Ontario

Book 11

Ontario Traffic Manual

March 2000

Pavement, Hazard and Delineation Markings

- 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

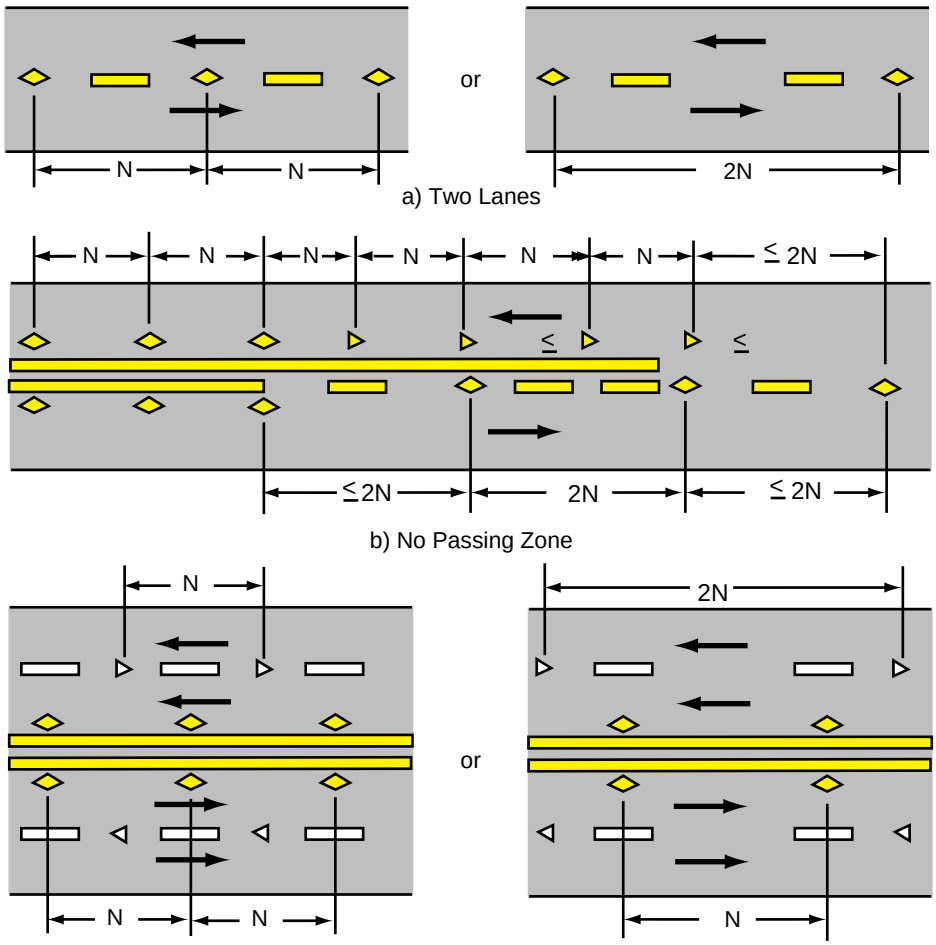
General

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.

Figure 5 – RPMs Supplementing Pavement Markings



Code: N Normal Spacing
Single white
Single Yellow
Double Yellow
Yellow Stripe
White Stripe
Direction of Traffic

Note: "N" is the combined length of one line segment and one gap in a broken line configuration appropriate to the road under consideration. "N" varies between 4.5 m and 12 m, as described in Section 3.4.

Source: U.S. Federal Highways Administration, Roadway Delineation Practices Handbook.

Supplementing Other Markings

RPMs may be used to supplement other markings such as directional dividing lines, lane lines, edge lines, guide lines, and continuity lines. They are particularly useful at hazardous locations such as channelizations, bridge approaches, lane transitions, horizontal curves, construction zones, and at approaches to obstructions.

For spacing and positioning of RPMs, refer to the following guidelines. (N is the combined length of one line segment and one gap in a broken-line configuration appropriate to the road under consideration.)

- When supplementing solid line markings, RPMs should be spaced no more than N, as shown in Figure 5. However, when supplementing left edge line markings, RPMs should be spaced at intervals of no more than N/2. RPMs should not be used to supplement right edge line markings.

- When supplementing broken line markings, RPMs should be spaced in gaps between segments, at intervals of N or 2N, as shown in Figure 5. When supplementing broken line markings that identify reversible lanes, a spacing of no more than N should be used.

- When supplementing guide lines, a RPM should be used for each short line segment.

- When supplementing continuity lines, RPMs should be spaced at intervals of N/2.

