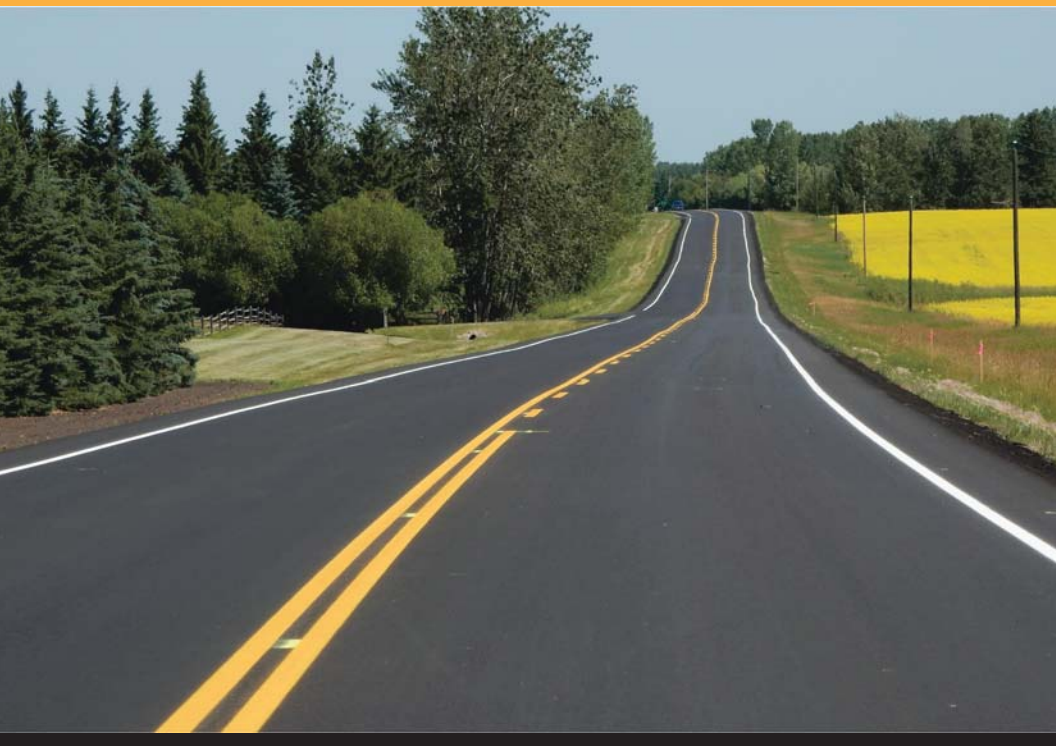
LAFRENTZ ROAD MARKING



Road Marking Best Practices Guide

www.LAFRENTZ.ca

LAFRENTZ ROAD MARKING

For over 35 years, Lafrentz has been Western Canada's Source for road marking materials, application and consultation.

Our team of consultants holds both technical knowledge and practical experience. We cater our services to your needs, whether it means having us apply the product or training your crews to do it themselves.

Focused on Western Canada

Products Manufactured

System 300 Thermoplastic
available in white and yellow
formulated for Canadian climate

System 400 Cold Plastic
SPRAY & EXTRUDE
for road marking application

SRM - Skid Resistant Material
custom colours
project dependent requirements

Services Available

Highway Painting

Airport Painting

Durable Markings Application
Suface-Applied
Inlaid
Profiled

Skid Resistant Markings

Skid Resistant Surfaces

Industrial Safety Markings

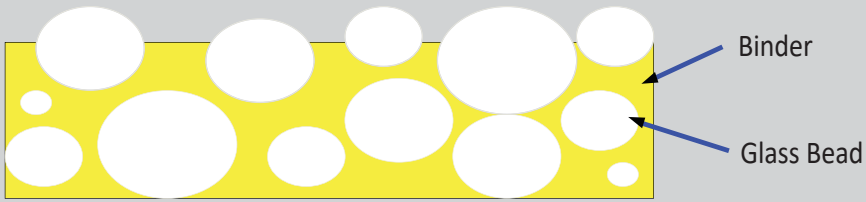
How To Use This Guide

This guide offers general information regarding the materials and application processes used for roadmarkings in Western Canada. These best practices have been developed through years of experience placing road markings in the diverse conditions encountered.

In all cases it is important to follow the project specifications with regards to materials and measurements. The pictures and descriptions found in these best practices demonstrate the when and how to do your measurements and the key data to monitor.

Anatomy of a Road Marking

Roadmarkings are made up of a binder or resin that holds the marking together and bonds it to the surface. Binders can be a variety of materials including paint, methyl methacrylate (MMA), thermoplastic and others. Filler materials, glass, sand and rock plus pigment makes up the rest. Glass beads can be incorporated into the mix and are used to top dress the line to provide retroreflectivity.



