
USACE / NAVFAC / AFCEA / NASA UFGS-32 12 19 (April 2006)

Preparing Activity: USACE Replacing without change
UFGS-02701 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2007

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 12 19

BITUMINOUS BINDER AND WEARING COURSES (CENTRAL-PLANT COLD-MIX)

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 UNIT PRICES
 - 1.2.1 Measurement
 - 1.2.1.1 Correctional Factor for Aggregates Used
 - 1.2.1.2 Bituminous Material Unit
 - 1.2.2 Payment
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS
 - 1.4.1 Mineral Aggregates
 - 1.4.2 Bituminous Materials
- 1.5 PLANT, EQUIPMENT, MACHINES, AND TOOLS
 - 1.5.1 General Requirements
 - 1.5.2 Mixing Plant
 - 1.5.3 Rollers
 - 1.5.4 Power Brooms and Power Blowers
 - 1.5.5 Straightedge
- 1.6 WEATHER LIMITATIONS
- 1.7 SAFETY PRECAUTIONS
- 1.8 WAYBILLS AND DELIVERY TICKETS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Bituminous Material
 - 2.1.2 Aggregates
 - 2.1.2.1 Coarse Aggregates
 - 2.1.2.2 Fine Aggregate
 - 2.1.2.3 Mineral Filler
 - 2.1.3 Hydrated Lime
 - 2.1.4 Liquefiers
- 2.2 JOB MIX FORMULA (JMF)
- 2.3 SAMPLING AND TESTING
 - 2.3.1 General Requirements
 - 2.3.2 Samples

- 2.3.3 Initial Sampling and Testing
 - 2.3.3.1 Source of Aggregates
 - 2.3.3.2 Source of Bituminous Materials

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
 - 3.1.1 Base Course
 - 3.1.2 Existing Pavement
- 3.2 GRADE CONTROL
- 3.3 MIXING
 - 3.3.1 Preparation of Mineral Aggregates
 - 3.3.2 Preparation of Bituminous Mixtures
- 3.4 TRANSPORTATION OF BITUMINOUS MIXTURES
- 3.5 PLACEMENT
 - 3.5.1 Thickness of Layer
 - 3.5.2 General Requirements for Use of Motor Grader
 - 3.5.3 General Requirements for Use of Mechanical Spreader
 - 3.5.4 Offsetting Joints Between Succeeding Courses
 - 3.5.5 Special Requirements for Laying Strips Succeeding Initial Strip
 - 3.5.6 Shoveling, Raking, and Tamping After Machine Spreading
 - 3.5.7 Hand Spreading in Lieu of Machine Spreading
- 3.6 COMPACTION
- 3.7 EDGES OF PAVEMENT
- 3.8 FINISHING
- 3.9 THICKNESS REQUIREMENTS
- 3.10 SURFACE-SMOOTHNESS REQUIREMENTS
 - 3.10.1 Intermediate Courses
 - 3.10.2 Finished Surfaces
 - 3.10.2.1 Roads and Streets
 - 3.10.2.2 Other Than Roads and Streets
- 3.11 JOINTS
 - 3.11.1 Transverse Joints
 - 3.11.2 Longitudinal Joints
- 3.12 FIELD QUALITY CONTROL AND TESTING
 - 3.12.1 Testing
 - 3.12.1.1 Field Density
 - 3.12.1.2 Gradation
 - 3.12.1.3 Abrasion Resistance
 - 3.12.1.4 Soundness Test
 - 3.12.1.5 Smoothness
 - 3.12.1.6 Thickness
 - 3.12.1.7 Bitumen Content
 - 3.12.2 Bituminous Material Sample
- 3.13 PROTECTION OF PAVEMENT
- 3.14 SCHEDULES

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEA / NASA UFGS-32 12 19 (April 2006)

Preparing Activity: USACE Replacing without change
UFGS-02701 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2007

SECTION 32 12 19

BITUMINOUS BINDER AND WEARING COURSES (CENTRAL-PLANT COLD-MIX) 04/06

NOTE: This guide specification covers the requirements for central-plant cold-mix bituminous binder and wearing courses.

