

**Technical Note 186**

# **Sealing in Cold Weather Conditions**

**August 2019**

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## 1 Introduction

Sprayed bituminous treatments (hereafter called sprayed seals) are the most common type of road surfacing on the road network administered by the Department of Transport and Main Roads.

The construction of sprayed seals involves several phases (viz. Austroads *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals*):

- planning and programming
- scheduling and organisation
- pavement/surface preparation
- sprayed sealing operations
- recording and monitoring of the completed works and payment.

It is recommended to, wherever possible, undertake sprayed sealing in warm, dry and stable weather conditions. Cold or cold and damp conditions that trigger a sealing risk level of 2 (Risk Level 2) or 3 (Risk Level 3) as determined in accordance with this Technical Note are generally undesirable for sprayed sealing. This is because the development of the adhesive bond between the bituminous binder and aggregate is substantially inhibited under these conditions meaning there is a major risk of the shearing force of vehicle tyres causing early aggregate loss (stripping) leading to the early failure of a sprayed seal. There are a number of factors to be considered when constructing sprayed seals in colder weather conditions when there is an increased risk of (stripping) failure.

The purpose of this Technical Note is to:

1. Provide guidance related to managing the risk of poor seal performance associated with sprayed sealing in cold weather conditions.
2. Identify mitigating measures that can be deployed to reduce the risk or impact of poor sprayed seal performance associated with sprayed sealing in cold weather conditions.
3. Determine conditions when the risk of poor sprayed seal performance is elevated due to cold weather conditions. In these cases, consideration should be given to changing the sprayed seal treatment/surfacing type and/or delaying sprayed sealing operations until there are more favourable weather conditions.

### 1.1 Scope

The guidance provided in this Technical Note is for Department of Transport and Main Roads projects and applies as follows:

- The guidance applies to all sprayed sealing works that are temporarily or permanently trafficked by the public and constructed under 'Construct Only' contracts. Sprayed sealing works constructed under 'Design and Construct' or similar contracts must adhere to the requirements in the 'Scope of Works and Technical Criteria (SWTC)' for the project.
- Primes, waterproofing seals under asphalt and Strain Alleviating Membrane Interlayers (SAMIs) not trafficked by the public are not within the scope of this Technical Note.
- This guidance does apply to the application of initial seals, which are often trafficked by the public for several months. The level of risk nominated for initial seals is identified in a table specific to those treatments.

- This Technical Note also does not apply to the use of bituminous emulsions in sprayed sealing works or to sprayed seals over small-scale maintenance/repair works that are typically smaller than 100 m<sup>2</sup>.

Other jurisdictions and 'road owners' that use the department's documents will need to decide how sprayed sealing in colder weather conditions is to be managed for their projects.

### **1.2 Related documents**

This Technical Note should be read in conjunction with the following departmental documents:

- a) TN175 *Sprayed Seal Selection and Design*
- b) MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)*
- c) MRTS12 *Sprayed Bituminous Emulsion Surfacing*
- d) MRTS22 *Supply of Cover Aggregate*

These are freely available from the department's Technical Publications internet page at:

<https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications>

### **1.3 Further information**

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## **2 Cold weather conditions for sprayed seals**

Important factors that influence the risk of sprayed sealing works include:

- climatic conditions during and after construction
- traffic volumes and composition
- condition of the existing pavement
- cover aggregate properties and condition
- construction processes and practices (e.g. use of cutter, traffic management)
- sprayed seal selection and type, and
- binder selection and type.

Generally, sprayed seals should be programmed to be constructed in favourable conditions (that is, warm and dry) to reduce the risk of stripping (related to cold weather conditions).

Stripping of sprayed seals is the removal of cover aggregate (stones) which leaves the bituminous binder exposed to tyre contact. It may occur as the loss of individual stones, or as the complete loss of stones in a localised area (for example, Figure 2). Stripping that occurs early in the life of a sprayed seal life may be caused by several factors, including low binder application rates and/or poor adhesion between the bituminous binder and cover aggregate.

Low binder application rates are often associated with the inputs used in the sprayed seal design not reflecting the actual conditions present on site.

Adhesion between the bituminous binder and cover aggregate is affected by many factors including the:

- bituminous binder class (type)
- cover aggregate geology
- presence of dust and/or surface moisture on the cover aggregate
- use of precoating agent on the cover aggregate (to mitigate the presence of dust)
- use of adhesion agent in the bituminous binder (to mitigate the presence of moisture in the aggregate)
- temperature of the pavement and cover aggregate at the time of sprayed sealing
- temperature of the bituminous binder when the cover aggregate is applied to the bituminous binder and when rolling is undertaken
- environmental conditions (for example, temperature and rainfall) during construction and the days following construction
- the quality of spraying operations and equipment used.

