Tack Coat Guidelines

CALIFORNIA DEPARTMENT OF TRANSPORTATION
Division of Construction
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Comments or suggestions regarding this manual should be sent to:

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Contents

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These guidelines provide general tack coat material terminology, tack coat type, and grade selection criteria. They explain how to estimate the quantity of tack coat, how to determine tack coat application rates, how to sample and test tack coat, and how to measure and pay for tack coat. The guidelines do not address the chemistry of tack coat materials, storing and handling procedures, construction equipment, or materials testing.

The guidelines are prepared to serve as a general reference for Caltrans and industry personnel in the contract administration of hot mix asphalt pavement specifications. These guidelines are not contract documents and impose no obligations or requirements on contractors. Resident engineers and other Caltrans personnel who administer Caltrans contracts must never attempt to use these guidelines as a substitute or supplement to the *Standard Specifications* or other contract requirements and provisions.

Use these guidelines with the current Section 39-2, “Hot Mix Asphalt”; Section 92, “Asphalt Binders”; and Section 94, “Asphaltic Emulsions”; of the *Standard Specifications*, which can be found at:

https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications

1.0 GENERAL

A tack coat is a very light application of asphaltic emulsion or asphalt binder to an existing pavement surface or between layers of hot mix asphalt. A tack coat is used to assure a good bond:

- Between the existing pavement surface and the new hot mix asphalt overlay, including planed surfaces.
- Between the layers of each lift of hot mix asphalt.
- At any vertical surfaces that the new hot mix asphalt will be placed against, such as curbs, gutters, and construction joints.

A tack coat is not required before placing a chip seal. However, some chip seals require a flush coat of fog seal and sand cover on their surfaces.

A tack coat is not generally required before a slurry seal or a micro-surfacing application unless the existing pavement surface is extremely dry and raveled or is concrete pavement.

For a geosynthetic pavement interlayer, asphalt binder as tack coat is applied in accordance with Section 39-2, “Hot Mix Asphalt,” of the *Standard Specifications*. Do not allow the use of an emulsion. The asphalt binder tack coat used to bond the geosynthetic pavement interlayer is sufficient to provide the bond for the layer of hot mix asphalt that will placed over the geosynthetic pavement interlayer.

2.0 ESSENTIAL TERMINOLOGY

Anionic—Emulsified asphalt particles can be anionic, or negatively charged, and, in theory, should be used with aggregates carrying a positive charge. Absence of the letter “C” in an emulsion type denotes anionic emulsified asphalt particles. For example, SS-1 grade emulsion is anionic, and CSS-1 grade emulsion is cationic, or positively charged.

Cationic—Emulsified asphalt particles can be cationic and, in theory, should be used with aggregates carrying a negative charge. The type of emulsifying agent used in the asphaltic emulsion determines if the emulsion will be cationic or anionic. The principal difference in the two is that cationic emulsion gives up water faster. The letter “C” in the emulsion type denotes cationic emulsified asphalt particles. For example, SS-1 grade emulsion is anionic, and CSS-1 grade emulsion is cationic. Do not use cationic and anionic emulsions together.

Diluted Emulsion—An emulsion that has been diluted by adding an amount of water equal to or less than the total volume of emulsion.

Emulsion—Made of asphalt binder and water containing a small amount of emulsifying agent. For example, slow-setting grade emulsions contain as much as 43 percent water and additives, and rapid-setting grade emulsions contain as much as 45 percent water and additives.

Residual Asphalt—The amount of asphalt binder remaining on the pavement surface after all water has evaporated from an emulsion.

Tack Coat Break—When water separates from the emulsion and the color of the tack coat begins to change from brown to black.

Tack Coat Set—When water has completely evaporated from an emulsion leaving a thin film of asphalt binder on the pavement.

3.0 TACK COAT MATERIALS

Asphaltic Emulsion

Asphaltic emulsion consists of three basic ingredients: asphalt binder, water, and emulsifying agent. At times, asphaltic emulsions contain additives such as polymers. Polymers are either preblended with asphalt binder before emulsification or added as latex. Whenever the term emulsion is used in these guidelines, it means asphaltic emulsion.

Emulsions must comply with the requirements in Section 94, “Asphaltic Emulsions,” of the *Standard Specifications.*

Asphaltic Emulsion Notations

The following notations are typically used for identification of emulsion grades:

C Cationic, or positively charged, emulsified asphalt particles. If there is no **C** at the beginning of the emulsion grade, the emulsified asphalt particles are anionic and negatively charged.

SS Slow setting

RS Rapid setting

QS Quick setting

LM Latex modified

HF High float

PM Polymer modified

1 Low viscosity

2 High viscosity

H Hard grade asphalt, or low penetration

Figures 3-1a. through 3-1c. are examples of how these notations are used:

Figure 3-1a.

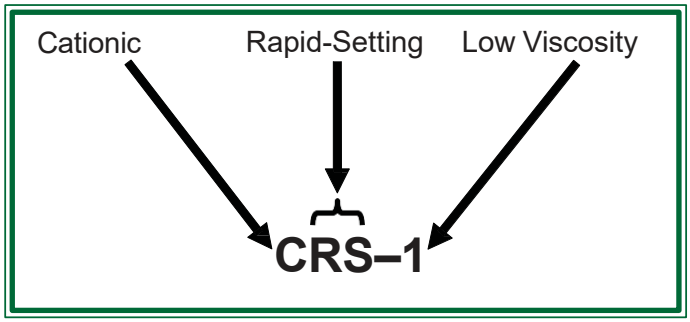


Figure 3-1b.

