Preparing Activity: USACE Superseding
UFGS-32 12 19 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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USACE / NAVFAC / AFCEC / NASA **UFGS-32 12 16.19 (November 2019)**

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SECTION 32 12 16.19

COLD-MIX ASPHALT PAVING
11/19

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NOTE: This guide specification covers the requirements for cold-mix asphalt paving.

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 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 if the work covered by this section is included in one lump sum Contract price for the entire work covered by the invitation for bids. Revise this paragraph to combine the payment for cold-mix recycled mixture, rejuvenator (if needed), and emulsified asphalt cement, when separate payment for emulsified asphalt cement material is not considered warranted based on local experience and job conditions. Lump sum Contracts can be used when the total job does not exceed 17000 square m 20,000 square yd or 1000 metric tons 2000-lb tons.

****

1.1.1 Measurement

Pay for cold-mix recycling by the number of[metric tons 2000-lb tons][square m square yds] used in the accepted work. Pay for aggregates by the number of[metric tons 2000-lb tons][square m square yds] used in the accepted work. Pay for the recycling agent by the number of[L gal][metric tons 2000-lb tons] of material used in accepted work. Pay for the emulsified asphalt cement by the number of[L gal][metric tons 2000-lb tons] of material used in accepted work. Determine the number of liters gallons of emulsified asphalt cement used either by measuring the material at a temperature of 15 degrees C 60 degrees F or by correcting the amount measured at another temperature to L gal at 15 degrees C 60 degrees F, using a coefficient of expansion of 0.00045 per degree C 0.00025 per degree F for the emulsified asphalt.

1.1.2 Payment

****

NOTE: Deletet this paragraph if the work covered by this section is included in one job (lump sum) Contract price for the entire work covered by the invitation for bids.

****

Pay for the quantities of recycled paving mixture, aggregates, recycling agent, and emulsified asphalt cement, determined as provided above, at respective Contract unit prices per[metric ton 2000-lb ton] [square m square yd] for paving mixture and aggregates and per[L gal][metric ton 2000-lb ton] for recycling agent and emulsified asphalt cement. If deficiencies in the finished product exceed specified tolerances, no payment will be made for such areas of pavement until the defective areas are corrected and accepted by the Contracting Officer.

1.1.3 Waybills and Delivery Tickets

Submit copies of waybills or delivery tickets during the progress of the work. Before the final payment is allowed, provide waybills or certified delivery tickets for bituminous materials and paving mixtures used in the construction. Do not remove bituminous material from the tank car or storage tank until the initial outage has been taken; nor 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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 81	(1992; R 2017) Standard Specification for Cutback Asphalt (Rapid-Curing Type)
AASHTO M 226	(1980; R 2017) Standard Specification for Viscosity-Graded Asphalt Cement
AASHTO R 66	(2016) Standard Practice for Sampling Asphalt Materials
AASHTO T 326	(2005; R 2013) Standard Method of Test for Uncompacted Void Content of Coarse Aggregate (As Influenced by Particle Shape, Surface Texture, and Grading)

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 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 C183/C183M	(2022) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D75/D75M	(2019) Standard Practice for Sampling

	Aggregates
ASTM D140/D140M	(2016) Standard Practice for Sampling Asphalt Materials
ASTM D242/D242M	(2009; R 2014) Mineral Filler for Bituminous Paving Mixtures
ASTM D692/D692M	(2020) Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
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 D979/D979M	(2015) Sampling Bituminous Paving Mixtures
ASTM D1073	(2016) Fine Aggregate for Bituminous Paving Mixtures
ASTM D1461	(2017) Standard Test Method for Moisture or Volatile Distillates in Asphalt Mixtures
ASTM D2027/D2027M	(2019) Cutback Asphalt (Medium-Curing Type)
ASTM D2028/D2028M	(2015) Cutback Asphalt (Rapid-Curing Type)
ASTM D2041/D2041M	(2011) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
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 D2489/D2489M	(2016) Standard Test Method for Estimating Degree of Particle Coating of Asphalt Mixtures
ASTM D2950/D2950M	(2014) Density of Bituminous Concrete in Place by Nuclear Methods
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 D3628	(2015) Standard Practice for Selection and Use of Emulsified Asphalts

ASTM D4215	(2007; R 2013) Standard Specification for Cold-Mixed, Cold-Laid Bituminous Paving Mixtures
ASTM D4791	(2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5404/D5404M	(2012; R 2017) Standard Practice for Recovery of Asphalt from Solution Using the Rotary Evaporator
ASTM D5821	(2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6307	(2019) Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
ASTM D6925	(2014) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
ASTM D6926	(2020) Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus
ASTM D7175	(2015) Standard Test Method for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer

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

Bituminous Materials

Aggregates

Job Mix Formula (JMF); G[, [_____]]

Control Strip; G[, [_____]]

SD-06 Test Reports

Tests; G[, [_____]]

SD-07 Certificates

Bituminous Material

1.4 SAFETY

[Do not permit smoking or open flames within 8 m 25 ft of heating, distributing or transferring operations of bituminous materials other than bituminous emulsions.]

