SECTION 32 12 15

AIRFIELD PAVING, HOT MIX ASPHALT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Unless specifically noted, the current edition of the reference will be used.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO M 320	Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 329	Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

AI MS-2	Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C117	Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C1252	Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C128	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C29	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D140	Standard Practice for Sampling Bituminous Materials
ASTM D1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D242	Mineral Filler for Bituminous Paving Mixtures
ASTM D2489	Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D4791	Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Mechanical Size Analysis of Extracted Aggregate
ASTM D6307	Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6925	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	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM D946	Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979	Sampling Bituminous Paving Mixtures
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph

OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT SSHC Standard Specifications for Highway Construction

1.2 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. Hot-mix asphalt (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 proposed Placement Plan, indicating lane widths, longitudinal joints, and transverse joints for each course or lift.

1.2.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of AASHTO M 156 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 semi annually by an approved calibration laboratory.
b. Testing Facilities. Provide laboratory facilities at the plant for the use of the acceptance testing and the Contractor's quality control testing.
c. Inspection of Plant. The CO 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 procurement of 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 a mix loaded directly into trucks.

1.2.2 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.

1.2.3 Material Transfer Vehicle (MTV)

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 with a swing conveyor 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.

1.2.4 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 placements.

1.2.4.1 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.

1.2.4.2 Automatic Grade Controls

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 string line set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.2.5 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.

1.3 SUBMITTALS

Government approval of all materials, designs, procedures, and equipment is required prior to use. The following are in addition to the submittals required by other sections and are to be submitted in accordance with Section 01 33 00; SUBMITTAL PROCEDURES.

The JMF design and all incorporated materials tests shall have been performed within 120 days of submittal.

SD-02 Shop Drawings

Placement Plan

SD-03 Product Data

Mix Design (JMF)
Contractor Quality Control

SD-04 Samples

Asphalt Cement Binder
Aggregates

SD-06 Test Reports

Aggregates
QC Monitoring

SD-07 Certificates

Asphalt Cement Binder
Testing Laboratory

1.4 ACCEPTABILITY OF MATERIALS and WORKMANSHIP

1.4.1 Materials

1.4.1.1 All Hot Mix Asphalt and incorporated materials shall be new. RAP is not allowed to be used in airfield paving.

1.4.1.2 The materials shall be accepted on the basis of tests made by the Contractor's approved commercial laboratory. The Government may, at its discretion, make check tests to validate the Contractor's testing. Validation tests shall be performed on duplicate samples.

1.4.1.3 If the results of the Government’s tests and Contractor’s tests vary by less than 2.0 percent, the results of the Contractor's tests will be considered valid.

1.4.1.4 If the results of the Government’s tests and Contractor’s tests vary by 2.0 percent or more, but less than 4.0 percent, the average of the two will be considered the value to be used. The Government’s and Contractor’s quality control personnel shall inspect and evaluate all equipment and procedures to identify and correct the reason for the discrepancy.

1.4.1.5 Operations shall cease immediately if the tests results vary by 4.0 percent or more. The Government’s and the Contractor’s quality control personnel shall inspect all equipment and shall evaluate each sampling and testing procedure. Operations may continue when the cause for the discrepancy has been identified and corrected and the variance of test results on duplicate samples is within tolerance.

1.4.2 Pavement

Hot Mix Asphalt pavement shall be accepted based on in place density, laboratory air voids and conformance to the lines, grade, smoothness, and thickness as specified.

1.4.2.1 In-Place Density

For determining in-place density, one random core, 4 inches or 6 inches in diameter, will be taken at locations identified by the CO 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 D979/D979M. Fill all core holes with hot-mix asphalt. The core holes shall be dry and tack coated before filling. Each random core will be full thickness of the layer being placed. When the random core is less than 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 D2726.

1.4.2.2 Plan and Grade

The finished pavement shall conform to the dimensions, elevations, and lines as shown on the approved plans or in the project specifications. The contractor shall verify all dimensions, elevations, and lines no earlier than 24 hours and no later than five working days after each placement. All measurements are to be taken in the presence of the representative of the CO. A clear and legible copy of the results, signed by the contractor and the representative of the CO witnessing the measurements, will be submitted to the CO no later than three working days after the completion of the verification measurements.

a. Conformance

The finished surface of the pavement shall be tested by the Contractor by running lines of levels at intervals of 20 feet in both directions. The results of this survey shall be recorded and a copy furnished to the CO at the end of each day’s testing. The finished surfaces of all pavements, including runway, taxiway, and apron pavements, shall not vary more than one half of an inch horizontally from the plan grade line nor more than one half of an inch above or below the elevation specified.

