



## Memo

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**TO:** File: Research on Longitudinal Joint Deterioration

**FROM:** Mark Watson  
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**DATE:** 17 September, 2009

**SUBJECT:** Longitudinal Joint Fog Seal Test Sections

### Introduction:

This memo describes the longitudinal joint fog seal treatment and documents the application and early performance of MnROAD test sections.

### Longitudinal Joint Fog Seal Treatment:

A cationic slow set emulsion (CSS-1h), diluted 1:1 for a residual asphalt content of 30%, was spray applied over the longitudinal construction joint between the driving and passing lanes (Right and Left) of west bound I-94 near Albertville, Mn. The slow setting nature of the emulsion gave it time to penetrate into the longitudinal joint before fully curing. This penetration allowed the emulsion the opportunity to seal the pavement which should reduce its' susceptibility to moisture and age related distresses. This treatment can be performed on new or aged HMA pavements, but must be coordinated with pavement striping.

### T.H. 94 (MnROAD Mainline) Test Section:

On September 17, 2009 on T.H. 94 (On MnROAD Mainline)

Application:

- 0.10 gal/SY (2' wide by 50' long) in transition zone, between cells 19-18
- 0.15 gal/SY (2' wide by 50' long) in transition zone, between cells 18-17
- 0.20 gal/SY (2' wide by 50' long) in transition zone, between cells 17-16



Figure 1. T.H. 94, September, 2009 – 0.10 gal/SY CSS-1h Fog Seal



**Figure 2. T.H. 94, September, 2009 – 0.15 & 0.20 gal/SY CSS-1h Fog Seal**



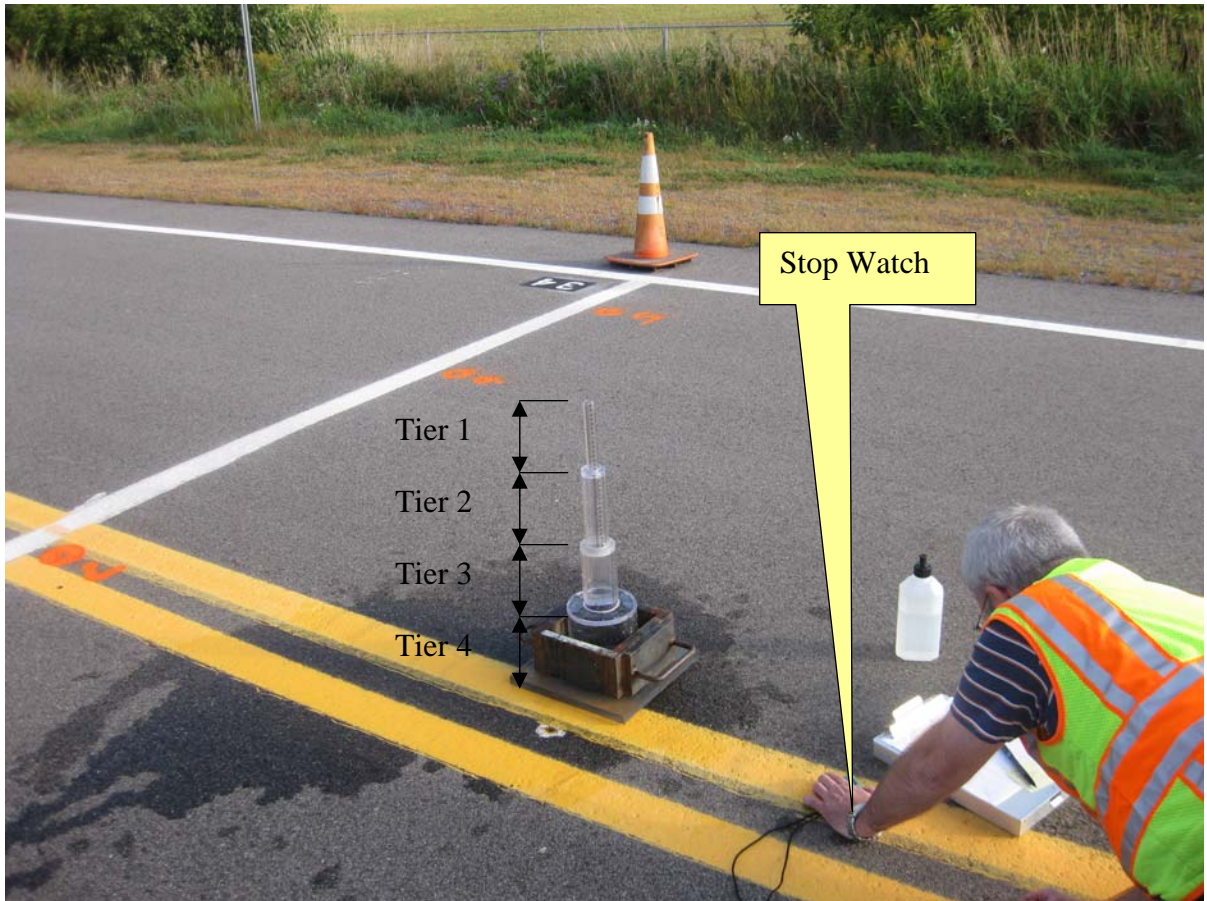
**Figure 3. T.H. 94, CSS-1h Fog Seal after 25+ minutes, September, 2009**

