

Removal of Pavement Markings

1 Purpose

To provide general guidance on the removal of pavement markings.

2 Definitions

Pavement Marking

The term used to define all line marking, road marking and raised pavement markers.

Line Marking

The term used to define all longitudinal lines such as centre, lane, edge, turn and continuity lines.

Road Marking

The term used to define all transverse lines and markings applied by hand such as Stop/Give Way lines, pedestrian lines, arrows, and legends.

3 Introduction

The removal of pavement markings can result in several issues, including:

- Contrasting surface texture to the rest of the pavement. This may result in the removed markings becoming visible under various conditions, such as on a wet road surface or in sun glare. This can then cause confusion for road users due to incorrect or unclear delineation, particularly when the removed marking becomes more visible than any new markings that have been installed.
- Damage to the surfacing, reducing its life and potentially the life of the entire pavement

The removal of markings and placement of temporary markings need to be carefully planned and implemented.

4 Planning

Construction and maintenance planning should consider the following:

- avoiding or minimising the shifting of pavement markings where practicable
- using removable markings (e.g. retroreflective tapes) to minimise damage to the pavement where work requires multiple changes to markings
- making the provision for the cost of resurfacing in the project estimate if changes to markings are unavoidable. Resurfacing will provide clear and unambiguous delineation at the completion of the works
- ensuring continuity, from the road users' perspective, by assessing markings on either side of the works
- noting the removal of markings will likely result in damage to the surface.

Consideration should also be given to undertaking a Road Safety Audit to assess the risks associated with the proposed pavement marking removal method.

5 Treatment methods

Selection of an appropriate removal treatment method is important to avoid or reduce ambiguous or confusing delineation. There are several methods available to remove pavement markings, a range of which are summarised in Table 1.

Reference should also be made to the VicRoads supplement to AS1742.2 on the use of temporary pavement markings.

Table 1: Summary of methods for removing and covering of pavement markings

Method	Issues	Method	Issues
Resurfacing	<ul style="list-style-type: none"> Provides the best long-term solution. Presents the least risk of confusing road users and damaging the road surface. Requires work to be undertaken in full lane widths and over reasonably long lengths, to minimise the number of joints in the road surface. Reduces the ongoing maintenance burden on the asset owner. 	Grinding	<ul style="list-style-type: none"> Suitable for small jobs only. Should not be confused with milling which is far more aggressive process. The most appropriate method to treat Audio Tactile Line Markings (ATLM) prior to resealing or microsurfacing. Capable of removing most marking materials on dense graded asphalt surfaces. Can cause damage to road surfaces and is not appropriate for the removal of markings on sprayed seals, stone mastic, open graded or ultra-thin asphalts. Treated areas can be mistaken as pavement markings under certain conditions. The treatment generates substantial noise.
High pressure water retexturing	<ul style="list-style-type: none"> Capable of removing most types of markings. May cause considerable damage to the road surface if applied inappropriately, due to the removal of excessive fines and smaller aggregates. 	Strip sealing	<ul style="list-style-type: none"> Effective for covering most marking materials on low to moderately trafficked sprayed seal surfaces. Pavement markings to be covered may require treatment (such as water, grit or shot blasting) prior to strip sealing to ensure an adequate bond is achieved. Does not damage the road surface. After some trafficking / wear, previous markings may become visible. May result in a lip where water can pond against the edge of the strip seal. Not appropriate for asphalt surfaces.
Grit blasting (dry)	<ul style="list-style-type: none"> Capable of consistently removing most types of markings with less damage to the surface compared to high pressure water. Treatment leaves residue after removing the markings, which requires removal. The treatment generates substantial noise. 	Blacking out	<ul style="list-style-type: none"> Effective for temporarily covering markings on all road surfaces. After some trafficking / wear, previous markings may become visible and the treated area can be mistaken as pavement markings under certain conditions Application over large areas can reduce skid resistance Does not damage the road surface.
Shot blasting (dry)	<ul style="list-style-type: none"> Can damage road surfaces and may cause significant damage to open graded asphalts. Not effective on some new sprayed seal surfaces or removing long life markings. 		
Soda blasting (dry or wet)	<ul style="list-style-type: none"> Capable of removing painted marking material with minimal damage to road surface. Limited effect on some marking materials, such as cold applied plastic. New markings may not be able to be placed immediately due to wet road surface. The treatment generates substantial noise. 		

Further information on marking removal is available in the *NZRF Line Removal Guide* (New Zealand Roadmarkers Federation Inc. 2017).

5.1 Resurfacing

Resurfacing involves either removing and replacing the existing asphalt surface or placing a new surfacing over the existing pavement, either as an asphalt overlay or reseal. In the case of an asphalt overlay, consideration needs to be given to the affect that an additional layer of asphalt will have in terms of raising the road level or whether the pavement is in a suitable structural condition to support the new asphalt. Where there is a high proportion of long-life marking (thermoplastic or cold applied plastic) present, it may be necessary to remove the markings by milling before placing the overlay.

