation adhesive of the type recommended by the manufacturer. Offset longitudinal lines at least 2 inches from any longitudinal joints of portland cement concrete pavement.

Apply pavement markings to dry surfaces only, and when the ambient air and surface temperature is at least 50°F and rising for asphalt surfaces and 60°F and rising for concrete surfaces.

Apply pavement markings to the same tolerances in dimensions and in alignment specified in 710-5. When applying pavement markings over existing markings, ensure that no more than 2 inches on either end and not more than 1 inch on either side of the existing line is visible.

Apply thermoplastic material to the pavement by extrusion or other means approved by the Engineer. When thermoplastic pavement markings are to be removed and replaced, apply new thermoplastic pavement markings prior to opening to traffic.

Conduct field tests in accordance with FM 5-541. Take test readings representative of the pavement marking performance. Remove and replace pavement markings not meeting the requirements of this Section at no additional cost to the Department.

With the exception of short-term raised rumble strips, wait at least 14 days after constructing the final asphalt surface course to place thermoplastic pavement markings. Installation of thermoplastic on concrete requires a clean, dry surface. Follow the manufacturer's recommendations for surface preparation for thermoplastic on concrete. Provide temporary pavement markings during the interim period prior to opening the road to traffic.

711-4.1.1 Preformed Thermoplastic: Apply markings to dry surfaces only and when ambient air temperature is at least 32°F. Prior to installation, follow the manufacturer's recommendations for pre-heating. For railroad dynamic envelopes, keep all equipment and personnel out of the foul area.

711-4.1.2 High Friction Thermoplastic: High friction thermoplastic may be used as an alternative to preformed thermoplastic for special emphasis crosswalk markings. Apply markings only by gravity or air pressure thermoplastic hand liners set-up with double drop bead attachments. Install markings in accordance with the manufacturer's recommendations.

711-4.2 Thickness:

711-4.2.1 Standard Thermoplastic Markings: Apply or recap standard thermoplastic pavement markings for longitudinal lines to attain a minimum thickness of 0.10 inch or 100 mils and a maximum thickness 0.15 inch or 150 mils when measured above the pavement surface.

All chevrons, diagonal and transverse lines, messages, symbols, and arrows, wherever located, will have a thickness of 0.09 inch or 90 mils to 0.12 inch or 120 mils when measured above the pavement surface.

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Measure, record and certify on Department approved form and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

The Engineer will verify the thickness of the pavement markings in accordance with FM 5-541 within 30 days of receipt of the Contractor's certification.

711-4.2.2 Refurbishment Thermoplastic Markings: Apply a minimum of 0.06 inch or 60 mils of thermoplastic material. Ensure that the combination of the existing marking and the overlay after application of glass spheres does not exceed the maximum thickness of 0.150 inch or 150 mils for all lines.

Measure, record and certify on Department approved form and submit to the Engineer, the thickness of white and yellow pavement markings in accordance with FM 5-541.

The Engineer will verify the thickness of the pavement markings in accordance with FM 5-541 within 30 days of receipt of the Contractor's certification.

711-4.2.3 Preformed Thermoplastic: Apply 0.125 inch or 125 mils of preformed thermoplastic material. Use preformed thermoplastic for bicycle markings, shared use path markings, 24 inch markings on special emphasis crosswalks, route shields, ramp exit numbers, roundabout informational markings, railroad dynamic envelopes, white dotted lines (2'-4') with trailing black contrast, and black contrast arrows, messages, and symbols.

Measure, record and certify on Department approved form and submit to the Engineer, the thickness of the pavement markings in accordance with FM 5-541.

711-4.2.4 High Friction Thermoplastic: Apply lines to attain a minimum thickness of 0.09 inch or 90 mils and a maximum thickness of 0.12 inch or 120 mils, when measured above the pavement surface.

Measure, record and certify on Department approved form and submit to the Engineer, the thickness of the pavement markings in accordance with FM 5-541.

711-4.3 Retroreflectivity: Apply white and yellow pavement markings that will attain an initial retroreflectivity of not less than $450 \text{ mcd/lx}\cdot\text{m}^2$ and not less than $350 \text{ mcd/lx}\cdot\text{m}^2$, respectively for all longitudinal lines. All chevrons, diagonal lines, stop lines, messages, symbols, and arrows will attain an initial retroreflectivity of not less than $300 \text{ mcd/lx}\cdot\text{m}^2$ and $250 \text{ mcd/lx}\cdot\text{m}^2$ for white and yellow respectively. All crosswalks, railroad dynamic envelopes and bicycle markings shall attain an initial retroreflectivity of not less than $275 \text{ mcd/lx}\cdot\text{m}^2$. Black pavement markings must have a retroreflectance of less than 5 mcd/lx m^2 .

