



SECTION 11

TACK COATS & FOG SEALS USING ASPHALT EMULSIONS

11.1 Scope

This performance guide covers the use of asphalt emulsion for both tack coat and fog seal applications. It should be used as a guide in achieving successful results through proper construction practices and adequate knowledge and understanding of asphalt emulsions.

11.2 Definitions

11.2.1 Tack Coat

A spray application of asphalt emulsion, applied to an existing asphalt or portland cement concrete surface prior to a new asphalt overlay or patching to eliminate slippage planes and provide a bond between new and existing pavement layers.

11.2.2 Fog Seal

A light spray application of dilute asphalt emulsion used primarily to seal existing asphalt surfaces to reduce raveling and to enrich dry and weathered surfaces. Can also be used as a color coating and as a paint striping surface preparation.

11.2.3 Flush Coat

A fog seal applied for the purpose of increasing the asphalt content of under-asphalted, usually newly constructed, surfaces or chip seals. Flush coats are treated herein as fog seals.

11.2.4 Emulsion Break

The initial separation of the water from the emulsion, that can be detected by a marked color change from brown to black, and often by the release of fairly clear to straw-brown water. This break results in the deposition of the base asphalt on an aggregate or paved surface.

11.2.5 Dense Surface

Tight, relatively non-absorbent smooth textured surface.

11.2.6 Open Surface

Open, relatively porous and absorbent, rough textured surface. This type of surface will require a higher rate of application to compensate for the emulsion that flows into the large voids and cracks. Most chip sealed surfaces are open surfaces.



11.3 Applicable Documents

11.3.1 ASTM Documents

- D140 Practice for Sampling Bituminous Materials
- D244 Test Methods for Emulsified Asphalts
- D977 Specification for Emulsified Asphalt
- D2397 Specification for Cationic Emulsified Asphalt
- D2995 Practice for Determining Application Rate of Bituminous Distributors

11.3.2 AEMA Documents

- **A Basic Asphalt Emulsion Manual**

The emulsion used for tack coat or fog seals shall conform to ASTM D977 for SS-1 or SS-1h, or to D2397 for CSS-1 or CSS-1h. Normally these emulsions are diluted prior to application to reduce viscosity for spraying, to allow filling of small cracks or voids, and to more accurately apply very small quantities of residual asphalt per square yard. For fog seal, the emulsion is normally of the slow setting type in order to properly flow into and seal small cracks or porous surfaces. Other emulsion grades may be used provided the same results are obtained and provided they are checked for dilution compatibility prior to dilution.

Some emulsions, especially rapid setting types, cannot be diluted with water and require dilution with specific chemical emulsifier solutions to produce stable dilutions. Some agencies accept the use of RS type emulsions for tack coat. These are not to be diluted with water and must be carefully diluted by the manufacturer's chemical solution under controlled conditions. Consult the emulsion manufacturer for assistance when using unfamiliar emulsions.

11.3.3 Sampling

Material samples shall be furnished by the contractor as directed by the engineer. Procedures for sampling shall be in accordance with ASTM D140, unless otherwise specified.

11.3.4 Testing

The emulsion shall be tested in accordance with ASTM D244.

11.4 Water

Water is normally used for diluting slow set emulsions for tack coat and fog seal. It should be clean, potable water, free from detectable solids or incompatible soluble salts. Test for dilution incompatibility, whenever in doubt, by diluting the emulsion in the severest conditions anticipated (e.g., high dilution, cold water, hard water, high shear pumps). No instability or coagulation should appear. Consult the emulsion supplier if there are any questions.



11.4.1 Other Methods of Dilution

When water is not desirable for emulsion dilution, a small amount of compatible emulsifier solution can be used. The emulsion manufacturer is the one most familiar with the particular emulsion and must be consulted to determine specific method and materials for dilution.

11.4.2 Diluting the Emulsion

When the emulsion is to be diluted for spray application, the final product shall be a fluid, homogenous mixture. The use of hard or cold water or an improper emulsifier solution may chemically or thermally break the emulsion. Dilution may be improved by pre-warming the dilution liquid to 25 to 50° C (77 to 122° F). Never add emulsion to water, always add water or other diluent to emulsion. Normal dilution for tack coat is achieved by diluting 1 part water to 1 part emulsion. For fog seal, dilutions are often higher. To avoid possible problems with storage stability, it is recommended that dilution be done at the time of application. Diluted emulsions are normally not stored, unless weather or the like necessitates temporary storage. A diluted emulsion is more unstable than the original product.