Closer RPM spacing may be necessary when marking patterns for specialized applications at transition areas, intersection approaches, sharp curves, left-turn lanes, and freeway ramps.

Red reflectors, usually placed on the downstream side of a bidirectional RPM, may be used to warn road users that they are traveling the wrong way on a one-way street or ramp.

These devices should be properly maintained to ensure legibility and visibility. In order to command respect and attention, they should be removed or covered when they are no longer appropriate.

Substituting for Pavement Markings

When used as a substitute for pavement markings, RPMs should be entirely retroreflective. The pattern of RPMs should simulate the pattern and match the colour of the markings for which they are substituted so that the message conveyed to drivers is consistent.

RPMs are normally restricted to simulating lane lines or centre lines and should not be substituted for edge line markings.

For spacing of RPMs, refer to the following guidelines. ("N" is the combined length of one line segment and one gap in a broken-line configuration appropriate to the road under consideration.)

- When replacing a lane line, RPMs should be placed as shown in Figure 6(a).

- When replacing a directional dividing line on two-way, two-lane roads where passing is permitted, RPMs should be placed as shown in Figure 6(b).

- When replacing barrier lines on two-way roads where passing is prohibited, RPMs should be placed as shown in Figure 6(c) if passing is prohibited in both directions, and as shown in Figure 6(d) if passing is prohibited in one direction only. At least one marker in four should be a monodirectional retroreflective RPM oriented toward the vehicles in the no-passing direction.

Spacing may be reduced to alert the road user to changes in the travel path, such as at sharp curves or in transition areas where lanes are dropped or shifted.

Temporary RPMs

Temporary RPMs (TRPMs) can be utilized in construction and maintenance zones.TRPMs are surface mounted and are preferred to painted or thermoplastic markings because they are easily removed and leave no misleading residual markings behind.

TRPMs may be placed in groups as an alternative to temporary markings, provided their placement adequately simulates the visual display of and conforms to the specifications for colour and pattern for normal temporary pavement markings.

TRPMs may be placed individually only as an enhancement to temporary pavement markings except when placed to provide short-term delineation in construction zones prior to the placement of permanent markings. When used for this purpose, TRPMs must take the place of the short-term marking normally applied.

Figure 7 shows suggested spacing of temporary directional dividing lines using RPMs. Spacing is based on a value of "N", which is the combined length of one line segment and one gap in a broken-line configuration appropriate for the road under consideration. The traffic practitioner should use a similar interval and spacing between temporary concurrently flowing lanes.

In areas of heavy traffic, TRPMs should be regularly monitored and missing RPMs should be replaced.

Installation

RPMs must conform both day and night to colour and pattern specifications for longitudinal lines described in Sections 2.3 and 3.4 of this Book.

Good adhesion is the single most important determinant of a TRPM's durability. The major factors that affect pavement bond are properties of the bonding agent, design of the RPM's bonding surface, type of pavement, temperature, moisture content, and care in application.

Retroreflective RPMs may be reflective in one direction (monodirectional) or two (bidirectional). Care should be taken to use the appropriate reflectivity as RPMs can confuse road users if they are visible to them but do not apply to their direction of travel.

Retroreflective RPMs should be oriented so that their reflectivity is fully exploited. On small-radius curves, RPMs might need to be installed so that their reflective faces are aimed toward approaching traffic, rather than tangentially to the curve.

When RPMs are used to enhance delineation in a hazardous area, they should be introduced slightly in advance of the area to prepare road users for their use as a new guidance technique.

RPMs used to supplement painted or durable lines can be unintentionally obliterated by marking material during remarking operations if they are placed too close to an existing line. For this reason, RPMs should be installed far enough from an existing line to allow for a margin of error during remarking operations.

RPMs should not be used on cyclists' likely travel paths unless the lane shared by vehicles and cyclists is at least 4 m wide, giving cyclists adequate space to avoid the RPMs.

