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Preparing Activity: USACE Superseding
UFGS-32 11 23 (August 2017)

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
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**05/22**

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SECTION 32 11 23

[AGGREGATE BASE COURSE] [AND/OR][GRADED CRUSHED AGGREGATE BASE COURSE] FOR FLEXIBLE PAVING
**05/22**

**NOTE: This guide specification covers the requirements for base course to be used directly under bituminous pavement courses for airfields, roads, and streets.**

**Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.**

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

**Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).**

PART 1 GENERAL

**NOTE: This guide specification is applicable to base courses placed directly beneath bituminous surface courses.**

**a. Refer to the material in this specification and on the drawings as "aggregate base course (ABC)" whenever a base course material with a California Bearing Ratio (CBR) of 80 is required. Retain "Aggregate Base Course" in the title and edit the rest of the specification accordingly to retain the information necessary for this material.**

**b. Refer to the material in this specification and on the drawings as "graded-crushed aggregate base course (GCA)" wherever a base material with a CBR of 100 is required. Retain "Graded-Crushed Aggregate Base Course" in the title and edit the rest of the specification 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, change the title of this specification to "Aggregate and/or Graded-Crushed Aggregate Base Course". Verify 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, determine if only one of these materials can 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. Specify measurement by area for courses with constant thickness.**

**********

#### 1.1.1.1 Area

Measure the quantity of [___] mm inch thick [ABC] [and] [GCA] completed and accepted, in square meters yards.

#### 1.1.1.2 Volume

Measure the quantity of [ABC] [and] [GCA] completed and accepted, in cubic meters yards. Determine the volume of material in-place and accepted by the average job thickness obtained in accordance with paragraph LAYER THICKNESS and the dimensions shown on the drawings.

### 1.1.2 Payment

#### 1.1.2.1 Base Course Material

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

1.1.2.2 Stabilization

Cohesionless subgrade or subbase courses to be stabilized, as specified in paragraph PREPARATION OF UNDERLYING COURSE OR SUBGRADE, will be paid for as a special item on a tonnage basis including extra manipulation as required.

1.1.3 Waybills and Delivery Tickets

Submit copies of waybills and delivery tickets during progress of the work. Before the final payment is allowed, file certified waybills and certified delivery tickets for all aggregates actually used.

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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C29/C29M | (2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate |
| ASTM C88 | (2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM C117 | (2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C127 | (2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate |
| ASTM C128 | (2022) Standard Test Method for Density, |

| | |
|---|---|
| | Relative Density (Specific Gravity), and Absorption of Fine Aggregate |
| ASTM C131/C131M | (2020) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C136/C136M | (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C1252 | (2017) Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading) |
| ASTM D75/D75M | (2019) Standard Practice for Sampling Aggregates |
| ASTM D1556/D1556M | (2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method |
| ASTM D1557 | (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D2487 | (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D3665 | (2012; R 2017) Standard Practice for Random Sampling of Construction Materials |
| ASTM D4318 | (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D4718/D4718M | (2015) Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles |
| ASTM D4791 | (2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate |
| ASTM D5821 | (2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate |
| ASTM D6938 | (2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| ASTM D7928 | (2017) Standard Test Method for Particle-Size Distribution (Gradation) of |

| | |
|---|---|
| | Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis |
| ASTM E11 | (2022) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves |

## 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.

### 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 D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 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, express 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 as a percentage of the laboratory maximum dry density in accordance with ASTM D1557 Method C and corrected with ASTM D4718/D4718M.

## 1.4 SUBMITTALS

**********

**NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.**

**For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.**

**The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.**

**Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.**

**Tailoring options are available for "ADDITIONAL DATA COLLECTION PLAN SUBMITTALS", "DATA VISUALIZATION SPECIALIST", "WEB-BASED GIS INTERFACE", "DESKTOP GIS FILES", "CAD 3D MODEL", "CAD QUALIFICATIONS AND ROLES", and "OPENGROUND".**

**********

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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; G[, [_____]]

Waybills and Delivery Tickets

SD-06 Test Reports

Initial Tests; G[, [_____]]

In-Place Tests; G[, [_____]]

Test Section Report; G[, [_____]]

