Government of Canada | Gouvernement du Canada

Draft Strategic Plan for Implementing the Use of Low Volatile Organic Compound Traffic Marking Coatings

Working Group on Traffic Marking Coatings (WG-TM)

As of April 10, 2008

Canada

Library and Archives Canada Cataloguing in Publication

Draft strategic plan for implementing the use of low volatile organic compound traffic marking coatings [electronic resource].

Electronic monograph in PDF and HTML format.
Includes abstract in French.
"Summary of the Comments Received on the Draft Strategic Plan for Implementing the Use of Low Volatile Organic Compound Traffic Marking Coatings and Responses to Comments".
Issued also in French under title: Plan stratégique provisoire pour mettre en oeuvre l'utilisation de revêtements de marquage routier à faible concentration en composés organiques volatils.
ISBN 978-0-662-48465-3 (PDF)
Cat. no.: En84-64/2008E-PDF

1. Air--Pollution--Canada--Prevention. 2. Air quality management--Canada. 3. Volatile organic compounds--Environmental aspects--Canada. 4. Road markings--Environmental aspects--Canada. I. Canada. Environment Canada II. Canada. Commercial Chemicals Formulation Division.

TD196.O73P62 2008 363.739'270971 C2008-980244-6

Thank you to the many individuals who provided information and comments in the preparation of this Strategic Plan.

Special thanks to all the corresponding and participating members of the Working Group on Traffic Marking Coatings for their expertise and consistent help and efforts. Their involvement was essential for the production of this Strategic Plan and the members will continue to provide support by sharing test results.

Environment Canada
Products Division
Traffic Marking Coatings Strategic Plan
351 St. Joseph Blvd., 12th Floor
Gatineau, Quebec
K1A 0H3
Tel.: 819-994-6147
Fax: 819-994-0007
E-mail: vocinfo@ec.gc.ca

Website: http://www.ec.gc.ca/nopp/voc/en/secAIM.cfm
(For all WG-TM background documents, meeting minutes and further information)

Table of Contents

List of Acronyms and Abbreviations

CARB	California Air Resources Board
CO_2	Carbon dioxide
EC	Environment Canada
g/L	Grams per litre
MMA	Methyl methacrylate
OHS	Occupational health and safety
OTC	Ozone Transport Commission (made up of 12 northeast and mid-Atlantic states and the District of Columbia)
TAC	Transportation Association of Canada
TM (coatings)	Traffic marking (coatings)
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WG-TM	Working Group on Traffic Marking Coatings

1. Overview

This Strategic Plan has been prepared by the Working Group on Traffic Marking Coatings (WG-TM) to provide information and guidance during the transition toward regulations to limit the Volatile Organic Compound (VOC) concentration in traffic marking coatings to 150 g/L.

Environment Canada is currently in the process of preparing regulations to limit VOCs in architectural coatings by 2011. The WG-TM consists of representatives of manufacturers, importers and applicators of traffic marking coatings and also of federal, provincial and municipal governments and transportation authorities. The WG-TM has been meeting since June 2006 to produce this Strategic Plan as a starting point for stakeholders to begin to adapt to VOC-compliant traffic marking products (traffic marking products include liquid phase traffic marking coatings and other traffic marking products such as tapes, etc.).

The challenge lies in determining proper traffic marking alternatives that contain lower amounts of VOCs, in effect reducing contribution to smog and ground level ozone, while allowing for adequate performance and durability in the various Canadian climates. Importantly, a proper investigation of the costs and safety issues associated with any change in traffic marking products and practices is to be considered while weighing the potential benefits incurred over time.

Some Canadian jurisdictions also experiencing typical Canadian weather conditions are already using traffic marking products with a VOC concentration of 150 g/L or less. This Strategic Plan is being developed to assist other jurisdictions in changing to low VOC traffic marking coatings. Additional information regarding the proposed architectural coatings regulations or on this Strategic Plan may be obtained by contacting Environment Canada at the address provided on the front of this document.

2. Introduction

2.1. Background

Traffic marking products are critical for road driving safety because they increase visibility at night and during hazardous weather conditions such as rain, snow or fog.

Traffic marking coatings, particularly the traditional alkyd[1] types, contain a significant amount of solvents which end up being released into the atmosphere. Solvents used in the formulation of paints and coatings are used as a vehicle to transfer the solids to a substrate (the surface to be coated) and released to the atmosphere by evaporation following application. These solvents, found in both solvent-based and water-based coatings, contain volatile organic compounds (VOCs). Released VOCs react through photochemical processes in sunlight and contribute to the formation of ground level ozone, one of the main ingredients of smog.

