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DIVISION 02 - SITE CONSTRUCTION

SECTION 02745

ASPHALTIC CONCRETE PAVING

07/04

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NASA-02745 (July 2004)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION NASA
Superseding NASA-02745
(June 2004)

SECTION 02745

ASPHALTIC CONCRETE PAVING
07/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This broadscope section covers general small project asphaltic paving (and base course) such as secondary streets, drives, and parking lots. Do not use paving and base course narrowscope sections with this section.

Material and/or construction execution requirements from state or local highway agency specifications shall be incorporated into the following sections.

The specifier should review the Intermodal Surface Transportation Efficiency Act of 1991 for recommendations on recycling of scrap rubber tires into asphalt mixes. References: U.S. Code Congressional and Administrative News, ASTM D 2000 and ASTM D 1566, ASTM D 3515, and AI MS 2.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 145

(1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

AASHTO M 247 (2002) Glass Beads Used in Traffic Paints

AASHTO M 248 (1991; R 2000) Ready-Mixed White and Yellow Traffic Paints

AASHTO T 166 (2000) Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

AASHTO T 176 (2002) Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 2 (2000) Sampling of Aggregates

AASHTO T 30 (1993; R 1998) Mechanical Analysis of Extracted Aggregate

AASHTO T 37 (2001) Sieve Analysis of Mineral Filler for Road and Paving Materials

ASPHALT INSTITUTE (AI)

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

ASTM INTERNATIONAL (ASTM)

ASTM C 127 (2001) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 128 (2001e1) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

ASTM C 131 (2003) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 88 (1999a) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D 1073 (2001) Standard Specification for Fine Aggregate for Bituminous Paving Mixtures

ASTM D 113 (1999) Standard Test Method for Ductility of Bituminous Materials

ASTM D 1556 (2000) Standard Test Method for Density

	and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1754	(1997; R 2002) Standard Test Method for Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)
ASTM D 1856	(1995a; R 2003) Test Method for Recovery of Asphalt from Solution by Abson Method
ASTM D 2027	(1997; R 2004) Standard Specification for Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1997; R 2004) Standard Specification for Cutback Asphalt (Rapid-Curing Type)
ASTM D 2041	(2003a) Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2170	(2001a) Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens) IP Designation: 319/84 (89)
ASTM D 2172	(2001e1) Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1998) Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 242	(1995; R 2000; E 2001) Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D 2922	(2001) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3176	(1989; R 2002) Standard Practice for Ultimate Analysis of Coal and Coke
ASTM D 3180	(1989; R 2002) Standard Practice for Calculating Coal and Coke Analyses from As-Determined to Different Bases
ASTM D 3282	(1993; R 1997e1) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 4	(1986; R 1998) Standard Test Method for Bitumen Content
ASTM D 5	(1997) Standard Test Method for Penetration of Bituminous Materials
ASTM D 5581	(1996; R 2001) Standard Test Method for Resistance to Plastic Flow of Bituminous

	Mixtures Using Marshall Apparatus (6 Inch-Diameter Specimen)
ASTM D 692	(2000) Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 70	(2003) Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 854	(2002) Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
ASTM D 92	(2002b) Standard Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 946	(1982; R 1999) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 979	(2001) Standard Practice for Sampling Bituminous Paving Mixtures
ASTM E 11	(2001) Standard Specification for Wire-Cloth and Sieves for Testing Purposes

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

DOT	(2000; R1) Federal Highway Administration Publication: Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways
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1.2 DEFINITIONS

Conform to AASHTO M 145, for satisfactory soil materials, (ASTM D 3282) Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

Conform to AASHTO M 145, for unsatisfactory soil materials, Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat and other highly organic soil, and soil materials of any classification that have a moisture content at the time of compaction outside the range required to achieve the field dry unit weight as specified.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 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. Include a columnar list of appropriate products and tests beneath each submittal description.

Submit the following in accordance with Section 01330, SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit manufacturer's catalog data for bituminous concrete showing description, mixing, and application instructions for the following items:

Asphalt Cement
Bituminous Concrete
Bituminous Prime Coat
Bituminous Tack Coat
Paint
Reflective Beads
Subbase and Base Course

SD-04 Samples

Submit samples for the following in accordance with paragraph entitled, "Pavement Marking," of this section.

