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USACE / NAVFAC / AFCESA **UFGS-02713 (August 2004)**

Preparing Activity: NAVFAC **Superseding UFGS-02713N (September 1999)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 23 June 2005
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DIVISION 02 - SITE CONSTRUCTION

SECTION 02713

CEMENT STABILIZED [BASE] [SUBBASE] COURSE AT AIRFIELDS AND ROADS

08/04

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SECTION 02713

CEMENT STABILIZED [BASE] [SUBBASE] COURSE AT AIRFIELDS AND ROADS
08/04

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NOTE: This guide specification covers the requirements for portland cement-stabilized base or subbase for airfields, roads and streets.

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.
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NOTE: The following information should be shown on the project drawings:

1. Location, type and thickness of base and subbase materials.

2. Location of on-site aggregate sources when applicable.
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PART 1 GENERAL

1.1 REFERENCES

****
NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide

specifications.
****

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 140	(2003) Emulsified Asphalt
AASHTO M 208	(2001) Cationic Emulsified Asphalt
AASHTO M 81	(1992; R 2000) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; R 2000) Cut-Back Asphalt (Medium-Curing Type)

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2004) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(2004a) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 29/C 29M	(1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 59/C 59M5	(2000; Rev A) Blended Hydraulic Cements
ASTM C 59/C 59M5M	(1997) Blended Hydraulic Cements (Metric)
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1632	(1996) Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory

ASTM D 1633	(2000) Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2027	(1997; R 2004) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1997; R 2004) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 420	(1998; R 2003) Site Characterization for Engineering Design, and Construction Purposes
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 558	(2003) Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
ASTM D 559	(2003) Wetting and Drying Compacted Soil-Cement Mixtures
ASTM D 560	(2003) Freezing and Thawing Compacted Soil-Cement Mixtures
ASTM D 75	(2003) Sampling Aggregates
ASTM D 977	(2003) Emulsified Asphalt

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 81-123	(1981) Occupational Health Guideline for Chemical Hazards, (Vols. 1, 2, and 3)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS CCC-C-467	(Rev C) Cloth, Burlap, Jute (or Kenaf)

1.2 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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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 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

[Subbase aggregate]

[Base course aggregate]

[Flexible pavement base course]

[Rigid pavement base course]

Submit duplicate samples of material to be subjected to field testing, as required in paragraph entitled "Field Sampling and Testing." Select the source(s) and provide sample of the aggregate listed above before the materials are required for mix design. [Submit duplicate samples for approval at least 30 days prior to start of work. Do not use aggregate prior to receiving written approval of the samples]. Investigate new sources in accordance with ASTM D 420. Take samples from pits, borrow areas, stockpiles or other locations in conformance with ASTM D 75 and test. For determining optimum moisture content and maximum density, samples of the blended mixture(s) shall be representative of the processing area before addition of cement.

****

NOTE: Select the type of base or subbase for the required construction: airfields, roads, and streets.

****

SD-05 Design Data

****

NOTE: Specify at least 28 days for approval of mix designs. Identify the type of stabilized course.

****

****

NOTE: In wet-dry and freeze-thaw conditions, cement may be added to the above composite materials to obtain stability and load-carrying capacity as measured by the compressive strength, however:

(1) If high quality granular materials are not available, the use of substandard materials fully stabilized with cement is acceptable. For such materials, the amount of cement should be determined by ASTM test methods of wetting-and-drying, and/or freezing-and-thawing. Marginal materials having high plasticity or otherwise undesirable characteristics, should be carefully evaluated based on a percent weight loss not to exceed 14 percent as determined by ASTM D 559 or ASTM D 560. Gradations shall be limited to not more than 45 percent of the material should be retained on the 4.75 mm No. 4 sieve, and the maximum size of materials limited to 25 or 19 mm one or 3/4 inch.

(2) If the soil and aggregate mixture meet the requirements of the gradations given, the use of the test procedures in accordance with ASTM D 559 and ASTM D 560 may be waived and the required amount of cement may be determined on the basis of compressive strength. Maximum size of material for base course is usually limited to 38 mm 1 1/2 inches, with between 30 and 45 percent retained on the 4.75 mm No. 4 sieve. When freezing-and-thawing or wetting-and-drying does not occur in a specific location, the freeze-thaw test is valuable in that the test will indicate the internal structural weakness of the soil-cement-aggregate mixture, which otherwise appears more slowly under natural-occurring temperature or moisture fluctuations above the freezing point. The freeze-thaw and wet-dry tests determine the minimum cement content required to produce a structural material that will resist damage due to volume changes and are not meant to simulate specific climate environments.

(3) NOTE FOR TABLE I: Use Table I and Gradation (1) as a requirement of import materials for airfield or major road or street applications. For non-critical applications, design an applicable gradation [(2)] dependent upon the availability of local materials, or delete Table 1 in its entirety.

