
USACE / NAVFAC / AFCEA / NASA UFGS-32 11 26 (April 2006)

Preparing Activity: USACE Replacing without change
UFGS-02707 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

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04/06

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SECTION 32 11 26

BITUMINOUS BASE COURSE 04/06

NOTE: This guide specification covers the requirements for bituminous base course for pavements.

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).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

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

References not used in the text will automatically be deleted from this section of the project

**specification when you choose to reconcile
references in the publish print process.**

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 102 (1983; R 2000) Spot Test of Asphaltic Materials

ASTM INTERNATIONAL (ASTM)

ASTM C 127 (2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 128 (2004a) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

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

ASTM C 136 (2005) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 183 (2002) Sampling and the Amount of Testing of Hydraulic Cement

ASTM C 29/C 29M (1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 88 (2005) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D 1250 (2004) Petroleum Measurement Tables

ASTM D 140 (2001) Sampling Bituminous Materials

ASTM D 1856 (1995a; R 2003) Recovery of Asphalt from Solution by Abson Method

ASTM D 2172 (2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

ASTM D 2216 (2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D 242 (1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures

ASTM D 3381 (1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 3515	(2001) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 5	(2005a) Penetration of Bituminous Materials
ASTM D 75	(2003) Sampling Aggregates
ASTM D 946	(1982; R 1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction

1.2 UNIT PRICES

NOTE: These paragraphs will be deleted when lump-sum payment is desired. These paragraphs may be revised to include the payment for the bituminous material in the payment for bituminous base course mixtures when a separate payment for the bituminous material is not considered warranted based on local experience and job conditions.

1.2.1 Measurement for Payment

1.2.1.1 Bituminous Base-Course Tonnage

The amount paid for will be the number of **metric 2000-pound** tons of bituminous mixture used in the accepted work. Bituminous mixture shall be weighed after mixing, and no deductions will be made for the weight of bituminous material incorporated in the mix. No payment will be made for defective areas until corrected.

1.2.1.2 Correctional Factor for Aggregates Used

Quantities of paving mixtures called for in bid schedule are based on aggregates having a specific gravity of 2.65 as determined according to apparent specific gravity paragraphs in **ASTM C 127** and **ASTM C 128**. Correction in the tonnage of bituminous base course mixtures shall be made to compensate for the difference in the tonnage of mixtures used in the project, when specific gravities of aggregates used are more than 2.70 and less than 2.60. The tonnage paid for shall be the number of tons used, proportionately corrected for specific gravities using 2.65 as the base correctional factor.

1.2.1.3 Bituminous Material

Bituminous material to be paid for shall be measured in the number of [**liters gallons** of the material used in the accepted work, corrected to **liters gallons** at **15 degrees C 60 degrees F** in accordance with **ASTM D 1250.**] [**metric 2,000-pound** tons of the material used in the accepted work.]

1.2.2 Basis for Payment

The quantities of bituminous base course and bituminous materials shall be paid for at the respective contract unit prices in the bid schedule. Payment shall constitute full compensation for preparing and reconditioning

the underlying layer; for furnishing all material, equipment, plant, and tools; and for all labor and other incidentals necessary to complete the work required by this section.

1.3 SUBMITTALS

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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Job-Mix Formula (JMF)

Mix design at least [_____] days before it is to be used.

Waybills and delivery tickets Sources of Aggregates

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used. Plan for operation of a new source of

aggregates well in advance of starting production.

SD-04 Samples

Sources of Aggregates

Samples of a new source of aggregates for approval.

SD-06 Test Reports

Sources of Aggregates

Bituminous Materials

Sampling and testing

Copies of field tests results within [24] [_____] hours after the tests are performed. Certified copies of tests results for approval not less than [30] [_____] days before material is required for the work.

