UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 32 11 26.19

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USACE / NAVFAC / AFCEC / NASA | **UFGS-32 11 26.19 (May 2020)**

Preparing Activity: USACE | **Superseding UFGS-32 11 27 (August 2008)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 32 11 26.19

BITUMINOUS-STABILIZED BASE AND SUBBASE COURSES
05/20

****

NOTE: This guide specification covers the requirements for bituminous stabilization of base and subbase courses for airfield pavements, roads, streets, and parking areas.

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).

The purposes of bituminous stabilization are to waterproof and improve the cohesive strength of non-cohesive granular soils and aggregates. This specification is limited to soils and aggregates with less than 30 percent passing the No. 200 sieve and a Plasticity Index less than 10. For bituminous subgrade stabilization, use UFGS 32 11 13.16.

****

PART 1 GENERAL

1.1 UNIT PRICES

****

NOTE: Delete these paragraphs when lump sum payment is desired.

****

1.1.1 Measurement for Payment

1.1.1.1 Bituminous Stabilization

Measurement will be by the square meter yard of work completed and accepted.

1.1.1.2 Bituminous Material

Submit quantity of residual bituminous material used in the job. Bituminous material to be paid for will be measured in the number of [liters gallons of the material used in the accepted work, corrected to liters at 15 degrees C gallons at 60 degrees F in accordance with ASTM D1250. Use a coefficient of 0.00025 per degree C F for asphalt emulsion.] [metric 2000 pound tons of the material used in the accepted work.]

1.1.1.3 Select Material

****
NOTE: Delete the reference to select material when select material is not required.
****

Select material will be measured by the [cubic meter yard] [metric 2000 pound ton] of material placed and used in the completed and accepted stabilization. Measurement will not be made for select material that is wasted or used in work determined to be defective.

1.1.2 Basis for Payment

****
NOTE: Delete reference to select material when select material is not required.

Delete the last sentence in brackets if sanding or dusting of the bituminous-primed surfaces is not required or if bituminous-primed surfaces are to receive bituminous surfacing under the contract.
****

Bituminous-stabilized mixture, constructed and accepted, [and the quantities of bituminous material] [and select material] will be paid for at the respective contract unit prices. Payment will not be made for any material wasted, used for the convenience of the Contractor, unused or rejected, or for water used. [Select material obtained from grading and excavation operations at the project site will not be paid for under this section but will be included for payment under other sections specifying grading and excavating.] [Separate payment will not be made for sanding or dusting the bituminous prime-coated surfaces. Costs for sanding or dusting will be included in the contract unit price for bituminous material.]

1.1.3 Waybills and Delivery Tickets

Submit copies of waybills and delivery tickets during the progress of the work. Before the final payment is allowed, furnish waybills and certified delivery tickets for all bituminous materials [and select materials] actually used in the construction.

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.

ASPHALT RECYCLING AND RECLAIMING ASSOCIATION (ARRA)

ARRA FDR201A	(2018) Recommended Mix Design Guidelines for Full Depth Reclamation (FDR) Using Emulsified Asphalt Stabilizing Agent

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
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 D977	(2019a; E 2019) Standard Specification for Emulsified Asphalt
ASTM D979/D979M	(2015) Sampling Bituminous Paving Mixtures

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 D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1883	(2016) Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
ASTM D2172/D2172M	(2017; E 2018) Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
ASTM D2397/D2397M	(2019a) Standard Specification for Cationic Emulsified Asphalt
ASTM D2419	(2014) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2487	(2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	(2017; E 2018) Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2940/D2940M	(2020) Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
ASTM D3666	(2016) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6307	(2019) Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM E11 (2020) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.3 DEFINITION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure in accordance with ASTM D1557, abbreviated in this specification as percent laboratory maximum density.

1.4 SUBMITTALS

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

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

Plant, Equipment, Machines, and Tools

Mix Design; G[, [_____]]

Waybills and Delivery Tickets

Notification Of Selected Source

SD-06 Test Reports

Sampling and Testing

1.5 QUALITY CONTROL

1.5.1 Qualifications

****
NOTE: Include bracketed sentence for Corps-managed projects.
****

Perform sampling and testing using an approved commercial testing laboratory or on-site facilities. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM D3666, including all applicable test procedures. Do not start work requiring testing until the facilities have been inspected and approved. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. Maintain this certification for the duration of the project. [In addition, all contractor quality control testing laboratories performing acceptance testing require USACE validation by the Material Testing Center (MTC) for both parent laboratory and on-site laboratory. Validation on all laboratories is required to remain current throughout the duration of the paving project. Contact the MTC manager listed at http://www.erdc.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/9254/Articl for costs and scheduling.]