Reflective Beads (500 Grams)
White Paint
Yellow Paint

SD-05 Design Data

Submit a Job-Mix Formula for bituminous concrete in accordance with paragraph entitled, "Job-Mix Formulas," of this section.

SD-06 Test Reports

Submit a test report in accordance with the paragraph entitled, "Quality Control Testing During Construction," of this section.

SD-07 Certificates

Submit certificates for the following items and meet the performance requirements of the paragraph entitled, "Performance Requirements," and applicable standards contained within this section.

Asphalt Cement
Bituminous Concrete
Bituminous Prime Coat
Bituminous Tack Coat
Paint
Reflective Beads
Subbase and Base Course

1.4 PROTECTION OF PERSONS AND PROPERTY

Conduct paving operations in a manner that will ensure the safety of persons and property.

1.5 MAINTAINING TRAFFIC

Maintain vehicular and pedestrian traffic in accordance with FHWA, Part II, during the construction of the work by keeping open vehicular traffic lanes or by providing detour routes.

Barricade traffic lanes and detour routes and post with warning signs for safety and directing traffic. Provide warning lights during hours of darkness, in accordance with DOT.

1.6 SAMPLING AND TESTING

1.6.1 Testing and Inspection

The Contractor must provide a bituminous-concrete testing and inspection service. Approve testing service and include sampling and testing bituminous-concrete materials proposed for use in the work, tests and calculations for bituminous concrete mixture, and field-testing facilities for quality control during construction of bituminous-concrete courses.

1.6.2 Tests for Bituminous Concrete Materials

Provide tests and samples of bituminous-concrete materials proposed for use in the work as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Coarse and fine aggregates	Sampling	AASHTO T 2	One for each material
	Sieve analysis	ASTM C 136	
	Magnesium Sulfate Soundness Test	ASTM C 88	
	Sand Equivalent Test of fine aggregate	AASHTO T 176	
	Resistance to abrasion of small size coarse aggregate	ASTM C 131	
Mineral Filler	Sieve analysis	AASHTO T 37	One for each source of material
Asphalt cement	Penetration	ASTM D 5	One for each specified penetration grade
	Flash point	ASTM D 2170 ASTM D 92	
	Ductility	ASTM D 113	
	Loss on heating	ASTM D 1754	
	Solubility	ASTM D 4, Procedure No. 1	
	Ash	ASTM D 3176 ASTM D 3180	

1.6.3 Test for Bituminous Concrete Mixture

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Compacted bituminous-concrete mix	Bulk density	AASHTO T 166	Four for each bituminous-concrete mixture
	Marshall Stability Test	ASTM D 5581	
Aggregate and asphalt cement	Specific gravity of coarse aggregate	ASTM C 127	One for each material
	Specific gravity of fine aggregate	ASTM C 128	
	Apparent specific gravity of mineral filler	ASTM D 854	
	Apparent specific gravity of asphalt cement	ASTM D 70	
Uncompacted bituminous-concrete mix	Maximum theoretical specific gravity	ASTM D 2041	Two for each bituminous-concrete mixture

Calculate a density and voids analysis for each series of bituminous-concrete mixture test specimens in conformance with AI MS-02. Include the quantity of absorbed asphalt cement in pounds of dry aggregate, percent of air voids, and percent of voids in mineral aggregate.

Submit a report of each job-mix formula on the form entitled, "Hot-Mix Design Data by the Marshall Method" as shown in AI MS-02.

