Preparing Activity: USACE Superseding
UFGS-32 12 11 (November 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 32 01 13.62

ASPHALT SURFACE TREATMENT
05/18

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.

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 this paragraph when lump sum bidding is used.

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

1.1.1 Measurement

1.1.1.1 Bituminous Material

The amount of bituminous material to be paid for will be measured in [metric 2000 pounds 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].

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 paragraph "Mineral Aggregate" will be retained.
****

Spread the bituminous material and aggregate within the quantity limits shown in PART 2; base bids on the mean of the values in the tables. The individual quantities of bituminous material and aggregate may be varied to meet specific field conditions at all times during progress of the work, as directed, without adjustments to contract unit prices.

1.1.2 Payment

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

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

1.1.3 Waybills and Delivery Tickets

Submit copies of waybills and delivery tickets during progress of the work. Before the final statement is allowed, file with the Contracting Officer certified waybills and delivery tickets for aggregate and bituminous material used in the bituminous surface treatment. Do not remove bituminous material from the tank car or storage tank until initial outage and temperature measurements have been taken. Do not release the car or tank until final outage has been taken.

1.2 REFERENCES

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

this paragraph by organization, designation, date, and title.

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

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

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

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) 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 D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D140/D140M	(2016) Standard Practice for Sampling Asphalt Materials
ASTM D946/D946M	(2020) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D977	(2019a; E 2019) Standard Specification for Emulsified Asphalt
ASTM 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 D2028/D2028M	(2015) Cutback Asphalt (Rapid-Curing Type)
ASTM D2397/D2397M	(2019a) Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D3625/D3625M	(2012) Standard Practice for Effect of Water on Bituminous-Coated Aggregate Using Boiling Water
ASTM D6373	(2016) Standard Specification for Performance Graded Asphalt Binder

1.3 SUBMITTALS

****

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

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When

used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets
Cutback Asphalt
Emulsified Asphalt
Asphalt Cement

SD-06 Test Reports

Tests

1.4 QUALITY CONTROL

1.4.1 Safety Precautions

Smoking or open flames will not be permitted within 8 m 25 feet of heating, distributing, or transferring operations of bituminous materials other than bituminous emulsions.

1.4.2 Sampling and Testing

Sampling and testing is the responsibility of the Contractor. Perform sampling and testing using an approved commercial testing laboratory, or by the Contractor, subject to approval. Sampling must be in accordance with ASTM D75/D75M for aggregates and ASTM D140/D140M for bituminous material, unless otherwise directed. Perform aggregate gradation tests on each sample in accordance with ASTM C136/C136M. Perform all other aggregate tests on the initial source samples and repeat tests when there is a change of source. Perform sieve analyses daily from material samples including an analysis of each gradation of material. Perform tests in sufficient number to ensure that materials meet specified requirements. Submit copies of test results, within 24 hours after completion of each test. Repeat aggregate testing (wear, soundness, deleterious material and stripping) for each 18,000 metric tons 20,000 tons of aggregate used in the project.

1.4.3 Wear Test

Perform the wear test in accordance with ASTM C131/C131M to ensure that aggregates have a percentage of wear not exceeding 40 percent after 500 revolutions.

1.4.4 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 aggregates 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.

1.4.5 Stripping Test

Perform stripping tests meeting the requirements of ASTM D3625/D3625M. Deleterious substances must not exceed the requirements of ASTM D1139/D1139M.

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling. Store aggregates preventing segregation and contamination.

1.6 EQUIPMENT, TOOLS AND MACHINES

Provide equipment dependable and adequate for the purpose intended and properly maintained in satisfactory and safe operating condition at all times. Discontinue the use of equipment which fails to produce satisfactory work and replace with satisfactory equipment. Equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, must have been calibrated by an approved calibration laboratory within [12] [_____] months prior to commencing work [and every [_____] months thereafter, by such laboratory from the date of last calibration, during the term of the contract].

1.6.1 Bituminous Distributors

Provide a self propelled distributor with pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the surface being sprayed. Calibrate the distributer in accordance with ASTM D2995. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled total liquid rates from 0.14 to 4.5 L/square meter 0.03 to 1.0 gallons per square yard, with a pressure range of 172.4 to 517.1 kPa 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. 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. The distributor will be capable of circulating and agitating the bituminous material during the heating process.

1.6.2 Single-Pass, Surface-Treatment Machines

Use only machines capable of spraying bituminous material and spreading aggregate in one pass. Use only bituminous spraying equipment conforming

to the requirements given above for a bituminous distributor. Use only machines capable of spreading aggregates at controlled amounts per square yard as specified. In addition, only use single-pass, surface-treatment machines capable of placing a surface treatment adjacent to an existing surface treatment, forming a joint of the same thickness and uniformity as other portions of the surface treatment. Ridges or blank spaces will not be permitted. Form joints in the second application at least 300 mm 1 foot from those formed in the first application.