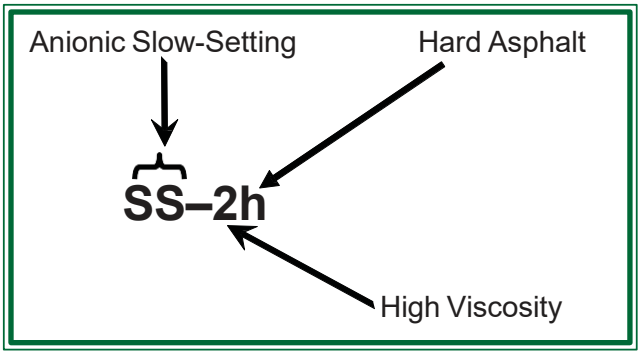
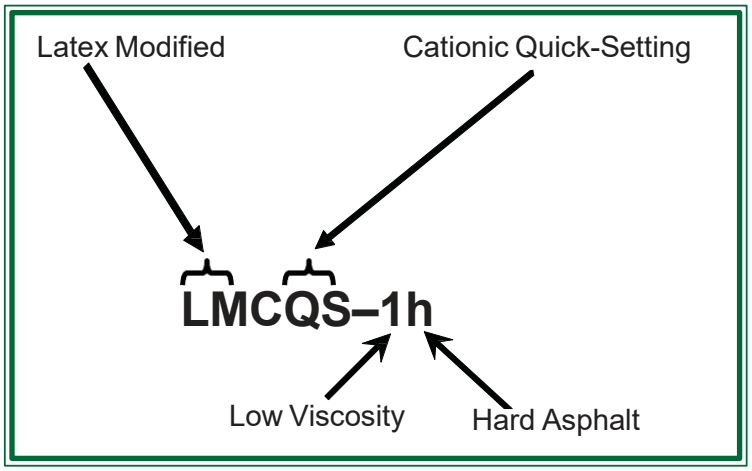


Figure 3-1c.



Emulsions are typically classified by how quickly they set, according to the following:

Slow-setting grades—Slow-setting grades of emulsion, used for tack coats are SS-1, SS-1h, CSS-1, and CSS-1h. Original slow-setting emulsions already contain a maximum of 43 percent water plus additives, and may be diluted with additional water.

Rapid-setting grades—Rapid-setting grades of emulsion, including polymer-modified emulsions, are RS-1, RS-2, CRS-1, CRS-2, PMRS-2, PMRS-2h, PMCRS-2, and PMCRS-2h. Rapid-setting emulsions already contain a maximum of 45 percent water plus additives, and must not be diluted with additional water.

Quick-setting grades—Quick-setting grades of emulsion used for tack coats are QS-1, QS-1h, CQS-1 and CQS-1h. Quick-setting emulsions used as a tack coat include an additive that reduces the setting time. Quick-setting emulsions already contain a maximum of 43 percent water plus additives, and may be diluted with additional water.

Asphalt Binder

The principal source of asphalt binders is the refining of crude oil. Asphalt binders must conform to the requirements in Section 92, “Asphalt Binders,” of the *Standard Specifications*. An asphalt binder, unlike emulsions, carries no charge. Asphalt binder may not be diluted with water. Any grade of asphalt binder is acceptable as tack coat

material. It is generally preferable that the grade of asphalt binder used in the hot mix asphalt for tack coat is used for the asphalt binder.

4.0 SELECTION OF TACK COAT MATERIAL

The contractor may use any emulsion or asphalt binder that conforms to the *Standard Specifications* for a tack coat. For emulsions, the rate of setting is dependent upon the type of emulsion, the amount of water added, the type and concentration of the emulsifying agent, and atmospheric conditions. Cationic emulsions should be used in areas with damp pavement, such as coastal areas, because they are less sensitive to moisture and temperature. If an emulsion is used as tack coat, cationic and anionic emulsions must not be used together.

Local contractor experience and manufacturer availability of tack coat material types and grades may dictate which type of material is ultimately selected by a contractor. The following information, based on contractor experience, is offered for each tack coat material type:

Slow-setting emulsions are most used by contractors for tack coat. However, they take longer to set than rapid-setting or quick-setting emulsions. For this reason, they are not recommended for use as a tack coat in relatively cool weather, at night, or when there is a short construction window.

Rapid-setting emulsions should be considered for use at night or in cooler weather since their break time is quicker than slow-setting emulsions. Rapid-setting emulsions typically have a higher viscosity than slow-setting emulsions, so uniform coverage is more difficult to achieve. Rapid-setting emulsions can stick to equipment tires rather than adhere to the surfaces to which they are applied, and cause tracking away from the treated area, because of the higher residual rate required for RS-1 and RS-2. Rapid-setting emulsion PMCRS-2 may cause “spider-webbing,” when number 1 nozzles are used with high pressure to obtain a low application rate.

Quick-setting emulsions are used for night work or work in cool weather as well as when rapid construction is needed. Quick-setting emulsions were originally designed for use in slurry seals and with micro-surfacing. Uniform tack coat coverage can be better obtained with quick-setting emulsions, which have lower viscosities than rapid-setting emulsions and can be diluted with water.

Asphalt binder is always used as a tack coat material when a geosynthetic pavement interlayer is placed. Asphalt binder should be considered for use for night work or in cooler weather. Asphalt binder is heated and applied at a much higher temperature than an emulsion. When the ambient temperature is above 85ºF, asphalt binder will easily adhere to equipment tires, so tracking may be a problem. Asphalt binder should not be used when the pavement surface is damp, dusty, or planed, because the binder will bead up and not penetrate the existing surface, preventing a good bond.

5.0 ESTIMATING TACK COAT QUANTITY

To check the estimated quantity of tack coat needed for a project, 3 factors are considered:

1. Number of layers in which a contractor will place the planned thickness of hot mix asphalt
2. Tack coat application rate
3. Area that will be paved as shown on the plans

Table 5-1., "Number of Layers for Hot Mix Asphalt Spreading and Compaction," provides a guide to determine the number of layers in which hot mix asphalt will be placed. For new construction, tack coat is not required for hot mix asphalt placed over aggregate base, so the number of layers should be reduced by one when determining the total number of layers requiring tack coat.