Air pollution and smog are linked to serious and adverse health effects for Canadians, resulting in thousands of premature deaths and hospitalizations each year. In recognition of the significant adverse human health effects of smog, Environment Canada is taking measures to reduce all VOC emissions from consumer and commercial products, including architectural coatings. The most appropriate method to reduce VOC emissions that result from the use of architectural coatings is to reformulate the coatings so that they contain lower levels of VOCs.

The second table in Appendix A lists a number of alternatives to traditional, high VOC concentration products and these options all have a VOC concentration of 150 g/L or less, in compliance with the proposed *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*. However, adoption of these products may require changes in application equipment and techniques. Water-based paints, for example, require corrosion proof equipment. Epoxy paints need separate tanks for the two reacting agents, plus mixing equipment. Tape markings require completely different application equipment, as some other durable traffic marking products do.

Most traffic marking applications are done during the summer months, but may take place during different times of the year. It is expected that traffic markings with a lower VOC concentration (i.e. with a VOC concentration of 150 g/L or less) may present a number of challenges during application in colder temperatures. Cold temperature conditions include the shoulder season (early spring and, especially, late fall) with near-zero temperatures and higher humidity, and the winter season with sub-zero temperatures. Traditionally, alkyd paints were used

[1] Alkyd coatings are a class of polyester coatings derived from the reaction of an alcohol and an acid or acid anhydride. They are the predominant binding agent in most oil-based coatings on the consumer market.

in almost all sub-zero or near-zero applications; however, even alkyd paints do not perform optimally in such unfavourable drying conditions. Moreover, friction from snowploughs, sand or salt applications reduce the paint durability during wintertime. Therefore, traffic marking coatings applied during sub-zero temperatures may have to be reapplied under better weather conditions.

The most suitable traffic marking alternatives with a maximum VOC level of 150 g/L thus need to be identified and tested, and their use needs to be implemented. Such a plan constitutes a challenge, but its achievement would reduce the contribution of traffic marking coatings to smog problems while ensuring their adequate performance and durability in various Canadian climates, and with minimum cost.

For the benefit of stakeholders, it is interesting to note that the proposed *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations* would not be the first federal initiative to limit the concentration of an ingredient in traffic marking coatings and to impact end-users. In accordance with Health Canada's *Surface Coating Materials Regulations*, which came into force in 2005, the maximum concentration of total lead will be 600 milligrams per kilogram of dried traffic marking coating, effective after December 31, 2010.

2.2. Approach

Environment Canada's proposed VOC concentration limit for traffic marking coatings is 150 g/L. This concentration limit is consistent with the U.S. EPA *National Volatile Organic Compound Emission Standards for Architectural Coatings* (the "U.S. EPA National Rule"), the Ozone Transport Commission (OTC) Model Rule, as well as the 2000 Suggested Control Measure of the California Air Resources Board (CARB). It should be noted that in 2007, CARB adopted a more stringent VOC concentration limit of 100 g/L for traffic marking coatings. In addition, the Master Painters Institute's (MPI) Green Performance™ Standard sets its recommended VOC limit at 150 g/L for traffic marking coatings.

In the spring of 2006, the Working Group on Traffic Marking Coatings (WG-TM) was formed to develop this Strategic Plan to implement the VOC concentration limit for traffic marking coatings set out in the *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations* proposed by Environment Canada. Appendix B provides a list of the WG-TM participating and corresponding members.

This Strategic Plan, including a timeline and steps for devising an implementation plan, addresses the challenges outlined through consultations, and proposes a means to assist stakeholders in the transition toward the application of traffic marking coatings with a VOC concentration of 150 g/L or less. Of these, the main issues are:

- Road safety – There are concerns regarding the feasibility and durability of cold weather application of low VOC traffic marking products (i.e. in shoulder seasons and winter emergencies).
- Costs – There are concerns regarding costs of the changeover to low VOC traffic marking products (i.e. equipment upgrades, modifications to marking practices, training, etc.).

This Strategic Plan reflects the discussions that ensued from WG-TM sessions and thereby attempts to address the challenges that stakeholders face in complying with the proposed regulations. The proposals laid out in this document address the main points considered regarding the transition to the new proposed requirements and the expansion of the different options to be considered by end-users for applying compliant traffic marking coatings in their area.

3. Strategic Plan Objective and Timeline

3.1. Objective

The principal objective of this Strategic Plan is to facilitate the transition to the use of traffic marking coatings that comply with the proposed VOC limit of 150 g/L, expected to be effective in 2011, pursuant to the proposed *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*.

3.2. Timeline

Environment Canada published the proposed *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations* in the *Canada Gazette*, Part I, in April 2008, followed by a 60-day comment period. The final regulations will be published thereafter and will come into force on the day on which they are registered. However, not all proposed provisions will take effect at the same time (see below).