1.5.2 Test Results

Verify that materials comply with the specification. When a material source is changed, test the new material for compliance. When deficiencies are found, repeat the initial analysis and retest the material already placed to determine the extent of unacceptable material.

1.5.3 Aggregate

Submit notification of selected source from which aggregates are to be obtained, within 15 days after the award of contract. Perform tests for determining the suitability of aggregate including, but not limited to: sieve analysis in accordance with ASTM C136/C136M using sieves conforming to ASTM E11, liquid limits and plasticity index in accordance with ASTM D4318, and sand equivalent test in accordance with ASTM D2419. Do not submit aggregate test data older than 6 months since the testing was performed. Take aggregate samples for laboratory tests in accordance with ASTM D75/D75M. Submit certified copies of aggregate test results, not less than [30] [_____] days before the material is required in the work.

1.5.4 Bituminous Material

Submit notification of selected source of bituminous material within 15 days after the award of contract. Submit certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than [30] [_____] days before the material is required in the work.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Environmental Requirements

Do not apply bituminous material when the atmospheric temperature is less than 10 degrees C 50 degrees F or to soils that are frozen or contain frost. If the temperature falls below 2 degrees C 35 degrees F, protect completed bitumen-treated areas against any detrimental effects of freezing.

1.7 ACCEPTANCE

1.7.1 Tolerances

Acceptance of bituminous stabilized [base course] [subbase] is based on compliance with the tolerances presented in Table 1. Remove and replace bituminous stabilized mixture represented by the failing tests or submit repair plan for approval.

TABLE 1

Attribute	Tolerance
Field Density	minimum of 95 percent
Asphalt Content	plus/minus 0.5 percent of mix design
Smoothness	maximum of 10 mm 3/8 inch
Thickness (individual measurement)	maximum of 13 mm 1/2 inch
Thickness (average of all measurements)	minimum of 6 mm 1/4 inch

1.7.2 Test Section

[Place a test section of at least 2.5 by 30 m 8 by 100 feet, utilizing the equipment and procedures proposed for use, to demonstrate that bituminous stabilized mixture conforming to this specification can be produced. Acceptance of the test section is based on compliance with the tolerances listed in Table 1.] [A test section is not required.]

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Material

****
NOTE: Select asphalt emulsion type for the bituminous-stabilized mixture

based on the classification of the soils evaluated during the site geotechnical investigation.

Course	Emulsion Type
Base Course	**MS-2h, HFMS-2h, HFMS-2s, SS-1, SS-1h, CSS-1, CSS-1h**
Subbase Course	
GP	**MS-1, HFMS-1, MS-2h, HFMS-2h, CMS-2, CMS-2h**
GW	**MS-2h, HFMS-2h, HFMS-2s, SS-1, SS-1h, CSS-1, CSS-1h**
SW, SP	**MS-2h, HFMS-2h, HFMS-2s, SS-1, SS-1h, CSS-1, CSS-1h**
GM, SM	**MS-2h, HFMS-2h, HFMS-2s, SS-1, SS-1h, CSS-1, CSS-1h**
Combinations of above	**MS-2h, HFMS-2h, HFMS-2s, SS-1, SS-1h, CSS-1, CSS-1h**

****

2.1.1.1 Bituminous-Stabilized Mixture

Provide emulsified asphalt conforming to [ASTM D977 Type [MS-1] [MS-2h] [HFMS-1] [HFMS-2h] [HFMS-2s] [SS-1] [SS-1h]] [ASTM D2397/D2397M Type [CMS-2][CMS-2h][CSS-1][CSS-1h]].

2.1.1.2 Prime Coat

Provide emulsified asphalt conforming to [ASTM D977, Type [SS-1] [SS1h]] [ASTM D2397/D2397M, Type [CSS-1] [CSS-1h]]. Asphalt emulsion can be diluted up to 1 part water to 1 part emulsion for prime coat use.