Table 5-1. Number of Layers for Hot Mix Asphalt Spreading and Compaction

Total Thickness Shown on Plans	Number of Layers
0.25 foot or less	1
0.26–0.50 foot	2
0.51–0.75 foot	3
0.76–1.00 foot	4

The tack coat application rate varies with the condition of the existing surface to which it is applied. In general, a tight or dense surface requires less tack coat than an open textured, raveled, or milled surface. A flushed or bleeding surface requires less tack coat than a dry or aged surface. The proper application rate also varies with the type of tack coat material used and the hot mix asphalt that will be placed as an overlay. Dense and gap-graded hot mix asphalt overlays require less tack coat than open-graded friction courses (OGFC) overlays.

Section 39-2.01C(3)(f), "Tack Coat," of the *Standard Specifications* specifies residual tack coat application rates for the different types of tack coat material and pavement surface condition. Because emulsions contain water, the tack coat application rates used by contractors are higher to achieve the minimum residual rates specified in Section 39, "Asphalt Concrete," of the *Standard Specifications*. Payment for emulsion

used as tack coat is based on the weight of residual asphalt. This is according to Section 39-2.01C(3)(f), “Tack Coat,” of the *Standard Specifications*.

For checking quantity of tack coat needed, use calculated minimum tack coat application rates shown in Tables 5-2a., “Tack Coat Application Rates for Estimating HMA Type A, and RHMA-G,” and 5-2b., “Tack Coat Application Rates for Estimating OGFC.” The tables are based on the application rates for RS-1, QS-1, and CQS-1 asphaltic emulsion, the highest minimum application rate for all emulsions and asphalt binder.

The minimum application rates in Tables 5-2a. and 5-2b. were calculated by dividing the highest residual rate shown in Section 39, “Asphalt Concrete,” of the *Standard Specifications* by the lowest percentage of residual by distillation, 55 percent for RS-1, in Section 94, “Asphaltic Emulsions,” of the *Standard Specifications*; for example: The residual rate of new HMA, .03, divided by 0.55 equals .05.

Table 5-2a. Tack Coat Application Rates for Estimating HMA Type A, and RHMA-G

Overlay Over	Minimum Application Rate (gal/sq yd)
New HMA between layers	0.05
Existing HMA and portland cement concrete pavement	0.07
Planed pavement	0.11
For a geosynthetic pavement interlayer	0.25 ±0.03 gal/sq yd of asphalt binder

Table 5-2b. Tack Coat Application Rates for Estimating OGFC

Overlay Over	Minimum Application Rate (gal/sq yd)
New HMA	0.07
Existing HMA and portland cement concrete pavement	0.11
Planed pavement	0.12

6.0 EMULSION DILUTION

Sometimes emulsion used for tack coats is diluted with water to increase the total volume of liquid while maintaining the same volume of asphalt within the emulsion. Dilution can help achieve a more uniform application without applying excessive residual amounts of asphalt. Caution should be used when emulsions are diluted, because problems can result from improper dilution. For example, excessive dilution of emulsion may cause delayed emulsion break. Other methods to obtain tack coat coverage, such as adjusting nozzle opening size or tack coat application pressure, should be investigated before dilution.

If an emulsion is diluted:

- The emulsion supplier, and not the contractor, should dilute the emulsion.
- Dilution may be as much as 1 part water to 1 part emulsion.
- Dilute only by adding water to the emulsion and not vice versa, which could cause the tack to break.
- Only slow-setting or quick-setting emulsions grades SS-1, SS-1h, CSS-1, CSS-1h, QS-1, CQS-1, QS-1h, and CQS-1h may be diluted.
- Diluted emulsions must be applied at higher application rates to obtain the specified residual asphalt rate.

Additional water added to an emulsion must be measured by either weight or metered so that a weight can be determined for the additional water. Payment for tack coat is made for the quantity of residual asphalt, not for the diluted emulsion. Do not pay for water that has been added to dilute the emulsion.

The dilution ratio of water to emulsion is determined by the contractor. In cooler weather, a dilution ratio of 0.5 parts water to 1 part emulsion may be appropriate. For milled pavement and warm ambient temperatures, a dilution ratio of 1:1 is appropriate. No dilution or a low dilution ratio is required when the pavement has high cross slopes and steep grades to avoid tack coat puddling and tack coat runoff.

For hot mix asphalt Type A, rubberized hot mix asphalt-gap graded, and OGFC, contractors must determine the tack coat application rate based on the dilution ratio to meet the specified minimum residual rate. To calculate the necessary application rate for a diluted emulsion to assure the specified residual rate, perform the following calculation:

Diluted emulsion application rate = (undiluted application rate) x (1 + water/emulsion)

To determine emulsion undiluted application rate based on emulsion type, use Table 5-2a. or 5-2b. in these guidelines.

Example 6.1

Diluted emulsion is CSS-1 (0.5 :1) ratio to be used for hot mix asphalt Type A between layers.

Diluted CSS-1 application rate = (undiluted application rate) x (1 + water/emulsion)

= (0.04 gal/sq yd x (1 + 0.5 /1) diluted CSS-1 application rate = 0.06 gal/sq yd

The diluted CSS-1 must be applied at a minimum application rate of 0.06 gal/sq yd to obtain the specified minimum residual rate.

For emulsion diluted (1:1 ratio), use Table 6-1a., “Application Rates for Diluted (1:1) Tack Coat HMA Type A, and RHMA-G,” as a guide to determine whether the approximate application rate meets the minimum residual rate specified in Section 39-2, “Hot Mix Asphalt,” of the *Standard Specifications*.

Table 6-1a. Minimum Application Rates for Diluted (1:1) Tack Coat HMA Type A, and RHMA-G

HMA applied	QS-1 / CQS-1 Asphaltic Emulsion	CSS-1 / CSS-1h SS-1 / SS-1h QS-1h / CQS-1h Asphaltic Emulsion
New HMA between layers	0.1	0.08
Existing HMA and portland cement concrete pavement	0.14	0.10
Planed pavement (See Note)	0.22	0.18

Note: In gallons per square yard. Use caution when application rates are more than 0.15 gal/sq yd because of potential tack coat puddling and runoff.

