
USACE / NAVFAC / AFCEA UFGS-02785 (July 2003)

Preparing Activity: USACE Superseding
UFGS-02785A (July 1997)
UFGS-02785N (September 1999)
UFGS-02786N (July 1997)
UFGS-02789N (September 1999)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

SECTION 02785

BITUMINOUS SEAL AND FOG COATS 07/03

NOTE: This guide specification covers the requirements for bituminous surface coatings for low volume roads, parking areas, and other general applications.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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

PART 1 GENERAL

NOTE: Bituminous seal coat should not be used on primary roads or airfield areas. Fog seals lower the frictional resistance 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 NAVFACENGCOMHQ, AFCEA or the TSMCX.

This section must be edited to remove all references to Fog Seal when it is not required in the project.

1.1 REFERENCES

NOTE: Issue (date) of references included in
project specifications need not be more current than
provided by the latest guide specification. Use of
SpecsIntact automated reference checking is
recommended for projects based on older guide
specifications.

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 20	(1970; R 2000) Penetration-Graded Asphalt Cement
AASHTO M 226	(1980; R 2000) Viscosity Graded Asphalt Cement
AASHTO M 81	(1992; R 2000) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; R 2000) Cut-Back Asphalt (Medium-Curing Type)
AASHTO T 182	(1984; R 2002) Coating and Stripping of Bitumen-Aggregate Mixtures
AASHTO T 40	(2002) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997) Clay Lumps and Friable Particles in Aggregates
ASTM C 29/C 29M	(1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D 1250	(1980; R 2002) Petroleum Measurement Tables
ASTM D 140	(2001) Sampling Bituminous Materials
ASTM D 2027	(1997) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2397	(2002) Cationic Emulsified Asphalt

ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors
ASTM D 3381	(1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 490	(1992; R 2001) Road Tar
ASTM D 633	(1997; R 2001) Volume Correction Table for Road Tar
ASTM D 75	(2003) Sampling Aggregates
ASTM D 946	(1982; R 1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(2003) Emulsified Asphalt

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

DOT D-6.1	(2000) Manual of Uniform Traffic Control Devices
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1.2 MEASUREMENT FOR PAYMENT

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

The bituminous material and aggregate to be paid for shall be the measured quantities used in the accepted work, 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.

1.2.1 Bituminous Material Measurement Methods

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

The amount of bituminous material to be paid for will be measured in [metric tons tons, 2000 pound] [liters at 15.6 degrees C gallons at 60 degrees F]. Volumes measured at temperatures other than 15.6 degrees C 60 degrees F shall be corrected in accordance with [ASTM D 633] [ASTM D 1250] [, using a coefficient of expansion of 0.00045 per degree C 0.00025 per degree F for asphalt emulsion].

1.2.2 Aggregate Measurement Methods

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

1.3 PAYMENT

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

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

1.4 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during the progress of the work. Before the final statement is allowed, certified waybills and delivery tickets for all materials used in the work covered by this section shall be filed.

Equipment List

List of equipment used in the project along with calibration reports.

Inspection Reports

Reports of climatic temperature during application of fog seal, emulsion temperature and rate.

SD-04 Samples

Bituminous Materials Aggregates

From each source of supply, a 4 L one gallon sample of bituminous material and a 23 kg 50 pound sample of aggregate for each aggregate size.

Fog Seal[; G][; G, [_____]]

Submit in accordance with paragraph titled "Sample Application", for approval and selection of one of the trial application rates.

SD-06 Test Reports

Tests

Copies of the test results, within 24 hours of the completion of the test. Certified copies of the aggregate test results, not less than [30] [_____] days before the material is required in the work. 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. A copy of the calibration test results, before the bituminous distributor and aggregate spreader are used on the job.

1.5 CONSTRUCTION EQUIPMENT

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

1.5.1 General Requirements

Equipment, plant and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated 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]. The Contractor shall submit an equipment list with calibration reports.

1.5.2 Bituminous Distributors

NOTE: The bracketed statements at the end of this paragraph apply specifically to Fog Seal.

The distributor shall have pneumatic tires of sufficient size and number to prevent rutting, shoving, or otherwise damaging any part of the pavement structure. The distributor shall be designed and equipped to 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 liters per square meter 0.05 to 2.0 gallons per square yard, with a pressure range of 172.4 to 517.1 kPa 25 to 75 pounds per square inch with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include 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. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process. [Provide distributor with an adjustable, both horizontally and vertically, 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 per second feet of travel per minute. 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.]