1.4 SAMPLING AND TESTING

**NOTE: Guidance for preparation of criteria to be
used in evaluating laboratory facilities is
contained in ASTM E 329.**

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the locations and times directed to ensure that materials, mixtures and compaction meet specified requirements. Samples of finished pavement, including samples that span the longitudinal joint, shall be obtained by the Contractor. Sizes of samples shall be suitable to determine conformance to density, thickness, and other specified requirements. Samples shall be taken at start of paving operations and at intervals throughout paving operations as directed. Samples of plant mixtures will be taken and tested by the Contractor to determine conformance to specified requirements. Certified copies of the test results shall be furnished to the Contracting Officer.

1.4.1 Aggregates

Sampling shall be in accordance with **ASTM D 75**. Samples of aggregates shall be tested at the start of production and at intervals during production of the bituminous base course. Intervals and points of sampling will be as approved. Test results on these samples will be the basis for approval of specific lots of aggregates.

1.4.2 Mineral Filler

Sampling of mineral filler shall conform to **ASTM C 183**.

1.4.3 Bituminous Materials

Sampling of bituminous materials shall conform to ASTM D 140.

1.4.4 Field Sampling of Pavements and Mixtures

The type, size, and locations of samples will be approved. The Contractor shall furnish all tools, labor, and materials for cutting samples and will be responsible for replacing pavement to meet specified requirements. Samples of finished pavement shall be cut at the rate of one sample per [_____] square meters yards of finished pavement.

1.5 PLANT, EQUIPMENT, MACHINES, TOOLS, AND PERSONNEL

1.5.1 Bituminous Plant

The bituminous plant shall be of such capacity, as specified herein, to produce the quantities of bituminous mixtures required for the project within the completion time of the contract. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output. A sufficient number of adequately trained personnel shall be available during paving operations to produce a pavement meeting the requirements in this specification.

1.5.2 Mixing Plants

NOTE: The type and capacity of the plant, the number and size of trucks, paving machines, and other equipment should be determined from the tons of paving mixtures required, haul distances, number of working days permitted by the contract, and other pertinent factors.

Mixing plants shall be an automatic or semiautomatic controlled, commercially manufactured unit designed, coordinated, and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of [_____] metric tons tons per hour. Drum mixers will be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction in accordance with ASTM D 2172 and recovery of the asphalt cement in accordance with ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration in accordance with ASTM D 5.

1.6 WEATHER LIMITATIONS

Bituminous courses shall not be constructed when the underlying course contains free surface water. Unless otherwise directed, asphalt courses shall not be constructed when temperature of the surface of the underlying course is below 5 degrees C 40 degrees F.

1.7 Waybills and Delivery Tickets

NOTE: This paragraph will be deleted when lump-sum

payment is desired.

Copies of waybills and delivery tickets shall be submitted during progress of work. Before the final statement is allowed, the Contractor shall submit certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in construction covered by the contract. The Contractor shall not remove bituminous material from the tank cars or storage tanks until the initial outage and temperature measurements have been taken, nor shall the car or tank be released until the final outage has been taken by the Contracting Officer.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed slag, crushed gravel screenings, sand, and mineral filler, as required. The portion of these materials retained on the 4.75 mm No. 4 sieve shall be known as coarse aggregate; the portion passing the 4.75 mm No. 4 sieve and retained on the 0.075 mm No. 200 sieve, as fine aggregate; and the portion passing the 0.075 mm No. 200 sieve, as mineral filler.

2.1.1 Coarse Aggregates

Coarse aggregates shall consist of clean, sound, durable fragments of crushed stone, crushed slag, or crushed gravel meeting the following requirements:

2.1.1.1 Aggregate Wear

The percentage of wear shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

2.1.1.2 Aggregate Loss

NOTE: The magnesium-sulfate soundness test is to be used in excluding aggregates known to be unsatisfactory or for evaluating aggregates from new sources. The percentage of loss will be inserted in the blanks. The values inserted will be based on knowledge of aggregates in the area that have been previously approved or that have a satisfactory service record in bituminous pavement construction for at least 5 years and will assure that aggregates from new sources will be equal to or better than these aggregates.