1.4.2.3 Surface Smoothness

a. The finished surfaces of airfield pavements shall have no abrupt changes in elevation. The finished surfaces of new pavement and the finished surface of existing pavement shall coincide at their juncture.

b. The profilograph method shall be used for all longitudinal testing, except for paving lanes less than 200 feet in length. The straightedge method shall be used for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, and at the ends of the paving limits of the project.

1.4.2.4 Straightedge Testing

a. Tolerance

(1) All pavements shall be within the limits specified in Table 1 when checked with an approved straightedge.

(2) The straightedge shall be 12 feet in length.

TABLE 1

STRAIGHTEDGE SURFACE SMOOTHNESS

Location	Direction	Limits (inches)
Runways and Taxiways	Longitudinal	1/8
	Transverse	1/4
Calibration Hardstands and Compass Swing Bases	Longitudinal	1/8
	Transverse	1/8
All Other Pavements and Paved Areas	Longitudinal	1/4
	Transverse	1/4

b. Method

(1) After final rolling, but not later than 48 hours after placement, test the entire surface of the pavement in each lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond 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 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline

of each paving lane less than or equal to 20 feet in width or at the 1/3 lines for paving lanes greater than 20 feet in width as shown on the drawings, and at the 1/8th line in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

(2) 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 measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be taken along the entire length of the straightedge at one foot intervals.

c. Detailed notes shall be kept of the results of the testing and a copy, signed by the contractor QC manager and the representative of the CO, shall be turned in to the CO after each day’s testing.

1.4.2.5 Profilograph Testing

a. Tolerance

All pavements shall have a Profile Index not greater than specified in Table 2 when tested with an approved California-type profilograph. If the extent of the pavement is less than 200 feet in either direction, that direction shall be checked by the straightedge method and shall meet the requirements of Table 1.

b. Method

Profilograph testing shall be performed using approved equipment and in accordance with the procedures specified in ASTM E-1274. The equipment shall use electronic recording and automatic computerized reduction of data to indicate “must-grind” bumps and the Profile Index for each one tenth mile segment of pavement. Grade breaks on aprons shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The blanking band shall be two tenths of an inch wide and the bump template shall span one inch with an offset of four tenths of an inch. The profilograph testing of the last 30 feet of a paving lane in the longitudinal direction from each day’s paving operation shall be counted on the following day’s continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each one tenth mile segment. The profile index for each segment shall be the average of the profile indices

for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent one tenth mile.

TABLE 2

PROFILOGRAPH SURFACE SMOOTHNESS

Location	Direction	Maximum Index (inches per mile)
Runways and Taxiways	Longitudinal	7
	Transverse	Use Straightedge
Calibration Hardstands and Compass Swing Bases	Longitudinal	Use Straightedge
	Transverse	Use Straightedge
All Other Pavements and Paved Areas	Longitudinal	9
	Transverse	9

c. A copy of the reduced tapes shall be furnished to the CO at the end of each day’s testing.

1.4.2.6. Bumps ("Must Grind" Areas).

Any bumps ("must grind" areas) shown on the profilograph trace which exceed 4/10 inch in height shall be reduced by diamond grinding until they do not exceed 3/10 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) planeing 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.

1.4.2.7 Where project plans require deviation from a plane surface (crowns, drainage inlets, etc.) the surface shall be finished in accordance with the approved plans.

1.5 ENVIRONMENTAL REQUIREMENTS

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 CO, however, all other requirements, including compaction, shall be met.

TABLE 3

MINIMUM SURFACE TEMPERATURE OF UNDERLYING COURSE

Mat Thickness (inches)	Temperature (^{o}F)
3 or more	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, and natural sand and mineral filler, as required. The portion of material retained on the #4 sieve is coarse aggregate. The portion of material passing the #4 sieve and retained on the #200 sieve is fine aggregate. The portion passing the #200 sieve is defined as mineral filler. Submit sufficient materials to produce 200 lb of blended mixture for mix design verification. All aggregate test results and samples shall be submitted to the CO 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

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 requirements of Table 4.