**Figure 2 – Stripping of a sprayed seal**



Source (Australian Road Research Board)

The risk of stripping is increased when cold or cold and damp weather occur early in the life of a sprayed seal. Bituminous binder sprayed at high temperatures will rapidly cool to the pavement surface temperature. Given this there is an increased risk of aggregate loss when there are low temperatures during and/or after construction.

In addition, high traffic volumes may result in long queue lengths at construction sites, often leading to the road being opened to traffic before adequate adhesion between the binder and aggregate has developed. Should any stripping occur, the subsequent damage to the sprayed seal and vehicles is influenced by the volume and type of traffic using the road.

### 3 Risks associated with constructing sprayed seals in cold weather conditions

The Austroads *Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals* discusses the major climatic variations in Australia, from alpine to desert and from high rainfall to arid, and the effects they have on sprayed sealing. The guide states:

*Development of adhesion between binder and aggregate is substantially reduced in cool or damp conditions, which can lead to early aggregate loss and seal failure. Weather conditions at the time of undertaking work are therefore extremely important. Weather conditions also influence the amount of care required in preparing and pre-coating of aggregates, use of cutter oils and adhesion agents, effect of modified binders and after-care of the completed work.*

*To reduce the risks of failure associated with sealing in cool weather, works should be programmed to be undertaken only in warm, dry condition, particularly for roads with high traffic volumes, single/single seals, PMBs and geotextile reinforced seals.*

Stripping can occur as light, isolated aggregate loss between wheelpaths and on the centreline, or as extensive loss across the entire sprayed seal. The extent of stripping can rapidly increase once aggregate loss commences, as the lack of support from surrounding stones can lead to the remaining aggregate dislodging at the edges of the affected areas. This deterioration from initially localised stripping to widespread stripping can lead to the bituminous binder and a slick surface being exposed to traffic. The resulting road surface can have reduced skid resistance and there is the potential for the bituminous binder to adhere to the tyres of vehicles using the road (and worsening the situation).

Stripping can also lead to the presence of surplus loose cover aggregate on the road surface. This loose aggregate may become a safety issue if it is not removed from the road surface as soon as practicable. The presence of an excessive amount of loose cover aggregate on the road surface may lead to vehicles losing control or stones being flicked up by vehicles leading to broken windscreens and/or injury to road users and the general public.

### 4 Important factors to consider when constructing sprayed seals in cold weather conditions

#### 4.1 Minimum temperatures

For sprayed sealing works, the pavement surface temperature must be stable or rising, and above the minimum temperature given in Annexure MRTS11.1 *Sprayed Bituminous Treatments (Excluding Emulsion)* or, if no indication is given, the above the minimum temperature given below for at least one hour before spraying commences:

1. 10°C for primes
2. 15°C for initial seals containing cutback bitumen
3. 20°C for treatments containing (unmodified) bitumen, multigrade bitumen and crumb rubber modified binders
4. 25°C for polymer modified binders (other than crumb rubber modified binders), unless the Administrator has given written permission to relax the minimum temperature to 20°C.

Sprayed sealing should not continue unless all operations up to the completion of the minimum rolling, as specified in MRTS11 *Sprayed Bituminous Treatments (Excluding Emulsion)*, can be completed before the temperature of the pavement surface drops below the temperature given in Annexure MRTS11.1 *Sprayed Bituminous Treatments (Excluding Emulsion)* or, if not so given, the minimum temperatures listed in this Section.

In situations where the air temperature is likely to fall below 10°C at any time during the seven days after a sprayed seal is constructed, implementation of special risk mitigation measures should be considered, as detailed in Section 7.1 of this Technical Note.

Localised areas where colder pavement surface temperatures are likely to occur (for example, shaded areas, low lying areas, river / creek crossings, and so on) should specifically be considered and appropriate measures implemented to reduce the risk of stripping in these areas.

The minimum pavement surface temperature to be adopted depends on many factors including:

- the type of treatment and/or class of bituminous binder being used
- the maximum amount of cutter to be used (for long-term performance reasons) – refer to Section 4.6 for details
- the use (or otherwise) of adhesion agent in the binder.

Consideration should be given to increasing the minimum pavement surface temperatures above the default minimum(s) listed in Clause 11.2 of MRTS11 where the Principal or Administrator places limits on the amount of cutter to be used and/or adhesion agent isn't used in the bituminous binder.

However, increasing the minimum pavement surface temperature requirements may restrict the amount of sprayed sealing work that can be completed during a shift and/or the time of year when sprayed sealing can be completed.