2.1.2 Material to be Stabilized

****

NOTE: Specify imported select material for 80 CBR bituminous base course.

Specify in-place or imported materials for subbase. The CBR depends on aggregate gradation as follows. Delete inapplicable materials.

Gradation No.	Design CBR
1	50 Max
2	40 Max
3	30 Max

Refer to UFC 3-250-11 and UFC 3-270-01 for further information, including applicability of bituminous stabilization.

****

2.1.2.1 Select Material for Bituminous Stabilized Base Course

[Select material conforming to ASTM D2940/D2940M, base course gradation Table 1. Verify select material has a liquid limit less than 25 [_____]

and a Plasticity Index less than 4 [_____] when tested in accordance with ASTM D4318; the percentage of wear less than 40 [_____] percent in accordance with ASTM C131/C131M; and a sand equivalent percentage greater than 35 percent in accordance with ASTM D2419. Perform sieve analysis in accordance with ASTM C117 and ASTM C136/C136M.]

2.1.2.2 Aggregate for Bituminous-Stabilized Subbase Course

[In-place or imported soil or aggregate conforming to soil classifications GW, GP, GM, SW, SP, SM, or combinations thereof. Soil classification in accordance with ASTM D2487 and ASTM D2488. Verify material has a plasticity index equal to or less than 10 in accordance with ASTM D4318 and a sand equivalent percentage greater than 35 percent in accordance with ASTM D2419. Perform sieve analysis in accordance with ASTM C117 and ASTM C136/C136M. Provide aggregates within the limits specified as follows:

TABLE 2			
Maximum Allowable Percentage by Weight Passing Square-Mesh Sieve			
Sieve Designation	No. 1	No. 2	No. 3
50 mm2 inch	100	100	100
2 mmNo. 10	50	80	100
0.075 mmNo. 200	30	30	30

]

2.1.3 Stockpiling Materials

****
NOTE: Delete this paragraph when select material is not required or when small quantities do not justify the inclusion of select materials.
****

Stockpile select material, including approved material available from excavation and grading in the manner and at the locations designated. Clear, drain, and level storage sites before stockpiling material. Separately stockpile materials obtained from different sources. Maintain a separation distance or barrier between stockpiles to prevent cross-contamination.

2.1.4 Water

Furnish clean, fresh, and potable water.

2.2 MIX DESIGN

****
NOTE: For base courses, specify a CBR of 80. For subbase courses, specify CBR value on the basis of the gradation chosen.

Specify soaked condition and surcharge load. Default values are 24-hour soaked and 4.5 kg 10 lb

surcharge load.
****

Develop and submit for approval a proposed mix design prior to stabilization work. Develop mix using samples of the material to be stabilized. Conduct mix design in accordance with ARRA FDR201A. Verify CBR bearing value of [80][50][40][30] or greater in accordance with ASTM D1883 when tested in a [24-hour soaked] [unsoaked] condition under a surcharge load of 4.5 [_____] kg 10 [_____] lb.

2.2.1 Mix Design Report

Perform trial design batches, mixture proportioning studies, testing, and submit results demonstrating that the proposed mixture proportions produce a bituminous-stabilized mixture of the qualities indicated. Submit test results in a mix design report to include:

a. Gradation, sand equivalent, and Plasticity Index of soil or aggregate.
b. Maximum dry density and optimum moisture content.
c. Density, maximum specific gravity, air void content, dry and moisture conditioned indirect tensile strength and level of saturation at each emulsified asphalt stabilizing agent content.
d. Optimum emulsified asphalt stabilizing agent content as a percentage of dry materials.
e. Density, air void content, dry and moisture conditioned indirect tensile strength and CBR value at recommended moisture and emulsified asphalt stabilizing content.
f. Emulsified asphalt stabilizing agent designation, supplier name and location.
g. Emulsified asphalt residue content and certificates of compliance.