Effective date for manufacture and import of traffic marking coatings

It is proposed that the manufacture and import of traffic marking coatings with a VOC concentration higher than 150 g/L be prohibited as of 3 years after the regulations are registered.

Effective date for sale and offer for sale of traffic marking coatings

It is proposed that the sale, supply or offer for sale of traffic marking coatings with a VOC concentration higher than 150 g/L be permitted for up to 2 years after the prohibition of manufacture and import becomes effective.

4. Developing an Implementation Plan

Migrating from an alkyd type of paint to a lower VOC alternative may require equipment and/or procedural changes for traffic marking applicators. To minimize the difficulties and to anticipate future needs, jurisdictions and organizations may need to develop an implementation plan for transitioning to the application of low VOC traffic marking products.

This section outlines key areas that may need to be considered in developing an implementation plan. These will assist in determining costs, training requirements, and the approach to mitigate impacts of the change, while allowing consideration for quality and safety, for communication strategies and for meeting timelines. Please refer to Appendix A for further details on alternative traffic marking products with a VOC concentration of 150 g/L or less.

The implementation plan should at least consider, without being limited to, the following items:

1. Identification of traffic marking coatings that are currently used and that do not comply with the proposed VOC limit of 150 g/L.

2. Identification of the alternative product(s) that could be used for different weather conditions and application types:
    a. Regular Summer Applications – Maintenance
    b. Regular Summer Applications – Construction
    c. Shoulder Season Applications
    d. Emergency Winter Applications

3. Identification of major challenges faced by institutions while changing to the identified low VOC alternative products:
    a. Provincial/territorial/municipal requirements and approvals. Determine regional/local regulations and policies and their associated approval procedures required to adapt to new traffic coating products. For more details, please see section 5: *Approvals and testing of products*.
    b. Ensure that proper specifications and compatible products (e.g. dual coated beads are required with waterborne paints) are approved by jurisdictions and used by applicators.
    c. Enquire about the availability of traffic marking coatings with a VOC concentration of 150 g/L or less, of raw materials and of equipment from distributors.
    d. Determine experience with new materials and preferences (coatings, equipment) and potential training needs.
    e. Consider using a smaller number of products.
    f. Durability of different products. Determine the performance, i.e., time between reapplications.
    g. Take into account safety concerns about:

i. Application crews;
ii. Manufacturing personnel;
iii. Motorists.

h. Take into account resistance to change and capacity building. For example, to apply new products, a contractor and equipment are needed, but what if no contractor with required equipment is available?
i. Take into account the cost of material:
    i. Are alternative products more expensive at this time?
    ii. Will market adjust with increased capacity?
    iii. Will cost increase for 100% of applications or for only a small percentage during shoulder season and winter?
j. Fixed price of markings versus durability. Determine the cost effectiveness of coatings by calculating the durability of the product per unit volume (i.e. years/tonne, months/litre). Initial unit cost of coating may be higher or lower for some products but without necessarily increasing long-term costs if the alternative product quality and performance are also increased.
k. Equipment and operating cost (initial capital investment versus long-term investment). Would you require upfront payment and purchases of equipment? Would this be cost effective in the long term? How many years before capital cost is recovered?
l. Take into account the cost of buying new equipment versus retrofitting. Is current equipment upgradeable? Is current equipment close to its end of life?
m. Is an increase in painting operations/capacity during warm months a good solution?
n. When converting to low VOC concentration markings, equipment may need to be modified. There are several factors to consider, including pump diameter, stainless steel grade plumbing, paint sheer, atmosphere-free system, atomization, transfer-efficiency vs. airless spray, lower heat/drying temperature requirement, residual materials, weight-per-volume and truck capacity or entirely new application equipment for coatings in solid phase (tape, U.V. cured, etc.)
o. Cleaning and contamination. How easy is it to clean the new products compared to traditional ones? Is there more/less chance of contamination or clogging? What are the cleaning costs? What does the paint supplier recommend? What are the local requirements, including but not limited to federal, provincial, territorial and municipal legislation regarding disposal of wash water?

4. Schedule changeover scheme for each alternative product in association with all involved players/parameters:
    a. Staff training, equipment retrofit

b. Contractors/Applicators
c. Jurisdictions (developers of standards for marking products)

5. Schedule a training program for all personnel when managing or performing changeover activities involving the use of new products (i.e. low VOC traffic markings). The training costs should not be significant for applicators, as it is usually the responsibility of the supplier.

6. Establish and implement corrective actions to address deficiencies identified in the operations. Revisit implementation plan by following the above-mentioned steps, as necessary.