1.5.3 Aggregate Spreader

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

1.5.4 Pneumatic-Tired Roller

The pneumatic-tired roller shall be of sufficient size to seat the cover aggregate into the bituminous material without fracturing the aggregate particles. The rollers shall have a total compacting width of not less than 1.52 m 5 feet. The gross weight shall be adjustable within 3, 572 to 6, 250 kg per m 200 to 350 psi of compacting width.

1.5.5 Power Brooms and Power Blowers

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

1.5.6 Scales

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

The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling aggregates. All scales shall be 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, the scales shall be tested in accordance with the state specifications by the Contractor in the presence of the Contracting Officer. The Contractor shall have the necessary number of standard weights on hand at all times for testing the scales.

1.5.7 Weighhouse

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

The weighhouse shall be weatherproof and shall be constructed in a manner that will afford adequate protection for the recording devices on the scales. The weighhouse shall be 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.

1.5.8 Storage Tanks

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

1.5.9 Power Rollers

Provide self-propelled tandem and three-wheel type rollers, weighing not less than 4.54 metric tons 5 tons and suitable for rolling bituminous pavements. The wheels of the rollers shall be equipped with adjustable scrapers. The rollers shall be equipped with water tanks and sprinkling apparatus for keeping the wheels wet in order to prevent adherence of the bituminous material to the wheels.

1.5.10 Single-Pass, Surface-Treatment Machines

The machines shall be capable of spraying bituminous material and spreading aggregate in one pass. The machine shall be capable 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.

1.5.11 Vacuum Sweepers for Fog Seal

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

1.6 WEATHER LIMITATIONS

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

The coating shall be applied 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.]

1.7 WAYBILLS AND DELIVERY TICKETS

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

The Contractor shall not remove bituminous material from the tank car or storage tank until measurements of the remaining quantity have been taken.

1.8 SAMPLING AND TESTING

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

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

1.8.1 Samples

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75. Samples of bituminous material shall be taken in accordance with AASHTO T 40 or ASTM D 140.

1.8.2 Aggregates Source

Sources from which aggregates are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the Contract. Tests for the evaluation of aggregates shall be made by an approved commercial laboratory at no expense to the Government. Tests for determining the suitability of aggregate shall include, but not limited to: gradation in accordance with ASTM C 136, abrasion resistance in accordance with ASTM C 131, clay lumps and friable particles in accordance with ASTM C 142, unit weight and voids in accordance with ASTM C 29/C 29M, and flat and elongated particles in accordance with ASTM D 4791. The use of an antistripping agent is subject to approval by the Contracting Officer.

1.8.3 Bituminous Material Source

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

1.8.4 Equipment Calibration

**NOTE: Bracketed statements apply to Fog Seal;
remove when Fog Seal is not requirede in the project.**

The Contractor shall furnish all equipment and materials and labor necessary to calibrate the bituminous distributor and the aggregate spreader. All calibrations shall be made with the approved job materials and prior to applying the coat materials to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.[Inspect all equipment prior to application of fog seal. Perform work to calibrate tank and measuring devices of the distributor. Perform inspection and calibration at the beginning of the work and at least once a day during construction.]

1.9 DELIVERY, STORAGE AND HANDLING

Deliver emulsified asphalt (fog seal) 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.

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.

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.

Tar grades RT-9 and RT-8 are suitable for most normal seal coat applications. Where cooler temperatures are anticipated, consider the use of grades RT-6 and RT-7. Consider the use of grades RT-10 and RT-11 in very warm climates when work will be performed during periods of high ambient temperature.

Bituminous material shall conform to [AASHTO M 20] [AASHTO M 81] [AASHTO M 82] [AASHTO M 226] or [ASTM D 490] [ASTM D 946] [ASTM D 977] [ASTM D 2027] [ASTM D 2028] [ASTM D 2397] [ASTM D 3381], [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.

Aggregate shall consist of crushed stone, crushed gravel, crushed slag, sand and screenings. The moisture content of the aggregate shall be [not

greater than [1] [3] percent] [such that the aggregate will readily bond with the bituminous material]. Drying may be required, as directed. The aggregate shall conform to the gradation shown in TABLE I. The aggregate gradation shall be allowed the tolerances 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 mm	100	--	--
9.5 mm	85-100	100	--
4.75 mm	10-30	85-100	100
2.36 mm	0-10	10-40	10-40
1.18 mm	0-5	0-10	0-10
0.30 mm	--	0-5	0-5

TABLE I. AGGREGATE GRADATIONS

(Percent by Weight Passing Square-Mesh Sieves)