## 1.5 QUALITY ASSURANCE

**********

**NOTE: Select UFGS Section 01 45 00 for Army, Air Force, and Navy Projects, and 01 45 00.00 40 for NASA projects. Delete the others.**

**For Navy projects, delete the bracketed sentence requiring MTC validation**

**********

Perform sampling and testing using a laboratory approved in accordance with Section [01 45 00][01 45 00.00 40] QUALITY CONTROL. Do not start work requiring testing until the testing laboratory has been inspected and approved. [All contractor quality control testing laboratories performing acceptance testing require USACE validation by the Material Testing Center (MTC) for both parent laboratory and on-site laboratory. Validation on all laboratories is required to remain current throughout the duration of the

paving project. Contact the MTC manager listed at https://mtc.erdc.dren.mil/requestvalidation.aspx# for costs and scheduling.] Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. Furnish copies of test results within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M.

1.5.2 Tests

1.5.2.1 Gradation Analysis

**********
**NOTE: Where frost susceptibility concerns exist, require testing in accordance with ASTM D7928 for the percentage passing the 0.02 mm particle size.**
**********

Perform gradation analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11.[Perform particle-size analysis of the soils in conformance with ASTM D7928].

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556/D1556M, or ASTM D6938. For the method presented in ASTM D1556/D1556M use the base plate as shown in the drawing. For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in Annex A2 of ASTM D6938. Use ASTM D6938 to determine the moisture content of the soil. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. Make the calibration checks of both the density and moisture gauges using the prepared containers of material method, as described in Annex A2 of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

1.5.2.5 Wear Test

Perform wear tests on [ABC] [and] [GCA] course material in conformance with ASTM C131/C131M.

1.5.2.6 Flat and Elongated Pieces

Determine flat and elongated pieces on [ABC] [and] [GCA] course material in conformance with ASTM D4791, Method A.

1.5.2.7 Soundness

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

Perform soundness tests on GCA in accordance with ASTM C88.

1.5.2.8 Fractured Faces

**********
**NOTE: Retain bracketed sentence only for GCA**
**********

Perform fractured faces test on [ABC] [GCA] coarse aggregate in comformance with ASTM D5821. [Determine uncompacted void content of the GCA fine aggregate in accordance with ASTM C1252, Method A.]

1.5.2.9 Weight of Slag

**********
**NOTE: Omit this paragraph when slag is unlikely to be supplied as base course material.**
**********

Determine weight per cubic meter foot of slag in accordance with ASTM C29/C29M on the [ABC] [and] [GCA] course material.

1.6 ENVIRONMENTAL REQUIREMENTS

**********
**NOTE: Delete this paragraph 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. Modify the protective measures specified 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.

1.7 ACCEPTANCE

1.7.1 Tolerances

Acceptance of [ABC] [GCA] is based on compliance with the tolerances presented in Table 1. Remove any materials found to be non-compliant and replace with compliant material or rework, as directed, to meet the requirements of this specification

| TABLE 1 | |
|---|---|
| Measurement | Tolerance |
| Grade | Plus 6 mm 1/4 inch, Minus 13 mm 1/2 inch |
| Smoothness | Plus/Minus 10 mm 3/8 inch |
| Individual Test Total Thickness | Plus/Minus 13 mm 1/2 inch |
| Average Job Thickness | Plus/Minus 6 mm 1/4 inch |
| Compaction | Minimum 100 percent |

1.7.2 Test Section

**********
**NOTE: A test section is required for base courses under airfield flexible pavements.**
**********

[Construct a test section consisting of 1000 square meters square yards to demonstrate the materials, equipment, and construction processes meet the requirements of this specification. Acceptance of the test section is based on compliance with the tolerances listed in Table 1. Rework, re-compact, or remove and replace test sections that do not meet specification requirements. Do not commence full operations until a test section report has been approved. Use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments are approved in advance.] [A test section is not required.]