****

Mix design

Job-mix formula

Submit a contractor-furnished mix design [thirty] [_____] days prior to commencement of work. After receiving approval of the mix design, submit a job-mix formula.

SD-06 Test Reports

****
NOTE: Specify test reports for soil-cement loss if such tests are required at paragraph entitled "Weight Loss of Specimens."
****

Aggregate plasticity index

Sieve analysis of aggregate

Compressive strength

[Soil-cement weight loss]

[Aggregate percentage of wear]

[Existing soil moisture-density]

Liquid limit of aggregates

Plasticity index of aggregates

Sieve analysis of combined material

Compressive strength of soil aggregate material

Optimum moisture content and maximum density

Submit results of ASTM C 136 sieve analysis and ASTM D 1633 compressive strength testing.

SD-07 Certificates

Portland cement

Location of aggregate source

Method of installation

Construction equipment list

1.3 DELIVERY AND STORAGE

1.3.1 Cement

Store cement immediately upon receipt. Store cement in bags on pallets in an airtight and weatherproof structure. Elevate pallets above surface a distance sufficient to prevent the absorption of moisture. Stack bags

close together to reduce circulation of air, but do not stack against outside walls. The manner of storage shall permit easy access for inspection and identification of each shipment. Transfer bulk cement to elevated airtight and weatherproof bins. Cement shall be free-flowing and free of lumps. Test cement that has been in storage longer than 6 months by standard mortar tests or loss on ignition test and use such cement only with approval of the Contracting Officer. Show the date of receipt of shipment on each bag of cement.

1.3.2 Aggregates

Store aggregates in a manner to minimize segregation and contamination. To prevent the inclusion of contaminants, store aggregates on surfaces covered with tightly laid wooden planks, sheet metal, or other hard and clean material. Store aggregates of different sizes in separate piles. Form stockpiles of coarse aggregates by spreading the materials in horizontal layers not exceeding 1.5 meters 5 feet in depth. Stockpiling may be the single-core type, cast and spread type or truck-dumped type. Should the coarse aggregates become segregated, re-mix the stockpile to conform to specified grading requirements. Aggregate obtained from below existing watertable shall be drained before use.

1.3.3 Curing Materials

Deliver curing materials in original sealed containers showing trade name, specification number and manufacturer's name. Store in a manner that will prevent damage and contamination.

1.4 ENVIRONMENTAL CONDITIONS

Do not construct [base] [subbase] when weather conditions will detrimentally affect quality of the finished course. Apply cement when the ambient temperature is a minimum of 5 degrees C 40 degrees F and rising. Do not apply cement to aggregate materials that are frozen or contain frost. If ambient temperature falls below 5 degrees C 40 degrees F, protect completed cement-treated areas against freezing. Reprocess, reshape, and recompact damaged material. Provide drainage to prevent water from collecting or standing stabilized areas, and on the pulverized, mixed, or partially mixed materials.

1.5 QUALITY ASSURANCE

1.5.1 Required Data

Submit location of aggregate source in writing. Do not construe Government approval of samples as approval of the source of the samples. Submit a construction equipment list, and method of proportioning, spreading, compacting and curing to be used, [thirty] [_____] days prior to commencement of work.

PART 2 PRODUCTS

2.1 CEMENT

****

NOTE: Specify the type of cement, as required. Example: When base materials are in contact with soils having a moderate sulfate content (exceeding 0.20 percent or 2000 ppm), specify Type II, low

alkali cement.
****

ASTM C 150, [Type I] [Type I or II] [Type II, low alkali] or ASTM C 59/C 59M5M ASTM C 59/C 59M5 [Type IP] [Type I PM].

2.2 AGGREGATE MATERIALS

****
NOTE: Select the type of base or subbase for the required construction: airfields, roads, and streets.
****

[2.2.1 Subbase Aggregate

****
NOTE: Choose this paragraph or the paragraph and subparagraphs below, entitled "Base Course Aggregate."
****

****
NOTE: Select gradation requirements and other soil index values appropriate for base course or subbase course materials. Where high quality granular materials are not available, select materials which may be available on, or adjacent to, the project site. Aggregate should be clean and free from vegetable matter and other deleterious substances. Also aggregates may be imported from local or commercial sources. Material should consist of sand-clay mixtures; gravel; crushed stone, slag or gravel; or combinations of the above. Percentage of wear should not exceed 50 percent; dry unit weight of slag should not be less than 1040 kilograms per cubic meter 65 pounds per cubic foot; liquid limits and plasticity indexes for flexible or rigid pavements should be in accordance with second technical "NOTE" in paragraph entitled "SD-05, Design Data."
****