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

Remove information and requirements not required in respective project, whether or not brackets are present.

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).

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 M 20	(1970; R 2004) Penetration-Graded Asphalt Cement
AASHTO M 226	(1980; R 2004) Viscosity Graded Asphalt Cement
AASHTO M 81	(1992; R 2004) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO T 40	(2002; R 2006) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(2004) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	(2002) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 29/C 29M	(1997; R 2003) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1250	(2004) Petroleum Measurement Tables
ASTM D 140	(2001; R 2007) Sampling Bituminous Materials
ASTM D 2028	(1997; R 2004) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2172	(2005) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 242	(2004) Mineral Filler for Bituminous Paving Mixtures
ASTM D 3381	(2005) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4791	(2005) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 490	(1992; R 2005) Road Tar
ASTM D 633	(1997; R 2005) Volume Correction Table for Road Tar
ASTM D 75	(2003) Standard Practice for Sampling Aggregates
ASTM D 946	(1982; R 2005) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(2005) Emulsified Asphalt

1.2 UNIT PRICES

1.2.1 Measurement

NOTE: This paragraphs will be deleted if the work covered by this section is included in one lump sum contract price for the entire work covered by the invitation for bids.

The amount paid for will be the number of **metric 2,000 pound** tons of bituminous mixture called for in the bid schedule and used in the accepted work. Bituminous-treated material shall be weighed after mixing, and no deduction shall be made for the weight of bituminous material in the mixture.

1.2.1.1 Correctional Factor for Aggregates Used

The quantities of bituminous mixtures called for in the bid schedule are based on aggregates having an apparent specific gravity of 2.65 as

determined in accordance with ASTM C 127 and ASTM C 128. A correction in the tonnage of bituminous mixtures shall be made to compensate for the difference in square meters yards of completed pavement obtained from the tonnage of mixtures used in the project, when the specific gravities of aggregates used are more than 2.70 or less than 2.60. The tonnage paid for shall be number of metric tons tons used, proportionately corrected for specific gravities using 2.65 as base correctional factor.

1.2.1.2 Bituminous Material Unit

NOTE: The method of measurement not applicable to
job conditions will be deleted.

The bituminous material to be paid for will be measured in the number of [liters gallons of the material used in the accepted work, corrected to liters gallons at 15.6 degrees C 60 degrees F in accordance with [ASTM D 633] [ASTM D 1250]. A coefficient of 0.00045/degree C 0.00025/degree F shall be used for asphalt emulsion.] [metric 2000 pound tons of the material used in the accepted work.]

1.2.2 Payment

NOTE: This paragraphs will be deleted if the work
covered by this section is included in one lump sum
contract price for the entire work covered by the
invitation for bids.

Bituminous binder and wearing course constructed and accepted will be paid for at the applicable contract unit prices in the unit schedule. No payment will be made for any material wasted, used for the convenience of the Contractor, unused, or rejected.

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).
Aggregates.
Bituminous Materials.

The job mix formula, at least [_____] days before it is to be used. Notification on the selection of aggregate source.
Notification on the selection of bituminous materials source.

Waybills and Delivery Tickets.

Copies of waybills or delivery tickets, during the progress of the work.

SD-06 Test Reports

Tests.

Certified copies of aggregate test results, not less than [30] [_____] days before the material is required in the work.

SD-07 Certificates

Bituminous Material.

Certified copies of the bituminous material manufacturer's test reports indicating compliance with applicable specified requirements, not less than [30] [_____] days before the material is required in the work.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site and stockpiled in such a manner to preclude fracturing of aggregate particles, segregation, contamination or intermingling of different materials in the stockpiles or cold feed hoppers. Before stockpiling material, the storage areas should

be cleared, drained and leveled. Mineral filler shall be delivered and stored in a manner to preclude exposure to moisture or other detrimental conditions.

1.4.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh bucket shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 150 degrees C 300 degrees F.

1.5 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.5.1 General Requirements

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.

All plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate for placing the bituminous mixtures at a rate equal to the plant output. The equipment shall be capable of producing the required compaction, meeting grade controls, thickness control and smoothness requirements as set forth herein.

1.5.2 Mixing Plant

The mixing plant shall be an automatic or semi-automatic controlled, commercially manufactured unit designed 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.

1.5.3 Rollers

Rollers shall be self-propelled, weigh not less than 9 metric tons 10 tons and have a maximum contact pressure of 620 kPa 90 psi. Wheels on the roller shall be equipped with adjustable scrapers and water sprinkling apparatus to keep the wheels wet to prevent the adherence of bituminous material. A sufficient number of rollers shall be used on the work so that one roller will be in continuous operation for 1 hour on each 100 square meters yards of completed pavement, operating at a speed of not more than 5 kph 3 mph.

1.5.4 Power Brooms and Power Blowers

Brooms and blowers shall be suitable for cleaning surfaces of the bases and the bituminous course.

1.5.5 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one [3.05] [3.66] meter [10] [12] foot straightedge for each bituminous paver for use in testing the finished surface. Straightedges shall be constructed of aluminum or other approved lightweight metal and shall have blades of box girder cross section with flat bottom, reinforced to insure rigidity and accuracy. Straightedges shall be equipped with handles for operation on pavement.

1.6 WEATHER LIMITATIONS

Bituminous courses shall be constructed only when the base course or existing pavement is dry and when the weather is not foggy or rainy. Unless otherwise directed, such courses shall not be constructed when the atmospheric temperature is below 15 degrees C 60 degrees F.

1.7 SAFETY PRECAUTIONS

[No smoking or open flames will be permitted within 8 m 25 feet of heating, distributing or transferring operations of bituminous materials other than bituminous emulsions.] [When tar is used, a full-face, organic, vapor-type respirator and protective creams shall be used by personnel exposed to fumes. Protective creams shall not substitute for cover clothing.]

1.8 WAYBILLS AND DELIVERY TICKETS

NOTE: This paragraph will be deleted if the work covered by this section is included in one lump sum contract price for the entire work covered by the invitation for bids.

Copies of waybills or delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, waybills or certified delivery tickets shall be furnished for all bituminous materials and paving mixtures used in the construction. The Contractor shall not remove bituminous material from the tank car or storage tank until the initial outage has been taken; nor shall the car or tank be released until final outage has been taken.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bituminous Material

NOTE: Only the desired type and grade of bituminous material and the appropriate ASTM specification should be retained. The grade of bituminous material should be selected based on the information contained in TM-5-822-8.

The bituminous material shall conform to [AASHTO M 20] [AASHTO M 81] [AASHTO M 226] or [ASTM D 490] [ASTM D 946] [ASTM D 977] [ASTM D 2028] [ASTM D 3381], Grade [_____].

2.1.2 Aggregates

NOTE: The desired gradation to be used for the project should be retained in the project specifications; the other gradation should be omitted. The gradation used in the JMF must meet the requirements of the specifications.

Aggregates shall consist of crushed stone, crushed slag, crushed gravel, screenings, sand, and mineral filler. The portion of these materials retained on the 2.36 mm No. 8 sieve shall be known as coarse aggregate; the portion passing the 2.36 mm No. 8 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. The aggregate when blended shall conform to the gradation shown in TABLE I when tested in accordance with ASTM C 117 and ASTM C 136.

2.1.2.1 Coarse Aggregates

Coarse aggregates shall consist of clean, sound, durable particles meeting the following requirements:

- a. Percentage of loss shall not exceed 40 after 500 revolutions as determined in accordance with ASTM C 131.

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 maximum allowable percentage of loss, usually in the range of 10 to 15 percent, 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.

- b. Percentage of loss shall not exceed [_____] after five cycles performed in accordance with ASTM C 88 using magnesium sulfate.
- c. The dry weight of crushed slag shall not be less than 1200 kg per cubic meter 75 pcf, as determined in accordance with ASTM C 29/C 29M.
- d. Crushed aggregate retained on the 4.75 mm No. 4 sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with an area of each face equal to at least 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes or fractures shall be at least 30 degrees to count as two fractured faces.
- e. Particle shape of crushed aggregates shall be essentially cubical.