In addition to adaptations required of traffic marking applicators, migrating to lower VOC alternatives may require the testing and approval of supplementary traffic marking coatings by transportation authorities. Therefore, the WG-TM also recommends that jurisdictions and organizations responsible for traffic marking standards and approvals develop their own implementation schedule in order to make sufficient numbers of marking products with a VOC concentration of 150 g/L or less available for application. Consideration should be given to the increased budget and resources needed to purchase new low VOC products and, for example, their associated testing, trial, approval, and contracting with applicators.

5. Approvals and Testing of Products

5.1. Jurisdictional Differences

A province, territory or another level of government may have the authority for its own approval and testing system to decide which new product may be applied in its area. As the methods, test periods and approval pathways are different, it is important to understand all requirements to ensure that there are approved alternative products in each jurisdiction before the regulations deadline. The following jurisdictional authorities had these approval and testing schemes in place as of February 2007; however, these may be subject to change:

- The Northwest Territories and Yukon are using the products that are on the list of approved substances of Alberta and British Columbia, respectively. Yukon has in the past used lists from Alberta and Manitoba.
- Starting in 2007, Manitoba will be using products that are on the "Approved List" of Saskatchewan.
- Some of the Atlantic Provinces (like some U.S. jurisdictions) do not test new products but accept or reject them on a compositional basis.
- Quebec, Alberta, Ontario and Saskatchewan have slightly different testing and approval systems which follow some or all of these steps:
    - Traffic marking manufacturers submit their new products
    - Application is made on a test deck at standard conditions (1–4 years depending on type of product and claim by manufacturer: will be deck tested for as long as manufacturer claims durability)
    - Compositional test analysis is made in laboratory
      (6–12 months)
    - Field test trials are performed
      (1 year)
    - If successful, the product is added to the "Approved List".

Some jurisdictions are applying low temperature application products on test decks in standard conditions to better compare results with normal temperature products and perform field trials at cold temperatures. Other jurisdictions are using test decks in colder temperatures.

The overall process of approving a product across jurisdictions may take from three to five years. The time required to approve a product should be seriously considered during the development of an implementation plan.

5.2. Other Factors for Consideration

Although different jurisdictions will have different mechanisms and pathways for approval of the use of a traffic marking product, some general considerations are relevant to all product testing. Various factors which influence the approval time of a traffic marking product include, but are not limited to:

- ✓ How long will it take for the manufacturer to have its product ready for testing?

- ✓ Is there sufficient time to have the product on the test decks for the upcoming season/testing period?

- ✓ What type of product is it? The testing of traditional paints takes less time than the testing of durable products. Cold weather application products need testing applications during colder weather.

- ✓ How can the process be accelerated? Is the product approved only after test deck and lab analysis (e.g. in Alberta there is no waiting for trials)? Is approval based on compositional evaluation (as in Atlantic provinces and some U.S. jurisdictions)? Have the results from other jurisdictions been consulted before undertaking the testing of a given product?

Colder weather application products must be thoroughly evaluated to ensure that the traffic marking coatings intended for shoulder season and emergency winter applications are safe, cost effective and in compliance with the proposed regulations.

Each jurisdiction is responsible for approving new products (e.g. test decks, trials, and/or compositional tests) to ensure that the products applied on the roads meet the specific performance and safety requirements.

6. General Considerations for Changing to Low VOC Products

In addition to emission reductions, certain factors should be considered when using products with a VOC concentration of 150 g/L or less. The following list summarizes some additional issues for consideration during the transition process:

Occupational health and safety (OHS) improvement. In some jurisdictions, low VOC traffic marking products have already been considered due to the occupational health and safety hazards that may result from using highly volatile, flammable products. Health and safety benefits will not only impact applicators, but manufacturers, distributors and transporters as well. It should be noted that OHS risks may be reduced when switching to latex, which is not necessarily the case if switching to methyl methacrylate (MMA) or acetone-based paint.

Safety of motorists. Some concerns regarding traffic safety and road visibility have been raised. Traffic marking coatings are critical to provide positive guidance for public safety. Public safety has to be a primary consideration when making changes to pavement markings. For example, certain types of traffic marking coatings provide greater visibility and higher retroreflectivity.[2] However, retroreflectivity is affected by various factors, including the use of glass beads, and is not solely dependent on the paint quality. Some manufacturers and users consider that water-based markings have the advantage of improved retroreflectivity (300–400 millicandelas) and longer glass bead retention.[3]

Climatic Factors. Application of traffic marking paints in the winter and shoulder season may present challenges due to their design, which provides for applications under more favourable climatic conditions. As waterborne paints generally have higher minimum ambient temperature requirements for application than solvent-based paints, proper application may be difficult in certain cold conditions. However, it should be kept in mind that all traffic paints applied below freezing point, including traditional solvent-based products, perform poorly. The search for alternatives could therefore result in more effective long-term traffic markings, with possibly less temperature dependence and improved performance/cost ratios.

