
USACE / NAVFAC / AFCEC UFGS-32 12 13 (May 2024)

Preparing Activity: USACE

Superseding
UFGS-32 12 13 (May 2017)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

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SECTION 32 12 13

BITUMINOUS TACK[AND][PRIME] COATS 05/24

NOTE: This guide specification covers the requirements for bituminous tack and prime coats for airfield pavements, roads, parking areas and general paving needs.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Prime coats are a tailoring option and should be selected when required. Prime coats are required for Navy projects. If the designer for Army or Air Force projects chooses not to specify a prime coat at the time of design, remove the tailoring option for prime coat within this section. Generally a prime coat should be used but may be deleted in certain situations. For example, the prime coat may be deleted when it is necessary to reduce construction time or when a drainage layer is used underneath the hot mix asphalt. The primary purpose of prime coat is to protect the underlying layers from wet or inclement weather by providing a temporary waterproofing layer. Additional benefits from prime coat are stabilizing or binding the surface fines together and promoting bond to the asphalt pavement layers above, as well as acting as a dust palliative. It is recommended to specify asphalt prime coats when using thinner lifts (less than 4 inches) or when the construction sequence is such that the compacted base course will carry light

traffic. Moreover, conditions where a prime coat may be beneficial include: preventing lateral movement of the unbound base during pavement construction, reducing lateral movement of the asphalt mixture during compaction over the unbound material, waterproofing during pavement construction, and forming a tight base to which the asphalt pavement will adhere. Indicate prime coat on Drawings (typically on the pavement cross-sections) as well as specifying them herein.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a [Criteria Change Request \(CCR\)](#).

PART 1 GENERAL

[1.1 UNIT PRICES

NOTE: Delete unit price paragraphs when lump sum bidding is used. Edit submittal requirements accordingly.

1.1.1 Measurement

NOTE: The quantity of material will be the quantity of residual asphalt.

Payment for the bituminous material is to be paid from measured quantities of residual bituminous material used in the accepted work, provided that the measured quantities are not 10 percent over the specified quantities. Accepted work and measured quantities will be determined by the Government. Deductions from the measured quantities are applicable for any amount of bituminous material more than 10 percent over the specified quantity. For bituminous materials, express measured quantities in [metric tons](#) [2000 pound tons](#) [liters](#) at [15.6 degrees C](#) [gallons](#) at [60 degrees F](#). Correct volumes measured at temperatures other than [15.6 degrees C](#) [60 degrees F](#) in accordance with [ASTM D1250](#) using a coefficient of expansion of [0.00045 per degree C](#) [0.00025 per degree F](#) for asphalt emulsion. Dilution water added to emulsified asphalt will not be measured for payment.

1.1.2 Payment

The quantities of bituminous material, determined as specified above, will be paid for at the respective contract unit prices. Payment will constitute full compensation for all operations necessary to complete the work as specified herein.

1.1.3 [Waybills and Delivery Tickets](#)

Submit waybills and delivery tickets, during progress of the work. Before the final payment is allowed, file with the Contracting Officer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the Contract.

]1.2 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D8	(2022a) Standard Terminology Relating to Materials for Roads and Pavements
ASTM D88/D88M	(2007; R 2009; E 2019) Standard Test Method for Saybolt Viscosity
ASTM D140/D140M	(2016) Standard Practice for Sampling Asphalt Materials
ASTM D946/D946M	(2020) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D977	(2020) Standard Specification for Emulsified Asphalt
ASTM D1250	(2019; E 2020) Standard Guide for Use of the Joint API and ASTM Adjunct for Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils: API MPMS Chapter 11.1
ASTM D2027/D2027M	(2019) Cutback Asphalt (Medium-Curing Type)
ASTM D2028/D2028M	(2015; R 2021) Cutback Asphalt (Rapid-Curing Type)
ASTM D2170/D2170M	(2018) Standard Test Method for Kinematic

Viscosity of Asphalts (Bitumens)

ASTM D2397/D2397M	(2020) Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	(2023) Determining Application Rate of Bituminous Distributors
ASTM D6373	(2023) Standard Specification for Performance Graded Asphalt Binder

1.3 DEFINITIONS

See [ASTM D8](#) for more definitions relating to this specification.

1.3.1 Prime Coat

Application of a low-viscosity asphalt material to an absorptive surface, such as an unbound granular layer, designed to penetrate, bond, temporarily weatherproof, and stabilize this existing surface and to promote adhesion between it and construction course that follows.

