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USACE / NAVFAC / AFCEC **UFGS-32 01 13.62 (November 2023)**

Preparing Activity: USACE **Superseding**
UFGS-32 01 13.62 (May 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
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DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 01 13.62

BITUMINOUS SURFACE TREATMENT [AND] [SAND SEAL]

11/23

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SECTION 32 01 13.62

BITUMINOUS SURFACE TREATMENT [AND] [SAND SEAL]
11/23

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NOTE: This guide specification covers the requirements for single and double bituminous surface treatment of pavements for airfields, roads, streets, parking areas, and other general applications.

Bituminous Surface and Sand Seal- A layer of spray-on bituminous material covered by aggregate used on existing unpaved or paved surfaces. The bituminous material can be hot liquid asphalt cement (Penetration graded, Asphalt Cement viscosity graded, Aged Residue graded, and Performance Graded), cutback asphalt, or asphalt emulsion with or without polymer modification. The most common are asphalt emulsions or cutback asphalts, with cutback use restricted to regions allowing environmental volatile release to the atmosphere.

The bituminous material is covered, normally within 1 minute, with a layer of approximately uniform size aggregate of about a 12.5 mm 1/2 inch nominal maximum size. BSTs can be applied in single, double, and triple applications, with a maximum thickness of about 19.5 mm 3/4 inch. DoD policy is to use single and double BSTs; the Designer needs to consider asphalt overlays if more than a double BST is needed. BSTs are low-cost maintenance methods, that produce all-weather surfaces, renew weathered pavement, improve skid resistance, improve lane demarcation, and seal pavement surfaces including small cracks.

This specification also addresses sand seals which are spray-applied liquid asphalt covered with sand, used to restore uniform cover, restore weathered pavement, and reduce raveling. The treated surface is rolled with a pneumatic roller. Delete sand seal aggregate and other paragraphs if not using sand seal. Do not apply over DoD airfield pavements

without approval of the Pavements Discipline Working Group or their designated representative. The Federal Aviation Administration has a similar product known as Seal Coat.

UFC 3-270-01 states not to use BSTs on airfield pavements except for overruns and not within 60.96 meters 200 feet of the threshold, but BSTs can be used on light-traffic roads, and parking lots. BSTs have been used as a dust palliative on unpaved airfield shoulders, and for unpaved airfield shoulder surface runoff erosion protection in arid regions where vegetation doesn't establish.

BSTs have fair performance to fill ruts up to 12.5 mm 1/2 inch depth. If the existing road is bleeding or flushing (appearance of liquid asphalt covering the existing pavement as if spilled on surface), do not use BST; sand seal or asphalt resurfacing is preferred. BSTs are also known as Chip Seals.

Alternative treatments to paved or unpaved surfaces are:

Section 32 12 36.13 BITUMINOUS FOG SEAL (ASPHALTIC SEAL AND FOG COATS) – A light spray application of asphalt emulsion to the surface of a chip seal, an open-graded mix, or a weathered asphalt surface. It is classified as a Preventive Maintenance process when nonstructural cracking or raveling first begins. Fog seals of asphalt emulsion slow the oxidation process of asphalt pavements but skid resistance is lowered.

Slurry Seal - A mixture of crushed, well-graded aggregate (e.g., fine sand, mineral filler) and asphalt emulsion that is spread over the entire pavement surface with either a squeegee or spreader box attached to the back of a truck. There is no UFGS for slurry seal. Application is restricted to parking lots, storage yards, container handling facilities, and other similar low-speed pavements due to loss of skid resistance. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative

Micro-Surfacing - Applied in a process similar to slurry seals, micro-surfacing consists of a mixture of cationic quick set emulsified asphalt, mineral aggregate, mineral filler, water, and additives. Micro-surfacing provides friction and rapid roadway surface correction. With a special mix design, it can fill ruts up to 19.5 mm 1.5 inches deep. Material is mixed in specialized, compartmentalized, self-powered trucks, and placed on the pavement using a screed box with auger. There is no UFGS for Micro-Surfacing. Application is restricted to parking lots, storage yards, container handling

facilities, and other similar low-speed pavements due to loss of skid resistance. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative

Cape Seal – An application of micro-surfacing a few days after construction of a BST; used to cover the aggregates and improve aggregate bonding. There is no UFGS for Cape Seal. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative

Sandwich Seal – Process is to spread large aggregate, spray-apply emulsion, then cover with smaller aggregate to lock in larger aggregate. Requires the use of very clean aggregate. Used to improve skid resistance and seal pavements. There is no UFGS for Sandwich Seal. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative

Rejuvenator, Spray-On – Rejuvenators are commercially available products (proprietary) designed to restore original properties to aged (oxidized) asphalt binders by restoring the original ratio of asphaltenes to maltenes. A rejuvenator will retard the loss of surface fines and reduce the formation of additional cracks. Rejuvenators will not fill or remove existing cracks unless cracking is very minor hairline cracking. Bituminous-based spray-on surface rejuvenators are covered in Section 32 01 13.64 REJUVENATION OF ASPHALT PAVEMENT SURFACES. There is no UFGS for bio-based rejuvenators.

Rejuvenator, Mix-in-Place – Designed to be used with advanced cold or hot in-place recycling of existing aged asphalt pavements which exhibit relatively high stiffness due to the aged binder. Proprietary chemical rejuvenators reduce the brittleness, but also affect the fatigue and thermal cracking properties of the recycled pavement. DoD provides a mix-in-place rejuvenator procedure in TM 5-822-10/AFM 88-6 Chapter 6. Section 32 01 16.70 COLD-MIX REUSED ASPHALT PAVING uses emulsion recycling agents and Section 32 01 16.74 IN PLACE HOT REUSED ASPHALT PAVING uses ASTM D4552 recycling agents. Substantial testing and engineering is required to specify the correct rejuvenator or emulsion and resultant mixture properties. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative.