PART 2 PRODUCTS

2.1 AGGREGATES

**********
**NOTE: Approval from AFCEC, the Navy EFDs, or USACE TSMCX is required before state or other local highway specifications can be used for airfield projects.**

**As an option for specifying ABC or GCA for roads, streets, or similar use pavements, incorporate material requirements from State or other local highway agency specifications if the following conditions are met:**

**a. Limit the percentage of material by weight passing the 0.075 mm (No. 200) sieve to a maximum of 8.**

**b. Where local conditions dictate a non-frost-susceptible material, limit particles passing the 0.02 mm particle size to a maximum of 3 percent.**

**c. Limit the portion of the material passing the**

**0.425 mm (No. 40) to a maximum liquid limit of 25 and a maximum plasticity index of 5.**

**d. Materials to be used for GCA are required to meet the specified L.A. Abrasion and Sulfate Soundness requirements.**

**********

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. [Provide ABC that is free of lumps of clay, organic matter, and other objectionable materials or coatings.] [Provide GCA that is free of silt and clay as defined by ASTM D2487, 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. When the coarse and fine aggregate is supplied from more than one source, provide aggregate from each source that meets the specified requirements.

2.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. Separately stockpile coarse aggregate supplied from more than one source.

a. Crushed Gravel: Provide crushed gravel that has been manufactured by crushing gravels and that meets all the requirements specified below.

b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

**********

**NOTE: Only recycled concrete aggregates (RCA) from on-base stockpiles or concrete pavement demolished under this contract are permitted, subject to an evaluation of suitability.**

**Verify the subgrade soil contains less than 0.3 percent of sulfates, to prevent expansive reaction with the recycled concrete. See UFC 3-250-11, "Soil Stabilization for Pavements" Appendix C for testing procedure. Otherwise, delete recycled concrete option.**

**Do not permit recycled concrete aggregate (RCA) to be used without evaluating for Alkali-Silica Reactivity (ASR). Evaluate the impact of potential Alkali-Silica Reaction (ASR) as follows;**

**a. For Roads and Streets: Use Figure 5.1 of IPRF-01-G-002-03-5, "Evaluation, Design and Construction Techniques for Airfield Concrete Pavement Used as Recycled Material for Base," to rate the ASR severity of the proposed source of RCA as either MILD or AGGRESSIVE. Evaluate the ratings as follows:**

**Ignore Table 5.1 for roads and streets.**

**If the rating is AGGRESSIVE, do not use the**

**proposed RCA as a base course.**

**If the rating is MILD, the proposed RCA can be used as a base course. Limit thickness to a maximum of 150 mm 6 inches to minimize potential swelling.**

**b. For DoD Airfields: Prepare a risk assessment as outlined in TSPWG 3-250-07.07-6, "Risk Assessment Procedure for Recycling Portland Cement Concrete (PCC) Suffering from Alkali-Silica Reaction (ASR) in Airfield Pavement Structures," and submit to the Base for approval.**

**If RCA is suitable for use, limit LA Abrasion loss to 45 percent and delete requirements for sulfate soundness testing. The sulfates in the testing solution can react with the cement, causing spurious results.**

**********

c. Crushed Recycled Concrete: Provide crushed recycled concrete (RCA) consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. Provide RCA of a consistent gradation and properties obtained from on-base stockpiles or concrete pavement demolished under this contract. Provide recycled concrete that is free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and that has been crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Provide crushed recycled concrete that meets all other applicable requirements specified below.

[d. Crushed Slag: Provide crushed slag that is an air-cooled blast-furnace product having a minimum air dry unit weight of 1120 kg/cubic meter 70 pcf as determined by ASTM C29/C29M, and meets all the requirements specified below.]

2.1.1.1 Aggregate Base Course

Limit the percentage of loss of ABC coarse aggregate to a maximum of 50 percent when tested in accordance with ASTM C131/C131M. Provide aggregate that contains a maximum of 30 percent flat and elongated particles when tested in accordance with ASTM D4791, Method A. 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, provide crushed aggregates containing a minimum of 50 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D5821. When two fractures are contiguous, the angle between planes of the fractures is required to be a minimum of 30 degrees in order to count as two fractured faces. Manufacture crushed gravel from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 2.

2.1.1.2 Graded-Crushed Aggregate Base Course

Limit the percentage of loss of GCA coarse aggregate to a maximum of 40 percent when tested in accordance with ASTM C131/C131M. Provide GCA coarse aggregate that does 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 C88. [Soundness tests are not required for RCA sources]. Provide aggregate that contains a maximum of 20 percent flat and elongated particles 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 when tested in accordance with ASTM D4791, Method A. 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, provide crushed aggregate containing a minimum of 90 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D5821. When two fractures are contiguous, the angle between planes of the fractures is required to be a minimum of 30 degrees in order to count as two fractured faces. Manufacture crushed gravel from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 2.

