



CONSTRUCTION SPECIFICATION FOR PAVEMENT MARKINGS

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710.01 SCOPE

This specification covers the requirements for the application of pavement markings.

710.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standards Specifications, Construction

OPSS 313 Hot Mix Asphalt - End Result

Ontario Provincial Standards Specifications, Material

OPSS 1712 Organic Solvent Based Traffic Paint
OPSS 1713 Thermoplastic Pavement Marking Materials
OPSS 1714 Field Reacted Polymeric Pavement Marking Materials
OPSS 1715 Preformed Plastic Pavement Marking Tape
OPSS 1716 Water-Borne Traffic Paint
OPSS 1750 Traffic Paint ReflectORIZING Glass Beads

Ontario Ministry of Transportation Publications

Designated Source for Materials (DSM)

Laboratory Testing Manual:

LS-425 Method of Test for Glass Bead Application Rate and Dry Film Thickness for Spray Applied Pavement Markings

MTO Forms:

PH-CC-360 Pavement Marking Sample Data

Ontario Traffic Manuals (OTM)

ASTM International

D7585/D7585M-10(2022) Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments

E1347-06(2020) Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

E1710-18 Standard Test Method for Measurement of Retroreflective Pavement Marking

710.03 DEFINITIONS

For the purpose of this specification, the following definitions shall apply:

Agglomerate Marking means a pavement marking that is comprised of irregular small clusters of material applied such that the pavement marking surface is textured but appears continuous from the driver's perspective.

Black Contrast Marking means a black pavement marking used to enhance daytime contrast for a pavement marking on a light-coloured pavement surface.

Black Line Mask means a preformed plastic tape applied over existing pavement markings to facilitate temporary lane shifts.

Blackout Marking means a black pavement marking material used to temporarily obscure an existing pavement marking until it can be removed by obliterating, milling, or paving.

Extrusion means the process for applying pavement marking material to a surface by forcing the material through a die to give it a specific shape.

Field Reacted Polymeric Pavement Marking Material means a pavement marking material consisting of two separate components; a polymerizable component and a curing agent or a polymerization catalyst.

Final Pavement Markings means permanent pavement markings and symbols applied to the pavement surface to delineate vehicle operating limits according to the size and shape specified in OTM Book 11.

Formed In Place Thermoplastic means a pavement marking material that becomes molten and flowable on heating and hardens after cooling. The pavement marking material is first melted before extrusion onto the pavement surface.

Northern Ontario means areas within and north of the Districts of Parry Sound, Nipissing, and Manitoulin within the Province of Ontario.

Organic Solvent Based Traffic Paint means a traffic paint in which the components are carried in an organic solvent system and will form a solid paint film upon evaporation of the solvent after application.

Pavement Marker means a manufactured reflector placed on the pavement surface or within a recess cut into the pavement surface.

Pavement Markings means markings on pavement surfaces used to delineate vehicle operating limits on Roadways, according to the size and shape specified in OTM Book 11.

Pavement Marking Material Standard Specifications means the following Standard Specifications, OPSS 1712, OPSS 1713, OPSS 1714, OPSS 1715, OPSS 1716 and OPSS 1750.

Preformed Plastic Pavement Marking Tape means a polymer material specifically designed with an adhesive backing and made into pliable rolls or ribbons of various lengths and widths, or into symbols.

Preformed Thermoplastic means a pavement marking material that becomes molten and flowable on heating and hardens after cooling. The pavement marking material is supplied in predefined extruded shapes that are melted onto the pavement surface with a propane torch.

Premarking means the process of laying out and identifying on the pavement surface the position of all pavement markings (including lane widths, marking type, marking spacing, and the location of passing zones).

Recessed Pavement Marking means a marking placed in a groove cut into the pavement surface.

Retroreflectivity means the reflection of light back to its source. In the context of pavement marking performance, retroreflectivity refers to the reflection of light from vehicle headlights onto the pavement marking and back to the driver's eyes. ASTM E1710 defines this retroreflectivity geometry at a distance of 30 m and 1.05°.

Reflectorizing Glass Beads means transparent glass microspheres that are applied to the pavement marking material surface to impart retroreflectivity and enhance nighttime visibility.

Rumble Stripe means a pavement marking that is applied to a pavement rumble strip.

Short Term Pavement Markings means markings applied to the pavement surface that are intended for short duration use and are generally shorter in marking length and have longer gap spacing than OTM Book 11 requirements.

Southern Ontario means areas south of the Districts of Parry Sound, Nipissing, and Manitoulin within the Province of Ontario.