Material Selection

Each material has different characteristics and choosing the right material for your road markings is important to a successful project.

Paint

Pros

- ease of application
- fast
- quality markings

Cons

- ambient and surface termperatures to be monitored
- humidity can affect drying / curing time
- limited durability

Cold Plastic - MMA

Pros

- works well on aged asphalt as well as new surfaces
- forms a tenacious bond
- designed as a surface applied product
- controled chemical reaction
- can be applied in a wide range of temperatures
- can be applied to concrete (suggest using a primer)
- can be repaired by recoating with the same product

Cons

- maximum thickness of application not to exceed 5mm
- paint materials must be removed before applicaiton

Thermoplastic

Pros

- hydrocarbon bond - heat activated - forms an intergral bond to the asphalt cement
- use on new asphalt or aged asphalt (after surface preparation to expose fresh asphalt)
- can be applied up to 15mm thick
- provides long term durability

Cons

- can be difficult to repair
- surface application requires +10^{0}C and rising of both ambient and surface temperature

Types of Applications

Surface - Spray

Typical spray applied material less than a millimeter in thickness. Includes paint, epoxy, and MMA.

Surface - Extruded

Extruded and struck off or applied by ribbon gun application of 1-3 millimeters of material on the surface. Thermoplastic or MMA materials.

Inlaid with Recessed Line

2-3 millimeters of material are applied typically by ribbon gun into a groove in the asphalt. The material is left flush or slightly below the surface of the asphalt. The advantage is that the material is hidden from the plow. But in the urban segment dirt and debris can collect on the markings. Often used on high speed roadway applications of profiled markings using thermoplastic or MMA materials.

Inlaid with Over Band

Thermoplastic is used to fill the 5-10 millimeter deep groove in the asphalt and then struck off at 2-3 millimeters above the surface over banding the groove by 10 millimeters on each side completely sealing the edges of the groove. The groove is cut to the design width and length of the roadmarking. The over band will wear away due to traffic and maintenance activities but the roadmarking will retain the correct dimensions.

Road Marking Selection Grid

Application Type	Material	Thickness	Expected * Service Interval	Initial Cost	Uses
Surface - Spray	Paint	0.2-0.3mm	1-3 times / year	$	Local Roads, Highways, Parking Lots
Surface - Spray	MMA	0.5-1.0mm	2-4 years	$$$	Local Roads, Highways, Parking Lots, Highway Messages
Surface - Extruded	MMA or Thermoplastic	2-3mm	3-5 years	$$$$	Medium ADT, Arterials, Collectors, High-Speed, Highway Messages
Inlaid with Recessed Line	MMA or Thermoplastic	2-4mm	4-6 years	$$$$$	High-Speed Urban, Highways
Inlaid with Over Band	MMA or Thermoplastic	3-10mm inlaid 2-3mm above surface	6-9 years	$$$$$$	High ADT, High-Wear, Arterials, High-Speed
Surface - Skid Resistant Material	MMA	1-3mm	3-5 years		High ADT, Arterials, Collectors, High-Speed

*varience is based on wear and intended application
(ie: longitudinal vs. transverse & areterials vs. collectors vs. high-speed, etc)

Notes

Paint

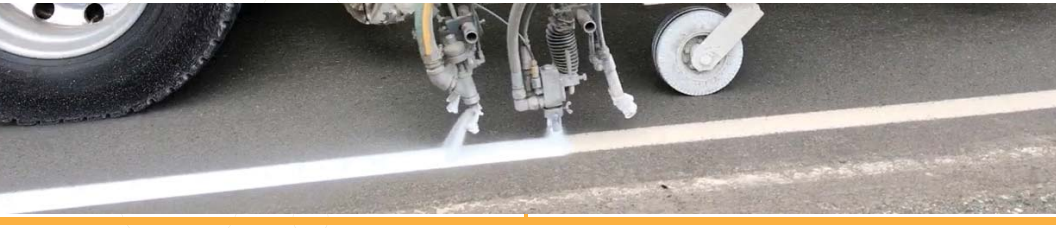
Paint represents the standard in road marking material. Paint application processes have evolved from a paint brush and can to large high speed trucks with laser or video guidance, fully instrumented to monitor all aspects of application with all data being uploaded into data warehouses. Precise accurate lines on any roadway can be achieved quickly and economically.

The following best practices apply to longitudinal line application completed by high volume applicators on both urban and highway segments.

Material Specification

Materials should be listed on the Provincial Transportation Department's recognized product lists. These materials conform to the current material specifications and have been tested and approved by the province. These lists can be found on the provincial website.

