Roadmarking Policy Guide:

Roadmarkings: where do I use what material?

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June 2004

This guide has been prepared by Alister Harlow, Executive Director of the NZ Roadmarkers Federation based on observations from LTSA RSS22 survey and other information currently available. It does not necessarily represent NZRF policy.
It's objective is to provide guidance to RCA' engineers and consultants in developing pavement marking specification policies.
The NZRF works with its member contractors and Road Controlling Authorities to provide improved safety for motorists.

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Roadmarkings: where do I use what material?

A traditional approach to pavement markings is to consider them as a roading maintenance activity.

Increasingly, the focus is moving to considerations of the safety implications of pavement markings.

Effective markings also contribute to greater **efficiency of the roading network**, through regulating the way that the roadway surface is shared. This could be through dividing the road for opposing traffic, creating multiple lanes to show how space should be used, or for positioning of vehicles at intersections to allow for efficient division of vehicles with different direction intentions.

Markings have important safety implications. For them to provide efficient information to drivers, they must be visible in a wide range of weather and light conditions.

Under night driving condition, pavement markings are generally the most important source of guidance information that the driver has. During daylight hours there are many visual cues to provide guidance to the driver, about the condition of the roadway ahead. Physical features such as kerbing, fences and hedges, and even the contrast in surface texture between the roadway and a footpath or vegetation, all provide information to assist in the driver's decision process, about vehicle placement and appropriate speed. At night, most of this information disappears, and the strongest visible message is marking systems which are retroreflective.

Marking systems are also available to address the visibility requirements that exist in adverse weather conditions, such as when the road surface is wet, or in conditions when it is raining.

Our starting point is to consider the service level which we wish to provide for motorists. The following represents an ascending **service level** that can be provided to motorists:

- Service level 1: Markings are visible during the day
- Service Level 2: Markings are visible at night
- Service Level 3: Markings are visible in wet night conditions
- Service Level 4: Markings are visible in conditions of raining

More difficult are wet day conditions, and conditions where there is, low angled light.

Marking systems are also available which provide an audio tactile message to motorists.

An important question is whether we are able to provide an objective assessment of these various service levels.

The move to performance based contracting through the 1990's, changed the emphasis in the industry from thinking about inputs – materials, application equipment and application rates – to thinking about outputs. In this instance, the overriding consideration was thinking about the needs of the motorist.

Performance based contracts asked specifiers to think about appropriate service levels.

Specifications were developed so that the performance of markings could be measured against these criteria.

The European specification **EN 1436 Road markings materials – Road marking performance for road users** set the following performance criteria:

4.2 Reflection in daylight or under road lighting (*Qd*)
4.3 Retroreflection under vehicle headlight illumination (*RI*) including
dry road conditions
wet road conditions
rain conditions
4.4 Colour
4.5 Skid resistance

However EN1436 offers a range of values for each of the key criteria, so that it is not possible to talk about a European standard. Indeed, except for colour (chromaticity), each value also offers an alternative listed as 'no requirement'.

EN1436 must be read together with specifications from each relevant roading body, to understand their requirements. Roading authorities offer supplementary schedules of requirements, based on such things as traffic volumes, and designated roadway speeds.

However the alternative values do offer some insight into the thinking of the specification writing committee. For instance dry retroreflective alternatives for white markings (Table 2) are
R0 No requirement
R2 RI> 100
R4 RI> 200
R5 RI> 300

In the **Transit NZ P/20** specification, the focus is also on roadmarking meeting the needs of the motorist. The central objective is that roadmarkings, to be effective, must be clearly visible at all times.

The performance criteria cover the following:
Colour
Visibility - day time
- night time
Skid resistance

Specifically the following criteria are set out in the P/20 specification (Clause reference in P/20)

2.1 Colour - White Y35 4/5 on colour scale
- Yellow Y12-14 4/5 on colour scale
2.2 Daytime visibility - clearly visible at 150 metres
2.3 Night-time visibility - Dry White 100 mcd/m2/lux
- Dry Yellow 100 mcd/m2/lux
(Wet retroreflectivity measures need to be determined.)
2.4 Skid resistance - 45BPN for materials less than .9mm (paints)
- 50BPN for materials greater than .9mm (thermoplastic/Cold Applied Plastic)

In considering appropriate service levels, the EN specification offered a range of values and then offered no guidance as to where it was appropriate to use each level. Transit NZ on the other hand offered somewhat modest performance values, but set them as standards across the entire State

Highway network. In addition, given the understanding of measurement that was thought to exist at the time the specification was developed, there is no requirement for wet night visibility of markings.

So where is the standard of marking in NZ? The recent LTSA RSS 22 roadmarking survey indicated that the standard is evenly split between levels one and two if we look at the above service level hierarchy. The State Highway network generally offers night and day visibility. While most of the survey TLA's offered satisfactory day visibility, many do not provide night visibile markings.