1.3.2 Tack Coat

Tack Coat is also referred to as bond coat. Tack coat is an application of bituminous material to an existing relatively nonabsorptive surface, such as existing densely graded asphalt mixture (milled or new), to provide a thorough bond between old and new surfacing.

1.3.3 Emulsion

Emulsion is also known as emulsified asphalt or asphalt emulsion. Mostly made of paving grade asphalt binder and water containing a small amount of emulsifying agent. Emulsifying agent may also be referred to as a surfactant. The purpose of the surfactant is to prevent the coalescence of the asphalt droplets and to keep them suspended independently in the water. Surfactants used in the emulsions can be produced with positive or negative charges resulting in anionic or cationic emulsions.

1.3.4 Diluted Emulsion

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

1.3.5 Residual Asphalt

The amount of asphalt binder remaining after all water has evaporated from an asphalt emulsion.

1.3.6 Shot Rate

Shot rate, also referred to as bar rate, is the application rate set by the computerized control system in the bituminous distributor for the cutback asphalt, asphalt binder, or the asphalt emulsion. This value is typically represented by units of $1/m^2$ g/yd².

1.3.7 Emulsion Break

Emulsion break, also referred to as break or breaking, is the initiation

of asphalt binder droplets coalescing and water separating within the emulsion, at which point color begins to change from brown to black.

1.3.8 Emulsion Set

Emulsion set, also referred to as cure or curing, is the completion of emulsion breaking when water has evaporated, leaving behind a thin film of asphalt binder residue.

1.3.9 Certificate of Analysis (COA)

The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications.

1.3.10 Certificate of Compliance (COC)

The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. Provide signed COC by the manufacturer's authorized representative. The COC may also be referred to as the Bill of Lading.

1.3.11 Screenings

Screenings are a uniformly sized, fine, sandy material with some silt particles. The term screening is used to designate the finer fraction of crushed stone that accumulates after primary and secondary crushing and separation on a 4.75mm No. 4 sieve. Screenings commonly range in particle size from 3.2 mm 1/8 in down to finer than 0.075 mm No. 200 sieve. The size distribution, particle shape, and other physical properties can be somewhat different from one quarry location to another, depending on the geological source of the rock quarried, the crushing equipment used, and the method used for coarse aggregate separation. Screenings generally contain freshly fractured faces, have a fairly uniform gradation, and do not usually contain large quantities of plastic fines.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for

Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Equipment; G, [_____]

Distributor Radar or Distance Measurement Instrument (DMI)
Calibration; G, [_____]

SD-03 Product Data

Waybills and Delivery Tickets

Prime Coat Certificate Of Analysis (COA); G, [_____]

Tack Coat Certificate Of Analysis (COA); G, [_____]

SD-06 Test Reports

Sampling and Testing

Application Rate Calibration; G, [_____]

Daily Application Rate Verification

SD-07 Certificates

Certificates Of Compliance (COC)

1.5 DELIVERY, STORAGE, AND HANDLING

NOTE: If specifying asphalt emulsions, keep bracketed text. Cutback asphalt and asphalt binder can be reheated to the appropriate application temperature with minimal impact to the material.

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with minimal handling.[Do not allow asphalt emulsions to freeze or boil during transport or storage. Asphalt emulsions, if allowed to freeze or boil, may cause the asphalt emulsion to

break. Remove this material from site if allowed to freeze or boil.]

1.6 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. A limited amount of moisture (approximately 0.14 liter/square meter 0.03 gallon/square yard) can be sprayed on the surface of unbound material when prime coat is used to improve coverage and penetration of asphalt material. Apply bituminous coat only when the atmospheric temperature in the shade is 4 degrees C 40 degrees F or above and when the temperature has not been below 2 degrees C 35 degrees F for the 12 hours prior to application, unless otherwise directed.

PART 2 PRODUCTS

2.1 EQUIPMENT

Submit equipment, tools and machines used in the work. Maintain the equipment in satisfactory working condition at all times.

2.1.1 Bituminous Distributor

Provide a self propelled pressure distributor with pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the surface being sprayed. Provide a bituminous distributor capable of circulating and agitating the bituminous material during the heating process. The distributor truck is required to have a ground speed control device (radar or contact-wheel: DMI) interconnected with the asphalt pump such that the desired application rate will be supplied at any speed. Include with the distributor equipment a tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose or wand attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. A uniform double or triple overlap is required to be produced by the equipped spray bar. Equip the distributor and spray bar with an instantaneous shutoff. No dripping of material from the spray bar is allowed after shutoff.

Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled total liquid rates from 0.14 to 4.5 L/square meter 0.03 to 1.0 gallon per square yard, with a pressure range of 172.4 to 517.1 kPa 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths.

2.1.1.1 Distributor Radar or Distance Measurement Instrument (DMI) Calibration

The radar or DMI mounted on the distributor truck, which monitors the travel speed and distance traveled, will be calibrated within 6-months of performing the. Provide certification of radar or DMI calibration with date of calibration by an officer of the company that operates the distributor truck stating the radar or DMI has been calibrated per the distributor manufacture's instructions.

2.1.1.2 Sampling Device

Equip the bituminous distributor and transport tanks with a spigot-type

sampling device.

2.1.1.3 Temperature Sensing Device

Equip the bituminous distributor and transport tanks with a minimum of 50 mm 2-inch dial type thermometer with a temperature range of 10 degrees C to 260 degrees C 50 degrees F to 500 degrees F, with increments having resolution of 5 degrees C 25 degree F or finer. Locate the thermometer near the midpoint of the tank's length and within the middle third of the tank's height, or as specified by the manufacturer. Enclose the thermometer in a well with a protective window or by other means as necessary to keep the instrument clean and in the proper working condition.

2.1.2 Spray Bar Nozzles

On the spray bar, each nozzle is required to be a fan nozzle and be at the same spray angle as all other nozzles except for the outermost left and outermost right nozzle which will be a end nozzle (half-fan) such that the spray stays to the inside of the spray bar, unless otherwise approved by the Government. Orient the nozzles of the spray bar approximately 30-degrees from the axis of the spray bar, unless otherwise directed by the the equipment manufacturer. Provide nozzles on the spray bar that produce the same flow rate, at the same distance above the pavement. Change the nozzles on the spray bar, as appropriate, for the material being applied and when substantial adjustments are required to the application rate.

2.1.3 Heating Equipment for Storage Tanks

Use steam, electric, or hot oil heaters for heating the bituminous material. Fix an armored thermometer to the tank with a temperature range from 10 degrees C to 260 degrees C 50 degrees F to 500 degrees F, with increments having resolution of 5 degrees C 25 degree F or finer so that the temperature of the bituminous material may be determined at all times.

2.1.4 Cleaning Equipment

Provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface. If using street sweeper type equipment, equip the street sweeper with a water tank, dust control spray assembly, both a pick-up and gutter broom, and a debris hopper.

2.2 PRIME COAT MATERIAL

NOTE: Remove brackets from around the material to be allowed in the contract specifications and delete the other materials and references.

Cutback asphalts are a source of volatile organic compounds (VOC). These VOC result in some jurisdictions prohibiting the use of cutback asphalt. VOC emissions from cutback asphalt result from the evaporation of the petroleum distillate used to liquefy the asphalt binder. For prime coat, cutback asphalt penetrates the unbound material better than emulsion and hence is often preferred, if available. If specifying cutback asphalt, ensure no violation of local environmental policy occurs.

If cutback asphalts are used, one of the following types and grades is recommended (medium-curing type cutback asphalts are the most common type of cutbacks used as prime coat):

Cutback Asphalts Types and Standards for Prime Coat ⁽¹⁾		
Type	Standard Specification	Designation
Medium-Curing	ASTM D2027/D2027M	MC-70, MC-250
Rapid-Curing	ASTM D2028/D2028M	RC-70, RC-250
(1) Recommendations per ASTM D2399 (2021).		

Selection of a particular type and grade should consider the nature of the surface to be treated. An open base course material will be penetrated readily, and all of the above types and grades can be considered except for the low viscosity MC-30. A tight surface will not be penetrated as readily; therefore, the less viscous materials are recommended such as RC-70, MC-30, MC-70 and SC-70. Some caution might be urged in using RC-70 or RC-250 because the solvent may separate or be absorbed by the base course fines and leave the asphalt deposited on the surface.

The following types of emulsions can be used for prime coats. If using an asphalt emulsion, it is recommended that prime coats be limited to slow-setting emulsified asphalt as these will allow the greatest opportunity for penetration into the underlying course.

Slow-Setting emulsions are indicated with SS.

