Preparing Activity: USACE Superseding
UFGS-32 01 13 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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USACE / NAVFAC / AFCEC / NASA **UFGS-32 12 36.13 (May 2017)**

Preparing Activity: USACE **Superseding**
UFGS-32 01 13 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 32 12 36.13

ASPHALTIC SEAL AND FOG COATS
05/17

****
NOTE: This guide specification covers the requirements for asphaltic surface coatings for low volume roads, parking areas, and other general applications. A fog coat can also be used on airfields in areas such as shoulders, taxiways, and overruns.

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.

This specification must be edited to remove all references to Fog Seal when it is not required in the project and to remove references to aggregates when aggregates are not used with the sealers.

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

PART 1 GENERAL

****
NOTE: Bituminous seal coat should not be used on primary roads or airfield areas where high speed traffic is expected. Seal coats with uncoated aggregate will not be used on airfields due to FOD potential. Fog seals lower the friction of paved surfaces and will not be used on runways, high speed

taxiway turnoffs, or moderate to high speed roads unless approval is obtained from NAVFAC HQ, AFCEC or the TSMCX.

UFC 3-250-03 should be used for guidance in preparing these specifications.

****

1.1 UNIT PRICES

****

NOTE: Delete this paragraph when lump sum bidding is used.

****

1.1.1 Measurement

Measure the quantities of bituminous material and aggregate used in the accepted work and to be paid for, provided that the measured quantities are not more than 10 percent over the specified application rate. Any amount of bituminous material and aggregate more than 10 percent over the specified application rate for each application will be deducted from the measured quantities except for irregular areas where hand spraying of the bituminous material and hand spreading of the aggregate is necessary.

1.1.1.1 Bituminous Material

****

NOTE: When the bituminous material is measured in liters gallons, the appropriate ASTM method will be retained for correcting the measured volume for the type of bituminous material specified.

****

The amount of bituminous material to be paid for will be measured in [metric 2000 pound tons,] [L at 15.6 degrees C gallons at 60 degrees F] of residual asphalt cement. 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].

1.1.1.2 Aggregate

****

NOTE: When for seal is being specified delete reference to aggregates.

****

The amount of aggregate to be paid for will be measured in [metric tons tons] [cubic meters yards] of dry aggregate. Measure materials [using approved weigh scales] [by determining the volume capacity of each vehicle delivering the material to the site of the work or stockpiles].

1.1.2 Payment

****

NOTE: Delete this paragraph when lump sum bidding

is used.
****

The quantities of aggregate and 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

****
NOTE: Delete this paragraph when lump sum bidding is used.
****

Do not remove bituminous material from the tank car or storage tank until measurements of the remaining quantity have been taken. Submit waybills and delivery tickets during the progress of the work. Before the final statement is allowed, file certified waybills and delivery tickets for all materials used in the work covered by this section.

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.

When fog seal is being specified delete reference for aggregates.
****

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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 81	(1992; R 2017) Standard Specification for Cutback Asphalt (Rapid-Curing Type)
AASHTO M 82	(2017) Standard Specification for Cutback Asphalt (Medium-Curing Type)

AASHTO M 226	(1980; R 2017) Standard Specification for Viscosity-Graded Asphalt Cement

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C142/C142M	(2017) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
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	(2019a; E 2019) 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) Cutback Asphalt (Rapid-Curing Type)
ASTM D2397/D2397M	(2019a) Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D3381/D3381M	(2018) Standard Specification for Viscosity-Graded Asphalt Binder for Use in Pavement Construction
ASTM D3625/D3625M	(2012) Standard Practice for Effect of Water on Bituminous-Coated Aggregate Using Boiling Water

ASTM D4791 (2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009; Rev 2012) Manual on Uniform Traffic Control Devices

1.3 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, Air Force, and NASA 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.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

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.][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-03 Product Data

Waybills and Delivery Tickets

Equipment List

Inspection Reports

SD-04 Samples

Bituminous Materials

Aggregates

Fog Seal; G[, [_____]]

SD-06 Test Reports

Tests

1.4 EQUIPMENT, TOOLS, AND MACHINES

****
NOTE: Retain equipment units required for the project and delete all others.
****

Equipment, plant and tools used in the work are subject to approval. Maintain in a satisfactory working condition at all times. Provide equipment which is adequate and has the capability of producing the results specified. Provide calibrated equipment, such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, that has been calibrated by an approved calibration laboratory within [12] [_____] months prior to commencing work [and every [_____] months thereafter, by such laboratory from the date of recalibration, during the term of the contract]. Submit an equipment list with calibration reports.