The percentage of loss shall not exceed [_____] after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.3 Dry Weight of Crushed Slag

The dry weight of crushed slag shall be not less than 1200 kg/cubic meters 75 pcf as determined in accordance with ASTM C 29/C 29M.

2.1.2 Fine Aggregates

Fine aggregates shall consist of clean, durable natural sands; manufactured sands prepared by crushing stone, slag, or gravel, or any combination of natural and manufactured sands. Natural sands shall consist of grains of clean, hard, durable rock.

2.1.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be measured in accordance with ASTM D 4318. Requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the 0.425 mm No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.1.5 Sources of Aggregates

NOTE: Satisfactory service record for an aggregate will be determined based on the aggregate's ability to resist polishing, raveling, stripping, and degradation under traffic and climate conditions similar to that expected during its use. If performance data indicate that an aggregate is susceptible to one or more of the above-mentioned problems, that source of aggregate shall be rejected.

Sources of aggregates shall be selected well in advance of the time the material will be required in the work. If a previously developed source is selected, test results shall be submitted with evidence that central plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least 5 years under similar climatic conditions. An inspection of the producer's operation may be made. When new sources are developed, the Contractor shall indicate the sources and submit samples for approval and a plan for operation well in advance of starting production. Proposed sources may be inspected. The Contractor shall make such tests and other investigations as necessary to determine whether or not aggregates meeting the requirements specified can be produced from the proposed sources. Inspection of the source of aggregate does not relieve the Contractor of the responsibility for delivery at the jobsite of aggregates that meet requirements specified herein.

2.2 BITUMINOUS MATERIALS

Sources where bituminous materials are obtained shall be selected in advance of time when materials will be required in the work, and test results shall be submitted for approval not less than [_____] days before such material is required for use in the work.

2.2.1 Asphalt Cement

NOTE: The appropriate types and grades of

bituminous materials for the pavement's use and climatic environment should be used (refer to UFC 3-250-03). When it is known that the asphalt has not been excessively heated or cracked in refining but is produced from a crude that shows a positive spot when subjected to the test in AASHTO Standard T 102, using the standard naphtha specified in paragraph 3 thereof, the specification will be modified to permit the use of a naphtha produced from the patent crude, provided the naphtha conforms to the same physical characteristics as the standard naphtha.

Asphalt cement to be mixed with mineral aggregates shall conform to [ASTM D 946] [ASTM D 3381], Grade [_____]. In addition, the asphalt cement shall show a negative spot when subjected to the spot test in accordance with AASHTO T 102, using the standard naphtha specified therein.

2.2.2 Quality Control

In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure that some condition of handling or storage has not been detrimental to the bituminous material.

2.3 AGGREGATE GRADATION

NOTE: The gradation corresponding to the desired maximum aggregate size will be retained. The inapplicable gradation will be deleted.

Mineral aggregate shall be of such size that percentage composition by weight, as determined by ASTM C 136, will conform to the gradation specified in TABLE 1. The table is based on aggregates of uniform specific gravity; percentages passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used.

TABLE 1. AGGREGATE GRADATION

Sieve Size	Percent Passing	Percent Passing	Percent Passing	Percent Passing
37.5 mm	100	---	---	---
25 mm	75-93	100	---	---
19 mm	67-85	74-92	100	---
12.5 mm	57-75	64-82	73-91	100
9.5 mm	50-68	55-73	63-81	74-92
4.75 mm	36-54	39-57	45-63	53-71
2.36 mm	26-44	28-46	32-50	38-56
1.18 mm	18-36	19-37	23-41	27-45
0.60 mm	11-29	12-30	15-33	19-37
0.30 mm	7-21	9-23	10-24	13-27
0.15 mm	4-14	6-16	7-17	9-19
0.075mm	3-7	3-7	3-7	3-7

