Ontario

Book 11

Ontario Traffic Manual

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Pavement, Hazard and Delineation Markings

3.2 Materials

Permanent Materials

Pavement markings can be applied using paint and more durable products. These markings may be enhanced by devices such as roadway pavement markers and rumble strips (discussed in Section 3.3), delineators (discussed in Section 4), and object markers (discussed in Section 5).

Paints, durable marking materials, and preformed tapes are briefly described in this section. For more detail concerning the performance, installation, maintenance, removal, inspection, and environmental impacts of these materials, refer to the 1994 U.S. Federal Highways Administration publication, *Roadway Delineation Practices Handbook*, on which the following discussion is based.

Durable markings such as thermoplastics, two-component cold-reacted materials and tapes tend to have higher profile than paint. This makes them more susceptible to damage, particularly by snowploughing. Their durability can be extended significantly, however, if they are made flush with the surrounding pavement. Pre-formed tapes can be rolled into freshly laid asphalt. By first routing a channel into the pavement, then laying the marking material, other types of durable materials can be inlaid as well.

Paint

A paint system contains three interactive elements:

- The paint itself (pigment and binder), discussed below;
- Retroreflective glass beads, if any. Beads can reflect differently depending on the binder used, its thickness, and the proportion of pigment;
- The substrate or pavement surface. Paints can react differently on asphaltic and concrete pavements. About 90% of all paint failures are due to the type of substrate and condition of the surface.

Paint can be hot-applied or cold-applied. Drying times vary from less than 30 seconds (instant-drying paints) to over 7 minutes (conventional paints).

Five main types of paint are available:

- **Alkyd and modified alkyd paints** are generally the cheapest and fastest-drying, but are the least durable. During application, these paints release volatile organic compounds (VOCs), a potential environmental hazard.
- **Chlorinated-rubber or chlorinated-polyolefin paints** are more durable than alkyd and modified alkyd paints, but have a longer drying time and strong odour.
- **Water-based latex paints** avoid the use of hazardous VOCs and lead-based pigments and have service lives as long as or longer than alkyd and chlorinated-rubber paints, but have longer drying times and less colour durability.
- **Two-component epoxy paints** and **polyester paints** are not as widely used as alkyd, rubber, and latex paint. Their long-term performance is still under observation. Epoxy paint may be of particular value in Ontario due to its expected resistance to abrasion from snow removal equipment and materials.

The estimated service life of painted markings is a function of a number of site-specific variables, including the type and condition of the substrate, the climate, and the average daily traffic. Most highway agencies consider a reasonable target service life to be between six and twelve months under normal conditions. On roads with very high

traffic flows, a service life of three months is considered acceptable; on roads with low traffic flows, a service life of one to two years can be expected.

Thermoplastic

Durable marking materials typically last three to fifteen times longer than painted markings, but have a higher initial cost. When durability is a prime concern, hot-applied thermoplastic materials are considered a cost-effective alternative to conventional paint markings. Thermoplastic is considered impervious to deicing chemicals and sand.

Hot-applied thermoplastics are synthetic resins that soften when heated and harden when cooled without changes to their inherent properties. A thermoplastic system contains three interactive elements:

- The thermoplastic itself (plastic and plasticizer binder, pigment, and fillers);
- Retroreflective glass beads, if any;
- The substrate or pavement surface. Thermoplastics are not appropriate for application on new portland cement concrete.

Thermoplastic markings are classified by the type of binder used. The two most commonly used thermoplastic types are alkyd-based and hydrocarbon-based. Hydrocarbon-based thermoplastic should not be used for transverse markings because it can be dissolved by oil drippings.

Although thermoplastic is regarded as the most durable delineation material, its installation, maintenance, and removal requires great care compared with paint. The high temperature required for application and the extreme heat sensitivity of the material require a high level of quality control. Thermoplastics can be applied by hot extrusion (requiring two to ten minutes' drying time) or hot spray (requiring less than one minute's drying time).

Two-component, Cold Curing

Methyl methacrylate is a two-component cold-curing material that can be applied by either a spray or extrusion process. Just before application, it is mixed in a static mixer, generating an exothermic reaction. As the material cools, it bonds to the pavement.

Preformed Tape

Cold-applied preformed marking tape is appropriate for use at sites where a small quantity of marking material is required. Preformed tape is relatively easy to install and repair, which makes it especially useful where heavy use or severe conditions can make frequent replacement necessary.

Limited observation of the performance of preformed tape indicates that it is generally durable, but requires careful application. Its retroreflectivity tends to diminish over its service life. Because of its high initial cost, preformed tape is considered a cost-effective alternative to conventional paint or thermoplastic markings only in limited circumstances.

Preformed tape is generally supplied in rolls or sheets, usually with a pressure-sensitive adhesive backing. It ranges in thickness from about 0.75 mm to 2.5 mm. A tape marking system contains two interactive elements:

- The preformed tape itself (resin binder, pigment, and fillers, with optional glass beads and adhesive); and

- The substrate or pavement surface. Preformed tapes are reported to perform better on bituminous asphalt surfaces than on portland cement concrete.

Preformed tapes are classified as permanent or temporary, according to their expected service life. Permanent tapes, with an expected service life greater than one year, are typically made of urethane or pliant polymer.

Preformed tapes are either inlaid on freshly-laid warm asphalt or overlaid on existing pavement. Installation requires great care, and a clean pavement is more important for preformed tapes than for any other pavement marking material. If applied improperly, adhesion failure is likely to result.

Temporary Materials

Temporary tapes are used for temporary markings in construction and maintenance work zones. Temporary tape is designed to be easily removed by hand, without heat, solvents, grinding, or sandblasting.

Temporary preformed tapes generally consist of a single layer of pigmented binder and glass beads applied to a backing layer of metal foil. They are applied by overlaying them on the road surface, using the tape's preapplied adhesive for bonding. A primer will enhance pavement bond. Because they are intended for short-term use, temporary preformed tapes generally have a shorter expected service life than permanent preformed tapes.

3.3 Devices

Roadway Pavement Markers

General

A roadway pavement marker (RPM) is a device mounted on or in the road surface to supplement or replace pavement markings. The greatest advantage of RPMs is the enhanced visibility they provide at night under wet or foggy conditions, compared to painted or durable markings. Another advantage is that motorists who accidently stray across a line of RPMs will be alerted by a rumbling noise. This can be especially useful if drivers are fatigued or inattentive.

RPMs have also been found to help lower driver stress in adverse conditions. Studies have shown that in wet weather and other conditions motorists guided by pavement markings alone become increasingly agitated and make potentially dangerous errors in positioning their vehicles laterally in the lane. When pavement markings are supplemented by RPMs, driver performance quickly recovers and stress levels return to normal.

However, RPMs have a higher initial cost than other markings, are susceptible to loss, and are subject to lens damage (cracking and abrasion) that greatly reduces their retroreflectivity. Due to their high initial cost, RPMs should not be installed on roads that will be reconstructed or resurfaced in the near future.