Disposal and Waste. Elimination of high VOC alkyd products will result in an increased use of waterborne products and an overall reduction in solvent-based clean-up and disposal. With proper training, the general daily operations and day-to-day cleaning of waterborne paints may be easier. Local environmental regulations should still be followed for disposal of wastewater.

Pavement Damage. Water-based and other low solvent coatings are far less intrusive in terms of pavement damage as compared to solvent-based paints, which lead to premature cracking in roadways.[3]

[2] Retroreflectivity is the measurement of reflection of light in the direction from which it came regardless of the angle of incidence.
[3] Information based on the experience of many WG-TM members and other stakeholders.

Environmental Benefits. Life cycle analysis shows that the use of water-based markings results in less long-term CO_2 emissions (greenhouse gases), VOC emissions, eutrophication (organic pollution of water), energy consumption, and production of solid wastes (Rohm & Haas 2005).

7. Path Forward

Readers and users of this strategy are encouraged to provide feedback to the WG-TM as Canadians continue a coordinated search for safe, cost-effective, and low VOC traffic marking alternatives. The WG-TM will monitor testing, approvals, alternatives and applications.

A product evaluation form has been distributed to provincial and territorial jurisdictions who are conducting tests on new traffic marking coatings. The WG-TM will facilitate the reporting and sharing of test results for new products. A copy of this evaluation form is found in Appendix C.

Due to the persistent challenge of cold weather applications, it is important that provinces, territories and other users commit to test products. In order to determine their feasibility, these products must be tested on decks and in field trials, during colder temperatures. A suggested timeline for colder weather testing is outlined below:

Table 1 – Timeline for cold weather testing

Timeline	Activities specific to TM coatings for testing in cold weather
Fall 2008	Application of traffic marking products with low VOCs at cold temperature
Spring 2009	1st evaluation of applied test products
Fall 2009	Application of larger amounts of the same traffic marking products, as well as any new product developed by then, at low temperature
Spring 2010	2nd evaluation of applied test products

These steps should be repeated annually, with all test and evaluation data shared between jurisdictions through the WG-TM. The results and list of scheduled and planned new products tested by different provincial and territorial jurisdictions will be posted on the Environment Canada web page (www.ec.gc.ca/nopp/voc/en/secAIM.cfm).

In addition to regular meetings and updates, the WG-TM will continue to:

- Inform stakeholders on advanced traffic marking products and VOC concentration limit/regulatory evolution in Canada and elsewhere.
- Encourage jurisdictions to perform testing on new traffic marking products with a VOC concentration of 150 g/L or less.
- Circulate information on the Strategic Plan on traffic marking coatings and related policies and procedures to the following entities:
  - The Transportation Association of Canada and its members
  - Paint manufacturers and their contacts (public and private applicators)
  - The Federation of Canadian Municipalities and its members

8. Selected References and Useful Websites

Martin, Peter T. (1996). *A Comparative Analysis of the Alternative Pavement Marking Materials for the State of Utah*. Utah Traffic Lab. University of Utah.

Rohm & Hass (2005). *Environmentally Friendly Water Based Paints*. Available at http://www.rohmhaas.com/fastrack/environment.htm

Tremblay, Michel. (2005). *État de la situation de la signalisation horizontale au Québec*, Ministère des Transports du Québec.

And various information provided by WG-TM members and stakeholders.

Schedule and updated information on testing of new products will be posted at: http://www.ec.gc.ca/nopp/voc/en/secAIM.cfm

Appendix A – Selected Alternatives to High VOC Concentration Coatings

NOTE: The following tables provide a summary of the information provided to Environment Canada during the fall 2005 traffic marking consultations and the WG-TM meetings. The following tables will continue to evolve after the distribution of this Strategic Plan. Therefore, updated versions will be posted on the WG-TM website. The first table provides the baseline numbers for comparison with the alternatives found in the subsequent table. **All** of the alternatives have a low VOC concentration and therefore this is not mentioned under "Advantages" in the table. Please consult section "Definitions and comments on the terms used in the table" at the end of this Annex for details on each column's content and on the terms used in the tables.