Sieve Size	Gradation No. 1	Gradation No. 2	Gradation No. 3
1/2 in.	100	--	--
3/8 in.	85-100	100	--
No. 4	10-30	85-100	100
No. 8	0-10	10-40	10-40
No. 16	0-5	0-10	0-10
No. 50	--	0-5	0-5

TABLE II. AGGREGATE GRADATION TOLERANCES

Material	Tolerances
Aggregate passing the 9.5-mm sieve and larger sieves	Plus or minus 5 percent
Aggregate passing the 4.75 -mm and smaller sieves	Plus or minus 3 percent

TABLE II. AGGREGATE GRADATION TOLERANCES

Material	Tolerances
Aggregate passing the 3/8-in. sieve and larger sieves	Plus or minus 5 percent
Aggregate passing the No. 4 and smaller sieves	Plus or minus 3 percent

2.2.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

2.2.1.1 Film Retention

The aggregate shall exhibit not less than 95 percent retention of bituminous film.

2.2.1.2 Particle Shapes

The quantity of flat and elongated particles on any sieve shall not exceed 20 percent by weight when determined in accordance with ASTM D 4791. 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

The percent weight loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

2.2.1.4 Friable Particles

The amount of friable particles shall not exceed 0.1 percent of the total weight of aggregate sample when tested in accordance with ASTM C 142.

2.2.1.5 Crushed Slag

The dry weight of crushed slag shall not be less than 1200 kilograms per cubic meter (75 pcf), 75 pcf, as determined in accordance with ASTM C 29/C 29M.

2.2.1.6 Crushed Aggregate

Crushed aggregate retained on the 4.75 mm No. 4 sieve and each coarser sieve shall 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 shall be at least 30 degrees to count as two fractured faces.

2.2.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles of crushed stone, durable particles of crushed stone, slag, or gravel. The aggregate shall meet its requirements for stripping, abrasion resistance and percent friable particles as specified for coarse aggregate.

2.3 ANTISTRIPPING AGENT

The use of antistripping agent is subject to prior approval by the Contracting Officer.

2.4 EMULSIFIED ASPHALT FOR FOG SEAL

NOTE: In the 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. Anionic emulsions possess a negative charge on the asphalt droplets and cationic emulsions carry a positive charge on the asphalt droplets. All aggregate possess a negative surface charge at their natural pH. This negative surface charge varies in intensity depending on the geological source of the aggregate.

Emulsified asphalt for Fog Seal shall conform to ASTM D 977, [SS-1] [SS-1h] [_____] for anionic and ASTM D 2397 [CSS-1] [CSS-1h] [_____] for cationic materials.

2.5 WATER

Water shall be fresh, clean, and potable.

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. 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.

Damaged surface shall be repaired and cracks filled before starting work. Immediately before starting work, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated with power brooms or power blowers, if needed. Paint firmly bonded to the surface that has the chalk removed may remain. Material removed from the surface shall not be mixed 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

The bituminous material shall be spread 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.

TABLE III. APPLICATION OF MATERIAL

(Quantities Per Square Meter)

Gradation No.	Bitumen, liters	Aggregate, kilograms
1	0.60-0.90	8-10
2	0.45-0.60	5-8
3	0.45-0.60	5-8

TABLE III. APPLICATION OF MATERIAL

(Quantities Per Square Yard)

Gradation No.	Bitumen, gallons	Aggregate, pounds
1	0.15-0.20	15-20
2	0.10-0.15	10-15
3	0.10-0.15	10-15

3.2.2 Temperature

[Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm per second, 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.] [Tar application temperature shall be within the following ranges as directed:]

RT-6	-----	26-65 degrees C	80-150 degrees F
RT-7	-----	65-107 degrees C	150-225 degrees F
RT-8	-----	65-107 degrees C	150-225 degrees F
RT-9	-----	65-107 degrees C	150-225 degrees F
RT-10	-----	52-120 degrees C	125-250 degrees F
RT-11	-----	52-120 degrees C	125-250 degrees F.

3.2.3 Application of Bituminous Material

Following the preparation and inspection of the pavement surface, the seal coat material shall be applied at the specified rates. The bituminous material shall be uniformly applied in a single pass of the distributor and with either a double or triple lap spray over the surface to be sealed. Building paper shall be spread 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 application, the building paper shall be removed. Spots missed by the distributor shall be properly treated with bituminous material. No smoking, fires, or flames other than the heaters that are a part of the

equipment shall be permitted within 8 meters 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. [If tar is used, a full-face organic vapor-type respirator and protective creams shall be used by personnel exposed to fumes. Protective creams shall not be used as a substitute for cover clothing.]