Cold or Hot In-Place Recycling - Detailed discussions are provided in TM 5-822-10/AFM 88-6

Chapter 6. Recent literature further refines cold in-place recycling (CIR) involves the recycling of the asphalt portion of flexible or composite pavements. This includes recycling of both hot-mix asphalt (HMA) layers and surface treatments, including chip, slurry, and cap seals of flexible pavements, mixed with asphalt emulsion or foamed asphalt. Full-depth reclamation (FDR) includes the recycling of the entire depth of the flexible pavement and, in some cases, a portion of the subgrade with asphalt, cement, or lime products. Do not apply over DoD airfield pavements without approval of the Pavements Discipline Working Group or their designated representative. Section 32 01 16.70 COLD-MIX REUSED ASPHALT PAVING uses emulsion recycling agents and Section 32 01 16.74 IN PLACE HOT REUSED ASPHALT PAVING used ASTM D4552 recycling agents.

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.

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 for waybills and quantities. Keep paragraph Waybills and Delivery Tickets for lump sum projects, they are for Government use to validate payment. For determining quantities for Government estimates, refer to application rates in UFC 3-270-01, Chapters 6 and 7.

****

1.1.1 Measurement

1.1.1.1 Bituminous Material

The bituminous material paid for will be the measured quantities of residual bituminous material used in the accepted work as approved by the Contracting Officer, provided that the measured quantities are not 10

percent over the specified quantities. Any amount of bituminous material more than 10 percent over the approved application rate will be deducted from the measured quantities. Express measured quantities in[metric tons 2000 pound tons.][the number of liters gallons of material used in the accepted work, corrected to liters at 15.6 degrees C gallons at 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.

1.1.1.2 Aggregate

The amount of aggregate paid for will be the number of [metric 2000 pounds tons] [cubic meters yards] of aggregate placed and accepted in the completed work or placed in authorized stockpiles.

1.1.1.3 Quantity Limits

****
NOTE: Only the appropriate application rates consistent with the gradations of Table III will be retained.
****

Spread the bituminous material and aggregate within the quantity limits shown in PART 2; base the bids on the mean of the values in the tables for bituminous material and aggregate application rates. Vary the individual quantities of bituminous material and aggregate to meet specific field conditions at all times during progress of the work, as approved by the Contracting Officer, without adjustments to Contract unit prices.

1.1.1.4 Waybills and Delivery Tickets

Submit waybills and delivery tickets during progress of the work. Before the final statement is allowed, file with the Contracting Officer certified waybills and certified delivery tickets for all bituminous and aggregate materials used in the construction of the pavement covered by the Contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

1.1.2 Payment

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

Accepted measured quantities of bituminous material and aggregate will be paid for at respective unit prices. Payment will constitute full compensation for providing all materials, equipment, plant, test section, testing, and tools, and for all labor and other incidentals necessary to complete work.

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.

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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 R 102	(2022) Standard Practice for Emulsified Asphalt Chip Seal Design

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2023) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
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; R 2023) 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	(2020) Standard Specification for Emulsified Asphalt
ASTM D1139/D1139M	(2015) Aggregate for Single or Multiple Bituminous Surface Treatments
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 D2397/D2397M	(2020) Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	(2023) 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
ASTM D6373	(2023) Standard Specification for Performance Graded Asphalt Binder

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2018) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

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

1.3 SUBMITTALS

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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-03 Product Data

Waybills and Delivery Tickets; G, [_____]

Bituminous Distributors; G, [_____]

Mechanical Spreader; G, [_____]

Mineral Aggregate; G, [_____]

Coarse Aggregate; G, [_____]

Fine Aggregate; G, [_____]

Cutback Asphalt; G, [_____]

Emulsified Asphalt; G, [_____]

Asphalt Cement; G, [_____]

Power Rollers; G, [_____]

Power Brooms and Power Blowers; G, [_____]

Scales; G, [_____]

Sand Seal Aggregate; G, [_____]

SD-04 Samples

Coarse Aggregate; G, [_____]

Bituminous Materials; G, [_____]

Fine Aggregate; G, [_____]

SD-06 Test Reports

Bituminous Materials; G, [_____]

Aggregate Testing; G, [_____]

Test Section; G, [_____]

Inspection Reports; G, [_____]

1.4 QUALITY CONTROL

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NOTE: For projects where surface treatment is the primary definable feature of work, the testing laboratory can be the Contractor's laboratory, the emulsion manufacturer's laboratory, or an independent commercial laboratory. Frequently, the emulsion manufacturer is the most knowledgeable of emulsion/aggregate interactions in the local area. What is important is the laboratory is accredited as referenced. Select the appropriate quality control section for the project and include with the Contract. If surface treatment is a minor part of a project, and an independent commercial laboratory is already part of the Contract, may select that option for continuity, provided accredited in the appropriate tests.

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Sampling and testing is the responsibility of the Contractor. Perform sampling and testing using [a] [an independent commercial] testing laboratory accredited in the required tests in accordance with Section 01 45 00 QUALITY CONTROL approved by the Contracting Officer. Sampling must be in accordance with ASTM D75/D75M for aggregates and ASTM D140/D140M for bituminous material. Contracting Officer may inspect testing facilities. Perform tests in the numbers, and at the location and times indicated, to ensure that the materials meet specified requirements. Submit copies of the test results within 24 hours after completion of each test.

1.4.1 Preconstruction Sampling and Testing

Conduct preconstruction sampling and testing of aggregates and bituminous materials in Part 2 PRODUCTS. Repeat testing when there is a change in source, size, or material type. Submit copies of test results within 24

hours after completion of each test.