Manufacturers can supply batch samples for Quality Assurance testing. Testing by a third party laboratory should be done to confirm compliance to the specifications.



Paint

Application

Adherence to the manufacturer's application instructions is essential to provide a quality end product.

Some parameters that should be confirmed include:
Substrate –free of debris and dust, perfectly clean and absolutely dry
Ambient and surface temperature

- for most waterborne paint a minimum of +10^{0}C
- other material formulations have specific temperature requirements check the manufacturer's instructions

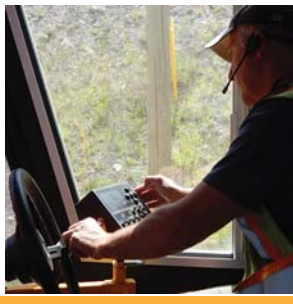
Application Rates of Paint and Bead
Application rates should be determined and included in the project specification. We have discovered that the quantity of paint, quantity of bead and size of bead all play a part in the quality of the end product. With a larger gradation of glass bead you need more paint to ensure bead retention and embedment.

Typical application rates are:
Paint:15-17 mils wet (38 to 42 liters /kilometer of 10cm line)
Bead: 600-700 grams of Type 1 M247 beads per liter of paint

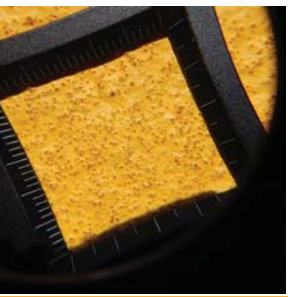
Measurements

A process should be in place to measure and record the length and width of the line applied, quantity of paint and bead applied for each control section or job site. From these measurements coverage rates should be calculated and reports made available for each segment of the project. These should be the responsibility of the applicator.

On board electronic monitoring systems on most large volume application equipment can provide you with reports that verify many of the application parameters. Current technologies exist and should be used to confirm the manual measurements and calculation. These monitoring systems also assist the application crew by providing timely feedback during application.



Paint



Inspection

You are looking for a consistent application of paint and beads from edge to edge of the line and along its entire length.

Line width should be confirmed with a measuring tape. Skip lines should be spot checked for length to confirm compliance with the specifications.

Spot checks using a wet film gauge, test plate or other measurement methodology should be completed to confirm the accuracy of the reporting system.

Reports demonstrating application rates, measurement confirmations and retroreflectivity (if required) should be reviewed for each project.

Retroreflectivity

A magnifier can confirm the distribution and embedment of the glass bead. Some jurisdictions set initial retroreflectivity standards which require performance measurements be taken shortly after application. These measurements if required should be recorded and reports made available in accordance with the specifications.

Typical glass beads used are: AASHTO M247 – Type 1 or 2

Typical Warranty

60 Days

Cold Plastic - MMA - Spray

Flexible, Two-Component, Solvent-Free, Field Reacting Roadmarking Material

Methyl methacrylate is the base resin for this material. Often referred to as cold plastic or MMA the material uses a controlled chemical reaction to cure and form a tenacious bond. Using a plural component spray applicator the A and B sides are mixed just before hitting the ground. Various mix ratios are available including 1:1 and 98:2. This product can be described as a super duty plastic paint.

Uses
Longitudinal Lines
Transverse Lines
Parking Areas
Messages – arrows, words
Stencil Work

Cold Plastic - MMA - Spray

Material Specification

The materials shall be manufactured to be applied by spraying onto the pavement in liquid form with glass beads being dropped onto the material immediately after it is applied.

The compound shall not deteriorate by contact with sodium chloride, calcium chloride, or other chemicals used against formation of ice on roadway or because of oil content of pavement materials or from oil dropping from traffic.

In the plastic state, the materials shall not give off fumes which are toxic or otherwise injurious to persons or property.

The material shall not be subject to discolouration or bond failure due to ultra-violet rays from the sun.

The curing time shall be controllable by the workers. Normal curing time shall be from 5 to 15 minutes. Total, 100% curing should be complete in under one hour.

MMA - Spray - physical properties

Test Performed	Results
Viscosity	
Brookfield LVT, Spindle D	1,200 - 1,800 mPas (@23 ^{0}C)
Density	1.55 to 1.65 g/cm^{3}
Indentation Resistance	
Shore D Hardness	48 - 60
Flashpoint	10 ^{o}C (closed cup)
Luminescence	
white	> 75%
yellow	> 55%
Volatile Organic Compounds	zero

Cold Plastic - MMA - Spray

Application

Adherence to the manufacturer's application instructions is essential to provide a quality end product. Attention to catalyst doping rates is important.

