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USACE / NAVFAC / AFCESA / NASA **UFGS-32 12 15 (May 2009)**

Preparing Activity: USACE **Superseding**
UFGS-32 12 15 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2009
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HOT-MIX ASPHALT (HMA) FOR AIRFIELDS

05/09

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SECTION 32 12 15

HOT-MIX ASPHALT (HMA) FOR AIRFIELDS

05/09

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

Edit this guide specification for each project specific requirements by adding, deleting, or revising text. Choose applicable bracketed items(s) or insert appropriate information.

Remove information and/or requirements not related to the respective project, whether or not brackets are present. Do not edit or rewrite the unbracketed text without the express consent of the Corps of Engineers Transportation Systems Center (TSMCX), the Air Force major command (MAJCOM) paving engineers, or the Naval Facilities Engineering Command (NAVFAC).

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents**, including their organization designation and telephone number, is on the Internet.**

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR)**.**

This guide specification includes tailoring options for FAA/OTHER THAN FAA agency use and for MARSHALL COMPACTION/SUPERPAVE GYRATORY COMPACTION. The gyratory compaction option should be selected only with the express consent of the Corps of Engineers Transportation Systems Center (TSMCX), the Air Force major command (MAJCOM) paving engineers, or the Naval Facilities Engineering Command (NAVFAC). Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

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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 asphalt aspects of the project and not to any surface preparation requirements dealing with aggregate base courses, milling, or tack and prime coats. Surface preparation requirements should be covered by either including them in this guide specification or by 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 Engineer to assure the final product meets the job requirements (see paragraph QUALITY ASSURANCE). Results of QA testing are the basis for pay. Quality Control refers to the actions of the Contractor to monitor the construction and production processes and to correct these processes when out of control. Results of QC testing are reported daily on the process control charts maintained by the Contractor. Quality Control is covered in paragraph CONTRACTOR QUALITY CONTROL.

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1.1 FULL 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. Lump-sum contracts should not be used when the job exceeds 1000 metric tons (tons).

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[The amount paid for will be the number of metric short tons of hot-mix asphalt mixture used in the accepted work. Hot-mix asphalt mixture shall be weighed after mixing, and no separate payment will be made for weight of asphalt cement material incorporated herein.] [Measurement of the quantity of hot-mix asphalt, per ton placed and accepted, shall be made for the purposes of assessing the pay factors stipulated below.]

1.1.2 Basis of Payment

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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. Include presciptive unit price based on the Government/Engineer estimate for payment adjustment. Lump-sum contracts should not be used when the job exceeds 1000 metric tons (tons).

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[Quantities of hot-mix aspalt, 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 QUALITY ASSURANCE. 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 asphalt 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 QUALITY ASSURANCE, a unit price of [_____] per ton will be used for purposes of calculating the payment reduction.]

1.2 PERCENT PAYMENT

When a lot of material fails to meet the specification requirements for 100 percent pay as outlined in the following paragraphs, that lot shall be removed and replaced, or accepted at a reduced price which will be computed by multiplying the unit price by the lot's pay factor. The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, grade or smoothness (each discussed below). Pay factors based on different criteria (i.e., laboratory air voids and in-place density) of the same lot will not be multiplied together to get a lower lot pay factor. At the end of the project, an average of all lot pay factors will be calculated. If this average lot pay factor exceeds 95.0 percent and no individual lot has a pay factor less than 75.1 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 2000 metric short tons, a weighted lot pay factor will be used to calculate the average lot pay factor.

1.2.1 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average TMD for the lot. The average TMD for each lot will be determined as the average TMD of the two random samples per lot. The average in-place mat density and joint density for a lot are determined and compared with Table 1 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 1. The area associated with the joint is then determined and will be considered to be 3 m 10 feet wide times the length of completed longitudinal construction joint in the lot. This 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 hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD will be used as the TMD needed to calculate the percent joint density. Rejected lots shall be removed and replaced. Rejected areas adjacent to longitudinal joints shall be removed 4 inches 100 mm into the cold (existing) lane. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 1. Pay Factor Based on In-place Density

