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USACE / NAVFAC / AFCEC / NASA	**UFGS-32 12 16.16 (November 2020)**

Preparing Activity: USACE	**Superseding**
	UFGS-32 12 16 (August 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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SECTION 32 12 16.16

ROAD-MIX ASPHALT PAVING

11/20

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SECTION 32 12 16.16

ROAD-MIX ASPHALT PAVING
11/20

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NOTE: This guide specification covers the requirements for intermediate and wearing courses (central-plant hot-mix and warm-mix) for roads using Marshall or Gyratory compaction methods.

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. Do not lessen the quality of the work.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

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NOTE: Modifications must be made to this guide specification during conversion to a project specification in accordance with the NOTES which are located throughout the document. These NOTES are instructions to the designer, and will not appear in the project specification.

This guide specification only pertains to the hot-mix and warm-mix asphalt aspects of the project and not to any surface preparation requirements dealing with aggregate base courses, milling, or tack and prime coats. Cover surface preparation requirements adding pertinent sections to the project documents.

This specification utilizes a Quality Assurance and Quality Control (QA/QC) construction management philosophy. Quality Assurance refers to the actions performed by the Government or designated representative to assure the final product meets the job requirements. This specification has been developed for QC testing to be used as a basis for acceptance and percent payment. The Government's QA testing should include as a minimum 10 percent of the QC tests.

For projects less than 1,000 tonnes tons, State DOT material's requirements may be specified. Only material requirements may be substituted as an option. The designer should select which DOT mix design is appropriate for the project. Construction procedures and acceptability of work requirements must stay the same. Designer has the option to eliminate submittal requirement for material samples for this size project.

For projects over 1,000 tonnes tons use this guide as is. Lot size should be specified appropriately.

Do not delete PART 1. Select the tailoring option for PERCENT PAYMENT when pay reduction factors are desired. Select the tailoring option for ACCEPT-REJECT when pass/fail criteria is desired. PERCENT PAYMENT is recommended for most projects and is the standard of practice used by most State DOTs. Adequate justification must be provided by the DOR when selecting the ACCEPT-REJECT tailoring option.

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1.1 PERCENT PAYMENT

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NOTE: The basis of pay testing program includes material tests to determine laboratory air voids and in-place density, which are needed to determine percent payment.

****

1.1.1 Method of Measurement

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NOTE: For unit-price contracts, include first bracketed statements and delete the second set.

For lump sum contracts, delete the first bracketed statements and include the second set.

Do not use lump sum contracts when the job exceeds 1,000 tonnes tons.

****

[The amount paid for will be the number of tonnes tons of hot-mix warm-mix

asphalt pavement mixture used in the accepted work. Weigh the hot-mix warm-mix asphalt pavement mixture after mixing. No separate payment will be made for weight of asphalt cement material incorporated herein.] [Measurement of the quantity of hot-mix warm-mix asphalt pavement, per tonne ton placed and accepted, will be made for the purposes of assessing the pay factors stipulated below.]

1.1.2 Basis of Payment

****

NOTE: For unit-price contracts, include first bracketed statements and delete the second set.

For lump sum contracts, delete the first bracketed statements and include the second set. Include prescriptive unit price based on the Government/Engineer estimate for payment adjustment.

****

[Quantities of hot-mix warm-mix asphalt pavement, determined as specified above, will be paid for at respective contract unit prices or at reduced prices adjusted in accordance with paragraphs PERCENT PAYMENT and ACCEPTANCE. Payment will constitute full compensation for furnishing all materials, equipment, plant, and tools; and for all labor and other incidentals necessary to complete work required by this section of the specification.] [The measured quantity of hot-mixed warm-mixed asphalt pavement will be paid for and included in the lump sum contract price. If less than 100 percent payment is due based on the pay factors stipulated in paragraph PERCENT PAYMENT, a unit price of [_____] per tonne ton will be used for purposes of calculating the payment reduction.]

1.1.3 Lot Pay Factor

The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, smoothness, or grade (each discussed below). Remove and replace lots when the lowest computed pay factor requires rejection. At the end of the project calculate the average pay factor for all lots. If this average lot pay factor exceeds 95.0 percent and no individual lot has a pay factor less than 75.0 percent, then the percent payment for the entire project will be 100 percent of the unit bid price. If the average lot pay factor is less than 95.0 percent, then each lot will be paid for at the unit price multiplied by the lot's pay factor. For any lots which are less than 2,000 tonnes tons, a weighted lot pay factor will be used to calculate the average lot pay factor. When work on a lot is required to be terminated before all four sublots are completed, the results from the completed sublots will be analyzed to determine the percent payment for the lot following the same procedures and requirements for full lots but with fewer or more test results as determined in paragraph PAVEMENT LOTS.

1.1.4 Payment Adjustment for Laboratory Air Voids

Laboratory air void calculations for each lot will use the average theoretical maximum density values obtained for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). The mean absolute deviation of the laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated as shown in the example below and a pay factor will be determined from Table 1. When 0 percent payment is determined, remove and replace the rejected

lot at least 100 mm 4 inches into the cold (existing) lane adjacent to the longitudinal joint.

Table 1. Pay Factor Based on Laboratory Air Voids	
Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, percent
0.60 or less	100
0.61 - 0.80	98
0.81 - 1.00	95
1.01 - 1.20	90
Above 1.20	reject (0)

1.1.4.1 Pay Factor Example for Laboratory Air Voids

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 sublots where one set of laboratory compacted specimens is from a single sublot. The laboratory air voids for the 4 sublots are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

Mean Absolute Deviation = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4

Mean Absolute Deviation = (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 1 that the lot's pay factor based on laboratory air voids is 100 percent.

1.1.5 Payment Adjustment for In-place Densities

The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). The average in-place mat density and joint density for a lot are determined and compared with Table 2 to calculate a single pay factor per lot. Use the following process to determine the single pay factor for in-place density:

a. Step 1: Determine the pay factors for mat density and joint density using Table 2.

b. Step 2: Determine ratio of joint area to mat area. The area associated with the joint is considered to be 3 m 10 feet wide times the length of completed longitudinal construction joint in the lot. This joint area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously.

c. Step 3: Compute the weighted pay factor for the joint using the

formula in the example below.

d. Step 4: Compare weighted pay factor for joint density to pay factor for mat density and select the smaller. This selected pay factor is the pay factor based on density for the lot.

When 0 percent payment is determined for mat density, remove and replace the rejected lot at least 100 mm 4 inches into the cold (existing) lane adjacent to the longitudinal joint. When 0 percent payment is determined for joint density, remove and replace the rejected longitudinal joint with a 3 m 10 feet wide paving lane that is centered over the joint.

Table 2. Pay Factor Based on In-place Density

Average Mat Density (4 Cores) (Percent of TMD)	Pay Factor, Percent	Average Joint Density (4 Cores) (Percent of TMD)
93.0 - 96.0	100.0	91.5 or above
92.9	100.0	91.4
92.8 or 96.1	99.9	91.3
92.7	99.8	91.2
92.6 or 96.2	99.6	91.1
92.5	99.4	91.0
92.4 or 96.3	99.1	90.9
92.3	98.7	90.8
92.2 or 96.4	98.3	90.7
92.1	97.8	90.6
92.0 or 96.5	97.3	90.5
91.9	96.3	90.4
91.8 or 96.6	94.1	90.3
91.7	92.2	90.2
91.6 or 96.7	90.3	90.1
91.5	87.9	90.0
91.4 or 96.8	85.7	89.9
91.3	83.3	89.8
91.2 or 96.9	80.6	89.7
91.1	78.0	89.6
91.0 or 97.0	75.0	89.5
below 91.0, above 97.0	0.0 (reject)	below 89.5

1.1.5.1 Pay Factor Example for In-place Density

An example of the computation of a pay factor (in I-P units only) based on in-place density, is as follows: Assume the following test results for field density made on the lot: (1) Average mat density = 92.2 percent (of lab TMD). (2) Average joint density = 90.5 percent (of lab TMD). (3) Total area of lot = 30,000 square feet. (4) Length of completed

longitudinal construction joint = 2,000 feet.

a. Step 1: Determine pay factor based on mat density and on joint density, using Table 2:

Mat density of 92.2 percent = 98.3 pay factor.