1.5 QUALITY ASSURANCE

Submit certified copies of test results, not less than [30][_____] days before the material is required in the work.

1.5.1 Sampling and Testing

Engage a commercial testing laboratory to perform sampling and testing or use Contractor facilities approved by the Contracting Officer. Do not permit work requiring testing until the testing facilities have been inspected and approved. The first inspection of the testing facilities

will be at the expense of the Government. Cost incurred by the Government for subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Perform tests in sufficient numbers and at the locations and times directed to ensure that materials and compaction meet specified requirements. Provide copies of the test results to the Contracting Officer within 24 hours of the completion of the tests.

1.5.2 Samples

Submit samples from the existing pavement obtained from at least two locations to provide representative samples of the pavement. Perform sampling in accordance with ASTM D75/D75M for aggregates, ASTM C183/C183M for mineral filler, AASHTO R 66 or ASTM D140/D140M for bituminous material, and ASTM D979/D979M for bituminous paving mixtures.

1.5.3 Sampling and Testing during Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL AND TESTING.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Mineral Aggregates

Deliver mineral aggregates to the site and stockpile them in such a manner to preclude fracturing of aggregate particles, segregation, contamination or intermingling of different materials in the stockpiles or cold feed hoppers. Before stockpiling material, clear, drain, level, and dry the storage areas if needed. Deliver and store mineral filler in a manner to preclude exposure to moisture or other detrimental conditions.

1.6.2 Bituminous Materials

Submit certified copies of the bituminous material manufacturer's test reports indicating compliance with specified requirements, not less than [30] [_____] days before the material is required in the work. Maintain bituminous material at appropriate temperature during storage but do not heat it by application of direct flame to walls of storage tanks or transfer lines. Clean storage tanks, transfer lines, and weigh bucket before a different type or grade of bitumen is introduced into the system. Heat the bituminous material to allow satisfactory pumping of the material; however, maintain the storage temperature below 150 degrees C 300 degrees F.

1.7 ENVIRONMENTAL REQUIREMENTS

Construct bituminous courses only when the base course or existing pavement is dry and when the weather is not foggy or rainy. Unless otherwise directed, do not construct such courses when the atmospheric temperature is below 15 degrees C 60 degrees F.

PART 2 PRODUCTS

2.1 PLANT, EQUIPMENT, MACHINES, AND TOOLS

2.1.1 General Requirements

****
NOTE: Determine the type and capacity of the plant, the number and size of trucks, paving machines, and other equipment from the metric tons 2000-lb tons of paving mixtures required, haul distances, number of working days permitted by the Contract, and other pertinent factors.
****

Maintain plant, equipment, machines, and tools used in the work in a satisfactory condition and are subject to approval. Provide equipment that is adequate for placing the bituminous mixtures at a rate equal to the plant output and that is capable of producing the required compaction, meeting grade controls, thickness control and smoothness requirements.

2.1.2 Mixing Plant

Use an automatic or semi-automatic controlled mixing plant, commercially manufactured unit designed and operated to consistently produce a mixture within the JMF. Use a plant with a minimum capacity of [_____] metric tons 2000-lb tons per hour.

2.1.3 Rollers

Provide rollers that are self-propelled, weigh not less than 9 metric tons 10 2000-lb tons and have a maximum contact pressure of 620 kPa 90 psi. Equip wheels on the roller with adjustable scrapers and water sprinkling apparatus to keep the wheels and prevent the adherence of bituminous material. Use a sufficient number of rollers on the work so that one roller is in continuous operation for 1 hour on each 100 square m square yd of completed pavement, operating at a speed of not more than 5 kph 3 mph.

2.1.4 Power Brooms and Power Blowers

Provide brooms and blowers for cleaning surfaces of the bases and the bituminous course.

2.1.5 Straightedge

Provide and maintain at the site, in good condition, one[3][3.7] m[10][12] ft straightedge for each bituminous paver for use in testing the finished surface. Construct the straightedges of aluminum or other approved lightweight metal with blades of box girder cross section and with flat bottom, reinforced to insure rigidity and accuracy. Equip straightedges with handles for operation on pavement.

2.2 MATERIALS

2.2.1 Bituminous Material

****

NOTE: Only retain the desired type and grade of bituminous material and the appropriate ASTM specification. Select the grade of bituminous material based on the information contained in UFC 3-250-10FA.

