



RESEARCH

2008-54

Recommended Practices for Crack Sealing HMA Pavement



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Technical Report Documentation Page

1. Report No. MN/RC – 2008-54	2.	3. Recipients Accession No.	
4. Title and Subtitle Recommended Practices for Crack Sealing HMA Pavement		5. Report Date February 2008	
		6.	
7. Author(s) Eddie Johnson and Jim McGraw		8. Performing Organization Report No.	
9. Performing Organization Name and Address Minnesota Department of Transportation Office of Materials 1400 Gervais Avenue Maplewood, MN 55109		10. Project/Task/Work Unit No. INV 822	
		11. Contract (C) or Grant (G) No.	
12. Sponsoring Organization Name and Address Minnesota Department of Transportation Research Services Section 395 John Ireland Boulevard Mail Stop 330 St. Paul, Minnesota 55155		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes http://www.lrrb.org/PDF/200854.pdf			
16. Abstract (Limit: 200 words) INV 822: This report is intended to present the conclusions from LRRB 822 Tasks 1-3 in combination with several other pertinent sources including: Chapter 4 of the Best Practices Handbook on Asphalt Pavement Maintenance (2000-04), the Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavement - Best Practice by the National Guide to Sustainable Municipal Infrastructure (NRC-CNRC, 2003), and Special Provision 2331, Bituminous Pavement Crack Treatment (Mn/DOT-Revised 2/7/2008).			
17. Document Analysis/Descriptors HMA Crack sealing Asphalt concrete		18. Availability Statement No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161	
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 7	22. Price

Local Road Research Board Project 822 : Recommended Practices for Crack Sealing HMA Pavement

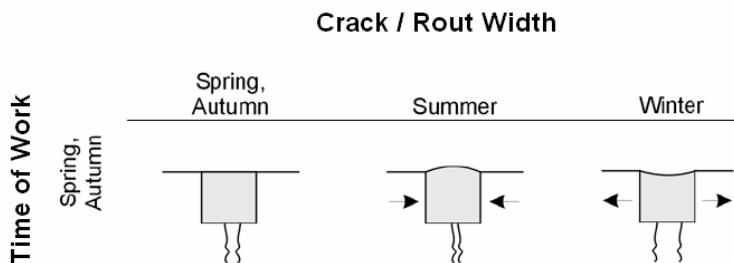
Mn/DOT Office of Materials: 2008

Introduction

This report is intended to present the conclusions from LRRB 822 Tasks 1 – 3 in combination with several other pertinent sources including: Chapter 4 of the *Best Practices Handbook on Asphalt Pavement Maintenance* (Mn/DOT, 2000), the *Guidelines for Sealing and Filling Cracks in Asphalt Concrete Pavement* – Best Practice by the National Guide to Sustainable Municipal Infrastructure (NRC – CNRC, 2003), and *Special Provision 2331, Bituminous Pavement Crack Treatment* (Mn/DOT – Revised 2/7/2008).

Crack *sealing* is used for active cracks in hot mix asphalt (HMA) pavements; those which open in winter and close in summer. Crack *filling* is only intended to treat cracks that show little movement. Sealant installation is affected by a number of factors including: humidity, rout size, crack preparation method, heating time, sealant finishing and protection, and the temperature of air,

sealant, and pavement. It is appropriate to crack seal or fill during spring or fall conditions since crack width is affected by temperature. Because of this, a compromise must be reached between the timing of optimal treatment width and other application conditions, usually best during summer.



Pavement management data has shown that the primary sources of distress are transverse and longitudinal cracks. This emphasizes the need for proper maintenance of HMA cracks. Crack condition and density should be considered when selecting the maintenance type. Sealing or filling may be the best option when the crack density is moderate and crack edges have some or little deterioration. In other situations it may be more suitable to patch or apply surface treatment or other measures. Sealing or filling is generally not recommended for situations where the pavement is in an advanced state of decay. Crack treatments on pavements in poor condition are not effective.

Pavement Management Systems (PMS) use various rating systems to quantify conditions in order to optimize maintenance strategies and identify cost-effective alternatives for pavement maintenance and rehabilitation. The Pavement Quality Index (PQI) is used by the Mn/DOT Pavement Management Unit. PQI is determined by calculating the square root of the product of ride and surface distress indices, where Ride Quality Index (RQI) is used to quantify ride quality and Surface Rating (SR) is used for surface distresses.

Selection considerations:

- ✓ Time to Rehabilitation – It is not recommended to fill or seal cracks during the last several years prior to rehabilitation.
- ✓ Age of Surface – The risk of poor performance of rout and seal increases significantly with pavement age.
- ✓ Traffic – Life of the treatment may be affected by traffic volumes, or some treatment types may cause greater traffic disruption during installation. Traffic volume may drive cost effectiveness.
- ✓ Pavement Roughness – Degree of ride improvement may be most beneficial to the users.