Joint density of 90.5 percent = 97.3 pay factor.

b. Step 2: Determine ratio of joint area to mat area. Multiply the length of completed longitudinal construction joint by the specified 10 foot width and divide by the mat area (total paved area in the lot).

Ratio = Ratio of joint area to mat area

Ratio = (2,000 feet x 10 feet)/30,000 square feet

Ratio = 0.6667

c. Step 3: Weighted pay factor (wpf) for joint is determined as indicated below:

wpf = joint pay factor + (100 - joint pay factor) x (1 - ratio)

wpf = 97.3 + (100-97.3) x (1-0.6667) = 98.2 percent

d. Step 4: Compare weighted pay factor for joint density to pay factor for mat density and select the smaller:

Pay factor for mat density: 98.3 percent.

Weighted pay factor for joint density: 98.2 percent

Selected pay factor: 98.2 percent

1.1.6 Payment Adjustment for Smoothness (Final Wearing Surface Only)

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NOTE: This paragraph may be deleted for projects where a profilograph cannot record 400 meters 0.25 miles in length.

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Profilograph Testing. Record the location and data from all profilograph measurements. When the Profile Index of a lot exceeds the tolerance specified in paragraph SMOOTHNESS REQUIREMENTS by 16 mm per km 1.0 inch per mile, but less than 32 mm per km 2.0 inches per mile, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 32 mm per km 2.0 inches per mile, but less than 47 mm per km 3.0 inches per mile, the computed pay factor will be 90 percent. When the Profile Index exceeds the tolerance by 47 mm per km 3.0 inches per mile, but less than 63 mm per km 4.0 inches per mile, the computed pay factor will be 75 percent. Remove and replace the lot when the Profile Index exceeds the tolerance by 63 mm per km 4.0 inches per mile or more, at no additional cost to the Government. Regardless of the above, correct any small individual area with surface deviation which exceeds the tolerance given above by more than 79 mm per km 5.0 inches per mile or more, by grinding to meet the specification requirements above or

remove and replace at no additional cost to the Government.

1.1.7 Payment Adjustment for Plan Grade

****
NOTE: The grade and surface smoothness requirements specified below are for the final wearing surface only. If there is a requirement to test and control the grade and smoothness for the intermediate courses, for example, when the intermediate courses will be exposed to traffic, slight modifications to this specification are required.
****

When more than 5 percent of all measurements made within a lot are outside the 15 mm 0.05 foot tolerance, the pay factor based on grade for that lot will be 95 percent. For individual locations where the grade exceeds 22.5 mm 0.075 foot tolerance, remove the surface lift full depth and replace the lift with asphalt pavement to meet specification requirements at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet grade requirements for the lot and at individual locations.

1.2 PAYMENT

****
NOTE: The basis of acceptance includes material tests to determine laboratory air voids and in-place density.
****

1.2.1 Method of Measurement

****
NOTE: For unit-price contracts, include first bracketed statements and delete the second set.

For lump sum contracts, delete the first bracketed statements and include the second set.

Do not use lump sum contracts when the job exceeds 1,000 tonnes tons.
****

[The amount paid for will be the number of tonnes tons of hot-mix warm-mix asphalt pavement mixture used in the accepted work. Weigh the hot-mix warm-mix asphalt pavement mixture after mixing. No separate payment will be made for weight of asphalt cement material incorporated herein.]
[Measurement of the quantity of hot-mix warm-mix asphalt pavement per lot will be made for the purposes of assessing acceptance stipulated in paragraph ACCEPTANCE.]

1.2.2 Basis of Payment

****
NOTE: For unit-price contracts, include first bracketed statements and delete the second set.

For lump sum contracts, delete the first bracketed

statements and include the second set.
****

[Quantities of hot-mix warm-mix asphalt pavement, determined as specified above, will be paid for at respective contract unit prices. Payment will constitute full compensation for furnishing all materials, equipment, plant, and tools; and for all labor and other incidentals necessary to complete work required by this section of the specification.][The measured quantity of hot-mixed warm-mixed asphalt pavement will be paid for and included in the lump sum contract price.]

1.3 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 156	(2013; R 2017) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO T 304	(2011; R 2015) Standard Method of Test for Uncompacted Void Content of Fine Aggregate
AASHTO T 329	(2015) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

AI MS-2	(2015) Asphalt Mix Design Methods

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 C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C142/C142M	(2017) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
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 D946/D946M	(2020) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979/D979M	(2015) Sampling Bituminous Paving Mixtures
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 D2419	(2014) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2726/D2726M	(2019) Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2872	(2019) Standard Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)
ASTM D3203/D3203M	(2017) Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures
ASTM D3665	(2012; R 2017) Standard Practice for Random Sampling of Construction Materials
ASTM D3666	(2016) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4791	(2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867/D4867M	(2009; R 2014) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5361/D5361M	(2016) Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
ASTM D5444	(2015) Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	(2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6084/D6084M	(2018) Standard Test Method for Elastic Recovery of Asphalt Materials by Ductilometer
ASTM D6307	(2019) Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
ASTM D6373	(2016) Standard Specification for Performance Graded Asphalt Binder
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 D6927	(2015) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D7405	(2020) Standard Test Method for Multiple Stress Creep and Recovery (MSCR) of Asphalt Binder Using a Dynamic Shear Rheometer
ASTM D8239	(2018) Standard Specification for Performance-Graded Asphalt Binder Using the Multiple Stress Creep and Recovery (MSCR) Test
ASTM E1274	(2018) Standard Test Method for Measuring Pavement Roughness Using a Profilograph

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-02 Shop Drawings

Placement Plan; G[, [_____]]

SD-03 Product Data

Diamond Grinding Plan; G[, [_____]]

Mix Design; G[, [_____]]

Contractor Quality Control; G[, [_____]]

SD-04 Samples

Aggregates

Asphalt Cement Binder

Warm-mix Additive

SD-06 Test Reports

Aggregates; G[, [_____]]

QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G[, [_____]]

Laboratory Accreditation and Validation

Warm-mix Additive

1.5 ACCEPTANCE

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NOTE: It is recommended that an independent material testing company be hired by the Contractor to provide the acceptance testing for the project.

Typically acceptance testing will be performed by the Contractor's independent laboratory with oversight from the Government. The results from laboratory testing need to be forwarded daily to the Government as the basis for acceptance and percent payment.

The acceptance testing program includes material tests to determine laboratory air voids and in-place density, which are needed to determine percent payment. The acceptance testing laboratory will also conduct tests to monitor aggregate gradation,

asphalt content, and voids in mineral aggregate (VMA). These tests would serve as a check to the Contractor's QC testing.

For projects with less than 2,000 tonnes tons, the entire project can be considered as a single lot. In this case, sublot sampling could occur over several days production, which could lead to higher sublot variability.

Select the tailoring option for PERCENT PAYMENT when pay reduction factors are desired. Select the tailoring option for ACCEPT-REJECT when pass/fail criteria is desired.