2.3 PLANT, EQUIPMENT, MACHINES, AND TOOLS

****
NOTE: NOTE: Specify a central plant and mechanical spreader for mixing and placing bituminous stabilized base course and delete the mixer/reclaimer and traveling plant provisions. For bituminous stabilized subbase, include central plant, mixer/reclaimer, and traveling plant provisions.
****

Submit list of proposed equipment to be used in performance of construction work, including descriptive data. Plant, equipment, machines, and tools used in the work are subject to approval. Maintain in a satisfactory working condition at all times. Provide equipment with the capability of producing the required compaction, meeting grade controls, thickness control and smoothness requirements indicated.

2.3.1 Central Plant

Provide a batch or continuous flow type central plant capable of producing a uniform bituminous stabilized mixture at the required asphalt emulsion and moisture contents. Equip the mixer with calibrated metering and feeding devices that introduce the aggregate, bituminous material, water, and additives (if used) into the mixer in the specified quantities. If necessary, use a screening device to remove oversized material greater than 2 inches (50 mm) from the raw aggregate feed.

2.3.2 Mechanical Spreader

Provide a steerable, self propelled, mechanical spreader having variable speeds forward and reverse. Mount the spreader on tracks, rubber tires, or drum-type steel rollers that will not disturb the underlying material. Provide a spreader containing a hopper, an adjustable screed, and outboard bumper rolls; designed to have a uniform, steady flow of material from the hopper; and capable of laying material without segregation, across the full width of the lane, to a uniform thickness and to a uniform loose density so that when compacted, the layer or layers conform to thickness and grade requirements indicated.

2.3.3 Mixer/Reclaimer

Provide a self-propelled, four-wheel drive rotary mixer/reclaimer, capable of pulverizing the soil in a single pass for the full depth to be stabilized and providing a mixing action capable of uniformly blending and mixing the required bituminous material content with the aggregate. Equip with a rotor capable of up or down cutting. Equip the mixer/reclaimer with an integrated additive injection system capable of introducing bituminous emulsion into the cutting drum during the mixing process. Provide a metering device capable of automatically adjusting the flow of the bituminous emulsion to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber.

2.3.4 Traveling Plant

Provide a traveling plant capable of moving at a uniform rate of speed and accomplishing thorough mixing of the materials in one pass. Deliver water and bituminous material from supply trucks or bins at a predetermined rate. Construct windrows of prepared bituminous stabilized mixture to cover a predetermined width to the indicated compacted thickness.

2.3.5 Bituminous Distributor

Provide a distributor with pneumatic tires that prevent rutting, shoving, or otherwise damaging other layers in the pavement structure. Provide capability to spray bituminous material in a uniform double or triple lap at the specified temperature, at variable widths, and at readily determined and controlled rates from 0.15 to 6.5 L/square meter 0.05 to 2.0 gallons/square yard. Equip distributor to circulate and agitate the bituminous material during the heating process. The bituminous distributor is permitted only for applying tack, prime, and seal coats and not for applying bitumen to be mixed into the stabilized mixture.

2.3.6 Rollers

Compact the bituminous stabilized mixture using one or a combination of the following pieces of equipment: tamping or grid roller; steel-wheeled roller; vibratory roller; pneumatic-tire roller, and/or vibrating plate compactor (for areas inaccessible to rollers). Compact the bituminous stabilized mixture using the number, type, and weight of rollers and/or compactors sufficient to compact the mixture to the required density.

2.3.7 Straightedge

Furnish and maintain at the site, in good condition, one [3.05] [3.66]

meter [10] [12] foot straightedge for each bituminous paver, for use in the testing of the finished surface. Make straightedge available for government use. Construct straightedges of aluminum or other lightweight metal having blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Equip straightedge with handles to facilitate straightedge movement on the bituminous stabilized surface.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

****

NOTE: Delete this paragraph when select material is not required or when small quantities do not justify the inclusion of select materials. Delete sentence in the first set of brackets when onsite material is not available.

****

Select aggregate sources than can produce the quality and quantity of base course materials meeting these specification requirements in the specified time limits. [Upon completion of the work, condition aggregate sources on Government property to drain readily and leave in a satisfactory condition.] [Obtain aggregate material from offsite sources. Condition aggregate sources on private lands in agreement with local laws or authorities.]

3.2 PREPARATION OF AREAS TO BE STABILIZED

****

NOTE: Delete inapplicable subparagraph.

Remove brackets and retain second sentence for imported base course material. Remove brackets and retain third sentence for in-place subbase material.

