

Fog Seal

1. Scope

The intent of this guideline is to aid in the design, testing, quality control, measurement and payment procedures for the application of a fog seal.

2. Description

This work consists of an application of a fog seal. A fog seal is a light application of an emulsified asphalt diluted with water that can be either slow or quick setting, anionic or cationic. Most public agencies in Michigan use quick setting, cationic fog seals.

Fog seals are an effective pavement preservation treatment to address:

1. Chip seal aggregate retention
2. Sealing minor cracks
3. Reduction of oxidation
4. Reduction of raveling
5. Aesthetic enhancements

3. Materials

A. Asphalt Emulsion. Furnish Cationic Quick Setting Emulsified Asphalt (CQSEA) meeting the requirements of Table 1 or according to AASHTO M-140, M-208 or M-316.

Dilute asphalt emulsion, at a maximum of one part asphalt emulsion to one part water, at the emulsion plant.

Table 1: Cationic Quick Setting Emulsified Asphalt (CQSEA)

Test Method	Requirements
Viscosity, Saybolt Furol, <i>AASHTO T59/ASTM D7496</i> :	
At 25 °C, sec	20–100
Storage Stability Test, <i>AASHTO T59/ASTM D6930</i> , 24 hr, % Difference, max	1
Particle Charge Test, <i>AASHTO T59/ASTM D7402</i> ^(a)	Positive
Sieve Test, <i>AASHTO T59/ASTM D6933</i> , % max (Distilled Water)	0.1
Residue, min	60
Tests on Distillation Residue:	
Penetration, 25 °C, 100 g, 5 sec, dmm, <i>AASHTO T49/ASTM D5/D5M</i>	40–90
Ductility, 25 °C, 5 cm/min, cm, min, <i>AASHTO T51/ASTM D113/D113M</i>	40
Solubility in Trichloroethylene, % min, <i>AASHTO T44/ASTM D2042*</i>	97.5
Ash Content, % max, <i>ASTM D128</i>	2

^(a) If Particle Charge Test is inconclusive, material having a maximum pH of 6.7 is acceptable.

*Substitute your labs solvent for Trichloroethylene.

- B. **Emulsion Best Practices.** Dilution dependent on desired asphalt residual. Dilution may be improved with warm or hot water. Never add emulsion to water. Always add water or other diluents to emulsion. Fog seals are not typically stored after dilution. If circumstances require storage, remix before use.

4. Construction

A. Equipment

Use equipment that is safe, environmentally acceptable, and capable of producing a quality product.

1. **Pressure Distributor.** Ensure the pressure distributor has the following characteristics:
 - a. Has a ground speed computer-controlled device interconnected with the asphalt emulsion pump such that the specified application rate is supplied at any speed.
 - b. Can maintain the asphalt emulsion at the specified temperature.
 - c. Has spray bar nozzles capable of producing a uniform fan spray and with shutoff control that is instantaneous, with no dripping.
 - d. Can maintain the specified application rate within ± 0.015 gallons per square yard (gal/syd) for each load.
2. **Brooms.** Furnish a power broom and all necessary hand tools, thermometers, etc.
3. **Lights on Equipment.** Ensure distributors and power brooms are equipped with at least one visible approved flashing, rotating, or oscillating amber light.

B. Pre-Production Meeting

A pre-paving meeting between the agency/owner and contractor should be held prior to beginning work. The agenda for this meeting should include a review of the following:

1. Work schedule,
2. Traffic control plan,
3. Equipment calibration and adjustments,
4. Condition of materials and equipment, and
5. Quality control plan (JMF, yield check methods, etc.).

C. Calibration.

Calibration of the equipment is necessary for proper application rates of emulsified asphalt and aggregate. Upon request, the contractor may provide documentation verifying machine calibration. A yield check should be conducted periodically.

1. **Asphalt Distributor.** The asphalt distributor applies asphalt to the pavement surface. ASTM D-2995 “Estimating Application Rate of Bituminous Distributors” is considered acceptable to calibrate the distributor in most parts of the United States. An exception to uniform nozzle size across the spray bar is allowed when lower application rates are desired in the wheel paths. In this case, smaller nozzles are inserted in the spray bar.

2. Nozzle Angle. The next step in calibrating the asphalt distributor is adjusting the spray bar nozzle angles. When the nozzle is threaded into the spray bar, the slot should be positioned at an angle of 15 to 30 degrees to the axis of the spray bar. The end nozzles of the spray bar may be positioned differently.

3. Spray Bar Height. The next step in calibrating the asphalt distributor is adjustment of the spray bar height to obtain a uniform, even application of asphalt. This adjustment process is accomplished by shutting off nozzles to determine where the spray pattern contacts the pavement. Every other nozzle should be turned off for a double lap application, and two nozzles should be turned off for every one that is left on for a triple lap application.

The asphalt distributor operator should spray emulsified asphalt onto the pavement surface for as short an interval as possible while an observer watches where the emulsified asphalt hits the pavement from each nozzle left open. If the emulsified asphalt overlaps for a double lap application, the bar is too high. If there is a gap between the emulsified asphalt applications, the bar is too low.

4. Longitudinal Flow Rate. Longitudinal calibration of the asphalt distributors is best accomplished by measuring the volume of the asphalt distributor before and after spraying enough emulsified asphalt to reduce the volume in the asphalt distributor from full to 70 to 90 percent empty.

First, the quantity of emulsified asphalt in the truck must be determined. Measure with the dip stick. Record this volume as 'beginning volume'. Set up the truck and initialize the asphalt distributor's computer (if equipped). Then spray the emulsified asphalt the required distance to reduce the volume 70 to 90 percent in the tank at the design application rate. Upon completion of the spraying, take a final computer reading and a second dip stick reading. Record this second dip stick reading as 'ending volume'. Then subtract 'ending volume' from 'beginning volume' and record this as 'volume used'.