Emulsified Asphalt Types and Standards for Prime Coat ^{(2),(3)}		
Emulsified Asphalt Charge	Standard Specification	Designation
Anionic	ASTM D977	SS-1, SS-1h ⁽¹⁾
Cationic	ASTM D2397/D2397M	CSS-1, CSS-1h ⁽¹⁾
(1) Emulsions with the designation including "h" in the name indicates a hard asphalt binder, or more specifically, an asphalt binder with lower penetration. Harder binders are known to resist pick up from traffic better than softer (higher penetration) asphalt binders.		
(2) Other products in the market (e.g. solvent free prime coats) can be considered, if approved on the state agency's qualified/approved product list.		

Emulsified Asphalt Types and Standards for Prime Coat ^{(2),(3)}
(3) Recommendations per ASTM D3628 (2015; R2021).

Some state DOT's use an asphalt emulsion that is designed for prime coat. It is normally referred to as EA-P (emulsified asphalt-prime) or AEP (Asphalt Emulsion Priming). Emulsions generally do not penetrate very much into the underlying layer (unbound base course) and these specially designed emulsions provide better penetration. This type of emulsion is preferred for prime coat if available. Check the approved product list (if available) on the State Agency/DOT website for EA-P prime coats before specifying.

Penetration and coating of prime coat material will be most efficient at approximately optimum moisture content. Water dilution of the emulsion is also sometimes required for prime coat to improve penetration but dilution of tack coat materials should not be allowed.

Provide the prime coat Certificate of Analysis (COA), including specific gravity, for the product specified below. COA's should be provided at preconstruction, prior to Application Rate Calibration, and any other COA's during production:

[2.2.1 Cutback Asphalt

Provide cutback asphalt conforming to [ASTM D2027/D2027M, Grade [MC-30] [MC-70] [MC-250]] [ASTM D2028/D2028M, Grade [RC-70] [RC-250]].

] [2.2.2 Emulsified Asphalt

Provide emulsified asphalt conforming to [ASTM D977, Type [SS-1] [SS-1h]] [ASTM D2397/D2397M, Type [CSS-1] [CSS-1h]] [EA-P]. Asphalt emulsion can be diluted up to 1 part water to 1 part emulsion for prime coat use. Where prime coats are to be diluted, certify the dilution was done in accordance with the specific dilution requirements for each product and for each load of material used.

] [2.3 TACK COAT MATERIAL

NOTE: Consider local practice as well as availability and cost of various grades within the area when evaluating alternate grades to be specified for the project.

Cutback asphalt has been used previously for tack coat applications. This specification has been edited to remove cutback asphalt for tack coats although it is still recommended in ASTM D2399. If required to use cutback asphalt for prime coat, RC-70 is recommended in the current edition of ASTM

D2399. Emulsions and asphalt binders are preferred over cutback asphalts for use as tack coat.

Table EMULSIFIED ASPHALT TYPES AND STANDARDS FOR TACK COAT identify many different emulsion variants. The Designer will need to investigate the needs of the project and determine what type of emulsified tack coat is appropriate for the project. The table below identifies examples of asphalt emulsions that are used for tack coats as recommended by ASTM D3628. In the market, there exist too many designations to list in this section. The following are only examples.

Emulsified Asphalt Types and Standards for Tack Coat ⁽⁴⁾			
Type	Standard Specification ⁽³⁾	Designation	Emulsified Asphalt Charge
Slow-Setting	ASTM D977	SS-1, SS-1h ⁽¹⁾	Anionic
	ASTM D2397/D2397M	CSS-1, CSS-1h ⁽¹⁾	Cationic
Medium-Setting	ASTM D977	MS-1, HFMS-1	Anionic
Reduced-Tracking ⁽²⁾	See Note 3.	NTSS-1HM, BC-1HT, CNTT-1hs	Anionic
		CBC-1HT	Cationic
		NTQS-1HL	Non-ionic
(1) Emulsions with the designation including "h" indicates an asphalt binder with lower penetration or higher high-end of Performance Grade binder. Harder binders are known to resist pick up from traffic better than softer (higher penetration or lower high-end temperature) asphalt binders.			
(2) In the market, there exists too many designations to list in this section. Providing as example only. Specify reduced-tracking (non-tracking) tack coats only if approved by the state DOT or agency and represented on their Approved Product List or Qualified Product List.			
(3) Some products used may not have a governing ASTM standard specification. If there is an equivalent AASHTO standard used by the state agency, modify the referenced standard appropriately.			
(4) Asphalt emulsions specified by ASTM D977 or ASTM D2397 in this table are recommended for tack coat applications by ASTM D3628 (2015; R2021). Other tack coat products (e.g. RS-1, CRS-1, CQS-1h, etc.) can be used if shown that a successful history for use by the state agency or DOT and is listed on the associated Approved Product List or Qualified Product List for tack coat applications.			