#### **4.2 Rainfall**

Sprayed sealing should not take place during rain or if rain is likely to fall prior to the spreading of cover aggregate and the completion of rolling. Rainfall relatively soon after the construction of a sprayed seal during cold weather conditions also increases the risk of early stripping occurring. The Principal and/or Contractor should be prepared to promptly implement contingencies if rain occurs shortly after sprayed sealing works are completed, as detailed in Section 7.4 of this Technical Note.

In addition to an increased risk of stripping occurring, sprayed sealing over a wet surface can also increase the risk of de-bonding between the sprayed seal and underlying pavement.

#### **4.3 Existing surface condition**

The condition (especially the texture depth) of the existing surface over which a sprayed seal will be applied has a significant impact on the risk of stripping occurring when constructing sprayed seals in cold weather conditions. The existing surface texture depth impacts on the effective binder available to fill the voids in the sprayed seal to be constructed and should therefore be carefully considered during the sprayed seal selection, design and construction processes.

Project specific texture depth measurements should be undertaken using the sand patch test in accordance with test method AG:PT/T250 – *Modified Surface Texture Depth (Pestle Method)* (Austroads 2008) and used for design (use of laser derived texture depth measurements is not recommended for sprayed seal selection and design).

It is also important for the Seal Designer and Seal Designer's Delegate to consider whether the texture depth measurements are representative of the area that will be sealed and make adjustments as necessary as works progress. The variability in the existing surface texture depth should be considered during the design stage and any necessary pre-treatments (for example, surface texture corrections, patching, and so on) undertaken in advance to ensure a uniform surface texture prior to a constructing a sprayed seal.

#### **4.4 Design application rates**

The risk of failure in cold weather is increased for sprayed seals that have low design binder application rates (for example, single / single sprayed seals on heavily-trafficked roads). Wherever possible, sprayed seal treatments that present less risk of failure should be used on heavily-trafficked roads that that will be subject to cold weather conditions at the time of construction or shortly thereafter.

The sprayed seal must be designed by a competent Seal Designer in accordance with the requirements in MRTS11. The sprayed seal design must also be based on project specific input parameters, including sand patch texture depth of the existing surface, ball penetration (if required) and properties of the cover aggregate being used (like particle size distribution, flakiness index and average least dimension).

It is important that the actual spray rate be within +/-5% of the adjusted design spray rate during construction, as any reduction in the applied binder rate beyond these limits can increase the risk of stripping.

The performance of sprayed seals is also dependent on how the cover aggregate is spread, both in terms of spread rate and the consistency of distribution. There is an increased risk of stripping if the actual / applied cover aggregate spread rates are too low, as the increased space between individual particles will not allow the aggregate to mechanically interlock sufficiently and mean the binder will not to rise sufficiently between the aggregates particles to achieve the desired level of adhesion.

However, there is also an increased risk of loose aggregate on the road surface shortly after construction if the actual/applied cover aggregate spread rates are too heavy. The presence of loose aggregate on the road surface can also lead to safety concerns (as described in Section 3).

#### **4.5 Binder class selection**

The adhesion characteristics of different bituminous binder classes can vary significantly. All else being equal highly modified binders (such as S20E) do not adhere to aggregates as well as Class 170 bitumen, particularly if the sprayed sealing work is completed during cooler weather conditions. Therefore, the risk of stripping increases when sprayed seals with highly modified bituminous binders are constructed during cold weather or cold / wet weather or are exposed to cold weather or cold / wet weather in the weeks after construction. For this reason, the use of highly modified binders should be avoided during cold weather, particularly those involving single / single sprayed seals on heavily-trafficked roads.

However, it is important to realise that highly modified binders are typically used on heavily-trafficked roads and/or high shear environments, particularly where the pavement surface temperature is high during summer. Therefore, changing the binder type (for example, using a lowly modified bituminous binder) to accommodate (manage the risks of) sprayed sealing during cold weather conditions could affect the future performance of the sprayed seal. For this reason, in these cases, it is preferable for the sprayed seal to be constructed during warmer weather.



#### **4.6 Cutting practices**

The adhesion between bituminous binders and cover aggregates can be improved by adding cutter oils to the bituminous binder, especially during cooler weather conditions. For guidance about cutting practices for sprayed seals, refer to the following work tips:

- Austroads/AAPA Pavement Worktip No. 14 *Sprayed Seal Cutting Practice*
- Austroads/AAPA Pavement Worktip No. 27 *Sprayed Sealing Cutting Back of Polymer Modified Binders*

For sprayed seal work, it is critical to correctly assess the pavement surface temperature applicable for determining the concentration of cutter oil. This is even more important for polymer modified binder (PMB) sprayed seals. In assessing the of pavement temperature to be used for determining the concentration of cutter oil due consideration should be given to the conditions that the pavement will be subjected to over the shift and following day(s) / night(s). For example, a pavement that is in sunshine during the middle of the day may be in the shade of trees or in shadow within a roadway cutting during the remainder of the day. In this case the quantity of cutter oil added should be based on the likely pavement surface temperature of the shaded areas of pavement.