Average Mat Density (4 Cores)	Pay Factor, %	Average Joint Density (4 Cores)
94.0 - 96.0	100.0	Above 92.5
93.9	100.0	92.4
93.8 or 96.1	99.9	92.3
93.7	99.8	92.2
93.6 or 96.2	99.6	92.1
93.5	99.4	92.0
93.4 or 96.3	99.1	91.9
93.3	98.7	91.8
93.2 or 96.4	98.3	91.7
93.1	97.8	91.6
93.0 or 96.5	97.3	91.5
92.9	96.3	91.4
92.8 or 96.6	94.1	91.3
92.7	92.2	91.2
92.6 or 96.7	90.3	91.1
92.5	87.9	91.0
92.4 or 96.8	85.7	90.9
92.3	83.3	90.8
92.2 or 96.9	80.6	90.7
92.1	78.0	90.6
92.0 or 97.0	75.0	90.5
below 92.0, above 97.0	0.0 (reject)	below 90.5

1.2.2 Pay Factor Based on 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 = 93.2 percent (of lab TMD). (2) Average joint density = 91.5 percent (of lab TMD). (3) Total area of lot = 30,000 square feet. (4) Length of completed longitudinal construction joint = 2000 feet.

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

Mat density of 93.2 percent = 98.3 pay factor.

Joint density of 91.5 percent = 97.3 pay factor.

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

(2000 ft. x 10 ft.)/30000 sq.ft. = 0.6667 ratio of joint area to mat area (ratio).

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

wpf = joint pay factor + (100 - joint pay factor) (1 - ratio) wpf = 97.3 + (100-97.3) (1-.6667) = 98.2%

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%. Weighted pay factor for joint density: 98.2%

Select the smaller of the two values as pay factor based on density: 98.2%

1.2.3 Payment Adjustment for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When between 5.0 and 10.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph Smoothness Requirements below, 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 more than 10.0 percent of all measurements exceed the tolerance, the computed pay factor will be 90 percent. When between 15.0 and 20.0 percent of all measurements exceed the tolerance, the computed pay factor will be 75 percent. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the GovernmentOwner. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the GovernmentOwner.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index of a lot exceeds the tolerance specified in paragraph Smoothness Requirements by 16 mm/km 1.0 inch/mile, but less than 32 mm/km 2.0 inches/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/km 2.0 inches/mile, but less than 47 mm/km 3.0 inches/mile, the computed pay factor will be 90 percent. When the Profile Index exceeds the tolerance by 47 mm/km 3.0 inches/mile, but less than 63 mm/km 4.0 inches/mile, the computed pay factor will be 75 percent. When the Profile Index exceeds the tolerance by 63 mm/km 4.0 inches/mile or more, the lot shall be removed and replaced at no additional cost to the GovernmentOwner. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 79 mm/km 5.0 inches/mile or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the GovernmentOwner.

1.2.4 Laboratory Air Voids and Theoretical Maximum Density

Laboratory air voids will be calculated in accordance with ASTM D 3203 by determining the Marshall density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method in ASTM D 2726 and determining the theoretical maximum density (TMD) of every other sublot sample using ASTM D 2041. Laboratory air void calculations for each sublot will use the latest theoretical maximum density values obtained, either for that sublot or the previous sublot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated and a pay factor determined from Table 2. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot. The TMD is also used for computation of compaction, as required in paragraph: Mat and Joint Densities above.

1.2.5 Mean Absolute Deviation

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 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each sublot sample 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

= (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 2 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 2. Pay Factor Based on Laboratory Air Voids

Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, %
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)

1.2.6 Pay Adjustment Based on Grade

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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, i.e., when the intermediate courses will be exposed to traffic, slight modifications to this specification will be required.
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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. All testing shall be performed in the presence of the Contracting OfficerEngineer. The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 9 mm 0.03 foot for runways or

15 mm 0.05 foot for taxiways and aprons from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide 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. 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. Detailed notes of the results of the testing shall be kept and a copy furnished to the GovernmentEngineer immediately after each day's testing. When more than 5 percent of all measurements made within a lot are outside the 9 or 15 mm 0.03 or 0.05 foot tolerance, the pay factor based on grade for that lot will be 95 percent. In areas where the grade exceeds the tolerance by more than 50 percent, remove the surface lift full depth; and replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the GovernmentOwner. Diamond grinding may 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.

1.3 REFERENCES

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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 RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 320	(2009) Performance-Graded Asphalt Binder
AASHTO T 308	(2009) Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 329	(2008) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) By Oven Method.