Measure, record and certify on Department approved form and submit to the Engineer, the retroreflectivity of white and yellow pavement markings in accordance with FM 5-541.

711-4.4 Glass Spheres:

711-4.4.1 Longitudinal Lines: For standard thermoplastic markings, apply the first drop of Type 4 or larger glass spheres immediately followed by the second drop of Type 1 glass spheres. For refurbishment thermoplastic markings, apply a single drop of Type 3 glass spheres. Apply reflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

711-4.4.2 Chevrons, Diagonal and Transverse Lines, Messages, Symbols, and Arrows: For standard or refurbishment thermoplastic markings, apply a single drop of Type 1 glass spheres. Apply retroreflective glass spheres to all markings at the rates determined by the manufacturer's recommendations.

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Apply a mixture consisting of 50% glass spheres and 50% sharp silica sand to all standard thermoplastic crosswalk lines at the rates determined by the manufacturer's recommendations.

711-4.4.3 Preformed Markings: These markings are factory supplied with glass spheres and skid resistant material. Apply glass spheres and skid resistant material in accordance with the manufacturer's instructions.

711-5 Contractor's Responsibility for Notification.

Notify the Engineer prior to the placement of the materials. At the time of notification, submit a certification to the Engineer with the APL number and the batch or Lot numbers of the thermoplastic and glass spheres to be used. Packaging labels that contain the information required by 971-1.1 will be accepted in place of a certification.

711-6 Protection of Newly Applied Thermoplastic Pavement Markings.

Do not allow traffic onto or permit vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace any portion of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

711-7 Observation Period.

Longitudinal pavement markings are subject to a 180 day observation period under normal traffic. The observation period shall begin with the satisfactory completion and acceptance of the work. The longitudinal pavement markings shall show no signs of failure due to blistering, excessive cracking, chipping, discoloration, poor adhesion to the pavement, loss of retroreflectivity or vehicular damage. The retroreflectivity shall meet the initial requirements of 711-4.3. The Department reserves the right to check the retroreflectivity any time prior to the end of the observation period. Replace, at no additional expense to the Department, any longitudinal pavement markings that do not perform satisfactorily under traffic during the 180 day observation period.

711-8 Corrections for Deficiencies.

Recapping applies to conditions where additional pavement marking material is applied to new or refurbished pavement markings to correct a thickness deficiency. Correct deficiencies by recapping or removal and reapplication of a 1 mile section centered around the deficiency, as determined by the Engineer, at no additional cost to the Department.

711-9 Submittals.

711-9.1 Submittal Instructions: Prepare a certification of quantities, using the Department's current approved form, for each project in the Contract. Submit the certification of quantities and daily worksheets to the Engineer. The Department will not pay for any disputed items until the Engineer approves the certification of quantities.

711-9.2 Contractor's Certification of Quantities: For all items except railroad dynamic envelope, request payment by submitting a certification of quantities no later than Twelve O clock noon Monday after the estimate cut-off date or as directed by the Engineer, based on the amount of work done or completed. Ensure the certification of quantities consists of the following:

Exhibit D

1. Contract Number, FPID Number, Certification Number, Certification Date and the period that the certification represents.
2. The basis for arriving at the amount of the progress certification, less payments previously made and less any amount previously retained or withheld. The basis will include a detailed breakdown provided on the certification of items of payment.

711-10 Method of Measurement.

711-10.1 Certified Quantities: The certified quantities, authorized and acceptably applied, under this Section will be paid as follows:

1. The length, in gross miles, of solid, 10'-30' skip, 3'-9' dotted, 6'-10' dotted, 2'-2' dotted, and 2'-4' dotted lines.
2. The length, in linear feet, of transverse lines, diagonal lines, chevrons, and parking spaces.
3. The number of pavement messages, symbols, and arrows. Each arrow is paid as a complete marking, regardless of the number of "points" or directions.
4. The area, in square feet, for removal of existing thermoplastic pavement markings acceptably removed. Payment for removal of thermoplastic pavement markings will only be made for locations where the existing pavement surface is to remain.

The gross mile measurement will be taken as the distance from the beginning of the thermoplastic line to the end of the thermoplastic line and will include the unmarked gaps for skip and dotted lines. The gross mile measurement will not include designated unmarked lengths at intersections, turn lanes, etc. Final measurement will be determined by plan dimensions or stations, subject to 9-1.3.1.

711-10.2 Plan Quantities: The plan quantity length, in linear feet of railroad dynamic envelope markings.

711-11 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including, all cleaning and preparing of surfaces, furnishing of all materials, application, curing and protection of all items, protection of traffic, furnishing of all tools, machines and equipment, and all incidentals necessary to complete the work. Final payment will be withheld until all deficiencies are corrected. Payment will be made under:

Line Item Exhibit "E"