****

1.5.1 Acceptability of Work

Acquire the services of an independent commercial laboratory to perform acceptance testing. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. The materials and the pavement itself will be accepted on the basis of production testing. The Government may make check tests from split samples to validate the results of the production testing. Testing performed by the Government does not reduce the required testing of the independent commercial laboratory. Split samples will be taken for Government testing to reduce the variability between the independent commercial laboratory and the Government's test results. When the difference between the independent commercial laboratory and the Government's test results for split samples exceed the acceptable range of two results for multilaboratory precision for the appropriate test method (i.e. ASTM) then at least one of the laboratories is determined to be in error. An evaluation of procedures and equipment in both laboratories will be made to determine the cause(s) for the differences. Develop steps to correct procedures and equipment to bring multilaboratory precision to within acceptable limits.

1.5.2 Acceptance Requirements

Provide all sampling and testing required for acceptance and payment adjustment. Where appropriate, adjustments in percent payment acceptance for individual lots of asphalt pavement will be made based on laboratory air voids, in-place density, smoothness, and grade in accordance with the following paragraphs. Surface smoothness and grade determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus smoothness and grade measurements for the entire lot cannot be made.

1.5.3 Pavement Lots

A standard lot for all requirements is equal to one day's production or 2,000 tonnes tons, whichever is smaller. Divide each lot into four equal sublots in order to evaluate laboratory air voids and in-place density. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, use the following procedure to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they constitute a lot. Where one or two sublots have been completed, incorporate them into the next lot and the total number of sublots (i.e. 5 or 6 sublots) is used for acceptance criteria. Include

partial lots at the end of asphalt production into the previous lot. Complete and report all theoretical maximum density, laboratory air voids, and in-place density testing within 24 hours after construction of each lot.

1.5.4 Sublot Sampling

Take one mixture sample for each sublot in accordance with ASTM D979/D979M from a random truck or another location for determining theoretical maximum density, laboratory air voids, any additional testing the Government desires, and Contractor Quality Control. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D3665 and employing tables of random numbers or computer programs.

1.5.5 Additional Sampling and Testing

The Government reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be treated as a separate lot. Payment Acceptance will be made for the quantity of asphalt pavement represented by these tests in accordance with the provisions of this section.

1.5.6 Theoretical Maximum Density (TMD)

Measure theoretical maximum density one time for each sublot in accordance with ASTM D2041/D2041M for purposes of calculating laboratory air voids and determining in-place density. The average TMD for each lot will be determined as the average TMD of the random sublot samples. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD values will be used as the TMD needed to calculate the percent joint density.

1.5.7 Laboratory Air Voids

****
NOTE: Select the appropriate tailoring option for the Marshall or Superpave Methods.
****

[Prepare one set of laboratory compacted specimens for each sublot in accordance with ASTM D6926 using the hand-held hammer for the Marshall Method.][Prepare one set of laboratory compacted specimens for each sublot in accordance with ASTM D6925 using the Superpave gyratory compactor.] Provide three test specimens prepared from the same sample for each set of laboratory compacted specimens. Compact the specimens within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Do not reheat samples prior to compaction. Provide insulated containers as necessary to maintain the sample temperature. Measure the bulk density of laboratory compacted specimens in accordance with ASTM D2726/D2726M. Determine laboratory air voids from one set (three laboratory compacted specimens) for each sublot sample in accordance with ASTM D3203/D3203M.

1.5.7.1 Tolerance

Provide laboratory air voids with a mean absolute deviation of 1.00 percent or less from the JMF for each lot. Remove and replace lots that

do not meet the laboratory air voids requirement at least 100 mm 4 inches into the cold (existing) lane adjacent to the longitudinal joint, at no additional cost to the Government. The mean absolute deviation of the laboratory air void contents from the JMF air void content will be evaluated as shown in the example below.

1.5.7.2 Calculating Laboratory Air Voids

Laboratory air void calculations for each lot will use the average theoretical maximum density values obtained for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). The mean absolute deviation of the laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated as in the following example:

Assume that the laboratory air voids are determined from 4 sublots where one set of laboratory compacted specimens is from a single sublot. The laboratory air voids for the 4 sublots are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

Mean Absolute Deviation = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4

Mean Absolute Deviation = (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen that 0.45 is less than 1.00 percent. The lot is acceptable for laboratory air voids.

1.5.8 In-place Density

Obtain one random 100 mm 4 inch or 150 mm 6 inch diameter core from the mat and joint of each sublot in accordance with ASTM D5361/D5361M for determining in-place density. Cut samples neatly with a diamond core drill bit. Obtain random cores that are the full thickness of the layer being placed. Select core locations randomly using the procedures contained in ASTM D3665. Locate cores for mat density no closer than 300 mm 12 inches from a transverse or longitudinal joint including the pavement edge. Center all cores for joint density on the joint. Discard samples that are clearly defective as a result of sampling and take an additional random core. When the random core is less than 25 mm 1 inch thick, it will not be included in the analysis. In this case, obtain another random core sample. Clean and tack coat dry core holes before filling with asphalt mixture. Fill all core holes with asphalt mixture and compact using a standard Marshall hammer to the density specified. Provide all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Measure in-place density in accordance with ASTM D2726/D2726M using each core obtained from the mat and joint.

1.5.8.1 Tolerance

Provide a minimum in-place mat density of 93.0 percent and a minimum in-place joint density of 90.0 percent for each lot. The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). Remove and replace lots that do not meet the in-place mat density requirement at least 100 mm 4 inches into the cold (existing) lane adjacent to the

longitudinal joint, at no additional cost to the Government. Remove and replace the longitudinal joint when the lot does not meet the in-place joint density, at no additional cost to the Government. Use a 3 m 10 feet wide paving lane that is centered over the joint.

1.5.9 Surface Smoothness

Use a straightedge and profilograph for measuring surface smoothness. Use the profilograph method for all longitudinal testing, except for paving lanes less than 400 meters 0.25 miles in length. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 400 meters 0.25 miles, and at the ends of the paving limits for the project. Smoothness requirements do not apply over crowns or grade breaks. Maintain detailed notes of the testing results and provide a copy to the Government immediately after each day's testing.

1.5.9.1 Smoothness Requirements

1.5.9.1.1 Straightedge Testing

Provide finished surfaces of the pavements with no abrupt change of 6 mm 1/4 inch or more when checked with an approved 4 m 12 foot straightedge. Remove and replace surface lift lots when the surface smoothness exceeds 9 mm 3/8 inch, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet surface smoothness requirements at individual locations.

1.5.9.1.2 Profilograph Testing

Provide finished surfaces with a Profile Index not greater than 140 mm per km 9 inches per mile when tested with an approved California-type profilograph. Remove and replace the lot when the Profile Index exceeds the tolerance by 63 mm per km 4.0 inches per mile or more, at no additional cost to the Government. Correct any small individual area with surface deviation which exceeds the tolerance given above by more than 79 mm per km 5.0 inches per mile or more by diamond grinding to meet the specification requirements above or remove and replace at no additional cost to the Government.

1.5.9.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in a manner to reveal surface irregularities exceeding the tolerances specified above. If any pavement areas are diamond ground, retest these areas immediately after diamond grinding. The maximum area allowed to be corrected by diamond grinding is 10 percent of the total area of the lot. Test the entire area of the pavement with a profilograph. Check a number of random locations along with any observed suspicious locations primarily at transverse and longitudinal joints with the straightedge.

1.5.9.2.1 Straightedge Testing

Use the straightedge to measure abrupt changes in surface smoothness. Hold the straightedge in contact with the pavement surface and measure the maximum distance between the straightedge and the pavement surface. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest

upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

1.5.9.2.2 Profilograph Testing

Perform profilograph testing using an approved California profilograph and procedures described in ASTM E1274. Provide equipment that utilizes electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. Use a "blanking band" that is 5 mm 0.2 inch wide and the "bump template" spanning 25 mm 1 inch with an offset of 10 mm 0.4 inch. Provide profilograph operated by an approved, factory-trained operator on the alignments specified above. Provide a copy of the reduced tapes to the Government at the end of each day's testing.

