
USACE / NAVFAC / AFCEA / NASA UFGS-32 11 23 (August 2008)

Preparing Activity: USACE Superseding
UFGS-32 11 23 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2008

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SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE 08/08

NOTE: This guide specification covers the requirements for base course to be used directly under bituminous pavement 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).

Use of electronic communication is encouraged.

PART 1 GENERAL

NOTE: This guide specification is applicable to base courses placed directly beneath bituminous surface courses. The following must be taken into consideration when editing this specification.

a. The material in this specification and on the drawings should be referred to as "aggregate base course (ABC)" whenever a base course material with a California Bearing Ratio (CBR) of 80 is required. "Aggregate Base Course" should be retained in the title and the rest of the specification should be edited accordingly to retain the information

necessary for this material.

b. The material in this specification and on the drawings should be referred to as "graded-crushed aggregate base course (GCA)" wherever a base material with a CBR of 100 is required. "Graded-Crushed Aggregate Base Course" should be retained in the title and the rest of the specification should be edited accordingly to retain the information necessary for this material.

c. When this specification is to be used in projects that require both types of materials, the title of this specification should be "Aggregate and/or Graded-Crushed Aggregate Base Course". Care must then be taken to assure that the drawings clearly call out which material is being used in any particular place and that this specification is edited to retain the information for both types of materials. If only a small amount of one of these types of materials is needed for the project, consideration should be made to determine if only one of these materials should be specified and the design adjusted.

1.1 UNIT PRICES

NOTE: Delete unit price paragraphs when the work is covered by a lump-sum contract price.

1.1.1 Measurement

NOTE: Delete the method of measurement paragraph not applicable to job conditions. The provision for stockpiling should be retained or deleted, as applicable, and the brackets will be removed.

1.1.1.1 Area

Measure the quantity of [ABC] [and] [GCA] completed and accepted, as determined by the Contracting Officer, in square meters yards.

1.1.1.2 Volume

Measure the quantity of [ABC] [and] [GCA] completed and accepted, as determined by the Contracting Officer, in cubic meters yards. The volume of material in-place and accepted will be determined by the average job thickness obtained in accordance with paragraph THICKNESS CONTROL and the dimensions shown.

1.1.1.3 Weight

The tonnage of [ABC] [and] [GCA] material will be the number of metric tons tons of aggregate, [placed and accepted in the completed course] [plus the

amount] [placed in authorized stockpiles], as determined by the Contracting Officer. Deductions shall be made for any material wasted, unused, rejected, or used for convenience of the Contractor, and for water exceeding specified amount at time of weighing.

1.1.2 Payment for Quantities

Quantities of [ABC] [and] [GCA], determined as specified above, will be paid for at the respective contract unit prices, which shall constitute full compensation for the construction and completion of the [ABC] [and] [GCA].

1.1.3 Payment for Stabilization of Underlying Course

Stabilization of cohesionless subgrade or subbase courses, as specified in paragraph PREPARATION OF UNDERLYING COURSE, will be paid for as a special item on a tonnage basis. This tonnage price will include the price of extra manipulation as required.

1.1.4 Waybills and Delivery Tickets

Before the final statement is allowed, file certified waybills and certified delivery tickets for all aggregates actually used, as specified in the Submittals paragraph.

1.2 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 in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180

(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AASHTO T 224	(2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test
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 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 127	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2007a) 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 29/C 29M	(2007) 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 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and

Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM D 75

(2003) Standard Practice for Sampling Aggregates

ASTM E 11

(2004) Wire Cloth and Sieves for Testing Purposes

1.3 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.3.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.3.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.3.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 19.0 mm 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 19.0 mm 3/4 inch sieve are expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.4 SYSTEM DESCRIPTION

NOTE: If desirable, requirements for types of
equipment applicable to methods of construction
based on local conditions will be included.

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 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.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

SD-06 Test Reports

Sampling and Testing[; G][; G, [____]]
Field Density Tests[; G][; G, [____]]

Certified copies of test results for approval not less than [30] [____] days before material is required for the work.

Calibration curves and related test results prior to using the device or equipment being calibrated.

Copies of field test results within [24] [_____] hours after the tests are performed.

1.6 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section 01 45 01 USACE QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements; perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.6.1 Sampling

Take samples for laboratory testing in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Tests

Perform the following tests in conformance with the applicable standards listed.

1.6.2.1 Sieve Analysis

NOTE: Testing in accordance with ASTM D 422 will be required when the materials need to be tested for the percentage passing the 0.02 mm particle size. See paragraph Gradation Requirements.