1.4.1 Bituminous Distributors

Provide distributors that have pneumatic tires of sufficient size and number to prevent rutting, shoving, or otherwise damaging any part of the pavement structure. Use distributors that distribute the bituminous material in a uniform double or triple lap at the specified temperature, at readily determined and controlled rates from 0.23 to 9.05 L/square meter 0.05 to 2.0 gallons/square yard, with a pressure range of 172.4 to 517.1 kPa 25 to 75 psi with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include in the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, 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-held hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. Provide distributor with a horizontally and vertically adjustable spray nozzle bar. Make normal width of bar application at least 3.7 m 12 feet, with provisions for lesser or larger width when necessary. Equip distributor with a meter having a dial registering meters of travel/sec feet of travel/min and a meter that registers the application rate in liters/square meter gallons/square yard. Make both dials visible to the distributor driver. Provide a thermometer and well, not in contact with any heating tubes, for accurately indicating temperature of asphalt emulsion.

1.4.2 Aggregate Spreader

****
NOTE: Delete this paragraph when fog seal is being specified.
****

Use aggregate-spreading equipment that is adjustable and capable of uniformly spreading aggregate at the specified rate in a single-pass operation over the surface to be sealed.

1.4.3 Pneumatic-Tired Roller

****
NOTE: Delete this paragraph when fog seal is being specified.
****

Provide a pneumatic-tired roller of sufficient size to seat the cover aggregate into the bituminous material without fracturing the aggregate particles. Use rollers that have a total compacting width of not less than 1.52 m 5 feet and a tire pressure of at least 350 Kpa 50 psi. Use rollers that weigh at least 8,182 Kg 18,000 pounds.

1.4.4 Power Brooms and Power Blowers

Provide power brooms and power blowers suitable for cleaning surfaces to [be treated] [which the seal coat is to be applied].

1.4.5 Scales

****
NOTE: Delete this paragraph when lump sum bidding is used or when fog seal is being specified.
****

Use scales of sufficient size and capacity to accommodate all trucks hauling aggregates in the job. Use scales that have been tested and approved by an inspector of the state inspection bureau charged with scales inspection within the State in which the project is located. If an official of the inspection bureau is not available, test the scales in accordance with the State specifications in the presence of the Contracting Officer. Keep the necessary number of standard weights on hand at all times for testing the scales.

1.4.6 Weighhouse

****
NOTE: Delete this paragraph when lump sum bidding is used and when fog seal is being specified.
****

Provide a weatherproof weighhouse, constructed in a manner that will afford adequate protection for the recording devices on the scales, of a suitable size with one sliding window facing the scales platform, one end window, and a desk-type area at least 600 mm 2 feet wide by 1.8 m 6 feet long.

1.4.7 Storage Tanks

Provide tanks capable of heating the bituminous material, under effective and positive control at all times, to the required temperature. Accomplish heating by steam coils, hot oil, or electricity. Affix to the tank an armored thermometer with a range from 37.8 to 148.9 degrees C 100 to 300 degrees F so that the temperature of the bituminous material may be read at all times.

1.4.8 Single-Pass, Surface-Treatment Machines

****
NOTE: Delete this paragraph when fog seal is bing specified.
****

Provide machines capable of spraying bituminous material and spreading aggregate in one pass; of distributing the bituminous material uniformly, at even heat, and in controlled amounts; and immediately spreading aggregates uniformly, in controlled amounts, over the surface to be sealed.

1.4.9 Vacuum Sweepers

Provide self-propelled, vacuum pickup sweeper capable of removing loose sand, water, and debris from pavement surface.

1.5 QUALITY ASSURANCE

****
NOTE: Keep applicable tests and delete the others depending on whether this Section is used for Seal or Fog Coat.
****

Perform sampling and testing using an approved commercial testing laboratory or facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved. The first inspection will be at the expense of the Government. Costs incurred for any subsequent inspection will be charged to the Contractor. Perform tests in sufficient numbers, and at the location and times directed, to ensure that the materials meet specified requirements.