**Application:**

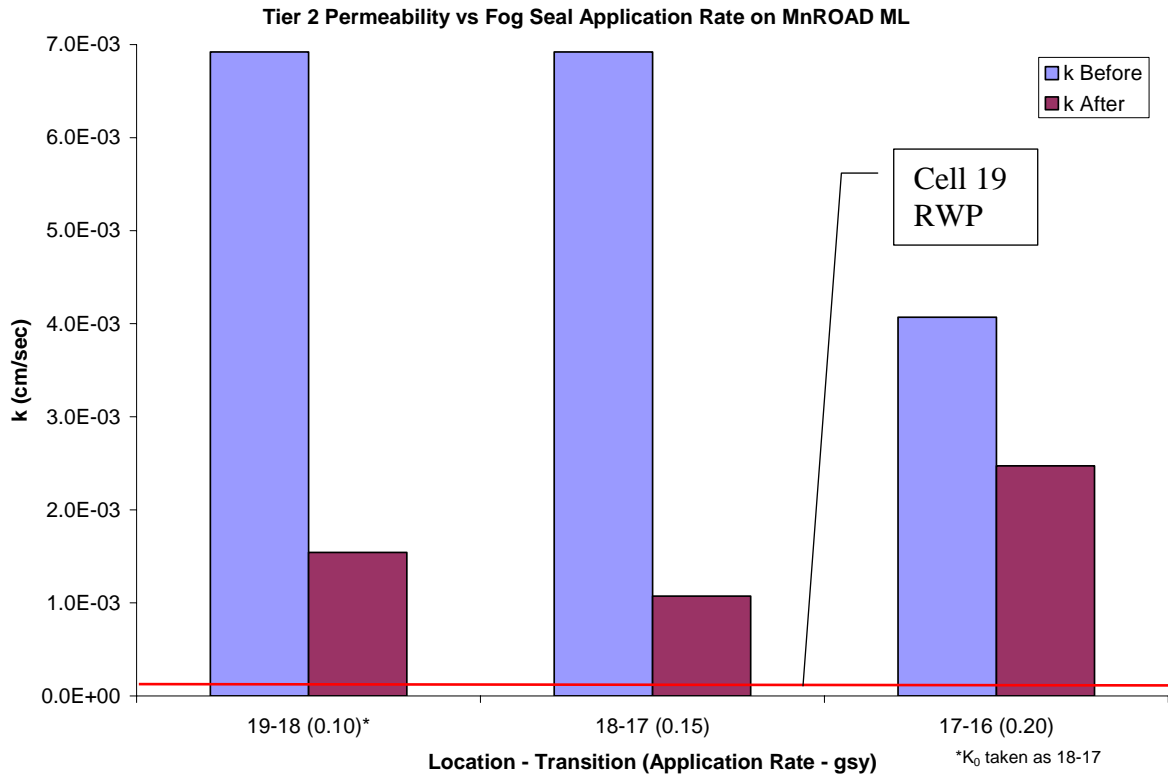
- Pavement striping was covered with special tape (3M Prespacing Tape SCPS-2), although effective for this project, this method may not be practical for larger projects. However, due to the quick cure time of the fog seal, the treatment could easily be coordinated with pavement striping
- A uniform application and coverage was critical to the success of this project (no dribbles)
- Proper material was also highly critical to the success of the project
- All three sections cured in approximately 25 - 30 minutes
- The application rate of 0.20 gal/SY may not be the upper limit of longitudinal joint fog sealing due to the low density and high permeability of the joint.