3.2.4 Aggregate Application Rate

The aggregate shall be spread 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, adjustments shall be made in the number of pounds of aggregate required per square yard to insure a constant volume of aggregate per square yard 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:

**1 - 1 1/2 Minutes for cutback asphalt
3 - 4 Minutes for emulsified asphalt
1 Minute for asphalt cement**

The specified quantity of cover aggregate shall be spread uniformly over the bituminous material. Before the bituminous material is applied, sufficient aggregate to cover the distributor load of bituminous material shall be on trucks at the site of the work. No bituminous material shall be down more than 3 minutes before it is covered with aggregate. Spreading shall be done uniformly with aggregate-spreading equipment. Trucks spreading aggregate shall be operated backwards, covering the bituminous material ahead of the truck wheels. Areas having insufficient cover shall be lightly recovered with additional aggregate by hand during the operations whenever necessary.

3.2.6 Rolling and Brooming

Immediately following the application of cover aggregate, rolling operations shall begin. Rolling shall be accomplished with pneumatic-tired rollers. The rollers shall be operated at a speed that will not displace the aggregate. Rolling shall continue until the aggregate is uniformly distributed and keyed into the bituminous material. All surplus aggregate shall be swept off the surface and removed not less than 24 hours nor more than 4 days after rolling is completed.

3.3 FIELD QUALITY CONTROL - SEAL COAT

3.3.1 Tests

Field tests shall be performed in sufficient numbers to assure that the specifications are being met. Testing shall be the responsibility of the Contractor and shall be performed by 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

Gradation tests shall be performed in accordance with ASTM C 136. A minimum of one gradation shall be performed for every [_____] [metric tons tons] [cubic meters cubic yards] of aggregate to be placed, with a minimum of three gradations for each day's run. When [the source of materials is changed or] deficiencies are found, the gradation shall be repeated and the material already placed shall be retested to determine the extent of the unacceptable material. All in-place unacceptable material shall be replaced at no additional expense to the Government.

3.3.1.2 Abrasion Resistance

Abrasion resistance tests shall be performed in accordance with ASTM C 131. One test shall be performed for every [_____] [metric tons tons] [cubic meters cubic yards] of aggregate placed.

3.3.1.3 Stripping

Perform stripping test on aggregate from each source, in accordance with AASHTO T 182, prior to incorporation into the work and when the source is changed.

3.3.2 Bituminous Material Sample

A sample of the bituminous material used will be obtained by the Contractor 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, a test section at least 30 meters 100 feet long by 6 meters 20 feet wide shall be placed by the Contractor using the approved job materials. The materials shall be placed and rolled in accordance with the specified requirements. Tests shall be made to determine the application rates of the bitumen and aggregate. If the test indicates that the seal coat test section does not conform to the specification requirements, necessary adjustments to the application equipment and to the spreading and rolling procedures shall be made, and additional test sections shall be constructed for conformance to the specifications. Where test sections do not conform to specification requirements, seal coat shall be removed 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. Quality control sampling and testing during construction shall be performed as required in paragraph FIELD QUALITY CONTROL above.

3.5 FOG SEAL APPLICATION

3.5.1 Sample Application

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, 0.24 liter (one half pint) of the proposed asphalt emulsion and 0.24 liter (one half pint) of the proposed water shall be combined, agitated, and allowed to sit for a period of 24 hours to test their compatibility. If they prove to be incompatible, an approved chemical treatment shall be provided for all water used for dilution or a different and compatible source of water shall be selected.

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 recommended by the manufacturer. Apply the water diluted asphalt emulsion in at least three test sections; each a minimum of 30 m 100 feet long. The trial applications shall be made at the rates of [0.36] [____], [0.63] [____], and [0.90] [____] liters per square meter [0.08] [____], [0.14] [____], and [0.20] [____] gallons per 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. The rate which has been satisfactorily applied without leaving an excess of asphalt residue on the surface and has been approved, shall be used for the fog seal.

3.5.2 Application Inspection

Inspect application of fog seal for uniformity. [During application, take [____] 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, emulsion temperature during application, and rate of emulsion application.

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 liters per square meter 0.14 gallon per square yard. 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

Contractor shall 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 [2] [24] hours after final application of coatings, or for such time as necessary to prevent picking up. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller. Provide warning signs and barricades for proper traffic control, in accordance with DOT D-6.1.

-- End of Section --