TABLE 4

REQUIREMENTS FOR COARSE AGGREGATE

Requirement	Test	Limits
LA Abrasion)	ASTM C 131	40% Maximum Loss
Sodium Sulfate Soundness	ASTM C 88	12% Maximum Loss
Magnesium Sulfate Soundness	ASTM C 88	18% Maximum Loss
Fractured Faces	ASTM D 5821	75% Minimum with 2 Fractured Faces
Flat and Elongated	ASTM D4791	20% Maximum at 3:1
Slag Compacted Weight	ASTM C 29	75 pcf Minimum
Clay Lumps and Friable Particles	ASTM C 142	0.3% by Weight

2.1.2 Fine Aggregate

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 requirements of Table 5.

TABLE 5

REQUIREMENTS FOR FINE AGGREGATE

Requirement	Test	Limits
Quantity of Uncrushed Material in Total Aggregate		15% Maximum, by Weight
Sand Equivalent of Source	ASTM D 2419	45% Minimum
Uncompacted Void Content of Fine Aggregate Portion of Blend	ASTM C 1252, Method A	45% Minimum
Clay Lumps and Friable Particles	ASTM C 142	0.3% by weight

2.1.3 Mineral Filler

Mineral filler shall be non-plastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The JMF combined aggregate gradation shall conform to one of the gradations specified in Table 6, when tested in accordance with ASTM C136 and ASTM C117. The gradation 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. The JMF shall be within the specification limits; however, the gradation can exceed the limits when the allowable deviation from the JMF shown in Tables 9 and 10 are applied.

TABLE 6

COMBINED AGGREGATE GRADATIONS

	Gradation 1	Gradation 2	Gradation 3
Sieve Size, inch	% Passing	% Passing	% Passing
1	100	---	---
3/4	90-100	100	---
1/2	68-88	90-100	100
3/8	60-82	69-89	90-100
#4	45-67	53-73	58-78
#8	32-54	38-60	40-60
#16	22-44	26-48	28-48
#30	15-35	18-38	18-38
#50	9-25	11-27	11-27
#100	6-18	6-18	6-18
#200	3-6	3-6	3-6
Minimum % Voids	13	14	15

2.1.5 Voids in Mineral Aggregate (VMA)

The VMA shall not be less than specified in Table 6 as determined by AI MS-2, based on ASTM D 2726.

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall be Performance Grade conforming to the requirements of AASHTO M 320 and the ODOT SSHC. 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 CO. The supplier is defined as the last source of any modification to the binder. The CO may sample and test the binder at the mix plant at any time before or during mix production.

2.3 MIX DESIGN (JMF)

2.3.1 The asphalt mix shall consist of asphalt binder, a well graded aggregate and, if required, a mineral filler.

2.3.2 All materials used in the JMF shall meet the requirements of this specification.

2.3.3 The Tensile Strength Ratio (TSR) shall be greater than 75 as determined by ASTM D 4867.

2.3.4 The JMF requires government approval prior to any placement. Submit the JMF for approval in accordance with Section 01 33 00; Submittal Procedures.

2.3.4.1 Submittal Requirements

The JMF submittal shall include, as a minimum, the following:

(a) Combined Aggregate Gradation
(b) Individual Aggregate Gradations
(c) Percent of individual aggregates or mineral filler used
(d) Percent of binder (asphalt cement)
(e) PG designation of binder
(f) Laboratory Mix temperature
(g) Laboratory Compaction Temperature
(h) Temperature - Viscosity relation of the binder
(i) Plot of the combined aggregate gradation on the 0.45 power gradation chart, stating the nominal maximum size
(j) Graphical plots and summary tabulation of air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2. Summary

tabulation shall include individual specimen data for each specimen tested.

(k) Specific gravity and absorption of the aggregates
(l) Percent of 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.

2.3.5 Adjustments to JMF

2.3.5.1 The JMF for each mixture shall be in effect until a new formula is approved, in writing, by the Contracting Officer.

2.3.5.2 Any change in source of any material will require a new JMF to be designed, submitted and approved prior to placement.