1.5.9.2.3 Bumps ("Must Grind" Areas)

Reduce any bumps ("must grind" areas) shown on the profilograph trace which exceed 10 mm 0.4 inch in height by diamond grinding until they do not exceed 7.5 mm 0.3 inch when retested. Taper diamond grinding in all directions to provide smooth transitions to areas not requiring diamond grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas.[At the Contractor's option, pavement areas including diamond ground areas can be rechecked with the profilograph in order to record a lower Profile Index.][Perform additional profilograph testing in all areas corrected by diamond grinding.]

1.5.10 Plan Grade

****

NOTE: For roadway projects, select the first bracketed option.

For parking lots, select the second bracketed option.

****

Provide a final wearing surface of pavement conforming to the elevations and cross sections shown and not vary more than 15 mm 0.05 foot from the plan grade established and approved at site of work. Within 5 working days after completion of a particular lot incorporating the final wearing course, test the final wearing surface of the pavement for conformance with specified plan grade requirements. Match finished surfaces at juncture with other pavements with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved.[For roads, the grade will be determined by running lines of levels along the centerline at intervals of 7.6 m 25 feet or less longitudinally to determine the elevation of the completed pavement surface. Measure transverse grades at appropriate intervals.][For parking lots, the grade will be determined by running lines of levels at intervals of 7.6 m 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement surface.] Diamond grinding can be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted. Maintain detailed notes of the results of the testing and provide a copy to the Government

immediately after each day's testing. Remove and replace surface lift lots when individual locations exceed the 15 mm 0.05 foot tolerance, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet plan grade requirements at individual locations.

1.5.11 Laboratory Accreditation and Validation

****
NOTE: Include bracketed sentence for Corps-managed projects. Utilization of the USACE Materials Testing Center (MTC) is optional for Air Force and Navy managed projects.
****

Provide laboratories used to develop the Job Mix Formula (JMF), perform acceptance testing, and Contractor Quality Control testing that meet the requirements of ASTM D3666. Provide laboratories with a masonry saw having a diamond blade for trimming pavement cores and samples. Perform all required test methods by an accredited laboratory. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory accreditation is not allowed.[The Government will inspect the laboratory equipment and test procedures prior to the start of hot-mix warm-mix operations for conformance with ASTM D3666. In addition, all testing laboratories performing acceptance testing require USACE validation by the Material Testing Center (MTC)[for both parent laboratory and plant testing laboratory]. Validation on all laboratories is required to remain current throughout the duration of the paving project. Contact the MTC manager listed at https://mtc.erdc.dren.mil for costs and scheduling.] Submit a certificate of compliance signed by the manager of the laboratory stating that it meets these requirements to the Government prior to the start of construction. At a minimum, include the following certifications:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

1.6 ENVIRONMENTAL REQUIREMENTS

****
NOTE: The temperature requirements in Table 3 Table 1 are included to avoid problems with the Contractor achieving density because the mix cools too fast. Waivers to these requirements for isolated incidences during production are applicable if the density requirements are still met.
****

Do not place the asphalt mixture upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3 Table 1. The temperature requirements may be waived by the Government, if requested; however, meet all other requirements including compaction.

Table 3. Table 1. Surface Temperature Limitations of Underlying Course	
Mat Thickness, mm inches	Degrees C F
75 3 or greater	4 40
Less than 75 3	7 45

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. Provide asphalt pavement designed and constructed in accordance with this section conforming to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and rolled, finished, and approved before the placement of the next course. Submit proposed Placement Plan indicating lane widths and longitudinal joints for each course or lift.

2.1.1 Asphalt Mixing Plant

Provide plants used for the preparation of asphalt mixture conforming to the requirements of AASHTO M 156 with the following changes:

2.1.1.1 Truck Scales

Weigh the asphalt mixture on approved scales, or on certified public scales at no additional expense to the Government. Inspect and seal scales at least annually by an approved calibration laboratory.

2.1.1.2 Inspection of Plant

Provide access to the Government at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure any desired samples.

2.1.1.3 Storage bins

The asphalt mixture can be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture can be stored in insulated storage bins for a period of time not exceeding 8 hours. Provide the mix drawn from bins that meets the same requirements as mix loaded directly into trucks.

2.1.2 Hauling Equipment

Provide trucks used for hauling asphalt mixture that have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a minimum amount of paraffin oil, lime solution, or other approved material. Do not use petroleum based products as a release agent. Provide each truck with a suitable cover to protect

the mixture from adverse weather, contamination, and loss of material during hauling. When necessary due to long haul distance and cold weather, provide insulated truck beds with covers (tarps) that are securely fastened.

[2.1.3 Material Transfer Vehicle (MTV)

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NOTE: A Material Transfer Vehicle (MTV) should be considered for use on high volume roads such as base entrance roads and roads that will be subjected to significant truck traffic or other heavy vehicles. This paragraph should be deleted if a MTV will not be required.

****

Provide Material Transfer Vehicle for placement of the asphalt mixture. Transfer the material from the hauling equipment to the paver using a self-propelled, material transfer vehicle with a swing conveyor that is capable of delivering material to the paver without making contact with the paver. Provide MTV capable to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. Provide Material Transfer Vehicle with remixing and storage capability to prevent physical and thermal segregation.

]2.1.4 Asphalt Pavers

Provide mechanical spreading and finishing equipment consisting of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. Provide paver screed capable of laying a uniform mixture to meet the specified thickness, smoothness, and grade without physical or temperature segregation, the full width of the material being placed. Provide a paver with a vibrating screed to be used during all placement.

2.1.4.1 Receiving Hopper

Provide paver with a receiving hopper of sufficient capacity to permit a uniform spreading operation and a distribution system to place the mixture uniformly in front of the screed without segregation. Provide a screed that effectively produces a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

[2.1.4.2 Automatic Grade Controls

****

NOTE: Automatic grade control is needed when the design requires elevations for the asphalt pavement surface. Many maintenance and rehabilitation projects require an overlay thickness and do not specify actual grades. Delete information on automatic grade control if not needed.

****

Provide a paver equipped with a control system capable of maintaining the specified screed elevation. One of three methods can be used to control grade: stringline, laser, or computerized elevations along with GPS. For multiple layers it is acceptable to control the grade in the underlying

layer and control the grade of the surface layer by applying a constant thickness over the underlying layer which has been placed to the desired grade. Slope control can also be used to control the grade of the surface for roads, but is not acceptable for wide pavements such as parking lots. Provide transverse slope controller capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A ski-type device of not less than 9.14 m 30 ft can be used to provide improved smoothness. Use a shoe on one side of the paver to match an existing paved surface to provide a smooth joint.

]2.1.5 Rollers

Provide rollers in good condition and operate at slow speeds to avoid displacement of the asphalt mixture. Provide sufficient number, type, and weight of rollers to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

2.1.6 Diamond Grinding

Those performing diamond grinding are required to have a minimum of three years experience in diamond grinding. In areas not meeting the specified limits for surface smoothness and plan grade, reduce high areas to attain the required smoothness and grade, except as depth is limited below. Reduce high areas by diamond grinding the asphalt pavement with approved equipment. Perform diamond grinding by sawing with saw blades impregnated with an industrial diamond abrasive. Assemble the saw blades in a cutting head mounted on a machine designed specifically for diamond grinding that produces the required texture and smoothness level without damage to the asphalt pavement or joint faces. Provide diamond grinding equipment with saw blades that are 3 mm 1/8-inch wide, a minimum of 60 blades per 300 mm 12 inches of cutting head width, and capable of cutting a path a minimum of 0.9 m 3 feet wide. Diamond grinding equipment that causes raveling, fracturing of aggregate, or disturbance to the underlying material will not be allowed. The maximum area corrected by diamond grinding the surface of the asphalt pavement is 10 percent of the total area of any lot. The maximum depth of diamond grinding is 12 mm 1/2 inch. Provide diamond grinding machine equipped to flush and vacuum the pavement surface. Dispose of all debris from diamond grinding operations off Government property. Prior to diamond grinding, submit a Diamond Grinding Plan for review and approval. At a minimum, include the daily reports for the deficient areas, the location and extent of deficiencies, corrective actions, and equipment. Remove and replace all pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified.