Make sieve analysis in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. [Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422].

1.6.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D 4318.

1.6.2.3 Moisture-Density Determinations

NOTE: ASTM D 1557 will be used for maximum density determinations, if gradation 3 is used (less than 30% retained on the 19 mm (3/4") sieve). AASHTO T 180, Method D will be used for the maximum density determinations, if gradations 1 or 2 are used (more than 30% retained on the 19 mm (3/4") sieve).

Determine the laboratory maximum dry density and optimum moisture content in accordance with [ASTM D 1557] [AASHTO T 180, Method D and corrected with AASHTO T 224].

1.6.2.4 Field Density Tests

Measure field density in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 6938. [For the method presented in ASTM D 1556 use the base plate as shown in the drawing.] [For the method presented in ASTM D 6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 6938 result in a wet unit weight of soil, and ASTM D 6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 6938, on each different type of material being tested at the beginning of a job and at intervals as directed.]

1.6.2.5 Wear Test

Perform wear tests on [ABC] [and] [GCA] course material in conformance with ASTM C 131.

1.6.2.6 Soundness

NOTE: Retain this paragraph only for graded-crushed
aggregate base course.

Perform soundness tests on GCA in accordance with ASTM C 88.

1.6.2.7 Weight of Slag

NOTE: This paragraph will be omitted when it is
highly unlikely that slag will be supplied as base
course material.

Determine weight per cubic meter foot of slag in accordance with ASTM C 29/C 29M on the [ABC] [and] [GCA] course material.

1.6.3 Testing Frequency

1.6.3.1 Initial Tests

NOTE: The 0.02 mm sieve analysis requirements will
be included when frost susceptibility concerns exist.

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis [including the 0.02 mm No. 635 sieve].

- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.
- e. [Soundness].
- f. [Weight per cubic meter foot of Slag].
- g. [_____].

1.6.3.2 In Place Tests

NOTE: If recycled concrete aggregate (RCA) is proposed as an aggregate source, include the last bracketed sentence

Perform each of the following tests on samples taken from the placed and compacted [ABC] [and] [GCA]. Samples shall be taken and tested at the rates indicated. [Perform sampling and testing of recycled concrete aggregate at twice the specified frequency until the material uniformity is established.]

- a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every [250 square meters 250 square yards] [_____], or portion thereof, of completed area.
- b. Perform sieve analysis [including the 0.02 mm No. 635 sieve] on every lift of material placed and at a frequency of one sieve analysis for every [500 square meters 500 square yards] [_____], or portion thereof, of material placed.
- c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
- d. Measure the total thickness of the base course at intervals, in such a manner as to ensure one measurement for each [500] [_____] square meters yards of base course. Measurements shall be made in 75 mm 3 inch diameter test holes penetrating the base course.

1.6.4 Approval of Material

Select the source of the material [30] [_____] days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.7 ENVIRONMENTAL REQUIREMENTS

NOTE: This paragraph may be deleted in localities where freezing temperatures do not occur, and elsewhere when it is definitely known that the work will not be carried on during periods when such temperatures are to be expected. Otherwise, this

requirement will be retained, but the protective measures specified may be modified to suit local conditions and individual project requirements.

Perform construction when the atmospheric temperature is above 2 degrees C 35 degrees F. When the temperature falls below 2 degrees C 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

NOTE: Material requirements from State or other local highway agency specifications may be incorporated in contract documents for constructing aggregate base course for roads, streets, or similar use pavements if the following conditions are met:

- a. Percentage of material by weight passing the 0.075 mm (No. 200) sieve will not exceed 8.
- b. Where local conditions dictate a non-frost-susceptible material, particles passing the 0.02 mm particle size will not exceed 3 percent.
- c. Portion of the material passing the 0.425 mm (No. 40) sieve must have a liquid limit not greater than 25 and a plasticity index not greater than 5.
- d. Projects requiring not more than 600 cubic meters (750 cubic yards) of material must be approved by the Division Engineer.
- e. Projects requiring more than 600 cubic meters (750 cubic yards) must be approved by AFCESA, Navy EFD, or TSMCX prior to incorporation in the contract documents. A copy of the specifications or proper reference thereto and information regarding traffic conditions and facilities to be paved will be submitted to the AFCESA, Navy EFD or TSMCX, with the request for approval.
- f. Materials to be used for GCA must also meet the specified L.A. Abrasion and Sulfate Soundness requirements.
- g. Rounded aggregates (such as river-run gravel) will not be allowed since they do not provide sufficient interlocking action to produce the desired strengths and durability.