Pre-existing painted markings will interfere with the bond of the MMA to the roadway surface. Paint materials need to be removed before applying MMA. Care should be taken that when removing markings by sandblasting, waterblast or mechanical abrasion that the surface should not be gouged or overly textured. The thin film MMA markings will conform to the surface texture.

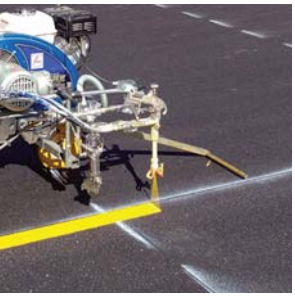
In some cases MMA can be used as a repair material to over coat an existing durable marking. If the existing markings are well bonded to the substrate and need to be refreshed this may be a solution. However, the bond between the MMA and existing material should be confirmed. MMA to MMA typically provides a monolithic repair as the fresh material chemically bonds to the material below.

The surface should be free of debris and dust, perfectly clean and absolutely dry. At a minimum sweeping and air blast of the surface is required.

Where MMA material is being applied to concrete an MMA based primer is recommended. Additional surface preparation for primer application may be required.

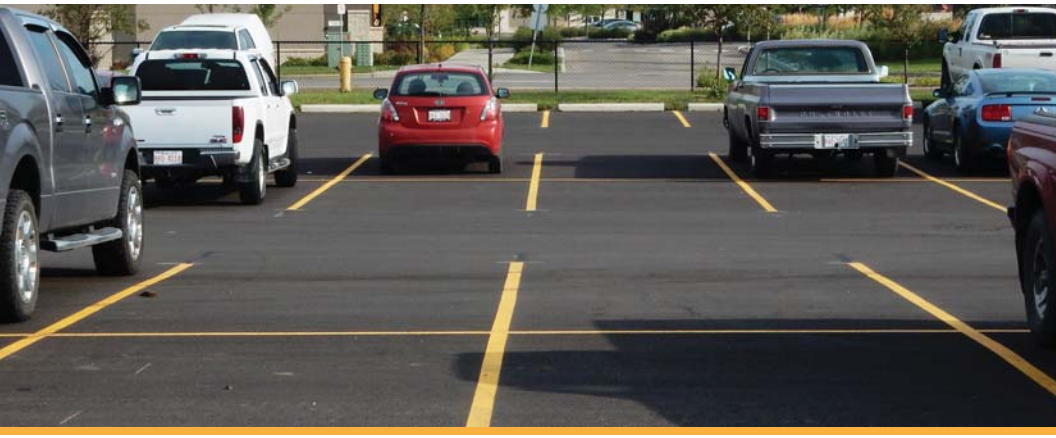
Cold Plastic - MMA - Spray

Proper mixing of the A and B components is important to ensure the material cures and bonds. Wet spots or uncured edges indicate problems with mixing and distribution of the catalyst. These issues must be addressed immediately.



Liquid material should be sprayed at the specified thickness from edge to edge across the entire marking. Immediately after the liquid material self-levels glass beads should be applied evenly across the marking. There should be enough glass bead to saturate the liquid and leave some loose beads on the surface. Once the marking has cured excess glass beads should be removed as they present a safety hazard.

Application Rates
Application film thickness should be from 0.5mm to 1.0mm of liquid material. Glass bead application will range from 300 to 500 g/m2. The project specifications should identify the precise application rates for the project.



Cold Plastic - MMA - Spray

Symbols should be checked to confirm that they accurately resemble the patterns and stencils specified.

A wet film thickness gauge will allow you to confirm the initial application of material. Measuring the cured marking thickness is very difficult. Variations in thickness will become noticeable but probably not until well into the life of the marking.

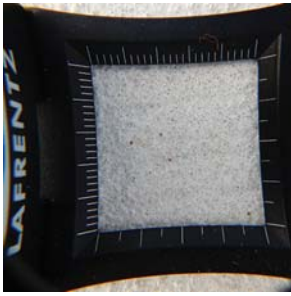
Inspection

You want to see an even surface of consistent material and glass bead application across the entire marking. The edges of the markings should be clean and straight, with little or no overspray.

There should be no hour glassing or narrowing of the line.

Retroreflectivity

A magnifier can confirm the distribution and embedment of the glass bead. Some jurisdictions set initial retroreflectivity standards which require performance measurements be taken shortly after application. These measurements if required should be recorded and reports made available in accordance with the specifications.