In the case where the material being recycled contains sufficient asphalt binder to meet the specification requirements, only add water as a lubricant to improve compaction. Specify Grade SS-1 or CSS-1 in moderate or cold climates. Specify Grade SS-1h or CSS-1h in hotter climates such as the southern or southwestern areas of the United States. Allow use of medium set, high float, or other emulsions with open graded mixtures or in instances where previous experience with these emulsions has provided good results.

****

Provide bituminous material conforming to [AASHTO M 81] [AASHTO M 226] [ASTM D946/D946M] [ASTM D977] [ASTM D2397/D2397M] [ASTM D2027/D2027M] [ASTM D2028/D2028M] [ASTM D3381/D3381M][, Grade [_____]].

2.2.1.1 Emulsified Asphalt

Provide emulsified asphalt conforming to [ASTM D977] [ASTM D2397/D2397M]. Select the type of emulsified asphalt according to ASTM D3628.

2.2.1.2 Cutback Asphalt

Provide cutback asphalt conforming to [ASTM D2027/D2027M] or [ASTM D2028/D2028M].

2.2.2 Aggregates

****

NOTE: Delete this paragraph when new or additional aggregates are not required as part of the recycling project. When required, allow new aggregates to be added to produce an aggregate gradation that meets the desired end product. Gradations for base course, stabilized base course or asphalt concrete intermediate course materials are specified in Table I below. Specify the gradation based on the type, quality, and uniformity of the RAP material available for use.

Retain the desired gradation to be used for the project in the project specifications; omit the other gradation. Use a gradation in the JMF meeting the requirements of the specifications.

Allow the gradation to only require a maximum aggregate particle size not be exceeded, or to require further processing or adjustment with new aggregates to meet the desired gradation. Follow the tolerances given for aggregates or asphalt aggregate mixtures when used in similar situations. When the recycled mixture is intended to be used as an

intermediate or binder course, follow the gradation tolerances in UFC 3-250-03, Table "Aggregate Gradations for Bituminous Concrete Pavements," for low-pressure tires. When the recycled mixture is to be used as a base course, an exact JMF aggregate gradation is not normally given and therefore tolerances are not required. Use a gradation that meets the gradation range specified.
****

Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screening, sand, and mineral filler, as required. Coarse aggregate is the portion of materials retained on the 4.75 mm No. 4 sieve. Fine aggregate is the portion passing the 4.75 mm No. 4 sieve and retained on the 0.075 mm No. 200 sieve. Mineral filler is the portion passing the 0.075 mm No. 200 sieve. Use a combined recycled aggregate gradation conforming to the gradation specified in TABLE I when tested in accordance with ASTM C117 and ASTM C136/C136M. TABLE I is based on aggregates of uniform specific gravity; allow the percentage passing various sieves to be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves to be changed by the Contracting Officer when the specific gravity of the aggregates varies by more than 0.2.

TABLE I. COMBINED RECYCLED AGGREGATE GRADATION	
Sieve Size	Percent Passing
[_____]	[_____]

2.2.2.1 Coarse Aggregates

Provide coarse aggregates consisting of clean, sound, durable particles conforming to ASTM D692/D692M and meeting the following requirements:

a. Do not allow the percentage of loss to exceed 40 after 500 revolutions as determined in accordance with ASTM C131/C131M.

****
NOTE: Use the magnesium-sulfate soundness test to exclude aggregates known to be unsatisfactory or to evaluate aggregates from new sources. Insert the maximum allowable percentage of loss, usually in the range of 10 to 15 percent, in the blanks. Base the values inserted 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. Assure that aggregates from new sources are of equal or better than these aggregates.
****

b. Do not allow percentage of loss to exceed [_____] after five cycles performed in accordance with ASTM C88 using magnesium sulfate.

c. Do not allow the dry weight of crushed slag to be less than 1200 kg per cubic m 75 lbs per cubic ft, as determined in accordance with

ASTM C29/C29M.

d. Determine the percentage of coarse aggregate that consists of fractured particles in accordance with [ASTM D5821][AASHTO T 326] and be not less than [____], by mass, of the aggregate particles retained on the 4.75 mm No. 4 sieve.

e. Particle shape of crushed aggregates are to be cubical. Do not allow the quantity of flat and elongated particles in any sieve size to exceed 20 percent by weight when determined in accordance with ASTM D4791.

2.2.2.2 Fine Aggregate

Provide fine aggregate consisting of clean, sound, durable particles of natural sand, crushed stone, slag or gravel conforming to ASTM D1073 and that meets the requirements for abrasion resistance and soundness specified for coarse aggregate. Do not allow the quantity of natural sand to be added to the wearing and intermediate course mixtures to exceed 25 percent by weight of coarse and fine aggregate and mineral filler. Provide natural sand that is clean and free from clay and organic matter. Do not allow the percentage of loss to exceed [_____] after five cycles of the soundness test performed in accordance with ASTM C88, using magnesium sulfate.

