
USACE / NAVFAC / AFCEA / NASA UFGS-32 11 26.16 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-02711 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated 18 July 2006

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BITUMINOUS CONCRETE BASE COURSE 04/06

NOTE: This guide specification covers the requirements for bituminous base course (central plant hot mix).

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 |
| AASHTO T 182 | (1984; R 2002) Coating and Stripping of Bitumen-Aggregate Mixtures |

ASTM INTERNATIONAL (ASTM)

- | | |
|-------------|---|
| 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 D 1073 | (2001) Fine Aggregate for Bituminous Paving Mixtures |
| ASTM D 1188 | (1996; R 2002) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens |
| ASTM D 1559 | (1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus |
| ASTM D 2172 | (2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures |
| ASTM D 242 | (1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 2726 | (2004) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures |
| ASTM D 3381 | (1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction |
| ASTM D 546 | (1999e1) Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures |
| ASTM D 692 | (2000; R 2004) Coarse Aggregate for Bituminous Paving Mixtures |

ASTM D 75	(2003) Sampling Aggregates
ASTM D 946	(1982; R 1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 979	(2001) Sampling Bituminous Paving Mixtures
ASTM D 995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

1.2 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.] [for 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-05 Design Data

Bituminous material [job-mix formula](#)

Submit a job-mix formula prior to preparing and placing

bituminous mixture. Formula shall indicate definite percentage of each sieve fraction, percentage of bitumen, percentage of each aggregate, temperature of mixture leaving mixer, number of blows of compaction per side of molded specimen, stability, flow, percent of voids total mix, percent of voids in mineral aggregate, and temperature/viscosity relationship of asphalt cement.

SD-06 Test Reports

Abrasion test reports on aggregate

Stripping test reports on aggregate

Bituminous mix test reports

Density test reports

Thickness test reports

Smoothness test reports

1.3 QUALITY ASSURANCE

1.3.1 Safety Requirements

Provide adequate and safe stairways with handrails to mixer platform and safe and protected ladders or other means for accessibility to plant operations. Guard equipment and exposed steam or other high temperature lines which endanger personnel or create a fire hazard or cover with a suitable type of insulation. Provide hearing protection to Contractor employees and roller and spreader operators in vicinity of equipment which may emit hazardous noise levels.

1.4 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage and store to prevent segregation.

1.5 ENVIRONMENTAL CONDITIONS

Construct bituminous courses when underlaying course is dry and do not construct when atmospheric temperature is below 4 degrees C 40 degrees F.

1.6 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by an approved calibration laboratory within [6] [_____] months of commencing work.

1.6.1 Mixing Plant

NOTE: Insert the minimum acceptable capacity.

Design, coordinate, and operate mixing plant to produce a mixture within job-mix formula tolerances. The mixing plant shall meet requirements of ASTM D 995, except as specified otherwise herein. The plant shall be a

batch type, continuous mixing type, or drum dryer-mixer type with a minimum capacity of [100] metric tons [100] [_____] tons per hour. Mixing plant and equipment shall remain accessible at all times for checking its adequacy, inspecting its operation, verifying weights, proportions, character of materials, and checking mixture temperatures. The plant and plant size shall meet the requirements of Section [01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.]

1.6.1.1 Plant Screens for Batch and Continuous Mix Plants

Use screens to obtain accurate gradation. Allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations.

1.6.1.2 Bins

Divide bins into at least three compartments arranged to insure separate and adequate storage of appropriate fractions of aggregate.

1.6.1.3 Dust Control

Equip plant with a dust collector designed to waste or return in a constant flow all or part of the material collected. Recover quantity as necessary to provide and maintain composition specified. Plant shall have a mixer cover and such additional housing to insure proper control of dust.

1.6.2 Paving Equipment

1.6.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized [by the Contracting Officer]. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 0.025 and 0.23 meter per second 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations will not be permitted.

1.6.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. All rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture.