Table 6-1b. Minimum Application Rates for Diluted (1:1) Tack Coat OGFC

OGFC applied	QS-1 / CQS-1 Asphaltic Emulsion	CSS-1 / CSS-1h SS-1 / SS-1h QS-1h / CQS-1h Asphaltic Emulsion
New HMA	0.14	0.10
Existing HMA and portland cement concrete pavement (See note)	0.22	0.18
Planed pavement (See note)	0.24	0.22

Note: In gallons per square yard. Use caution when application rates are more than 0.15 gal/sq yd because of potential tack coat puddling and runoff.

7.0 SAMPLING AND TESTING TACK COAT MATERIALS

Obtain the required test report and certificate of compliance from each truckload of tack coat delivered to the project before the application of tack coat starts. Compare the test report with the specifications. Shipments may be used before sampling and testing if certificates of compliance and the test results accompanying them comply with the specifications.

During progress of the work, the contactor should take samples of tack coat materials in the presence of the engineer, who sends the samples to METS for testing. Shipments of rapid-setting and polymer-modified tack coat samples need to be expedited because the material has a shorter shelf life, typically 15 days, than other emulsions.

Requirements for sampling and testing emulsion and asphalt binder are provided in Table 6-1.13, “Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete,” in the *Construction Manual.*

General Sampling Details

- Take samples of emulsion in conformance with the requirements in American Association of State Highway and Transportation Officials (AASHTO) T40, “Standard Method of Test for Sampling Bituminous Materials,” Chapter 6, “Sampling and Testing,” of the *Construction Manual,* and California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.”
- Observe safety procedures. The distributor truck driver must do the sampling in the presence of the engineer. Obtain a split sample, 1 part to test and the other to store for potential dispute resolution.
- Sample each shipment of emulsion using new, clean, dry 2-quart plastic jugs.
- Sample asphalt binder daily using new, clean, dry 1-quart round friction-top containers.
- Samples are normally taken from the spray bar at the rear of the distributor. Observe that sufficient material has been drained off through the nozzle to allow for removal of any material lodged there before collecting the sample.
- Samples should be taken after one-third and not more than two-thirds of the load has been removed.
- Immediately after sampling, use only a dry clean cloth to clean the outside of the containers. Do not submerge sample containers in solvent or wipe containers with solvent saturated cloth.
- Attach a Form TL-0101, “Sample Identification Card” to each material sample in accordance with Chapter 6, “Sampling and Testing,” of the *Construction Manual* and instructions printed on the TL-0101 booklet. Protect the TL-0101 against moisture and stains.
- Provide the email address of the resident engineer on the TL-0101.
- If the original emulsion was diluted, provide the dilution rate on the TL-0101. Emulsion test results are meaningless if the dilution rate is unknown or incorrect.
- If contract special provisions include tack coat material requirements, provide the required testing information on the TL-0101.
- Rapid-setting and polymer-modified emulsion has a shelf life, so it is important that samples be sent to METS daily.

- Store all samples in a cool environment, and do not allow samples to roll around or to be shaken during transportation.
- Send samples by commercial parcel delivery for testing to METS:

  Materials Engineering and Testing Services
  Office of Flexible Pavement Materials, MS-5
  5900 Folsom Boulevard
  Sacramento, CA 95819-4612

- Always prepay shipping for samples.

General Testing Details

Asphalt binder will be tested for compliance with Section 92, “Asphalt Binders,” of the *Standard Specifications*.

Emulsion will be tested for compliance with Section 94, “Asphaltic Emulsions,” of the *Standard Specifications*.

To expedite return of test results, test results are emailed or faxed to resident engineers. Failing test results are sent the same day the test is completed.

8.0 TACK COAT APPLICATION

The amount of asphalt binder left on the pavement surface is the most important factor in obtaining a bond between the existing pavement surface and the new hot mix asphalt overlay. Consequently, the application rate for an emulsion used as a tack coat should be based on the desired residual amount of asphalt binder. It is important to differentiate between the 2 spread rate types:

Tack Coat Residual Rate—The amount of asphalt binder remaining on the pavement surface after the water has evaporated from an emulsion.

Tack Coat Application Rate—The amount of asphalt binder or emulsion sprayed from the distributor.

Section 39, “Asphalt Concrete,” of the *Standard Specifications* specifies residual tack coat spread rates for the different types of tack coat material. When asphalt binder is used for tack coat, the residual amount of asphalt on the pavement surface will be the same as the applied rate, because there is no water to evaporate from the asphalt binder. Because emulsions contain water, the tack coat application rates used by contractors must be higher than the residual tack coat spread rates specified in Section 39. Tack coat residual rates in gallons for each square yard are shown in Table 8-1a., “Tack Coat Residual Rates HMA Type A, and RHMA-G.**”** and Table 8-1b., “Tack Coat Residual Rates OGFC.**”**

Table 8-1a. Minimum Tack Coat Residual Rates HMA Type A and RHMA-G

HMA over:	CSS-1/CSS-1h SS-1/ SS-1h and QS-1h/ CQS-1h Asphaltic Emulsion	RS-1/RS-2 and QS-1/CQS-1 Asphaltic Emulsion	Asphalt Binder and PMRS-2/PMCRS-2 and PMRS-2h/PMCRS-2h Asphaltic Emulsion
New HMA between layers	0.02	0.03	0.02
Existing HMA and portland cement concrete pavement	0.03	0.04	0.03
Planed pavement	0.05	0.06	0.04

Note: In gallons per square yard.