ASPHALT INSTITUTE (AI)

AI MS-02	(6th Edition; 1997) Mix Design Methods for Asphalt

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 1252	(2006) Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM C 127	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	(2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997; R 2004) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 29/C 29M	(2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 140/D 140M	(2009) Sampling Bituminous Materials
ASTM D 1461	(1985; R 2006) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 2041	(2003a) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(2005) Quantitative Extraction of Bitumen

	from Bituminous Paving Mixtures
ASTM D 2419	(2009) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 242/D 242M	(2009) Mineral Filler for Bituminous Paving Mixtures
ASTM D 2489/D 2489M	(2008) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(2009) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 3203	(2005) Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3381	(2009) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	(2007) Random Sampling of Construction Materials
ASTM D 3666	(2009) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 4125	(2005) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(2005e1) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867/D 4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(2008) Mechanical Size Analysis of Extracted Aggregate
ASTM D 6307	(2005) Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D 6925	(2009) 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 D 6926	(2004) Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D 6927	(2006) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D 946	(2009) Penetration-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 979	(2001; R 2006e1) Sampling Bituminous Paving Mixtures
ASTM D 995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526	(2002) Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171	(1994) Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

1.4 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. HMA designed and constructed in accordance with this section shall conform 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 a Placement Plan as specified in the Submittals paragraph.

1.4.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. Weigh the asphalt mixture on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. Provide laboratory facilities at the plant for the use of the Government's Engineer's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer Engineer shall have access 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 GovernmentEngineer to procure any desired samples.

d. Storage Bins. The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.4.2   Hauling Equipment

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.4.3   Material Transfer Vehicle (MTV)

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NOTE: A Material Transfer Vehicle (MTV) is required for runway and taxiway construction. The use of an MTV is optional for shoulder construction.

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Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle that can deliver material to the paver without making contact with the paver. The MTV shall be able 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. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

1.4.4   Asphalt Pavers

Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. The screed of the paver shall be 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. The screed will be equipped with a compaction device and it will be used during all placement.

1.4.4.1   Receiving Hopper

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

1.4.4.2   Automatic Grade Controls

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NOTE: Delete information on automatic grade control if not needed. Automatic grade control is needed when the design requires elevations for the hot-mix asphalt surface. Most specifications require an overlay thickness and do not specify actual grades.

****

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 9.14 m 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.4.5 Rollers

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.5 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation 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][; G, [_____]]

Proposed placement plan, indicating lane widths, longitudinal joints, and transverse joints for each course or lift.

SD-03 Product Data

Mix Design[; G][; G, [_____]]

Proposed JMF.

Contractor Quality Control[; G][; G, [_____]]

Quality control plan.

SD-04 Samples

Asphalt Cement Binder

20 L 5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 90 kg 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates[; G][; G, [_____]]
QC Monitoring

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder[; G][; G, [_____]]

Copies of certified test data.

Testing Laboratory

Certification of compliance.

1.6 QUALITY ASSURANCE

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NOTE: It is highly recommended to keep the Government'sEngineer's QA testing separate and distinct from the Contractor's QC testing. However, its recognized that in-house testing capability to provide the QA testing required by this section will not always be available; in this case, it is recommended that an independent material testing company be hired to provide the QA testing for the project. The cost of this testing to assure good long-term performance is very small relative to the overall cost of the construction, and especially compared to the cost of a pavement failure.

Although not recommended, this guide specification may be modified to require the Contractor to hire an independent material testing laboratory to perform the QA testing listed in this section. The results would need to be forwarded daily to the Contracting OfficerEngineer as the basis for acceptance and pay. This should only be done if there is no way of hiring an independent testing laboratory to perform the QA testing.

The QA testing program includes material tests to determine laboratory air voids and in-place density, which are needed to determine percent payment. The project engineer may choose to have additional tests conducted by the QA test agency to monitor aggregate gradation, asphalt content, Marshall stability and flow. These tests would serve as a check to the Contractor's QC testing. Marshall stability and flow could be done at minimal cost since the specimens have to be made anyway for laboratory air void determination. This additional testing, if conducted, is not included as part of this specification since the parameters are not used as a basis of pay.

For projects with less than 2000 total 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.
****

The Government's Engineer's quality assurance (QA) program for this project is separate and distinct from the Contractor's quality control (QC) program specified in Part 3. Testing for acceptability of work will be performed by the GovernmentEngineer or by an independent laboratory hired by the Contracting OfficerEngineer, except for grade and smoothness testing which shall be performed by the Contractor. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 metric short tons. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness 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 grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

1.6.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer Engineer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D 6926. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

1.6.2 Additional Sampling and Testing

The Contracting OfficerEngineer 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 GovernmentOwner. Testing in these areas will be treated as a separate lot. Payment will be made for the quantity of HMA represented by these tests in accordance with the provisions of this section.