Stripe means a long narrow band or strip, with a uniform width throughout its length and differing in color from the pavement surface surrounding it.

Temporary Pavement Markings means pavement markings and symbols intended for use on all types of driving surfaces temporarily, such as for detours, lane shifts, and other traffic diversions.

Temporary Non-Removable Pavement Markings means temporary pavement markings using materials designed to not be removed after use.

Temporary Removable Pavement Markings means temporary pavement markings consisting of a tape product with a supporting matrix such as a fibre web to aid in the removal of the marking from the pavement surface.

Traffic Paint means a paint specifically formulated for use as a pavement marking.

Water Borne Traffic Paint means a traffic paint whose components are carried in water either as an emulsion or a dispersion and will form a solid paint film on application after evaporation of water and volatiles.

Winter Period means the time period from October 1 to May 1 within northern Ontario, and October 15th to April 15th within southern Ontario.

710.04 DESIGN AND SUBMISSION REQUIREMENTS

710.04.01 Submission Requirements

710.04.01.01 Pavement Markings

A list of pavement marking products selected for use in the Work shall be submitted to the Contract Administrator at least 7 Days prior to the application of any pavement markings. The list shall identify the intended use for each product with reference to the pavement marking locations specified in the Contract Documents. The submission shall include a copy of the manufacturer's recommendations for the application of each product listed. The manufacturer's recommendations shall include the application equipment and environmental constraints such as temperature and relative humidity.

710.04.01.02 Recess Cut, Pavement Markings

The pavement marker manufacturer's recommendations for recess cut shall be submitted to the Contract Administrator.

710.05 MATERIALS

710.05.01 Blackout Marking

Line obliterating paint used for blackout marking shall be a product listed on the MTO DSM.

710.05.02 Pavement Markers

Pavement markers shall be a product listed on the MTO DSM.

710.05.03 Pavement Marking

710.05.03.01 General

Under no circumstances shall the pavement marking material formulation be altered from materials previously approved for use by the Owner.

710.05.03.02 Temporary and Final Pavement Markings

Temporary and final pavement markings shall be a product on the MTO DSM with approved use for the performance group specified in the Contract Documents and according to Table 1.

For the item Temporary Pavement Marking, Orange, a product on the MTO DSM with orange or fluorescent orange in the colour column and according to Table 1 shall be used.

710.05.04 Reflectorizing Glass Beads

When the MTO DSM associates a specific glass bead product with a pavement marking product selected for use, the specific glass bead product shall be used. Pavement marking products without an associated specific glass bead product shall use a reflectorizing glass bead product listed on the MTO DSM.

710.06 EQUIPMENT

710.06.01 General

The equipment used for application of pavement markings shall be as recommended by the manufacturer of the respective pavement marking material and shall meet the specific requirements below.

710.06.02 Air Compressor

The air compressor shall be equipped with oil and moisture filters and provide a minimum pressure of 700 kPa at a minimum air volume of 4.25 cubic metres per minute (150 cubic feet per minute).

710.06.03 Application Equipment

Equipment for application of field reacted polymeric pavement marking material shall be capable of thoroughly mixing the components at the manufacturer's specified ratio for proper curing of the applied product.

Equipment for the application of field reacted agglomerate polymeric material shall be capable of controlling the application such that the specified geometric elements of the agglomerate markings are met.

Equipment for application of thermoplastic material shall be capable of mixing, maintaining, and applying the material at the manufacturer's specified temperature.

710.06.04 Recessing Equipment

The recessing equipment shall be equipped with either a free-floating saw blade cutting head or a free-floating grinder cutting head configured with diamond or carbide tipped cutters capable of cutting well-defined grooves in a single or double pass using a dry cut method. The equipment shall result in a fine corduroy finish at the bottom of the cut.

710.06.05 Spray Equipment

Spray equipment shall provide a uniform stripe of the required width and thickness, with sharp edges without excessive splatter or overspray. The equipment shall have the capability to produce pavement markings according to OTM Book 11. The equipment shall include dispensers to apply reflectorizing glass beads at the specified rate(s).

Spray equipment used to apply pavement markings to centerline rumble strips shall be:

- a) Outfitted with a minimum of two dispensers for reflectorizing glass beads per line; and
- b) Angled appropriately both forward and backward to ensure that both sides of the centerline rumble strip inclines receive complete surface coverage of reflectorizing glass beads.

710.07 CONSTRUCTION

710.07.01 General

A minimum of 3 Business Days notice shall be provided to the Contract Administrator prior to the application of pavement markings.