Table 8-1b. Tack Coat Residual Rates OGFC

OGFC over:	CSS-1/CSS-1h SS-1/SS-1h and QS-1h/CQS-1h Asphaltic Emulsion	RS-1/RS-2 and QS-1/ CQS-1 Asphaltic Emulsion	Asphalt Binder and PMRS-2/PMCRS-2 and PMRS-2h/PMCRS-2h Asphaltic Emulsion
New HMA	0.03	0.04	0.03
Existing HMA and portland cement concrete pavement	0.05	0.06	0.04
Planed pavement	0.06	0.07	0.05

Note: In gallons per square yard.

The specified minimum residual rates for QS-1h and CQS-1h are lower than QS-1 and CQS-1, because QS-1h and CQS-1h are made with a harder base asphalt. Harder base asphalt will provide more cohesion and stronger bonding for the tack coat. The specified minimum residual rates for CSS-1 and SS-1 are lower than RS-1 and RS-2, because RS-1 and RS-2 emulsions break much more quickly than CSS-1 and SS-1. Therefore, more volume of RS-1 or RS-2 is required to obtain uniform coverage. For CSS-1 and SS-1, contractors typically dilute SS-1 and CSS-1 for improved uniform spreading, but RS-1 and RS-2 emulsions cannot be diluted to improve uniform spreading.

For undiluted emulsions, tack coat application rates shown in Tables 8-2a., “Tack Coat Application Rates HMA Type A, and RHMA-G,” and 8-2b., “Tack Coat Application Rates OGFC,” have been calculated based on the minimum percentage of residual by evaporation or distillation shown in Section 94, “Asphaltic Emulsions,” of the *Standard Specifications* and the minimum residual rates shown in Tables 8-1a. and 8-1b., “Tack Coat Residual Rates.” The contractor and hot mix asphalt inspector should verify that the minimum tack coat application rates shown in Tables 8-2a. and 8-2b., “Tack Coat Application Rates,” are used to assure that minimum specified residual application rate is achieved. For tack coat application rates for diluted emulsion see Section 6.0, “Emulsion Dilution,” in these guidelines.

Table 8-2a. Minimum Tack Coat Application Rates HMA Type A, and RHMA-G

HMA over:	CSS-1/CSS-1h, SS-1/SS-1h and QS-1h/CQS-1h Asphaltic Emulsion	RS-1/QS-1/ CQS-1 Asphaltic Emulsion	RS-2 Asphaltic Emulsion	PMRS-2/PMCRS-2 and PMRS-2h/ PMCRS-2h Asphaltic Emulsion	Asphalt Binder
New HMA between layers	0.04	0.05	0.05	0.03	0.02
Existing HMA and portland cement concrete pavement	0.05	0.07	0.06	0.05	0.03
Planed pavement	0.09	0.11	0.10	0.06	0.04

Note: In gallons per square yard.

Table 8-2b. Minimum Tack Coat Application Rates OGFC

OGFC over:	CSS-1/CSS-1h, SS-1/SS-1h and QS-1h/CQS-1h Asphaltic Emulsion	RS-1/QS-1/ CQS-1 Asphaltic Emulsion	RS-2 Asphaltic Emulsion	PMRS-2/PMCRS-2 and PMRS-2h/ PMCRS-2h Asphaltic Emulsion	Asphalt Binder
New HMA	0.05	0.07	0.06	0.05	0.03
Existing HMA and portland cement concrete pavement	0.09	0.11	0.10	0.06	0.04
Planed pavement	0.11	0.12	0.11	0.08	0.05

Note: In gallons per square yard.

Where to Apply Tack Coat

Tack coat is applied to existing pavement including planed surfaces, between hot mix asphalt layers, and to vertical surfaces of curbs, gutters, construction joints, dig outs, and milled pavements.

Additional Tack Coat Requirements

- Check that the residual tack coat rate will thoroughly coat a vertical face without running off.
- Authorize, when the contractor requests in writing, a change in specified tack coat residual rates.
- Immediately before hot mix asphalt is placed, check that additional tack coat is applied to damaged areas or where loose or extraneous material is removed.
- Check that areas receiving tack coat are closed to traffic and that tack coat is not tracked onto pavement surfaces beyond the project site.
- Verify that the temperature of asphalt binder tack coat is 285ºF to 350ºF when applied.
- When geosynthetic pavement interlayer is used, verify that asphalt binder as tack coat is applied in accordance with Section 39-2.01C(3)(g) “Geosynthetic Pavement Interlayer,” of the *Standard Specifications*.
- If requested by the contractor, authorize waiving the application of tack coat between hot mix asphalt layers when both of the following apply:
    - The surface to be paved does not have a film of dust or clay that could prevent bonding.
    - The surface to be paved is 140ºF or hotter.

Where Not to Apply Tack Coat

Tack coat application must be limited to an area that can be covered in the same day’s paving. It should not be applied to a sticky surface.

For bituminous seals, a tack coat is not required before placing a chip seal. However, a chip seal should receive a flush coat, a fog seal, and sand cover on its surface.

A tack coat is generally not required before a slurry seal or micro-surfacing application unless the existing surface is extremely dry and raveled or is concrete pavement.

Placement Considerations for Tack Coat

When tack coat is applied, use the following guidance to assure a proper placement:

Figure 8-1. A spreader applies tack coat.

- Check that the surface is free of dirt or dust, which will inhibit bonding of the tack coat, and may create a slippage plane. A fine dust coating can occur overnight; a sweeper should be used to remove the dust. In some parts of the state, liquid agricultural waste spilled on the surface, for example, juice from tomatoes leaked on highway during harvesting season, may need to be removed by washing before tack coat application. When washing of surface is required, water pollution control best management practices may be required.
- Obtain the required test report and certificate of compliance from each truckload of emulsion or asphalt binder before the application of tack coat starts. Compare the test report with the specifications. Shipments may be used before sampling and testing if certificates of compliance and the test results accompanying them comply with the specifications.
- Obtain initial weighmaster certificates from each load of emulsion or asphalt binder. For diluted emulsions, obtain weight or meter readings to determine the emulsion dilution ratio and pay quantity. If partial loads were used, collect weigh-back slips to determine pay quantities.
- Verify that the application is uniform. Distributor application rates are dependent upon pump rates and speed of the truck.

