Pavement Marking Specifications

Pavement Marking Specifications – General

Abbreviations

When the following abbreviations are used in the Pavement Marking Specifications, they shall have the following meanings:

BPN British Pendulum Number

DSM Designated Sources for Materials

MMA Methyl Methacrylate

MTO Ontario Ministry of Transportation

OPSS Ontario Provincial Standard Specification

General Requirements for Pavement Markings

These general requirements apply to Items PM001 to PM012, as applicable, and shall be read in conjunction with OPSS.MUNI 710 (Nov 2021), OPSS.MUNI 1712 (Nov 2021), OPSS.MUNI 1713 (Nov 2021), OPSS.MUNI 1714 (Apr 2023) and OPSS.MUNI 1750 (Nov 2021).

The following Standard Drawing is applicable to Items PM001 to PM012, as applicable: DS-400.

Scope of Work

The Contractor shall:

* supply and apply:
	+ reflectorized, non-coning, permanent durable pavement markings; and/or
	+ traffic paint pavement markings;
* provide pre-marking to establish the position of all pavement markings in accordance with OPSS.MUNI 710; and
* use appropriate traffic control measures to protect freshly painted lines from being tracked or smeared by the travelling public.

Equipment Requirements

The Contractor shall use a self-propelled pavement marking unit to perform the pavement marking work. The unit shall:

* be capable of producing top quality markings, with true edges, free from waviness or variations;
* have a large sign with a checkerboard border mounted on its rear to advise motorists that line painting operations are in progress;
* be equipped with a full complement of lights for safety; and
* a mobile radio equipped for direct truck to truck communication.

The Contractor shall also supply and operate at least two (2) safety warning trucks during the performance of the pavement marking work. Each safety warning truck must be equipped with the following, at a minimum:

* a full complement of lights for safety;
* rotating amber lights, clearly visible from the front and the rear of the truck;
* four (4) way flashers;
* A rear mounted bi-directional arrow board sign (TC 12), in accordance with the Ontario Traffic Manual, Book 7; and
* a mobile radio equipped for direct truck to truck communication.

The pavement marking unit and safety warning trucks shall be subject to inspection and approval by the Owner.

Materials

All non-coning permanent durable markings and reflectorizing glass beads shall be from sources indicated in MTO’s DSM.

Non-coning permanent durable markings being laid on freshly laid asphalt shall meet the requirements of OPSS.MUNI 1713.

Non-coning permanent durable markings being laid on existing asphalt shall meet the requirements of OPSS.MUNI 1714.

Traffic paint pavement markings shall meet the requirements of OPSS.MUNI 1712.

Reflectorizing glass beads shall meet the requirements of OPSS.MUNI 1750.

The Contractor shall provide the Owner with proof that the materials are from an approved source under MTO’s DSM and meet the requirements of the applicable OPSS referenced above.

Operations

All pavement marking work shall be carried out in accordance with OPSS.MUNI 710 and the following:

1. Traffic control shall be maintained in accordance with the requirements of the Ontario Traffic Manual, Book 7. The Contractor shall ensure that freshly painted lines are not tracked or smeared by motorists.
2. All work shall be carried out in compliance with the *Occupational Health and Safety Act*, the *Highway Traffic Act*, the *Environmental Protection Act* and all applicable regulations of these statutes.
3. Pavement marking work shall be conducted by qualified operators who have all of the necessary licensing requirements to carry out the work.
4. Paint application shall have a wet film thickness of 0.40 mm and a dry film thickness of 0.30 mm, plus or minus 10%. Paint thinners shall not be used. The rate of paint application shall be a minimum of 20 metres per litre and a maximum of 18 metres per litre.
5. Glass beads shall be applied at the rate of 0.7 kg/litre of raw paint applied. Beads that do not become embedded in the pavement markings must be swept up and properly disposed of.
6. The minimum width of line applied shall be 100 mm. Where double line is applied, the space between the two (2) lines shall not be less than 100 mm. The maximum width of the above described line or space shall be 115 mm.
7. Centre line markings shall be yellow, 10 cm wide line(s).
8. Pavement markings shall be applied when the temperature is above 10 degrees Celsius and the pavement is completely dry, as determined by the Owner.
9. Any workmanship that does not conform to the requirements of OPSS.MUNI 710, as amended herein, shall be corrected at the Contractor’s expense.
10. The Contractor shall correct any severe tracking situation which was created by the Contractor, or as a result of poor traffic control operations or other errors/omissions on the part of the Contractor.