1.6.3 In-place Density

For determining in-place density, one random core (100 mm 4 inches or 150 mm 6 inches in diameter) will be taken by the GovernmentEngineer from the mat (interior of the lane) of each sublot, and one random core will be taken from the joint (immediately over joint) of each sublot, in accordance with ASTM D 979. Each random core will be full thickness of the layer being placed. When the random core is less than 25 mm 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to meet the requirements for laboratory-prepared, thoroughly dry specimens, cores obtained from the mat and from the joints will be used for in-place density determination in accordance with ASTM D 2726.

1.6.4 Surface Smoothness

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NOTE: Edit these paragraphs as appropriate to the project. It is desired to restrict surface smoothness testing and evaluation to either straightedge method or profilograph method. Retain the one and delete the other; otherwise, retain both as a Contractor's option. Generally, designer should require use of the profilograph method. If the profilograph method is allowed, and there are areas with dimensions less than 60 m (200 feet) in any direction, part of the straightedge method must be retained for these short runs.

****

Use [one] [both] of the following methods to test and evaluate surface smoothness of the finished surface of the pavement final grade. All testing shall be performed in the presence of the Contracting Officer Engineer. Detailed notes of the results of the testing shall be kept and a copy furnished to the GovernmentEngineer immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 60 m 200 feet in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting OfficerEngineer.

1.6.4.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 3 mm 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 3 when checked with an approved 4 m 12 foot straightedge.

Table 3. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, mm
Runways and taxiways	Longitudinal	3
	Transverse	6
Calibration hardstands and compass swinging bases	Longitudinal	3
	Transverse	3
All other airfields and helicopter paved areas	Longitudinal	6
	Transverse	6

Table 3. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
Runways and taxiways	Longitudinal	1/8
	Transverse	1/4
Calibration hardstands and compass swinging bases	Longitudinal	1/8
	Transverse	1/8
All other airfields and helicopter paved areas	Longitudinal	1/4
	Transverse	1/4

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 3 mm 1/8 inch or more, and all pavement shall have a Profile Index not greater than specified in Table 4 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 60 m 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 4. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (mm/km)
Runways	Longitudinal	110
	Transverse	140
Taxiways	Longitudinal	140
	Transverse	(Use Straightedge)
Calibration Hardstands & Compass Swinging Bases		(Use Straightedge)
All Other Airfield & Helicopter Paved Areas	Longitudinal	140
	Transverse	140

Table 4. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
Runways	Longitudinal	7
	Transverse	9
Taxiways	Longitudinal	9
	Transverse	(Use Straightedge)
Calibration Hardstands & Compass Swinging Bases		(Use Straightedge)
All Other Airfield & Helicopter Paved Areas	Longitudinal	9
	Transverse	9

1.6.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are diamond ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 4.5 m 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 6.1 m 20 feet and at the third points for lanes 6.1 m 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined 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.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 5 mm 0.2 inches wide and the "bump template" shall span 25 mm 1 inch with an offset of 10 mm 0.4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the GovernmentEngineer at the end of each day's testing.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 10 mm 0.4 inch in height shall be reduced by diamond grinding until they do not exceed 7.5 mm 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring 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 ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

1.7 ENVIRONMENTAL REQUIREMENTS

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NOTE: The temperature requirements in Table 5 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.

****

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 5. The temperature requirements may be waived by the Contracting OfficerEngineer, if requested; however, all other requirements, including compaction, shall be met.

Table 5. Surface Temperature Limitations of Underlying Course

Mat Thickness, mm	Degrees C
75 or greater	4
Less than 75	7

Table 5. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist 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. All aggregate test results and samples shall be submitted to the Contracting OfficerEngineer at least 14 days prior to start of construction.Aggregate testing shall have been performed within 90 days of performing the mix design.

2.1.1 Coarse Aggregate

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

Percentage of Wear (ASTM C 131) 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.

****

Coarse aggregate shall consist 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. The coarse aggregate particles shall meet the following requirements:

a. The percentage of loss shall not be greater than 40 [__] percent after 500 revolutions when tested in accordance with ASTM C 131.

b. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with ASTM C 88.

c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 1200 kg/cubic meter 75 lb/cu ft when tested in accordance with ASTM C 29/C 29M.

f. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142.

2.1.2 Fine Aggregate

****

NOTE: The lower limit for uncompacted void content (requirement c., below) should be set at 45 for fine aggregate angularity unless local experiences indicate 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 should the limit be set less than 43.