Typical glass beads used are: AASHTO M247 – Type 1 or 2

Glass beads used with MMA should have a silane coating

Typical Warranty

2 years – 90% of the markings on a project in place

Cold Plastic - MMA - Extrude

Flexible, Two-Component, Solvent-Free, Field Reacting Roadmarking Material

Methyl methacrylate is the base resin for this material. Often referred to as cold plastic or MMA the material uses a controlled chemical reaction to cure and form a tenacious bond. The materials shall be manufactured to be applied by extrusion onto the pavement in liquid form with glass spheres mixed in and also dropped onto the material after it is applied. The optimum thickness of the marking is 2mm.

Uses
Longitudinal Lines
Transverse Lines
Messages – arrows, words, symbols

Cold Plastic - MMA - Extrude

Material Specification

The compound shall not deteriorate by contact with sodium chloride, calcium chloride, or other chemicals used against formation of ice on roadways or streets, or because of oil content of pavement materials or from oil dropping from traffic.

In the plastic state, the materials shall not give off fumes which are toxic or otherwise injurious to persons or property.

The material shall not be subject to discolouration or bond failure due to ultra-violet rays from the sun.

During manufacture, reflectorizing glass spheres shall be mixed into the material to the extent of not less than 20 percent or more than 50 percent by weight of the material.

The curing time shall be controllable by the workers. Normal curing time shall be from 10 to 35 minutes. Total, 100% curing should be complete in under one hour.

MMA - Extrude - physical properties

Test Performed	Results
Viscosity	
Daniel Flow Gauge	Between 13-15 (@ 25 ^{0}C)
Haake VT 02, Spindle 2	Approx. 14,000 mPas (@ 25 ^{0}C)
Density	1.85 - 1.90 kg/l
Indentation Resistance	
Shore D Hardness	50 - 60
Boiling Point	100 - 101 ^{o}C
Flashpoint	10 ^{o}C (closed cup)
Freezing point	-48^{o}C
Specific Gravity	2.0 g/ml
Luminescence	
white	> 75%
yellow	> 55%
Volatile Organic Compounds	zero

Cold Plastic - MMA - Extrude

Application

Adherence to the manufacturer's application instructions is essential to provide a quality end product. Attention to catalyst doping rates and mixing time is essential.

Pre-existing painted markings will interfere with the bond of the MMA to the roadway surface. Paint materials need to be removed before applying MMA. Care should be taken that when removing markings by sandblasting, waterblast or mechanical abrasion that the surface should not be gouged or overly textured.

In some cases MMA can be used as a repair material to over coat an existing durable marking. If the existing markings are well bonded to the substrate and need to be refreshed this may be a solution. However, the bond between the MMA and existing material should be confirmed. MMA to MMA typically provides a monolithic repair as the fresh material chemically bonds to the material below.

The surface should be free of debris and dust, perfectly clean and absolutely dry. At a minimum sweeping and air blast of the surface is required.

Where MMA material is being applied to concrete an MMA based primer is recommended. Additional surface preparation for primer application may be required.

Ambient and surface temperatures +5ºC to +35ºC

Proper mixing of the A and B components is important to ensure the material cures and bonds. Wet spots or uncured edges indicate problems with mixing and distribution of the catalyst. These issues must be addressed immediately.

Cold Plastic - MMA - Extrude

Extrusion material can be applied using a number of methods.
These include:
Trowel
Hand form – drag box
Push applicator
Ribbon gun

Extrusion material can be applied on the roadway surface or in a groove or filling the groove and over banding.

In all cases the material should be applied in compliance with the project specifications.

MMA materials have a certain amount of internal resilience, which means they tend to be pulling or contracting on a continuous bases. On an asphalt surface if the markings are applied too thick and across a large area this resilience may produce cracks in the asphalt along the edge of the markings. As the asphalt ages the markings become stronger than the asphalt and the cracks appear. To combat this issue and still provide durability the optimum MMA application thickness for extruded formulas is 2.0mm on an asphalt surface.

Glass spheres shall be applied to the surface of the material at a uniform rate of approximately 150 - 250 grams per square meter. The glass spheres shall be applied while the plastic is in a liquid state.

Cold Plastic - MMA - Extrude

Measurements

Surface application

A tape measure can be used to confirm line width. Tape measure, rolling tape or electronic distance measuring devices can confirm the length of line. Width and length should conform to the design specifications.

Symbols should be checked to confirm that they accurately resemble the patterns and stencils specified.

Application thickness should be confirmed by measuring the rise above the surface. This can be done by calipers or comparison to objects of a known thickness. A Canadian 1 dollar coin is 1.9mm in thickness. Optimum thickness of extrude material is 2.0 mm.

Cold Plastic - MMA - Extrude

Measurements

Groove with material below surface

The groove width should be checked periodically. Consistency of the groove depth is crucial and should be checked often as the groove is being produced. If the groove is deep and leaves the marking too far below grade the marking will not be visible. If the groove is shallow the marking will be above grade defeating the purpose of the groove.