Pre-marking shall be applied prior to the application of pavement markings.

Pavement markings and symbols shall be applied according to OTM Book 11, the manufacturer's recommendations, and as specified in the Contract Documents

All pavement markings shall be accurately located and spaced as specified in the Contract Documents. All pavement markings shall be accurately located, spaced, present a clean-cut, and uniform appearance during both the day and night.

Markings shall be offset from longitudinal pavement joints according to OPSS 313.

Reflectorizing glass beads shall not be applied to black marking material when used either as a black contrast marking or as a blackout marking.

710.07.02 Operational Constraints

Pavement marking materials shall only be applied when the environmental conditions are according to Table 2.

All pavement markings shall be fully cured and dry prior to permitting traffic onto the markings. Uncured pavement markings shall be protected from potential damage using traffic control procedures according to OTM Book 7 until the pavement markings has cured and dried.

Blackout markings may be applied and maintained to completely obscure existing pavement markings as a temporary measure and shall not to exceed 7 Days. A reapplication of blackout markings to extend the time period for a further 7 Days is not permitted. The blackout and existing markings shall be completely obliterated prior to the expiration of the 7 Day period.

710.07.03 Pavement Marking Obliterating

Pavement marking obliterating shall be to the minimum depth required to completely remove the existing pavement markings.

The obliterating shall not damage the pavement. Dust and effluent generated by the work shall be controlled. Pavement marking obliterating on final course asphalt pavement shall be done using compressed air abrasive blasting.

Pavement marking obliterating on concrete pavement and non-final course asphalt pavement shall be done using compressed air abrasive blasting or high-pressure water blasting.

710.07.04 Surface Preparation

710.07.04.01 General

All surface preparation shall be completed without leaving the pavement in a condition that may mislead or misdirect road users.

710.07.04.02 Recessed Pavement Marking, Symbol, and Pavement Markers

Cutting into pavement for recessed pavement markings, symbols, and pavement markers shall be at the locations specified in the Contract Documents, using recess cutters.

For pavement markings and symbols, the recess cut depth shall be 3.0 mm to 5.0 mm. The recess cut width shall be not more than 20 mm wider than the width of the pavement markings and symbols to be placed. For concrete pavement, the recess cut shall extend 3 m beyond each lane line marking for the installation of black contrast marking. Cuttings shall be removed by truck mounted vacuum.

The recess cut for pavement markers shall be according to the Contract Documents and the pavement marker manufacturer's recommendations.

710.07.04.03 Cleaning

710.07.04.03.01 Pavement Surfaces Other Than Non-Recessed Concrete

The pavement surface shall be dry and cleaned of all dirt, loose material, and other contaminants using an air compressor immediately prior to the application of the pavement markings.

710.07.04.03.02 Non-Recessed Concrete Pavement Surfaces

Non-recessed concrete pavement surfaces shall be cleaned using a high-pressure water blasting or compressed air abrasive blasting.

The blasting shall completely remove curing compounds, concrete surface sealers, surface and embedded accumulations of laitance, trowel finishes, and other similar characteristics and leave a bare concrete surface with exposed aggregate. The blast preparation of the concrete pavement surface shall be a minimum of 10 cm wider than the pavement markings to be applied, such that an additional 5 cm of prepared area is on both sides of the pavement markings after they are applied.

The pavement surface shall be dry and cleaned of all dirt, loose material, and other contaminants using an air compressor immediately prior to the application of pavement markings.

710.07.05 Pavement Marking Application

710.07.54.01 General

Pavement markings shall be applied to produce a uniform dry film thickness across the width of the pavement marking. The dry film thickness of the applied materials shall be according to Table 3.

Lane lines, continuity lines and edge lines on tangent sections of constant width shall:

- a) Be placed parallel to one another,
- b) Maintain the correct offset from the centreline and from one another, and
- c) Be straight and true.

Pavement markings placed to delineate changes in the number of lanes, variations in Roadway width or adjustments in lane width shall be straight and true.

Pavement markings placed on curves shall accurately follow the change in direction prescribed by the Roadway.

Transition from adjacent tangent sections shall occur smoothly and at a constant rate over the specified distance.

Pavement markings shall always maintain the specified lane width.

Where longitudinal pavement joints and pavement markings coincide, the pavement markings shall be uniformly offset a minimum of 50 mm, to a maximum of 150 mm.

Agglomerate markings shall be applied by a process which results in agglomerate islands with the following geometric elements:

- a) A height of 1 to 5 mm.
- b) Voids of 20 to 35% of the surface area between the agglomerate islands.