Pavement Marking Specifications – Items

Item PM001 Permanent Durable Pavement Markings

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

This item is for:

* white dashed and solid lane lines, including markings for left and right turn lanes
* white dashed and solid bike lane lines
* white edge lines
* yellow directional dividing lines

The pavement markings shall be applied to the final surface course in the location(s) shown on the Drawings.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 10 cm wide lines, excluding gaps. Wider lines shall be measured in 10 cm equivalents.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM002 Permanent Durable Pavement Markings – Crosswalk Lines

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

The following Standard Drawing is applicable to this item: DS-408.

This item is for white crosswalks lines.

Crosswalk lines shall be 15 cm wide and shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with Standard Drawing DS-408.

Crosswalk lines shall be applied within 24 hours of the new ramp construction. In the event that the permanent crosswalk lines cannot be applied within 24 hours of the new ramp construction, the Contractor shall apply temporary crosswalk lines under Item PM012 within 24 hours of the new ramp construction.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 15 cm wide lines, excluding gaps.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM003 Permanent Durable Pavement Markings – Intersection Stop Lines

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

This item is for white intersection stop lines.

Intersection stop lines shall be 45 cm wide and shall be applied to the final surface course in the location(s) shown on the Drawings.

Intersection stop lines shall be applied within 24 hours of the new ramp construction. In the event that the permanent intersection stop lines cannot be applied within 24 hours of the new ramp construction, the Contractor shall apply temporary intersection stop lines under Item PM012 within 24 hours of the new ramp construction.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 45 cm wide lines, excluding gaps.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM004 Permanent Durable Pavement Markings – Inlaid Crosswalk Lines

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

The following Standard Drawing is applicable to this item: DS-408.

This item is for white inlaid crosswalks lines.

Inlaid crosswalk lines shall be 15 cm wide and shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with Standard Drawing DS-408.

Crosswalk lines shall be applied within 24 hours of the new ramp construction. In the event that the permanent crosswalk lines cannot be applied within 24 hours of the new ramp construction, the Contractor shall apply temporary crosswalk lines under Item PM012 within 24 hours of the new ramp construction.

The surface shall be routed, by mechanical means, to a uniform cross-section for the full width as specified on the Drawings and to a minimum depth of 5 mm. The material shall be applied to fill the groove and extrude above the groove by 2 mm, and to overlap the groove by 12.5 mm to 17.5 mm on each side.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 15 cm wide lines, excluding gaps.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM005 Permanent Durable Pavement Markings – Inlaid Intersection Stop Lines

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

This item is for white inlaid intersection stop lines.

Inlaid intersection stop lines shall be 45 cm wide and shall be applied to the final surface course in the location(s) shown on the Drawings.

Intersection stop lines shall be applied within 24 hours of the new ramp construction. In the event that the permanent intersection stop lines cannot be applied within 24 hours of the new ramp construction, the Contractor shall apply temporary intersection stop lines under Item PM012 within 24 hours of the new ramp construction.

The surface shall be routed, by mechanical means, to a uniform cross-section for the full width as specified on the Drawings and to a minimum depth of 5 mm. The material shall be applied to fill the groove and extrude above the groove by 2 mm, and to overlap the groove by 12.5 mm to 17.5 mm on each side.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 45 cm wide lines, excluding gaps.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM006 Permanent Durable Pavement Markings – Zebra Markings

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

The following Standard Drawings are applicable to this item: DS-412 (zebra markings within crosswalk lines) and DS-413 (zebra markings within crossrides).