Select aggregate materials which conform to ASTM D 2487, classified as GW, GP, GM, GC, SW, SM, SC, SP or combination(s) thereof except as modified. Sample materials in accordance with ASTM D 75. Plasticity index shall not exceed 12 or liquid limit not more than 21 when tested in accordance with ASTM D 4318. [Dry weight of air cooled, blast-furnace slag shall be not less than [1041] [1121] [_____] kilograms per cubic meter [65] [70] [_____] pounds per cubic foot in accordance with ASTM C 29/C 29M]. Perform sieve analysis in accordance with ASTM C 117 AND ASTM C 136. Conform to the following gradation limits:

TABLE I

Sieve Designation	Percent by Weight Passing (1)	[(2)]
4.75 mm	55 - 100	[_____]
2.00 mm	36 - 60	[_____]
150 micrometers	3 - 20	[_____]

TABLE I

Sieve Designation	Percent by Weight Passing (1)	[(2)]
No. 4	55 - 100	[_____]
No. 10	36 - 60	[_____]
No. 100	3 - 20	[_____]

][2.2.2 Base Course Aggregate

****
NOTE: Choose this paragraph and subparagraphs or the paragraph above, entitled "Subbase Aggregate."
****

****
NOTE: Select gradation requirements and other soil index values appropriate for base course or subbase course materials. Where high quality granular materials are not available, select materials which may be available on, or adjacent to, the project site. Aggregate should be clean and free from vegetable matter and other deleterious substances. Also aggregates may be imported from local or commercial sources. Material should consist of sand-clay mixtures; gravel; crushed stone, slag or gravel; or combinations of the above. Percentage of wear should not exceed 50 percent; dry unit weight of slag should not be less than 1040 kilograms per cubic meter 65 pounds per cubic foot; liquid limits and plasticity indexes for flexible or rigid pavements should be in accordance with second technical "NOTE" in paragraph entitled "SD-05, Design Data."
****

[Crushed] [and] [uncrushed] coarse and fine aggregate. Sample materials in accordance with ASTM D 75. Material passing the 425 micrometers No. 40 sieve shall have a maximum liquid limit of [25] [_____] and a maximum plasticity index of 12 in accordance with ASTM D 4318. The aggregate sand equivalent is to exceed 18. Perform sieve analysis in accordance with ASTM C 117 and ASTM C 136.

[2.2.2.1 Flexible Pavement Base Course

****

NOTE: Choose this subparagraph or the subparagraph below, entitled "Rigid Pavement Base Course" when using the paragraph above, entitled "Base Course Aggregate."

****

Plasticity index of less than [6] [_____] and liquid limit less than [25] [_____] in accordance with ASTM D 4318. [Percentage of wear less than [50] [_____] percent in accordance with ASTM C 131.]

][2.2.2.2 Rigid Pavement Base Course

Plasticity index of less than [8] [_____] and liquid limit less than [25] [_____] in accordance with ASTM D 4318.

]2.2.2.3 Gradation of Aggregate

****

NOTE: Aggregate for use in Gradation (1) of Table II when mixed with Type II modified portland cement in an amount not to exceed 5 percent by weight of the dry aggregate and compacted at optimum moisture content, the minimum compressive strength of the compacted mixture shall be 5171 kPa 750 psi at 7 days. Aggregate for use in Gradation (2) of Table II cement treated base shall have a compressive strength of 1725 kPa 250 psi before mixing with Type II modified portland cement in an amount not to exceed 2 1/2 percent by weight of the dry aggregate and compacted at optimum moisture content to a minimum compressive strength of 4136 kPa 600 psi at 7 days. For specially designed gradations, [(3)], of Table II, see second technical "NOTE" in paragraph entitled "Cement Content."

****

Conform to the following:

TABLE II

Sieve Designation	Percent by Weight Passing		
	(1)	(2)	[(3)]
75 mm		100	[_____]
63 mm		90-100	[_____]
50 mm			[_____]
37.5 mm			[_____]
25.0 mm	100		[_____]
19.0 mm	90-100		[_____]
12.5 mm			[_____]
4.75 mm	55-70	55-70	[_____]
2.00 mm			[_____]
600 micrometers	12-55		[_____]
425 micrometers			[_____]
75 micrometers	3-15	3-20	[_____]

TABLE II

Sieve Designation	Percent by Weight Passing (1)	(2)	[(3)]
3 inch		100	[_____]
2 1/2 inch		90-100	[_____]
2 inch			[_____]
1 1/2 inch			[_____]
1 inch	100		[_____]
3/4 inch	0-100		[_____]
1/2 inch			[_____]
No. 4	5-70	55-70	[_____]
No. 10			[_____]
No. 30	2-55		[_____]
No. 40			[_____]
No. 200	3-15	3-20	[_____]

]2.3 WATER

Provide potable, clean, fresh and free from injurious amounts of oils, acid, salt, alkali, organic matter and other substances deleterious to the hardening of soil-cement.