Reflectorizing glass beads application rate shall be according to Table 3. Reflectorizing glass beads shall be applied immediately after pavement marking material application.

710.07.05.02 Traffic Signal Controlled Intersections

The application of pavement markings and activation of traffic signals shall be coordinated as specified in the Contract Documents.

The application of temporary and final pavement markings for stop lines, pedestrian crosswalks, and lane designation markings for the two higher volume approaches to traffic signals shall be completed the same Day the traffic signals are activated.

The application of the pavement markings for stop lines, pedestrian crosswalks, and lane designation markings for the two lower traffic volume approaches to the traffic signals, and all edge lines shall be completed within a 48-hour window prior to the activation of the traffic signals.

710.07.05.03 Short Term Pavement Marking

Short term pavement marking shall be applied when a paved Roadway will be opened to public traffic prior to the application of temporary or final pavement markings according to the Contract Documents. Short term pavement markings shall consist of centerline, edge, and lane lines.

Short term pavement markings applied to the final surface course shall be temporary removable pavement markings. Short term pavement markings for milled surfaces shall be paint.

The short term markings shall be applied according to Table 4, OTM Book 11, and the manufacturer's specifications. In the event of conflict between Table 4 and OTM Book 11, Table 4 shall govern.

Temporary or final pavement markings shall be applied prior to the end of the maximum length of time period specified in Table 4.

710.07.05.04 Temporary Pavement Marking

When traffic paint and reflectorizing glass beads are selected for use as temporary pavement marking, the materials shall be reapplied in the spring and in the fall of any year. A minimum of two applications shall have been applied prior to the commencement of a seasonal shutdown period. When more than one application is required, the second application shall be the same material used for the first application, or chemically compatible with the first application according to the pavement marking manufacturer.

Temporary raised pavement markers shall be installed according to the Contract Documents and the manufacturer's recommendations.

Preformed plastic pavement marking tape joints shall be butt joints without overlap.

Black line mask shall be used as specified in the Contract Documents. Black line mask shall completely cover the existing pavement markings.

Preformed plastic pavement marking tape and black line mask shall not be used during a seasonal shutdown period.

Removable temporary pavement markings shall be removed when no longer required. Existing pavement markings damaged during black line mask removal shall be repaired to the satisfaction of the Contract Administrator.

710.07.05.05 Removal of Short Term, Temporary, and Temporary Non-removable Pavement Markings

Removal of pavement marking shall completely remove the pavement marking without damaging the pavement surface, colour, or texture.

Short term pavement markings shall be obliterated prior to the application of final pavement markings.

Temporary pavement markings shall be obliterated prior to the application of final pavement markings. Removal is not required if a letter from the manufacturer of the final pavement marking material is submitted to the Contract Administrator stating that the final pavement marking material is compatible with the temporary marking material.

Temporary non-removable pavement markings shall be removed prior to the application of final pavement markings using compressed air abrasive blasting.

710.07.05.06 Final Pavement Marking

710.07.05.06.01 General

Final pavement markings shall not be applied until a minimum of 10 Days has elapsed after the application of short term pavement markings.

When final pavement markings are applied to rumble strips, the final pavement marking shall be applied for complete coverage across the rumble strips, including both side walls of the rumble strip groove.

Recessed pavement markers shall be installed according to the Contract Documents and the manufacturer's recommendations.

710.07.05.06.02 Traffic Paint

Two applications of traffic paint shall be applied to the pavement surface. The second application shall be aligned on top of the first application. The second application shall be applied between no earlier than 24 hours and no later than 7 Days after the first application.

710.07.05.06.03 Preformed Thermoplastic

Prior to the application of the preformed thermoplastic, any pavement surface moisture shall be removed by drying the area with a propane fueled torch. The torch shall be kept moving and held at a sufficient distance to prevent damage to the pavement.

All connecting individual segments of the preformed thermoplastic shall be positioned on the pavement surface with the top side up and no gaps between adjoining segments. The preformed thermoplastic material shall be heated with a propane fueled torch until the heat indicator indents close, the material seams fuse together, and the material edges are round.

710.07.05.06.04 Black Contrast Marking

Black contrast marking shall be used on concrete pavement surfaces.

Black contrast marking shall be applied 3 m beyond each lane line marking, in the direction of traffic flow. The width of the black contrast markings shall be identical to the preceding lane line marking.

710.07.07 Material Sampling and Testing

710.07.07.01 Pavement Marking and Reflectoring Glass Bead - Material Property Testing

Sampling, handling, identification, and delivery of pavement marking materials shall be according to Table 5 and the Contract Documents. One sample of each material shall be taken per lot for testing by the Owner.