For most applications, cationic and anionic emulsions will perform equally well. Anionic emulsions, such as SS-1, may provide better adhesion to calcareous aggregates with pH less than 7, such as limestone. Cationic emulsions such as CSS-1 may provide better adhesion to siliceous aggregates with pH greater than 7, such as granite.

Reduced-tracking tack coats are recommended for stressed airfield pavements and high volume roads due to significantly greater bond strengths. Grades SS-1h, CSS-1h may also be considered for these applications if there is a history of adequate performance. Other grades can be considered for general use (e.g. tack coats for low volume roads, parking lots, and other similar features). Grades SS-1, and SS-1h or their cationic equivalents, are the most widely used tack coat materials.

In warmer climates, or when material pick-up is of concern, reduced-tracking tack coats should be considered. Oftentimes, "h" grade emulsions, such as SS-1h or CSS-1h, do not provide a hard enough base asphalt to prevent cohesive failure that may be present with high temperatures or short set times prior to commencing with paving. Several State, Federal, and Military agencies have begun to use tack coats with reduced-tracking properties to minimize spreading the tack coat along the haul route. Moreover, some State agencies have mandated reduced-tracking tack coats on all state projects, therefore resulting in significantly reduced or eliminated local availability for alternate tack coat products. In most cases, if a State agency has moved to reduced-tracking tack coats, it is not practical to specify alternate products that would require the supplier to devote an emulsion tank to local non-standard products. Before specifying, check with local DOT or state agency to determine their experience with reduced-tracking materials. Reduced tracking tack coats may require specialized application equipment. If necessary, modify the equipment section and materials section per manufacturer's guidance if reduced-tracking tack coats are specified.

Emulsions may not be desirable when night operations, short set times, or high-humidity environmental conditions are expected. In these scenarios, it is common to select quick setting emulsions, rapid setting emulsions, or hot-applied asphalt binders. High heat is required to achieve spraying consistency for asphalt binders. When asphalt binder is used, the tack coat grade should be the same grade as that for the asphalt mixture or the normal unmodified asphalt grade used for the local area by the DOT.

Provide the [tack coat Certificate of Analysis \(COA\)](#), including specific gravity, for the product specified below. No dilution is allowed for tack coat applications.

[2.3.1 Asphalt Binder

NOTE: See Note above for guidance on selected grade

of asphalt binder for use.

Provide asphalt binder conforming to [ASTM D946/D946M Penetration Grade [____], Table 2][ASTM D6373 PG [____], Table 1].

]2.3.2 Emulsified Asphalt

NOTE: Other emulsified asphalt products can be specified besides those listed below if the product is approved by the state agency or DOT and is listed on the associated Approved Product List or Qualified Product List for tack coat applications.

Provide emulsified asphalt conforming to [ASTM D977, Type [MS-1] [HFMS-1] [SS-1] [SS1h]] [ASTM D2397/D2397M, Type [CRS-1] [CSS-1] [CSS-1h]].

]2.3.3 Reduced-Tracking Tack Coat

Provide emulsified asphalt conforming to [____].

]2.4 Blotter Aggregate

NOTE: Blotter aggregate such as a clean, dry sand, screenings, or other cover material may need to be specified when traffic is allowed on a primed surface or when friction is needed on a tacked surface. Blotter aggregates are also used to remove excess tack or prime coat material.

Provide an aggregate gradation that conforms to gradations specified in Table 1. Obtain material used as blotter aggregate from an approved state agency or Department of Transportation (DOT) source.

Table 1		
Blotter Aggregate Gradation		
	Sand(1)	Screenings
Sieve Size, mm inch	Percent Passing by Mass	Percent Passing by Mass
9.53/8	100	100
4.75No. 4	95 - 100	75 - 100
2.36No. 8	85 - 100	---
1.18No. 16	65 - 97	---
0.60No. 30	25 - 70	---

Table 1		
Blotter Aggregate Gradation		
	Sand(1)	Screenings
Sieve Size, mm inch	Percent Passing by Mass	Percent Passing by Mass
0.30No. 50	5 - 35	---
0.15No. 100	0 - 7	---
0.075No. 200	0.0 - 4.0	0.0 - 15.0

]PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT STORAGE AND BITUMINOUS DISTRIBUTOR

NOTE: Keep bracketed text if emulsified asphalt is specified.