Prior to production diamond grinding operations, perform a test section at the approved location, consisting of a minimum of two adjacent passes with a minimum length of 12 m 40 feet to allow evaluation of the finish and transition between adjacent passes. Production diamond grinding operations cannot be performed prior to approval.

2.2 AGGREGATES

Notify the Government at least 7 days before sampling aggregates. Obtain samples in accordance with ASTM D75/D75M that are representative of the materials to be used for the project. Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screenings, natural sand, and mineral filler as required. The portion of material retained on the 4.75

mm No. 4 sieve is coarse aggregate. The portion of material passing the 4.75 mm No. 4 sieve and retained on the 0.075 mm No. 200 sieve is fine aggregate. The portion passing the 0.075 mm No. 200 sieve is defined as mineral filler. Submit sufficient materials to produce 90 kg 200 pounds of blended mixture for mix design verification. Submit all aggregate test results and samples to the Government at least 14 days prior to start of construction. Perform job aggregate testing no earlier than 6 months before contract award.

2.2.1 Coarse Aggregate

****

NOTE: Retain the sulfate soundness (requirement b., below) in areas where freeze-thaw occurs. The requirement for sulfate soundness may be deleted in climates where freeze-thaw does not occur. However, in those areas where freeze-thaw does not occur, requirement b. must remain if experience has shown that this test separates good performing aggregates from bad performing aggregates. Retain this requirement for all Navy projects.

Percentage of Wear (ASTM C131/C131M) must not exceed 40. Aggregates with a higher percentage of wear may be specified, provided a satisfactory record under similar conditions of service and exposure has been demonstrated.

****

Provide coarse aggregate consisting of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Provide coarse aggregate particles meeting the following requirements:

a. The percentage of loss not greater than [40] [_____] percent after 500 revolutions when tested in accordance with ASTM C131/C131M.

[b. The sodium sulfate soundness loss not exceeding 12 percent, or the magnesium sulfate soundness loss not exceeding 18 percent after five cycles when tested in accordance with ASTM C88.]

c. At least 75 percent by weight of coarse aggregate containing two or more fractured faces when tested in accordance with ASTM D5821 with fractured faces produced by crushing.

d. The particle shape essentially cubical and the aggregate containing not more than 10 percent, by weight, of flat and elongated particles (5:1 ratio of length to thickness) when tested in accordance with ASTM D4791, Method B.

e. Slag consisting of air-cooled, blast furnace slag with a compacted weight of not less than 1200 kg/cubic meter 75 lb/cu ft when tested in accordance with ASTM C29/C29M.

f. Clay lumps and friable particles not exceeding 0.3 percent, by weight, when tested in accordance with ASTM C142/C142M.

2.2.2 Fine Aggregate

****

NOTE: Set the lower limit for uncompacted void content (requirement c., below) at 45 for fine aggregate angularity unless local experience indicates that a lower value can be used. There are some aggregates which have a good performance record and have an uncompacted void content less than 45. In no case set the limit at less than 43.

****

Provide fine aggregate consisting of clean, sound, tough, durable particles. Provide aggregate particles that are free from coatings of clay, silt, or any objectionable material, contain no clay balls, and meet the following requirements:

a. Quantity of natural sand (noncrushed material) added to the aggregate blend not exceeding 15 percent by weight of total aggregate.

b. Individual fine aggregate sources with a sand equivalent value greater than [45] [_____] when tested in accordance with ASTM D2419.

c. Fine aggregate portion of the blended aggregate with an uncompacted void content greater than 45.0 percent when tested in accordance with AASHTO T 304 Method A.

d. Clay lumps and friable particles not exceeding 0.3 percent, by weight, when tested in accordance with ASTM C142/C142M.

2.2.3 Mineral Filler

Provide mineral filler consisting of a nonplastic material meeting the requirements of ASTM D242/D242M.

2.2.4 Aggregate Gradation

****

NOTE: Delete from Table 4 Table 2 the gradations that will not be used as a part of this project.

Gradation 1 is limited to intermediate courses. Do not use gradation 1 for surface courses.

Gradation 2 is suitable for intermediate and surface courses. Typically gradation 2 is used on most projects except where leveling courses are needed.

Gradation 3 is limited to leveling courses and shoulders.

Generally, the layer thickness for gradation No. 1 is at least 57 mm 2.25 inches, the thickness for gradation No. 2 is at least 37.5 mm 1.5 inches, and thickness for gradation No. 3 is at least 25 mm 1.0 inch. The preferred thickness of the surface layer is 50 mm 2 inches. The surface layer should not be less than 37 mm 1.5 inches. The thickness of the underlying layers can be up to 75 mm 3 inches

depending on the total designed thickness of the asphalt pavement.

****

Provide a combined aggregate gradation that conforms to gradations specified in Table 4 Table 2, when tested in accordance with ASTM C136/C136M and ASTM C117, and does not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grades uniformly from coarse to fine. Provide a JMF within the specification limits; however, the gradation can exceed the limits when the allowable deviation from the JMF shown in Tables 6 and 7 Tables 4 and 5 are applied.

Table 4. Table 2. Aggregate Gradations

Sieve Size, mm inch	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing by Mass	Gradation 3 Percent Passing by Mass
25.0 1	100	---	---
19.0 3/4	90-100	100	---
12.5 1/2	68-88	90-100	100
9.5 3/8	60-82	69-89	90-100
4.75 No. 4	45-67	53-73	58-78
2.36 No. 8	32-54	38-60	40-60
1.18 No. 16	22-44	26-48	28-48
0.60 No. 30	15-35	18-38	18-38
0.30 No. 50	9-25	11-27	11-27
0.15 No. 100	6-18	6-18	6-18
0.075 No. 200	3-6	3-6	3-6

2.3 ASPHALT CEMENT BINDER

****

NOTE: For CONUS locations specify Performance Graded (PG) asphalt binders. Consider using the same grade PG binder used by the State DOT near the project location. For example the PG grade typically specified in that region of the state for dense graded mixes on highways with design ESALs less than 10 million. The exception to that would be grades with a low temperature higher than PG XX-22 must not be used such as PG XX-16 or PG XX-10 unless the Engineer has had successful experience with them.

For OCONUS locations penetration graded asphalt binders may be used.

If rutting is a typical problem in the area or if high traffic volume is expected then consider "bumping" the high temperature grade for the top 100

mm 4 inches of pavement. The low temperature grade should remain the same. For most roads rutting is not a concern.

For State DOTs that use performance graded asphalt binder, select ASTM D6373. For State DOTs that use performance graded asphalt binder using the Multiple Stress Creep Recovery test, select ASTM D8239.

When the PG spread between the high and low temperature is less than 90, delete the three bracketed options for elastic recovery and MSCR recovery.

When the PG spread between the high and low temperature is greater than 90, a PG Plus Test will be required to determine if the asphalt cement has been polymer modified. Use the PG Plus Test found in the State DOT specifications for the project location. When the State DOT does not specify a PG Plus Test, use ASTM D6084/D6084M with a minimum elastic recovery of 75 percent.