1.4.2 Equipment Calibration

Furnish all equipment, materials, and labor necessary to calibrate equipment in accordance with paragraph EQUIPMENT, TOOLS, AND MACHINES. Perform all calibrations with the approved job materials and prior to applying the specified coatings to the prepared surface. Inspect all equipment prior to start of work and at regular intervals as needed during work.

1.4.3 Construction Quality Control Testing

Sample and conduct aggregate gradation tests one working day prior for each material used, and repeat each day of application. Conduct aggregate testing (wear, soundness, deleterious material and stripping) for each 18,000 metric tons 20,000 tons of aggregate used in the project, or fraction thereof. Submit copies of test results, within 24 hours after completion of each test. Repeat testing when there is a change in source, size, or material type. Conduct measurement and testing each application day to ensure bituminous and aggregate application rates are satisfactory in accordance with paragraph FIELD QUALITY CONTROL.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver bituminous materials to the site in a homogenous and undamaged condition. Inspect the materials for contamination and damage. Unload and store the materials with minimal handling. Bituminous materials, if stored on project site, must be stored in a manner recommended by the bituminous supplier and not exceed storage life or temperatures ranges.[Do not allow asphalt emulsions to freeze or boil.] Replace defective or damaged materials.

1.5.1 Bituminous Delivery Tickets

For every distributor load of bituminous material brought to site, provide the following: manufacturer, manufacture date, lot number, storage tank number, total volume of bituminous material on truck, weight of bituminous material, and weight of dilution water added for emulsions. Include data for the type of bituminous material used: percent oil distillate by volume of emulsion (prior to field dilution), cutback residue from distillation to 360 C 680 F, penetration of penetration grade at 25 C 77 F.

1.5.2 Aggregate Delivery Tickets

For every load of aggregate brought to site provide the aggregate source, supplier's aggregate size designation, size designation in accordance with this Section (Gradation 1, 2, 3, or 4), and the weight of aggregate on the truck.

1.5.3 Safety Precautions

Smoking or open flames will not be permitted within 8 meters 25 feet of heating, distributing, or transferring operations of bituminous materials that are flammable.

1.6 PROJECT SITE CONDITIONS

1.6.1 Environmental Requirements

Apply the bituminous surface treatment [and]sand seal when the existing surface is dry, and when the weather is not foggy, rainy, or when the wind velocity will prevent the uniform application. Apply bituminous surface treatment only when the existing surface or base course is dry or contains moisture not in excess of the amount that will permit uniform distribution of the asphalt material and provide the desired adhesion between the asphalt material and the materials underneath and above. Do not apply bituminous surface treatment when either the atmospheric temperature, in the shade, is below 10 degrees C 50 degrees F or the pavement surface to be treated is below 20 degrees C 70 degrees F unless otherwise directed. Do not apply if wind disperses bituminous material application. Delay application if rain appears imminent within 8 hours following time of application.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

****
NOTE: Edit the following paragraph for the work included in the project.
****

Provide bituminous surface treatment [and]sand seal on existing prepared pavement surface.

2.2 EQUIPMENT, TOOLS, AND MACHINES

Provide equipment for the purpose intended and properly maintained in satisfactory and safe operating condition at all times. Discontinue the use of equipment which fails to safely produce satisfactory work and replace with satisfactory equipment.

2.2.1 Scales

****
NOTE: For CONUS, select NIST 44 Class III L. For OCONUS, select the local governing authority, note the tolerances are the same as NIST 44 Class III L. For the scale divisions, 9 kg 20 lb is common for manufacturers; e.g. 20 X 2000=40,000 lb capacity for the lowest capacity Class III L scale.
****

Use standard truck scales of the beam type equipped with a weight-recording device. Use scales with sufficient size and capacity to accommodate the trucks used in hauling aggregates. Keep the necessary number of standard weights on hand, at all times, for testing the scales. Permanent or portable scales used for payment and application rates must be calibrated by a certified calibration agency before commencing work, following the method and calibration frequency [in accordance with NIST HB 44 Class III L.][recognized by governing local authority in which the project is located with the scale division 2 kg 5 lb or greater and a minimum of 2000 divisions and a maximum of 10,000 divisions. Scale acceptance tolerance is 2 kg 5 lb for 2000 scale divisions, and increases

1 kg 2.5 lb for each 500 increase of scale divisions. Example: for 5000 scale divisions, tolerance is 2 kg 5 lb + (6 x 1kg 2.5 lb) = 8 kg 15 lb.] Conduct calibrations in presence of the Contracting Officer. Provide certified calibration documentation. Recalibrate at 6 months from date of last approved calibration for permanent scales, and weekly for portable scales, for the duration of the Contract. Recalibrate scales if previous recognized calibration is outdated. Recalibrate scales or equipment if directed by the Contracting Officer. Provide adequate protection for the indicating and recording devices of the scales.