1.6.4 Quality Control Testing During Construction

Test soil and base materials during construction as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Subbase or Base course	Soil classification	ASTM D 3282	One for each Soil material
	Moisture content of subbase or base material (Just prior to compaction)	ASTM D 2216	
Soil materials prior to compaction	Moisture-density relations of soil	AASHTO T 180, Method Bor D	One for each type of soil material
Soil	Unit Weight of	ASTM D 1556,	At least three

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
material-in-place after compaction	soil-in-place	Sand Cone Method, or ASTM D 2922, Nuclear Method	daily for each soil material and for each layer; additional test whenever there is any change in moisture conditions

Provide tests and samples of bituminous-concrete mixtures for quality control during construction of the bituminous-concrete courses as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Uncompacted bituminous-concrete mix	Sampling	ASTM D 979	One for each mixture or day of operation
	Asphalt cement content	ASTM D 2172	
	Mechanical analysis extracted aggregates	AASHTO T 30	
	Recovery of asphalt cement by Abson Method	ASTM D 1856	
	Penetration of recovered asphalt cement	ASTM D 5	
Compacted bituminous-concrete Marshall samples	Ductility of recovered asphalt cement	ASTM D 113	Same as specified for uncompacted mix
	Bulk density	AASHTO T 166	
In-place pavement	Marshall Stability and Flow Tests	ASTM D 5581	One specimen for each 500 square yards of completed bituminous-concrete course
	Density and thickness	As specified	

Provide test and samples of Bituminous-concrete mixtures for quality control during construction of the bituminous-concrete courses as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Uncompacted bituminous-	Sampling	ASTM D 979	One for each mixture or day of

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
concrete mix	Asphalt cement content	ASTM D 2172	operation
	Mechanical analysis extracted aggregates	AASHTO T 30	
	Recovery of asphalt cement by Abson Method	ASTM D 1856	
	Penetration of recovered asphalt cement	ASTM D 5	
	Ductility of recovered asphalt cement	ASTM D 113	
Compacted bituminous-concrete Marshall samples	Bulk density	AASHTO T 166	Same as specified for uncompacted mix
	Marshall Stability and Flow Tests	ASTM D 5581	
In-place pavement	Density and thickness	As specified	One specimen for each 418 square meter of completed bituminous-concrete course

Provide a written test report of the results on the same day that tests are made.

A bituminous-concrete mixture that does not meet the requirements specified shall not be used in the specified work.

1.6.5 Field Testing Facilities at the Mixing Plant

Provide field-testing facilities for testing bituminous-concrete materials and mixes at the bituminous mixing plant.

1.7 CONSTRUCTION EQUIPMENT LIST

The Contractor must submit a construction equipment list for all major equipment used for transporting, spreading and finishing prior to construction.

PART 2 PRODUCTS

2.1 SUBBASE AND BASE COURSE MATERIALS

Provide aggregate of clean, sound, durable particles; i.e., limerock crushed stone or crushed gravel and screening. Ensure aggregate be free of

silt, clay, vegetable matter and other objectionable materials or coatings.

Apply gradation requirements to the completed subbase or base course after undergoing the mixing, placing, compacting and other operations. Provide aggregates of a maximum size of 2 inch 50 millimeter and grade continuously within the limits specified below. Conform to ASTM E 11 for sieves.

NOTE: Retain only the gradations applicable for the project. On the basis of local conditions, the percentage passing the No. 200 73 micrometer sieve may be further restricted to help control the amount of particles having diameters less than 0.02 millimeter as specified for non-frost-susceptible material.

GRADATION OF AGGREGATES

PERCENTAGE BY WEIGHT PASSING

SQUARE-MESH SIEVE

<u>SIEVE DESIGNATION</u>	<u>NO. 1</u>	<u>NO. 2</u>	<u>NO. 3</u>
2 inch	100	---	---
1-1/2 inch	70-100	100	---
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

GRADATION OF AGGREGATES

PERCENTAGE BY WEIGHT PASSING

SQUARE-MESH SIEVE

<u>SIEVE DESIGNATION</u>	<u>NO. 1</u>	<u>NO. 2</u>	<u>NO. 3</u>
50 millimeter	100	---	---
37.5 millimeter	70-100	100	---
25 millimeter	45-80	60-100	100
12.5 millimeter	30-60	30-65	40-70
4.75 millimeter	20-50	20-50	20-50

GRADATION OF AGGREGATES

PERCENTAGE BY WEIGHT PASSING

SQUARE-MESH SIEVE

<u>SIEVE DESIGNATION</u>	<u>NO. 1</u>	<u>NO. 2</u>	<u>NO. 3</u>
2.00 millimeter	15-40	15-40	15-40
425 micrometer	5-25	5-25	5-25
75 micrometer	0-10	0-10	0-10

2.2 BITUMINOUS CONCRETE

2.2.1 Aggregate for Bituminous-Concrete

Conform to ASTM D 692 for coarse aggregate.