The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight when determined in accordance with ASTM D 4791.

2.1.2.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles of natural sand, crushed stone, slag or gravel that meets the requirements for abrasion resistance and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the 0.60 mm No. 30 sieve.

2.1.2.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

2.1.3 Hydrated Lime

Hydrated lime shall conform to ASTM C 206.

2.1.4 Liquefiers

The use of liquefiers as anti-stripping agent is subject to prior approval by the Contracting Officer.

2.2 JOB MIX FORMULA (JMF)

NOTE: The procedure for the design mixture given in
UFC 3-250-03 should be used to determine the JMF.

No bituminous mixture shall be produced until a JMF has been determined by the Contractor and approved by the Contracting Officer. The formula will indicate the definite percentage of each sieve fraction of aggregate, the percentage of bituminous material and the temperature of the completed mixture as discharged from the mixer. The JMF will be allowed the tolerances given in TABLE II. Aggregate gradation and bitumen content may be adjusted, as directed, within the limits specified to improve paving mixtures.

2.3 SAMPLING AND TESTING

2.3.1 General Requirements

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 and compaction meet specified requirements. Copies of the test results shall be furnished to the Contracting Officer within 24 hours of the completion of the tests.

2.3.2 Samples

Sampling shall be in accordance with ASTM D 75 for aggregates, ASTM C 183 for mineral filler, and AASHTO T 40 or ASTM D 140 for bituminous material.

2.3.3 Initial Sampling and Testing

2.3.3.1 Source of Aggregates

Sources from which aggregates are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days of the award of the contract. Tests for the evaluation of aggregates shall be made by an approved commercial laboratory at no expense to the Government. Tests for determining the suitability of aggregate shall include, but not limited to: gradation in accordance with ASTM C 136, abrasion resistance in accordance with ASTM C 131, and soundness in accordance with ASTM C 88.

2.3.3.2 Source of Bituminous Materials

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Base Course

The surface of the base course shall be cleaned of loose and foreign material. Ruts or soft yielding spots, areas having inadequate compaction, and deviations of surface from requirements specified for the base course shall be corrected by loosening affected areas, removing unsatisfactory material, adding approved material where required, reshaping, and recompact to line and grade to specified density requirements. The surface shall be sprayed with bituminous material conforming to Section 32 12 10 BITUMINOUS TACK AND PRIME COATS.

3.1.2 Existing Pavement

The existing pavement shall be cleaned of loose and foreign matter. Cracks 5 mm 1/4 inch in width and larger shall be cleaned and filled with crack filler material. Deteriorated areas of the pavement shall be repaired as directed. The surface shall be sprayed with a thin coat of bituminous material conforming to Section 32 12 10 BITUMINOUS TACK AND PRIME COATS.

3.2 GRADE CONTROL

The finished and completed surface course shall conform to the lines, grades, cross sections, and dimensions as indicated. Line and grade stakes shall be placed by the Contractor at the site of the work, in accordance with the SPECIAL CONTRACT REQUIREMENTS, to maintain indicated lines and grades.

3.3 MIXING

3.3.1 Preparation of Mineral Aggregates

Each component of various sizes of aggregates blended in preparing

bituminous mixtures shall be placed in separate stockpiles in such manner that separate sizes will not be intermixed. Aggregate shall be fed into the cold elevator by means of separate mechanical feeders to produce a total aggregate graded within requirements specified.

3.3.2 Preparation of Bituminous Mixtures

NOTE: If asphalt emulsion is specified the statement in brackets pertaining to moisture content is not applicable and should be deleted.

The appropriate mixing temperatures for the bituminous material and aggregate are found in TABLE III-4 and Paragraph 9.4, Appendix III, respectively, in UFC 3-250-03.