Width should be slightly larger than the marking; 100mm wide marking – 110mm wide groove

Depth should be a maximum of 2.0mm greater than the material thickness; material thickness of 2.0mm the groove depth should be 2.0 to 4.0mm.

The finished markings should conform to the design dimensions and be fully contained within the groove. Line width can be checked using a tape measure. Tape measure, rolling tape or electronic measuring devices can confirm the length of line.

The marking thickness can be confirmed using calipers along the inside of the groove. Alternately if the marking is being applied using a ribbon gun a sample could be applied to a test plate and checked using calipers.

The recess of the line marking should be confirmed using a straight edge and calipers. Typical specifications require the material be flush to negative 2.0mm with the road surface.

Cold Plastic - MMA - Extrude

Measurements

Inlaid with over band

The groove dimensions should match the design dimensions of the markings. For a lane line of 100mm wide line by 3meters long the groove will have these dimensions. The over band of the material will exceed these dimensions, ensuring that all the edges are sealed.

The groove width should be checked periodically using a tape measure. Tape measure, rolling tape or electronic measuring devices can confirm the length of the groove.

Consistency of the groove depth is important and should be checked often. The typical groove depth for MMA is 2.0 mm. This can be confirmed using a straight edge and calipers. Other instruments such as the calibrated wedge pictured are available.

Once the material has been applied the rise of the material above the surface of the asphalt should be checked using calipers or to objects of known thickness. A Canadian 1 dollar coin is 1.9mm in thickness. Optimum thickness of extrude material is 2.0 mm. Typically the rise should be 2.0mm.

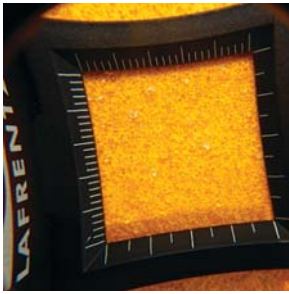
Cold Plastic - MMA - Extrude

Inspection

You want to see an even surface of consistent material and glass bead application across the entire marking. The edges of the markings should be clean and straight with the marking standing proud.

Retroreflectivity

A magnifier can confirm the distribution and embedment of the glass bead. Some jurisdictions set initial retroreflectivity standards which require performance measurements be taken shortly after application. These measurements if required should be recorded and reports made available in accordance with the specifications.



Typical glass beads used are: AASHTO M247 – Type 1 or 2

Glass beads used with MMA should have a silane coating

Typical Warranty

Surface Applied
2 years – 90% of the markings on a project in place

Inlaid in groove
2 years – 90% of the markings on a project in place

Inlaid with over band
5 years – 80% of the markings on a project in place

Thermoplastic

Thermoplastic pavement marking materials utilize heat to generate a bond to the asphalt cement in the pavement surface. These materials are manufactured to be applied onto the pavement in molten form with glass spheres mixed in and also dropped on the material immediately after it is applied.

Many municipalities in Western Canada have found that inlalid thermoplastic with an over band has been the most long lasting road marking compared to any other product. This proven application has demonstrated that it can withstand the most rigourous snow and ice control activities.

Uses
Longitudinal Lines
Transverse Lines
Messages – arrows, words, symbols

Thermoplastic

Material Specification

The material shall be suitable for application in film thickness from 1.0mm up to 15.0mm. Normal surface applications will be from 2.0 to 3.0mm thick.

The material when cured shall be flexible when cast into film thickness of 2.0mm to 5.0mm.

The material shall contain no solvents.

The material shall be suitable for application on new and old asphalt. Bond strength on any of these surfaces shall be sufficient for the material to remain in place for a number of years, under normal conditions. Inlaid application is required where snow and ice control activities are required.

Thermoplastic - physical properties

Test Performed	Results	Test Method
Density		ASTM D792
White	1.95 - 2.15 kg/l	
Yellow	1.9 - 2.1 kg/l	
Indentation Resistance	46°C 50 ± 5	ASTM D2240-03
Shore Durometer type A2	25°C 80 ± 5	
Softening Point	Min. 110°C	ASTM E-28
Boiling Point	Not applicable	
Freezing point	Not applicable	
Luminescence		ASTM E1347
White	> 70%	
Yellow	> 55%	
Volitile Organic Compounds	zero	
Chemical Resistance	No sign of degradation after exposure to: 5% NaCl (24 hours) 5% CaCl (24 hours)	
Water Absoprtion	< 0.5 percent by weight	ASTM D-570
Abrasion Resistance	Maximum weight loss 0.8 grams*	ASTM D4060

*When subjected to 200 revolutions on a Taber Abraider at 25°C using H-22 Calibrade wheels weighted to 500 gram on a material 3mm ±0.1mm thick on a 100mm square plate. Test shall be performed wet.