This item is for white zebra markings within white crosswalk lines or crossrides.

Zebra markings shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with Standard Drawing DS-412 or DS-413, as applicable.

Zebra markings shall be comprised of alternating 60 cm wide bars and 60 cm spaces and shall be laid out parallel to the through lane. The first zebra marking bar at each end of the crosswalk shall be a full 60 cm wide bar, placed a minimum of 60 cm from the edge of pavement in order to prevent pedestrian from contacting the zebra marking when taking their first step in the crosswalk.

The crosswalk lines shall be installed and paid for under Items PM002 and PM004, as applicable.

Elephant feet markings shall be installed and paid for under Item PM008.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 60 cm wide lines, excluding gaps.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM007 Permanent Durable Pavement Markings – Symbols

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

This item is for symbols (i.e. arrows, crosses, bicycle, sharrows, etc.).

Symbols shall be white and shall be applied to the final surface course in the location(s) shown on the Drawings.

Measurement for Payment

Measurement for payment shall be a count of each symbol applied.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

# Item PM008 Permanent Durable Pavement Markings – Elephant Feet Markings

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

The following Standard Drawings are applicable to this item: DS-413 (at signalized intersections), DS-414 (at unsignalized intersections), DS-415 (at driveway with multi-use path crossing) and DS-416 (at driveway with in-boulevard cycle track crossing).

This item is for elephant feet markings.

Elephant feet markings shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with Standard Drawing DS-413, DS-414, DS-415 or DS-416, as applicable.

Elephant feet markings shall be comprised of alternating 40 cm x 40 cm squares and 40 cm spaces and shall be oriented parallel to the through lane.

At signalized intersections the elephant feet markings shall be laid 85 cm from the edge of the zebra markings.

Zebra markings shall be installed and paid for under Item PM006.

Measurement for Payment

Measurement for payment shall be a count of each 40 cm x 40 cm square applied.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM009 Green Skid/Slip Resistant Preformed Thermoplastic Pavement Markings

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

The following Standard Drawings are applicable to this item: DS-414 (at unsignalized intersections), DS-415 (at driveway with multi-use path crossing) and DS-416 (at driveway with in-boulevard cycle track crossing).

This item is for green, skid/slip resistant, preformed thermoplastic pavement markings.

Green, skid/slip resistant, preformed thermoplastic pavement markings shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with the manufacturer’s specifications and Standard Drawing DS-414, DS-415 or DS-416, as applicable.

Green, skid/slip resistant, preformed thermoplastic pavement markings shall:

* be a durable, retro-reflective, resilient, light green thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area and shall exhibit high anti-skid/anti-slip properties;
* demonstrate a uniform level of sufficient night-time retro-reflection when tested in accordance with ASTM E 1710.
* have heating indicators on the top surface (same side as the factory applied surface beads);
* have regularly spaced indents to act as a visual cue during application that the material has reached a molten state so satisfactory adhesion and proper bead embedment has been achieved and a post application cue that the installation procedures have been followed;
* provide a minimum skid resistance value of 45 BPN when tested in accordance with ASTM E 303;
* be resistant to the detrimental effects of motor fuels, lubricants, hydraulic fluids, etc. and deterioration due to sunlight, water, salt or adverse weather conditions;
* be capable of being affixed to bituminous and/or Portland cement concrete pavements using the normal heat of a propane torch;
* be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures;
* have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic; and
* not have minimum ambient and road temperature requirements for application, storage, or handling.

Measurement for Payment

Measurement for payment shall be per square metre of green skid/slip resistant preformed thermoplastic pavement markings applied.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM010 Interim Traffic Paint Pavement Markings – Lines (Provisional)

This Specification shall be read in conjunction with the General Requirements for Pavement Markings.