TABLE 1. AGGREGATE GRADATION

Sieve Size	Percent Passing	Percent Passing	Percent Passing	Percent Passing
_____	_____	_____	_____	_____

TABLE 1. AGGREGATE GRADATION

Sieve Size	Percent Passing	Percent Passing	Percent Passing	Percent Passing
_____	_____	_____	_____	_____
1 1/2 inch	100	---	---	---
1 inch	75-93	100	---	---
3/4 inch	67-85	74-92	100	---
1/2 inch	57-75	64-82	73-91	100
3/8 inch	50-68	55-73	63-81	74-92
No. 4	36-54	39-57	45-63	53-71
No. 8	26-44	28-46	32-50	38-56
No. 16	18-36	19-37	23-41	27-45
No. 30	11-29	12-30	15-33	19-37
No. 50	7-21	9-23	10-24	13-27
No. 100	4-14	6-16	7-17	9-19
No. 200	3-7	3-7	3-7	3-7

2.4 COMPOSITION OF MIXTURE

 NOTE: Consult CEMP-ET on test method to be used and
 include in subparagraphs below.

2.4.1 Job-Mix Formula (JMF)

 NOTE: The procedures for determining the JMF to be
 used in the mixtures are described in UFC 3-250-03.
 Proportioning of the aggregates for the JMF should
 be carefully determined because the gradations will
 be those on which the Contractor's tolerances will
 be applied. Application of these tolerances may
 cause the gradation to be outside the limits of the
 gradation in the specification, but this is
 acceptable.

No bituminous mixture shall be produced until a JMF has been approved by the Contracting Officer. The formula will indicate the percentage of each sieve fraction of aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. The JMF will be allowed tolerances given in TABLE 2 herein. Bitumen content and aggregate gradation may be adjusted within the limits of tables specified herein to improve the paving mixtures, as directed, without adjustments in contract prices.

TABLE 2. JOB-MIX FORMULA TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing 4.75 mm sieve or larger	5 percent
Aggregate passing 2.36 mm, 1.18 mm, 0.60 mm and 0.30 mm sieves	4 percent
Aggregate passing 0.15 mm and 0.075 mm sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	13 degrees C

TABLE 2. JOB-MIX FORMULA TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 8, 16, 30, and 50 sieves	4 percent
Aggregate passing Nos. 100 and 200 sieves	2 percent
Bitumen	0.25 percent
Temperature of mixing	25 degrees F

2.4.2 Test Properties of Bituminous Mixtures

The finished mixture shall meet requirements described below when tested in accordance with [____]. All samples will be compacted with 75 blows of specified hammer on each side of sample.

2.4.2.1 Stability, Flow, and Voids

- a. Nonabsorptive Aggregate: When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined by [ASTM C 127](#) and [ASTM C 128](#), aggregate is designated as nonabsorptive. The apparent specific gravity shall be used in computing the voids total mix and voids filled with bitumen; the mixture shall meet the requirement in TABLE 3.

TABLE 3. NONABSORPTIVE AGGREGATE MIXTURE

Test Property	Limits
Stability, minimum, kilonewtons	8.0
Flow, maximum, 25/100-millimeter units	16
Voids total mix, percent	4-6
Voids filled with bitumen, percent	65-75

TABLE 3. NONABSORPTIVE AGGREGATE MIXTURE

Test Property	Limits
Stability, minimum, pounds	1800
Flow, maximum, 1/100-inch units	16
Voids total mix, percent	4-6
Voids filled with bitumen, percent	65-75

TABLE 3. NONABSORPTIVE AGGREGATE MIXTURE

Test Property	Limits
b. Absorptive Aggregate: When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. Bulk-impregnated specific gravity, as determined from [____], shall be used in computing the percentages of the voids total mix and voids filled with bitumen; the mixture shall meet the requirements in TABLE 4.	