2.2.2.3 Mineral Filler

Use mineral filler in accordance with ASTM D242/D242M. Determine grain size in accordance with ASTM D422. Use the tabulated gradation requirements in Table II in areas where dune sand or one-size material is allowed as mineral filler, unless otherwise directed.

TABLE II. MINERAL FILLER GRADATION REQUIREMENTS	
Particle Size mm inch	Percent Finer
0.05 [_____]	70-100
0.02 [_____]	35-65
0.005 [_____]	10-22

2.2.3 Recycling Agents

****

NOTE: Depending on the material properties of the existing asphalt cement binder and the type and method of recycling used, select an appropriate type of recycling agent (rejuvenator). Specify non-emulsified recycling agents according to ASTM D4552/D4552M. Specify a rejuvenator matching the recycling process used. Select the recycling agent capable of decreasing the viscosity of the recycled asphalt cement to levels that approach the viscosity values of asphalt cement in new asphalt concrete pavements for that area or region. Delete this

paragraph if a recycling agent is not required.
****

Use bituminous recycling agent consisting of either foamed asphalt or emulsified asphalt. Use [_____] for the recycling agent or an approved equal. Submit notification on sources from which recycling agent are to be obtained within 15 days after Contract award.

Allow cement, lime slurry and corrective aggregates to be used as recycling additives to improve CCPR mix properties.

2.2.4 Liquifiers

The use of liquefiers as anti-stripping agent is subject to prior approval by the Contracting Officer.

2.2.5 Water

Use water in accordance with ASTM C1602/C1602M. Do not use hot water unless approved by a Contracting Officer. Prior to construction, mix a sample of the water intended for use on the job with a sample of the emulsion at the ratio to be used in the project. If adverse effect is observed on the emulsion, use a new source of water

2.3 JOB MIX FORMULA (JMF)

****
NOTE: Use the procedure for the design mixture given in UFC 3-250-03 to determine the JMF.
****

Do not produce bituminous mixtures until a JMF has been determined and approved by the Contracting Officer. Submit the JMF, at least [_____] days before it is to be used, notification on the selection of aggregate source, and notification on the selection of bituminous materials source. The Contracting Officer will verify this JMF through samples of materials submitted. No payment will be made for cold recycled mixtures produced prior to the completion and acceptance of the JMF. Submit a 45 kg 100 lb sample of each aggregate, a 90 kg 200 lb representative sample of the recyclable asphalt pavement, a 20 L 5 gal sample of recycling agent, and a 20 L 5 gal sample of emulsified asphalt cement for mix design, not less than [30] [_____] days before material is required in the work. Indicate the gradation of the aggregate and a definite percentage of water [,recycling agent] and asphalt to be added to the mixture.

The JMF is allowed the tolerances given in TABLE III. Allow the aggregate gradation and bitumen content to be adjusted, as directed, within the limits specified to improve paving mixtures. Determine the proportions established in the JMF using ASTM D4215.

TABLE III. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
[Liquefier]	[0.20 percent]

TABLE III. JOB-MIX TOLERANCES	
Temperatures	-4 degrees C 25 degrees F

2.3.1 Gradation Tolerances

****
NOTE: Eliminate the corresponding material size and tolerance values to agree with sieve sizes specified in Table 1. Eliminate these completely if no new aggregate is added and no specific JMF gradation is developed.
****

The tolerances allowed on the aggregate gradation - coarse aggregate, fine aggregate and mineral filler combined are presented in Table IV.

TABLE IV. GRADATION TOLERANCES	
Material	Tolerance, Plus or Minus
Aggregate passing 4.75 mm No. 4 sieve	4 percent
Aggregate passing 2.36, 1.18, 0.6 and 0.3 mm Nos. 8, 16, 30, and 50 sieves	3 percent
Affregate passing 0.15 and 0.075 mm Nos. 100 and 200 sieves	1 percent

2.3.2 Asphalt Content

The JMF is allowed an asphalt content tolerance of plus or minus 0.3 percent. Allow the asphalt content to be adjusted by the Contracting Officer to improve paving mixture, without adjustment in Contract unit price. Select the optimum asphalt content to provide the tabulated properties when samples are compacted [at 120 degrees C 250 degrees F with [50] [75] blows of standard Marshall hammer on each side of the specimen, according to the test procedure in [ASTM D6926][prepared in accordance with ASTM D6925].]

2.3.3 Water Content

Select the water content to provide maximum dry density when samples are prepared at the optimum asphalt content and [compacted with [50] [75] blows of standard Marshall hammer on each side of the specimen, according to the test procedure in ASTM D6926][prepared in accordance with ASTM D6925]. When no asphalt binder is added to the mixture, select the water content to provide maximum dry density. Prepare samples with water contents, in 0.5 percent intervals, from 0 to 2.5 percent (increase water content to achieve maximum density). After compaction, place the samples in an oven at 60 degrees C 140 degrees F for 96 hours. After cooling to ambient temperature, determine the dry density according to ASTM D6925.