2.3.5.3 The Contractor will be allowed to make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF shall be limited to the amounts shown in Table 7. Any adjustment exceeding these limits shall require a new JMA be designed, submitted and approved prior to placement.

TABLE 7

ALLOWABLE ADJUSTMENTS TO THE JMF

Item	Allowable Adjustment
Asphalt Cement	± 0.4%
#4 and Coarser	± 4%
#8 to #50	± 3%
#100	± 1%
#200	± 1%

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

3.1.1.1 The Contractor shall submit Quality Control Plan (CQPC) to the Government for approval. The CQPC must be approved prior to any production or placement. 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 the average of three specimens per trial blow application.
(h) Mixture Volumetrics
(i) Moisture Content of Mixture
(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 equipped with HVAC units to maintain a temperature of 75 ± 5 degrees F). Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The CO 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 CO 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 the following tests:

(a) Control of asphalt content,
(b) Aggregate gradation,
(c) Temperatures,
(d) Aggregate moisture,
(e) Moisture in the asphalt mixture,
(f) Laboratory air voids,
(g) Stability,
(h) Flow,
(i) In-place density,
(j) Grade and smoothness.

3.1.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot by one of the following methods: extraction method in accordance with ASTM D2172, Method A or B, the ignition method in accordance with the AASHTO T 308, ASTM D6307, or the nuclear method in accordance with ASTM D4125, provided each method is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D2172, 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 Properties

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D5444 or ASTM D6307. For batch plants, aggregates shall be tested in accordance with ASTM C136 using actual batch weights to determine the combined aggregate gradation of the mixture. The specific gravity of each aggregate size grouping shall be determined for each 20,000 tons in accordance with ASTM C127 or ASTM C128. Fractured faces for gravel sources shall be determined for each 20,000 tons in accordance with ASTM D5821. The un-compacted void content of manufactured sand shall be determined for each 20,000 tons in accordance with ASTM C1252 Method A.

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 C566.

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

Mixture samples shall be taken at least four times per lot and compacted into specimens, After compaction, the laboratory air voids and VMA of each specimen shall be determined. 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 Submit all QC test results to the 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 CO, 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 the last four samples for the parameters listed in Table 8, as a minimum. These control charts shall be posted as directed by the CO 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 8 applicable to the test parameter being plotted, and the Contractor's test results. Target values (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 suspense limit, halt production until the problem is solved. When the suspense limit is exceeded for individual values or running average values, the Contracting Officer has the option to require the Contractor to remove and replace 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. 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 8

PARAMETERS TO BE PLOTTED AND ACTION AND SUSPENSE LIMITS

Parameter	**Deviation From JMF Target**			
	Individual Samples		Running Average of Last Four Samples	
	Action Limit ± %	Suspense Limit ± %	Action Limit ± %	Suspension Limit ± %
#4 Sieve, Cumulative % Passing	6	8	4	5
#30 Sieve, Cumulative % Passing	4	6	3	4
#200 Sieve, Cumulative % Passing	1.4	2.0	1.1	1.5
Asphalt Content	0.4	0.5	0.2	0.3
Laboratory Air Voids	-	-	-	-
In-place Mat Density, percent of TMD	-	-	-	-
In-place Joint Density, percent of TMD	-	-	-	-
VMA; Gradation 1	13.3	13.0	13.5	13.0
VMA; Gradation 2	14.3	14.0	14.5	14.0
VMA; Gradation 3	15.3	15.0	15.0	15.0

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

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 325 degrees F when added to the aggregates. Performance Graded (PG) asphalts shall be within the temperature range shown in Table 9 when added to the aggregates.

TABLE 9

PG ASPHALT MIXING TEMPERATURES

Binder Grade	Mixing Temp Range (degrees F)
PG 64-22 OK	265 - 320
PG 70-28 OK	275 - 325
PG 76-28 OK	280 - 330

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 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 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 D1461. The government may test the mixture at any time.

3.5 PREPARATION OF THE UNDERLYING SURFACE

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

3.6 TEST SECTION

Prior to full production, a test section may be required by the government for each JMF used. The test section shall consist of a maximum of 250 tons, placed with two paver passes, two paving lanes in width, 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 may be placed as part of the project pavement with prior approval of the CO.