****

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. The fine aggregate particles shall meet the following requirements:

a. The quantity of natural sand (noncrushed material) added to the aggregate blend shall not exceed 15 percent by weight of total aggregate.

b. The individual fine aggregate sources shall have a sand equivalent value greater than 45 when tested in accordance with ASTM D 2419.

c. The fine aggregate portion of the blended aggregate shall have an uncompacted void content greater than 45.0 percent when tested in accordance with ASTM C 1252 Method A.

d. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242/D 242M.

2.1.4 Aggregate Gradation

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NOTE: Delete from Table 6, the gradations that will not be used as a part of this project. Generally, the layer thickness should be at least 75 mm (3 inches) for gradation 1, 50 mm (2 inches) for gradation 2 and 37 mm (1.5 inches) for gradation 3 shown in Table 6.

Use of gradation 1 must be limited to intermediate courses. Gradation 2 is suitable for intermediate and surface courses. Use of gradation 3 must be limited to shoulders and leveling courses. Do not use gradation 1 for surface courses.

****

The combined aggregate gradation shall conform to gradations specified in Table 6, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 6. Aggregate Gradations

Sieve Size, mm	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing by Mass	Gradation 3 Percent Passing by Mass
25.0	100	---	---
19.0	76-96	100	---
12.5	68-88	76-96	100
9.5	60-82	69-89	76-96
4.75	45-67	53-73	58-78
2.36	32-54	38-60	40-60
1.18	22-44	26-48	28-48
0.60	15-35	18-38	18-38
0.30	9-25	11-27	11-27
0.15	6-18	6-18	6-18
0.075	3-6	3-6	3-6

Table 6. Aggregate Gradations

Sieve Size, inch	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing by Mass	Gradation 3 Percent Passing by Mass
1	100	---	---
3/4	76-96	100	---
1/2	68-88	76-96	100
3/8	60-82	69-89	76-96
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27
No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.2 ASPHALT CEMENT BINDER

****

NOTE: Performance Graded (PG) asphalt binders should be specified wherever available. The same grade PG binder used by the state highway department in the area should be considered as the base grade for the project (e.g. the grade typically specified in that specific location for dense graded mixes on highways with design ESALS less than 10 million). The exception would be that grades with a low temperature higher than PG XX-22 should not be used (e.g. PG XX-16 or PG XX-10), unless the Engineer has had successful experience with them.

Typically, rutting is not a problem on airport runways. However, at airports with a history of stacking on end of runways and taxiway areas, rutting has accrued due to the slow speed of loading

on the pavement. If there has been rutting on the project or it is anticipated that stacking may accrue during the design life of the project, then the following grade "bumping" should be applied for the top 125 mm (5 inches) of paving in the end of runway and taxiway areas: for aircraft tire pressure between 0.7 and 1.4 MPa (100 and 200 psi), increase the high temperature one grade; for aircraft tire pressure greater than 1.4 MPa (200 psi), increase the high temperature two grades.

For Navy projects, a high temperature increase of two grades is required. Each grade adjustment is 6 degrees C. Polymer Modified Asphalt, PMA, has shown to perform very well in these areas.

The low temperature grade should remain the same. The Engineer may lower the low temperature grade to comply with the recommendations of the FHWA's software program "LTPPBind", if it is believed to be appropriate.
****

Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) [_____]. [As an alternate, ASTM D 3381 Table 2, Viscosity Grade [_____] or ASTM D 946 Penetration Grade [_____] may be used]. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting OfficerEngineer. The supplier is defined as the last source of any modification to the binder. The Contracting OfficerEngineer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained in accordance with ASTM D 140/D 140M and in the presence of the Contracting OfficerEngineer. These samples shall be furnished to the Contracting OfficerEngineer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

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NOTE: Use 75 blow Marshall hand-held hammer compaction or 75 gyration Superpave gyratory compaction for all pavements designed for tire pressures of 690 kPa (100 psi) or higher.

Use 50 Blow Marshall hand-held hammer compaction or 50 gyration Superpave gyratory compaction for all shoulder pavements and pavements designed for tire pressures less than 690 kPa (100 psi).

For Marshall mixes, delete the column in Table 7 which does not apply, unless the project includes both 75 Blow and 50 Blow mixes.