Samples shall be taken as directed by the Contract Administrator. Samples for field reacted polymeric pavement marking materials shall be taken prior to addition of catalyst.

Samples of all liquid pavement marking materials shall be representative of the material used and shall not be altered in any way. The pavement marking material shall be well mixed and homogeneous and shall be acquired approximately mid-way through the pavement marking application operation. Sample containers shall be filled to within 5 mm of the bottom of the lid rim.

A Pavement Marking Sample Data Form PH-CC-360 and appropriate safety data sheets shall be submitted to the Contract Administrator with each sample.

710.07.07.02 Sampling for Reflectorizing Glass Bead Application Rate and Dry Film Thickness

Steel panels shall be provided according to LS-425, for sampling of glass bead application rate and dry film thickness testing by the Owner. One set of 2 samples (one unbeaded and one beaded) shall be taken per lot for acceptance testing by the Owner. The samples shall be taken at a random location within the lot, as directed by the Contract Administrator. Samples shall be taken according to LS-425. A set of samples for referee testing purposes shall be taken at the same random location as each set of acceptance samples. Handling, identification and delivery of samples shall be according to the Contract Documents.

710.07.07.03 Traffic Control for Retroreflectivity Measurements

Traffic control shall be provided as required for the purpose of retroreflectivity measurements, including rescheduled measurements and remeasurements.

710.07.08 Management of Excess Materials

Management of excess material shall be according to the Contract Documents.

710.08 QUALITY ASSURANCE

710.08.01 General

Acceptance of pavement marking materials shall be based on quality assurance testing by the Owner and visual observations carried out by the Contract Administrator during material application. Unacceptable pavement markings shall be repaired or removed and replaced, as directed by the Contract Administrator, at no additional cost to the Owner.

710.08.02 Pavement Marking and Glass Bead Material Properties

710.08.02.01 Lot Size

The lot size for pavement marking and glass bead material property testing shall consist of all the material applied in 1 Day.

710.08.02.02 Acceptance

Samples of pavement marking materials and reflectorizing glass beads shall be tested for acceptance according to the pavement marking material Standard Specifications. The lot for pavement marking and glass bead materials shall be acceptable if the samples tested meet the DSM requirements. Unacceptable lots of pavement markings and reflectorizing glass beads shall be removed and replaced at no additional cost to the Owner.

710.08.02.03 Referee Testing

Referee testing may only be invoked by the Contractor within 5 Business Days of receiving the test result.

When referee testing is invoked, the sample representing a lot shall be referee tested and the acceptance test results discarded. The lot referee test results shall replace the acceptance test result in the acceptance requirements of this specification.

Referee testing shall be carried out on the remaining sample that was tested for acceptance.

710.08.03 Reflectoring Glass Bead Application Rate and Dry Film Thickness

710.08.03.01 Lot Size

The lot size for reflectoring glass bead application rate and dry film thickness shall consist of all the pavement markings of each material type, placed in 1 Day.

710.08.03.02 Acceptance

Pavement marking and reflectoring glass bead application rates for extruded, ribbon, screed and textured markings shall be determined using plates according to LS-425. Pavement marking dry film thickness and reflectoring glass bead application rate, for a lot, shall be acceptable if they meet the requirements specified in Table 3. Unacceptable lots of pavement markings and reflectoring glass beads shall be removed and replaced at no additional cost to the Owner.

710.08.03.03 Referee Testing

Referee testing may only be invoked by the Contractor within 5 Business Days of receiving the test result.

When referee testing is invoked, the sample representing a lot shall be referee tested and the acceptance test results discarded. The lot referee test results shall replace the acceptance test result in the acceptance requirements of this specification.

Referee testing shall be carried out on the duplicate samples taken at the same time as the acceptance samples.

710.08.04 Line Quality

The Contract Administrator shall carry out a visual inspection to assess the line width, thickness, spacing, the nature of the edges and uniformity in appearance. Markings shall be sharp, well defined, uniformly reflective, and with no over-spray.

Reflectoring glass bead distribution shall be inspected for evenness of distribution, degree of embedment, application rate and retroreflectance.

All or a portion of the work that does not meet the line quality requirements of this specification is unacceptable. Unacceptable pavement markings shall be repaired or removed and replaced, as directed by the Contract Administrator, at no additional cost to the Owner.

710.08.05 Retroreflectivity

The lot size for retroreflectivity measurements shall be 250 lineal meters of pavement marking.