2.1.2 Fine Aggregate

Provide fine aggregates consisting of angular particles of uniform density.

2.1.2.1 Aggregate Base Course

Provide ABC fine aggregate that consists 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. Provide fine aggregate that contains a minimum of 45 percent by weight of uncompacted voids when tested in accordance with ASTM C1252, Method A.

2.1.3 Gradation Requirements

**********

**NOTE: Specify the gradation or gradations applicable to the specific job. Delete the frost susceptibility requirement 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 can be further restricted to help control the amount of particles passing the 0.02 mm particle size. However, the cleaner gradations can have reduced stability. If more than one gradation is maintained, 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. Provide aggregates that are continuously well graded within the limits specified in TABLE 2. Use sieves that conform to ASTM E11.

| TABLE 2. GRADATION OF AGGREGATES | | | |
|---|---|---|---|
| Percentage By Weight Passsing Square-Mesh Sieve | | | |
| Sieve Designation | No. 1 | No. 2 | No.3 |
| 50 mm 2 inch | 100 | --- | --- |
| 37.5 mm 1-1/2 inch | 70-100 | 100 | --- |
| 25.0 mm 1 inch | 45-80 | 60-100 | 100 |
| 12.5 mm 1/2 inch | 30-60 | 30-65 | 40-70 |
| 4.75 mm No. 4 | 20-50 | 20-50 | 20-50 |
| 2.0 mm No. 10 | 15-40 | 15-40 | 15-40 |
| 0.425 mm No. 40 | 5-25 | 5-25 | 5-25 |
| 0.075 mm No. 200 | 0-8 | 0-8 | 0-8 |

NOTE 1: Limit particles having diameters less than 0.02 mm to a maximum of 3 percent by weight of the total sample tested as determined in accordance with ASTM D7928.

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, test the materials in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. Correct the percentages passing the various sieves as directed if the specific gravities vary by more than 10 percent.

NOTE 3: Gradations containing more than 30 percent retained on the 37.5 mm ¾ inch sieve can produce inconsistent compacted density values when tested in accordance with paragraph DEGREE OF COMPACTION.

## 2.2 LIQUID LIMIT AND PLASTICITY INDEX

**********
**NOTE: Values shown are the 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. Limit the portion of any component or of the completed course

passing the 0.425 mm No. 40 sieve to be either nonplastic or have a maximum liquid limit of 25 and a maximum plasticity index of 5.

## 2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.3.1 Initial Tests

**********
**NOTE: Include the 0.02 mm sieve analysis requirements when frost susceptibility concerns exist.**
**********

Perform one of each of the following initial tests on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed. Submit certified copies of test results for approval a mimimum of [30] [_____] days before material is required for the work.

a. Gradation Analysis [including 0.02 mm material].

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Flat and Elongated Pieces.

f. [Soundness].

g Fractured Faces [and Uncompacted Voids].

h. [Weight per cubic meter foot of Slag].

i. [_____].

### 2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

## 2.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work are subject to approval by the Government before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

# PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

When the [ABC] [or] [GCA] is constructed in more than one lift, clean the previously constructed lift of loose and foreign matter by sweeping with power sweepers or power brooms. Use hand brooms 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.

## 3.2 OPERATION OF AGGREGATE SOURCES

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**NOTE: Retain the first sentence in brackets for aggregate sources on private lands. Retain the second sentences in brackets for aggregate sources on Government-owned land.**

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[Condition aggregate sources on private lands in accordance with local laws or authorities.] [Clear, strip, and excavate as required. Condition aggregate sources on Government property to readily drain and leave in a satisfactory condition upon completion of the work.]

## 3.3 STOCKPILING MATERIAL

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. Stockpile aggregates on the cleared and leveled areas designated to prevent segregation. Stockpile materials obtained from different sources separately.