- a. Vibratory Rollers: At the Contractor's option, vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and any underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers at no cost to the Government. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.6.2.3 Hand Tampers

Hand tampers shall weigh not less than 10 kilograms 25 pounds and have a tamping face of not more than 0.03 square meter 50 square inches.

1.6.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Grade and proportion aggregates and filler such that combined mineral aggregate conforms to grading specified herein.

2.1.1.1 Coarse Aggregates

NOTE: Select slag weight of 1120 kilograms per cubic meter 70 pounds per cubic foot for base courses of airfield pavements.

NOTE: Where aggregates meet all requirements except being hydrophilic, the use of "anti-stripping" agents should be considered when cost effective and appropriate.

ASTM D 692, except as modified herein. Crushed gravel shall have at least 75 percent by weight of pieces having two or more fractured faces. Percentage of wear (Los Angeles abrasion test), except for slag, shall not exceed 50 at 500 revolutions in accordance with ASTM C 131. Weight of slag shall be not less than [1050] [1120] kilograms per cubic meter [65] [70] pounds per cubic foot. Reject aggregates which show stripping when tested in accordance with AASHTO T 182. However, "anti-stripping" agent(s) may be used subject to certified laboratory performance test(s) on the aggregate to be used and approval of the Contracting Officer.

2.1.1.2 Fine Aggregate

ASTM D 1073, except gradation as specified herein.

2.1.1.3 Mineral Filler

Provide not less than two-thirds non-plastic material passing 75 micrometers 200 mesh sieve to meet requirements of ASTM D 242 when tested in accordance with ASTM D 546. Material passing a 75 micrometers 200 mesh sieve may be limestone dust or other suitable non-plastic material and supplement as required by adding limestone dust, portland cement, or non-plastic material as required to obtain composition specified.

2.1.2 Asphalt Cement

NOTE: Delete designations which are not suitable for the project. Asphalt cement penetration grade 40-50 or penetration grade 200-300 may be used for extreme climates.

ASTM D 946, penetration grade [120-150] [85-100] [60-70] or ASTM D 3381, viscosity grade [AC-30] [AC-20] [AC-10] [AC-5]. Asphalt shall show a negative spot when tested in accordance with AASHTO T 102. Furnish Contracting Officer temperature-viscosity relationship of the asphalt cement.

2.1.3 Composition of Mixtures

NOTE: Select 50 blow compacting, 340 kilograms 750 pound stability, and 20 maximum flow for traffic tire pressure less than 690 kPa 100 psi; select 75 blow compacting, 680 kilograms 1500 pound stability, and 16 maximum flow for tire pressure 690 kPa 100 psi and over. For Air Force projects, aggregate gradations shall be as shown in Table 7-4 of DM 21.3, "Flexible Pavement Design for Airfields." For Navy and Marine Corps projects, use Table 7-4 of DM 21.3 or local highway department (as appropriate to the Marshall Method for Design and Control of Bituminous Paving Mixtures).

Gradation in accordance with typical gradations listed herein for selected maximum aggregate size when tested in accordance with ASTM C 136. Gradation shall be within job mix formula tolerance limitations specified herein. Grade combined aggregate and filler smoothly from coarse to fine with no variance from low limit on one sieve to high limit on adjacent sieve. Table I is based on aggregates of uniform specific gravity; percentages passing various sieves are subject to appropriate correction when aggregates of varying specific gravities are used. Determine stability and flow by ASTM D 1559 using [50] [75] blows per side of molded specimen, meeting the following requirements:

- a. Stability (minimum), [340] [680] kilograms [750] [1500] pounds.
- b. Flow 0.25 mm 0.01 inch, Not more than [20] [16] nor less than 8.