The area to be resurfaced needs to be large enough to allow the efficient placement of the surfacing and to enable the quality requirements of the relevant specification sections to be met. Resurfacing of full lane widths is recommended and small areas identified for treatment should be joined to form continuous lengths. This will assist in minimising joints and improving the ride quality.

There are many types of asphalt and sprayed seal treatments available. As such specialist advice may need to be sought to ensure that the surfacing selected is suitable considering the existing pavement condition, traffic levels, road geometry and the time of year that the work will be undertaken. Further guidance can be found in *Selection and Design of Pavements and Surfacing* (VicRoads 2018a).

5.2 Removal

The aim of removal is to prevent the markings from providing unintended delineation. Effective removal is a compromise between leaving residual markings, creating ghost markings (refer Figure 1) and causing damage to the pavement surface (refer Figure 2). Ghost marking is where an area is so highly textured it can be confused by road users as markings in certain circumstances e.g. wet weather or poor lighting conditions.

Figure 1: Ghost marking due to highly textured surface following marking removal



Figure 2: Asphalt surface damaged by marking removal



Whilst complete removal is often targeted, this can have undesirable effects (e.g. damage to the surface or producing ghost markings).

The amount of residual markings that can remain after removal will vary depending on the speed environment and the texture of the existing surface. Typically, 75-85% removal is the range where marking removal is considered effective.

Methods for marking removal are discussed below and further information on field trials of marking removal methods can be found in *Methods for Traffic Stripe Removal* (Oregon Department of Transport 2001).

It is recommended where removal is going to be attempted that a short length of work is undertaken at the start of the job so that it can be examined for the presence of ghost markings or damage to the pavement. This will provide the opportunity to adjust the removal technique to minimise any negative effects.

When assessing a removal method, it is critical that thought is given to all likely road conditions in that particular environment. Consideration must be given to but not limited to, day-light, wet-night, low incident light, change of lay-out, posted speed limits, consequences of possible driver confusion.

5.2.1 High pressure water retexturing

High pressure water retexturing can be used on most road surfaces. This process removes most marking materials but may damage the road surface. The treatment applies water pressurised up to 280 MPa (40,000 psi) to the road surface to remove the markings (Figure 3).

Figure 3: Marking removed by High Pressure Water Retexturing



Most systems include the vacuuming of the water and removed materials which are then recycled through a filtering process that removes the paint and other material before reusing the water.

Even when undertaken correctly on a suitable surface, high pressure water retexturing will to varying degrees damage the pavement surface. Removal should be avoided on surfaces that are visibly aged, open textured or in poor condition due to the increased risk of significant damage occurring.

5.2.2 Grit blasting (dry)

Grit blasting can be used on all road surfaces. The process utilises a dry blasting technique with an abrasive agent such as sand or slag. When undertaken correctly, there is typically minimal damage to the road surface. Grit blasting creates dust and loose material that can be removed, either manually or by using a suction sweeper.

Grit blasting creates a significant amount of noise, so consideration should be given to the locations and times when this method is used.

5.2.3 Shot blasting (dry)

Shot blasting is similar to grit blasting but uses small steel shot rather than grit. Whilst it can be used on most pavement surfaces and removes all marking materials, it can cause damage to open graded asphalts. Also, it may be less effective on relatively new sprayed seal surfaces (typically less than four years old) or on sprayed seals in hot weather where the shot particles and relatively 'lively' bitumen can tend to "ball up" and block the equipment. There is likely to be some minor remaining markings on the pavement surface using this method.

Shot blasting is less noisy and cleaner than grit blasting but consideration should still be given to the locations and times when this method is used due to dust and noise.

5.2.4 Soda blasting (dry or wet)

Soda blasting is less aggressive than other methods and subsequently also less damaging to the underlying surface. It involves the removal of markings by water or air blasting using carbonated soda which is a softer abrasive agent compared to other materials. This can be used on all road surfaces and is very effective at removing paint. However, there are concerns regarding its effectiveness at removing other types of markings such as thermoplastic and cold applied plastic.

With the wet method, new markings cannot be applied immediately after the treatment as the road surface is left in a wet condition.

Soda blasting creates a significant amount of noise, so consideration should be given to the locations and times that this method is used.

5.2.5 Grinding

Grinding involves the removal of markings using high-speed rotating hardened steel or tungsten carbide cutters. It is commonly used to remove audio tactile markings.

This method can be used on most asphalt surfaces but can cause some damage to the road surface. Where grinding has been used, the road surface can become indented and hold water, which can be mistaken as markings under certain conditions.