Baseline: details on high VOC concentration product (concentration > 150 g/L)

Product type above VOC limit	Cost of material/metre	Total maintenance cost (M+A)	Total construction cost (M+A)	Durability	VOC concentration (g/L)	Use type	Advantages	Disadvantages	Has been/is being used/tested	Application surface type
"Traditional" alkyd	$0.11	$0.19 – $0.23	$0.50 – $3.00	6 months – 1 year	> 200	Maintenance + Construction + Temporary	• Low initial cost • Easy to apply • Known by applicators • Already have equipment • Cold weather application possible (but short-term durability) • Cleaning solvent may be recycled	• High VOC concentration • User safety (flammability, volatility) • Durability (various results) • Poor retroreflectivity • First application does not stick as well	The industry standard Widely used	Asphalt Concrete

Selected alternatives to high VOC concentration products:

Identified alternative product type	Cost of material/metre	Total maintenance cost (M+A)	Total construction cost (M+A)	Durability	VOC concentration (g/L)	Use type	Advantages	Disadvantages	Has been/is being used/tested	Application surface type
Waterborne acrylic (different versions)	≈ $0.11	$0.19 – $0.25	$0.50 – $3.00	6 months – 1 year	≤ 150	Maintenance + Construction + Temporary	• User safety (less flammable and volatile) • Retroreflectivity • Better durability • Better glass bead retention • Less intrusive to pavement • Easy daily cleaning • Easy to convert to • Close cost/performance ratio • Easy to apply	• Snowplough can remove it if too many layers • Disposing of cleaning solvent (ammonia) • Cold/cool temperature limitations • High humidity (rain) application not possible • May be fussy to work with • Slightly longer dry times • Winter storage can be problematic • Loss of production days during alkyds-to-acrylic changeover • Rustproof equipment required	Tested, approved and used Over 90% of maintenance markings (Ontario)	Asphalt Concrete
Waterborne acrylic – low temperature	≈ $0.16	$0.50 – $0.75	N/A	6 months – 1 year	≤ 150	Maintenance + Construction + Temporary	Same as acrylic waterborne but: • Allows colder application (0°–2°C) for early & late season, night time • Allows higher air humidity application (no test results)	Same as waterborne acrylic but: • Higher-cost than normal waterborne acrylic at this time • Limited experience in Canada	Tested, approved and used in some jurisdictions	Asphalt Concrete
Waterborne acrylic – high build, HD21, DT400	$0.40	$1.00 – $1.50	N/A	6 months – 2 years	≤ 150	Maintenance	Same as acrylic waterborne but: • Better retroreflectivity if applied properly • Better durability	Same as waterborne acrylic	Applied on test deck, approved and field trials initiated	Asphalt

Identified alternative product type	Cost of material/metre	Total maintenance cost (M+A)	Total construction cost (M+A)	Durability	VOC concentration (g/L)	Use type	Advantages	Disadvantages	Has been/is being used/tested	Application surface type
Epoxy – medium/long life	$0.48 – $0.60	$1.50 – $3.00	$3.00 – $4.00	2–4 years	≤ 150	Construction + Maintenance	• Retroreflectivity • Excellent durability • Less tendency to flake (long life) • Low cost considering its durability	• Higher cost product • Longer dry time: coning required • Cannot be used below 10°C • Cannot be applied on other existing markings • Cannot be applied on really old pavement • Rare allergic reactions • Special application equipment • UV colour degradation (white changes to cream) • Mixing of 2 products	Used widely Several epoxy products are on test decks	Asphalt Best product for application on concrete
Methyl methacrylate (MMA) / cold plastic (screed applied)	$1.30	N/A	$4.00 – $6.00	3–7 years	≤ 150	Specialty markings + Construction	• Wear resistant • Excellent durability • Any temperature application (below 0°C, has been applied at –20°C) • Short dry time • Easy to apply extrusion	• Long-term retroreflectivity highly dependent on type of beads used • Mixing of 2 products: control of application critical • Expensive • Low average application speed	Used widely	Asphalt Concrete
Methyl methacrylate (MMA) (spray applied)	$0.70	$2.00 – $3.00	$3.00 – $3.50	2–3.5 years	≤ 150	Specialty markings + Construction + Maintenance (possibility)	• Wear resistant • Excellent durability • Any temperature application (below 0°C, has been applied at –20°C) • Short dry time • Could be applied with regular alkyd truck (new development) • High reflectivity	• Mixing of 2 products: control of application critical • Expensive • Specialized equipment • Low average application speed • Dedicated machinery cost	Used widely	Asphalt Concrete