Provide [ABC] [and] [GCA] consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, [crushed recycled concrete,] angular sand, or other approved material. [ABC shall be free of lumps of

clay, organic matter, and other objectionable materials or coatings.] [GCA shall be free of silt and clay as defined by [ASTM D 2487](#), organic matter, and other objectionable materials or coatings.] The portion retained on the [4.75 mm No. 4](#) sieve is known as coarse aggregate; that portion passing the [4.75 mm No. 4](#) sieve is known as fine aggregate.

2.1.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

- a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.
- b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

NOTE: Verify the subgrade soil contains less than 0.3 percent of sulfates, to prevent expansive ettringite reaction with the recycled concrete. See TM 5-822-14, AFJMAN 32-1019, Appendix C for testing procedure. Otherwise, delete recycled concrete option.

c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. The recycled concrete aggregate shall have a percent of expansion not to exceed 0.08 percent, when tested in accordance with [ASTM C 1260](#). Reject recycled concrete aggregate exceeding this value. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than [1120 kg/cubic meter](#) [70 pcf](#) as determined by [ASTM C 29/C 29M](#), and shall meet all the requirements specified below.

2.1.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with [ASTM C 131](#). The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.1.2 Graded-Crushed Aggregate Base Course

NOTE: The percentages of wear and soundness applicable to the specific job will be specified. A wear value of 40 will be used except that a value up to 50 percent may be used where local experience indicates that the material is satisfactory.

GCA coarse aggregate shall not show more than [40] [50] percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with ASTM C 88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 12.5 mm 1/2 inch sieve nor 20 percent for the fraction passing the 12.5 mm 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.2.2 Graded-Crushed Aggregate Base Course

NOTE: The GCA fine aggregate will be entirely the product of crushing, but need not be of the same material crushed for the coarse aggregate. Retain only the statement describing the method of crushing desired.

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, [recycled concrete,] or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. [Fine aggregate shall be produced by crushing only particles larger than 4.75 mm No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces

in the portion passing the 4.75 mm No. 4 sieve and retained on the 2 mm No. 10 sieve, and in the portion passing the 2 mm No. 10 sieve and retained on the 0.425 mm No. 40 sieve.] [Fine aggregate shall be manufactured from gravel particles 95 percent of which by weight are retained on the 12.5 mm 1/2 inch sieve.]

2.1.1.3 Gradation Requirements

 NOTE: Specify the gradation or gradations applicable to the specific job. The maximum size of aggregates will be specified in the blank space. The frost susceptibility requirement will be deleted in areas where the material is not subject to frost action. On the basis of local conditions, the percentage passing the 0.075 mm (No. 200) sieve may be further restricted to help control the amount of particles passing the 0.02 mm (No. 635) particle size. However, the cleaner gradations can have reduced stability. If more than one gradation is maintained, the designer must edit this specification and/or the project drawings to make sure it is evident where these different gradations are to be used.

Apply the specified gradation requirements to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
-----	-----	-----	-----
50.0 mm	100	----	----
37.5 mm	70-100	100	----
25.0 mm	45-80	60-100	100
12.5 mm	30-60	30-65	40-70
4.75 mm	20-50	20-50	20-50
2.00 mm	15-40	15-40	15-40
0.425 mm	5-25	5-25	5-25
0.075 mm	0-8	0-8	0-8

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
-----	-----	-----	-----
2 inch	100	----	----
1-1/2 inch	70-100	100	----

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
-----	-----	-----	-----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.02 mm No. 635 shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

NOTE: Aggregate should be nonplastic or as nearly so as possible. Values shown are the absolute maximum allowable values for liquid limit and plasticity index.

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the [ABC] [or] [GCA] is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area. Provide line and grade stakes as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

NOTE: Investigate the availability of

Government-owned aggregate source that meets the specification requirement. If none is available, delete material in the brackets.

Clearing, stripping, and excavating are the responsibility of the Contractor. Operate the aggregate sources to produce the quantity and quality of materials meeting the specified requirements in the specified time limit. [Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and shall be left in a satisfactory condition.] Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.3 STOCKPILING MATERIAL

NOTE: In cases where material previously stockpiled under a separate contract is utilized in the construction of the base course, this requirement will be included in the specifications. When applicable, a separate item of work will be shown in the bid schedule to provide for the use of previously stockpiled materials.