Figure 5 shows the permeability measurements taken directly over the centerline construction joint on the test sections the day prior to (Before) and the day after (After) the fog seal application. The two before measurements were located in the cell transition zones (between cells 18-17 and between cells 17-16). Note that there wasn't a before measurement for the transition zone between cells 19-18, so it was assumed to be equal to the transition between cells 18-17 due to similar conditions. The coefficient of hydraulic conductivity was measured using a falling head Permeameter as shown in Figure 4. This test involves sealing

the Permeameter to the ground, then filling it with water and measuring the time it takes for water to “fall” from one level (tier) to the next. The hydraulic conductivity measures the ease with which water can travel through the pavement, higher values denote less resistance to flow and lower values denote greater resistance to flow. Note the dramatic reduction in permeability as a result of the fog seal treatments. The fog seal hydraulic conductivity values are still higher than the permeability of cell 19 (not in the transition zone) measured in the right wheel path; this value ( $6.5 \times 10^{-5}$  cm/sec) is shown with a red line near the bottom of Figure 5 for comparison purposes.



**Figure 4. Field Permeameter**



**Figure 5. Before and After Hydraulic Conductivity Measurements**

**Conclusions:**

- The longitudinal joint fog seal treatment was successfully applied: it cured rapidly, penetrated and sealed the pavement and did not create tracking or other aesthetic issues.
- Proper planning preserved the pavement markings
- The effectiveness of the seal is evident in the reduced permeability of the pavement surface

**Recommendations:**

- Recommended application rates are 0.08 – 0.15 gal/SY for new (0 -1 yr. old pavements)
- Apply the treatment more widely as a preventive maintenance tool on both new and aged HMA pavements
- Continue monitoring the field performance of these test sections
- Continue permeability, friction and texture measurements and track performance with time

**MnROAD Low Volume Road (LVR) Test Section:**

On September 17, 2009 at MnROAD Low Volume Road

**Application:**

- Applied in the transition zone between cells 33-34 (Sta 6875 – 6945 dist. of 50') over the centerline construction joint

- This treatment is part of a larger study to complement the Joint Stabilizer (Joint Bond) treatment applied in 2008 as shown in Table 1 below.

Table 1. MnROAD LVR Longitudinal Joint Test Sections

| Station     | Location           | Length (ft.) | Treatment (Year of Application) |
|-------------|--------------------|--------------|---------------------------------|
| 6375 – 6350 | 33 – Loop          | 25           | Control                         |
| 6875 – 6945 | 33-34 – Transition | 70           | CSS-1h (2009)                   |
| 7445 – 7495 | 34-35 – Transition | 50           | JointBond (2008)                |
| 7987 - 8012 | 35-36 - Transition | 25           | Control                         |