Thermoplastic

Application

Adherence to the manufacturer's application instructions is essential to provide a quality end product.

Thermoplastic material can be applied on the roadway surface or in a groove or filling the groove and over banding.

Thermoplastic material can be applied using a number of methods. These include:

- Trowel
- Hand form – drag box
- Push applicator
- Ribbon gun
- Self-propelled extruder

Glass spheres shall be applied to the surface of the material at a uniform rate of approximately 350 grams per square meter. The glass spheres shall be applied while the plastic is in a molten state.

Thermoplastic

The surface should be free of debris and dust, perfectly clean and absolutely dry. At a minimum sweeping and air blast of the surface is required.

Ambient and surface temperatures:
+10ºC to +35ºC for surface / groove with material below the surface applications
+5ºC to +35ºC for inlaid with over band applications

Material application temperature
Following the manufacturer's recommended material application temperature is crucial to generate a strong bond to the pavement. This bond can be enhanced if the material is allowed to heat the pavement and cool naturally. Typically the slower the cooling the stronger the bond.

As an example Lafrentz 0320 white formula application temperature is 200ºC with Lafrentz 0358 yellow formula being applied at 190ºC. At these temperatures cooling can take 10 or more minutes depending on ambient temperature.

Material temperature should be monitored during heating, when being transferred from the pre-heater to the applicator, in the applicator and as it is being applied to the pavement. Accurate temperature gauges on each piece of equipment should be visible and checked. A hand held thermometer to spot check and confirm the application temperature is important.

If the material appears to be stretching or the line has a rough texture these typically indicate improper application temperatures.

Thermoplastic

Measurements

Surface application

Pre-existing painted markings will interfere with the bond of the thermoplastic to the roadway surface. Paint materials must be removed before application. It is important that the thermoplastic be applied so it is in direct contact with non-oxidized asphalt in order to develop a bond.

Surface and ambient temperatures are crucial to the bond of the thermoplastic to the asphalt. Often it is only in the mid-summer months that the recommended +10ºC and rising surface and amblient temperature criteria can be met.

A tape measure can be used to confirm line width. Tape measure, rolling tape or electronic distance measuring devices can confirm the length of line. Width and length should conform to the design specifications.

Symbols should be checked to confirm that they accurately resemble the patterns and stencils specified.

Application thickness should be confirmed by measuring the rise above the surface. This can be done by calipers or comparison to objects of a known thickness. A Canadian 1 dollar coin is 1.9mm in thickness. Thermoplastic material should be applied at 2.0 to 3.0 mm.

Thermoplastic

Measurements

Groove with material below surface

The groove width should be checked periodically. Consistency of the groove depth is crucial and should be checked often as the groove is being produced. If the groove is deep and leaves the marking too far below grade the marking will not be visible. If the groove is shallow the marking will be above grade defeating the purpose of the groove.

Width should be slightly larger than the marking; 100mm wide marking – 110mm wide groove

Depth should be a maximum of 2.0mm greater than the material thickness; material thickness of 2.0mm the groove depth should be 2.0 to 4.0mm.

The finished markings should conform to the design dimensions and be fully contained within the groove. Line width can be checked using a tape measure. Tape measure, rolling tape or electronic measuring devices can confirm the length of line.

The marking thickness can be confirmed using calipers along the inside of the groove. Alternately if the marking is being applied using a ribbon gun a sample could be applied to a test plate and checked using calipers.

The recess of the line marking should be confirmed using a straight edge and calipers. Typical specifications are the material should be flush to negative 2.0mm with the road surface.

Thermoplastic

Measurements

Inlaid with over band

The groove dimensions should match the design dimensions of the markings. For a lane line of 100mm wide line by 3meters long the groove will have these dimensions. The over band of the material will exceed these dimensions, ensuring that all the edges are sealed.

The groove width should be checked periodically using a tape measure. Tape measure, rolling tape or electronic measuring devices can confirm the length of the groove.

Consistency of the groove depth is important and should be checked often. Groove depth for thermo-plastic will vary and should be identified in the specifications. Most often the groove depth for longitudinal markings is 5.0mm with transverse markings being up to 10.0mm. This can be confirmed using a straight edge and calipers. Other instruments such as a calibrated wedge are available.

The material should be applied in one pass. The groove is filled and over banded with the material being struck off. Once the material has been applied the rise of the material above the surface of the asphalt should be checked using calipers or to objects of known thickness. Typically the rise should be 2.0 to 3.0mm.

The surface of the completed line should not dish or dip from edge to edge. Dishing should be less than 1.0mm as measured across the line using a straight edge and calipers.