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

NOTE: Only the reference to the specification section that covers the preparation of the underlying course will be retained; other references will be deleted. The surface of the cohesionless subgrade or subbase may require stabilization prior to placement of the base course. This may be accomplished by compacting a layer of crushed aggregate into the surface. It may also be obtained by methods based on local experience. The additional crushed aggregate will be considered as part of the underlying course and may be paid for or included in the specification section that covers the preparation of subgrade or subbase for the particular project.

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to [Section 31 00 00 EARTHWORK] [Section 32 11 16 SUBBASE COURSES]. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the

requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompact to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in **ASTM D 2487**, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing [ABC] [or] [GCA] into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the base course is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

NOTE: More details of applicable methods of placing, mixing, and spreading will be included when appropriate.

Mix the coarse and fine aggregates in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

3.5.2 Placing

Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer **150 mm 6 inches** or less in thickness is required, place the material in a single layer. When a compacted layer in excess of **150 mm 6 inches** is required, place the material in layers of equal thickness. No layer shall be thicker than **150 mm 6 inches** or thinner than **75mm 3 inches** when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

NOTE: The extra width of material is provided for a

working platform during construction. This will provide the paving equipment a solid surface to track on and will help ensure a smoother pavement.

The base course(s) shall be placed so that the completed section will be a minimum of [600] [] mm [2] [] feet wider, on all sides, than the next layer that will be placed above it. Additionally, place approved fill material along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 600 mm 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

NOTE: Appropriate percentage will be inserted in the first bracketed blank. Cohesionless materials are often free-draining; as such, the optimum water content is normally limited to the maximum water content the material will retain. This is usually evidenced by free water running from the mold during compaction testing.

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus [2] [] percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Begin rolling 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. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Continue compaction until each layer has a degree of compaction that is at least [100] [] percent of laboratory maximum density through the full depth of the layer. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

NOTE: When base courses are constructed less than 150 mm (6 inches) in total thickness, a deficiency of 13 mm (1/2 inch) in thickness of any area of such paving is considered excessive. Applicable to job conditions, the thickness-tolerance provisions may be modified as required, restricting all deficiencies to not over 6 mm (1/4 inch).

Construct the compacted thickness of the base course as indicated. No individual layer shall be thicker than 150 mm 6 inches nor be thinner than 75 mm 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 13 mm 1/2 inch of the thickness indicated. Where the measured thickness is more than 13 mm 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompact as directed. Where the measured thickness is more than 13 mm 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 6 mm 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each [500] [_____] square meters yards of base course. Measurements shall be made in 75 mm 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

NOTE: Drawings should be checked to ensure that any supplementary information required by this paragraph has been shown and that there is no conflict between the drawings and the specifications.

Proof rolling is only applicable for flexible airfield pavement (see UFC 3-260-02). This paragraph will be deleted from all project specifications for courses under road pavement and under rigid airfield pavement unless it is specifically required by the design engineer. Proof rolling is not needed for airfield shoulder pavements.

Air Force Bases: Proof roll each layer of base course of Type A traffic areas and the center 23 meters (75 feet) of heavy, modified heavy, and medium load runways with 30 coverages.

Navy and Marine Corps Airfields: Proof roll top of completed base course on center 12 meters (40 feet) of taxiways and on center 30.5 meters (100 feet) of runways with 8 coverages. Apply 4 coverages to all other paved areas, exclusive of runway overrun and blast protection areas.

Army Airfields: On Class IV airfields with runways greater than 1525 meters (5000 feet), proof roll each layer of base course in Type A traffic areas and center 23 meters (75 feet) of runways with 30 coverages.

Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of [_____] coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 13,600 kg 30,000 pounds and inflated to a minimum of 1034 kPa 125 psi. In areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to each layer of

base course [top of the completed [ABC] [GCA] course]. Maintain water content of the underlying material at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the base course shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any base course materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompact and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of base course shall be finished after [final compaction] [and] [proof rolling] by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 13 mm 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 75 mm 3 inches and new material shall be blended in [and compacted] [, compacted and proof rolled] to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompact or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 10 mm 3/8 inch when tested with a 3.66 meter 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at [15] [] meter [50] [] foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

NOTE: Traffic will not be allowed on any base course placed for airfield pavements. For roads, traffic should only be allowed on the base courses when it cannot be diverted elsewhere; but precautions should be taken to limit the traffic and keep heavy equipment off. Any damage caused by traffic should be repaired to meet these specification requirements. Designer will choose the appropriate bracketed information.

[Do not allow traffic on the completed base course]. [Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.]

3.7 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of [outside the limits of Government-controlled land] [as directed] [in waste disposal areas indicated]. No additional payments will be made for materials that must be replaced.

-- End of Section --