Retroreflectivity measurements shall be completed by the Contract Administrator using a handheld or mobile retroreflectometer instrument. The initial retroreflectivity shall be measured no earlier than 2 Days after exposure of the pavement markings to traffic. The pavement markings shall be dry and free of debris immediately prior to measurement. In the event of unacceptable measurement conditions, the measurement shall be rescheduled by the Contract Administrator.

Measurements with a mobile retroreflectometer shall be according to ASTM E1710 and averaged in 250 m increments. Measurements with a hand-held retroreflectometer shall be according to ASTM D7585.

Retroreflectivity shall be measured initially within 14 Days of pavement marking application.

The initial measured retroreflectivity, (millicandelas/square meter/lux, mcd/m² lx), shall be according to Table 6. The Table 6 retroreflectivity requirements shall apply for a period of 14 Days after the application of temporary pavement markings, and for a period of 45 Days after the application of final pavement markings.

Lots meeting the requirements of this specification are acceptable. Unacceptable lots shall be repaired or removed and replaced, as directed by the Contract Administrator, at no additional cost to the Owner.

710.08.06 Warranty

710.08.06.01 General

The warranty period shall apply to the entire duration of use of Group I and Group II temporary pavement markings, and for one year after the date of application of Group 1, 2, 3 and 4 final pavement markings.

710.08.06.02 Retained Retroreflectivity

For the duration of the warranty period, the minimum retroreflectivity shall be 175 mcd/m² lx for white markings and 150 mcd/m² lx for yellow and orange markings when measured according to ASTM E1710.

710.08.06.03 Durability

For the duration of the warranty period:

- a) There shall be not more than 25% material loss within any 100 m length of continuous pavement marking. The durability class shall be Class 1 or 2.
- b) There shall be not more than 25% material loss from any individual broken lane line marking. The durability class shall be Class 1 or 2.
- c) There shall be not more than 25% material loss from any pavement marking symbol. The durability class shall be Class 1 or 2.

Material loss and durability class shall be assessed according to Figures 1, 2 ,3, 4 and 5.

710.08.07 Black Line Mask

If more than 10 m of black line mask within any 300 m length of continuous or broken black line masking fails, exposing the underlying existing pavement markings, the black line mask shall be reapplied to all failed areas within 48 hours of the occurrence of the failure.

If less than 10 m of black line mask within any 300 m length of continuous or broken black line masking fails, exposing the underlying existing pavement markings, black line mask shall be reapplied in the failed areas within 7 Days of the occurrence of the failure.

Black line mask reapplications shall be completed as many times as is necessary to meet these requirements.

712.08.08 Removal and Replacement

Temporary and final pavement markings that fail to meet the requirements of this specification shall be rejected.

Rejected markings shall be removed and replaced within 7 Days of receiving written notification from the Contract Administrator. All removed pavement marking material shall be replaced with material from the same performance group as the originally applied material.

Rejected final pavement markings shall be removed such that a minimum of 90% of the rejectable pavement marking is removed prior to applying replacement final pavement markings. The removal operation shall be controlled so that the pavement surface or texture is not materially or structurally damaged in any way.

Rejected final pavement markings that require repair during the winter period shall be repaired using temporary pavement markings within 7 Days of the Contract Administrator notification. The temporary and underlying unacceptable final pavement markings shall be removed after the end of the winter period immediately prior to applying replacement final pavement markings according to the Contract Documents.

All replacement final pavement markings shall meet the Table 6 retroreflectivity requirements for a minimum of 45 Days after replacement and shall meet the retained minimum retroreflectivity and durability requirements for the remainder of the original warranty period.

710.09 MEASUREMENT FOR PAYMENT

710.09.01 Actual Measurement

- 710.09.01.01 Pavement Marking Obliterating**
- Pavement Marking Obliterating - Abrasive Blasting**
- Temporary Pavement Marking, Non-Removable, Group I**
- Temporary Pavement Marking, Non-Removable, Group II**
- Temporary Pavement Marking, Removable**
- Temporary Pavement Marking, Black Line Mask**
- Temporary Pavement Marking, Orange**
- Black Contrast Marking**
- Final Pavement Marking, Group 1**
- Final Pavement Marking, Group 2**
- Final Pavement Marking, Group 3**
- Final Pavement Marking, Group 4**
- Recessed Marking Cut**

Measurement shall be by the horizontal length in metres of 10 cm wide pavement markings and recessed cuts, excluding gaps. Wider markings and cuts shall be measured in 10 cm equivalents.