[Most anionic and cationic emulsions are not compatible. Thoroughly clean the asphalt emulsion storage and bituminous distributor if previous asphalt emulsion used is non-compatible with the specified emulsion. As an example, if CSS-1h (cationic) was utilized in the distributor previously, and the specified emulsion is a SS-1h (anionic), this would require the storage to be thoroughly cleaned prior to receiving the material and the bituminous distributor storage tanker to be thoroughly cleaned prior to depositing into the bituminous distributor storage tanker.
]

Ensure bituminous material is at the recommended application temperature and it has been thoroughly cycled through the distributor bar. Test the bituminous distributor under pressure by means of a test shot area (outside the project limits) to ensure there are no leaks or dripping for the nozzles after shut-off.

3.2 PREPARATION OF SURFACE

NOTE: If the surface to be treated requires repair, the method of repair and extent of work involved should be shown or described.

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. Apply treatment only when the surface is dry and clean.

3.3 TRIAL APPLICATIONS AND CALIBRATIONS

NOTE: Most modern distributors are typically equipped with computerized methods to manage and control application rate of the bituminous material.

Calibrations for these computerized control systems are needed to confirm the residual asphalt rate is being obtained. Do not remove the distributor truck calibrations. Edit only what is in bracketed text for emulsified asphalts. Residual asphalt rate is the basis of this specification.

3.3.1 Trial Applications

Trial applications below are for the initial settings of the bituminous distributor computer controlled application rate settings prior to performing the APPLICATION RATE CALIBRATION.

3.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.66 L/square meter 0.15 gallon per square yard (shot rate). For emulsions, make other trial applications using various amounts of material or adjusting other setting as may be deemed necessary to meet the residual application rate and uniform coverage.

3.3.3 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.27 L/square meter 0.06 gallons per square yard. Make other trial applications using various amounts of material or adjusting other setting as may be deemed necessary to meet the residual application rate and uniform coverage.

3.3.4 Application Rate Calibration

NOTE: Modern distributors are typically equipped with computerized methods to manage application rate. Calibration of the radar or DMI that utilize inputs based upon forward rate of speed and total distance traveled is required. Even with computerized rate control, based upon radar or DMI, calibration of the distributor is still needed to verify residual application rates. Application Rate Calibration and the Daily Application Rate Verification apply to both prime coat and tack coats.

Provide all equipment, materials, and labor necessary to calibrate the application rate produced from the bituminous distributor per the following guidance. Each distributor truck proposed for use on the project will have the application rate calibrated for each material type proposed for use. Perform the application rate calibration after the distributor arrives on the project, after the test shot, and at least 24 hours prior to use for application of prime coat and tack coat. Calibrate the application rate in accordance with ASTM D2995. If utilizing a cutback or asphalt binder, utilize ASTM D2995 Option A. If utilizing an emulsified asphalt, utilize ASTM D2995 Option B. Provide pads made from berber carpet (or other approved durable absorbent pad) with rubber or waterproof backing measuring 305 mm 12 inches by 305 mm 12 inches. For transverse testing, stack pads end-to-end that spans the maximum width of

the spray bar. For longitudinal testing, stack three sets of six pads end-to-end longitudinally with 30 meter 100 foot separation between sets.

Measure the transverse and longitudinal application rates with all nozzles inserted in the distributor bar. Submit the results for the application rate calibration in the longitudinal direction and the transverse direction to the Government identifying, at a minimum, the following items:

- a. Project name, Contract number, testing date.
- b. Emulsified, cutback, or asphalt binder material.
- c. Distributor make, model and serial number.
- d. Distributor setup at time of calibration including target application rate (shot rate as shown on the computer control system), spray bar height, and distributor truck speed or motor RPM.
- e. Dry weight of each pad prior to application.
- f. Wet weight of each pad immediately after application.
- g. For emulsions, oven dry each pad until constant mass. Record oven dry mass of each pad in 20 minute increments. Mass at the end of a 60 minute oven dry period is considered constant mass.
- h. For emulsions, residual asphalt rate for each pad and average residual asphalt rate. For cutbacks, shot rate for each pad and average shot rate.

For the Application Rate Calibration to be acceptable, provide the average residual asphalt rate for emulsions or the average shot rate for cutbacks and asphalt binder in compliance with Table 3a or Table 3b and no individual pad rate is to vary more than 20 percent from the average. Perform the Estimating Application Rate of Bituminous Distributors in the presence of the project QC staff and the Government. Reference ATTACHMENT 1. If the application rate calibration fails to meet the requirements of this section, make adjustments to the distributor setup, shot rate or other settings as appropriate, and re-perform the application rate calibration until the results are within an acceptable range. Do not modify the distributor setup, or shot rate after application rate calibration is accepted without approval by the Government. Use ASTM D2995 to determine the estimation of application rate of bituminous distributors every 14 days of production, or as determined necessary by the Government.