2.4 CEMENT-TREATED [BASE] [SUBBASE]

****
NOTE: Select the type of base or subbase for the required construction: airfields, roads, and streets.
****

Uniformly blend aggregates and cement together, mixed with water. Provide cement treated [base] [subbase] produced with the following characteristics:

2.4.1 Compressive Strength

****
NOTE: Determine the load capacity requirements of the base. Select method (freeze-thaw method is more critical) for determining cement contents for soil-aggregate mixtures based on the nature of the available soil materials, climate conditions (wet-dry or freeze-thaw), and base requirements. For substandard granular materials, select wet-dry and/or freeze-thaw tests for mix design and the cement contents to determine if the hardened cement-treated materials will remain hard or soften from exposure to severe moisture variations and alternate freezing and thawing conditions. Specify compressive strength tests to evaluate the hardened characteristics of the soil-cement mixtures. Site investigation is necessary to determine the nature of existing on-site materials, and, if necessary, the availability and need of imported select materials. The specifier should insure that the following information is covered:

(1) Identify the type of base in the project specification and on the drawings.

(2) Specify the type or quality of the aggregate or soil-aggregate material before cement is added.

(3) Specify test methods for determining the exact percentage of cement required for the select materials. Establish criteria for selecting the cement content to produce hard, durable cement stabilized base or subbase course. For substandard materials, specify maximum soil-cement losses for specimens tested that contain two or more different cement contents at 12 cycles of wetting-and-drying test or freezing-and-thawing test. For all types of material, specify compressive strength determinations of soil-cement mixtures for preparation of mix design and for field control tests. (Minimum unconfined compressive strengths: 2064 kPa 300 psi for subbase and 4481 kPa 650 psi for base course. See MIL-HDBK-1021/4).

****

Unconfined compressive strength at optimum moisture content a minimum of [4481] kPa [650] psi [_____] at 7 days when tested in accordance with ASTM D 1633.

2.4.2 Cement Content

****

NOTE: Select the applicable paragraph(s) from the following:

****

[When blended with soil aggregates and water, mixture shall meet the indicated compressive strength not to exceed [[_____] percent of cement by weight of drying aggregate for base] [and] [[_____] percent of cement by weight of dry aggregate for subbase].]

****

NOTE: Use this paragraph when the cement content is known or can be approximated by verification from local material sources. If such information is not available, substitute with an appropriate basis of bid paragraph or use unit prices. When conditions are favorable cement content may be as low as 1 1/2 percent of weight of dry aggregate. Should design requirements for cement content be higher than 4 percent for subbase and 6 percent for base course, compare and consider other more cost effective means of accomplishment. Alternate or additive treatments with lime, fly ash, filter cloth etc. should also be considered. Compressive strength minima/maxima indicated in second technical "NOTE" in paragraph entitled "SD-05, Design Data."

****

[When blended with imported aggregates and water, mixture is to meet

indicated compressive strength while not exceeding [[6] [_____] percent of cement by weight of aggregate for base] [[3] [_____] percent of cement by weight of aggregate for subbase].]

2.4.3 Weight Loss of Specimens

****
NOTE: Select the applicable paragraph(s) from the following:
****

****
NOTE: Select both of these tests together, or use the freeze-thaw test only (it is the more critical).
****

[Less than 14 percent when subjected to 12 cycles of wet-dry tests in accordance with ASTM D 559.]

****
NOTE: Select both of these tests together, or use the freeze-thaw test only (it is the more critical).
****

[Less than 14 percent when subjected to 12 cycles of freeze-thaw tests in accordance with ASTM D 560.]

2.5 MIX DESIGN

****
NOTE: Specify 7-day compressive tests when high-quality granular materials are specified. However, if available materials have between 37 and 63 percent retained on the 4.75 mm No. 4 sieve or if materials are substandard in quality (cohesive) or are excessive in fines, specify freezing and thawing (ASTM D 560) tests in conjunction with compressive tests.
****

****
NOTE: Select the type of base or subbase for the required construction: airfields, roads, and streets.
****

Provide a mix design and job-mix formula for [plant mix material] [mixed-in-place material] for [subbase] [base] prepared by an approved laboratory. Show amount of cement needed and the moisture-densityrelations of the composite aggregate mixture in accordance with ASTM D 558. Mix design shall include certified test reports showing results of tests [and results of 7-day compressive tests] [and results of 7-day compressive tests and wetting and drying tests] [and results of 7-day compressive test and the freezing and thawing tests]. Mold a minimum of [two] [three] [four] cylinders of each cement mixture in accordance with ASTM D 1632, except that test specimen molds shall be 100 mm 4 inches in diameter by 117 mm 4.6 inches high. Cure and test specimens in accordance with ASTM D 1633 with the following exceptions: (1) cure specimens in moist room at 100 percent relative humidity for 7 days; and (2) after curing, cap specimens and

immerse in water at room temperature for a period of 4 hours prior to testing. Before or during construction, if the source of any materials is changed, or if there is any variation in quality of materials furnished, conduct additional tests and adjust amount of cement as required to obtain the specified results.