2.2.2 Bituminous Distributors

Provide self-propelled distributors with pneumatic tires of such size and number to prevent rutting, shoving, or otherwise damaging the surface being sprayed. Clean distributor trucks and lines of all materials before loading for project; open inspection hatches if requested by the Contracting Officer. Include with 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 hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Provide a distributor that is approved by the Contracting Officer and:

a. Is capable of circulating and agitating the bituminous material during the heating process.

b. Is capable of spraying in a triple overlap. Equip the spray bar with the appropriate nozzle sizes to achieve a uniform bituminous application across the pavement at the specified rate and acceptable distributor speed. Adjust all nozzles to 30 degrees from the spray bar long axis, or to the same angle between 15 and 30 degrees only as recommended by the manufacturer and Contractor will demonstrate that the specified application rate is achieved. Only use the calibrated wrench provided by manufacturer to adjust nozzle angle.

c. Is designed and equipped to spray the bituminous material at variable widths at the specified temperature, at readily determined and controlled total liquid rates from 0.14 to 4.5 liters per square meter 0.03 to 1.0 gallons per square yard. Operate the distributor within 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.

d. Each nozzle to be within 10 percent of the average flow rate for all the nozzles. Repair/replace out of tolerance nozzles.

e. Provide certification of distributor radar calibration for equipment with mounted radar which monitors travel speed and distance, used for the project. The date of calibration is to be no more than 6 months prior to project application

2.2.2.1 Distributor Calibration

Verify the distributors application rate no more than 96 hours prior to the start of bituminous application following ASTM D2995. Use ASTM D2995 Method A for cutbacks and asphalt cements, use ASTM D2995 Method B for emulsified asphalts. For each day of application, validate using the

dipstick method of volume applied divided by the applied area. Repeat ASTM D2995 calibration after 7 calendar days after start of project application. May use Berber carpet for ASTM D2995 Method A. Submit bituminous material application rate and the residual asphalt application rate (for emulsified asphalts and cutbacks) results to Government. Provide the following information for ASTM D2995 Method A:

a. Project name, Contract number,and testing date.

b. Emulsified, cutback, or asphalt cement material.

c. Distributor make, model and serial number.

d. Distributor setup at the time of calibration including target application rate (shot rate as shown on the computer control system), spray bar height, and distributor truck speed.

e. Dry weight of each pad prior to application.

f. Wet weight of each pad immediately after application.

g. For emulsions, oven dry weight of each pad in 15 minute increments until constant weight (all water has evaporated).

2.2.3 Mechanical Spreader

****
NOTE: If a mechanical spreader of the type described is not available, contact the Pavements Discipline Working Group for direction.
****

Provide a self-propelled aggregate spreader that is capable of uniformly distributing aggregate at the specified rates. Equip the spreader with a hopper at the rear that accepts bulk aggregate from a dump truck, a delivery or belt system internal to the machine that carries the aggregate to the front of the machine, and a series of gates on the front hopper that applies a uniform layer of aggregate across the width of the roadway. Use a front hopper at least 3.6 meters 12 feet wide and adjustable so the width of the laydown can be adjusted by turning gates on or off. Connect the spreader to the dump truck and pull it along the roadway, preventing excessive spillage between the two. Apply a uniform, single, even layer of aggregate across the full width of the binder at the specific rate with the spreader. Truck-attached spreader boxes [are not allowed.] [are only to be used in areas not subject to aircraft or vehicle traffic and as shown on plans.] Calibrate aggregate spreaders no more than 96 hours prior to the first day of each aggregate layer spreading. Calibrate the aggregate spreader by dividing the dry weight of aggregate, contained on a series of pads laid across the pavement for the full width of the spreader, by the area of the pads. Recalibrate spreader after 7 calendar days after start of project application. Submit calibration measurements, aggregate spread rates, and spreader speed to the Contracting Officer.

2.2.4 Bituminous Storage Tank

Provide bituminous storage 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.

Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot come in contact with the bituminous material. Affix an armored thermometer to the tank with a range from 4.4 to 204.4 degrees C 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times. Clean tanks and pipelines of all materials before loading for project; open inspection hatches if requested by the Contracting Officer.

2.2.5 Power Rollers

Use only rollers conforming to the following requirements:

a. Use self-propelled pneumatic-tired rollers having wheels mounted on two axles in such manner that the rear tires will not follow in the tracks of the forward group. Provide rollers with four or more tires on the front axle and five or more tires on the rear axle. Maintain uniform tire inflation to not less than 414 kPa 60 psi nor more than 552 kPa 80 psi pressure. Equip pneumatic-tired rollers with boxes or platforms for ballast loading. Load rollers so that the tire print width of each wheel is not less than the clear distance between tire prints. All rollers used on sand seals are to follow this requirement.

b. Use steel-wheeled rollers having at least one steel drum and weigh a minimum of 4.5 metric tons 5 tons. Equip steel-wheeled rollers with adjustable scrapers.

c. Use combination rollers meeting the requirements of a pneumatic-tired roller in the front and a steel-wheeled roller in the rear, with a gross weight of 4.5 metric tons 5 tons or more.

2.2.6 Power Brooms and Power Blowers

Provide power brooms and power blowers capable of cleaning surfaces to be treated.

2.3 MATERIALS

2.3.1 Bituminous Materials

****

NOTE: In some states and localities, the use of cutback asphalt is prohibited or curtailed by local air pollution regulations. In areas where cutback asphalt is restricted by air pollution regulations, asphalt cement or emulsified asphalt should be used. RC-800 is most commonly recommended for surface treatments. Where cooler temperatures are anticipated, use of RC-250 may be desirable. The type of cutback or emulsion to be used will depend on local conditions and temperature; and these factors must be carefully considered in making the selection for surface treatments.

Penetration Graded, Viscosity Graded and Performance Graded asphalt cements can also be used. A majority of surface treatments utilize asphalt emulsion. Sand seals often use the same bituminous materials as BSTs. Some agencies have substantial experience with BSTs and sand seals and have advanced

bituminous materials well-matched to regional aggregates, climates, and application rates; it is acceptable for the Designer to research and edit the specification to the local practices, with prior approval of Pavements Discipline Working Group or its representative and documented in the design analysis.

Include bracketed sentence if a sample is desired. For enduring facilities or applications with activity projected for 5 or more years, recommend always requesting sample.