Aggregates shall be measured and conveyed into the mixer in proportionate quantities of each aggregate size required to meet the JMF. [The moisture content of the finished mixture shall not exceed 2 percent by weight.] Materials shall be introduced into the mixer in the following order: aggregate, [lime,] [flux oil,] [liquefier,] and bituminous material, unless otherwise directed. The temperature of the bituminous material shall be [_____] at the time of mixing. The temperature of the aggregate and mineral filler in the mixer shall not exceed [_____] when the bituminous material is added. If slag aggregate is used, the liquefier shall be sprayed over slag after coating with asphalt cement. [The percentage of hydrated lime used in the mix shall range from 0.5 to 1.5 percent by weight, as directed.] Aggregates and other ingredients shall be mixed for 35 seconds or longer, as necessary, to coat thoroughly all particles with bituminous material. The finished mixture shall not vary from the approved JMF without prior approval of the Contracting Officer.

3.4 TRANSPORTATION OF BITUMINOUS MIXTURES

Mixtures shall be transported to the site in trucks having tight, clean, smooth bodies. Deliveries shall be scheduled so that the spreading and rolling of all mixtures delivered to the site can be completed during daylight unless approved artificial light is provided.

3.5 PLACEMENT

3.5.1 Thickness of Layer

The mixture shall be spread in a layer not greater than 50 mm 2 inches in thickness. Each layer shall be allowed to cure at least 12 hours or longer if required to achieve proper curing before placing a succeeding layer.

3.5.2 General Requirements for Use of Motor Grader

When approved motor graders are used for spreading the mixture, the material shall be placed on the roadbed in a windrow so that the proper amount of material is available to cover a predetermined width to the indicated compacted thickness. The motor grader may be used to aerate the mixture by working it back and forth across the roadbed in order to get the mixture to the proper condition for compaction.

3.5.3 General Requirements for Use of Mechanical Spreader

When mechanical spreaders are used, the bituminous mixture shall be dumped into an approved mechanical spreader and placed as nearly continuous as possible. The speed of placing shall be adjusted to permit proper rolling.

3.5.4 Offsetting Joints Between Succeeding Courses

Placing of a succeeding course shall be done in such a manner that the longitudinal joints of the succeeding course will not coincide with joints of the previous course and will be offset from joints in the previous course by at least 300 mm 1 foot. Transverse joints in the succeeding course shall be offset by at least 600 mm 2 feet from transverse joints in the previous course.

3.5.5 Special Requirements for Laying Strips Succeeding Initial Strip

In laying each succeeding strip after the initial strip has been spread and compacted as specified, the blade of the motor grader or the screed of the mechanical spreader shall overlap previously placed strip 75 to 100 mm 3 to 4 inches at a height required for compaction to produce a smooth, dense joint.

3.5.6 Shoveling, Raking, and Tamping After Machine Spreading

Shovelers and rakers shall follow the spreading machine, raking, removing, and adding mixture as required to obtain a course that, when completed, will conform to all specified requirements. Excessive handwork and broadcasting or fanning of mixture will not be permitted.

3.5.7 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. Mixture shall be spread uniformly in a loose layer of thickness that, when rolled, will conform to required thickness.

3.6 COMPACTION

NOTE: Consult CEMP-ET on test method to be used and indicate below.

[Compaction shall begin immediately after placement.] [The mixture shall be allowed an adequate amount of time for aeration and curing. After curing, the mixture shall be shaped approximately to the specified lines and grades and thoroughly loosened to its full depth and width. Rolling shall begin as soon after placing as the mixture will bear the roller without undue displacement.] Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. The speed of the roller shall be such that displacement of the material does not occur. The density of the compacted mixture shall be at least 96 percent of that of laboratory specimens of the same mixture subjected to 50 blows of the standard Marshall hammer according to the test procedure in [_____].

3.7 EDGES OF PAVEMENT

The edges of the pavement shall be compacted to the required density and shall be straight and true to required lines. Approved material shall be placed along the edges of the pavement in such quantity as will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 300 mm 1 foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the pavement as directed.