1.5.1 Samples

Take aggregate samples for laboratory tests in accordance with ASTM D75/D75M. Take samples of bituminous material in accordance with ASTM D140/D140M.

1.5.2 Aggregates Source

Select sources from which aggregates are to be obtained and notify the Contracting Officer within 15 days after the award of the Contract. Submit a 23 kg 50 pound sample of each aggregate to be used. Perform tests for the evaluation of aggregates by using an approved commercial laboratory at no expense to the Government. Tests for determining the suitability of aggregate include, but are not limited to: gradation in accordance with ASTM C136/C136M, abrasion resistance in accordance with ASTM C131/C131M, clay lumps and friable particles in accordance with ASTM C142/C142M, unit weight and voids in accordance with ASTM C29/C29M,

and flat and elongated particles in accordance with ASTM D4791.

1.5.3 Bituminous Material Source

Select sources from which bituminous materials are to be obtained and notify the Contracting Officer within 15 days after the award of the contract. From each source of supply, submit a 4 L one gallon sample of bituminous material.

1.5.4 Equipment Calibration

Furnish all equipment, materials and labor necessary to calibrate the bituminous distributor and the aggregate spreader. Perform all calibrations with the approved job materials and prior to applying the specified coatings to the prepared surface. Perform calibration of the bituminous distributor in accordance with ASTM D2995. Inspect all equipment prior to start of work and at regular intervals as needed during work.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver asphalt materials to the site in a homogenous and undamaged condition. Inspect the materials for contamination and damage. Unload and store the materials with a minimum of handling. Protect stored aggregate from contamination and segregation. Replace defective or damaged materials.

1.7 ENVIRONMENTAL REQUIREMENTS

****

NOTE: Retain correct temperatures depending on the type of coating used for the project.

****

Apply the coating when the existing surface is dry, and when the weather is not foggy, rainy, or when the wind velocity will prevent the uniform application of the bitumen or aggregates. [Apply the bituminous seal coat only when the atmospheric temperature is above 15.5 degrees C 60 degrees F in the shade and when the pavement surface temperature is above 15.5 degrees C 60 degrees F, unless otherwise directed.] [Apply fog seal when atmospheric temperature is above 10 degrees C 50 degrees F and rising or when pavement temperature is above 15.5 degrees C 60 degrees F, unless otherwise directed.]

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIAL FOR SEAL COAT

****

NOTE: One type of bituminous material will be retained. All other materials and references will be deleted.

Cutback asphalt grades MC- or RC-800, and MC- or RC-250, in order of preference, are recommended for most normal seal coat applications where a rapid-setting binder providing maximum "hold" of cover aggregate is desired. Where cooler temperatures are anticipated, preference should be

given to the use of MC- or RC-3000 in very warm climates when work will be performed during periods of high ambient temperature. In most areas cutback asphalts are no longer used for seal coat applications. Emulsified asphalts are typically used.

Emulsified asphalt grades RS-1, RS-2, CRS-1, and CRS-2 are suitable for seal coat applications. Emulsions are better suited to coat aggregate when the aggregate moisture content is over 1 percent but less than 3 percent. The following considerations should be included in the evaluation of alternate grades to be specified for the project:

a. Local practice and experience, as well as availability and cost of various grades within the area.

b. The rapid-setting emulsions, particularly the cationic types, are effective when damp aggregates must be used.

c. Where cooler temperatures are anticipated, consider the use of CRS-1 and CRS-2 grades.

d. Anionic emulsions provide better adhesion to basic aggregates such as limestone, while cationic emulsions are better with acidic aggregates such as silicates.

Asphalt cement penetration grades 120-150 and 200-300, in order of preference, are suitable for most normal seal coat applications. Where cooler temperatures are anticipated, preference should be given to the use of 200-300 grade. However, the use of asphalt cement will require that aggregates be quickly applied before the asphalt cement has time to cool. This can be difficult.

****

Use bituminous material conforming to [AASHTO M 81] [AASHTO M 82] [AASHTO M 226] or [ASTM D946/D946M] [ASTM D977] [ASTM D2027/D2027M] [ASTM D2028/D2028M] [ASTM D2397/D2397M] [ASTM D3381/D3381M], [grade [_____]] [penetration grade [_____]].