****

For each bituminous material used, provide manufacturer, manufacture date, lot number, and storage tank number. Include data for the type of bituminous material used: percent oil distillate by volume of emulsion, cutback residue from distillation to 360 C 680 F, penetration of penetration grade at 25 C 77 F.[From each source of supply, submit a 4.0 liter 1.0 gallon sample of bituminous material sampled at the project site for the Government to store for one year in case of latent issues.]

[2.3.1.1 Cutback Asphalt

****

NOTE: Some regions and designers may have experience or local practice to use medium cure cutbacks on BSTs. If this is not the case with known and documented local practice, delete the following bracketed sentence.

****

Use rapid-curing cutback asphalt conforming to ASTM D2028/D2028M, Designation [RC-250] [RC-800] [RC-3000] [_____]. Submit temperature-viscosity relationship of cutback asphalt.[Use medium-curing cutback asphalt conforming to ASTM D2027/D2027M, Designation [MC-3000] [_____].]

]2.3.1.2 Emulsified Asphalt

****

NOTE: ASTM D977 RS-1, RS-2, HFRS-2, and ASTM D2397 CRS-1 and CRS-2 are very commonly used with BSTs. However, the Designer should allow the use of the local agency emulsions meeting either of the ASTMs, as some emulsions adhere better to the local aggregate than others, local knowledge and testing is required for such determination.

Rapid setting asphalt emulsions should be selected where the BST will be exposed to traffic immediately after construction. By breaking or setting quickly, the asphalt cement in the asphalt emulsion is able to develop a strong bond with the cover aggregate, providing the BST with more resistance to the disintegrating forces of traffic. Fast traffic should never be allowed on newly constructed BSTs.

Rapid-setting asphalt emulsions may be modified with

a polymer additive. ASTM does not have published specifications for polymer modified asphalt emulsions, and most specifying agencies have developed their own specifications for them. AASHTO M316 does address cationic polymer modified asphalts typically used for BSTs. Polymer-modified asphalt emulsions are generally used for BST of pavements that are subject to higher traffic volumes. The polymer modified asphalt emulsions offer a more resilient surface course and tend to reduce chip or aggregate loss due to traffic and environmental conditions. Adjustments may also be made to the asphalt used in the emulsion based on climatic conditions. Edit the bracketed sentence for polymer modified emulsified asphalts, insert the local agency criteria that is to be used.

Even though rapid setting asphalt emulsions are most commonly used for BST, there may be certain applications where medium setting asphalt emulsions provide better performance. Graded aggregate BSTs (not used in this specification) most often use medium-setting high float (HFMS-1 or HFMS-2) asphalt emulsion. Medium setting asphalt emulsions may also work better with cover aggregate that is "dirty" or contains larger amounts of fine particles than desirable.

****

Use [rapid-setting][_____] emulsified asphalt conforming to ASTM D977, [Grade RS-1, or RS-2, HFRS-2] [_____] or ASTM D2397/D2397M, [Grade CRS-1 or CRS-2] [_____][or polymer modified emulsified asphalt conforming to [_____]]. Do not dilute emulsified asphalt.

[2.3.1.3 Asphalt Cement

Use asphalt cement conforming to ASTM D946/D946M, Penetration Grade [120-150] [200-300] or ASTM D6373, Performance Graded Asphalt Binder [PG 64-22] [PG 58-28] [PG 52-34] [_____], ASTM D3381/D3381M Viscosity-Graded Asphalt Binder [AC-2.5] [AC-5] [AC-10] [AC-20] [AC-30] [AC-40]. Submit temperature-viscosity relationship of asphalt cement.

]2.3.2 Application Rate for Bituminous Surface Treatment

****

NOTE: Designer is to evaluate the pavement and determine the traffic correction factor and pavement correction factor following procedures in AASHTO R 102. Some agencies may have a more refined version of AASHTO R 102; Designer can review and use if alternative method is at least as adequate as AASHTO R 102 and document in design analysis. Select bracketed application rates for emulsion and cutbacks as appropriate for project.

****

Contractor to determine the bituminous material application rate and aggregate spread rate following AASHTO R 102 as approved by the Contracting Officer. The Traffic Correction Factor is [_____]. The

pavement correction factor is [_____]. AASHTO R 102 provides the residual asphalt cement application rate; calculate and submit the bituminous material application rate of [emulsified asphalt][and][cutback asphalt] for the bituminous distributor.

2.3.2.1 Application Rate Adjustments

Vary the individual quantities of bituminous material and aggregate to meet specific field conditions during progress of the work, as approved by the Contracting Officer[, without adjustments to Contract unit prices]. Aggregate weights shown are for aggregates having a specific gravity of 2.65. Adjust the number of kilograms pounds required if the specific gravity of the aggregate used is other than 2.65 in order to ensure a constant volume of aggregate per square meter yard of treatment.

2.3.3 Mineral Aggregate

Provide aggregate consisting of crushed stone,[crushed slag,] or crushed gravel. The portion of material retained on the 4.75mm No. 4 sieve is coarse aggregate. The portion of material passing the 4.75 mm No. 4 sieve is fine aggregate.

2.3.3.1 Coarse Aggregate

Provide coarse aggregate of such nature that thorough coating of bituminous material, used in the work, will not strip off upon contact with water when tested using ASTM D3625/D3625M.

2.3.3.1.1 Moisture

Maintain aggregate moisture content so that the aggregate will be readily coated with the bituminous material.

2.3.3.1.2 Gradation

Use aggregate conforming to the gradation shown below. Determine gradation of the aggregates by ASTM C136/C136M.

2.3.3.1.3 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 Method A and include all of the reportable items for Method A. 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.