The expected prevailing weather conditions for the next few days and weeks should also be considered.

It is important to note sprayed sealing in cold weather is a compromise. For instance, the use of:

- a high amount cutter oil can lead to poor cohesive strength of the binder and flushing and/or bleeding of the treatment during subsequent warm / hot weather
- the use of insufficient cutter oil can lead to poor wetting of the aggregate and consequent aggregate loss (stripping) during initial trafficking of the sprayed seal.

#### **4.7 Aggregate condition**

Aggregates should be clean and dry, and comply with the requirements of MRTS22 *Supply of Cover Aggregate*. Aggregates should preferably be precoated (to mitigate the presence of dust) and otherwise comply with specification requirements (for example, not contain free surface water). Water finding paste can be used to identify aggregate that has been precoated and contains free surface moisture (as it is often difficult to differentiate between free moisture and excess precoat when the aggregate is in stockpile).

#### **4.8 Cold weather sprayed seal selection**

Single / single sprayed seals that use a large aggregate size present a higher risk of failure when sprayed sealing in cold weather conditions. Therefore double / double sprayed seals (for example, 14/7 mm or 10/5 mm) are typically preferred in these circumstances.

Emulsion sprayed sealing is an alternative to hot sprayed sealing and may help manage risks associated with constructing hot sprayed seals in cooler weather. However, emulsions are not recommended when pavement surface temperatures at the time of construction (including the breaking and curing periods) are outside the range of 10°C to 50°C. It is important to note however emulsions can take longer to break and cure at lower temperatures. Emulsion sprayed seals are also vulnerable to the action of traffic, particularly when rain falls during construction or within a few days of construction.

The maximum recommended size for emulsion sprayed seals is 10 mm and the use of a scatter coat is typically adopted in these cases.

## **5 Scheduling of works and sprayed seal type selection – risk mitigation measures**

The methodology to be used for assessing the risk of scheduling the construction of sprayed seals during cold weather conditions is presented in the sections below.

Various factors are considered in assessing the stripping risk of a sprayed seal constructed in cold weather conditions or that experiences cold weather following construction. Historical climatic data has been analysed to predict the weather conditions that can be expected at specific times and locations. This information informs the strategy for the scheduling and undertaking sprayed sealing works.

This scheduling risk assessment is to be used alongside the project level risk mitigation measures outlined in Section 7.

### **5.1 Risk categories**

The factors used to assess the risk of sprayed sealing works outside of summer months for locations in Queensland are historical:

- air temperatures as measured and recorded by the Australian Bureau of Meteorology (BoM)
- rainfall as measured and recorded by the BoM.

The criteria for assessing these risk factors are described below.

#### **5.1.1 Temperature**

The temperature categories adopted are based on the 50<sup>th</sup> percentile of the number of days with an expected minimum temperature below 10°C (based on historical temperature data as measured and recorded by the BoM within the 24 hours of a day), in the month and location that the sprayed sealing works are to be undertaken.

The temperature categories adopted are:

- Low: <3 days in a month with an expected minimum air temperature of below 10°C
- Medium: 3–10 days in a month with an expected minimum air temperature below 10°C
- High: >10 days in a month with an expected minimum air temperature below 10°C.

#### **5.1.2 Rainfall**

The likelihood of rainfall occurring is determined by the 50<sup>th</sup> percentile of number of days with an expected rainfall above 2 mm (based on historical rainfall data as measured and recorded by the BoM within the 24 hours of a day), for the month and location that the sprayed sealing works are to be undertaken.

The rainfall categories adopted are:

- Low: <3 days in a month with an expected rainfall above 2 mm
- Medium: 3–10 days in a month with an expected rainfall above 2 mm
- High: >10 days in a month with an expected rainfall above 2 mm.

### **5.2 Quantifying risk**

Historical weather data from the BoM was sourced for locations throughout Queensland and classified into the selected rainfall and temperature categories (as noted in Sections 5.1.1 and 5.1.2 respectively).

The overall risk of conducting sprayed seal works is estimated by assessing the likelihood of cold or cold and damp conditions occurring during and after the sprayed sealing works. These factors are combined in a matrix to define an overall risk level, as described below.

When assessing the sprayed sealing risk level, the nearest relevant BoM weather station listed in Appendix A that will reasonably represent the weather characteristics of the site of the works should be used.