Figure 6 – Roadway Pavement Markers Substituting for Pavement Markings

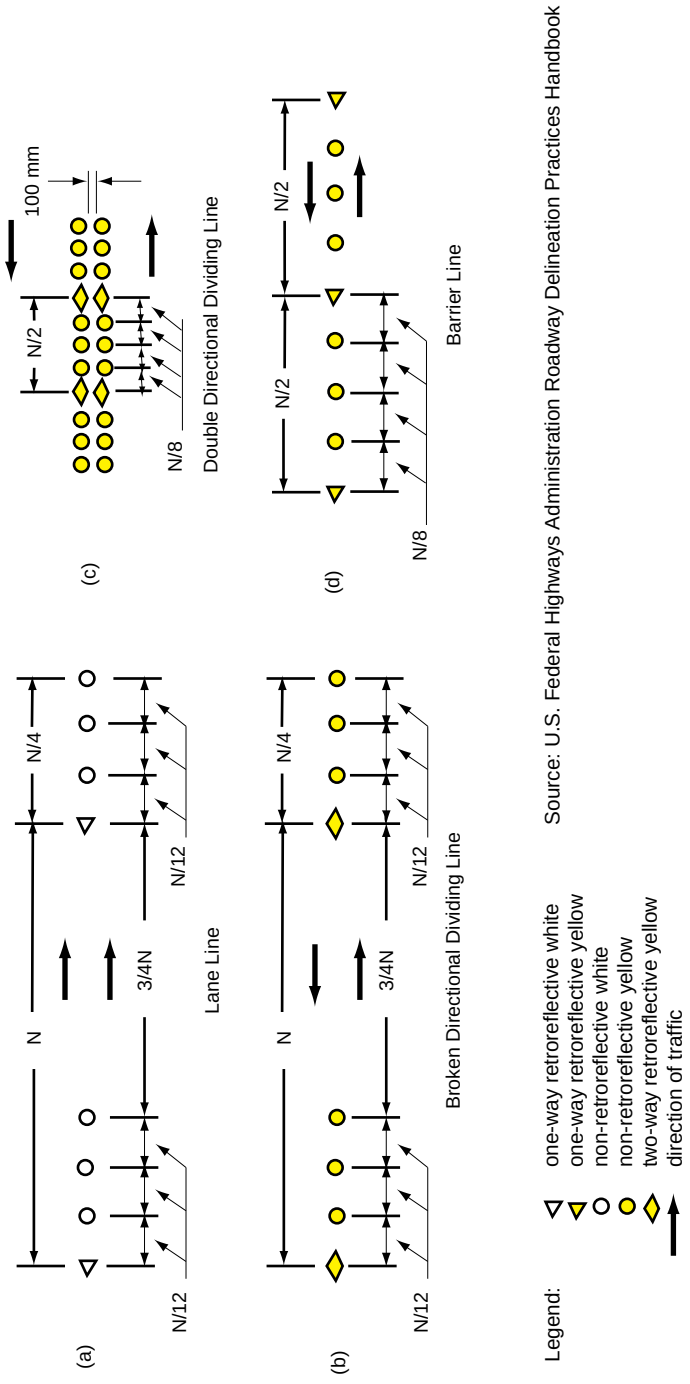
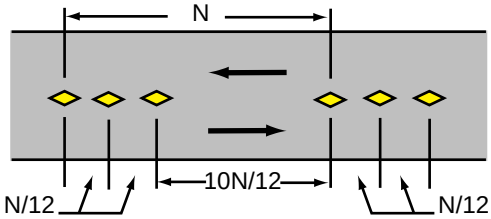
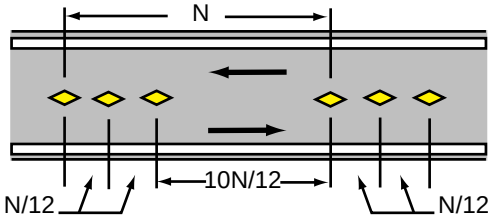


Figure 7 – Temporary Roadway Pavement Markers

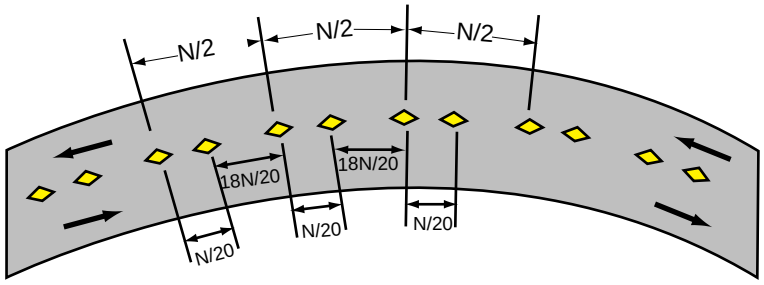
(a) Two-lane two-way road (14 days or less)



(b) Two-lane two-way road (over 14 days)



(c) Two-lane two-way road with severe curvature (14 days or less)



Legend: ◇ two-way reflective yellow
"N" is the combined length of one line segment and one gap in a broken line configuration appropriate to the road under consideration. "N" is generally 9m as described in section 3.4

Source: U.S. Federal Highways Administration Roadway Delineation Practices Handbook

RPMs are susceptible to removal by snowploughs. When used in areas or during seasons when snowploughing is common, RPMs must be designed and installed to be snowploughable, or inset so that their upper surface is flush with the pavement to avoid destruction. Where markers are recessed to withstand snowploughing, the grooves in which they are set can collect debris, rain, snow, or sand, reducing the visibility of the inset markers. Ongoing cleaning of the grooves may not be practicable. An alternative is the snowploughable RPM, which consists of a steel casing that guides the snowplough blade up and over the plastic retroreflective unit. If properly installed, snowploughable markers can usually withstand ploughing, although snowplough blades can damage their replaceable lenses. Lenses can also lose retroreflectivity through abrasion or cracking.