2.6 CURING MATERIALS

2.6.1 Bituminous Material

****
NOTE: Cutback and Emulsified Asphalts: Prior to specifying cutback and emulsified asphalts contact the State, County or Local Air Pollution Control District for guidelines as to which asphalt material is allowed in the applicable area.
****

2.6.1.1 Liquid Asphalt

ASTM D 2027 or AASHTO M 82, Type [MC-70] [MC-250] for medium-curing asphalt; ASTM D 2028 or AASHTO M 81, type [RC-70] [RC-250] for rapid-curing asphalt.

2.6.1.2 Emulsified Asphalt

ASTM D 977 or AASHTO M 140, Type [RS-1] [RS-2] or AASHTO M 208[CRS-1] [CRS-2].

2.6.2 Burlap

FS CCC-C-467.

2.6.3 Polyethylene Sheeting

White, opaque, free of defects, uniform in appearance, a minimum 0.10 mm 4 mils thick. Water retention requirements shall be in accordance with ASTM C 171.

2.6.4 Polyethylene-Coated Burlap

White, opaque, 0.10 mm 4 mil thick film, impregnated into, extruded on, or permanently affixed to surface of one side of burlap weighing not less than 0.30 kilograms per square meter 9 ounces per square yardprior to coating. Water retention requirements shall be in accordance with ASTM C 171.

2.6.5 Waterproof Paper

White topside. Water retention requirements shall be in accordance with ASTM C 171.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Cleaning and Grading

****
NOTE: Select the type of base or subbase for the

required construction: airfields, roads, and streets.

****

****

NOTE: Specify this paragraph where subgrade or subbase preparation is required. Add compaction requirements if Section 02301, "Earthwork for Structures and Pavements," is not utilized.

****

Clean debris from the area to be stabilized. Inspect [subgrade] [subbase] for capability to withstand without displacement, compaction specified for the aggregate-cement mixture. Correct ruts, soft or yielding areas in [subgrade] [subbase] by removing or adding material or aerating or wetting materials as required. [Clear and grub,] grade [proof roll] and shape the area to be stabilized to conform to lines, grades, and cross sections prior to placing cement-treated course [according to Section 02300 EXCAVATION] [with a minimum compaction of [_____] percent of maximum density in accordance with ASTM D 1557.] The surface shall be approved by the Contracting Officer prior to [base] [subbase] course placement. Determine moisture-density relationship of existing soils in accordance with ASTM D 1557. Perform laboratory tests on existing materials prior to initial construction.

3.1.2 Grade Control

Maintain lines and grades indicated. When the stabilized course is part of a pavement which is to meet a fixed grade, construct a transition of sufficient length to minimize abrupt or noticeable grade changes.

3.1.3 Operation of Government Borrow Pits

Perform cleaning, stripping, and excavating in opening or operation of pits or quarries. Open pits in a manner that will expose vertical faces of the deposit for suitable working depths. Obtain materials excavated from pits in successive vertical cuts extending through exposed strata. Waste pockets or strata of unsuitable materials overlying or occurring in the deposit. Methods of operating pits and processing and blending of materials may be changed or modified by the Contracting Officer without adjustments in the contract price when such action is necessary to obtain material conforming to specified requirements. Upon completion of work, leave condition of pits in accordance with Section [01575N TEMPROARY ENVIRONMENTAL CONTROLS.]

3.2 MIXING AND PLACING

3.2.1 Mixing

****

NOTE: Specify central mixing plant when cement-stabilized base is used under rigid airfield pavements which have butt-type construction joints without load transfer devices and for all airfield base course applications under flexible pavement. For soil-cement subgrade or subbase, specify mixed-in-place method if mixing of cement to on-site native materials or to import materials is required at the site of the work. The method may also be

used for subbase under rigid airfield pavements when butt-type construction joints are required in contracts. Central-plant mixing is preferred for cement stabilization for finer materials. (See DM 5.4 and MIL-HDBK 1021/4).

****

Mix cement and aggregate [in a central mixing plant] [in a traveling plant] [in place]. Proportion aggregate by weight or by volume in such quantities that specified gradation, bearing ratio, liquid limit, and plasticity index requirements are met after [base] [subbase] has been placed and compacted. Proportion cement by weight in accordance with job-mix formula. Provide necessary moisture content for specified compaction by addition of water by weight or by volume. Mixing operations shall produce uniform blending and the method of discharging shall not produce segregation.