This item is for the interim painting of:

* white dashed and solid lane lines, including markings for left and right turn lanes
* white dashed and solid bike lane lines
* white edge lines
* yellow directional dividing lines

with traffic paint in the event that the permanent durable pavement markings to be applied under Item PM001 cannot be successfully applied due to unfavourable weather conditions, as determined by the Owner.

Once the weather conditions are favourable, the Contractor shall replace the interim pavement markings with the permanent durable pavement markings to be applied under Item PM001.

Interim pavement markings shall be applied in the location(s) shown on the Drawings.

Two (2) coats of paint shall be applied to new surfaces and for first time applications. One (1) coat shall be applied when painting over existing pavement markings.

Measurement for Payment

Measurement for paymentshall be by the horizontal length in metres (m) of 10 cm wide lines, excluding gaps. Wider lines shall be measured in 10 cm equivalents.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM011 Interim Traffic Paint Pavement Markings – Symbols (Provisional)

The General Requirements for Pavement Markings shall apply to this item.

This item is for the interim painting of symbols (i.e. arrows, crosses, bicycle, sharrows, etc.) with traffic paint in the event that the permanent durable pavement markings to be applied under Item PM007 cannot be successfully applied due to unfavourable weather conditions, as determined by the Owner.

Once the weather conditions are favourable, the Contractor shall replace the interim pavement markings with the permanent durable pavement markings to be applied under Item PM007.

The interim pavement markings shall be white and shall be applied in the location(s) shown on the Drawings.

Measurement for Payment

Measurement for payment shall be a count of each symbol applied.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM012 Interim Traffic Paint Pavement Markings – Crosswalk Lines and Stop Lines (Provisional)

The General Requirements for Pavement Markings shall apply to this item.

This item is for the interim painting of:

* white crosswalk lines
* white intersection stop lines

with traffic paint in the event that the permanent durable pavement markings to be applied under Items PM002, PM003, PM004 and PM005, as applicable, cannot be successfully applied within 24 hours of the new ramp construction.

**The Contractor shall replace the interim pavement markings with the permanent durable pavement markings to be applied under Items PM002, PM003, PM004 and PM005, as applicable.**

Interim pavement markings shall be applied in the location(s) shown on the Drawings.

Two (2) coats of paint shall be applied to new surfaces and for first time applications. One (1) coat shall be applied when painting over existing pavement markings.

Measurement for Payment

Measurement for payment shall be by the horizontal length in metres (m) of 15 cm wide lines, excluding gaps. Wider lines shall be measured in 15 cm equivalents.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM013 Permanent Aggregate Reinforced Thermoplastic System

This Specification shall be read in conjunction with OPSS.MUNI 710 (Nov 2021).

The following Standard Drawing is applicable to this item: DS-409.

This item is for the installation of a permanent aggregate reinforced thermoplastic surfacing system that provides a textured and durable topical treatment to the surface of asphalt pavement to create an enhanced pedestrian crosswalk facility.

The permanent aggregate reinforced thermoplastic system shall be applied to the final surface course in the location(s) shown on the Drawings and in accordance with Standard Drawing DS-409 and the manufacturer’s specifications.

The Contractor shall provide pre-marking to establish the position of the permanent aggregate reinforced thermoplastic system in accordance with OPSS.MUNI 710.

The Contractor shall ensure that all freshly applied panels are protected from being damaged by the travelling public, by the use of appropriate traffic control measures.

The aggregate reinforced thermoplastic system shall be applied to asphalt pavement using asphalt pavement reheating equipment acceptable to the manufacturer. The asphalt surface shall be covered with 600 mm x 600 mm panels of aggregated reinforced thermoplastic then heated to the required liquefaction temperature. Sand shall be applied at the end of the melting process to achieve added friction properties on the surface. As the material is cooling, it shall be imprinted with a template made from 9.5 mm flexible wire rope in the required design to create crisp, clean lines to define the pattern specified on Standard Drawing DS-409. For crosswalks, apply white preformed thermoplastic transverse lines on both sides of the installation.