2.4 INITIAL SAMPLING AND TESTING

2.4.1 Source of Aggregates

Select sources from which aggregates are to be obtained and provide notification of the selection to the Contracting Officer within [15][_____] days of the award of the Contract. Make tests for the evaluation of aggregates by an approved commercial laboratory at no expense to the Government. Include tests for determining the suitability of aggregate, but not limited to: gradation in accordance with ASTM C136/C136M, abrasion resistance in accordance with ASTM C131/C131M, and soundness in accordance with ASTM C88.

2.4.2 Source of Bituminous Materials

Select sources from which bituminous materials are to be obtained and provide notification of the selection to the Contracting Officer within [15][_____] days after the award of the Contract.

2.4.3 Reclaimed Asphalt Pavement (RAP)

****

NOTE: Cold-mix recycling could include the use of existing RAP material stockpiles. If this condition exists, include the desired material properties below. Determine the gradation of the existing stockpile.

****

Evaluate the properties of the RAP, extracted aggregate, and recovered bituminous material. Determine the moisture content in accordance with ASTM D1461.

a. RAP Binder: Recover the aged asphalt binder from the RAP according to ASTM D5404/D5404M. Test the recovered asphalt binder to determine the effects of aging on the stiffness and consistency in accordance with ASTM D7175. Determine the asphalt content in accordance with [ASTM D2172/D2172M][ASTM D4215][ASTM D6307].

b. RAP Aggregate: Determine the gradation of the RAP in accordance with ASTM C136/C136M. Do not permit the maximum particle size of the RAP material to exceed half the thickness of the compacted recycled pavement. When lifts of 75 mm 3 in or more are used, do not permit the maximum particle size of the RAP material to exceed a maximum of 38 mm 1-1/2 in and having a minimum of 90 percent of the RAP passing the 25 mm 1 in sieve.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Base Course

Clean the surface of the base course of loose and foreign material. Correct ruts or soft yielding spots, areas having inadequate compaction, and deviations of surface from requirements specified for the base course by loosening affected areas, removing unsatisfactory material, adding approved material where required, reshaping, and recompacting to line and grade to specified density requirements. Spray the surface with bituminous material conforming to Section 32 12 13 BITUMINOUS TACK AND

PRIME COATS.

3.1.2 Existing Pavement

Clean the existing pavement of loose and foreign matter. Clean cracks 5 mm 1/4 in in width and larger and fill with crack filler material. Repair deteriorated areas of the pavement as directed. Spray the surface with a thin coat of bituminous material conforming to Section 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.2 GRADE CONTROL

Confirm the finished and completed surface course (whether a base course or existing pavement) conform to the lines, grades, cross sections, and dimensions as indicated in the drawings. Place line and grade stakes at the site of the work, in accordance with the SPECIAL CONTRACT REQUIREMENTS, to maintain indicated lines and grades.

3.3 MIXING

3.3.1 Preparation of Mineral Aggregates

Place each component of various sizes of aggregates blended in preparing bituminous mixtures in separate stockpiles in such manner that separate sizes are not intermixed. Feed aggregate into the cold elevator by means of separate mechanical feeders to produce a total aggregate graded within requirements specified.

3.3.2 Preparation of Bituminous Mixtures

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NOTE: If asphalt emulsion is specified, delete the statement in brackets pertaining to moisture content.

****

Measure aggregates and convey into the mixer in proportionate quantities of each aggregate size required to meet the JMF. [Do not allow the moisture content of the finished mixture to exceed 2 percent by weight.] Introduce materials into the mixer in the following order: aggregate, [lime,] [flux oil,] [liquefier,] and bituminous material, unless otherwise directed. Check that the temperature of the bituminous material is [_____] at the time of mixing. Do not allow the temperature of the aggregate and mineral filler in the mixer to exceed [_____] when the bituminous material is added. If slag aggregate is used, spray the liquefier over slag after coating with bituminous material. [Use the percentage of hydrated lime in the mix ranging from 0.5 to 1.5 percent by weight, as directed.] Mix aggregates and other ingredients for 35 seconds or longer to coat particles with bituminous material. Do not permit the finished mixture to vary from the approved JMF without prior approval of the Contracting Officer.

3.3.3 Construction Methods

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NOTE: Depending on the type of recycling desired, edit the following paragraphs to remove the undesired method.