TABLE I
GRADATION OF AGGREGATES
TOTAL PERCENT PASSING (BY WEIGHT)

<u>SIEVE SIZE</u>
37.5 mm
25.0 mm
19.0 mm
12.5 mm
9.5 mm
4.75 mm
2.36 mm
1.18 mm
600 micrometers
300 micrometers
150 micrometers
75 micrometers

TABLE I
GRADATION OF AGGREGATES
TOTAL PERCENT PASSING (BY WEIGHT)

<u>SIEVE SIZE</u>
1 1/2 inch
1 inch
3/4 inch
1/2 inch
3/8 inch
No. 4
No. 8
No. 16
No. 30
No. 50
No. 100
No. 200

c. Bituminous content: Base percentage on approved job-mix formula.

2.1.4 Variations

Variations from approved job-mix formula shall not exceed the following; however, in no case shall job-mix formula, with tolerances applied, fall outside the general limits for aggregate gradation and bituminous material specified herein:

<u>Aggregate</u>	<u>Tolerance (plus or minus)</u>
12.5 mm or larger	8 percent
9.5 mm and 4.75 mm	7 percent
2.36 mm and 1.18 mm	6 percent
600 micrometers and 300 micrometers	5 percent
150 micrometers	4 percent

Aggregate
75 micrometers

Tolerance (plus or minus)
3 percent

Aggregate

Tolerance (plus or minus)

1/2 inch or larger
3/8 inch and No. 4
No. 8 and 16
No. 30 and 50
No. 100
No. 200

8 percent
7 percent
6 percent
5 percent
4 percent
3 percent

PART 3 EXECUTION

3.1 MIXING

Produce bituminous mixture in a plant as specified herein. Stockpile fine and coarse aggregates separately and feed to drier by separate mechanical feeders in a manner to produce an asphaltic concrete mixture within tolerances specified for job-mix formula. Heat and dry aggregates thoroughly. Make temperature of aggregate, mineral filler, and asphalt in mixer such that viscosity of asphalt in mixture shall be in the range of 0.0002 to 0.0003 square meter per second 150 to 300 centistokes kinematic or 75-150 seconds, Saybolt-Furol. Provide adequate dry storage for mineral filler at mixing plant. After aggregates have been prepared, accurately weigh or measure and convey them into mixer in proportionate amounts of each aggregate size required. Weigh or feed mineral filler by some accurate and uniform measurement, and add separately, and in a dry condition, as near as possible to center of mixer. Introduce required amount of asphalt for each batch, or calibrated amount for continuous mixing, into mixer. In batch mixing, charge aggregates into mixer, add asphalt, and continue mixing for at least 25 seconds or longer to obtain a homogeneous mixture. When a continuous mixer is used, mixing time shall be not less than 30 seconds to obtain a homogeneous mixture. Temperature of asphalt at time of mixing shall not exceed 175 degrees C 350 degrees F. When prepared in a twin pugmill mixer, depth of mixture shall be not greater than the tips of mixer blades when blades are in a vertical position. Reject overheated and carbonized mixtures, and mixtures that foam, segregate, or strip. When excessive moisture causes foaming, segregation, or stripping, remove all aggregates in hot bins and place in their respective stockpiles; for drum-drier plant mixes, waste the mix, except as otherwise approved by the Contracting Officer.

3.2 TRANSPORTATION OF BITUMINOUS MIXTURES

Transport bituminous mixture from paving plant to the site in trucks having tight, clean, smooth beds which have been painted or sprayed with a limewater, soap, or detergent solution at least once a day to prevent adhesion of the mixture to truck bodies. Cover each load with canvas or other suitable material of ample size to protect it from the weather and to prevent loss of heat. Make deliveries so that spreading and rolling of all mixture prepared for a day's run can be completed during daylight, unless satisfactory artificial light is provided. Deliver mixture to the area to be paved in such a manner that temperature at the time of dumping the spreader shall be not less than 105 degrees C 225 degrees F or that required to obtain the specified compaction. Reject any load that has become wet prior to placing.