Figure 8-2. Set the height of the spray bar high enough above the roadway for the surface to receive double or triple coverage.

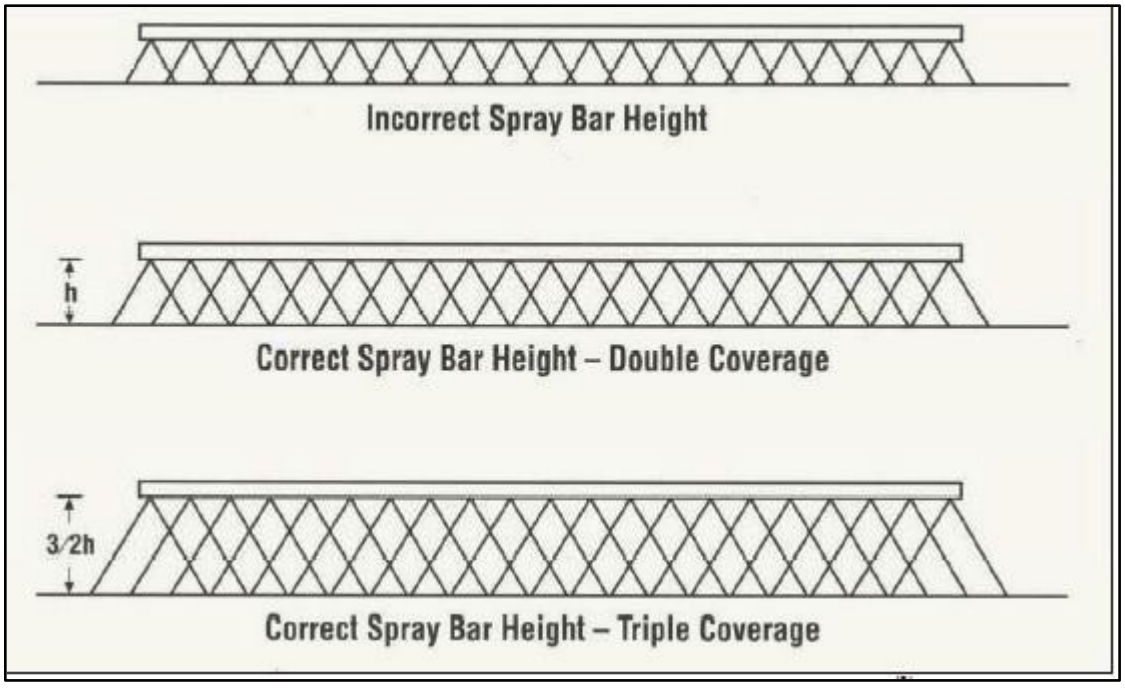


Figure 8-3. The spray bar should be set high enough to get double or triple coverage.

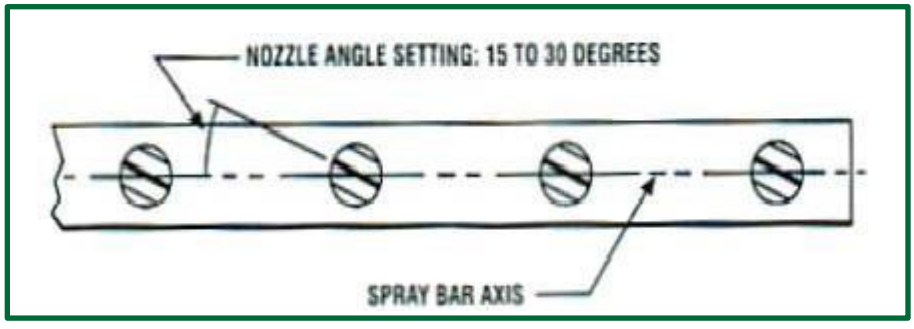


Figure 8-4. Set the spray bar nozzles at an angle between 15º and 30º.

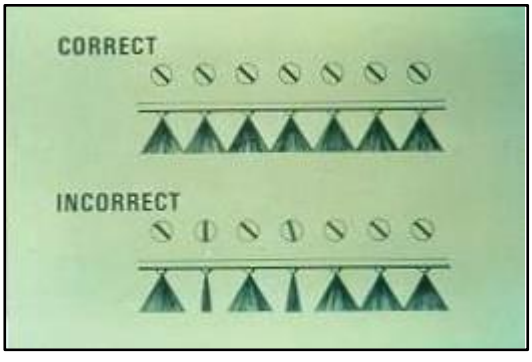


Figure 8-5. Streaking and puddling, two extremes of application, indicate improper spread rates or improper height of the spray bar.

Figure 8-6. Poor, left, versus good, right, tack coat coverage. Note streaky coverage of poor coat and nearly complete coverage of good coat.

- Test in accordance with California Test 339, “Method of Test for the Determination of the Distributor Spread Rate.” Work with the distributor truck driver to complete the following procedure:
  1. Record the weight of a 1-square-yard pan or nonwoven geotextile materials.
  2. Place the pan or geotextile on the road surface.

3. Have the distributor apply the tack coat over the pan or geotextile.
4. Record the weight of the pan and tack coat or the geotextile with tack coat.
5. Record the temperature of the tack coat.
6. Subtract the tare weight to determine the weight of tack coat.
7. Convert the weight of tack coat to application rate, using the table at the end of Section 94, “Asphaltic Emulsions,” of the *Standard Specifications*.
8. Correct the calculated application rate using temperature correction multiplier found in the table at the end of Section 94.
9. Calculate the tack coat residual application rate using the residual percentages shown in the tables in Section 94.
10. If the minimum residual rate for the grade of emulsion and for the condition of the underlying surface does not meet the specification requirement, have the contractor adjust the application rate and retest.

Example 8.1

If you run a distributor spread rate test for undiluted SS1-h emulsion and find that the weight of the empty 1 square yard of the non-woven geotextile material is 0.45 pounds and that the weight of the saturated geotextile is 1.15 pounds at 80ºF, the weight of the sprayed tack coat = 1.15 - 0.45 = 0.7 lb.