Identified alternative product type	Cost of material/metre	Total maintenance cost (M+A)	Total construction cost (M+A)	Durability	VOC concentration (g/L)	Use type	Advantages	Disadvantages	Has been/is being used/tested	Application surface type
Methyl methacrylate (MMA) (textured)	$0.35	N/A	$4.00 – $5.00	2–7 years (new product)	≤ 150	Specialty markings + Construction	• Wear resistant • Excellent durability • Any temperature application (below 0°C, has been applied at −20°C) • Short dry time • Good wet retroreflectivity	• Mixing of 2 products: control of application critical • Expensive product • Specialized equipment • Low average application speed • Dedicated machinery cost	Used widely	Asphalt Concrete
Water-based urethane / modified polyurethane	N/A	N/A	N/A	2–4 years	≤ 150	N/A	• Good durability	• Similar to epoxy but average reflectivity	New development Not currently used	N/A
Polyurea	N/A	N/A	N/A	N/A	≤ 150	N/A	• Quick drying	• Mixing of 2 products	Currently on Alberta and Quebec's test decks	Asphalt Concrete
Thermoplastic (spray applied)	$0.65 – $0.70	$4.00 – $20.00	N/A	1–2 years	≤ 150	Maintenance	• Quick drying • Excellent durability • Good retroreflectivity (varies with season)	• Not recommended for concrete pavement • Spray will not work in Canada (temperature)	Used in the U.S.	Asphalt
Thermoplastic (screed applied)	$0.65 – $0.70	N/A	$3.00 – $5.00	2–4 years	≤ 150	Construction	• Quick drying • Excellent durability • Good retroreflectivity (varies with season)	• Not recommended for concrete pavement • Cold weather limitations	Applied on test decks (1975) Used extensively	Asphalt

Identified alternative product type	Cost of material/metre	Total maintenance cost (M+A)	Total construction cost (M+A)	Durability	VOC concentration (g/L)	Use type	Advantages	Disadvantages	Has been/is being used/tested	Application surface type
Thermoplastic (textured – has to be inlaid)	$0.65 – $0.70	N/A	$8.00 – $12.00	6–8 years	≤ 150	Construction	• Quick drying • Excellent durability • Good retroreflectivity (varies with season) • Wear resistant • Good wet retroreflectivity	• Not recommended for concrete pavement • Cold weather limitations	Applied on test deck 1 field trial Approved Used on ring roads in Calgary, Edmonton and BC	Asphalt
Tape (inlaid)	$7.00 – $10.00	N/A	$12.00 – $20.00	4–7 years	≤ 150	Construction	• Excellent appearance • Good durability • Retroreflectivity	• To be applied only to new surfaces • Slow application speed • Warm temperature only	Used	New Asphalt
Low VOC solvent-based (with acetone)	$0.15	N/A	N/A	6 months – 1 year (new product)	≤ 150	Construction + Maintenance	• Cold temperature use (lowest 0°C)	• Flammable (more than regular alkyd)	Test deck June 06 Will be applied at colder temp. fall 06	Asphalt Concrete

Examples of alternative VOC excluded solvents (i.e. compounds that are excluded under item 65 of Schedule 1 of the *Canadian Environmental Protection Act, 1999*):

- Acetone, which works very well in cool conditions, but dries too quick at high temperature and raises user safety concerns (flammable)
- Methyl acetate
- Parachlorobenzotrifluoride (PCBTF)

Other traffic marking coatings that were considered but not included in the table because they are not widely used and sufficient information is not available:

- Polyester: less expensive products with similar results exist
- Abraline: this product is similar to polyester

Definitions and comments on the terms used in the table:

- **Cost of material/metre**
  - The acquisition cost (per metre applied) of the marking products. The cost should include all materials that have to be applied to the pavement, i.e. coating, glass beads, etc. The costs given in this column are for maintenance type of application. It is understood that if a product is bought/applied in smaller quantity, i.e. for construction type of application, the average price per metre would likely be higher. The average price for maintenance is used to allow for comparison of different types of products and the cost for construction sites is not considered in this column.
  - To calculate the price per metre, an application rate of 40 litres per kilometre has been used as basis for paints and 58 litres per kilometre for resins.
  - The prices are given for an average applied stripe width of 10 centimetres.
- **Total Maintenance Cost – Material and Application (M+A)**
  The acquisition cost for the product and the cost of application for large volume (maintenance) per meter of application. It includes the materials, equipment, crews, trucks, time required, etc. An application is said to be of maintenance type when it is more than 1000 km long but more often around 3000 km long.
- **Total Construction Cost – Material and Application (M+A)**
  The acquisition cost for the product and the cost of application for small volume (construction) per meter of application. It includes the materials, equipment, crews, trucks, time required, etc. The size of a construction type of application can vary greatly, but is usually less then 100 km long.
- **Durability**
  This parameter is related to the time it takes before a subsequent application is required.
- **VOC concentration (g/L)**
  The approximate quantity (in grams per litre) of VOC contained in each product type, as calculated according to the methodology set out in the proposed *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*.