Figure 6. MnROAD CSS-1h Fog Seal applied at 0.10 gal.SY, September, 2009

**Application:**

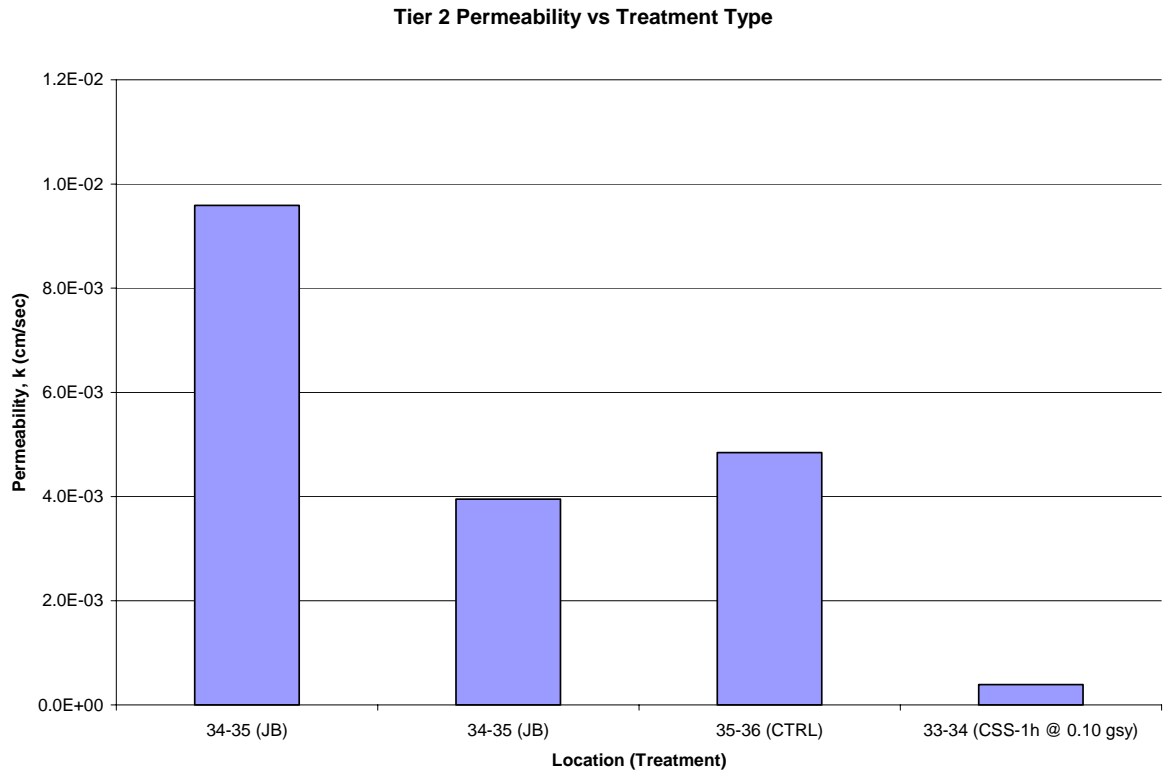
- Pavement striping was obliterated with the treatment, but new latex paint was applied shortly afterwards.
- A uniform application and coverage was critical to the success of this project (no dribbles)
- The test section cured in approximately 25 minutes, longer over the centerline paint stripes

Figure 7 shows the permeability measurements taken on the MnROAD low volume road test sections. There is a dramatic reduction in permeability as a result of the fog seal treatments, and the JointBond results appear to be inconclusive with one measurement slightly lower than the control and another significantly higher. Note that the joint bond treatment has been in-place for 1-year at the time of measurement, but the CSS-1h fog seal was applied the day prior.

**Recommendations:**

- Continue monitoring the field performance of the test section
- Perform permeability, friction and texture measurements (MnROAD location will facilitate testing and evaluation due to the controlled traffic environment which can be challenging on a higher volume 2-lane rural highway)

- Compare the cost effectiveness of the three options (control, joint stabilizer (JointBond) and CSS-1h)



**Figure 7. Hydraulic Conductivity Measurements of LVR Test Sections**

**Summary:**

In Summary the longitudinal joint fog seal treatment was applied on mainline interstate pavement, as well as a low volume road directly over the centerline joint of a one year old pavement. This treatment cured rapidly, penetrated into the pavement providing a seal which should prevent the deterioration of the longitudinal joint. Pavement markings must be preserved either with protection, or restriping.

Performance evaluations and rigorous field testing will be conducted to evaluate the treatment's performance with time.