Equipment Requirements

The Contractor shall supply and operate at least two (2) safety warning trucks during the performance of this work. Each safety warning truck must be equipped with the following, at a minimum:

* a full complement of lights for safety;
* rotating amber lights, clearly visible from the front and the rear of the truck;
* four (4) way flashers;
* a rear mounted bi-directional arrow board sign (TC 12), in accordance with the Ontario Traffic Manual, Book 7; and
* a mobile radio equipped for direct truck to truck communication.

The safety warning trucks shall be subject to inspection and approval by the Owner.

Materials

All materials shall be approved by the Owner prior to application.

Operations

The Contractor shall ensure that all aggregate reinforced thermoplastic system work is carried out in accordance with OPSS.MUNI 710 and the following:

1. Traffic control shall be maintained in accordance with the requirements of the Ontario Traffic Manual, Book 7. The Contractor shall ensure that freshly applied panels are not damaged by motorists.
2. All work shall be carried out in compliance with the *Occupational Health and Safety Act, Highway Traffic Act* and *Environmental Protection Act* and all applicable regulations of these statutes.
3. The work shall be conducted by qualified operators/applicators who have all of the necessary licensing requirements to carry out the work.
4. Aggregate reinforced thermoplastic shall be applied when the temperature of both the ambient air and the pavement is above 10 degrees Celsius and the pavement is completely dry, as determined by the Owner.
5. Any workmanship that does not conform to the requirements of OPSS.MUNI 710, as amended herein, shall be corrected at the Contractor’s expense.
6. The Contractor shall correct any severe damage that was created by the Contractor, or as a result of poor traffic control operations or other errors/omissions on the part of the Contractor.

Measurement for Payment

Measurement for payment shall be per square metre (m2) of permanent aggregate thermoplastic system supplied and installed.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM014 Pavement Markings – Obliterating

This Specification shall be read in conjunction with OPSS.MUNI 710 (Nov 2021) and OPSS.MUNI 1712 (Nov 2021).

Existing pavement markings that do not form part of the operational traffic lane arrangement for any interim stage of the Work or part of the final Contract layout shall be ground out and then blacked out using by applying two (2) coats of black paint in accordance with OPSS.MUNI 710 and OPSS.MUNI 1712 (Black-CGSB 1-GP-12C black 512-301).

Measurement for Payment

Measurement for payment shall be per metre (m) of pavement markings obliterated, based on a 10 cm width, horizontally measured.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM015 Inlaid Pavement Markings – Obliterating

Existing inlaid pavement markings that do not form part of the operational traffic lane arrangement for any interim stage of the Work or part of the final Contract layout shall be ground out and then filled by applying PMi PolyMight International Anti-skid MMA grey durable cold plastic (Product code 20-8175), or Equivalent, as required to fill the void in the road surface created by grinding. The void shall be filled until flush.

Measurement for Payment

Measurement for payment shall be per metre (m) of pavement markings obliterated, based on a 10 cm width, horizontally measured.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

Item PM016 Temporary Stop Lines – Traffic Paint

This Specification shall be read in conjunction with OPSS.MUNI 710 (Nov 2021), OPSS.MUNI 1712 (Nov 2021) and OPSS.MUNI 1750 (Nov 2021).

This item is for the painting of temporary stop lines.

Temporary stop lines shall be painted in the permanent location(s) shown on the Drawings and in accordance with OPSS.MUNI 710.

Temporary stop lines shall be painted within 24 hours of the placement of the top course of asphalt.

Materials shall conform to the requirements of OPSS.MUNI 1712 and OPSS.MUNI 1750.

Measurement for Payment

Measurement for payment shall be per metre (m) of temporary stop line painted.

Basis of Payment

Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.