### 5.2.1 Likelihood of climate risk

The climate (that is, temperature and rainfall) categories are used to assign a likelihood of cold or cold and damp weather conditions occurring during and after the sprayed sealing works using Table 5.2.1(a). This allows a level of expected risk of stripping occurring to be assigned. As noted earlier, the use of initial seals still entails some additional risk when applied in cold or cold and wet conditions. However, the risk of these treatments stripping is somewhat reduced as they typically contain at least six parts of cutter oil when constructed during the colder months of the year. Guidance for the level of risk associated with initial seals is provided in Table 5.2.1(b).

**Table 5.2.1(a) – Climate risk levels for sprayed seals other than initial seals**

		Days with predicted rainfall above 2 mm (50 <sup>th</sup> percentile)		
		<3 days	3–10 days	>10 days
Days with predicted minimum temperature below 10°C (50 <sup>th</sup> percentile)	<3 days	Level 1 (L1)	Level 1 (L1)	Level 1 (L1)
	3–10 days	Level 2 (L2)	Level 2 (L2)	Level 3 (L3)
	>10 days	Level 3 (L3)	Level 3 (L3)	Level 3 (L3)

**Table 5.2.1(b) – Climate risk levels for initial seals only**

		Days with predicted rainfall above 2 mm (50 <sup>th</sup> percentile)		
		<3 days	3–10 days	>10 days
Days with predicted minimum temperature below 10°C (50 <sup>th</sup> percentile)	<3 days	Level 1 (L1)	Level 1 (L1)	Level 1 (L1)
	3–10 days	Level 2 (L2)	Level 2 (L2)	Level 2 (L2)
	>10 days	Level 2 (L2)	Level 2 (L2)	Level 2 (L2)

### 5.3 Assigning locations to risk categories

Using the procedures defined in Sections 5.1 and 5.2, historical climatic data has been used to define risk categories for sprayed sealing works constructed in cold weather conditions, for various locations throughout Queensland.

The available locations are shown in Appendix A, Figure A1.

The risk category is used to determine a strategy for undertaking the sprayed seal works, as detailed in Section 5.4.

### 5.4 Recommended risk mitigation strategy

The department's recommended risk mitigation strategy for undertaking sprayed seal works in cold weather conditions is presented in Table 5.4.

**Table 5.4 – Recommended risk mitigation strategy for sprayed sealing works for various risk levels**

Risk level	Recommended strategy
Level 1 (L1)	Follow TN175 and MRTS11/12 procedures.
Level 2 (L2)	If sprayed sealing is scheduled for <b>Level 2</b> risk periods, additional risk treatments are to be adopted. Projects to be undertaken during these periods must implement risk mitigation measures (refer Section 7) and project-specific risk documentation (refer Section 8).
Level 3 (L3)	If possible schedule or construct projects for warmer times of the year. If sprayed sealing during <b>Level 3</b> risk periods cannot be rescheduled, approval must be sought and obtained from the District Director. Level 2 risk mitigation measures must be implemented if the District Director approves sprayed sealing at this time of year.

## 6 Risk mitigation measures – design and tendering

The risk mitigation measures in Table 6 should be considered during the design and tendering phase for sprayed sealing works expected to occur in cases where the risk is assessed to be at Level 2 or Level 3 (as determined in accordance with Section 5.3).

**Table 6 – Risk mitigation measures (design and tendering)**

Item	What	Risk mitigation measures to be considered	Who
1	Scheduling of works (construction window)	<ul style="list-style-type: none"> <li>Schedule projects or separable portions of works for warmer periods if possible.</li> </ul>	Principal
2	Sprayed seal type selection	<ul style="list-style-type: none"> <li>Use of double / double sprayed seals instead of single / single sprayed seals.</li> <li>Liaise with departmental Inspectors regarding possible risks.</li> </ul>	Principal and Seal Designer
3	Binder type selection	<ul style="list-style-type: none"> <li>Avoid using highly modified bituminous binders where possible.</li> <li>Consider using emulsions where suitable.</li> <li>Liaise with departmental Inspectors regarding possible risks.</li> </ul>	Principal and Seal Designer
4	Sprayed seal design	<ul style="list-style-type: none"> <li>The sprayed seal design must be undertaken by a competent Seal Designer in accordance with the requirements in MRTS11</li> </ul>	Principal and Seal Designer
5	Contract and specification provisions	<ul style="list-style-type: none"> <li>Provide for contingencies in the contract. Contingencies can include allowing for additional costs for: re-establishment, changes in sprayed seal treatment or binder type; and additional activities, materials or equipment. It could also entail specifying certain requirements for these items.</li> <li>Include additional project specific requirements in MRTS11.1 Annexure (for example, minimum pavement temperatures, cutting requirements, additional rolling, testing and monitoring requirements).</li> </ul>	Principal

## 7 Risk mitigation measures – construction

The risk mitigation measures outlined in this Technical Note should be considered at various stages when constructing sprayed seals in risk Level 2 or Level 3 locations determined in accordance with Section 5.3.