Select the appropriate gradation and VMA requirements in Table 8 to be consistent with the gradation chosen in Table 6. Delete the other two

lines in Table 8.
****

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of Table 6. No hot-mix asphalt for payment shall be produced until a JMF has been approved. [The hot-mix asphalt shall be designed using hand-held hammer procedures contained in AI MS-02 and the criteria shown in Table 7.] [The hot-mix asphalt shall be designed using the Superpave gyratory compactor set at [50] [75] gyrations. Samples shall be prepared at various asphalt contents and compacted in accordance with ASTM D 6925.] Laboratory compaction temperatures for Polymer Modified Asphalts shall be as recommended by the asphalt cement manufacturer. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided at no additional cost to the Government. Sufficient materials to produce 90 kg 200 pound of blended mixture shall be provided to the Contracting OfficerEngineer for verification of mix design at least 14 days prior to construction of test section.

2.3.1 JMF Requirements

Submit the job mix formula 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 viscosity grade, penetration grade, or performance grade.

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

f. Laboratory mixing temperature.

g. Lab 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 stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02. Summary tabulation shall include 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.

q. Antistrip agent (if required).

r. List of all modifiers.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 7. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, newtons minimum	9560[1]	6000[1]
Flow, 0.25 mm	8-16[2]	8-18[2]
Air voids, percent	4[4]	4[4]
Percent Voids in mineral aggregate (minimum)	See Table 8	See Table 8
Dust Proportion[3]	0.8-1.2	0.8-1.2
TSR, minimum percent	75	75

Table 7. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, pounds minimum	2150[1]	1350[1]
Flow, 0.01 inch	8-16[2]	8-18[2]
Air voids, percent	4[4]	4[4]
Percent Voids in mineral aggregate (minimum)	See Table 8	See Table 8
Dust Proportion[3]	0.8-1.2	0.8-1.2

Table 7. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
TSR, minimum percent	75	75

(1) This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

(2) The flow requirement is not applicable for Polymer Modified Asphalts

(3) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the 0.075 mm No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.

(4) Select the JMF asphalt content corresponding to an air void content of 4 percent. Verify the other properties of Table 7 meet the specification requirements at this asphalt content.

Table 7. Superpave Gyratory Compaction Criteria

Test Property	Value
Air voids, percent	4 (1)
Percent Voids in mineral aggregate (minimum)	See Table 8
Dust Proportion (2)	0.8-1.2
TSR, minimum percent	75

Table 7. Superpave Gyratory Compaction Criteria

Test Property	Value
Air voids, percent	4 (1)
Percent Voids in mineral aggregate (minimum)	See Table 8
Dust Proportion (2)	0.8-1.2
TSR, minimum percent	75

(1) Select the JMF asphalt content corresponding to an air void content of 4 percent. Verify the other properties of Table 7 meet the specification requirements at this asphalt content.

(2) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the 0.075 mm No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.

Table 8. Minimum Percent Voids in Mineral Aggregate (VMA)(4)

Aggregate (See Table 6)	Minimum VMA, percent
Gradation 1	13.0
Gradation 2	14.0
Gradation 3	15.0

(1) Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting OfficerEngineer. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be 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. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 6; this is acceptable. Adjustments to the JMF shall be limited to plus or minus 1.0 percent on the 0.075 mm No. 200 sieve. The resulting aggregate grading on the 0.075 mm No. 200 sieve shall not be outside the limits shown in Table 6. Asphalt content adjustments shall be limited to plus or minus 0.40 of binder content. If adjustments are needed that exceed these limits, a new mix design shall be developed.

2.4 RECYCLED HOT MIX ASPHALT

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NOTE: Reclaimed Asphalt Pavement (RAP) should not be used for surface mixes, except on shoulders. It can be used very effectively in lower layers, or for shoulders. The Contractor should be able to use RAP, up to 30%, as long as the resulting recycled mix meets all requirements that are specified for virgin mixtures. Remove these paragraphs if RAP is not used.

****

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 50 mm 2 inches. The individual aggregates in a RAP chunk shall not exceed the maximum size aggregate of the gradation specified in Table 6. The recycled HMA mix shall be designed using procedures contained in AI MS-02. The job mix shall meet the requirements of paragraph MIX DESIGN. RAP shall only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent.

2.4.1   RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2   RAP Mix

****

NOTE: The appropriate test should be selected to conform to the grade of new asphalt specified. If a penetration grade is specified, use penetration test. If a viscosity grade is specified, use a viscosity test. If a PG asphalt binder is specified, use the dynamic shear rheometer and bending beam tests.