11.4.2.1 Consult your AEMA emulsion supplier for guidance on exact dilutions.

11.5 Storage and Handling

Suitable storage and handling facilities shall be provided for the emulsion, so as to:

1. Prevent contamination by water, oils or other liquids.
2. Prevent contamination by other incompatible emulsions.
3. Protect from freezing and boiling temperatures that break the emulsion and cause separation into asphalt and water.
4. Protect from local overheating caused by high temperature heating coils and surface heating pads. Use of hot water is recommended for heating emulsion. Where steam, hot oil or direct fire must be used, controls must keep coil surfaces below 85° C (185° F).
5. Use bottom loading wherever possible or employ full-length drop hose to eliminate foaming. Foaming may cause a volume gauge error.
6. Allow surface crust that may form on emulsion in storage to float without disturbance. Vertical tanks can help maintain constant and minimal surface area. Return lines into tanks should have outlets near the tank bottom and circulation should not free fall or disturb surface crust.
7. Reduce high shear that can break emulsions by enlarging clearances on new gear pumps by milling if necessary.
8. Prevent unnecessary circulation that can cause drop in emulsion viscosity and emulsion instability.
9. Do not agitate emulsion with forced air as it may cause the emulsion to break.



11.6 Equipment

11.6.1 Emulsion Distributor or Hand Sprayer

A properly calibrated emulsion distributor or a hand sprayer shall be used for spraying emulsions. ASTM D2995 can be used for distributor calibration. The distributor shall be free of any contaminants that can harm the emulsion.

11.6.2 Pump

A pump for continuous circulation of emulsion through the spray bar shall be provided. Pumps should have a greater clearance for use with emulsions than with other asphalts at least 0.76 mm (0.030 in.) to prevent over-shearing. This can cause breakdown of the emulsion particles, especially in their diluted form. Pressure created within the distributor should be as low as possible. Heat applied to the tank or spray bar shall not exceed 85° C (185° F) at any point, which would boil the emulsion and cause it to break, plugging the nozzles with asphalt.

11.6.3 Recommended Spray Nozzle Sizes

Recommended spray nozzle sizes are 3.2 to 4.8 mm (1/8 to 3/16 in.). Spray nozzle angles should be adjusted using nozzle wrench provided by equipment distributor or manufacturer and spray bar height adjusted to produce correct overlap. A hand sprayer should be used for applying small amounts of tack to cleaned potholes and utility cuts prior to filling or patching, as well as to small areas which cannot be sprayed by the distributor.

11.7 Preparation of Surface

11.7.1 Existing Surface

Existing surface shall be repaired as directed by the engineer prior to further construction. The emulsion will flow into the small cracks and seal them, but it cannot be expected to take the place of adequate repair of major deterioration of the pavement.

The surface shall be free from dust, loose or foreign matter and any objectionable material that would hinder adhesion of the emulsion. If the dust layer is minimal and brooming is not deemed necessary, a very light 0.68 L/m² (0.15 gal/yd²) spray of clean water prior to application can significantly improve adhesion of the tack coat or penetration into the surface cracks by the fog seal. Allow excess water to run off before applying emulsion. Parking lots or other areas with heavy oil drippings should be cleaned with detergent or by other methods prior to spraying with emulsions.

11.8 Weather

Spray application of emulsions should be avoided prior to probable rainfall and shall not be applied during rain. High humidity will slow the emulsion break. Pavement and air temperatures should be above 10° C (50° F). With extreme hot, dry conditions, it may be advantageous to lightly dampen the surface to be sprayed with 0.68 L/m² (0.15 gal/yd²) water to prevent premature break of the emulsion.



11.9 Application

11.9.1 Spraying

Emulsion applied by pressure distributor shall be applied at a uniform rate, without splattering or drilling from the spray bar, by using low pressure. Nozzle angle and spray bar height must be adjusted to insure correct spray pattern.