2.3.3.1.4 Abrasion Resistance

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

2.3.3.1.5 Soundness Test

****

NOTE: The magnesium-sulfate soundness test is to be used in excluding aggregates known to be unsatisfactory or for evaluating aggregates from new sources. The maximum allowable percentage of loss

will be inserted in the blank and normally should be within the range of 10 to 20 percent. The values used will be based on knowledge of aggregated in the area that have been previously approved or that have a satisfactory service record in bituminous pavement construction for at least 5 years and will assure that aggregates from new sources will be equal to or better than these aggregates. Default value should be 18 for magnesium sulfate and 12 for sodium sulfate.

****

Perform the soundness test as specified by ASTM C88 to ensure that aggregates have a weight loss not greater than [18] [_____] percent when subjected to five cycles of the magnesium sulfate test or [12] [_____] percent when subjected to five cycles of the sodium sulfate test.

2.3.3.1.6 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.

2.3.3.1.7 Stripping Test

Deleterious substances must not exceed the requirements of ASTM D1139/D1139M.

[2.3.3.1.8 Crushed Slag

****

NOTE: Delete crushed slag if it is not common in the locality.

****

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.

]2.3.3.1.9 Fractured Faces

Coarse aggregate 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.

2.3.3.2 Fine Aggregate

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

2.3.3.3 Bituminous Surface Treatment Gradations

****

NOTE: Delete the sentence and table below that does not apply. If project has both single and double bituminous surface treatments, keep both.

****

[Select gradations for Single Bituminous Surface Treatment from Table I.] [Select gradations for Double Bituminous Surface Treatment from Table II.]

****

NOTE: Designer to select the aggregate size from Table I and II. Note that for single BST, Gradation 1 can only be used with approval with the Pavements Discipline Working Group or its representative. For estimating quantities for unit pricing, Designer may use local experience or from Table III. Generally, the coarser or more uniformly graded aggregate will be the heavier application rate. For an initial application on unpaved surfaces (e.g. aggregate or granular base, sand, lime or cement stabilized layer, or similar), use a prime coat and the double BST.

For single BST do not use Gradation 1 unless the Designer has direct knowledge that this is an established local practice and there is an established engineering reason for doing so. Edit tables as appropriate for application; delete if not using Bituminous Surface Treatments (BST).

For double surface treatment, select the required gradations (either No.1 and No. 2 or No. 3 and No. 4) from Table II.

Delete Table I if not using single BST; delete Table II if not using double BST.

****

[

TABLE I. AGGREGATE GRADATION SINGLE BITUMINOUS SURFACE TREATMENT
(PERCENT BY WEIGHT PASSING)

Sieve Designation (mm)	No. 1	No. 2	No. 3
25.0 1 inch	100	--	--
19.0 3/4 inch	90-100	100	--
12.5 1/2 inch	20-55	90-100	100
9.5 3/8 inch	0-15	40-70	85-100
4.75 No. 4	0-5	0-15	10-30
2.36 No. 8	--	0-5	0-10
1.18 No. 16	--	--	0-5
0.075 No. 200	0-1	0-1	0-1

]

[

TABLE II. AGGREGATE GRADATION DOUBLE BITUMINOUS SURFACE TREATMENT (PERCENT BY WEIGHT PASSING)1				
Sieve Designation (mm)	No. 1	No. 2	No. 3	No. 4
25.0 1 inch	100	--	--	--
19.0 3/4 inch	90-100	--	100	--
12.5 1/2 inch	20-55	100	90-100	--
9.5 3/8 inch	0-15	85-100	40-70	100
4.75 No. 4	0-5	10-30	0-15	85-100
2.36 No. 8	--	0-10	0-5	10-40
1.18 No. 16	--	0-5	--	0-10
0.30 No. 50	--	--	--	0-5
0.075 No. 200	0-1	0-1	0-1	0-1
1 Select Gradation 1 and 2, or Gradation 3 and 4. Gradations 1 or 3 must be the first aggregate application for double bituminous surface treatments.				

]

2.3.3.4 Aggregate Application Rates – Bituminous Surface Treatments

****

NOTE: If only single or double bituminous surface treatment is being used, delete the bracketed sentence as appropriate. If the project requires both, keep both sentences.

****

[For single Bituminous Surface Treatment use Gradation [1] [,or] [2] [or,] [3] of Table III.] [For Double Bituminous Surface Treatment, use [Gradation 1 for the first application and Gradation 2 for the second application] [,or] [Gradation 3 for the first application and Gradation 4 for the second application] of Table III.]

TABLE III. Bituminous Surface Treatment Aggregate Application Rates, pounds/cubic yard				
Aggregate Gradation	Gradation 1	Gradation 2	Gradation 3	Gradation 4
Single	35-50	20-35	15-25	---
Double	28-45	20-30	20-35	10-15

2.3.4 Sand Seal Aggregate

****

NOTE: 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. Adjust the moisture content based upon local knowledge, otherwise,

select the bracket to readily bond.
****

Use mineral 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 by the Contracting Officer, to improve bonding. Use aggregate conforming to gradation shown in TABLE IV.

TABLE IV. SAND SEAL AGGREGATE GRADATIONS (Percent by Weight Passing Square-Mesh Sieves)

Sieve Designation (mm)	Percent Passing
12.5 1/2 inch	---
9.5 3/8 inch	---
4.75 No. 4	100
2.36 No. 8	10-40
1.18 No. 16	0-10
0.3 No. 50	0-5
Aggregate passing the 4.75 No. 4 and smaller sieves	Tolerance of plus or minus 3 percent

2.3.4.1 Sand Seal Application Rates

Spread the bituminous material at the rate of 0.45-0.60 liters per square meter 0.10-0.15 gallons per square yard. Spread the aggregate at a rate of 5-8 kg per square meter 10-15 pounds per square yard. The aggregate weights identified 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 kilograms pounds of aggregate required per square meter yard to ensure a constant volume of aggregate per square meter yard of treatment. 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. Apply additional sand as blotter if bituminous material bleeds through to the surface.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Site Protection

****

NOTE: Modify the bracketed sentence as appropriate for the project location. Public notices and signage 3 days prior is reasonable, unless local ordinance requires otherwise. Designer is to identify temporary parking for homes or business access that is interrupted by the work and curing. Delete paragraph if not needed.