TABLE 4. ABSORPTIVE AGGREGATE MIXTURE

Test Property	Limits
Stability, minimum, kilonewtons	8.0
Flow, maximum, 15/100-millimeter units	16
Voids total mix, percent	3-5
Voids filled with bitumen, percent	70-80

TABLE 4. ABSORPTIVE AGGREGATE MIXTURE

Test Property	Limits
Stability, minimum, pounds	1800
Flow, maximum, 1/100-inch units	16
Voids total mix, percent	3-5
Voids filled with bitumen, percent	70-80

2.4.2.2 Reduction in Stability by Immersion

If the index of retained stability of specimens of composite mixture as determined from [____] is less than 75 percent, aggregates shall be rejected or the bitumen shall be treated with an approved antistripping agent. The quantity or type of antistripping agent to add to the bitumen shall be sufficient, as approved, to produce an index of retained stability of not less than 75 percent. Payment will not be made to the Contractor for the addition of the antistripping agent that may be required.

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING COURSE

Prior to placing the bituminous base course, the underlying surface shall be cleaned of foreign or objectionable matter. The condition of the underlying course will be inspected and approved.

3.2 MIXING

3.2.1 Preparation of Mineral Aggregates

Each aggregate stockpile shall be placed and maintained in such a manner to prevent segregation. Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within

tolerances specified herein. Dry storage shall be provided for mineral filler.

3.2.2 Preparation of Bituminous Mixtures

Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. The mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. The temperature of bitumen at time of mixing shall not exceed 150 degree C 300 degrees F. The temperature of aggregate and mineral filler in the mixer shall not exceed 160 degree C 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam will be rejected.

3.2.3 Water Content of Aggregates

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with ASTM D 2216. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

3.2.4 Storage of Bituminous Paving Mixture

The mixture shall be stored according to the requirements of ASTM D 3515.

3.3 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation of bituminous mixture from the paving plant to the site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of mixture to truck bodies. Excessive releasing agent will be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and prevent loss of heat. Loads that have crusts of cold, unworkable material or have become wet by rain will be rejected. Hauling over freshly placed material will not be permitted.

3.4 PLACING

Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless satisfactory artificial lighting is provided.

3.4.1 Spraying of Contact Surfaces of Structures

Contact surfaces of previously constructed pavement, curbs, manholes, and similar structures shall be sprayed with a thin coat of bituminous material conforming to the requirements of Section 32 12 10 BITUMINOUS TACK AND PRIME COATS.

3.4.2 Offsetting Joints in Bituminous Base Course

The bituminous base course shall be placed so that longitudinal joints will be offset from joints in the underlying course by at least 300 mm 1 foot. Transverse joints shall be offset by at least 600 mm 2 feet from transverse joints in the underlying course.

3.4.3 General Requirements for Use of Mechanical Spreader

The range of temperatures of mixtures, when dumped into the mechanical

spreader, shall be as approved. Mixtures having temperatures less than 110 degrees C 225 degrees F when dumped into the mechanical spreader will be rejected. The mechanical spreader shall be adjusted and speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section, grade, and contour indicated. Placing with respect to the center line, areas with crowned sections, or the high side of areas with one-way slope shall be as directed. Placing of the mixture shall be as nearly continuous as possible, and the speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected. Irregularities in alignment of the course left by the mechanical spreader shall be corrected by trimming directly behind machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping laterally with a lute. Distortion of the course during tamping will not be permitted.

3.4.4 Special Requirements for Placing Strips Succeeding Initial Strips

In placing each succeeding strip after the initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap previously placed strip 75 to 100 mm 3 to 4 inches and shall be sufficiently high so that compaction will produce a smooth, dense joint.

The mixture placed on the edge of the previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip being placed by using a lute. Excess mixture shall be removed and wasted.

3.4.5 Handwork Behind Machine Spreading

A sufficient number of shovelers and rakers shall follow the spreading machine, adding or removing hot mixture and raking mixtures as required to obtain a course that, when completed, will conform to all requirements specified herein. Excessive handwork will not be permitted. Broadcasting or fanning of the mixture over areas being compacted will not be permitted.