****

The blend of new asphalt cement and the RAP asphalt binder shall meet the [penetration] [viscosity] [dynamic shear rheometer at high temperature and bending beam at low temperature] requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3   EXECUTION

3.1   CONTRACTOR QUALITY CONTROL

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NOTE: The Contractor may be able to meet the specified quality control requirements with in-house capability or may have to hire a material testing firm to provide the required quality control testing.

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3.1.1   General Quality Control Requirements

Develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall 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

f. Mixing and Transportation

g. 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 he average of three specimens per trial blow application.

h. Mixture Volumetrics

i. Moisture Content of Mixtures

j. Placing and Finishing

k. Joints

l. Compaction, including HMA-PCC joints

m. Surface Smoothness

n. Truck bed release agent

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site. It shall be 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. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting OfficerEngineer will advise the Contractor 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, the incorporation of the materials into the work shall be suspended immediately and 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. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.1.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph QUALITY ASSURANCE) by one of the following methods: extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO T 308, ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided each method is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.1.3.2 Aggregate Gradation and Specific Gravity

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444 or ASTM D 6307. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture. The specifc gravity of each aggregate size grouping shall be determined for each 18,000 metric tons 20,000 tons in accordance with ASTM C 127 or ASTM C 128.

3.1.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.1.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with AASHTO T 329.

3.1.3.6 Laboratory Air Voids, VMA, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, [using [50] [75] blows per side with the Marshall hand-held hammer as described in ASTM D 6926.] [using [50] [75] gyrations of the Superpave gyratory compactor as described in ASTM D 6925.] After compaction, the laboratory air voids and VMA of each specimen shall be determined[, as well as the Marshall stability and flow, as described in ASTM D 6927].. The VMA shall be within the limits of Table 8.

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 may be used to monitor pavement density.

3.1.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph QUALITY ASSURANCE.

3.1.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.1.3.10 QC Monitoring

submit all QC test results to the Contracting OfficerEngineer on a daily basis as the tests are performed. The Contracting OfficerEngineer 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 Contracting OfficerEngineer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.1.5 Control Charts

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 9, as a minimum. These control charts shall be posted as directed by the Contracting OfficerEngineer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 9 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown 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. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
4.75 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
0.6 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
0.075 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, newtons (minimum)				
75 blow JMF	7830	7290	9560	9030
50 blow JMF	4230	3690	6000	5470

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples Action Limit	Individual Samples Suspension Limit	Running Average of Last Four Samples Action Limit	Running Average of Last Four Samples Suspension Limit
Flow, 0.25 mm				
75 blow JMF	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 blow JMF	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples Action Limit	Individual Samples Suspension Limit	Running Average of Last Four Samples Action Limit	Running Average of Last Four Samples Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum)				
75 blow JMF	1760	1640	2150	2030
50 blow JMF	950	830	1350	1230
Flow, 0.01 inches				

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples: Action Limit	Individual Samples: Suspension Limit	Running Average of Last Four Samples: Action Limit	Running Average of Last Four Samples: Suspension Limit
75 blow JMF	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.
50 blow JMF	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

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NOTE: For Performance Graded (PG) asphalt cements, insert the plant temperature range from the Table below into the last sentence of the following paragraph.

Performance Graded Asphalt Plant Mixing Temperatures

Binder Grade	Mixing Temp Range (deg F)	Mixing Temp Range (deg C)
PG 46-28	240 - 295	115 - 146
PG 46-34	240 - 295	115 - 146
PG 46-40	240 - 295	115 - 146
PG 52-28	240 - 300	115 - 149
PG 52-34	240 - 300	115 - 149
PG 52-40	240 - 300	115 - 149
PG 52-46	240 - 300	115 - 149
PG 58-22	260 - 310	127 - 154
PG 58-28	260 - 310	127 - 154
PG 58-34	260 - 310	127 - 154
PG 64-22	265 - 320	129 - 160
PG 64-28	265 - 320	129 - 160
PG 64-34	265 - 320	129 - 160
PG 67-22	275 - 325	135 - 163
PG 70-22	280 - 330	138 - 166
PG 70-28	275 - 325	135 - 163
PG 76-22	285 - 335	141 - 168

Performance Graded Asphalt Plant Mixing Temperatures		
PG 76-28	**280 - 330**	**138 - 166**
PG 82-22	**290 - 340**	**143 - 171**

****

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Performance Graded (PG) asphalts shall be within the temperature range of [_____] to [_____] degrees C F when added to the aggregates.