11.9.2 Application Rates for Tack Coat

See [Table 11-1 Suggested Application Rates Tack Coat](#).

11.9.3 Application Rates for Fog Seal

See [Table 11-2 Suggested Application Rates Fog Coat](#).

11.9.4 Objective.

11.9.4.1 Tack Coat

The objective for proper application rate of tack coat is to apply a uniform coverage of residual asphalt, sufficient to provide a thin, tacky, adhesive film, yet not in excess which would create runoff or a future slippage plane. To reduce localized fat spots of tack coat or to speed the break of the emulsion, the use of pneumatic-tired rollers on the freshly applied tack is recommended. The tack coat should be allowed to break before application of the overlay or surface treatment.

11.9.4.2 Fog Seal

The objective for proper application of fog seal is to apply a uniform coverage of emulsion, sufficient to flow into and seal the pavement pores, small cracks, and voids against water and weathering. Ideally, the peaks of most aggregate particles should remain uncoated with asphalt to prevent reduction of skid resistance. Two or more successive applications of the respective proportion of the desired total application can aid in preventing excess over-application. The distributor should be operated in opposite directions on each pass to minimize inconsistencies in spray pattern. Upon over-application and at the discretion of the supervising engineer, a light cover of clean, fine sand may be applied onto the uncured fog seal at the rate of 3.3 to 5.4 kg/m² (6 to 10 lb/yd²) to provide for a safe, skid resistant surface. A pass of a pneumatic tired roller should be made over this light sand dusting to firmly embed the fine sand. The fog seal should be allowed to completely cure before opening to traffic.

11.9.5 Traffic Control

Traffic control during application shall be employed to protect the freshly sprayed emulsion until it is overlaid or cured to a safe condition. Excessive pickup of the fresh emulsion by construction traffic shall be avoided especially with tack coat. Traffic volume should determine the type and extent of control needed, and safety is also a major factor, as the tack coat produces an extremely slippery film and fog seal, if overapplied, reduces skid resistance and creates unsafe conditions. Suitable methods

shall be used, such as signing, barricades, flagmen, pilot cars, etc. to protect the construction and the public.



Table 11-1 Suggested Application Rates Tack Coat

Rate of Dilution	Type of Surface to be Tack Coated	
	Dense Surface low absorption	Open Surface high absorption
% Emulsion (emulsion + water)	L/m ² (gal/yd ²)	L/m ² (gal/yd ²)
Net residual asphalt desired	0.09 to 0.18 (0.02 to 0.04)	0.14 to 0.27 (0.03 to 0.06)
0% (undiluted)	too low	0.22 to 0.44 (0.05 to 0.10)
75% (3 + 1)	too low	0.30 to 0.58 (0.06 to 0.13)
50% (1 + 1)	0.30 to 0.58 (0.06 to 0.13)	0.45 to 0.87 (0.10 to 0.19)
40% (2 + 3)	0.36 to 0.72 (0.08 to 0.16)	0.56 to 1.09 (0.12 to 0.24)

Table 11-2 Suggested Application Rates Fog Coat

Rate of Dilution	Type of Surface to be Fog Sealed	
	Dense Surface low absorption	Open Surface high absorption
% Emulsion (emulsion + water)	L/m ² (gal/yd ²)	L/m ² (gal/yd ²)
Net residual asphalt desired	0.04 to 0.14 (0.01 to 0.03)	0.13 to 0.22 (0.03 to 0.05)
50% (1 + 1)	0.14 to 0.49 (0.03 to 0.11)	0.42 to 1.03 (0.09 to 0.23)
40% (2 + 3)	0.18 to 0.55 (0.04 to 0.13)	0.52 to 1.29 (0.12 to 0.30)
25% (1 + 3)	0.26 to 0.90 (0.06 to 0.21)	0.84 to 2.06 (0.19 to 0.47)
20% (1 + 4)	0.32 to 1.13 (0.08 to 0.25)	1.05 to 2.58 (0.24 to 0.59)
16.7% (1 + 5)	0.39 to 1.35 (0.09 to 0.31)	too high
14.3% (1 + 6)	0.52 to 1.81 (0.12 to 0.41)	too high
12.5% (1 + 7)	0.58 to 2.03 (0.13 to 0.47)	too high