Conform to ASTM D 1073 for fine aggregate. Sand equivalent value must be a minimum of 30.

2.2.2 Mineral Filler

Conform to ASTM D 242 for mineral filler for bituminous paving mixtures.

2.3 ASPHALT CEMENT

Conform to ASTM D 946 for cement, penetration grade [60-70] [85-100] [120-150].

2.4 BITUMINOUS PRIME COAT

Provide bituminous prime coat of medium-curing cut-back asphalt conforming to ASTM D 2027, designation MC-70 or MC-250.

2.5 BITUMINOUS TACK COAT

Provide Bituminous tack coat of rapid-curing cut-back asphalt conforming to ASTM D 2028, designation RC-70.

2.6 JOB-MIX FORMULAS

Submit a job-mix formula for each bituminous-concrete mixture proposed for use in the work for approval prior to start of work.

Provide each job-mix formula within the limits specified for the particular type of bituminous-concrete mixture. Each job-mix formula must establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to the aggregate, and single temperature at which the bituminous-concrete mixture is to be produced.

Provide maximum permitted variation from the job-mix formula, within the limits specified for the type of bituminous-concrete mixture, as follows:

Aggregate passing a No. 4 sieve or larger	7 percent
Aggregate passing No. 8, 30, 50, and 100 sieves	4 percent

Aggregate passing No 200 sieve	8 percent
Asphalt cement	0.4 percent
Temperature of mixing	200 degrees F

2.7 PERFORMANCE REQUIREMENTS

Bituminous-concrete mixtures must meet the performance requirements described when sampled, and tested. Calculations must be made for density and voids analyses.

NOTE: Choose values to suit bituminous concrete mixture.

PERFORMANCE REQUIREMENTS

<u>TEST PROPERTY</u>	<u>BASE COURSE</u>	<u>SURFACE COURSE</u>
Number of compaction blows, each end of specimen	35 to 75	35 to 75
Marshall stability, pounds	750 to 500	750 to 500
Marshall flow, 1/100 inch units	8 minimum 20 maximum	8 minimum 20 maximum
Percent air void	3 minimum 8 maximum	3 minimum 5 maximum
Percent of voids in mineral aggregate	11 to 23.5	11 to 23.5

PERFORMANCE REQUIREMENTS

<u>TEST PROPERTY</u>	<u>BASE COURSE</u>	<u>SURFACE COURSE</u>
Number of compaction blows, each end of specimen	35 to 75	35 to 75
Marshall stability, newton	[_____]	[_____]
Marshall flow, 0.254 millimeter	8 minimum 20 maximum	8 minimum 20 maximum
Percent air void	3 minimum 8 maximum	3 minimum 5 maximum
Percent of voids in mineral aggregate	11 to 23.5	11 to 23.5

Asphalt cement used in the bituminous-concrete mixture, when extracted

and recovered, must have the following test properties:

Penetration must be less than 45.

Ductility at 77 degrees F 25 degrees C must be not less than 24 inch 600 millimeter.

2.8 PAVEMENT MARKING

[Submit samples of White Paint, Yellow Paint and Reflective Beads (500 Grams) in one quart containers, unless otherwise noted.]

2.8.1 Paint

Conform to AASHTO M 248 for paint, Type [S] [____], and DOT, Part III. Conform to standards of DOT, Part III for parking lanes and crosswalks.

2.8.2 Reflective Beads

Conform to AASHTO M 247, Type 1 for glass beads for reflectorized paint shall c.