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3.3.3.1 Central Plant Mixing

Introduce the required amount of bituminous material for each batch, or calibrated amount of continuous mixing, into the mixer to meet the requirements of the JMF. Provide a uniform dispersion of the emulsified asphalt and water to achieve a coating (visually) of aggregate particles. If this process requires excessive mixing, resulting in premature breaking of the emulsified asphalt, shorten the mixing times as directed by the Contracting Officer. As a minimum, when the recycled mixture contains fine particles passing the 4.75 mm No. 4 sieve, provide a coating of these particles.

3.3.3.2 In-Place-Mixing

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NOTE: In-place recycling can be divided into either partial- or full-depth recycling. Partial-depth recycling involves only a portion of the asphalt bound layers and normally involves recycling to a depth of 50 to 100 mm 2 to 4 in. Full-depth recycling involves asphalt bound layers and often portions of the underlying base course layer.

****

Produce a uniform blend of the RAP, aggregate (when required), asphalt emulsion, water, and a mixture containing the required amounts of emulsified asphalt and water as given in the JMF when using the in-place recycling process.

3.4 TRANSPORTATION OF BITUMINOUS MIXTURES

Transport mixtures to the site in trucks having tight, clean, smooth bodies. Schedule deliveries so that the spreading and rolling of mixtures delivered to the site are completed during daylight unless approved artificial light is provided.

3.5 CONTROL STRIP

****

NOTE: Use of a test section is recommended for recycled mixtures, especially for central-plant mix recycling. The following paragraph is written for placing central-plant mix with a paver; edit when another type of recycling is used.

****

Prior to the start of the recycling project, prepare a sufficient quantity of mixture to construct a control strip at least 15 m 50 ft long, two spreader widths wide and of thickness to be used in the project. Place, spread, and roll the mixture with the equipment to be used in the project and in accordance with requirements specified above. Test and evaluate the control strip as a lot conforming to specification requirements. If approved by the Contracting Officer, allow the control strip to be located in one of the less critical areas of the project pavement construction. Otherwise, allow it to be located outside the project paving. If tests results are satisfactory, allow the control strip to remain in place as part of the completed pavement if constructed in the project pavement

area. If tests indicate that the pavement does not conform to specification requirements, remove the control strip and the material disposed of offsite. Make necessary adjustments to the plant operations and rolling procedures immediately, and construct another control strip, all at no additional cost to the Government. Construct and sample other additional control strips and test for conformance with specification requirements. Do not start full production with the recycled mixture without approval of the Contracting Officer.

3.6 PLACEMENT

3.6.1 Thickness of Layer

Spread the mixture in a layer not greater than 50 mm 2 in in thickness. Allow each layer to cure at least 12 hours or longer, if required to achieve proper curing before placing a succeeding layer.

3.6.2 General Requirements for Use of Motor Grader

When approved motor graders are used for spreading the mixture, place the material on the roadbed in a windrow so that the proper amount of material is available to cover a predetermined width to the indicated compacted thickness. Allow use of the motor grader to aerate the mixture by working it back and forth across the roadbed in order to get the mixture to the proper condition for compaction.

3.6.3 General Requirements for Use of Mechanical Spreader

When mechanical spreaders are used, dump the bituminous mixture into an approved mechanical spreader and placed as nearly continuous as possible. Adjust the speed of placing to permit proper rolling.

3.6.4 Offsetting Joints Between Succeeding Courses

Place a succeeding course in such a manner that the longitudinal joints of the succeeding course do not coincide with joints of the previous course and are offset from joints in the previous course by at least 300 mm 1 ft. Offset transverse joints in the succeeding course by at least 600 mm 2 ft from transverse joints in the previous course.

3.6.5 Special Requirements for Laying Strips Succeeding Initial Strip

In laying each succeeding strip after the initial strip has been spread and compacted as specified, overlap the blade of the motor grader or the screed of the mechanical spreader of the previously placed strip 75 to 100 mm 3 to 4 in at a height required for compaction to produce a smooth, dense joint.

3.6.6 Shoveling, Raking, and Tamping After Machine Spreading

Follow the spreading machine with shovelers and rakers, raking, removing, and adding mixture as required to obtain a course that, when completed, conforms to specified requirements. Do not permit excessive handwork and broadcasting or fanning of mixture.

3.6.7 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, spread the mixture by hand. Spreadin a manner to prevent segregation. Spread

mixture uniformly in a loose layer of thickness that, when rolled, is in accordance with the required thickness.

3.7 COMPACTION

[Begin compaction immediately after placement.][Allow the mixture an adequate amount of time for aeration and curing. After curing, shape the mixture approximately to the specified lines and grades and loosened to its full depth and width. Begin rolling as soon after placing as the mixture bears the roller without undue displacement.] Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Use alternate trips of the roller that are slightly different lengths. Operate the the roller at a speed that displacement of the material does not occur. [Check that the density of the compacted mixture is at least 96 percent of that of laboratory specimens of the same mixture [subjected to 50 blows of the standard Marshall hammer according to the test procedure in ASTM D6926][prepared in accordance with ASTM D6925].] [Roll bituminous mixtures until roller marks are eliminated, and a field density of at least 86 percent of the theoretical maximum density is obtained when tested in accordance with ASTM D2041/D2041M.]