****

Clean area and dispose of debris and unsatisfactory in-place material [as directed] [in waste disposal areas indicated]. [Visually inspect area for adequate compaction and capability of withstanding, without displacement, compaction specified for the bituminous-stabilized base course mixture.] [Visually inspect the exposed material to be stabilized prior to mixing.] When the stabilized course is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire construction period to prevent water from collecting or standing on the area to be stabilized or on pulverized, mixed, or partially mixed material.

3.2.1 In-Place Material to be Stabilized

Grade and shape the entire area to conform to the lines, grades, and cross sections shown prior to being processed. Make soft or yielding areas stable before construction is begun.

3.2.2 In-Place Materials to Receive Stabilized Course

[Remove and replace or rework soft or yielding areas on the surface prior to placing bituminous-stabilized mixture. Aerate material in the affected area and remove all unsatisfactory materials. Add material as directed. Shape to line, grade, and cross section and compact the new work to the specified density.] [Conform subgrade to Section 31 00 00 EARTHWORK.] [Conform subbase course to Section 32 11 20 [BASE COURSE FOR RIGID][AND][SUBBASES FOR FLEXIBLE] PAVING.]

3.2.3 Select Material

****

NOTE: Delete paragraph if select material is not required.

****

Utilize sufficient select material to provide the required thickness of the bituminous-stabilized layer after compaction; process it to meet the requirements specified, before bituminous stabilization is undertaken.

3.3 GRADE CONTROL

Excavate underlying material to sufficient depth for the required bituminous-stabilized course thickness so that the finish stabilized course and the subsequent surface course will meet the fixed grade. Provide line and grade stakes as necessary for control. Place grade stakes in lines parallel to the centerline of the area under construction and suitably spaced for string lining. Verify the finished and completed stabilized area conforms to the lines, grades, cross section, and dimensions indicated.

3.4 MIXING OF MATERIALS

****

NOTE: For base courses, specify central plant mixing method and delete requirements for traveling plant and mix-in-place mix methods.

For subbase courses, select mixing method based on material source (imported or in-place).

****

3.4.1 Mixed-in-Place Method

****

NOTE: Mixing the materials by the mixed-in-place method should be considered for those jobs where the thickness of the stabilized layer is 150 mm 6 inches or less. Because the maximum layer thickness is 150 mm 6 inches, constructing a thicker layer by this method would require removal of the top portion of material. The lower portion would then be mixed and compacted, and the top portion mixed, replaced and compacted.

****

3.4.1.1 Scarifying and Pulverizing of Soil

Prior to the application of bituminous materials, scarify and pulverize the soil [to the depth shown on the drawings] [to a depth of [_____] mm inches]. Control scarification so that the layer beneath the layer to be stabilized is not disturbed. Do not exceed the depths indicated. Unless otherwise noted, do not scarify or pulverize any area larger than can be completed in 2 working days.

3.4.1.2 Application of Water

Once soils have been scarified and pulverized, shape to cross sections and grades indicated and determine moisture content of the soils. Add water in increments and partially incorporate each increment of water in the mix to avoid concentration of water near the surface. After the last increment of water has been added, continue mixing until the water is uniformly distributed throughout the mixture, including satisfactory moisture distribution along the edges of the section.

3.4.1.3 Application of Bituminous Material

Distribute the bituminous material at the specified rate of residual asphalt by a spray bar integrated into the mixer/reclaimer cutting drum within a temperature range of 25 to 55 degrees C 75 to 130 degrees F. Uniformly mix bituminous material with the soil. If the bituminous material is applied in more than one increment, partially mix each application into the material as directed. After the required amount of bituminous material has been added to the loose material, thoroughly mix the bituminous material and soil. After mixing is completed, verify the bituminous-stabilized mixture conforms to the mix design proportions and the moisture content is within 1 percent of the mix design. Include the water used to dilute the asphalt emulsion in the moisture content calculation. Do not permit heavy equipment, except the soil mixer, to pass over the freshly spread bituminous material.

3.4.2 Traveling Plant Method

Place the pulverized material in windrows of sufficient size to cover a predetermined width to the indicated compacted thickness. Operate the traveling plant at a constant speed and sufficiently slowly so that the soils and bitumen are thoroughly mixed. Deliver water and bituminous material separately or together at a predetermined rate.