PART 3 EXECUTION

3.1 SUBBASE OR BASE COURSE

3.1.1 Preparation of Subgrade or Subbase

Prior to constructing the subbase or base course, clean the previously constructed subgrade or subbase course of foreign substances. At the time of construction of the base course, do not contain frozen material for the subgrade or subbase course.

Correct ruts or soft, yielding spots that may appear in the subgrade or subbase course, areas having inadequate compaction and deviations of the surface from the requirements in the applicable section. Perform correction by loosening the affected areas, removing unsatisfactory material, adding approved material and reshaping and recompacting to line and grade to the specified density requirements.

3.1.2 Placing and Compacting

Level material to a uniform thickness so that the layer, after compaction, will not exceed 6 inch 150 millimeter. Add water by sprinkling and mixing or reduced by aeration as necessary. Mix and aerate until the water content is at optimum. Compact layer through the full depth to the specified density. In places inaccessible to rolling equipment, compact approved mechanical compactors. Construct successive layers in a similar manner, scarifying between layers to ensure adequate bonding. Replace materials found unsatisfactory with satisfactory material or reworked to produce an acceptable standard.

3.1.3 Smoothness

Do not show deviations of surface of each layer in excess of 1/2 inch 13 millimeter when tested with a 10-foot 3048 millimeter straightedge applied parallel with, and at right angles to, centerline of area to be paved.

3.1.4 Thickness Control

Completed thickness of the subbase or base course must be within 1/2 inch 13 millimeter of plan. Measure thicknesses at intervals providing at least one depth measurement for each 500 square yards 418 square meter. Make depth measurement by test holes 3 inch 76 millimeter minimum in diameter. Where the measured thickness is more than 1/2 inch 13 millimeter deficient, correct the areas by scarifying, adding mixture of proper gradation, reblading, and recompacting. Provide average of job measurements within 1/4 inch 6 millimeter thickness of plan.

3.2 ASPHALT CONCRETE SURFACE COURSE

3.2.1 Weather Limitations

Apply bituminous prime and tack coats only when the ambient temperature in the shade is above 50 degrees F 10 degrees C or when the temperature has not been below 35 degrees F 2 degrees C for 12 hours immediately prior to application. Application may commence when the aggregate base course is dry or contains moisture not in excess of the amount that will permit uniform distribution and the required penetration.

Construct bituminous-concrete courses only when the ambient temperature is above 40 degrees F 5 degrees C and the underlying base course is dry.

3.2.2 Transportation of Mixtures

Transport bituminous-concrete mixtures from the mixing plant to the project site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of a concentrated solution of hydrated lime and water to prevent adhesion of the mixture to the truck beds.

Cover each load of mixture with canvas or similar material of sufficient size and weight to retard heat loss and to protect the mixture from the weather.

In cool weather or for long hauls, insulate the entire contact area of each truck bed. Covers shall be securely fastened.

Schedule deliveries of the mixture so the placing and compaction can be completed during daylight unless satisfactory light is provided.

Deliver mixture in a such manner that the temperature of the mixture at the time of dumping into the paver will be not less than [_____] degrees F C.

Do not allow trucks to travel on the mixture until compaction is complete and the bituminous-concrete pavement surface will support traffic without measurable deformation.

3.3 PREPARATION OF AREA TO BE PAVED

3.3.1 Surface Preparation

Immediately before application of a bituminous prime coat to the aggregate base-course surface or other contact surface, remove loose material or other objectionable substances.

3.3.2 Priming the Base Course Surface

Apply a bituminous prime coat to the prepared base course surface. Rate of application must be within the range of 0.20 and 0.40 gallon per square yard 0.91 and 1.81 liter per square meter of surface. Temperature of the bituminous material at the time of application must be within the range of 105 and 180 degrees F 41 to 82 degrees C.

Provide proper care for the amount of prime coat at the junction of previous and subsequent applications is not in excess of that specified in the rate of application. Clean up the excess prime-coat material from the surface. Treat areas missed by the bituminous prime coat distributor with prime coat material by means of hand sprayers.