[3.2.2 Plant Mix Materials

****

NOTE: Select the applicable paragraph(s) from the following:

****

****

NOTE: Specify central mixing plant when cement-stabilized base is used under rigid airfield pavements which have butt-type construction joints without load transfer devices and for all airfield base course applications under flexible pavement. For soil-cement subgrade or subbase, specify mixed-in-place method if mixing of cement to on-site native materials or to import materials is required at the site of the work. The method may also be used for subbase under rigid airfield pavements when butt-type construction joints are required in contracts. Central-plant mixing is preferred for cement stabilization for finer materials. (See DM 5.4 and MIL-HDBK 1021/4).

****

Materials from several sources which are blended and mixed or processed in a central mixing plant or in a traveling mixing plant. [Prepare base course materials for airfield portland cement concrete pavement in a central mixing plant.] Add cement in accordance with job-mix formula. Uniformly mix materials with required amount of water. After mixing is completed, transport the materials to, and spread on, prepared underlying course without undue loss of the moisture content.]

[Mixed-In-Place Materials

Materials which are proportioned and mixed or blended in place. Add cement in accordance with the job-mix formula. Apply water uniformly prior to and during the mixing operation, if necessary, to maintain required moisture content.

]3.2.3 Placing

****

NOTE: Specify central mixing plant when

cement-stabilized base is used under rigid airfield pavements which have butt-type construction joints without load transfer devices and for all airfield base course applications under flexible pavement. For soil-cement subgrade or subbase, specify mixed-in-place method if mixing of cement to on-site native materials or to import materials is required at the site of the work. The method may also be used for subbase under rigid airfield pavements when butt-type construction joints are required in contracts. Central-plant mixing is preferred for cement stabilization for finer materials. (See DM 5.4 and MIL-HDBK 1021/4).

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[Loose] [compacted] thickness of individual layers shall not exceed [200] mm [8] inches [_____]. When stabilized course is constructed in more than one layer, clean previously constructed layers of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used where permitted by the Contracting Officer. Not more than 60 minutes shall elapse between start of moist mixing and start of compaction of treated layer. Not more than 30 minutes shall elapse between placement of cement-treated aggregates in adjacent lanes. If elapsed time exceeds 30 minutes, provide construction joint. Layers are to be uniform in thickness.

3.2.4 Compaction

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NOTE: Specify degree of compaction in accordance with DM-5.4 or MIL-HDBK-1021/4 for flexible and rigid pavements. (For example: Specify 100 percent compaction for base course of flexible airfield pavements; see MIL-HDBK-1021/4).

****

With the exception of materials placed by traveling-plant method, thoroughly loosen blended materials to full depth by disks or scarifiers and determine moisture content of mixture and compare with laboratory optimum moisture content. Begin rolling and compaction when moisture content is within plus or minus 2 percentage points of optimum moisture content. Compact layers of [base] [subbase] course materials. Continue compaction until layer or layers are compacted through full depth of [base] [subbase]. Begin rolling at outside edge of a minimum one half the width of the roller. Subsequent rolled trips shall be slightly different lengths. In places not accessible to rolling equipment, compact the material by mechanical tamping. Continue blading, rolling and tamping until surface is smooth and free from waves and irregularities. Determine in-place density of compacted cement-aggregate mixture in accordance with ASTM D 1556 with minimum compaction of [100] [_____] percent of maximum density in accordance with ASTM D 558.

3.3 FINISHING

3.3.1 Finishing

After compaction, moisten surface if necessary, and shape to required lines, grades and cross section. Lightly scarify surface to eliminate imprints made by the compacting or shaping equipment. Thoroughly compact surface to specified density with rubbertired rollers and smooth-wheel

tandem rollers to provide a smooth, dense, uniform surface free of surface checking, ridges or loose material and conforming to crown, grade and line indicated. Complete finishing operations within 2 hours after completion of mixing operations. In places not accessible to finishing and shaping equipment, compact mixture with mechanical tampers to density specified; shape and finish by hand methods. Reprocess with additional cement, the portion of the compacted mix with density less than that specified, or that has not properly hardened, or that is improperly finished.

3.3.2 Edges of Stabilized Course

Place material along edges of the stabilized course in a quantity that will compact to thickness of course being constructed. If constructed in two or more layers, place in a quantity that will compact to thickness of each layer. Allow in each operation, a minimum width of 300 mm one foot of the shoulder to be rolled and compacted simultaneously with each layer of the stabilized course.