Conclusions from LRRB 822, Tasks 1 – 3

These tasks evaluated standard Minnesota sealing materials and installation practices through performance based testing and field performance evaluations. Details are available in the individual task reports. By comparing field performance failure rates and installation methods it found that poor application practices do not provide for acceptable field performance of crack sealants.

Because uniformity is desired, it is recommended that a training and certification course for contractors and inspectors should be developed. The course should discuss best practices and standards for HMA crack preparation and sealing as well as material handling. Training delivery could be completed through updated handbooks, and made available through either classroom or video.

Other observations include:

- ✓ Increased enforcement of sealing specification or issuing a warranty specification is needed to bring the crack sealing program to a desirable level.
- ✓ Recommended manufacturer safe heating temperatures should be followed. Kettle temperatures should be monitored with a thermocouple. Kettle temperature gauges compared well to a thermocouple attached to an infrared gun.
- ✓ Sealant samples should be obtained from application wands to assure overheating has not occurred.
- ✓ A double walled kettle with applicator wand should be used to fill routs and cracks.
- ✓ Most contractors followed Mn/DOT requirements for rout cleaning. The $\frac{3}{4}$ -in. x $\frac{3}{4}$ -in. (Mn/DOT standard) rout had greater failures than the other rout geometries. This difference needs to be verified by additional field trials as installation quality may have contributed to the differences.
- ✓ Performance data from the evaluation shows the need for improvements in crack sealing installation procedures; however, the filling method did not seem to affect performance. All contractors used overband or band-aid filling techniques. A flush fill was not performed, but was recommended by one supplier technical manager.
- ✓ 3725 sealants outperformed 3723.

Types of Crack Repair Treatments

Several types of crack repair treatments are commonly used in Minnesota:

- ✓ Clean and seal: Prepare cracks by blowing out debris and heating the crack face. Use hot air lances and compressed air before filling with sealant. This technique is used on all types of pavement systems in Minnesota.
- ✓ Crack filling: This treatment differs from crack sealing mainly in the preparation given to the crack prior to treatment and the type of material used. Various fillers may not exhibit the same type of adhesive or elastic properties that is expected of sealant. Crack filling is most often reserved for more worn pavements with more random cracking that is usually wider than $\frac{3}{4}$ inch.
- ✓ Rout and seal: This treatment is used on transverse cracks. A pavement saw or router creates a reservoir centered over existing cracks. The routed crack is then filled with sealant. This technique is used on all types of pavement systems in Minnesota.
- ✓ Saw and seal: Pavement saws create transverse joints at regular intervals along a newly placed pavement, and are then filled with sealant. In the past this technique has been used on all types of pavement systems in Minnesota, but is not currently used by Mn/DOT.

Materials

At the time of this report there were three active Mn/DOT material specifications for HMA pavement crack treatment.

- ✓ Mn/DOT 3725 has low resiliency properties, and is recommended sealant for transverse rout and seal applications. It is also recommended sealant for agencies that saw and seal.
- ✓ Mn/DOT 3723 exhibits good adhesion qualities. This product can also be used for the clean and seal method and also for rout and seal in situations where wider reservoir widths are needed.
- ✓ Mn/DOT 3719 is the recommended sealant for crack filling.

NOTE: AC-3 type crack filler has been removed from Mn/DOT specifications. It is an air-blown asphalt that has sometimes been used to fill cracks. However, the product possesses little flexibility and is very temperature susceptible. It becomes brittle in the winter and may track in warmer weather. The use of AC-3 as a crack filler is discouraged.

Crack Sealant Selection

Mn/DOT has been involved in a national pooled fund study concerned with the development of performance-based tests for the selection of crack sealants and crack fillers. The performance-based tests include viscosity at installation temperature, low temperature tests to measure cohesion and adhesion and a tracking test at high pavement temperatures. The expected field performance indicated by these tests has correlated well with actual sealant field performance. Mn/DOT Materials has tested the crack sealants on the Approved Products List and will update the list based on field evaluations and test results.

Mn/DOT 3725 sealants should be used in transverse rout and seal applications. Mn/DOT 3723 and Mn/DOT 3719 should be used in clean and seal applications. Mn/DOT 3723 should be used in longitudinal applications, and can be used in rout and seal.

Polymer-modified asphalt emulsion or AC-3 should not be used for crack filling. Tests show that polymer-modified emulsion becomes brittle at -13.8 °C (7 °F) and AC-3 becomes brittle at -2.5 °C (27.5 °F). Mn/DOT sealant typically performs well down to -34 °C (-29 °F) to -40 °C (-40 °F).