****

[Provide public notices and post signage at least [3] [_____] days in advance of starting work. Plan detours as provided in the Contract prior to performing work at site.]During work, protect adjacent buildings, structures, vehicles, manhole covers, inlet grates, and trees to prevent splattering or marring. Protect manhole covers, inlet grates, electrical boxes, utility boxes, and other similar pavement penetrations with building paper cut to size to protect the entire casting size and opening. If the building paper becomes dislodged, replace with plywood, or other continuous board medium, cut to fit and of a thickness sufficient to remain in place during bituminous and aggregate application. Open and remove debris from all covers, grates, and boxes after bituminous and aggregate application.

3.1.2 Traffic Control

Provide warning signs and barricades for proper traffic control, in accordance with [MUTCD] [local governing traffic control authority].

3.1.3 Surface Preparation

****

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

****

[Complete repairs to existing pavement as specified in the Contract documents [and] [or] [as shown on plans].]Immediately before applying the first course of bituminous material, clean the surface of loose material with power brooms or power blowers. Take care to remove all dirt, clay, and other loose or foreign matter. Flush the surface with water when necessary to remove dirt or debris not removed by sweeping or brooming; allow the surface to dry after flushing.

3.2 STOCKPILING ON SITE

Use the following aggregate stockpiling techniques for stockpiles at the project site:

a. Build the stockpile on a platform acceptable to the Contracting Officer [by either a][600 mm 24 inch sacrificial layer beneath the entire area of the piles and where the loader will operate] [300 mm 12 inch thick layer of the project aggregate stabilized with Portland cement or asphalt] [300 mm 12 inch thick lime stabilized subgrade in accordance with Section 32 11 13.13 LIME TREATED SUBGRADE] [on existing pavement as shown on plans] [on existing pavement selected by the Contractor and as approved by the Contracting Officer]. All platforms except existing pavement must be removed at end of project.

b. Use a computer-automated radial telescoping stacker that makes small

windrow piles no more than 1.8 meters 6 feet high and then automatically adjusts position and height to make larger windrow piles.

c. Build piles with end loaders to a maximum height from ground level of the bucket hinge point.

3.3 PRIME COAT

****
NOTE: For unpaved surfaces such as aggregate base course or unpaved shoulders, where there is no previous hard pavement, apply a prime coat and then a double BST. If using an emulsion prime, ensure schedule allows for full penetration and curing before double BST is applied. Penetrating Emulsified Prime (PEP) may provide better penetration and curing, but not less than 4 hours; edit prime coat specification accordingly.
****

Apply bituminous prime coat following Section 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.4 TEST SECTION

****
NOTE: Adjust test section length for the project conditions. Typical BST test sections are 60 to 150 meters 200 to 500 feet in length. For sand seals, 30 meters 100 feet is common. Select brackets for BST and/or Sand Seal as appropriate for project.
****

Determine the required application rates from test sections on the pavement to be treated.

3.4.1 Bituminous Distributor Temperature

Ensure bituminous material is at the recommended application temperature and 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 from nozzles after shut-off.

3.4.2 Test Section Construction

Construct three test sections in the presence of the Contracting Officer at least [60 to 150 meters 200 to 500 feet] [_____] long for bituminous surface treatments. Construct each test section at the start of the project in a location agreed upon with the Contracting Officer for each layer of Bituminous Surface Treatment. For each test section, vary the bituminous application rate or aggregate spread rate. [For Double Bituminous Surface Treatments, the test sections must be at the start of each layer.]Construct three test sections in the presence of the Contracting Officer at least [30 meters 100 feet] [_____] long for sand seals. Construct each test section at the start of the project in a location agreed upon with the Contracting Officer.

3.4.3 Test Section Evaluation

Evaluate each test section for acceptable application of bituminous material, aggregate spread rate, rolling pattern, time to complete rolling, proper aggregate embedment after rolling, and brooming operations. Contractor must adjust application rates, equipment, and operations as necessary to demonstrate compliance with specification, and as approved by the Contracting Officer. Application rates are as approved by the Contracting Officer to bind the aggregate without bleeding, flushing, or streaking. Continue constructing test sections until an acceptable test section is achieved. Summarize the results, including the recommended application rates, and submit to the Contracting Officer within 24 hours of test section completion. Bituminous surface treatment [and]Sand seal construction may begin as soon as acceptable test section is demonstrated. Sweep, remove, or recoat unacceptable test sections as approved by the Contracting Officer with adjusted application rates to avoid unbound aggregate on the surface, bleeding, or flushing of the bituminous material, at no additional cost to Government.

3.5 BITUMINOUS APPLICATION TEMPERATURE

****

NOTE: Emulsified asphalt temperatures obtained from Asphalt Emulsion Manufacturers Association & Asphalt Institute 2008; A Basic Asphalt Emulsion Manual Series No. 19 (MS-19), Fourth Edition. Lexington, KY: The Asphalt Institute. Polymer modified asphalt emulsions and polymer modified asphalt cements may require different application temperatures unique to the producer. Designer may adjust temperature to local materials or allow producer to submit recommended application temperatures.

****

3.5.1 Cutback Asphalt

Apply cutback asphalt in the range of[38 to 93 degrees C 100 to 200 degrees F] [_____] [or as recommended by cutback asphalt producer].