Following the application of prime coat material, allow the surface to dry without being disturbed for a period of not less than 48 hours or longer as may be necessary to attain penetration into the aggregate base course and evaporation of the volatile from the bituminous material. Do not permit blotting the prime coat with fine aggregate.

3.3.3 Priming Other Contact Surfaces

Apply a bituminous tack coat to the contact surfaces of previously constructed bituminous-concrete or portland-cement concrete pavement and other similar surfaces by means of a bituminous distributor. Rate of application must be 0.05 to 0.15 gallon per square yard of surface. Temperature of the bituminous material at the time of application must be 105 and 180 degrees F.

Contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting the concrete pavement must be coated with a thin, uniform coating of bituminous tack-coat material prior to the bituminous-concrete mixture being placed against such structures.

Following the application of the tack coat, allow the surface to dry until it is in a condition of tackiness to receive the bituminous-concrete mixture. Clean up the excess tack-coat material from the surface.

3.4 PLACING BITUMINOUS-CONCRETE COURSES

3.4.1 General

Place bituminous-concrete mixture on the prepared surface, uniformly spread and struck off. Place bituminous-concrete courses in layers of approximately equal thickness except that no layer must be more than 2 inch 50 millimeter thick after compaction. Courses must be so placed that, when compacted, they will conform to the indicated grade, cross-section, and thickness.

3.4.2 Pavement Placing

Adjust each paver and regulate the speed so that the surface of the bituminous-concrete mixture will be smooth and, when compacted, will conform to the depths, cross sections, grades, and contours indicated.

Begin placing along the centerline of areas to be paved on a crowned section, at the high side of a section with a one-way slope and in the direction of the traffic flow. Place the mixture for each course in strips not less than 10 feet 3048 millimeter wide. Progressive strip placement

must commence after rolling of the first strip. Extend rolling to overlap the preceding strips. Placing the bituminous-concrete mixture must be continuous.

Experienced shovelers and rakers must follow each paver, adding hot bituminous-concrete mixture and raking the mixture as required to produce a course that, when completed, will conform to requirements specified.

3.4.3 Hand Placing

In areas where the use of machine spreading is not practicable, spread the mixture and finish by the use of heated hand tools.

Dump mixture on approved dump boards and distribute into place from the dump boards in a uniformly loose layer of a thickness that will, when compacted, conform to required grade and thickness. Take caution in the mixture so that it can be handled properly by the shovelers and rakers.

3.4.4 Joints

Provide joints of the same texture, density, and smoothness as other sections of the course. Joints between old and new pavements, or between successive days' work, must be made to ensure a continuous bond between the old and new sections of the pavement.

Offset transverse joints in succeeding courses at least 24 inch 600 millimeter. Cut back the edge of the previously placed course to expose an even vertical surface over the full thickness of the course.

Offset longitudinal joints in succeeding courses at least 6 inch 150 millimeter. When the edges of longitudinal joints are irregular or do not conform to the specifications, cut back the edge to expose an even vertical surface over the full thickness of the course.

3.5 COMPACTION

3.5.1 General

Compaction must commence as soon after placing as the bituminous-concrete mixture will bear the weight of the roller without undue displacement.

Do not permit delays in compacting the freshly spread mixture.

During rolling, keep the wheels moist with the minimum amount of water required to avoid picking up the bituminous-concrete mixture.

In places not accessible to the rollers, compact the mixture with hot hand tampers.

3.5.2 Rolling Procedure

Rolling must commence longitudinally at the extreme sides of lanes and proceed toward the center of the pavement, except on superelevated curves. Rolling on superelevated curves must commence on the low side and progress to the high side, overlapping on successive trips by at least one-half the width of the rear wheel of the roller.

Allow alternate trips of the roller of slightly different lengths.

Move rollers at a slow but uniform speed with the drive roll or wheel nearest the paver. Do not exceed 3 miles per hour 5 kilometer per hour for steel-wheeled rollers or 5 miles per hour 8 kilometer per hour for pneumatic-tired rollers.

Do not park rollers on the pavement.