Curb and Gutter Maintenance

It is recommended that the longitudinal joint between a PCC pavement and HMA shoulder be sealed. This concept can be extended to recommend that the PCC curb-HMA pavement joint should also be sealed when urban sections are receiving a clean and seal or rout and seal treatment. A Mn/ROAD study showed that 85 percent of the water entering edge drains was entering through the crack at the interface of the PCC mainline pavement and bituminous shoulder.

Rout and Seal Treatment

Timing

- ✓ Recommend spring or autumn time frame during dry conditions.

Preparation options

- ✓ Refer to Mn/DOT Special Provision 2331, S-135.1 Rout and Seal at Transverse Cracks.
- ✓ Transverse cracks less than or equal to 19 mm [0.75 inches] wide shall be routed, cleaned and sealed.

Material choices

- ✓ Transverse cracks – Sealant meets requirements of Mn/DOT specification 3725, low modulus type sealant.

- ✓ Longitudinal cracks – Clean and seal, do not rout. Use Mn/DOT specification 3723 sealant, or 3719 sealant on more severe longitudinal cracks with approval of the Engineer.

Methods

- ✓ Follow proper acceptance procedures as outlined in Mn/DOT 2332 S-135.1D
- ✓ Mn/DOT standard rout configuration is $\frac{3}{4}$ -in. x $\frac{3}{4}$ -in. A rout Width/Depth ratio ≥ 1 may improve sealant performance, but excessive widths are prone to failure.
- ✓ Use a square die to inspect routed cracks.
- ✓ Avoid wide, thick overbands that can be pulled up by snowplows or by slow moving traffic in hot temperatures.
- ✓ The sealant temperature in the application equipment shall not exceed the safe heating temperature recommended by the manufacturer. Temperatures above the safe heating temperature will result in rejection and disposal of the sealant material.
- ✓ Sealant placement is not permitted if the temperature of the material is below the manufacturer's recommended minimum application/ pouring temperature.
- ✓ Mixing of different manufacturer's brands or different types of sealants is prohibited.
- ✓ A 20 horse power pavement cutter is specified.
- ✓ The specified air compressor is capable of producing a continuous stream of clean, dry air 517 to 1034 kPa [75 to 150 pounds per square inch] at 3.5 m³/minute [125 cubic feet per minute (CFM)] minimum.
- ✓ The use of backpack blowers (leaf blowers) is not allowed.
- ✓ The use of vacuum cleaning equipment will be allowed after demonstrating that the vacuum equipment can successfully clean the cracks.
- ✓ Heat Lance: shall operate with propane and compressed air in combination and be capable of achieving a temperature of heated air at the exit orifice of 982° C [1,800° F] and a discharge velocity of 914 m/sec. [3,000 feet per second].

Traffic control

- ✓ Review the traffic schedule during the pre-construction meeting.

Crack Filling Treatment

Timing

- ✓ Recommend spring or autumn time frame during dry conditions.

Preparation options

- ✓ Refer to Mn/DOT Special Provision 2331, S-135.1 Rout and Seal at Transverse Cracks.

Material choices

- ✓ Transverse cracks – Sealant meets requirements of Mn/DOT specification 3723 or 3719 sealant.
- ✓ Longitudinal cracks – Use Mn/DOT specification 3723 sealant, or 3719 sealant on more severe longitudinal cracks with approval of the Engineer.

Methods

- ✓ Follow proper acceptance procedures as outlined in Mn/DOT 2332 S-135.1D
- ✓ Avoid wide, thick overbands that can be pulled up by snowplows or by slow moving traffic in hot temperatures.
- ✓ The sealant temperature in the application equipment shall not exceed the safe heating temperature recommended by the manufacturer. Temperatures above the safe heating temperature will result in rejection and disposal of the sealant material.
- ✓ Sealant placement is not permitted if the temperature of the material is below the manufacturer's recommended minimum application/ pouring temperature.
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- ✓ Heat Lance: shall operate with propane and compressed air in combination and be capable of achieving a temperature of heated air at the exit orifice of 982° C [1,800° F] and a discharge velocity of 914 m/sec. [3,000 feet per second].

Traffic control

- ✓ Review the traffic schedule during the pre-construction meeting.



NEED MORE INFORMATION ON CRACK SEALING?

Contact: *Minnesota Department of Transportation*

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A list of Mn/DOT certified crack sealant sources is available at

<http://www.mrr.dot.state.mn.us/materials/materials.asp>

View the Mn/DOT Special Provision for Bituminous Crack Treatment (2331) at

<http://www.dot.state.mn.us/tecsup/prov/>

View the NRC-CNRC Infra-guide at

http://sustainablecommunities.fcm.ca/files/infraguide/roads_and_sidewalks/guidelines_sealing_fil_cracks_pavmnt.pdf