### 7.1 Project specific weather forecasting

In situations where the air temperature is likely to fall below 10°C or rainfall is forecast at any time during the first seven days after the sprayed seal is constructed, the Contractor must seek approval from the Administrator to proceed prior to the commencement of spraying.

It is recommended that information obtained from the BoM is used to undertake the project specific weather forecasting.

### 7.2 Pre-work preparation

As part of the scheduling and approval process for works assessed to have a risk at Level 2 or Level 3, the Contractor must complete a project specific risk assessment in consultation with the Administrator.

If the project specific risk assessment indicates that the risk of early life stripping can be appropriately managed, the relevant details should be documented by the Contractor for submission to the Administrator in the 'Project Details' and 'Authority to Proceed' forms, examples of which are illustrated in Section 8 and which are available on the Transport and Main Roads [Technical Notes: Pavements, materials and geotechnical](#) webpage. The risk mitigation measures must at a minimum include the additional requirements specified in Annexure MRTS11.1 *Sprayed Bituminous Treatments (Excluding Emulsion)*. The pre-work risk assessment should also consider (where appropriate) the items listed in Table 7.2.

If the risk assessment indicates that the risks of early life stripping cannot be appropriately managed, the sprayed seal should be re-scheduled until more favourable weather conditions are expected.

**Table 7.2 – Preparation tasks (before works start)**

Item	What	Key Points	Other Notes / Points	Who
1	Pre-start meeting with sprayed sealing contractor / subcontractor	Discuss: <ul style="list-style-type: none"> <li>• potential risks</li> <li>• risk mitigation measures and their implementation (for example, strategy to be implemented if sprayed seal strips that is, traffic management/repair treatment and so on)</li> <li>• contingencies</li> <li>• decision making processes and authority</li> <li>• aftercare requirements / strategy</li> <li>• specification and other contract requirements</li> </ul>	<ul style="list-style-type: none"> <li>• At least 7 days before sprayed sealing works commence.</li> <li>• May require a special / separate prestart meeting that includes the Head Contractor, Sprayed Sealing Contractor / Subcontractor, Administrator and Principal's Representatives.</li> </ul>	Principal Contractor, sprayed sealing contractor / subcontractor, Administrator and Principal's Representatives

Item	What	Key Points	Other Notes / Points	Who
2	Confirm whether any atypical traffic movements are expected during or soon after construction that were not allowed for in the sprayed seal design	<ul style="list-style-type: none"> <li>• The first preference is to delay the works until such time that typical movements are expected.</li> <li>• If this is not possible then adjust the sprayed seal design as/if needed to take into account these atypical movements.</li> </ul>	<ul style="list-style-type: none"> <li>• For example, seasonal variations, a local 'show day', army convoy or an agricultural harvest.</li> </ul>	Seal Designer, Seal Designer's Delegate and Administrator
3	Sprayed seal design and on site decisions (for example, cutting rates).	<ul style="list-style-type: none"> <li>• Check competency of Seal Designer and Seal Designer's Delegate</li> <li>• Ensure Seal Designer / Seal Designer's Delegate's involvement in design and construction, including decisions on site and proposed changes</li> <li>• If required, adjust the binder spray rate and aggregate spread rate by visual inspection and in agreement with the Contractor and Administrator.</li> </ul>	<ul style="list-style-type: none"> <li>• Refer to MRTS11</li> </ul>	Seal designer, Seal Designer's Delegate, Contractor and Administrator
4	Aggregate and its condition.	Only use complying cover aggregate that has been visually inspected and tested.	<ul style="list-style-type: none"> <li>• Check testing of actual aggregate to be used is done, including for Average Least Dimension, Flakiness Index and Degree of Aggregate Precoating.</li> <li>• Binder spray rates to be adjusted based on these results (and surface texture results).</li> </ul>	Contractor, Administrator and Surveillance Officers.

Item	What	Key Points	Other Notes / Points	Who
5	Binder sampling and testing.	Sampling and testing by the Contractor are required at the point of delivery and point of release from the Manufacturer in all cases irrespective of who the binder supplier is.	<ul style="list-style-type: none"> <li>Confirm this will occur.</li> </ul>	Contractor, Administrator and Surveillance Officers.
6	Check contingencies are in place and actionable at short notice.	Materials, people and equipment readily available.	May require local aggregate stockpiles to be established.	Contractor and Administrator

### 7.3 Processes during works

There are a number of possible risk mitigation measures that can be undertaken when sprayed sealing during cold weather conditions. The measures listed in Table 7.3 detail processes to be considered when sprayed sealing works are undertaken in Level 2 or Level 3 risk locations.