1.6.3 Heating Equipment for Storage Tanks

Use equipment consisting of coils and equipment for producing steam or hot oil and designed to prevent the introduction of steam or hot oil into the material. Affix an armored thermometer with a range of 35 to 200 degrees C 100 to 400 degrees F to the tank so the temperature of the bituminous material may be determined at all times.

1.6.4 Power Rollers

Use only steel-wheeled or pneumatic-tired type power rollers conforming to the following requirements:

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

b. Use only 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. 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.

1.6.5 Mechanical Spreaders

Use only adjustable spreaders capable of spreading aggregate at controlled amounts per square yard, as specified.

1.6.6 Brooms and Blowers

Use only power type brooms and blowers capable of cleaning surfaces to be treated.

1.6.7 Scales

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. The scales must be tested and approved by an inspector of the State Inspection Bureau charged with scale inspection within the state in which the project is located. If an official of the inspection bureau is not available, test the scales in accordance with state specifications and in the presence of the Contracting Officer. Keep the necessary number of standard weights on hand, at all times, for testing the scales.

1.6.8 Weighhouse

Provide a weatherproof weighhouse constructed in a manner to afford adequate protection for the indicating and recording devices of the scales.

1.7 ENVIRONMENTAL REQUIREMENTS

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][15.5] degrees C [50][60] degrees F or the pavement surface to be treated is below 20 degrees C 70 degrees F unless otherwise directed.

PART 2 PRODUCTS

****

NOTE: Delete designations, materials, grades, and aggregate sizes which are not available or desirable for the project. In selecting alternate materials, consider the cost effect of competition between materials along with engineering considerations.

****

Use mineral aggregate and bituminous material of the following types, gradations, grades, and consistencies that meet the requirements of stripping, wear, deleterious materials and soundness tests as specified in paragraph SAMPLING AND TESTING.

2.1 MINERAL AGGREGATE

****

NOTE: The desired gradations to be used for the project will be specified. For single surface treatment, select the required gradation from the table for single bituminous surface treatment. For double surface treatment, select the required gradations (either No. 1 and No. 2 or No. 3 and No. 4) from the table for double bituminous surface treatment.

****

Provide aggregate consisting of crushed stone, crushed gravel, or crushed slag of such nature that thorough coating of bituminous material, used in the work, will not strip off upon contact with water when testing using ASTM D3625/D3625M. Maintain aggregate moisture content so that the aggregate will be readily coated with the bituminous material. Drying may be required, as directed. Use aggregate conforming to the gradation shown below. Determine gradation of the aggregates by ASTM C136/C136M.

AGGREGATE GRADATION SINGLE BITUMINOUS SURFACE TREATMENT (PERCENT BY WEIGHT PASSING)			
Sieve Designation (mm)	No. 1	No. 2	No. 3
25.01 inch	100	--	--
19.03/4 inch	90-100	100	--
12.51/2 inch	20-55	90-100	100
9.53/8 inch	0-15	40-70	85-100
4.75No. 4	0-5	0-15	10-30
2.36No. 8	--	0-5	0-10
1.18No. 16	--	--	0-5

AGGREGATE GRADATION DOUBLE BITUMINOUS SURFACE TREATMENT (PERCENT BY WEIGHT PASSING)				
Sieve Designation (mm)	No. 1	No. 2	No. 3	No. 4
25.01 inch	100	--	--	--
19.03/4 inch	90-100	--	100	--
12.51/2 inch	20-55	100	90-100	--
9.53/8 inch	0-15	85-100	40-70	100
4.75No. 4	0-5	10-30	0-15	85-100
2.36No. 8	--	0-10	0-5	10-40
1.18No. 16	--	0-5	--	0-10
0.30No. 50	--	--	--	0-5

2.1.1 Crushed Stone

Provide crushed stone consisting of clean, sound, durable particles, free of soft or disintegrated pieces, dust, or foreign matter.

2.1.2 Crushed Gravel

Provide crushed gravel consisting of clean, sound, durable particles, free of soft or disintegrated pieces or foreign matter. At least 90 percent by weight of the particles must have at least two fractured faces.

2.1.3 Crushed Slag

Provide crushed slag which is an air-cooled blast-furnace product having a dry weight of not less than 1120 kg/cubic meter 70 pcf, and consists of

angular particles uniform in density and quality and free of dust and foreign matter. Determine the weight of a cubic meter foot of slag aggregate by ASTM C29/C29M.