If we accept that day and night visibility of markings is the minimum standard that is acceptable, then we need to at least ensure that all marking systems incorporate the use of glass microspheres, and that a marking system is remarked before day and night time visibility drops below acceptable levels. To ensure that the glass beads are captured and retained, we will probably eliminate standard low solids alkyd material. This is because this material exhibits poor bead retention, and once the glass is no longer held by the binder, night time visibility will fall to an unacceptable level.

The remaining products listed below – properly installed - have a good prospect of meeting day and night visibility requirements.

Effective wet night visibility of markings will be achieved through the use of large size beads; through the use of profiled or embossed markings; or through the use of a structured line system. Paint systems using large size beads perform best on coarse textured surfaces. The 'constructed' marking systems are not affected by road surface as they sit above the road surface and water film.

There has been little research carried out in NZ about the comparative effectiveness of marking systems, in conditions of raining. At this time we should set aside this service level as an area requiring further work. Let's concentrate our efforts on getting markings up to at least, wet night visible standard.

Our objective here is to bridge the gap between the prescriptive approach of method based specifications which tell contractors what/how/when, and the performance based contract that focuses solely on outcomes. It seeks to develop a selection framework, and promotes a matrix of materials selection.

Lets look first at the **Materials selection considerations** and discuss some of the implications of the facors.

- Traffic volumes
- Vehicle type mix – in particular % heavy vehicles
- Surface type – smooth or textured surfaces
- Projected life of materials
- Special conditions – eg. snow and gritting, surface contamination from agricultural machinery, logging trucks, or effluent from the transport of animals

Traffic volumes and mix

This has been the main focus of various approaches to materials trials. These may be through:

- on road – real world testing (TIPES)
- on road accelerated wear testing such as M7, that looks at wear of transverse lines against vehicle passes
- accelerated wear testing on a simulator. This method has acceptance in some European countries, and we have the CAPTIF facility in Christchurch.

Traffic volumes in most instances are the most important component in marking wear. We do however need to understand the difference between wear on straight section of longitudinal markings, wear on curved sections of roadway, and wear on transverse markings such as intersection limit lines.

With very low traffic volumes, environmental degradation – UV, temperature change and vegetation may act faster than traffic wear, to degrade markings.

Where there are particularly high percentages of heavy vehicles, the additional vehicle weights and numbers of tyres, will accelerate wear beyond nominal vehicle numbers. This is because the movement of trailers and semi trailers leads to scuffing of marking, through the vehicles constant sideways movement, even on straight sections of road.

Surface type.

Performance of markings is affected significantly by the surface type. Smooth textured surfaces compared with coarse textured surfaces, generally produce comparatively high retroreflectivity numbers in the dry, and low numbers on wet road surfaces, unless the marking system incorporates large size beads, or it is a textured marking system.
It is usual to find that the smooth textured road surfaces are used on those roads with higher traffic volumes.

Projected life of materials.

In order of durability, we have the following marking systems:

- low solids alkyd (see the notes above about why we eliminate this as an option)
- chlorinated rubber modified or high solids alkyd
- waterborne and polymer modified solvent
- thermoplastic and cold applied plastic

However we do need to consider that materials may be applied at different application rates, and the 'system', which may also include glass beads and angular material to improve skid resistance, may have a significant affect on materials performance. Also, within the general groupings there may be a significant variance in manufacturers' formulations, which can affect performance.
Time of installation can also have a significant affect on performance, with waterborne being perhaps the material most sensitive to temperatures and rainfall – both at the time of installation, but over the curing period, which could be several days or even weeks depending on the formulation. This would also direct selection, to a product that fits a remarking cycle of 1, 2, 3 years rather than say 9 months.

What/Where?

We have previously highlighted vehicle counts as the most significant consideration in materials selection.
This is also true, because a number of other factors are decided through an assessment of traffic volumes. A RCA will set it's roading hierarchy by traffic volumes. This hierarchy determines seal width, surface type – smooth textured surfaces are on higher trafficked roads, marking format – ie centre line only on narrow roads, or those with low traffic volumes.
Traffic counts determine traffic control requirements at the time of installation of markings, and this affects the cost of installation.

The following roading hierarchy is offered for consideration.