Select one of the three bracketed option below for PG plus testing. Use the first option for State DOTs with elastic recovery, ASTM D6084/D6084M. Use the second option for State DOTs that have Multiple Stress Creep Recovery testing, ASTM D7405. Use the third option for State DOTs that have no PG plus testing, ASTM D6084/D6084M.

Consider contacting a materials engineer or the State DOT when editing this criteria.
****

Provide asphalt cement binder that conforms to [ASTM D6373] [ASTM D8239] Performance Grade (PG) [_____].[As an alternate, provide ASTM D946/D946M Penetration Grade [_____]]. [Provide an asphalt binder with a minimum elastic recovery of [_____] percent when tested at 25 degrees C plus or minus 0.5 degrees C 77 degrees F plus or minus 0.9 degrees F in accordance with ASTM D6084/D6084M. Condition the specimen for elastic recovery in accordance with ASTM D2872.][Provide an asphalt binder with an average recovery of [_____] percent at [_____] kPa psi when tested in accordance with ASTM D7405. Condition the specimen for elastic recovery in accordance with ASTM D2872.][Provide an asphalt binder with a minimum elastic recovery of 75 percent in accordance with ASTM D6084/D6084M.] Provide test data indicating grade certification by the supplier at the time of delivery of each load to the mix plant. When warm-mix asphalt technology involves additives, grade the asphalt binder with the asphalt binder additive included. Submit copies of these certifications to the Government. The supplier is defined as the last source of any modification to the binder. The Government may sample and test the binder at the mix plant at any time before or during mix production. [Submit 20 L 5 gallon sample of the asphalt cement or asphalt binder not less than 14 days before start of the test section for mix design verification and approval. Obtain samples for this verification testing in accordance with ASTM D140/D140M and in the presence of the Government. Provide these samples to the Government for the verification testing, which will be performed at the Government's expense.]

2.4 WARM-MIX ASPHALT TECHNOLOGIES/PRODUCTS

****

NOTE: Warm-mix asphalt (WMA) can be used in lieu of hot mix asphalt (HMA). The WMA is primarily used to reduce emissions during production and placement of HMA. Research has shown that WMA mixes provide similar performance to HMA mixture. It is recommended only HMA should be specified unless there is a good reason to use WMA.

Delete if WMA is not allowed.

****

Provide warm-mix asphalt technologies/products that have a record of good performance and are included on the local state DOT's qualified products list, if the DOT maintains a qualified products list. These qualified products lists can be found at each state DOT's website.

2.5 MIX DESIGN

****

NOTE: Select the appropriate gradation and VMA requirements in Table 5 Table 3 to be consistent with the gradation chosen in Table 4 Table 2. Delete from Table 5 Table 3 the gradations that will not be used as a part of this project.

Use 75 blows with the Marshall hand-held hammer for high traffic areas or all pavements designed for tire pressures of 690 kPa 100 psi or higher.

Use 50 blows with the Marshall hand-held hammer for all shoulder pavements and pavements designed for tire pressures less than 690 kPa 100 psi.

For Marshall mixes, select the appropriate Marshall column in Table 5 Table 3 and delete the column that will not be used as a part of this project.

Use 75 gyrations with the Superpave gyratory compactor for high traffic areas or all pavements designed for tire pressures of 690 kPa 100 psi or higher.

Use 50 gyrations with the Superpave gyratory compactor for all shoulder pavements and pavements designed for tire pressures less than 690 kPa 100 psi.

For Superpave mixtures delete the columns in Table 5 Table 3 that refer to Marshall.

****

Develop the mix design. Perform Job Mix formula (JMF) and aggregates testing no earlier than 6 months before contract award. Provide asphalt mixture composed of well-graded aggregate, mineral filler if required, and asphalt material. Provide aggregate fractions sized, handled in separate size groups, and combined in such proportions that the resulting mixture

meets the grading requirements of Table 4 Table 2. Do not produce asphalt pavement for payment acceptance until a JMF has been approved.[Design the asphalt mixture using [50] [75] blows with the Marshall hand-held hammer procedures contained in AI MS-2 and the criteria shown in Table 5 Table 3.][Design the asphalt mixture using the Superpave gyratory compactor set at [50] [75] gyrations. Prepare samples at various asphalt contents and compacted in accordance with ASTM D6925.] Use laboratory compaction temperatures for Polymer Modified Asphalts as recommended by the asphalt binder manufacturer. Determine the Tensile Strength Ratio (TSR) of the composite mixture in accordance with ASTM D4867/D4867M. Compact the TSR specimens to an air void content of 7 percent plus or minus 1 percent. If the Tensile Strength Ratio (TSR) of the composite mixture is less than 75, reject the aggregates or treat the asphalt mixture with an anti-stripping agent. Add a sufficient amount of anti-stripping agent to produce a TSR of not less than 75. If an antistrip agent is required, provide it at no additional cost to the Government. Provide sufficient materials to produce 90 kg 200 pound of blended mixture to the Government for verification of mix design at least 14 days prior to construction of test section.

2.5.1 JMF Requirements

Submit the proposed JMF in writing, for approval, at least 14 days prior to the start of the test section including, as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt performance grade or penetration grade.

e. [Number of blows of hammer per side of molded specimen.][Number of Superpave gyratory compactor gyrations.]

f. Laboratory mixing temperature.

g. Laboratory compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots and summary tabulation of[Marshall stability, flow,] air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2. Include summary tabulation that includes individual specimen data for each specimen tested.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles in coarse aggregate.

p. Tensile Strength Ratio and wet/dry specimen test results.

q. Antistrip agent (if required).

r. List of all modifiers.

s. Percentage and properties (asphalt content, aggregate gradation, and aggregate properties) of RAP in accordance with paragraph RECYCLED ASPHALT PAVEMENT, if RAP is used.

t. Warm-mix additive or process.

Table 5. Table 3. Mix Design Criteria			
Test Property	Marshall (50 Blows)	Marshall (75 Blows)	Superpave ([50][75] gyrations)
Stability, N pounds, minimum (NA for Superpave)	44501000(1)	80001800(1)	NA
Flow, 0.25 mm 0.01 inch, (NA for Superpave)	8-18	8-16	NA
Air voids, percent	3-5	3-5	3-5
Minimum Percent Voids in Mineral Aggregate (VMA)(2)			
Gradation 1	13.0	13.0	13.0
Gradation 2	14.0	14.0	14.0
Gradation 3	15.0	15.0	15.0
TSR, minimum percent	75	75	75
(1) This is a minimum requirement. Provide significantly higher average during construction to ensure compliance with the specifications.			
(2) Calculate VMA in accordance with AI MS-2, based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate.			

2.5.2 Adjustments to JMF

The JMF for each mixture is in effect until a new formula is approved in writing by the Government. Should a change in sources of any materials be made, perform a new mix design and a new JMF approved before the new material is used. Make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF are limited to plus or minus 4 percent on the 4.75 mm No. 4 and coarser sieves; plus or minus 3 percent on the 2.36 mm No. 8 to 0.30 mm No. 50 sieves; and plus or minus 1 percent on the 0.15 mm No. 100 sieve and 0.075 mm No. 200 sieve. Asphalt content adjustments are limited to plus or minus 0.40 from the original JMF. If adjustments are needed that exceed these limits, develop a new mix design.

2.6 RECYCLED HOT MIX ASPHALT

****

NOTE: Reclaimed Asphalt Pavement (RAP) can be used but the amount of asphalt binder from RAP cannot exceed 30 percent of the total asphalt content in the recycled asphalt mixture. The resulting recycled mix must meet all requirements that are specified for virgin mixtures.