2.2 AGGREGATE FOR SEAL COAT

****

NOTE: The aggregate gradation to be used will be retained in Table I and the remaining gradations deleted. Specify a maximum moisture content of 3 percent when asphalt emulsion is used and 1 percent when other asphalt types are used.

****

Use aggregate consisting of crushed stone, crushed gravel, crushed slag, sand and screenings. Use aggregate with a moisture content [of not

greater than [1] [3] percent] [such that the aggregate will readily bond with the bituminous material]. Drying may be required, as directed. Use aggregate conforming to the gradation shown in TABLE I. Allowable aggregate gradation tolerances are given in TABLE II.

TABLE I. AGGREGATE GRADATIONS (Percent by Weight Passing Square-Mesh Sieves)			
Sieve Size	Gradation No. 1	Gradation No. 2	Gradation No. 3
12.5 mm1/2 inch	100	---	---
9.5 mm3/8 in	85-100	100	---
4.75 mmNo. 4	10-30	85-100	100
2.36 mmNo. 8	0-10	10-40	10-40
1.18 mmNo. 16	0-5	0-10	0-10
0.30 mmNo. 50	---	0-5	0-5

TABLE II. AGGREGATE GRADATION TOLERANCES	
Material	Tolerances
Aggregate passing the 9.5 mm 3/8 inch sieve and larger sieves	Plus or minus 5 percent
Aggregate passing the 4.75 mm No. 4 and smaller sieves	Plus or minus 3 percent

2.2.1 Coarse Aggregate

Use coarse aggregate consisting of clean, sound, durable particles meeting the following requirements.

2.2.1.1 Film Retention

Use aggregate that exhibits not less than 95 percent retention of bituminous film(ASTM D3625/D3625M.

2.2.1.2 Particle Shapes

Use aggregate that has no more than 20 percent by weight of flat and elongated particles on any sieve when determined in accordance with ASTM D4791. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

2.2.1.3 Weight Loss

Use aggregate with a percent weight loss not exceeding 40 after 500 revolutions, as determined in accordance with ASTM C131/C131M.

2.2.1.4 Friable Particles

Use aggregate with no more than 0.1 percent of the total weight of aggregate sample consisting of friable particles when tested in accordance with ASTM C142/C142M.

2.2.1.5 Crushed Slag

Use crushed slag aggregate with a dry weight not less than 1200 kg/cubic meter 75 pcf, as determined in accordance with ASTM C29/C29M.

2.2.1.6 Crushed Aggregate

Crushed aggregate retained on the 4.75 mm No. 4 sieve and each coarser sieve must contain at least 75 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 75 percent of the smaller midsectional area of the aggregate particle. When two fractures are contiguous, the angle between the planes of fractures must be at least 30 degrees to count as two fractured faces.

2.2.2 Fine Aggregate

Use fine aggregate consisting of clean, sound, durable particles of crushed stone, slag, or crushed gravel. Use aggregate that meet the requirements for stripping, abrasion resistance and percent friable particles as specified for coarse aggregate.

2.3 EMULSIFIED ASPHALT FOR FOG SEAL

****

NOTE: In a majority of applications, the cationic (CSS-1h) is preferable to the anionic (SS-1h) for use as fog seal. Cationic emulsion will cure at a faster rate than anionic and is more suitable where high humidity prevails.

****

Use emulsified asphalt for Fog Seal conforming to ASTM D977, [SS-1] [SS-1h] [_____] for anionic and ASTM D2397/D2397M[CSS-1] [CSS-1h] [_____] for cationic materials.

2.4 WATER

Provide fresh, clean, and potable water.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

****

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

Removal of paint and rubber deposits are generally accomplished by high pressure water blasting but care must be used to ensure that the water pressure does not significantly damage the asphalt pavement surface. Few approved chemicals are effective and

sandblasting is not permitted by air pollution regulations at some locations. Mechanical abrasion generally causes damage to the pavement.

Bracketed sentence at the end of this paragraph applies to Fog Seal; remove when not used in the project.

****

Repair damaged surface and fill cracks before starting work. Immediately before starting work, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated with power brooms or power blowers, if needed. Paint firmly bonded to the surface may remain. Do not mix material removed from the surface with the cover aggregate.[When necessary to achieve a clean surface for fog application, flushing with water will be permitted.]