Up to 250 AADT (reference RTS 5)
From 250 to 1500 AADT
From 1500 to 8000 AADT
Over 8000 AADT

Up to 250 AADT

Very low traffic volumes will be encountered on minor rural roads and on residential streets. With minor rural roads the seal width may preclude markings, or markings may be limited to edge lines on bends or centre line only. On residential streets, markings may be limited to those associated with intersections. Where traffic volumes are very low, the markings will degrade through environmental factors such as UV exposure, temperatures leading to expansion and contraction and cracking etc, rather than traffic wear.
Markings should be carried out using:

- high solids alkyd or chlorinated rubber modified alkyd, or
- waterborne or polymer modified solvent

Application rates of 180um DFT (dry film thickness) with 275grams per square metre of Type B bead (Drop-on)

From 250 to 1500 AADT

As traffic volumes increase we would expect to see edge and centre lines on rural roads and centre line marking on urban roads.
Markings should be carried out using:

- high solids alkyd or chlorinated rubber modified alkyd, or
- waterborne or polymer modified solvent

Application rates of 180um DFT (dry film thickness) with 275 grams per square metre of Type B bead (Drop-on)

From 1500 to 8000 AADT

This traffic volume range includes major rural roads and urban collectors. On rural roads we would see edge and centre lines with some wider than normal edge lines on curves. Urban roads will have centre line marking and edgelines to define parking areas or to delineate the edge of the carriageway.
For day and night visibility of lines, markings should be carried out using:

- high solids alkyd or chlorinated rubber modified alkyd or
- waterborne or polymer modified solvent

Application rates of 220um DFT (dry film thickness) with 275 grams per square metre of Type B (Drop-on) or 300 grams per square metre Type C bead (Intermix)

If wet night visibility of markings is required, Type C (intermix) beads should be considered as a minimum, and on smooth surfaces it may be necessary to use 300um DFT of waterborne or polymer modified solvent with 500 grams per square metre of Type D beads (large sized bead).

Over 8000 AADT

This traffic volume will be found on urban arterials, expressways, motorways and part of the rural state highway network. The roadway may be multi-laned and road side parking may be restricted or eliminated. Longer remark cycles will be desirable to limit disruption to traffic, and traffic control requirements to meet COPTTM Level 2 or 3, will impact on installation cost.

Wet night visibility of markings should be a routine requirement.
Marking should be carried out using:

- waterborne or polymer modified solvent

Application rates of 300um DFT (dry film thickness) with 500 grams per square metre of Type D beads (large size bead), or

- thermoplastic or cold applied plastic

Standard flat thermoplastic or cold applied plastic should incorporate 500 grams per square metre Type D (large size beads) as a drop on, or the marking system should be profiled, embossed or a structured line system.

To minimise risk of changing from one marking system to another, it is recommended that marking systems be trialled and results assessed, using a system such as the roadmarking TIPES testing framework. This will give the road owner, supplier and contractor confidence about outcomes, and the opportunity to gain knowledge about risks and other considerations.

Trialling

Where a RCA is contemplating a change to their current specification, it is desirable that trialling of new marking systems be carried out. Trialling should be carried out following consultation with the RCA's roadmarking contractor. The roadmarking contractor may be able to draw on their experience using markings systems for other clients. A trial should be of a sufficient scale to enable a fair assessment of the performance of the marking system. It may be better to move through a process of gradual improvement rather than attempt quantum leaps in standards. It should be noted that some marking systems require specialised application equipment, and small scale installations may involve substantial establishment and set up cost.
Manufacturers recommendations should be carefully noted. In particular guidelines about climatic conditions at the time of installation. The trial should give the marking system a fair chance to succeed. Reviews of the markings should be carried out on a regular basis and the observations recorded. The emphasis should be on the general standard of the marking, and extreme wear sites such as stock crossing points, and driveway entrances should be avoided. The use of a retroreflectometer is recommended, in addition to visual checks.

Some special conditions
Reseals

Reseals are particularly problematic for roadmarkings. There is likely to be loose material as stones roll and settle. The aggregate may be coated to aid flow during the sealing process. There may be a dust coating on the aggregate. In any event, the new aggregate is likely to be sharp sided as it has had no traffic wear.
Performance of marking systems is better where there is a build up of material. A desirable approach is to apply a 'sacrificial' marking immediately after the reseal and then to apply a further marking coat before it is too worn.

Compatibility and adhesion of markings

Failures may result from application of marking systems on surfaces or other marking systems. Concrete and paved surfaces present particular problems and it may be necessary to etch the surface or apply an undercoat to get good adhesion.
Application of alkyd and waterbourne marking systems to each other, do not appear to present problems. It is recommended that with polymer modified chlorinated rubber markings, the manufacturers recommendations be taken into account.
There are likely to be compatibility issues with paint and both thermoplastic and cold applied plastic. The greater the film build of the paint, the potentially greater the problem. Removal or all or part of the paint marking may be required, to get a bond between markings, and to minimise compatibility issues.
There are compatibility issues between thermoplastic and cold applied plastic. Removal may be required, and manufacturers guidelines should be followed.

Further information:

NZRF Materials Guide is available on the NZRF website at www.nzrf.co.nz