3.7.1 Operation of Rollers and Tampers

Provide the sufficient number, weight, and type of rollers to obtain the required density. Begin initial rolling of the recycled mixture as the emulsion is starting to break. Where lift thicknesses exceed 75 mm 3 in, accomplish breakdown rolling with a large 23 to 27 Mg 25 to 30-lb tons pneumatic roller. Use either a pneumatic or a steel-wheel roller to breakdown roll thinner lifts. Equip rollers with watering devices to prevent material adhesion; however, do not permit excess water. Allow vibratory rolling to achieve required density. Use finish rolling with a steel-wheel roller to remove existing roller marks.

3.7.2 Correcting Deficient Areas

Remove mixture that becomes contaminated with foreign material or is defective, to the full thickness of the course. Cut the hole with sides vertical and perpendicular to each other, with one pair parallel to the direction of traffic. Do not permit rolled areas to be skin patched to correct low areas and to be planed to correct high areas. Place fresh paving mixture in holes in sufficient quantity to produce a finished surface conforming to grade and smoothness requirements. Aerate paving mixture and compact to the density specified. Provide workmen capable of performing work incidental to the correction of deficiencies and defects.

3.8 EDGES OF PAVEMENT

Compact the edges of the pavement to the required density and straight and true to required lines. Place approved material along the edges of the pavement in such quantity to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 300 mm 1 ft width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the pavement as directed.

3.9 FINISHING

Finish the surface of the top layer to grade and cross section shown in

the drawings. Provide a finished surface with a uniform texture. Allow light blading during rolling for the finished surface to conform to the lines, grades, and cross sections in the drawings. If the surface becomes rough, corrugated, uneven in texture, or traffic-marked prior to completion, scarify, rework, relay or replace such unsatisfactory portion as directed. If the course, when laid, becomes water-soaked, remove that portion immediately, and placethe mix in a windrow, aerated, and then spread, shaped, and rolled as specified. If required, this will be at no additional expense to the Government.

3.10 CURING

After compaction has been achieved and prior to opening the pavement layer to traffic, apply a fog seal, if required, to the pavement surface. Use a fog seal composed of [ASTM D2397/D2397M CSS-1H][ASTM D977 SS-1h] emulsified asphalt diluted up to 50 percent by volume with water or an engineered emulsion diluted up to 60 percent by volume with water. Apply the fog seal at a rate of 0.2 to 0.7 L per square m 0.05 to 0.15 gal/square yd. When sand blotter is required, apply it to the surface at approximately 1 to 5 kg per square m 2 to 3 lbs per square yd. Use sand free from clay or organic material. Determine the application rates of the fog seal and sand blotter and be such that a stable and safe roadway surface can be maintained until the surface course is placed.

3.11 THICKNESS REQUIREMENTS

Confirm the compacted thickness of the pavement is within 13 mm 1/2 in of the thickness indicated in the drawings. Where measured thickness of the pavement is more than 13 mm 1/2 in deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed at no additional expense to the Government. Where the measured thickness of the pavement is more than 13 mm 1/2 in thicker than indicated, consider the pavement as conforming to the specified thickness requirements.

3.12 SURFACE-SMOOTHNESS REQUIREMENTS

3.12.1 Intermediate Courses

Check the surface of each intermediate course longitudinally with a [3] [3.7] m [10] [12] ft straightedge and checked transversely with a template conforming to the specified cross section. Do not allow the surface of the layer, after rolling to deviate more than 6 mm 1/4 in from the [3] [3.7] m [10] [12] ft straightedge nor 6 mm 1/4 in from the template. Correct irregularities by loosening and reshaping the aggregate, removing or adding aggregate as required, and rerolling such areas.

3.12.2 Finished Surfaces

3.12.2.1 Roads and Streets

Check the surface of the finished pavement longitudinally with a [3] [3.7] m [10] [12] ft straightedge and transversely with a template cut to the specified cross section. Do not allow the finished surface of the surface course to deviate more than 3 mm 1/8 in from the [3] [3.7] m [10] [12] ft straightedge or from the template. Correct surface irregularities exceeding those specified as [_____] [directed].

3.12.2.2 Other Than Roads and Streets

Check the surface of the finished pavement longitudinally and transversely with a [3] [3.7] m [10] [12] ft straightedge. Do not allow the finished surface of the finished pavement to deviate more than 6 mm 1/4 in from the [3] [3.7] m [10] [12] ft straightedge. Correct surface irregularities exceeding tolerances specified as [_____] [directed].