3.2 SEAL COAT APPLICATION

3.2.1 Rate

Spread the bituminous material in the quantities shown in TABLE III. The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contractor and approved by the Contracting Officer prior to use. The bituminous quantities may have to be increased when the pavement has rough surface texture and may have to be decreased when the pavement surface is very tight.

TABLE III. APPLICATION OF MATERIAL
(Quantities Per Square Meter)

Gradation No.	Bitumen, liters gallons	Aggregate, kg pounds
1	0.60-0.900.15-0.20	8-1015-20
2	0.45-0.600.10-0.15	5-810-15
3	0.45-0.600.10-0.15	5-810-15

3.2.2 Temperature

Apply asphalt at a temperature that will provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec 20 and 120 centistokes, kinematic. Furnish the temperature/viscosity relationship to the Contracting Officer.

3.2.3 Application of Bituminous Material

Following the preparation and inspection of the pavement surface, apply the seal coat material at the specified application rates. Uniformly apply the bituminous material in a single pass of the distributor and with either a double or triple lap spray over the surface to be sealed. Spread building paper on the surface for a sufficient distance back from the ends of each application so that flow through the spray bar may be started and stopped on the paper and so that all sprays will be operating at the proper pressure on the surface to be sealed. Immediately after the bituminous material application, remove the building paper. Apply bituminous material to all areas missed with the distributor. No smoking,

fires, or flames, other than the heaters that are a part of the equipment, will be permitted within 8 meters 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions.

3.2.4 Aggregate Application Rate

Spread the aggregate in the quantities shown in TABLE III. The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contractor, and approved by the Contracting Officer prior to use. The aggregate weights shown in this table are those of aggregate having a specific gravity of 2.65. If the specific gravity of the aggregate to be used is less than 2.55 or greater than 2.75, make adjustments in the number of kilogramspounds of aggregate required per square meteryard to insure a constant volume of aggregate per square meteryard of treatment.

3.2.5 Application of Aggregate

****

NOTE: When using cutback asphalt, the asphalt cools to the temperature of the surface to which it is applied in approximately 1 1/2 minutes. In the case of emulsified asphalt, breaking of the emulsion occurs in 3 to 4 minutes. No bituminous material should be down more than the following number of minutes before it is covered with aggregate:

Cutback Asphalt	**1 to 1-1/2 minutes**
Emulsified Asphalt	**3 to 4 minutes**
Asphalt Cement	**1 minute**

****

Spread the specified quantity of cover aggregate uniformly over the bituminous material. Provide sufficient aggregate on trucks at the work site to cover the distributor load of bituminous material before the bituminous material is applied. No bituminous material may be down more than [3 to 4] [_____] minutes before it is covered with aggregate. Uniformly spread aggregate with aggregate-spreading equipment. Lightly recover areas having insufficient cover with additional aggregate by hand during the operations whenever necessary.

3.2.6 Rolling and Brooming

Begin rolling operations immediately following the application of cover aggregate. Perform rolling using pneumatic-tired rollers. Operate the rollers at a speed that will not displace the aggregate. Continue rolling until the aggregate is uniformly distributed and keyed into the bituminous material. Sweep off the surface and remove all surplus aggregate not less than 24 hours nor more than 4 days after rolling is completed. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller.

3.3 FIELD QUALITY CONTROL - SEAL COAT

3.3.1 Tests

Perform field tests in sufficient numbers to assure that the specifications are being met. Submit copies of the test results, within 24 hours of the completion of the test. Submit certified copies of the aggregate test results, not less than [30] [_____] days before the material is required in the work and certified copies of the bituminous materials test reports indicating compliance with applicable specified requirements, not less than [30] [_____] days before the material is required in the work. Provide a copy of the calibration test results before the bituminous distributor and aggregate spreader are used on the job. Testing is the responsibility of the Contractor. Perform test using an approved commercial laboratory. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type of operation.

3.3.1.1 Gradation

Perform gradation tests in accordance with ASTM C136/C136M. Perform a minimum of three gradations for each day's run. Repeat the gradation test when the source of materials is changed. When deficiencies are found, retest the material already placed to determine the extent of the unacceptable material. Replace all in-place unacceptable material at no additional expense to the Government.