3.5.3 Initial Rolling

The initial rolling must immediately follow the rolling of the longitudinal joint and edges. Operate as close to the paver as possible without causing undue displacement.

Preliminary tests of crown, grade and smooth immediately after the initial rolling.

Before the rolling is continued, correct deficiencies by adding or removing material so that the finished course will conform to the specified requirements for grade and smoothness.

3.5.4 Second Rolling

Second rolling must follow the initial rolling as closely as possible, while the mixture is hot and in condition suitable for proper compaction.

Rolling must be continuous (at least 3 complete coverages) after the initial rolling until the mixture has been compacted.

Causing undue displacement will not be permitted.

3.5.5 Finish Rolling

Finish rolling must be done while the mixture is warm enough for the removal of roller marks. Rolling must continue until all roller marks are eliminated and the course has the specified density.

3.5.6 Patching Deficient Areas

Bituminous-concrete mixtures that become mixed with foreign material or that are defective, such as low areas or "bird-baths," must be removed, replaced with fresh bituminous-concrete mixture to obtain the required grade and smoothness for the finished surface, and compacted to the specified density.

Remove pavement in deficient areas to the full thickness of the bituminous-concrete course and so cut that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Spray edges with bituminous tack-coat material.

Skin patching an area that has been rolled will not be permitted.

3.5.7 Protection of Pavement

After final rolling, do not permit vehicular traffic on the pavement until the pavement has cooled and hardened and in no case sooner than 6 hours.

3.6 ACCEPTANCE PROVISIONS

3.6.1 General

Test density, surface smoothness, and thickness of completed bituminous-concrete base and surface courses to verify compliance with the specified requirements.

3.6.2 Density and Thickness Requirements

Pavement specimens of each completed bituminous-concrete course must be taken on the basis specified. Diameter of pavement core specimens shall be not less than 3 inch, 76 millimeter, and must be through the entire base course and surface course. Locations for the removal of pavement specimens must be directed by the Contract Officer. Repair test holes.

Thickness must not vary from the indicated thickness by more than 1/2 inch 13 millimeter for the base course and 1/4 inch 6 millimeter for the surface course.

3.6.3 Surface Requirements

Test the finished surface of each bituminous-concrete course for smoothness with a 10-foot 3048 millimeter straightedge applied parallel with, and at right angles to, the centerline of the paved area. Check the entire paved area from one side to the other. Advancement along the pavement must be in successive stages of not more than half the length of the straightedge.

Base-course surface must not vary more than 1/4 inch 6 millimeter from the straightedge.

Surface-course surface must not vary more than 1/8 inch 3 millimeter from the straightedge.

Test crown of each bituminous-concrete course for conformance to the required cross section with a crown template centered on, and at right angles to, the centerline of the crown. Check crown along its entire length. Finished crown surface for each bituminous-concrete course must not vary more than 1/4 inch 6 millimeter from the crown template.

Final surface must have a uniform texture and conforms to the required grade and cross section. Correct low or defective areas immediately by cutting out the faulty areas and replacing them.

3.7 PAVEMENT STRIPING

3.7.1 Surface Preparation

New pavement surfaces must be cured for [14] [_____] days before application of marking materials. Where oil or grease are present on old pavements, scrub the affected areas with approved detergent or degreaser, and rinsed thoroughly.

3.7.2 Traffic Control

Place traffic control markers along newly painted lines to prevent damage to newly painted surfaces.

3.7.3 Application

Apply paint recommended by the manufacturer, when the air and pavement temperatures are between [40] [_____] and [95] [_____] degrees F [4] [_____] and [35] [_____] degrees C, with the relative humidity not higher than 85 percent at time of application.

Where reflectorized paint is specified, dispense glass beads at [6] [10] [_____] pounds per gallon [.719] [.1198] [_____] kilogram per liter of paint.

Markings must be sharply outlined, with uniform thickness, and with indicated widths.

If there is a deficiency in drying of the markings, discontinue painting operations until the cause of the slow drying time is determined and corrected.

If discoloration occurs due to bleeding of bituminous materials, apply two coats of paint.

-- End of Section --