Section 94-1.04, “Payment” of the *Standard Specifications*, indicates 1 gallon of asphaltic emulsion at 60ºF equals 8.33 pounds.

The application rate = 0.7 lb ÷ 8.33 lb/gal = 0.084 gal/sq yd

Using a 0.99500 temperature correction multiplier found in the table in Section 94, you see that the corrected application rate = 0.084 x 0.99500 = 0.0836, or 0.08 gal/sq yd at 60ºF.

To determine the residual application rate, use the table in Section 94-1.02B, “Slow-Setting Anionic Asphaltic Emulsions,” of the *Standard Specifications*. The column for slow-setting grade SS-1h shows the residue by distillation to be 57 percent. To determine the residual asphalt application rate calculate the following:

Tack coat residual application rate = (actual application rate) x (percentage residual)

= .0836 gal/sq yd x .57

= .0476 gal/sq yd tack coat residual application rate = .05 gal/sq yd

An alternative method of measuring spread rate uses the distributor dipstick or the meter on the pump to measure the volume in gallons that was applied, as follows:

1. After the distributor is parked on level ground, measure and record the number of gallons of tack coat.
2. Measure off a known area for a test section.
3. Have the distributor apply tack coat to the test section.
4. After the distributor is again parked on level ground, re-measure the tack coat in the distributor.
5. Subtract the second measurement from the first to determine the volume of tack coat applied.

6. Record the temperature of the tack coat in the distributor.
7. Determine the application rate in gal/sq yd by dividing the amount of tack coat applied by the test area (using feet, [length x width] ÷ 9 = square yards).
8. Using the temperature correction multiplier found in Conversion Table in Section 94-1.04, "Payment," of the *Standard Specifications*, calculate the application rate.
9. Calculate the tack coat residual application rate using the residue percentages from the appropriate table in Section 94, "Asphaltic Emulsions," of the *Standard Specifications*.
10. If the minimum residual rate for the grade of emulsion and for the condition of the underlying surface does not meet the specification requirement, ask the contractor to adjust the application rate and retest. Note the request on the daily report.

Example 8.2

Run a distributor spread rate test for PMCRS-2 emulsion first by determining that the distributor is loaded with emulsion and that the volume of the emulsion in the tank of the distributor is 500 gallons.

The area sprayed with the emulsion was 3,600 square feet (3,600 sq ft ÷ 9 = 400 sq yd), and the remaining emulsion in the tank was 475 gal at 70ºF. The volume of the sprayed emulsion = 500 – 475 = 25 gallons at 70ºF.

The application rate = 25 gal ÷ 400 sq yd = 0.062 gal/sq yd at 70ºF.

A 0.99750 temperature correction multiplier found in "Conversion Table," at the end of Section 94-1.04, "Payment,"," of the *Standard Specifications,* shows that the corrected application rate = 0.062 x 0.99750 = 0.0618 or 0.06 gal/sq yd at 60ºF.

To determine the residual application rate, use the table in Section 94-1.02F, "Rapid-Setting Polymer-Modified Asphaltic Emulsions," of the *Standard Specifications*. The columns for cationic grade PMCRS-2 show the residue by evaporation to be 65 percent for PMCRS-2. To determine the residual asphalt application rate, calculate the following:

Tack coat residual application rate = (actual application rate) x (percentage residual)

= .0618 gal/sq yd x 0.65

= 0.0401 gal/sq yd tack coat residual application rate = 0.04 gal/sq yd

Verify that tack coat integrity is maintained until the paving is complete. Additional activities include:

- Making sure that the contractor blots excessive tack coat by applying sand and using a pneumatic-tire roller to prevent excessive tack coat from acting as a slip plane.
- Verifying that the tack coat has broken before paving or, if the contractor chooses to pave before the tack coat has broken, that tracking is minimized.

Figure 8-7. The brown color indicates that the freshly placed emulsion tack coat has not yet broken.

Figure 8-8. The same tack coat 23 minutes later. The brown color now appears in splotches, indicating it is beginning to break.

Figure 8-9. Tack coat using an asphalt emulsion. The black color indicates it has broken.

- When tracking of tack coat materials by vehicle tires occurs, ask the contractor to clean the affected areas and reapply the tack coat before resuming paving operations.

Figure 8-10. Tack coat tracking resulting in no tack coat in the wheel path.

- Contractors must clean tack coat tracked onto adjacent structures or concrete pavement.
- For safety reasons, keep traffic off tack coat surface. If traffic must use the surface where tack coat has been applied, request application of a sand cover or other appropriate actions to provide adequate skid resistance.
- Make sure sand is reapplied if it rains on a newly placed tack coat, because the tack coat can become slick. If sand is unavailable for reapplication, lanes must remain closed during inclement weather. If sand is applied to the tack coat to keep lanes open, the pavement

must be swept or flushed with water to remove the sand before the tack coat is reapplied and paving operations resume.

- Sample and test tack coat material in accordance with the frequency in Table 6-1.13., "Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39)," of the *Construction Manual.*
- Verify the tack coat application rate daily by an application test section or by calculation based on tack coat placed versus area covered.

9.0 MEASUREMENT AND PAYMENT

Emulsion and asphalt binder are measured for payment by weight, and the unit of weight is the ton. Note that payment for asphaltic emulsion used as a tack coat is made for the weight of residual in the emulsion, not for the water in the emulsion. When asphaltic emulsion is used for tack coat, do not pay for any water that has been added to the emulsion.

The hot mix asphalt paving inspector should collect initial weighmaster certificates from each load of emulsion or asphalt binder and, if partial loads were used, collect weigh-back slips or certificates to determine pay quantities. The paving inspector should sign all weighmaster certificates to indicate that the material represented thereon was incorporated in the work.