- **Use Type**
  Is this product designed to be applied for maintenance or durable type of applications?
- **Advantages/Disadvantages**
  Lists all the identified advantages and disadvantages of each product; in the table of alternatives, these are most often given in comparison with the baseline ("traditional" alkyd).
- **Has been/is being used/tested**
  States if the product has been used or tested, currently or in the past, by certain jurisdictions/end-users.
- **Application surface type**
  Identifies the type of surface to which this product can be applied (i.e. old/new asphalt, concrete, recycled asphalt, others).

Appendix B

Working Group on Traffic Marking Coatings – Participating Members

Employer	First name	Last name
Environment Canada	Alex	Cavadias
Environment Canada	Paula	Critchley
Alberta Infrastructure and Transportation	Joe	Filice
British-Columbia Ministry of Transportation	Daryl	Finlayson
Environment Canada	Guy	Gagné
Ennis Paint	John	Haupenthal
Environment Canada	Martin	Jeanson
Newfoundland and Labrador Transportation and Works	Dean	Osmond
New Brunswick Department of Transportation	Tyrone	Parsons
Ennis Paint	Mario	Pelletier
Ontario Ministry of Transportation	Grant	Ridley
Lafrentz Road Marking	Glenn	Thamer
Transports Québec	Michel	Tremblay
IBIS Products Ltd.	James	Zhang

Working Group on Traffic Marking Coatings – Corresponding Members

Employer	First name	Last name
Ennis Paint	Bryce	Anderson
Manitoba Transportation and Government Services	Peter	Arlukiewicz
City of Winnipeg	Jean	Belair
City of Calgary	Bill	Biensch
Saskatchewan Highways and Transportation	Stan	Bowditch
City of Edmonton	Gord	Cebryk
PEI Department of Transportation and Public Works	Kevin	Campbell
Ennis Paint	Denis	Hogue
Ville de Montréal	Robert	Kahle
Alberta Infrastructure and Transportation	Moh	Lali
Chemical Sensitivities Manitoba	Sandra	Madray
London and District Labour Council	Jim	Mahon
Yukon Territory Department of Highways and Public Works	Michael	McArthur
Ennis Paint	Klyne	Mc Carty
New Brunswick Department of Transportation	Brian	Mc Kinney
Nova Scotia Department of Transportation and Public Works	Kevin	Mitchell
IBIS Products Ltd.	Christine	Montrichard
Transports Québec	Claude	Nazair
British-Columbia Ministry of Transportation	Nicole	Pharand-Fraser
Transports Québec	Jocelyn	Racine
Ennis Paint	Alex	Sekulovski
Northwest Territories Department of Transportation	John	Suwala
Transports Québec	Constantin	Traian
IBIS Products Ltd.	Gary	Tran
Cloverdale Paint Inc.	Tim	Vogel
Transportation Association of Canada	Sarah	Wells

Appendix C – Product Evaluation Form

Product Evaluation Form		
Jurisdiction		
Product Type / Name		
Type of evaluation (Test Deck / Trial / Compositional)		
Date of application		
Weather conditions at application (temperature, humidity, wind speed)		
Details		
Paint specifications		
Wet film thickness		
Pavement temperature		
Paint temperature		
Bead type		
Bead loading		
Airless or air-assisted system		
Tips used for beads		
Tips used for paint		
Speed of application		
Average daily traffic		
Type of substrate		
Evaluation: During Application		
Compare each of the following criteria against a normal alkyd application using the following scale: -5: Much worse 0: Similar 5: Much better		Comments
Ease of application of paint		
Ease of application of beads		
Bead retention		
Drying time		
Color - Appearance		
Cleaning of equipment		
Training requirements		
Equipment problems		
Safety		
Retroreflectivity		
Evaluation: Long Term		
Durability		
Retroreflectivity		
Color - Appearance		
Bead Retention		
Results / Conclusions		
This product should be used in the following manner/conditions (temperature, humidity, equipment, type of pavement, type of beads, etc.)		

Notices

Environment Canada and the WG-TM members accept no responsibility should any damages be caused to a person, directly or indirectly, by Environment Canada's and the WG-TM members' participation in the WG-TM, as a result of the use that is made of information provided in, or taken from, this or other related document, or as a result of reliance on the information available in this or other related document.

This document should be used for general information purposes only. Environment Canada or the other WG-TM members do not warrant the currency, quality, accuracy, or reliability or completeness of any information in this or other related document. It is understood by the User of these documents (the "User") that these document and the information within is provided "as is" without warranty or condition of any nature, including fitness for a particular purpose or non-infringement of proprietary rights regarding any information, materials or other documents that are referenced by and included within this or other related document.

This or other related document does not constitute an endorsement of its content, or any of the products listed in the document and it is not an exemption from any laws or regulations that are in force in Canada that may apply.