3.8 FINISHING

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be uniform texture. Light blading during rolling may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic-marked prior to completion, such unsatisfactory portion shall be scarified, reworked, relaid, or replaced as directed. Should any portion of the course, when laid, become watersoaked for any reason, that portion shall be removed immediately, and the mix placed in a windrow, aerated, and then spread, shaped, and rolled as specified.

3.9 THICKNESS REQUIREMENTS

The compacted thickness of the pavement shall be within 12.7 mm 1/2 inch of the thickness indicated. Where measured thickness of the pavement is more than 12.7 mm 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompact as directed. Where the measured thickness of the pavement is more than 12.7 mm 1/2 inch thicker than indicated, the pavement shall be considered as conforming to the specified thickness requirements.

3.10 SURFACE-SMOOTHNESS REQUIREMENTS

3.10.1 Intermediate Courses

The surface of each intermediate course shall be checked longitudinally with a [3.05] [3.66] meter [10] [12] foot straightedge and checked transversely with a template conforming to the specified cross section. The surface of the layer, after rolling shall not deviate more than 6.4 mm 1/4 inch from the [3.05] [3.66] meter [10] [12] foot straightedge nor 6.4 mm 1/4 inch from the template. Any irregularities shall be corrected by loosening and reshaping the aggregate, removing or adding aggregate as required, and rerolling such areas.

3.10.2 Finished Surfaces

3.10.2.1 Roads and Streets

The surface of the finished pavement shall be checked longitudinally with a [3.05] [3.66] meter [10] [12] foot straightedge and transversely with a template cut to the specified cross section. The finished surface of the surface course shall not deviate more than 3.2 mm 1/8 inch from the [3.05] [3.66] meter [10] [12] foot straightedge or from the template. Surface irregularities exceeding those specified shall be corrected [as specified] [as directed].

3.10.2.2 Other Than Roads and Streets

The surface of the finished pavement shall be checked longitudinally and transversely with a [3.05] [3.66] meter [10] [12] foot straightedge. The finished surface of the finished pavement shall not deviate more than 6.4 mm 1/4 inch from the [3.05] [3.66] meter [10] [12] foot straightedge. Surface irregularities exceeding tolerances specified shall be corrected [as specified] [as directed].

3.11 JOINTS

Joints shall present the same texture, density, and smoothness as other sections of the course. Joints between old and new pavements or between successive days' work shall be made carefully to insure continuous bond between old and new sections of the course. Contact surfaces of previously constructed pavements shall be painted with a thin, uniform coat of bituminous material, conforming to Section 32 12 10 BITUMINOUS TACK AND PRIME COATS, just before the fresh mixture is placed.

3.11.1 Transverse Joints

The roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued. The edge of the previously laid course shall be cut back to expose an even, vertical surface for the full thickness of the course. The fresh mixture shall be raked against the joints, thoroughly tamped, and then rolled.

3.11.2 Longitudinal Joints

When the edges of the longitudinal joints are irregular, honeycombed, or poorly compacted, all unsatisfactory sections of the joint shall be cut back to expose an even, vertical surface for the full thickness of the course. Where required, fresh mixture shall be raked against the joint, thoroughly tamped, and then rolled.

3.12 FIELD QUALITY CONTROL AND TESTING

NOTE: The appropriate frequency interval of testing
should be inserted in the blanks.

3.12.1 Testing

Field tests shall be performed in sufficient numbers to assure that the specifications are being met. Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial laboratory. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type of operation.

3.12.1.1 Field Density

NOTE: Consult CEMP-ET on test method to be used and
indicate below.

The field density shall be expressed as a percentage of the laboratory density. Laboratory samples shall be prepared from an uncompacted mixture

taken from the pavement immediately prior to field compaction and the samples shall be compacted in accordance with [____]. The asphalt mixture shall not be reheated in the laboratory. A minimum of one field density test shall be performed for every [____] metric tons tons of mixture placed.