3.6.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant; triplicate specimens compacted and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. An additional portion of the sample shall be tested to determine the Tensile Strength Ratio (TSR). Adjust the compactive effort as required to provide TSR specimens with an air void content of 7 ± 1 percent. 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 D3665. 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 and another test section shall be constructed.

3.6.2 Additional Test Sections

If the initial test section is unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and a second test section shall then be placed and tested. Full production shall not begin until an acceptable section has been constructed and accepted.

TABLE 10

TEST SECTION REQUIREMENTS

Property	# of Samples	Allowable Deviation from JMF
#4 and Larger	1	± 8%
#16, #30, & #50	1	± 6%
#100 & #200	1	± 2%
Asphalt Content		± 0.5%
Laboratory Air Voids	3	± 1%
VMA; Gradation 1	3	± 13%
VMA; Gradation 2	3	± 14%
VMA; Gradation 3	3	± 15%
Tensile Strength Ratio (TSR)	1	75% minimum
Conditioned Strength	1	60 psi minimum
Mat Density	4	94 ±2% of TMD
Joint Density	4	92% minimum of TMD

3.7 TESTING LABORATORY

The laboratory used to develop the JMF, perform Contractor Quality Control testing, and for acceptance testing shall meet the requirements of ASTM D3666. All required test methods shall be performed by an accredited laboratory. The Government may inspect the laboratory equipment and test procedures prior to the start of hot-mix operations for conformance with ASTM D3666. The laboratory shall maintain this validation for the duration of the project. Submit a certification of compliance signed by an officer of the company stating that the laboratory meets these requirements 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 140 degrees F.

3.8.2 Placing

The mix shall be placed and compacted in equal lifts of 6 inches or less in thickness, 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 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 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 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 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, compacted and sealed manually.

3.9 COMPACTION OF MIXTURE

3.9.1 General

3.9.1.1 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 are at the discretion of the Contractor, with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and 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.

3.9.1.2 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 will not be permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers. 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 hot mixture and immediately compact 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

If the in-place material appears to be segregated, the CO 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 the 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 either method, 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, un-compacted, cold (less than 175 degrees F) at the time of placing the adjacent lane, or otherwise defective, shall be cut back a maximum of 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

3.10.3.1 Joints between HMA and PCC will require specific construction procedures for the HMA. The following criteria are applicable to the first 10 feet or paver width of HMA adjacent to the PCC.

(a) Pave the HMA side of the joint in a direction parallel to the joint.

(b) Place the HMA side sufficiently high so that when fully compacted the HMA will be greater than 1/8 inch but less than 1/4 inch higher than the PCC side of the joint.

(c) Compaction shall be provided with steel wheel rollers and at least one rubber tire roller. The rubber tire roller shall be at least 20 tons in weight and have tires that are inflated to at least 90 psi. Avoid spalling the PCC during placement and compaction of the HMA. Steel wheel rollers shall be operated in a way that prevents spalling the PCC. Any damage to PCC edges or joints shall be repaired as directed by the CO. If damage to the PCC joint or edge exceeds a total length of 3 feet, the PCC panel shall be

removed and replaced at no additional expense to the Government.

(d) After compaction is finished the HMA shall be leveled by grinding so that the HMA side is less than 1/8 inch higher than the PCC side. The HMA immediately adjacent to the joint shall not be lower than the PCC after the grinding operation. Transition the grinding into the HMA in a way that ensures good smoothness and provides drainage of water. The joint and adjacent materials when completed shall meet all of the requirements for grade and smoothness. Smoothness across the PCC-HMA joint shall be measured using a 12 feet straightedge. The acceptable tolerance is 1/8 inch.

(e) Consider the HMA next to the PCC as a separate lot for evaluation. Lots are based on individual lifts. Take four cores for each lot of material placed adjacent to the joint. The size of lot shall be 10 feet wide by the length of the joint being paved. Lots are based on individual lifts and shall not be comingled for density evaluation purposes. Locate the center of each of the four cores 6 inches from the edge of the concrete. Take each core at a random location along the length of the joint. The requirements for density for this lot, adjacent to the joint, are the same as that for the mat specified earlier.

(f) All procedures, including repair of damaged PCC, shall be in accordance with the approved Quality Control Plan.

-- End of Section --