Maintenance

Abrasion of the lens can affect the performance of retroreflective RPMs. Studies conducted in other jurisdictions have concluded that abrasion and dirt can cause retroreflective RPMs to lose 70% to 95% of their initial retroreflectivity within the first year of installation. For this reason, regular inspection and replacement of abraded RPMs is an essential element of their maintenance program.

Road sections employing RPMs should undergo scheduled routine maintenance inspections according to their expected service life and future plans for the maintenance of the roadway. High traffic volumes, especially truck traffic, can reduce longevity. In some areas, vandalism and vehicle collisions affect average service life. Inspections are normally conducted by maintenance staff, and normally require only that inspectors drive a roadway section at night, evaluating RPM visibility and counting the number missing. RPMs should be replaced when three or more consecutive RPMs are missing or significantly damaged.

In addition to abrasion and other forms of damage, RPMs can be compromised by the presence of road film, salt dust, or soil dust. RPMs are normally cleaned of road film or dust during wet weather by the action of passing traffic. Cleaning RPMs is not normally part of a regular maintenance schedule.

Rumble Strips

Rumble strips generate vibration and noise when vehicle tires traverse them, thus alerting motorists. Two distinct types of devices fall within this definition:

- **Longitudinal Rumble Strips**
  Longitudinal rumble strips are placed in long, continuous ribbons on paved or partially paved shoulders, adjacent to the traveled portion of the roadway. They are intended to alert motorists that they have strayed from the travel lane.

- **Transverse Rumble Strips**
  Transverse rumble strips are placed in clusters, at intervals, across the travel lane and paved or partially paved shoulders, if present. They are intended to alert the motorists in the vicinity of traffic control devices, or of site-specific hazards.

Rumble strips may consist of:

- Grooves cut or impressed directly in the pavement; or

- Profiled strips which stand above the pavement.

Rumble strips consisting of a profiled strip which stands above the pavement surface can be achieved through the application of durable marking materials, or groups of non-retroreflective roadway pavement markers.

Before installing a rumble strip, possible reductions in road traction and interference with motorcycles and bicycles should be considered. Because rumble strips can present a hazard for cyclists, the observed or expected number of bicycles using the shoulder should be considered. If possible, sufficient space should be provided on the shoulder for cyclists to safely avoid the rumble strip. If this is not possible, the needs of cyclists can best be met by cutting low-profile grooves in the pavement, since cut grooves usually provide a traveling surface free of the raised bumps or wide undulations present with the other methods.

Rumble strips may be inappropriate in quiet residential areas, since they are audible outside a vehicle as well as inside. Grooves cut or impressed into the pavement may also accelerate its deterioration.

3.4 Lines

General

Lines are used to organize traffic into proper lanes, advise motorists where passing is prohibited, and supplement other warning devices. These markings help reinforce the limits of the travel path without diverting the driver's attention from the roadway.

Principles of colour and pattern for pavement markings are detailed in Figures 3 and 4.

(1) When used as dividing lines between traffic lanes, longitudinal pavement markings must conform to the following principles:

(a) yellow lines delineate the separation of traffic flows in opposing directions;

(b) white lines delineate the separation of traffic flows in the same direction;

(c) yellow broken lines are permissive, and indicate that adequate passing sight distance is available and passing is permitted where traffic allows;

(d) white broken lines are permissive, and indicate that lane changing is permitted where traffic allows;

(e) solid yellow lines are restrictive, and indicate that passing is unsafe and is not permitted;

(f) solid white lines are restrictive, and indicate that lane changing is unsafe and is not permitted.

Passing may be unsafe due to insufficient passing sight distances, the presence of intersecting roads nearby, or other operational concerns.

(2) When used as dividing lines between traffic lanes and shoulders, longitudinal pavement markings must conform to the following principles:

(a) solid yellow edgelines delineate the separation of traffic lanes and shoulders when the shoulder is to the left of the traffic lane in the direction of travel;

(b) solid white edge lines delineate the separation of traffic lanes and shoulders when the shoulder is to the right of the traffic lane in the direction of travel;