3.3.1.2 Abrasion Resistance

Perform abrasion resistance tests in accordance with ASTM C131/C131M. Perform one test prior to start of work. If sources of aggregate are changed, conduct an abrasion resistance test prior to using another source.

3.3.1.3 Stripping

Perform stripping test on aggregate from each source, in accordance with ASTM D3625/D3625M, prior to incorporation into the work and when the source is changed.

3.3.2 Bituminous Material Sample

Obtain a sample of the bituminous material used under the supervision of the Contracting Officer. The sample will be retained by the Government.

3.4 TRIAL APPLICATION - SEAL COAT

Prior to applying the seal coat, place a test section at least 30 meters 100 feet long by 6 meters 20 feet wide using the approved job materials and roll them in accordance with the specified requirements. Perform tests to determine the application rates of the bitumen and aggregate. If the tests indicate that the seal coat test section does not conform to the specification requirements, make necessary adjustments to the application equipment and to the spreading and rolling procedures, and construct additional test sections for conformance to the specifications. Where test sections do not conform to specification requirements, remove seal coat at no expense to the Government; no separate payment will be made for seal coat materials and labor, either in placement or removal of any test section. Perform quality control sampling and testing during construction as required in paragraph FIELD QUALITY CONTROL above.

3.5 FOG SEAL APPLICATION

3.5.1 Sample Application

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NOTE: In some localities an incompatibility may exist between the asphaltic emulsion and the water to be used for dilution due to their characteristics. Clear, potable water should be used, and if there is any doubt with the compatibility of the water and the asphalt emulsion, add the following to this paragraph: Prior to commencing work, combine 0.24 liter one half pint of the proposed asphalt emulsion and 0.24 liter one half pint of the proposed water, agitate, and allow to sit for a period of 24 hours to test their compatibility. If they prove to be incompatible, provide an approved chemical treatment for all water used for dilution or a different and compatible source of water.

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Determine the required application rate from a sample installation. Select an area of the prepared pavement at least 90 m 300 feet long and as wide as the distributor spray bar. Dilute emulsified asphalt with an equal part of water or as agreed to by the Contracting Officer. Apply the water diluted asphalt emulsion in at least three test sections; each a minimum of 30 m 100 feet long. Make trial applications at residual rates of 0.36, 0.63 , and 0.90 L/square meter 0.08, 0.14, and 0.20 gallons/square yard. The trial application rates may be modified if approved by the Contracting Officer. Additional trial applications may be made if warranted by pavement surface conditions. Use the rate which has been satisfactorily applied without leaving an excess of asphalt residue on the surface and has been approved, for the fog seal.

3.5.2 Application Inspection

Inspect application of fog seal for uniformity. During application, take one sample for each 400 square meters 500 square yards of surface area to receive emulsified asphalt. Weigh samples to determine conformance with application rate.

3.5.3 Inspection Reports

Furnish a written report citing climatic temperature during application of fog seal, emulsion temperature during application, rate of emulsion application, and any significant observations.

3.5.4 Application

Following preparation of the surface, apply the water diluted asphalt emulsion at the rate determined from the trial application. Maintain application temperature of emulsified asphalt between 24 and 71 degrees C 75 and 160 degrees F. To obtain uniform application of the fog seal at the junction of previous and subsequent applications, spread building paper on the surface of the applied material for a sufficient distance back from the ends of each application so that flow from the spray bar may be started and stopped on the paper, and so that all sprayers will operate

at full force. Immediately after application, remove and properly dispose of the building paper. Treat spots unavoidably missed with the hand spray equipment. Base bids on application of diluted emulsion at 0.63 L/square meter 0.14 gsy. If the actual amount required is more or less than 0.63 L/square meter 0.14 gsy, an adjustment in the contract price will be made as provided by the contract.

3.6 SITE PROTECTION

During applications, protect adjacent buildings, structures, vehicles, manhole covers, inlet grates, and trees to prevent being spattered or marred.

3.7 TRAFFIC CONTROL

Protect freshly placed coatings from damage by traffic. Provide sufficient warning signs and barricades to prevent traffic over freshly treated surfaces. Protect treated areas from traffic for at least 24 hours after final application of coatings, or for such time as necessary to prevent picking up. Provide warning signs and barricades for proper traffic control, in accordance with MUTCD.

-- End of Section --