3.3.3 Thickness Control

Where average measured thickness of stabilized course is more than 13 mm 1/2 inch deficient in thickness, conduct additional tests and correct deficiencies as directed by the Contracting Officer. Correct excesses in thickness if so directed by the Contracting Officer. Average job thickness is the average of the job measurements determined as specified in paragraph entitled "Thickness Test," in this section, but within 13 mm 1/2 inch of the thickness indicated. Replace material removed for test holes or for deficient thickness reconstruction and compact with new soil-cement mixture.

3.3.4 Construction Joints

At the end of each work day, form a straight transverse construction joint by cutting back into completed work to form a true vertical face free of loose or shattered material. Remove improperly compacted material along construction joints and replace with soil-cement that is mixed, moistened, and compacted in accordance with this specification.

3.4 CURING AND PROTECTION

3.4.1 Curing, Protection and Cover

Immediately after completion of finishing operations, but no later than the end of each days stabilization work, protect the surface against rapid drying for seven days by one of the methods specified. In addition, protect the stabilized area from freezing during the curing period or until hardened, whichever period is longer.

3.4.2 Bituminous Material

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NOTE: Cutback and Emulsified Asphalts: Prior to specifying cutback and emulsified asphalts contact the State, County or Local Air Pollution Control District for guidelines as to which asphalt material is allowed in the applicable area.

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NOTE: For the specified bituminous materials, the

recommended application temperatures may be selected from the following table and inserted in the blanks:

LIQUID ASPHALT	DEGREES C
RC-70 or MC-70	49 - 85
RC-250 or MC-250	74 - 110
EMULSIFIED ASPHALT	
RS-1	24 - 54
RS-2	43 - 71
CRS-1	24 - 54
CRS-2	43 - 85
LIQUID ASPHALT	**DEGREES F**
RC-70 or MC-70	120 - 185
RC-250 or MC-250	165 - 230
EMULSIFIED ASPHALT	
RS-1	75 - 130
RS-2	110 - 160
CRS-1	75 - 130
CRS-2	110 - 185

****

Immediately after finishing, clean surface of loose and foreign matter. Ensure that surface contains sufficient moisture, by applying water in a fine spray as required, to prevent penetration of bituminous material. Using a distributor, apply bituminous material at a temperature between [_____] and [_____] (degrees C [_____] and [_____] (degrees F and at a rate between [0.90] and [1.13] [_____] liters per square meter [0.20] [_____] and [0.25] [_____] gallons per square yard. Treat areas inaccessible to, or missed by distributor using manually operated hose attachment. Apply sand at [_____] (kilograms per square meter [_____] (pounds per square yard to treated surfaces requiring protection from traffic.

3.4.3 Burlap or Cotton Mats

Burlap covers consisting of two or more layers of burlap having a combined weight of 0.47 kilograms or more per square meter 14 ounces or more per square yard in a dry condition. Burlap may be either new or have been used only for curing concrete. Cotton mats and burlap strips shall have a length, after shrinkage, at least 300 mm one foot greater than required to cover the entire width and edges of finished stabilized area. Mats shall overlap each other at least 150 mm 6 inches. Thoroughly wet mats before placing and keep them continuously wet and in intimate contact with surface and edges of finished stabilized area during entire curing period.

3.4.4 Waterproof Paper, Blankets, or Impermeable Sheets

Moisten surface with a fine spray of water, then cover with waterproof-paper, waterproof-paper blankets, polyethylene-coated burlap blankets, or polyethylene sheeting. Thoroughly saturate polyethylene-coated burlap with water before placing. Place waterproof-paper blankets, polyethylene-coated burlap blankets, or polyethylene sheeting with the light-colored side up. Extend sheets over

the edges of stabilized area and secure in place during the curing period. Overlap edges of sheets a minimum of 300 mm one foot and securely cement or tape to form continuous closed joints. Immediately repair tears and holes in sheets. Reject curing material that does not provide a continuous cover.

3.4.5 Moist Curing

Apply a 50 mm 2 inch covering of soil or minimum 2.17 kilograms per square meter 4 pounds per square yard of straw. Moisten material initially and keep moistened throughout curing period.

3.5 MAINTENANCE AND TRAFFIC CONTROL

3.5.1 Maintenance

After stabilization is completed, maintain [base] [subbase] except where succeeding course is under construction. Maintenance shall include drainage and watering as required to maintain course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness or density which develop during maintenance to conform to requirements specified. Maintain surface moisture by lightly sprinkling with water to prevent dust.

3.5.2 Traffic Control

Completed portions of the cement-stabilized area may be opened to light, local traffic provided the curing process is not impaired and to other traffic after curing period has elapsed, provided that the cement-stabilized course has hardened sufficiently to prevent surface marring or distortion by equipment or traffic. Do not permit heavy equipment on the area during protection and curing periods. Necessary cement and water may be hauled over the area with pneumatic-tired equipment on approval of the Contracting Officer. Protect finished portions of cement stabilized [base] [subbase] from traffic of equipment used in constructing adjoining sections in a manner to prevent marring or damaging completed work.