- 712.09.01.02 Temporary Pavement Marking Symbols, Non-Removable, Group I**
- Temporary Pavement Marking Symbols, Non-Removable, Group II**
- Temporary Pavement Marking Symbols, Removable**
- Final Pavement Marking Symbols, Group 1**
- Final Pavement Marking Symbols, Group 2**
- Final Pavement Marking Symbols, Group 3**
- Final Pavement Marking Symbols, Group 4**
- Recessed Marking Symbol Cut**
- Raised Pavement Markers, Temporary**
- Pavement Markers, Recessed**

For measurement purposes, a count shall be made of the number of symbols applied, symbol recesses cut, and pavement markers installed.

710.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurements shall be based on the units shown in the clauses under Actual Measurement.

710.10

BASIS OF PAYMENT

710.10.01

- Pavement Marking Obliterating - Item**
- Pavement Marking Obliterating - Abrasive Blasting - Item**
- Temporary Pavement Marking, Non-Removable, Group I - Item**
- Temporary Pavement Marking, Non-Removable, Group II - Item**
- Temporary Pavement Marking, Removable - Item**
- Temporary Pavement Marking Symbols, Non-Removable, Group I - Item**
- Temporary Pavement Marking Symbols, Non-Removable, Group II - Item**
- Temporary Pavement Marking Symbols, Removable - Item**
- Temporary Pavement Marking, Black Line Mask - Item**
- Temporary Pavement Marking, Orange - Item**
- Black Contrast Marking - Item**
- Final Pavement Marking, Group 1 - Item**
- Final Pavement Marking, Group 2 - Item**
- Final Pavement Marking, Group 3 - Item**
- Final Pavement Marking, Group 4 - Item**
- Final Pavement Marking Symbols, Group 1 - Item**
- Final Pavement Marking Symbols, Group 2 - Item**
- Final Pavement Marking Symbols, Group 3 - Item**
- Final Pavement Marking Symbols, Group 4 - Item**
- Recessed Marking Cut - Item**
- Recessed Marking Symbol Cut - Item**
- Raised Pavement Markers, Temporary - Item**
- Pavement Markers, Recessed - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

The Contract price for the above tender items shall be deemed to include the cost of all labour, Equipment, and Material to apply short term pavement markings.

The application of temporary pavement markings, as required, shall be at no additional cost to the Owner.

**TABLE 1
Material Sources**

Type of Pavement Marking	Item	DSM Description	DSM Listing
Temporary Line	Temporary Pavement Marking, Non-Removable, Group I	Pavement Markings, Paint	5.85.40
	Temporary Pavement Marking, Non-Removable, Group II	Pavement Markings, Field Reacted Polymeric Spray, Pavement Markings, Durable	5.85.43, 5.85.45
	Temporary Pavement Marking, Removable	Pavement Markings, Temporary Tape	5.85.50
	Temporary Pavement Marking, Black Line Mask	Temporary Line Obliterating Paint	5.85.33
Temporary Symbol	Temporary Pavement Marking Symbols, Non-Removable, Group I	Pavement Markings, Paint	5.85.40
	Temporary Pavement Marking Symbols, Non-Removable, Group II	Pavement Markings, Field Reacted Polymeric Spray, Pavement Markings, Durable	5.85.43, 5.85.45
	Temporary Pavement Marking Symbols, Removable	Pavement Markings, Temporary Tape	5.85.50
Final Line	Final Pavement Marking, Group 1	Pavement Markings, Paint	5.85.40
	Final Pavement Marking, Group 2, High Build Water Borne Paint	Pavement Markings, High Build Paint, Premium Paint	5.85.44
	Final Pavement Marking, Group 3	Pavement Markings, Field Reacted Polymeric Spray	5.85.43
	Final Pavement Marking, Group 4	Pavement Markings, Durable	5.85.45
	Black Contrast Marking	Pavement Markings, Field Reacted Polymeric Spray	5.85.43
Final Symbol	Final Pavement Marking Symbols, Group 1	Pavement Markings, Paint	5.85.40
	Final Pavement Marking Symbols, Group 2, High Build Water Borne Paint	Pavement Markings, High Build Paint, Premium Paint	5.85.44
	Final Pavement Marking Symbols, Group 3	Pavement Markings, Field Reacted Polymeric Spray	5.85.45
	Final Pavement Marking Symbols, Group 4	Pavement Markings, Durable	5.85.45
Reflectorizing Glass Beads	All Applicable Items	Reflectorizing Glass Beads	5.85.38