Determine the area of emulsified asphalt sprayed and divide the 'volume used' by the area sprayed in square yards. This is the gallons per square yard applied to the pavement. This value should then be compared to the asphalt distributor's computer final volume reading to evaluate the accuracy of the computer. A correction factor may then be applied to the computer output, if needed, and used for the remainder of the day.

This calibration should be accomplished each day. An example of this calibration is presented below:

Given:

1800-gallon capacity asphalt distributor
12-foot spray width
Trial spray distance = 3630 feet
0.32 gallon/yd² design spray rate
Dipstick reading beginning of spray = 1765 gallons
Dipstick reading end of spray = 265 gallons

Calculations:

Check to see if enough volume sprayed. $1765 - 265 = 1500$ gallons
 $1500 / 1765 = 85$ percent $>70\%$ and $<90\%$. OK, enough applied to be valid
Calculate spray rate = $1500 \text{ gallons} / (12 \times 3630 / 9) = 0.31 \text{ gallons/yd}^2$

Therefore, decrease asphalt distributor speed, or recalibrate computer and re-check.

D. Surface Preparation

- 1. Protecting Utility Castings and Raised Pavement Markers.** Before beginning the fog seal operation, protect utility castings and raised pavement markers using other protective coverings approved by the agency/owner. Remove the protective coverings before opening to traffic. Cover or protect curb and gutter from receiving fog seal overspray.
- 2. Preparing Pavement Surface.** Prepare the pavement surface to receive the fog seal. Clean pavements with a motorized power broom to remove loose material. Use pick-up sweepers on roadways with curbs and gutter

E. Application Methods and Rates

If applying fog seal to a chip seal, do not apply on the same day as the application of chip seal.

Use pressure sufficient to apply emulsion at a uniform rate, but without splattering or drilling from the spray bar. Adjust nozzle angle and spray bar height to ensure double or triple overlap spray pattern.

Apply fog seal at a rate of 0.07 to 0.15 gallons of diluted material per square yard of pavement treated. Ensure the fog seal application results in a uniform coverage of emulsion just sufficient to flow into and seal the pavement pores, small cracks, and voids. The asphalt emulsion application rate, as determined by a yield check, must not exceed a tolerance of ± 0.015 gal/syd from the established JMF application rate.

F. Construction Best Practices

Fog seal cannot be applied within the first 24 hours after a chip seal operation. For the most effective chip seal aggregate retention, fog seal should be applied as soon as possible after the 24-hour waiting period.

The surface should be broomed prior to applying the fog seal to remove loose debris and or aggregate.

Return to traffic as soon as possible following break and set of the fog seal. Early release to traffic may result in emulsion overspray contamination of vehicles and pedestrians. If necessary, use blotter aggregates to meet return to traffic requirements.

If friction measurements fall below desired levels, blotter aggregates can be used to temporarily increase friction.

G. Notification and Traffic Control

1. **Notification.** Homeowners and businesses affected by the construction must be notified at least one day in advance of the fog sealing. Should work not occur on the specified day, an updated notification should be distributed. The notification will take place in the form of a written posting, stating the time and date the fog sealing will take place. If necessary, signage alerting traffic to the intended project should be posted.

When parking restrictions are necessary, the agency/owner should prepare a plan for communication with residents and removing vehicles to allow the project to continue. Notices to homeowners and businesses should include plan details, including the schedule, agency/owner contact details and the towing company where a towed vehicle is located.

2. **Traffic Control.** A traffic control plan approved by the agency/owner will be required before any work begins. The cost of signage, markers and traffic control necessary to complete the project will be included in the unit price of the fog sealing. Traffic control devices must be in accordance with the agency/owner's requirements and conform to the requirements of the Michigan Manual for Uniform Traffic Control Devices.

H. Weather Limitations

1. Apply the fog seal only when the pavement and air temperature is 55 °F or above.
2. Do not apply the fog seal if there is a forecast of greater than 50 percent chance of rain within 2 hours of application.
3. Do not apply the fog seal if temperatures are forecast to be below 32 °F within 24 hours from the time of application.

I. Quality Control

1. **Quality Control Plan.** Establish, maintain, and follow a Contractor Quality Control (CQC) plan. The CQC plan must cover all fog seal operations. Submit a copy of the plan to the owner/agency at the preconstruction meeting, for approval. Follow the approved plan throughout the project. Include the following information, at a minimum, in the CQC plan.

1. Materials to be used on the project
2. Sampling and testing methods used to determine compliance with material specifications
3. Equipment to be used on the project
4. The method of calibration is used to determine compliance with the application rates.
5. Procedures for pavement preparation.
6. Controls implemented by the contractor to ensure that the fog seal material is cured or set up satisfactorily before opening to traffic.
7. Procedures implemented by the contractor to monitor initial acceptance requirements.

2. **Documentation.** Furnish the agency/owner a daily report including the following

information.

1. Control section, project number, county, route
2. Date, air temperature, pavement temperature, humidity
3. Asphalt emulsion temperature
4. Beginning and ending stations
5. JMF: application and dilution rates (asphalt emulsion)
6. Yield checks on asphalt emulsion (1 per day, minimum)
7. Length, width, total square yards; and
8. Furnish asphalt emulsion documentation as required by agency/owner
9. Contractor's signature

J. Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

Pay Item	Pay Unit
Seal, Fog	Square Yard

Seal, Fog includes placement of the asphalt emulsion including surface preparation, stationing, traffic control, utility and other protections, and documentation.