3.6 SAFETY REQUIREMENTS

In addition to Safety Requirements contained within the Contract Clauses; prevent employee respiratory, eye or skin contact with Portland Cement during wet or dry mixing or of cutback asphalts during transport or application. Provide and require employee to use and dispose or clean the following in accordance with the pertinent provisions of NIOSH 81-123:

a. Impervious: Clothing, boots and gloves.

b. Splash-proof safety goggles and face shields.

c. Respiratory protection equipment.

3.6.1 Additional Safety Requirements for Cutback Asphalts

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NOTE: Prior to specifying cutback and emulsified asphalts contact the State, County or Local Air Pollution Control District for guidelines as to which asphalt material is allowed in the applicable area.

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Application temperatures of asphalt cutbacks specified usually exceed flash point of the material. Take suitable safety precautions to prevent flashing of asphalt. Exercise the following minimum safety precautions:

a. Do not permit open flames or sparks close to the cutback asphalts. Apply controlled heat in heating kettles, mixers, distributors, or other equipment designed and approved for the purpose.

b. Do not use open flames to examine drums, tank cars, or other containers or cutback asphalts.

c. Properly and fully vent vehicles transporting cutback asphalts.

d. Permit only experienced personnel to supervise the handling of cutback asphalt materials.

e. Comply with all applicable intrastate and interstate commerce regulations for transporting cutback asphalts.

3.7 FIELD SAMPLING AND TESTING

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NOTE: Specify duplicate samples for large projects which will require five or more days of continuous operation in processing and placement of base materials. In subsequent paragraphs, specify frequency of sampling according to size of proposed contract.

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In addition to provisions set forth elsewhere in this contract, specified sampling and testing shall be conducted by an approved laboratory. [Provide duplicate samples to the Contracting Officer on the average of [_____] samples a [week] [month]. Take duplicate samples at the same time and in the same manner as the original.]

3.7.1 Sampling

3.7.1.1 Aggregates at Source

Collect samples by taking three incremental specimens at random from source material to make a composite sample a minimum of 68 kilograms 150 pounds. Thereafter, during the course of the project, take one random sample from each [4000] metric tons [4000] [_____] tons of material or a day's run, whichever is less. Take the samples at random to make a composite sample of not less than 22 kilograms 50 pounds. Repeat the sampling when source of material is changed or when unacceptable deficiencies or variations from specified grading of materials are found in testing.

3.7.1.2 Cement-Treated Materials

After cement and water have been added to the aggregates, thoroughly blend the mixture. Place a sample in a closed and insulated container, before cement hydration is completed, and promptly transport to the laboratory.

3.7.1.3 Sample Identification

Place each sample in a clean container and securely close. Identify each sample with a tag containing the following information:

Contract No.:

Sample No.: Quantity:

Date of Sample:

Sampler:

Source:

Intended Use:

For Testing:

3.7.2 Testing

3.7.2.1 Aggregate Testing

Perform the following tests on each sample of the specified aggregate and existing soil-aggregate materials:

a. Sieve analysis of combined material: ASTM C 136 and ASTM D 1140.

b. Liquid limit: ASTM D 4318.

c. Plasticity index: ASTM D 4318.

Perform other specified tests when there is a change of aggregate source. Material shall conform to approved test results developed for the mix design.

3.7.2.2 Compressive Tests

Test composite sample of cement treated materials for compressive strength. Mold specimens in accordance with ASTM D 558, Method A or B (as appropriate), cure and test according to ASTM D 1632 and ASTM D 1633. Test specimens for compressive strength at 7 days, and submit results to the Contracting Officer.

3.7.2.3 Smoothness Test

Test compacted surface with a 3 m 10 foot straightedge applied parallel with, and at right angles to center line of paved area, and correct deviations in excess of 13 mm 1/2 inch. When [base] [subbase] course is to be constructed in more than one layer, specified smoothness requirements apply only to the top layer.

3.7.2.4 Thickness Test

Measure thickness of the [base] [subbase] course using 75 mm 3 inch diameter test holes through the full depth for each [420] square meters [500] [_____] square yards of completed course. Refill holes with cement treated material and compact.

3.7.2.5 Field Density Tests

Perform field density tests in accordance with ASTM D 1556 or ASTM D 2922 and ASTM D 3017. Perform one field density test for each [1675] square meters [2000] [_____] square yards for each layer of [base] [subbase] material placed.

3.7.2.6 Laboratory Test

Determine optimum moisture content and maximum density relationship in accordance with ASTM D 558.

-- End of Section --