3.3 PLACING

Provide line and grade stakes as necessary for control. Place grade stakes in lanes parallel to centerline of area to be paved, and suitably space for string lines. Place and compact bituminous courses in such thicknesses to achieve density and smoothness requirements. Maximum lift of bituminous base course shall not exceed 150 mm 6 inches. Prior to laying the base course, clean underlying course of foreign and objectionable matter with power blowers, power brooms, or hand brooms in places inaccessible to power equipment, and inspect for compaction and smoothness requirements. The range of temperatures of the mixtures at the time of spreading shall be between 105 degrees C 225 degrees F and 150 degrees C 300 degrees F. Reject bituminous mixture having a temperature outside these limits when dumped into the hopper of the spreader. Adjust mechanical spreader and regulate speed so that the surface of the course is smooth, and when compacted conforms to depth, cross sections, grades, and contours indicated. When irregularities of surface or deficiency in depth is more than specified tolerances, remove defective work and replace with new material. Whenever possible, place the mixture in strips not less than 3 m 10 feet wide. Overlap rolling to previously placed strip and extend to overlap first strip. Place mixture as continuously as possible. Shovelers and rakers shall follow spreading equipment, adding hot mixture and raking as required to produce a course that, when completed, shall conform to requirements specified. In areas where the use of machine spreading is impractical, mixture may be spread by hand. Distribute mixture into place from dump boards by means of hot shovels and spread with hot rakes in a uniformly loose layer of such thickness that, when completed, it conforms to required grade and thickness. Do not dump loads any faster than they can be handled by shovelers and rakers. Paint contact surfaces of previously constructed curbs, manholes, and similar structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture.

3.4 JOINTS

All joints shall present the same texture, density, and smoothness as other portions of the course. Carefully make joints between old and new pavements or within new pavements in a manner as to ensure a thorough and continuous bond between old and new sections of the course. Paint all vertical contact surfaces of previously constructed sections with a thin uniform coat of emulsion or other approved bituminous material just before the fresh mixture is placed.

3.4.1 Transverse

The roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of the previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against the joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. In all cases, transverse joints in adjacent lanes shall be offset a minimum of 600 mm 2 feet.

3.4.2 Longitudinal

Place longitudinal joints so that they shall not coincide with that of underlying course and shall be separated by at least 300 mm one foot. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint to expose an even,

vertical surface for the full thickness of the course. Prior to placing adjacent asphalt concrete, roll joint first, then proceed to opposite side and roll, moving each time toward the joint.

3.5 COMPACTION OF MIXTURE

NOTE: Use 97 percent for pavements for tire pressures of 1.7 MPa 250 psi and above; use 96 percent for all other pavements.

Affect compaction by rolling. Begin rolling as soon after placing as the mixture will bear the roller without undue displacement. Delays in rolling freshly spread mixture will not be tolerated. Start rolling longitudinally at extreme sides of lanes and proceed toward center of pavement, overlapping on successive strips by at least one-half the width of rear wheel of roller. Alternate trips of roller shall be slightly different lengths. Affect initial longitudinal rolling by the use of steel roller. Make tests for conformity with specified crown, grade, and smoothness immediately after initial compression. Before continuing rolling, correct any variations by removing or adding materials, then roll course using pneumatic-tired rollers or tandem rollers, while mixture is hot and in condition suitable for proper compaction. Speed of rollers shall not exceed 4.50 kilometers per hour 3 miles per hour and at all times be slow enough to avoid displacement of hot mixture. Correct any displacement of mixture at once by use of rakes and apply fresh mixture or remove mixture as required. Continue rolling until all roller marks are eliminated and course has a density of at least [96] [97] [_____] percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten rollers to prevent adhesion of mixture to rolling surfaces, but do not permit an excess of water. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to rollers, compact mixture with hot pneumatic or manual hand tampers. Skin patching of an area that has been rolled is not permitted. Remove any mixture that becomes mixed with foreign material or is defective, replace with fresh mixture, and compact to density of surrounding area. Roller shall pass over unprotected edge of course only when laying of course is to be discontinued for a length of time to permit mixture to become cold. Contractor shall provide workmen who are capable of performing work incidental to correction of pavement irregularities. After final rolling, permit no traffic of any kind on the pavement until the surface temperature has cooled to at least 50 degrees C 120 degrees F. Measure surface temperature with surface thermometers or other satisfactory methods.