3.3 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 175 degrees C 350 degrees F when the asphalt cement is added. The temperature shall not be 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 HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a thorough and uniform coating of asphalt binder (testing in accordance with ASTM D 2489/D 2489M may be required by the Contracting Officer) and is thoroughly distributed throughout the mixture. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.5 PREPARATION OF THE UNDERLYING SURFACE

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NOTE: If the underlying surface to be paved is an unbound granular layer, a prime coat should be applied, 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 HMA layer, and preventing the base from shifting under construction equipment. If the prime coat requirement is not a separate pay item and is waived from this contract, an adjustment to the contract price should be made. Environmental laws in certain states may not allow prime coats to be applied.

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

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

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Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A [prime coat] [and/or] [tack coat] shall be applied in accordance with the contract specifications.

3.6 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section 75 - 150 m 250 - 500 feet long and two paver passes wide placed in two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting OfficerEngineer.

3.6.1 Sampling and Testing for Test Section

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NOTE: Table 10 applies only to the test section. The limits in Tables 1, 2, and 9, apply to a number of tests run from a lot. This is why the limits listed in Table 10 are different from those listed in Tables 1, 2, and 9.

Select the appropriate VMA requirement to match the selected gradation. Select the appropriate stability and flow value to match the laboratory compactive effort (50 or 75 blows).

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One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, laboratory air voids, and Tensile Strength Ratio (TSR). A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances or exceed the minimum values shown in Table 10 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government Owner and another test section shall be constructed.

Table 10. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
4.75 mm and larger	JMF plus or minus 8
2.36, 1.18, 0.60, and 0.30 mm	JMF plus or minus 6
0.15 and 0.075 mm	JMF plus or minus 2.0
Asphalt Content, Percent	JMF plus or minus 0.5

Table 10. Test Section Requirements for Material and Mixture Properties

Property (Individual Test Result)	Specification Limit
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	See Table 8
Stability, newtons (Average of 3 specimens)	[6000] [9560] minimum
Flow, 0.25 mm (Average of 3 specimens)	[8 - 16] [8 - 18]
Tensile Strength Ratio (TSR)	75% minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 minimum

Table 10. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 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 8
Stability, pounds (Average of 3 specimens)	[1350] [2150] minimum
Flow, 0.01 inches (Average of 3 specimens)	[8 - 16] [8 - 18]
Tensile Strength Ratio (TSR)	75% minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 minimum

3.6.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.7 TESTING LABORATORY

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NOTE: Include bracketed sentence for Corps-managed projects.
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The laboratories used to develop the JMF, perform Contractor Quality Control testing, and for GovernmentEngineer acceptance testing shall meet the requirements of ASTM D 3666. All required test methods shall be performed by an accredited laboratory. [The Government will inspect the laboratory equipment and test procedures prior to the start of hot-mix operations for conformance with ASTM D 3666. The laboratory shall maintain this validation for the duration of the project.] A certification signed by the manager of the laboratory stating that it meets these requirements shall be submitted to the Contracting OfficerEngineer prior to the start of construction. The certification shall contain as a minimum:

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.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.8 TRANSPORTING AND PLACING

3.8.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided 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.

3.8.2 Placing

The mix shall be placed in lifts of adequate thickness and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. Waste mixture shall not be broadcast onto the mat or recycled into the paver hopper. Collect waste mixture and dispose off site. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 3 m

10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 300 mm 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 3 m 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset 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 may be spread and luted by hand tools.

3.9 COMPACTION OF MIXTURE

3.9.1 General

a. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor, with the exception that the Contractor shall not apply more than three passes with a vibratory roller in the vibrating mode. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

b. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue 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, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9.2 Segregation

The Contracting OfficerEngineer can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Contracting OfficerEngineer 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 10. If the material fails to meet these specification requirements, the extent of the segregated material will be removed and replaced 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.

3.10 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.10.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.10.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C 175 degrees F at the time of placing the adjacent lane), or otherwise defective, shall be cut back a maximum of 75 mm 3 inches from the top edge of the lift with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. All cutback material shall be removed from the project. Cutting equipment that uses water as a cooling or cutting agent shall not be permitted. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint.

3.10.3 HMA-Portland Cement Concrete Joints

Avoid spalling portland cement concrete (PCC) pavement when compacting HMA at a HMA-PCC joint. Pneumatic-tire rollers should be used and the HMA shall be rolled parallel to the joint. All procedures, including repair of damaged PCC, shall be in accordance with the approved Quality Control Plan.

-- End of Section --