Grinding is not considered an appropriate method on open-graded, ultra-thin, and stone mastic asphalt as it does not completely remove markings and can weaken the surface, which can result in ravelling and potholes.

Grinding on sprayed seal surfaces risks damaging the integrity of the seal. If treating ATLM prior to resealing complete removal is not generally required but must be sufficient to mitigate the potential for the ATLM to generate tyre induced noise after the seal is placed.

Grinding creates a significant amount of noise, so consideration should be given to the locations and times that this method is used.

5.3 Targeted Concealment

Targeted concealment aims to mask the underlying pavement marking as opposed to removing it.

5.3.1 Strip sealing

Strip sealing involves covering existing markings, generally with a small sized sprayed seal and is intended to be used to cover line markings rather than large areas of road markings where a full width resurfacing is more appropriate. Strip sealing can be effective on existing sprayed sealed surfaces, especially in rural areas with low to moderate traffic volumes (i.e. less than 2,500 vehicles per day) where painted pavement markings are generally used.

The aggregate selected should have the same colour as that used in the existing seal to reduce any confusion that the strip sealing is a form of delineation.

There is a risk of aggregate loss when strip sealing over thermoplastic markings. Consideration may be given to a two-stage treatment involving the partial removal of the thermoplastic marking and then completing the treatment with a strip seal.

It may be necessary to apply a more robust seal (double/double as a HSS or XSS) over the entire pavement where:

- markings will not be reinstated in the same positions after resealing.
- the texture of the underlying sprayed seal means that markings may reflect through a 5 mm or 7mm strip seal.
- existing painted lines are highly reflective (i.e. glass bead retention is high) increasing the risk of poor adhesion of the bitumen to the lines.

Alternatively, for highly reflective markings, a two-part process, as described above, can be utilised to partially remove the paint and glass beads prior to covering the markings with a small sized strip seal.

Strip sealing is not considered an effective permanent treatment on:

- Asphalt surfaces as the texture difference between the asphalt and strip seal creates ghost markings.
- Over ATLM as the seal can follow the profile of the ribs which can result in noise still being generated by tyres.

5.3.2 Blacking out

Blacking out involves covering the markings with either a black paint or long-life material and grit. Blacking out is a temporary treatment when immediate removal is not possible. It can be used for all road surfaces and marking materials. However, under traffic, the life expectancy can be as little as two to three weeks for black paint and up to two to three years for black long-life material.

Blacking out is only recommended as a temporary treatment (i.e. less than about three months). Under certain conditions the “blacked out” pavement can be mistaken for pavement marking. As such, it is important to assess the risks associated with blacking out as it may result in conflicting and confusing delineation.

6 Temporary markings

Guidance for the application of temporary pavement and line markings is provided in *Supplement to AS 1742.2* (VicRoads 2017).

7 Road Safety Audit

A Road Safety Audit (RSA) should be considered for marking removal works, especially for long duration projects such as major projects or works that are staged over time due to the potential for ghost markings to confuse road users and create a hazard.

Further information can be found in the Austroads Guide to Road Safety Part 6A, Implementing Road Safety Audits, AGRS06A-19 (Austroads 2019).

8 Conclusion

The removal of markings should be avoided, where possible. Where removal can't be avoided, resurfacing is the preferred option as it provides the most effective long-term solution.

Of the other methods:

- High pressure water retexturing and grit blasting are the most common methods of removal. Both methods can cause damage to the surface.
- Blasting using carbonated soda provides reasonable results but has been reported to be less effective than other methods of removal on some pavement marking materials, such as cold applied plastic.
- Grinding, although effective, causes damage to the road surface and the treated surface can be confused as pavement markings under certain conditions.
- Strip sealing should be limited to use on surfaces with a sprayed seal in low to moderately trafficked areas, where it is considered an effective method of removing pavement markings.
- Blacking out has a limited life span and should only be considered as a temporary treatment based on assessing risks. Blacking out with long-life materials may be the only temporary option if the road surface is in a very poor condition, brittle, or has a crumbling surface.

9 References

Austroads 2019, Austroads Guide to Road Safety Part 6A, Implementing Road Safety Audits, AGRS06A-19, Austroads, Sydney, NSW.

Oregon Department of Transport 2001, *Methods for Traffic Stripe Removal*, Research notes, RSN 02-05, Oregon Department of Transportation, Salem. USA.

New Zealand Roadmarkers Federation Inc 2017, *NZRF Line Removal Guide*, Rev 3, NZ Roadmarkers Federation Inc, Auckland, NZ.

VicRoads 2017, *VicRoads Supplement to AS 1742.2*, Edition 1 Revision 2, VicRoads, Victoria.

VicRoads 2018a, *Selection and Design of Pavements and Surfacing*, Code of Practice 500.22, VicRoads, Victoria.

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