3.4.6 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to the required grade and thickness.

3.5 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surfaces of bituminous base courses, when tested as specified below, shall conform to the gradeline and elevations shown and to surface-smoothness requirements specified.

3.5.1 Plan Grade

Finished surfaces shall conform, within tolerances specified, to the lines, grades, and cross sections indicated. Finished surfaces of runways, taxiways, and aprons shall vary not more than 12.2 mm 0.04 foot from the plan gradeline or elevation established and approved at the site of work. Finished surfaces of nonaircraft traffic areas, such as blast pads and stabilized shoulders, shall vary not more than 18.3 mm 0.06 foot from the plan gradeline and elevation established and approved at the site.

Finished surfaces at the juncture with other pavements shall coincide with finished surfaces of abutting pavements. The 12.2 and 18.3 mm 0.04-and 0.06-foot deviations from the plan gradeline and elevation will not be permitted in areas of pavements where closer conformance with plan grade and elevation is required for the proper functioning of drainage and other appurtenant structures involved.

3.5.2 Surface Smoothness

Finished surfaces shall not deviate from the testing edge of a 3.66 meter 12 foot straightedge more than 5 mm 1/4 inch in any direction.

3.5.3 Equipment

The Contractor shall furnish and maintain at the site, in good condition, one straightedge for each bituminous paver for use in testing the finished surface. Straightedges shall be aluminum and have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

3.6 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After the initial rolling, preliminary tests of the crown, grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for the grade and smoothness specified herein. After the Contractor assures himself of meeting crown, grade, and smoothness requirements, rolling shall be continued until a density of at least 96 percent of laboratory compacted specimens of the same mixture is obtained. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

3.6.1 Testing of Mixture

At the start of plant operation, a quantity of the mixture sufficient to construct a test section at least 15 meters 50 feet long and two spreader widths wide shall be prepared. The mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with requirements specified above. This test section shall be tested and evaluated and shall conform to all specified requirements. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately. Additional test sections shall be constructed and sampled for conformance to specification requirements. In no case shall the Contractor start production of the bituminous base course mixture without approval.

3.6.2 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed. Skin patching of an area that has been rolled will not be permitted. Holes shall be cut the full thickness of the base course so that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Bulges shall be sprayed with bituminous materials conforming to requirements of Section 32 12 10 BITUMINOUS TACK AND PRIME COATS. Fresh paving mixture shall be placed in holes in sufficient quantity so that the finished surface will conform to grade, smoothness, and density

requirements.

3.7 JOINTS

3.7.1 General

Joints between old and new pavements or between successive day's work, or joints that have become cold because of delay, shall be made carefully to insure continuous bond between old and new sections of course. All joints shall have the same texture, density, and smoothness as other sections of the course. Contact surfaces of previously constructed pavements that have become coated with dust, sand, or other objectionable material shall be cleaned by brushing or cut back with approved power saw, as directed. The surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to requirements of Section 32 12 10 BITUMINOUS TACK AND PRIME COATS. The material shall be applied far enough in advance of placement of the fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of sprayed surface.

3.7.2 Transverse Joints

The roller shall pass over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of the mixture is interrupted to the extent that the unrolled material may become cold. In all cases, the edge of the previously placed course shall be cut back to expose an even, vertical surface for the full thickness of the course. In continuing placement of the strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.7.3 Longitudinal Joints

Edges of a previously placed strip that have cooled or are irregular, honeycombed, poorly compacted, damaged, or otherwise defective, and unsatisfactory sections of the joint shall be cut back to expose a clean, sound surface for the full thickness of the course as directed.

3.8 EDGES OF PAVEMENT

Bulges adjacent to shoulders shall be trimmed neatly to the line.

3.9 PROTECTION OF PAVEMENT

After final rolling of the pavement, no vehicular traffic of any kind shall be permitted until the pavement has cooled to ambient temperature.

-- End of Section --