3.12.1.2 Gradation

A minimum of one gradation shall be performed for every [____] metric ton ton of aggregate used in the mixture, with a minimum of three gradations for each day's run. When the source of materials is changed or deficiencies are found, the gradation shall be replaced and the material already placed shall be retested to determine the extent of the unacceptable material. All in-place unacceptable material shall be replaced at no additional expense to the Government.

3.12.1.3 Abrasion Resistance

Abrasion resistance tests shall be performed in accordance with ASTM C 131 to ensure that the aggregates have a percentage of wear not exceeding 40 percent after 500 revolutions. One test shall be performed for every [____] metric ton ton of aggregate placed.

3.12.1.4 Soundness Test

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 maximum allowable percentage of loss, usually in the range of 10 to 15 percent, 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.

Soundness tests shall be performed as specified by ASTM C 88 to insure that the aggregates have a weight loss not greater than [____] percent when subjected to five cycles of the magnesium sulfate test. One test shall be performed for every [____] metric tons tons of aggregate placed.

3.12.1.5 Smoothness

Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline, with a [3.05] [3.66] meter [10] [12] foot straightedge. The surface of each course shall be checked transversely with [a template cut to the specified cross section] [a [3.05] [3.66] meter [10] [12] foot straightedge] placed perpendicular to the road centerline at [____] meter foot intervals.

3.12.1.6 Thickness

The thickness of the pavement shall be determined every [____] meters feet along the finished surface. Measurements shall be made in 76.2 mm 3 inch diameter test holes penetrating the pavement. The holes shall be refilled

to conform to these specifications.

3.12.1.7 Bitumen Content

Samples of finished plant mixture shall be taken and tested for each [_____] ~~metric tons~~ ~~tons~~ or fraction thereof, to determine if bitumen content is in accordance with ~~ASTM D 2172~~ and conforms to the specified requirements.

3.12.2 Bituminous Material Sample

A sample of the bituminous material used will be obtained by the Contractor under the supervision of the Contracting Officer. The sample will be retained by the Government.

3.13 PROTECTION OF PAVEMENT

The pavement shall be maintained in a satisfactory condition until accepted by the Contracting Officer.

3.14 SCHEDULES

TABLE I. AGGREGATE GRADATIONS FOR PLANT-MIXED
COLD-LAID BITUMINOUS PAVEMENTS

Percent by Weight Passing Square-Mesh Sieve		
Sieve Size	No. 1	No. 2
12.5 mm	100	---
9.5 mm	77-95	100
4.75 mm	57-75	76-94
2.36 mm	44-62	62-80
1.18 mm	32-50	48-66
0.600 mm	22-40	34-52
0.300 mm	13-29	23-39
0.150 mm	7-19	13-25
0.075 mm	3-6	3-9

TABLE I. AGGREGATE GRADATIONS FOR PLANT-MIXED
COLD-LAID BITUMINOUS PAVEMENTS

Percent by Weight Passing Square-Mesh Sieve		
Sieve Size	No. 1	No. 2
1/2 inch	100	---
3/8 inch	77-95	100
No. 4	57-75	76-94
No. 8	44-62	62-80
No. 16	32-50	48-66
No. 30	22-40	34-52
No. 50	13-29	23-39
No. 100	7-19	13-25

TABLE I. AGGREGATE GRADATIONS FOR PLANT-MIXED
COLD-LAID BITUMINOUS PAVEMENTS

Percent by Weight Passing Square-Mesh Sieve		
Sieve Size	No. 1	No. 2
No. 200	3-6	3-9

TABLE II. JOB-MIX TOLERANCES

Material	Tolerance, Plus or Minus
Aggregate passing 4.75 mm sieve or larger	5 percent
Aggregate passing Nos. 2.36, 118, 0.6, and 0.3 mm sieves	4 percent
Aggregate passing No. 0.075 mm	1.5 percent
Bitumen	0.25 percent
[Liquefier	0.20 percent]
Temperature	-4 degrees C

TABLE II. JOB-MIX 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 No. 200 sieve	1.5 percent
Bitumen	0.25 percent
[Liquefier	0.20 percent]
Temperature	25 degrees F

-- End of Section --