**Table 7.3 – Processes during works**

Item	What	Key Points	Other Notes / Points	Who
1	'Project Details' and 'Authority to Proceed' Forms completed.	<ul style="list-style-type: none"> <li>Need to be signed.</li> <li>Local / additional measures need to be captured on the form.</li> </ul>	–	Contractor and Administrator
2	Weather watch monitoring system	<ul style="list-style-type: none"> <li>Review, on an ongoing basis, the 7-day forecast for the sites / area.</li> <li>It is recommended to erect mobile weather stations at each construction site, to verify sudden drops of temperature that may lead to aggregate stripping.</li> </ul>	<ul style="list-style-type: none"> <li>Consider both daytime and night-time temperatures (including pavement temperatures) during and after sprayed sealing works.</li> <li>Re-schedule works if the road is wet or rain is expected in the coming days / nights.</li> </ul>	Contractor and Administrator

Item	What	Key Points	Other Notes / Points	Who
3	Sprayed seal design and on-site decisions (for example, cutting rates)	<ul style="list-style-type: none"> <li>Seal Designer and/or Seal Designer's Delegate involved in decisions, including those made on site (for example, cutting rates).</li> <li>Identify and allow for isolated areas with lower temperatures (for example, shaded areas).</li> <li>Consider shorter spray runs.</li> </ul>	<ul style="list-style-type: none"> <li>Consider forecast weather and temperatures including for coming days / weeks.</li> <li>Refer to MRTS11 / SWTC and Austroads/AAPA Work Tips.</li> <li>The aggregate should be placed onto the binder promptly after spraying and rolled into the binder as soon as practicable.</li> </ul>	Contractor, Administrator and Surveillance Officers
4	Quantity of materials used	Verify the actual quantity of binder and aggregate used to check against sprayed seal design.	–	Contractor, Administrator and Surveillance Officers
5	Contingencies	<ul style="list-style-type: none"> <li>Ensure these are in place and can be practically implemented in a short time if issues arise.</li> <li>Refer to Table 7.4</li> </ul>	Materials, plant and people on site or readily available at short notice.	Contractor (include in construction procedures for works)
6	Conduct 'pull-out' test to assess level of bonding of the aggregate to the binder surface	<ul style="list-style-type: none"> <li>Testing to be conducted in accordance with Transport and Main Roads Test Method Q227.</li> <li>Determine an average pull-out force required to dislodge cover aggregate pieces from a bituminous binder on a sprayed seal.</li> </ul>	The data from this testing could prove useful for sprayed sealing work by indicating the degree of early trafficking control required on fresh sprayed seals	Contractor (include in construction procedures for works)
7	Removal of loose aggregate after rolling	Ensure loose aggregates are adequately removed in accordance with the requirements in MRTS11	–	Contractor



Item	What	Key Points	Other Notes / Points	Who
8	Traffic management	Avoid stopping traffic on exposed binder.	<ul style="list-style-type: none"> <li>Consider use of pilot vehicles, particularly in early stages.</li> <li>Consider moving (wandering) vehicles over width of sprayed seal if pilot vehicles are used or use delineation (for example, by moving traffic cones) to achieve this.</li> </ul>	Contractor (include in construction procedures for works).

#### 7.4 After completion of sprayed seal

The measures listed in Table 7.4 detail processes should be considered after sprayed sealing works have been completed in Level 2 or Level 3 risk locations.

**Table 7.4 – Processes after completion of sprayed seals**

Item	What	Key Points	Other Notes / Points	Who
1	Weather watch monitoring system	Review, on an ongoing basis, the 7-day forecast for the sites / area.	Be ready to rapidly implement contingencies if cold or wet weather occurs in the following days / nights.	Contractor
2	Monitoring	Regular on-site monitoring by competent / experienced personnel.	<ul style="list-style-type: none"> <li>As a minimum early morning including during any morning peak period.</li> <li>Increase level of monitoring promptly if cold or wet weather is experienced in the days/weeks after the works are finished (for example, several times a day).</li> <li>Increase level of monitoring when / if speed limits are increased.</li> </ul>	Contractor, Administrator and Surveillance Officers