3.3.5 Daily Application Rate Verification

Following acceptable results as outlined in paragraph APPLICATION RATE CALIBRATION, perform daily application rate verification each day when the distributor is in use and provide results daily during execution. The production application rates will utilize the volume method of determination as follows:

- a. Determine the total distance to be sprayed.
- b. Calculate the area sprayed.
- c. Calculate the liters gallons of material applied by subtracting the

beginning volume by the ending volume. Utilizing the dipstick which has been provided with the distributor truck or the onboard meter.

- d. Correct for temperature back to 15.6 degrees C 60 degrees F by applying correction factor as provided in ASTM D1250.
- e. Calculate and report the temperature corrected shot rate by dividing the corrected liters gallons per item d. by the total area sprayed.

3.4 APPLICATION RATE CORRECTION

If the daily application rate verification varies by more than 0.07 liters per square meter 0.015 gallon per square yard from the shot rate established during application rate calibration that met the rates in Table 3a or Table 3b, immediately re-perform the application rate calibration in accordance with paragraph APPLICATION RATE CALIBRATION and ensure results are in compliance with the rates specified in Table 3a or Table 3b prior to applying additional prime coat or tack coat.

3.5 APPLICATION TEMPERATURE

3.5.1 Viscosity Relationship

Apply bituminous material at a temperature that will provide a viscosity between 10.0 and 60.0 seconds, Saybolt Furol in accordance with ASTM D88/D88M or between 20 and 120 square mm/sec 20 and 120 centistokes in accordance with ASTM D2170/D2170M. Furnish the temperature viscosity relation to the Contracting Officer.

3.5.2 Temperature Ranges

NOTE: Typical spray application temperatures are provided. Edit and coordinate materials with Part 2 PRODUCTS. Retain material to be allowed in the specification and delete the other materials.

The viscosity requirements determine the application temperature to be used. Table 2 presents a normal range of application temperatures. If Table 2 is different than the manufacturer's recommendation, use the manufacturer's recommendation.

Table 2	
Tack Coat or Prime Coat Application Temperatures	
Cutback Asphalt	
MC-70, RC-70 ⁽¹⁾	50-107 degrees C120-225 degrees F
MC-250, RC-250 ⁽¹⁾	75-132 degrees C165-270 degrees F
Asphalt Emulsion	
Cationic Emulsified Asphalt	54-77 degrees C130-170 degrees F
Anionic Emulsified Asphalt	65-82 degrees C150-180 degrees F

Table 2	
Tack Coat or Prime Coat Application Temperatures	
Non-Ionic Emulsified Asphalt	65-82 degrees C 150-180 degrees F
Asphalt Binder	
All Grades	135-175 degrees C 275-350 degrees F ⁽²⁾
(1) Some temperatures within these ranges provided may exceed the flash point for certain rapid cure cutbacks. Care should be taken in their heating.	
(2) Max temperature may be increased to 190 degrees C 375 degrees F if recommended by the manufacturer to facilitate uniform application free of equipment clogging issues when hard base asphalt is used.	

3.6 APPLICATION

3.6.1 General

Following preparation and subsequent inspection of the surface, apply the prime coat or tack coat with the distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots, not capable of being sprayed with the distributor, with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 8 meters 25 feet of heating, distributing, and transferring operations of cutback materials. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed.

3.6.2 Prime Coat

Apply the prime coat at locations shown on the Drawings only when the underlying material meets the specified material density requirements, and the moisture content is within 2 percent of optimum moisture. Application should be achieved within the limits of the temperature described in paragraph ENVIRONMENTAL REQUIREMENTS and quantities to achieve the rate of residual asphalt shown in Table 3a. At the time of priming, ensure that the base is firm, unyielding and in such condition that no undue distortion will occur. Ensure the prime coat adheres to the underlying material. Apply the prime coat material using a bituminous distributor. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application, remove and discard the building paper. If blotter aggregate is used, lightly sweep the area with a power broom, or other approved means, to remove any excess blotter aggregate.

Table 3a		
Prime Coat Application Rates		
Surface Type	Product Type	Rate (L/m ²)(gal/yd ²)
Unbound Layers	Emulsion ⁽¹⁾	0.23 - 0.540.05 - 0.12 (residual rate)
	Cutback Asphalt	0.36 - 0.81 0.08 - 0.18 (shot rate)
(1) Emulsion prime coats may be diluted up-to a 1 to 1 dilution rate.		