3.13 JOINTS

Make joints having the same texture, density, and smoothness as other sections of the course. Make joints between old and new pavements or between successive days' work carefully to insure continuous bond between old and new sections of the course. Apply a thin, uniform coat of bituminous material, conforming to Section 32 12 13 BITUMINOUS TACK AND PRIME COATS, just before the fresh mixture is placed to contact surfaces of previously constructed pavements.

3.13.1 Transverse Joints

Pass the roller over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued. Cut back the edge of the previously laid course to expose an even, vertical surface for the full thickness of the course. Rake the fresh mixture against the joints, tamp and then roll.

3.13.2 Longitudinal Joints

When the edges of the longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of the joint to expose an even, vertical surface for the full thickness of the course. Where required, rake fresh mixture against the joint, tamp, and then roll.

3.14 FIELD QUALITY CONTROL AND TESTING

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NOTE: Insert the appropriate frequency interval of testing in the blanks.
****

3.14.1 Testing

Perform field tests in sufficient numbers to assure that the specifications are being met. Perform testing by an approved commercial laboratory. The following number of tests, if performed at the appropriate time, are the minimum acceptable for each type of operation.

3.14.1.1 Field Density

Express the field density as a percentage of the laboratory density. Prepare laboratory samples from an uncompacted mixture taken from the pavement immediately prior to field compaction and compact the samples in accordance with [_____]. Do not reheat the asphalt mixture in the laboratory. Perform a minimum of one field density test for every [_____] metric tons 2000-lb tons of mixture placed. Determine field density according to ASTM D2950/D2950M, or other Owner Agency approved method.

3.14.1.2 Gradation

Perform a minimum of one gradation test for every [_____] metric ton 2000-lb ton of aggregate used in the mixture, with a minimum of three gradations for each day's run. When the source of materials is changed, or deficiencies are found, replace the gradation and retest the material already placed to determine the extent of the unacceptable material. Replace in-place unacceptable material at no additional expense to the Government.

3.14.1.3 Abrasion Resistance

Perform abrasion resistance tests in accordance with ASTM C131/C131M to ensure that the aggregates have a percentage of wear not exceeding 40 percent after 500 revolutions. Perform one test for every [_____] metric ton 2000-lb ton of aggregate placed.

3.14.1.4 Soundness Test

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NOTE: The magnesium-sulfate soundness test is to be used in excluding aggregates known to be unsatisfactory or for evaluating aggregates from new sources. Insert the maximum allowable percentage of loss, usually in the range of 10 to 15 percent, in the blanks. Base the values inserted 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 assure that aggregates from new sources are of equal to or better than these aggregates.

****

Perform soundness tests as specified by ASTM C88 to ensure that the aggregates have a weight loss not greater than [_____] percent when subjected to five cycles of the magnesium sulfate test. Perform one test for every [_____] metric tons 2000-lb tons of aggregate placed.

3.14.1.5 Smoothness

Take measurements, for deviation from grade and cross section shown in the drawings, in successive positions parallel to the road centerline, with a [3] [3.7] m [10] [12] ft straightedge. Check the surface of each course transversely with [a template cut to the specified cross section] [a [3] [3.7] m [10] [12] ft straightedge] placed perpendicular to the road centerline at [_____] m ft intervals.

3.14.1.6 Thickness

Determine the thickness of the pavement every [_____] m ft along the finished surface. Make measurements in 75 mm 3 in diameter test holes penetrating the pavement. Refill the holes to conform to these specifications.

3.14.1.7 Asphalt Paving Mixtures

Obtain samples in accordance with ASTM D979/D979M. Take stockpile samples at least 100 mm 4 in below surface excluding the slight outer crust that has formed.

a. Coating: Determine adequate coating of the aggregate by the asphalt emulsion in accordance with ASTM D2489/D2489M.

b. Bitumen Content: Take samples of finished plant mixture and test for each [_____] metric tons 2000-lb tons or fraction thereof, to determine if bitumen content is in accordance with ASTM D2172/D2172M and conforms to the specified requirements.

c. Stripping: Determine stripping of residual asphalt from aggregate in accordance with ASTM D3625/D3625M.

3.14.2 Bituminous Material Sample

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

3.15 PROTECTION OF PAVEMENT

Maintain the pavement in a satisfactory condition until accepted by the Contracting Officer.

3.16 TRAFFICKING

Do not allow trafficking on newly placed recycled mixtures prior to completion of compaction and the curing period.

3.17 MAINTENANCE

After opening to traffic and prior to placing the surface course, maintain the surface of the recycled pavement in a condition suitable for the safe movement of traffic. Protect and maintain the recycled surface from nuisance water, other deleterious substances, and/or other damage. Repair damage to the completed recycled material prior to placement of the surface course.

-- End of Section --