Item	What	Key Points	Other Notes / Points	Who
3	Controlled opening to traffic	<ul style="list-style-type: none"> <li>• To determine an appropriate time to open newly constructed sprayed seals to traffic, monitor and record: <ul style="list-style-type: none"> <li>○ bond strength development and visual observations regarding adhesion</li> <li>○ ambient and road surface temperatures</li> <li>○ humidity and rainfall.</li> </ul> </li> <li>• Maintain reduced speed limits for at least 1 week – for example, 40 km/h where the normal speed limit is 60 km/h or less or 60 km/h where the normal speed limit is more than 60 km/h.</li> </ul>	<ul style="list-style-type: none"> <li>• Where additional rolling is required following completion of the sprayed seal to promote adequate adhesion, this should be done when road surface temperatures are above 15°C.</li> <li>• Consideration should be given to trafficking fresh sprayed seals when road surface temperatures exceeds 15°C.</li> <li>• Consider extending the period for controlling traffic if wet or cold weather is experienced in the weeks after works are finished.</li> </ul>	Contractor and Administrator / Surveillance Officers
4	Contingencies	<ul style="list-style-type: none"> <li>• Confirm contingencies in place and ready to be deployed if necessary.</li> <li>• May include bitumen emulsion enrichment spray, scatter coat for initial sprayed seals and large size sprayed seals, or dry matting materials, and operators and plant to apply these.</li> </ul>	<ul style="list-style-type: none"> <li>• Be ready to deploy at short notice, particularly if wet or cold weather is experienced in the days/weeks after works are finished.</li> <li>• The ideal size for scatter coat and dry matting aggregate is half the size of the underlying aggregate. Two sizes may need to be available for dry matting (for example, 10 mm and 7 mm).</li> </ul>	Contractor and Administrator

## 8 Documentation

### 8.1 Project details form

When cold or cold and damp weather conditions are likely to be encountered early in the life of a sprayed seal, works should not commence until the 'Project Details' Form is completed. An example of this form follows; an interactive version of the form is available on the Transport and Main Roads [Technical Notes: Pavements, materials and geotechnical](#) webpage.

**Table 8.1 – Example of project details form**

Project name	
Contract number	
Job location including chainages and lanes included in works:	
Seal Designer	Name: Mobile phone: Email:
Seal Designer's Delegate	Name: Mobile phone: Email:
Aftercare and contingency arrangements agreed	Yes / No
Project specific measures to be implemented	Capture all project specific measures to manage risk. Include references and attach documents as needed.
Prepared by Contractor	Name: Signature: Date: Mobile phone: Email: Out of hours contact:
Approved by Administrator	Name: Signature: Date: Mobile phone: Email: Out of hours contact:

**8.2 Authority to proceed form**

The 'Authority to Proceed' Form must be completed each day before any sprayed seal construction commences in cold or cold and damp weather conditions. An example of this form follows; an interactive version of the form is available on the Transport and Main Roads [Technical Notes: Pavements, materials and geotechnical](#) webpage.

**Table 8.2 – Example of authority to proceed form**

<b>Complete Daily Before Works Start (if the answer to any item is 'No' then do not proceed)</b>	
Weather forecast for the site, for the shift and 7 days following the work shift, reviewed and provided to Seal Designer and/or Seal Designer's Delegate.	Yes / No
Aggregate to be supplied to job has been inspected and deemed to be complying. (Aggregate is to be clean, pre-coated, cured and without free surface water viz. Clause 14.1 of MRTS11.) The Administrator may order that wet aggregate be tested using the Binder Stripping Value – Modified Plate test (Q212B). Test results should be reported to the Administrator	Yes / No
Aggregate to be supplied to job has been tested and results supplied to Seal Designer and/or Seal Designer's Delegate.	Yes / No
Surface texture along /across job has been tested and results supplied to Seal Designer and/or Seal Designer's Delegate. Aggregate size to be used is compatible with the texture of the existing surface (refer Table 6.4 of AGPT4K).	Yes / No
For initial seals, ball penetration along the job has been tested, the pavement conforms with the ball penetration requirements (where applicable) and results supplied to Seal Designer and/or Seal Designer's Delegate.	Yes / No
Sampling and testing of the binder by the Contractor have been done/is occurring at the point of: <ul style="list-style-type: none"> <li>• delivery</li> <li>• release from manufacturer.</li> </ul>	Yes / No
Seal design and adjustments (attach written advice for Seal Designer and/or Seal Designer's Delegate). Guidance provided in Austroads/AAPA Worktip No. 14 <i>Sprayed Seal Cutting Practice</i> and Worktip No. 27 <i>Sprayed Sealing Cutting Back of PMB</i> .	Binder spray rate(s): Aggregate spread rate(s): Cutting rate(s):
Contingencies in place and can be implemented rapidly during and after works	Yes / No
Traffic management arrangements in place (e.g. pilot vehicles)	Yes / No
Aftercare planned and implemented	Yes / No
Monitoring plan developed and implemented	Yes / No
Prepared by Contractor: Name: Position: Signature: Date:	
Approval conditions (include references and attach documents as needed):	
Authority to proceed approved / not approved (strike out where applicable) by Administrator: Name: Signature: Date:	





Figure A1 – Visual representation of selected locations assigned a risk level