3.4.3 Central Plant Method

3.4.3.1 Mixing

Load and haul select material from pits or stockpiles so that a uniform grade of each material is delivered to the central-mixing plant. Feed properly batched or proportioned aggregate and soil binder materials into the mixing unit together with the bituminous material and the quantity of water needed to obtain the required optimum moisture content. Continue mixing until a homogeneous mixture is obtained. Haul mixture to the job in trucks equipped with protective covers. Place mixture with mechanical spreaders.

3.4.3.2 Placing

Place the mixed material on the prepared subgrade or subbase in layers of

uniform thickness with an approved spreader. When a compacted layer 150 mm 6 inches or less in thickness is required, place the material in a single layer. When a compacted layer in excess of 150 mm 6 inches is required, place the material in layers of equal thickness. Do not place layers more than 150 mm 6 inches or less than 80 mm 3 inches when compacted. When compacted, provide layers true to the grades or levels required with the least possible surface disturbance. Make such adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to ensure an acceptable base course.

3.5 PLACEMENT AND COMPACTION

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NOTE: If central plant is not specified, delete the first sentence. Density will be based on the material being stabilized.

****

[For plant-mixed, machine laid materials, begin compaction immediately following placement.] [For mixed-in-place material, allow the bituminous-stabilized mixture an adequate amount of time to cure. After curing, shape the bituminous-stabilized mixture approximately to the specified lines and grades and thoroughly loosen to its full depth and width.] Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive passes at least one-half the width of the roller. Make adjacent passes of the roller at slightly different lengths. Do not permit bituminous-stabilized materials to displace, pump, or shove. Continue compaction efforts until the compacted mixture is at least [95] [_____] percent of laboratory maximum density. Compact areas inaccessible to rollers using mechanical tamping equipment.

3.6 JOINTS

3.6.1 Longitudinal Joints

For areas where plant-mixed bituminous-stabilized material is placed in successive strips, remove 300 mm 1 foot of the edge of the material prior to placing the adjacent strip. For the shoulders of the bituminous-stabilized areas, place approved material along the edges of the bituminous-stabilized course to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course. Compact at least 300 mm 1 foot width of the shoulder or previously placed strip at the same time as compacting each layer of the bituminous-stabilized course.

3.6.2 Transverse Joints

At the end of each day's construction, form a straight transverse construction joint by cutting back into the completed work to obtain a true vertical face free of loose or shattered material. Remove material along construction joints not properly compacted and replace with bituminous-stabilized mixture that is mixed, moistened, and compacted in accordance with this specification.

3.7 FINISHING

Finish the surface of the top layer to grade and cross section as shown on the drawings and to a uniform texture. Light blading during compaction

may be necessary for the finished surface to conform to the lines, grades, and cross sections. If the surface becomes rough, corrugated, uneven in texture, or traffic-marked prior to completion, rework or replace the unsatisfactory area, as directed. If any areas become saturated by water, immediately remove that portion, place in a windrow and aerate until a moisture content within the limits specified is obtained. Verify the moisture content is within the specified limits, replace the bituminous-stabilized mixture in layers, and compact to the specified density.

3.7.1 Smoothness

****

NOTE: For subbase stabilization, delete this paragraph.

****

Evaluate the finished surface with a straightedge. Limit deviations in the surface of each layer to the tolerances shown in Table 1. Correct deviations exceeding this tolerance by removing and replacing with new bituminous-stabilized mixture, or by reworking existing material and compacting, as directed.

3.7.2 Thickness Control

****

NOTE: When subbase or base courses are constructed less than 150 mm 6 inches in total thickness, a deficiency of 13 mm 1/2 inch in thickness is considered excessive. Applicable to job conditions, the thickness tolerance provisions may be modified as required, restricting all deficiencies to not over 6 mm 1/4 inch. Coordinate changes with Table 1.