3.6.3 Tack Coat

Immediately following the preparation of the surface for treatment, apply the tack coat by means of the distributor, within the limits of the temperature described in paragraph ENVIRONMENTAL REQUIREMENTS and in quantities to achieve the rate of residual application rates shown in Table 3b. Ensure the surface is clean and dry. Apply tack coat at the locations shown on the Drawings sufficiently in advance of placing the asphalt mixture to permit breaking and initial stages of curing. Do not apply tack coat so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material. When using a spray paver with appropriate tack coat products, tack coat breaking requirements do not apply. Dilution of tack coat is prohibited. A tack coat should be applied to every bound surface (asphalt or concrete pavement) that is being overlaid with asphalt mixture and at transverse and longitudinal joints. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor by spraying with a hand wand or using other approved method. To obtain uniform application of the tack coat, at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the tack coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application, remove and discard the building paper. If blotter aggregate is used, lightly sweep with a power broom, or other approved means, to remove any excess blotter aggregate. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

Table 3b		
Tack Coat Application Rates ^(1,3,4)		
Surface Type	Residual Rate (L/m ²)(gal/yd ²)	Approximate Bar Rate Undiluted ⁽²⁾ (L/m ²)(gal/yd ²)
New Asphalt (between layers)	0.09 - 0.230.02 - 0.05	0.14 - 0.320.03 - 0.07

Table 3b		
Tack Coat Application Rates ^(1,3,4)		
Surface Type	Residual Rate (L/m ²)(gal/yd ²)	Approximate Bar Rate Undiluted ⁽²⁾ (L/m ²)(gal/yd ²)
Existing Asphalt	0.18 - 0.320.04 - 0.07	0.27 - 0.500.06 - 0.11
Milled Surface	0.18 - 0.360.04 - 0.08	0.27 - 0.540.06 - 0.12
Portland Cement Concrete	0.14 - 0.230.03 - 0.05	0.23 - 0.360.05 - 0.08
(1) Dilution of tack coat is not allowed		
(2) Assumes emulsion is 33 percent water and 67 percent asphalt		
(3) Emulsified asphalt is prohibited to be applied at application rates over 0.54 L/m ² 0.12 gal/yd ²		
(4) Residual rate is the same as bar rate when using hot-applied asphalt binders. Use residual rate tolerances as shown above for target when using hot-applied asphalt binders.		

3.7 FIELD QUALITY CONTROL

NOTE: Retain bracketed text for unit price bids only. For lump sum Contracts, remove bracketed text.

Certificates of compliance (COC) for asphalt materials delivered will be obtained and checked to ensure that specification requirements are met. Quantities of applied material will be determined.[Payment will be for amount of residual asphalt applied.] Prime coat materials when emulsions are used can be diluted on site with potable water up to 1 part water to 1 part emulsion, as long as the residual rate is still being met. Do not dilute tack coat materials. If requested by the Government, obtain samples of the bituminous material under the supervision of the Government per paragraph SAMPLING and send for analysis.

3.7.1 Sampling and Testing

Furnish certified copies of the manufacturer's test reports indicating temperature-viscosity relationship for asphalt materials and compliance with applicable specified requirements, not less than 5 days before the material is required in the work.

3.7.2 Sampling

Unless otherwise specified, sample bituminous material in accordance with ASTM D140/D140M.

3.8 PRIME COAT SET PERIOD

NOTE: It is recommended for prime coats to set for a minimum of 48 hours. This set time allows the prime coat to penetrate into the base course and also minimize pick-up during paving operations. Some solvent-free prime coats may not require the full 48 hour set time. If solvent-free prime coats are specified, obtain direction from the manufacturer on how to edit the set time.

Allow the prime coat to set without being disturbed for a period of at least [48 hours][_____] or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough blotter aggregate to effectively blot up excess bituminous material.

3.9 TACK COAT BREAKING PERIOD

Following application of an emulsified asphalt tack coat and prior to application of the succeeding layer of asphalt mixture, allow emulsified asphalt tack coats to break. No break period is required for cutback or hot-applied asphalt binder tack coat products.

3.10 TRAFFIC CONTROLS

Maintain the primed surface and tacked surface in good condition until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

3.11 ATTACHMENT

ATTACHMENT 1: Estimating Application Rate of Bituminous Distributors

-- End of Section --