Thermoplastic

Inspection

You want to see an even surface of consistent material and glass bead application across the entire marking. The edges of the markings should be clean and straight with the marking standing proud.

Retroreflectivity

A magnifier can confirm the distribution and embedment of the glass bead. Some jurisdictions set initial retroreflectivity standards which require performance measurements be taken shortly after application. These measurements if required should be recorded and reports made available in accordance with the specifications.

Typical glass beads used are: AASHTO M247 – Type 1 or 2

Glass beads used with thermoplastic should be uncoated or dual coat bead.

Typical Warranty

Surface Applied
2 years – 90% of the markings on a project in place

Inlaid in groove
2 years – 90% of the markings on a project in place

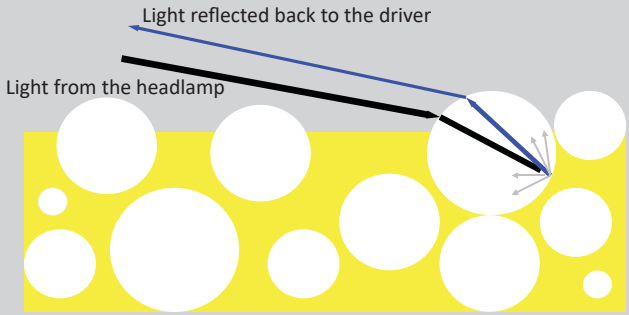
Inlaid with over band
5 years – 80% of the markings on a project in place

Retroreflectivity

Retroreflectivity

This is how you can see the lines in the dark. The light from your headlamps strikes the glass beads, it is refracted and reflected back to your eyes. The small spheres of glass do all the work.

The right glass bead package, (mixture of sizes, quality, refractive index) properly applied is crucial to the performance of the finished product. Retroreflectivity measurements can be included in your specifications.



Both mobile and handheld retrorflectometers are available. These instruments measure the amount of light returned from a known light source. The unit of measure is: mcd/lux/m²

FHWA has established minimum retroreflectivity standards determined by road type and posted speed. In Canada there are no regulations in place. However this is a topic of study with some jurisdictions placing retroreflectivity requirements into their contracts.

In order to attain high initial retroreflective values speciality bead packages may need to be designed as the drop on bead for the markings. The cost of the various bead types vary greatly. This additional cost should be weighed against the fact that winter maintenance acitivities will quickly damage the glass bead leaving them ineffective. In areas where there is little winter maintenance we anticipate retroreflectivity numbers not dropping as quickly.

Retroreflectivity

Glass bead facts:

Glass beads must be clear and perfectly round to effectively refract and reflect the light.

Only those glass beads embedded between 40% and 60% will function effectively. An optimum balance between the quantity of glass bead and binder will allow the glass bead to be embedded as required.

Snow and ice control activities can directly affect the retroreflective performance of a line. If the glass beads are scratched, crushed or removed the line looses retroreflectivity.

The glass bead mixed into the binder, will be revealed as the binder wears away. However the line will not regain its initial retroreflectivity, even if the intermix bead is of the same type and quality as the drop on glass bead.

Physical Characteristics of Glass Beads

Gradation (size)

Glass beads can vary in size from .06mm to 1.0mm. The larger the bead the more binder required to hold it in place. Mixing gradations may allow some beads to sink into the binder while others remain at the surface.

Refractive Index

The refractive index indicates how the light is refracted within the glass bead. A 1.5 index is considered the standard. A 1.9 index bead tends to focus the light returning toward the source and increasing the retroreflectivity.

Composite Structure

There are beads available that attach multiple beads of various index ratings around a central core. This composite structure provides numerous advantages including compensating for being under water.

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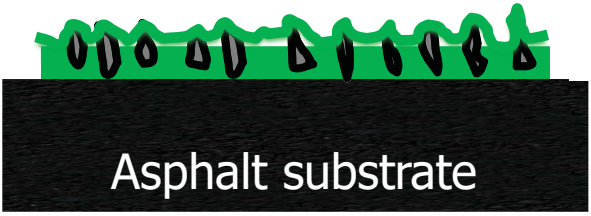
Skid Resistant Surfaces

Outline:

1) Description
2) Physical Properties of Materials - tests
3) Certification testing of material
3) Application
    - Ambient conditions
    - Substrate conditions
    - Process
    - Material and bead quantities
4) Measurements - identify critical parameters
    - Tools and Methods
    - QC Reporting
5) Inspection
    - Visual - texture, uniformity, edges
6) Warranty



Skid Resistant Surfaces

Ideas Mentioned:
Testing Methods - picture of British Pendulum tester

Lessons Learned