When partial loads of emulsion or asphalt binder are used for tack coat, and no scales are located within 20 miles of the job site, the weight of the emulsion and asphalt binder remaining on the distributor can be determined from volumetric measurements. The unit of volume is the gallon. To determine the volume of material used, stab the tank after spreading or read the vehicle tank meter, to determine the temperature of the remaining material. It is important to record the temperature of the material to be able to convert the volume of the material at any other temperature to the volume it would occupy at 60°F. The volume of the asphalt emulsion or asphalt binder at 60°F is then converted to weight. See the requirements in Section 92-1.04, “Payment,” of the *Standard Specifications* for asphalt binder or Section 94-1.04, “Payment,” for asphalt emulsions.

Example 9.1a

A partial load of anionic slow-setting diluted 1:1 ratio emulsion was used for a tack coat and no scales are located within 20 miles of the job site. The difference in the vehicle tank meter before and after spreading the tack coat is 130 gallons. The temperature of the emulsion is 122°F. Calculate the pay quantity for the tack coat.

It is determined from the Conversion Table in Section 94-1.04 of the *Standard Specifications* that the multiplier for converting the volume of the emulsion at 122°F to the volume it would occupy at 60°F is 0.98450. Therefore, the volume of emulsion used is calculated as follows:

Volume of emulsion = 130 gal x 0.98450 = 127.985 volume of emulsion = 128 gal

Section 94-1.04 gives the density of emulsion at 60°F as 240 gal/ton.

Weight of emulsion = 128 gal ÷ 240 gal/ton weight of emulsion = 0.5333 tons

However, because the slow-setting emulsion was diluted 1:1 with water and no payment is allowed for the additional water, the final pay quantity is calculated as follows:

Asphaltic emulsion quantity = 0.5333 tons x 0.50 (emulsion to water ratio) = 0.2667 asphaltic emulsion quantity = 0.27 tons

Payment is made for the weight of residual in the asphaltic emulsion not the water in the emulsion. In this example, an anionic slow-setting emulsion was used. For slow setting anionic emulsion, Section 94-1.02B, “Slow-Setting Anionic Asphaltic Emulsion Requirements,” lists that the residue from evaporation, or distillation minimum requirement, is 57 percent.

Tack coat quantity for payment = 0.27 tons x 0.57 = 0.15 tons

Example 9.1b

If a partial load of slow-setting emulsion was used for a tack coat and scales were located within 20 miles of the job site, the weigh-back slips or weighmaster certificates would have shown directly that approximately 0.53 ton of emulsion was spread. The emulsion was diluted 1:1 with additional water, but the asphaltic emulsion quantity would still be 0.27 tons.

And tack coat quantity for payment would still be = 0.27 x 0.57 = 0.15 tons

Example 9.2

A partial load of anionic slow-setting diluted (0.5:1) emulsion is used for tack coat, and no scales are located within 20 miles of the job site. The difference in the vehicle tank meter before and after spreading the tack coat is 221 gallons. The temperature of the emulsion is 122°F.

It is determined from the Conversion Table in Section 94-1.04, “Payment,” of the *Standard Specifications* that the multiplier for converting the volume of the emulsion at 122°F to the volume it would occupy at 60°F is 0.98450. Therefore, the volume of emulsion used is calculated as follows:

Volume of emulsion = 221 gal x 0.98450 = 217.574 volume of emulsion = 218 gallons

Section 94-1.04 gives the density of emulsion at 60°F as 240 gallons per ton.

Weight of Emulsion = 218 gallons ÷ 240 gal/ton weight of emulsion = .9083 tons

However, because the slow-setting emulsion was diluted 0.5 :1 (1 ÷ 1.5 = 0.67 emulsion ratio) with water and no payment is allowed for the additional water, the final pay quantity is calculated as follows:

Asphaltic emulsion quantity = 0.9083 tons x 0.67 (emulsion ratio) = 0.6086 = 0.61 tons. From Section 94-1.02B, “Slow Setting Anionic Asphaltic Emulsion Requirements,” of the *Standard Specifications,* residue from evaporation, or distillation requirement minimum is 57 percent.

Tack coat final pay quantity = 0.61 x 0.57= 0.35 tons

Example 9.3

A partial load of PG 64-10 asphalt binder is used for a tack coat, and no scales are located within 20 miles of the job site. The difference in the vehicle tank meter before and after spreading the tack coat is 130 gallons, and the temperature of the asphalt binder is 321°F. The density of PG 64-10 at 60°F is determined to be 63.6 pounds per cubic foot (pcf). Determine the payment quantity of tack coat placed.

According to the Conversion Table in Section 92-1.04, “Payment” the “A” multiplier used for reducing volumes of asphalt with a density greater than 60.3 pcf to the volume it would occupy at 60°F is 0.9118 at 321°F.

Therefore, the volume of asphalt binder used is calculated as follows:

Volume of asphalt binder = 130 gallons x 0.9118 = 118.534 volume of asphalt binder = 119 gallons

Tack coat quantity = 119 gallons ÷ 235 gal/ton weight of asphalt binder = 0.5064 tons
tack coat quantity = 0.51 tons

10.0 COMPENSATION ADJUSTMENT FOR PRICE INDEX FLUCTUATIONS FOR ASPHALT

Both emulsions and asphalt binder used for tack coats are eligible for asphalt price adjustment if the price of asphalt increases or decreases more than 5 percent based on the California Statewide Paving Asphalt Price Index. Before making any adjustments, the engineer verifies that the project's special provisions allow the adjustment and other requirements. The engineer will use the residual percentage specified in Section 94, "Asphaltic Emulsions," of the *Standard Specifications* to determine the quantity of asphalt in an emulsion subject to adjustment. The contractor may provide daily test results for actual percentage of asphalt residue in emulsions used as tack coat.

For asphaltic emulsion and asphalt binder used as tack coat, the quantity used to calculate compensation for paving asphalt price fluctuation adjustment will be the same quantity of tack coat paid in the contract item for tack coat.