**TABLE 2
Operational Constraints - Pavement Marking Application**

Pavement Marking Material Type	Environmental Conditions		
	Pavement Surface Temperature, °C	Ambient Air Temperature, °C	Relative Humidity, %
Standard Water Borne Paint	≥ 5	-	-
High Build Water Borne Paint	≥ 5	-	-
Organic Solvent Based Traffic Paint	≥ 3 (Note 1)	-	-
Preformed Thermoplastic	≥ 5	-	≤ 70
Formed In Place Thermoplastic	≥ 5	-	≤ 70
Field Reacted Polymeric	≥ 5 and ≤ 35	-	≤ 70
Preformed Plastic Tape (Note 2)	≥ 10	≥ 10	-
Notes:			
1. The temperature requirements do not apply when organic solvent based traffic paint is used as a blackout marking.			
2. Pavement and air temperatures shall be forecasted to be a minimum of 10 °C for at least 2 hours following application.			

**TABLE 3
Dry Film Thickness and Reflectorizing Glass Beads Application Rate**

Pavement Marking Type	Dry Film Thickness	Reflectorizing Glass Beads Application Rate
Standard Water Borne Markings	230 µm, minimum	1.0 kg per litre of marking material, minimum
High Build Water Borne Markings	400 µm, minimum	1.0 kg per litre of marking material, minimum
Organic Solvent Based Traffic Paint	230 µm, minimum	1.0 kg per litre of marking material, minimum
Blackout Markings	150 µm, minimum	N/A
Thermoplastic Markings, Extrusion Applied	1.90 mm ± 0.40 mm	1.5 kg ± 0.1 kg per 10 m ² of marking
Field Reacted Polymeric Pavement Marking Material?, Extrusion Applied	1.90 mm ± 0.40 mm	1.5 kg ± 0.1 kg per 10 m ² of marking
Field Reacted Polymeric Pavement Marking Material?, Spray Applied	500 µm, minimum	2.0 kg per litre of marking material
Agglomerate	-	1.5 kg ± 0.1 kg per 10 m ² of marking

TABLE 4
Short-Term Pavement Markings

Type of Roadway	Minimum Length of Lines	Maximum Length of Gaps	Maximum Length of Time before Temporary or Final Pavement Markings are Applied
Freeway - Six Lanes or Greater, Three Lanes or Greater per Direction	3 m	9 m	21 Days
Freeway - Four Lanes, Two Lanes per Direction	0.3 m	15 m	21 Days
Major Roadways- Six Lanes or Greater, Three Lanes per Direction	3 m	6 m	21 Days
Major Roadways - Four Lanes, or Less	0.3 m	15 m	21 Days
Minor Roadways	0.3 m	15 m	28 Days

TABLE 5
Pavement Marking Material Sampling for Material Properties Testing

Material	Sample Size	Container Material	Source
Organic solvent based traffic paint	125 mL	Metal	Outlet valve (not spray gun)
Water borne traffic paint	125 mL	Plastic or plastic lined	Outlet valve (not spray gun)
Field reacted polymeric pavement marking materials, Resin (Note 1)	250 g	Metal or plastic	Pail
Field reacted polymeric pavement marking materials, Catalyst (Note 1)	50 g	Metal or plastic	Pail
Thermoplastic materials	250 g	Steel panel	Applicator (Note 2)
Reflectorizing glass beads	250 g	Metal or plastic	Bead gun
Preformed tape	1 m	Container not required	Roll
<p>Notes:</p> <ol style="list-style-type: none"> 1. Material type and manufacturer's mixing ratio of each unmixed material shall be indicated on the container. 2. An approximate 8 cm x 8 cm raw material block sample of the thermoplastic material can be substituted for the coated panel sample. 			

TABLE 6
Retroreflectivity Minimum Requirements (mcd/m² lx)

Pavement Marking Type	Marking Colour		
	White	Yellow	Orange
Temporary Pavement Marking Non-Removable – Group I	350	250	250
Temporary Pavement Marking Non-Removable – Group II	400	300	300
Final Pavement Marking – Groups 1, 2 and 3	350	250	-
Final Pavement Marking – Group 4	400	300	-



**FIGURE 1:
Durability Class 1 (<5% Material Loss)**



**FIGURE 2:
Durability Class 2 (5% to 25% Material Loss)**



**FIGURE 3:
Durability Class 3 (50% to 75% Material Loss)**



**FIGURE 4:
Durability Class 4 (75% to 85% Material Loss)**



**FIGURE 5:
Durability Class 5 (85% to 100% Material Loss)**