The 30 percent is an upper limit. If the existing asphalt pavement is relatively old, the amount of RAP used should not approach this limit. If the recycling involves relatively new RAP materials, the percentage of RAP specified below can reach 30 percent binder as long as the recycled mixture meets the specification requirements.

Select the first option if RAP is not used.

In addition to MS-02, refer to UFC 3-250-03, "Standard Practice Manual for Flexible Pavements" for further design guidance.

****

[Recycled asphalt mixture is not allowed for the project.] [Provide recycled asphalt mixture consisting of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. Provide RAP of a consistent gradation, asphalt content, and properties. Maintain RAP stockpiles free from contamination including coal-tar sealers. Limit the maximum RAP chunk size to 50 mm 2 inches when feeding RAP into the plant. The individual aggregates in a RAP chunk are not to exceed the maximum size aggregate of the gradation specified in Table 4 Table 2. Design the recycled asphalt mixture using procedures contained in AI MS-2. Provide RAP job mix that meets the requirements of paragraph MIX DESIGN. Limit the amount of RAP so the asphalt binder from the RAP does not exceed 30 percent of the total asphalt content.]

[2.6.1 RAP Aggregates and Asphalt Cement

Provide a blend of aggregates used in the recycled mix that meet the requirements of paragraph AGGREGATES. Establish the percentage of asphalt binder in the RAP for the mixture design according to ASTM D2172/D2172M or ASTM D6307 using the appropriate dust correction procedure.

2.6.2 RAP Mix

Select the virgin asphalt binder as described below:

a. For 0 to 20 percent recycled binder content - no change in virgin binder selection.

b. For 20+ percent to 30 percent recycled binder content - select virgin binder one grade softer than normal.

]PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

****
NOTE: The Contractor may be able to meet the specified quality control requirements with in-house capability or may have to use the independent commercial laboratory to provide the required quality control testing.

Select the bracketed option for Marshall mixes.
****

3.1.1 General Quality Control Requirements

Submit the Quality Control Plan. Do not produce hot-mix warm-mix asphalt for payment acceptance until the quality control plan has been approved. In the quality control plan, address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design and unique JMF identification code

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management and procedures to prevent contamination

e. Proportioning including percent of warm-mix additive

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Compaction

j. Joints

k. Surface Smoothness

l. Truck bed release agent

[m. Correlation of mechanical hammer to hand hammer. Determine the number of blows of the mechanical hammer required to provide the same density of the JMF as provided by the hand hammer. Use the average of three specimens per trial blow application.]

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site that is equipped with heating and air conditioning units to maintain a temperature of 24 plus or minus 2.3 degrees C 75 plus or minus 5 degrees F. Provide laboratory facilities that are kept clean and all equipment maintained in proper working condition. Provide the Government with unrestricted access to inspect the laboratory facility, to witness quality control activities, and to perform any check testing desired. The

Government will advise in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, immediately suspend the incorporation of the materials into the work. Incorporation of the materials into the work will not be permitted to resume until the deficiencies are corrected.

3.1.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. Use the independent commercial laboratory for acceptance testing in paragraph ACCEPTANCE. Use in-house capabilities or the independent commercial laboratory for quality control testing. Required elements of the testing program include, but are not limited to tests for the control of asphalt content, aggregate gradation, aggregate moisture, moisture in the asphalt mixture, temperatures, VMA, [Marshall stability, flow,]and in-place density. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.1.3.1 Asphalt Content

Determine asphalt content a minimum of twice per lot (a lot is defined in paragraph PAVEMENT LOTS) using the ignition method in accordance with ASTM D6307. Use the extraction method in accordance with ASTM D2172/D2172M if the correction factor for the ignition method in ASTM D6307 is greater than 1.0. The asphalt content for the lot will be determined by averaging the test results.

3.1.3.2 Aggregate Properties

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136/C136M, and ASTM C117. Determine the specific gravity of each aggregate size grouping for each 18,000 tonnes 20,000 tons in accordance with ASTM C127 or ASTM C128. Determine fractured faces for gravel sources for each 18,000 tonnes 20,000 tons in accordance with ASTM D5821. Determine the uncompacted void content of natural sand, manufactured sand, and blended aggregate for each 18,000 tonnes 20,000 tons in accordance with AASHTO T 304 Method A.

3.1.3.3 Moisture Content of Aggregate

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C566.

3.1.3.4 Moisture Content of Asphalt Mixture

Determine the moisture content of the asphalt mixture at least once per lot in accordance with AASHTO T 329.

3.1.3.5 Temperatures

Check temperatures at least four times per lot, at necessary locations to determine the temperature at the dryer, the asphalt cement binder in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.6 VMA[, Marshall Stability, and Flow]

Obtain mixture samples at least four times per lot. Calculate the VMA of each specimen in accordance with AI MS-2 based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate[, as well as the Marshall stability and flow, as described in ASTM D6927]. Provide VMA within the limits of Table 5 Table 3.

3.1.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge or other non-destructive testing device can be used to monitor pavement density.

3.1.3.8 Additional Testing

Perform any additional testing deemed necessary to control the process.

3.1.3.9 QC Monitoring

Submit all QC test results to the Government on a daily basis as the tests are performed. The Government reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.1.4 Sampling

When directed by the Government, sample and test any material which appears to not meet specification requirements unless such material is voluntarily removed and replaced or deficiencies corrected. Perform all sampling in accordance with standard procedures specified.

3.1.5 Control Charts

****

NOTE: For Marshall mixes, select the appropriate Marshall row in Table 6 Table 4 and delete the row that will not be used as a part of this project.

For Superpave mixes, delete the rows in Table 6 Table 4 that refer to Marshall.

Select the appropriate gradation and VMA requirements in Table 6 Table 4 to be consistent with the gradation chosen in Table 4 Table 2.

For projects less than 2,000 tonnes tons, the control chart requirements may be deleted.

****

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6 Table 4, as a minimum. Post the control charts as directed by the Government and maintain current at all times. Identify the following on the control charts: the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 Table 4 applicable to the test parameter being plotted, and the test results. Also show target values (JMF) on the control charts as indicators of central tendency for the

cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. When the Suspension Limit is exceeded for individual values or running average values, the Government has the option to require removal and replacement of the material represented by the samples or to leave in place and base acceptance on mixture volumetric properties and in place density. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Make decisions concerning mix modifications based on analysis of the results provided in the control charts. In the Quality Control Plan, indicate the appropriate action to be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
4.75 mm No. 4 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	6	8	4	5
0.6 mm No. 30 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	4	6	3	4
0.075 mm No. 200 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	1.4	2.0	1.1	1.5
Asphalt content, percent deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Stability, Newtons pounds (minimum) (NA for Superpave)				
75 Blow JMF	80001800	75601700	84401900	80001800
50 Blow JMF	44501000	4000900	49001100	44501000
Flow, 0.25 mm 0.01 inch (NA for Superpave)				
75 Blow JMF	8 min.	7 min.	9 min.	8 min.
	16 max.	17 max.	15 max.	16 max.
50 Blow JMF	8 min.	7 min.	9 min.	8 min.
	18 max.	19 max.	17 max.	18 max.
Laboratory Air Voids, percent deviation from JMF target value	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Mat Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Joint Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
VMA				
Gradation 1	13.5	13.0	13.3	13.0

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts				
	Individual Samples		Running Average of	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
Gradation 2	14.5	14.0	14.3	14.0
Gradation 3	15.5	15.0	15.3	15.0

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material while avoiding local overheating. Provide a continuous supply of the asphalt material to the mixer at a uniform temperature. Maintain the temperature of the asphalt delivered to the mixer to provide a suitable viscosity for adequate coating of the aggregate particles. For hot-mix, do not heat unmodified asphalt to a temperature exceeding 160 degrees C 325 degrees F when added to the aggregate. Do not heat modified asphalt to a temperature exceeding 175 degrees C 350 degrees F when added to the aggregate. For warm-mix, do not heat asphalt binder to a temperature exceeding 132 degrees C 270 degrees F when added to the aggregate.