2.1.4 Aggregate Quantities

Spread the bituminous material and aggregate within the quantity limits shown below. The individual quantities of bituminous material and aggregate may be varied to meet specific field conditions at all times during progress of the work, as directed, without adjustments to contract unit prices. Aggregate weights shown are for aggregates having a specific gravity of 2.65. Adjust the number of kg 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.

QUANTITIES (PER SQUARE METER YARD) [FOR SINGLE SURFACE TREATMENT]		
Gradation No.	Bituminous Material (Liter) (Gallons)	Aggregate (kg) (Pounds)
1	1.14-1.700.30-0.45	16-2335-50
2	0.57-1.140.15-0.30	9-1620-35
3	0.38-0.760.10-0.20	7-1115-25

QUANTITIES (PER SQUARE METER YARD) [FOR DOUBLE SURFACE TREATMENT]				
Gradation No.	Bituminous Material (Liter) (Gallons) First Application	Aggregate (kg) (Pounds) First Spreading	Bituminous Material (Liter) (Gallons) Second Application	Aggregate (kg) (Pounds) Second Spreading
1	0.76-1.14 0.20-0.30	13-1528-34	--	--
2	--	--	0.76-1.14 0.20-0.30	9-1120-25
3	0.57-0.76 0.15-0.20	9-1120-25	--	--
4	--	--	0.57-0.76 0.15-0.20	5-710-15

2.2 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 and performance graded asphalt cements can also be used. A majority of surface treatments utilize asphalt emulsion as the binder.
****

2.2.1 Cutback Asphalt

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

2.2.2 Emulsified Asphalt

Use rapid-setting emulsified asphalt conforming to ASTM D977, Grade RS-1 or RS-2 or ASTM D2397/D2397M, Grade CRS-1 or CRS-2.

2.2.3 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]. Submit temperature-viscosity relationship of asphalt cement.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

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 achieve a clean surface, only when directed by the Contracting Officer; allow the surface to dry after flushing.

3.2 APPLICATION OF FIRST COURSE

3.2.1 Bituminous Material

****
NOTE: Application temperatures will vary with the grade of asphalt used. Recommended materials and application temperatures may be found in paragraph APPLICATION TEMPERATURE OF MATERIALS, 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 APPLICATION TEMPERATURE OF MATERIALS, below or as directed; and within the limits specified in paragraph QUANTITY LIMITS in PART 1. Apply bituminous material in such a manner that uniform distribution is obtained over all surfaces treated. 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. Immediately after application, remove and destroy the building paper. Properly treat areas inaccessible to the distributor with bituminous material using the hose attachment. Protect adjacent buildings, structures, and trees to prevent their being spattered or marred.

3.2.2 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. 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. Continue spreading during these operations when necessary.

3.2.3 Brooming and Rolling

Roll the surface with a pneumatic-tired and a steel-wheeled roller after sufficient aggregate is spread. Continue rolling until no more aggregate can be worked into the treated surface. The use of the steel-wheeled roller will be discontinued, or a lighter weight steel wheel roller substituted, as directed, if the roller being used causes excessive crushing and shattering of the aggregate. If the aggregate is not distributed properly, broom the surface as soon as possible after the first coverage by the roller, but not until the surface has set sufficiently to prevent excessive marking. Continue brooming, rolling, and supplemental spreading of aggregate until the surface is cured and rolled sufficiently to key and set the aggregate. 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.

3.3 APPLICATION OF SECOND COURSE

3.3.1 Bituminous Treatment

Apply the bituminous material for the second course within 48 hours after construction of the first course, weather permitting. Remove excess aggregate 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 paragraph APPLICATION OF FIRST COURSE, including temperature and QUANTITY LIMITS.

3.3.2 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.

3.3.3 Brooming and Rolling Second Course

Roll and broom the surface in the manner specified for the first course until a thoroughly bonded, smooth, even-textured surface is produced. Sweep off the surface surplus aggregate and remove it prior to final acceptance.

3.4 APPLICATION TEMPERATURE OF MATERIALS

3.4.1 Cutback Asphalt

Apply cutback asphalt in the range of 38 to 93 degrees C 100 to 200 degrees F.

3.4.2 Emulsified Asphalt

Apply asphalt emulsions in the range of 32 to 71 degrees C 90 to 160 degrees F.

3.4.3 Asphalt Cement

Apply asphalt cement in the range of 163 to 191 degrees C 325 to 375 degrees F.

3.5 TRIAL APPLICATION

****
NOTE: This paragraph will be deleted if project size does not warrant trial application.
****

Preliminary to providing a complete surface treatment, treat [three] [_____] lengths of at least 30.5 m 100 feet each for the full width of the distributor bar. Use the appropriate typical application rates specified herein for one surface treatment trial. Make other surface treatment trials using various amounts of materials as may be deemed necessary.

3.6 PROTECTION

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 picking up. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller.

-- End of Section --