****

Build the compacted thickness of the stabilized course within 13 mm 1/2 inch of the thickness indicated. Where measured thickness of the stabilized course is more than 13 mm 1/2 inch deficient, correct such areas by removing the full depth of the layer, replacing with new material of proper gradation, and recompacting as directed. Where the measured thickness of the stabilized course is more than 13 mm 1/2 inch thicker than indicated, consider the course as conforming to the specified thickness requirements. Average job thickness is the average of all thickness measurements taken for the job, but within the tolerances of Table 1.

3.8 PRIME COAT

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NOTE: A bituminous stabilized course should be waterproof without an additional prime coat. Retain prime coat provisions if sanding or dusting of the bituminous-primed surfaces is required or if it will be at least 7 days before an asphalt mixture is constructed on the stabilized course.

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Before dust settles on the area, apply a prime coat of bituminous material to the finished surface. Uniformly apply bituminous material at the rate

of 0.22 to 0.91 L/square meter 0.05 to 0.20 gallons/square yard. [Protect bituminous material by sanding or dusting the treated surface. Uniformly apply sand at the rate of 3.5 to 4.5 kg/square meter 6 to 8 pounds/square yard].

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling and Testing

Perform sampling and testing in sufficient numbers and at the locations and times directed to ensure that materials and compaction meet specified requirements. Furnish certified copies of test results within 24 hours of completion of tests. Replace or repair all in-place unacceptable material.

3.9.2 Field Density

Express compaction as a percentage of the laboratory maximum density. Prepare laboratory samples from an uncompacted mixture obtained immediately prior to field compaction and compact the samples in accordance with ASTM D1557. Perform a minimum of one laboratory compaction test for each 4 hours of mixture placed. Determine as-built density of the bituminous-stabilized and compacted course in accordance with [ASTM D1556/D1556M][ASTM D6938. When a nuclear gauge is used, check the calibration curves and adjust if necessary, using the sand cone method as described in paragraph Calibration of ASTM D6938. ASTM D6938 results in a wet unit weight of soil and is used to determine the moisture content of the soil. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. If ASTM D6938 is used, check the in-place densities by ASTM D1556/D1556M at least once per lift for each day's production of stabilized material. Furnish calibration curves and calibration test results within 24 hours of conclusion of the tests.] Perform at least one field density test for each [200] [_____] square meters [250] [_____] square yards of each layer of stabilized material.

3.9.3 Sieve Analysis

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NOTE: Delete the bracketed reference to source of materials when select material is not required.
****

Perform a minimum of 1 analysis for each [1000] [_____] metric tons tons of material to be stabilized until the course is completed. When [the source of materials is changed or] deficiencies are found, repeat the analysis and retest the material already placed to determine the extent of unacceptable material. Replace all in-place unacceptable material at no additional cost to the Government.

3.9.4 Liquid Limit and Plasticity Index

Perform one liquid limit and plasticity index for each sieve analysis in accordance with ASTM D4318.

3.9.5 Extraction Test

Conduct asphalt content tests in accordance with ASTM D2172/D2172M or ASTM D6307, to confirm the amount of bitumen and moisture in the mixture. Adjust operation as required to maintain the asphalt content within the

tolerances of Table 1. Conduct one test [for every 4 hours of placement] [for every 275 metric tons 300 tons of mixture placed]. Take samples in accordance with ASTM D979/D979M.

3.9.6 Smoothness Test

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NOTE: For subbase stabilization, delete this paragraph.
****

Test the entire area of the bituminous-stabilized course in both a longitudinal and a transverse direction on parallel lines. Perform the transverse lines 4.5 m 15 feet or less apart, as directed. Locate the longitudinal lines at the centerline of each bituminous-stabilized pass and at the 1/8th point in from each side of the pass.

3.9.7 Thickness

Measure thickness of the stabilized course at intervals of 1 measurement for each [400] [_____] square meters [500] [_____] square yards of stabilized course. Take measurements in 75 mm 3 inch diameter test holes penetrating the stabilized course.

3.9.8 Bituminous Material

Sample the bituminous material used in accordance with ASTM D140/D140M.

3.10 MAINTENANCE

Maintain stabilized area in a satisfactory condition until accepted. Maintenance includes immediate repairs to any defects, repeated as often as necessary to keep the area intact. Correct defects as specified.

3.11 TRAFFIC

Completed portions of the bituminous-stabilized area may be opened to controlled traffic within 4 hours of completion of the course, if approved.

-- End of Section --