3.6 FIELD SAMPLING AND TESTING

Approve materials and material sources not less than [21] [_____] days prior to use of such materials in work.

3.6.1 Sampling

3.6.1.1 Aggregates at Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75 [at the source] [from each stockpile]. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 25 kilograms 50

pounds. Make repetition of the above sampling when source of material is changed or when unacceptable deficiencies or variations from specified grading of materials are found in testing.

3.6.1.2 Cold Feed Aggregate Sampling

Take two samples daily from belt conveying materials from cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 25 kilograms 50 pounds. Take samples in accordance with ASTM D 75.

3.6.1.3 Coarse and Fine Aggregates

Take 25 kilograms 50 pounds sample from cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests on mineral fillers, or will be required when analyses show deficiencies, or unacceptable variances or deviations. Method of sampling is as described herein for aggregates.

3.6.1.4 Mineral Filler

ASTM C 183. Take samples large enough to provide ample material for testing.

3.6.1.5 Pavement and Mixture

Take samples for the determination of mix properties, thickness and density of the completed pavements. Furnish all tools, labor and material for samples and for satisfactory replacement of pavement. Take samples and test at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.6.1.6 Sample Identification

Furnish each sample in a clean container, securely fastened to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

Contract No. _____
Sample No. _____ Quantity _____
Date of Sample _____
Sample _____
Source _____
Intended use _____
For testing _____

3.6.2 Testing

3.6.2.1 Aggregate

- a. Gradation: ASTM C 136 for fine and coarse aggregate. ASTM D 546 for mineral filler.
- b. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into work and whenever source is changed.

- c. **Stripping Test:** AASHTO T 182. Perform a stripping test initially on all aggregate prior to incorporation into work and whenever source is changed.

3.6.2.2 Bituminous Mix

ASTM D 2172. Test one sample for each 500 metric tons 500 tons, or fraction thereof, of the uncompacted mix for extraction. Sieve analysis per ASTM C 136. Test one sample for each 500 metric tons 500 tons, or fraction thereof, for stability and flow in accordance with ASTM D 1559.

3.6.2.3 Pavement Course

- a. **Density:** For each [1000] [_____] metric tons [1000] [_____] tons of bituminous course placed, determine the representative laboratory density by averaging the density of 4 laboratory specimens prepared in accordance with ASTM D 1559; samples for these specimens shall be taken from trucks delivering mixture to the site; the Contractor shall record in an approved manner the project areas represented by the laboratory densities. From each representative area so recorded, determine field density of the pavement by averaging the densities of 100 mm 4 inch diameter cores obtained from the base course; take one core for each [1670] [_____] square meters [2000] [_____] square yards or fraction thereof of course placed. Determine density of the laboratory prepared specimens and the cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. The maximum allowable deficiency at any point shall not be more than 2 percent less than the specified density. The average density shall be not less than the specified density. When the deficiency is more than the specified tolerances, the Contractor shall correct each such representative area or areas by removing the pavement in question and replacing with new pavement.
- b. **Thickness:** Determine thickness of the course from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 6 mm 1/4 inch less than the indicated thickness for the course. The average thickness of the course shall be not less than the indicated thickness. Where the deficiency is more than the specified tolerances, the contractor shall correct each such representative area or areas by removing the pavement in question and replacing with new pavement.
- c. **Smoothness:** Straightedge test the compacted surface of the course as the work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of the course shall not vary more than plus or minus 6 mm in 3 m 1/4 inch in 10 feet. Correct any portion of the pavement showing irregularities greater than that specified.

-- End of Section --