3.5.2 Emulsified Asphalt

Apply asphalt emulsions in the range of[20 to 71 degrees C 70 to 160 degrees F] [_____] for all grades [except for RS-2, HFRS-2, CRS-1, and CRS-2 the range is[50 to 85 degrees C 125 to 185 degrees F] [_____]] [and for RS-1 the range is[20 to 60 degrees C 70 to 140 degrees F] [_____]] [or as recommended by emulsified asphalt producer].

3.5.3 Asphalt Cement

Apply asphalt cement in the range of[163 to 191 degrees C 325 to 375 degrees F] [_____] [or as recommended by asphalt cement producer].

3.6 APPLICATION OF FIRST COURSE

3.6.1 Bituminous Material

****

NOTE: Application temperatures will vary with the grade of asphalt used. Recommended materials and

application temperatures may be found in paragraph Bituminous Application Temperature, below and in Asphalt Institute Publications: Asphalt Surface Treatments - Specifications (publication No. ES-11) and Asphalt Surface Treatments - Construction Techniques (publication No. ES-12).

****

Apply bituminous material by means of a bituminous distributor at the temperature specified in paragraph Bituminous Application Temperature below or as directed, and within the limits specified in paragraph Quantity Limits in PART 1. Apply bituminous material using triple overlap in such a manner that uniform distribution is obtained over all surfaces treated.
Reduce spray bar height to double overlap if wind disperses triple overlap and only if double overlap applies the specified coverage, otherwise discontinue work until acceptable coverage is obtainable. For double overlap, adjust distributor operation and settings to achieve target application rate. Unless the distributor is equipped to obtain a satisfactory result 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 so that flow through the sprays may be started and stopped on the paper in order that all sprays will operate at full force on the surface treated. Remove the building paper immediately after application. Properly treat areas missed by the distributor with the hand spray. Protect adjacent buildings, structures, and trees to prevent spattering or marring.

3.6.2 Spreading of Aggregate

Immediately following application of bituminous material, spread aggregate uniformly over the surface within the limits of the quantities specified in paragraph Quantity Limits in PART 1 using mechanical spreaders. Increase or decrease aggregate spread rate up to 10 percent to avoid aggregate pick up on rollers. Spread aggregate evenly by hand on all areas missed by the mechanical spreader. Operate equipment spreading aggregate so that the bituminous material will be covered ahead of the truck wheels. When hand-spreading is employed on inaccessible areas, spread aggregate directly from trucks. Spread additional aggregate by hand over areas having insufficient cover.

3.6.3 Application of Sand Seal Aggregate

****

NOTE: Designer to edit the paragraph for only the appropriate time frames for the bituminous material selected. 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 planned application of bituminous material before the bituminous material is applied. No bituminous material may be down more than [_____] minutes before it is covered with aggregate. Uniformly spread aggregate with aggregate-spreading equipment. Re-cover areas having insufficient cover with additional aggregate by hand during the operations whenever necessary.

3.6.4 Rolling and Brooming Single Bituminous Surface Treatment

Roll the surface with at least three passes of a pneumatic-tired roller after sufficient aggregate is spread. Continue rolling until no more aggregate can be worked into the treated surface. If the aggregate is not distributed properly, broom the surface 24 hours after rolling but not until the surface has set sufficiently to prevent excessive marking. In places not accessible to rollers, compact the aggregate with pneumatic tampers. Remove aggregate that has become contaminated with foreign matter and replace with clean aggregate and reroll as directed. Maintain and protect the treated areas by use of barricades until properly cured.

3.7 APPLICATION OF SECOND COURSE

****

NOTE: If not being used in double BST, delete the following paragraphs.

****

3.7.1 Bituminous Treatment

Apply the bituminous material for the second course within 48 hours after construction of the first course, weather permitting. Remove excess aggregate by sweeping prior to the second application of bituminous material. If the treated surface is excessively moistened by rain, allow the surface to dry for such time as deemed necessary. Perform the second application of bituminous material in the manner specified in article APPLICATION OF FIRST COURSE, including temperature and Quantity Limits.

3.7.2 Aggregate

Immediately following the second application of bitumen, spread aggregate conforming to the gradation and limits specified in paragraph Quantity Limits uniformly over the bituminous material and process in the manner specified for the first course.

3.7.3 Rolling and Brooming Second Course Bituminous Surface Treatment

Roll and broom the surface in the manner specified for the first course until a thoroughly bonded, smooth, even-textured surface is produced. For double bituminous surface treatments, after first application of aggregate is completed and accepted, use a steel-wheeled or combination roller after at least three coverages of pneumatic-tired rollers. Sweep off the

surface surplus aggregate and remove it prior to final acceptance.

3.8 SAND SEAL 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 seated 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.

3.9 FIELD QUALITY CONTROL

Inspect application uniformity and determine application rates of bituminous material and aggregate each day of application.

3.9.1 Inspection Reports

****
NOTE: Edit the following paragraph for the products used in the work.
****

Furnish a written report each day of application citing climatic temperature during application of bituminous surface treatment [and]sand seal, bituminous temperature during application, rate of bituminous material application, residual bituminous material rate, truck speed in meters per minute feet per minute, RPM of truck, digital wet (shot) rate, spray bar height, pump setting, aggregate application rates, and aggregate spreader speed. Include any observations.

3.10 SURFACE PROTECTION

****
NOTE: Delete bracketed sentence if pavement markings are not in Contract.
****

Keep all traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. Protect the treated areas from traffic for at least 24 hours after final application of bituminous material and aggregate, or for such time as necessary to prevent tracking. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller.[Apply pavement markings as required in Contract after final brooming.] After opening, post speed to maximum 32 kilometers per hour 20 miles per hours for 3 days.

-- End of Section --