3.3 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate prior to mixing. Provide a rate of heating and a maximum temperature that does not damage the aggregates. Do not heat the aggregate to a temperature exceeding 175 degrees C 350 degrees F when the asphalt binder is added. Maintain the temperature no lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.4 PREPARATION OF ASPHALT MIXTURE

Weigh or meter the aggregates and the asphalt cement and introduce into the mixer the amount specified by the JMF. Mix the combined materials until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. The moisture content of all asphalt mixture upon discharge from the plant is not to exceed 0.5 percent by total weight of mixture as measured by AASHTO T 329.

3.5 PREPARATION OF THE UNDERLYING SURFACE

****

NOTE: If the underlying surface to be paved is an unbound granular layer, apply a prime coat, especially if this layer will be exposed to weather for an extended period of time prior to covering with an asphalt mixture. Benefits derived from a prime coat include an additional weatherproofing of the base, improving the bond between the base and asphalt layer, and preventing the base from shifting under construction equipment.

If the underlying surface to be paved is an existing asphalt or concrete layer, use a tack coat to ensure an adequate bond between layers.

Tack and prime coat requirements will need to be covered in the contract documents.

****

Immediately before placing the asphalt mixture, clean the underlying course of dust and debris. Apply a [prime coat] [or] [tack coat] in accordance with Section 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.6 TEST SECTION

****

NOTE: Delete requirement for a test section if the project requires less than 2,000 tonnes tons.

****

Prior to full production, place a test section for each JMF used. Construct a test section 75 to 150 m 250 to 500 feet long and two paver passes wide with a longitudinal cold joint. Do not place the second lane of test section until the temperature of pavement edge is less than 80 degrees C 175 degrees F. Construct the test section with the same depth as the course which it represents. Ensure the underlying grade or pavement structure upon which the test section is to be constructed is the same or very similar to underlying layer for the project. Use the same equipment and procedures in construction of the test section as on the remainder of the course represented by the test section. Construct the test section as part of the project pavement, as approved by the Government.

3.6.1 Sampling and Testing for Test Section

****

NOTE: Table 7 Table 5 applies only to the test section and localized areas appearing to deviate from the specification. The limits in Tables 1, 2, and 6 Table 4 apply to the results of 4 full scale production tests run for each lot. This is why the limits listed in Table 7 Table 5 are different from those listed in Tables 1, 2, and 6 Table 4.

Select the appropriate VMA requirement to match the selected gradation.

For Marshall mixes, select the appropriate stability and flow value to match the laboratory compactive effort (50 or 75 blows).

For Superpave mixes, delete the rows in Table 7 Table 5 that refer to Marshall.

****

Obtain one sample at the plant from a random truck. Compact three specimens and test for laboratory air voids[as well as the Marshall stability and flow]. Test a portion of the same sample for theoretical maximum density (TMD), aggregate gradation, asphalt content, and TSR. Adjust the compactive effort as required to provide TSR specimens with an air void content of 7 plus or minus 1 percent. Obtain four randomly selected cores from each finished pavement mat (eight total), four from the longitudinal joint, and test for density. Perform random sampling in accordance with procedures contained in ASTM D3665. Construction may continue provided the test results are within the tolerances or exceed the minimum values shown in Table 7 Table 5. If all test results meet the

specified requirements, the test section may remain as part of the project pavement. If test results exceed the tolerances shown, remove and replace the test section and construct another test section at no additional cost to the Government.

Table 7. Table 5. Test Section Requirements for Material and Mixture Properties	
Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
4.75 mm No. 4 and larger	JMF plus or minus 8
2.36, 1.18, 0.60, and 0.30 mmNo. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
0.15 and 0.075 mmNo. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	See Table 5 Table 3
Tensile Strength Ratio (TSR) (At 7 percent plus/minus 1 percent air void content)	75 percent minimum
Conditioned Strength	415 kPa 60 psi minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0 93.0 minimum
Joint Density, Percent of TMD (Average of 4 Random Cores)	89.5 minimum 90.0 minimum
Stability, newtons pounds (Average of 3 specimens) (for Marshall only)	[4450 1000 minimum for 50 blows][8000 1800 minimum for 75 blows]
Flow, 0.25 mm 0.01 inch (Average of 3 specimens) (for Marshall only with non-modified asphalt)	[8 - 18 for 50 blows][8 - 16 for 75 blows]

3.6.2 Additional Test Sections

If the initial test section should prove to be unacceptable, make the necessary adjustments to the JMF, plant operation, placing procedures, and rolling procedures before beginning construction of a second test section. Construct and evaluate additional test sections, as required, for conformance to the specifications. Full production paving is not allowed until an acceptable section has been constructed and accepted.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

Transport asphalt mixture from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 60 degrees C 140 degrees F.

3.7.2 Placing

Place the mix in lifts of adequate thickness and compact at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; strike off in a uniform layer of such depth that, when the work is completed, the required thickness is obtained and the surface conforms to the grade and contour indicated. Do not broadcast waste mixture onto the mat or recycle into the paver hopper. Collect waste mixture and dispose off site. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Begin placement of the mixture along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 3 m 10 feet. Offset the longitudinal joint in one course from the longitudinal joint in the course immediately below by at least 300 mm 1 foot; however, locate the joint in the surface course at the centerline of the pavement. Offset transverse joints in one course by at least 3 m 10 feet from transverse joints in the previous course. Offset transverse joints in adjacent lanes a minimum of 3 m 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture can be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

3.8.1 General

a. After placing, thoroughly and uniformly compact the mixture by rolling. Compact the surface as soon as possible without causing displacement, cracking, or shoving. Determine the sequence of rolling operations and the type of rollers used with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. Maintain the speed of the roller, at all times, sufficiently slow to avoid displacement of the asphalt mixture and to be effective in compaction. Correct at once any displacement occurring as a result of reversing the direction of the roller, or from any other cause.

b. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened, but excessive water is not permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers or small compactors. Remove the full depth of any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective. Replace with fresh asphalt mixture and immediately compact to conform to the surrounding

area. Perform this work at no expense to the Government. Skin patching is not allowed.

3.8.2 Segregation

****

NOTE: Select the first bracketed option when a test section is required.

Select the second bracketed option for projects less than 2,000 tonnes tons.

****

The Government can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Government has the option to sample the material and have it tested and compared to the [aggregate gradation, asphalt content, and in-place density requirements in Table 7 Table 5][in-place density requirements in Table 2 paragraph ACCEPTANCE]. If the material fails to meet these specification requirements, remove and replace the extent of the segregated material the full depth of the layer of asphalt mixture at no additional cost to the Government. When segregation occurs in the mat, take appropriate action to correct the process so that additional segregation does not occur.

3.9 JOINTS

Construct joints to ensure a continuous bond between the courses and to obtain the required density. Provide all joints with the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, construct by means of placing a bulkhead or by tapering the course. Utilize a dry saw cut on the transverse joint full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. Remove the cutback material from the project. In both methods, provide a light tack coat of asphalt material to all contact surfaces before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Provide a joint that meets density and smoothness requirements for joints and has uniform texture. Cut back longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C 175 degrees F at the time of placing adjacent lanes), or otherwise defective, a maximum of 75 mm 3 inches from the top of the course with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. Remove all cutback material from the project. Provide a light tack coat of asphalt material to all contact surfaces prior to placing any fresh mixture against the joint.

-- End of Section --