## 3.4 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

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**NOTE: For cohesionless underlying courses and subgrades, as defined in 31 00 00, include bracketed text for stabilization and coordinate with paragraph PAYMENT.**

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Clean the underlying course or subgrade of all foreign substances prior to constructing the base course(s). Do not construct base course(s) on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. [For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, stabilize the surface prior to placement of the base course(s). Stabilize by mixing [ABC] [or] [GCA] into the underlying course and compacting by approved methods. Proof roll in accordance with paragraph PROOF ROLLING. Consider the stabilized material as part of the underlying course and meet all requirements of the underlying course. Do not allow traffic or other operations to disturb the finished underlying course and maintain in a compliant condition until the base course is placed.]

## 3.5 GRADE CONTROL

Provide a finished and completed base course conforming to the lines, grades, and cross sections shown. Place line and grade stakes as

necessary for control.

## 3.6 MIXING AND PLACING MATERIALS

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**NOTE: The most uniform mixture of coarse and fine aggregates is produced by using a stationary plant.**

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### 3.6.1 Mixing

Mix the coarse and fine aggregates in a stationary plant[, or in a traveling plant]. Make adjustments in mixing procedures or in equipment to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to produce a satisfactory base course meeting all requirements of this specification.

### 3.6.2 Placing

Place the mixed material on the prepared subgrade or subbase in lifts of uniform thickness with an approved spreader. Place the lifts so that when compacted they are true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one lift, clean the previously constructed lift of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms. Make adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to produce an acceptable base course.

## 3.7 LAYER THICKNESS

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**NOTE: When base courses are constructed less than 150 mm (6 inches) in total thickness, limit all deficiencies to a maximum of 6 mm (1/4 inch). Revise Table 1 to match.**

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Compact the completed base course to the thickness indicated. Limit individual compacted lifts to a maximum thickness of 150 mm 6 inches and a minimum thickness of 75 mm 3 inches. Compact the base course(s) to a total thickness that is within the tolerances of paragraph ACCEPTANCE 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 recompacting as directed. Where the measured thickness is more than 13 mm 1/2 inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements. However, the requirements for wearing course thickness and plan grade are still applicable. The average job thickness will be the average of all thickness measurements taken for the job and within the tolerances of paragraph ACCEPTANCE of the thickness indicated.

## 3.8 COMPACTION

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**NOTE: Cohesionless materials are often free-draining; as such, the optimum water content is normally limited to the maximum water content the material will retain.**

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Compact each lift of the base course, as specified, with approved compaction equipment. For cohesive soils, 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 and for cohesionless soils, maintain the water content to facilitate compaction without bulking. 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. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction until each lift is compacted through the full depth to meet the compaction requirements of Table 1. Make such adjustments in compacting or finishing procedures to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to produce a compliant base course. Remove any materials found to be non-compliant and replace with compliant material or rework, as directed, to meet the requirements of this specification.

## 3.9 PROOF ROLLING

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**NOTE: Check the drawings to verify 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 required when a base course is used under a flexible airfield pavement with the following conditions:**

**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 aggregate base course on center 12 meters (40 feet) of taxiways and on center 30.5 meters (100 feet) of runways with eight coverages. To all other paved areas exclusive of runway overrun and blast protection areas, apply four coverages.**

**Army Airfields. On Class IV airfields with runways greater than 1,525 meters (5,000 feet), proof roll each layer of aggregate base course in Type A traffic areas and center 23 meters (75 feet) of runways with 30 coverages**

**The specified roller might not be available in all areas. UFC 3-250-01, "Pavement Design for Roads and Parking Areas," recommends a smaller roller with the following properties: a rubber-tired roller loaded to provide a minimum tire force of 20,000 lb (90 kN) and inflated to at least 90 psi (620 kPa).**

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In addition to the compaction specified, proof roll areas designated on the drawings by application of [_____] coverages of a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 13,600 kg 30,000 pounds and inflated to a minimum of 862 kPa 125 psi. A coverage is defined as the application of one tire print over the designated area. In the areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to the top of [each lift of] [the completed] base course. Maintain water content of the underlying material and each lift of the base course as specified in Paragraph COMPACTION from start of compaction to completion of proof rolling of that lift. Remove any base course materials or any underlying materials that produce permanent deformation exceeding 10 mm 3/8 inch by proof rolling and replace with satisfactory materials. Then recompact and proof roll to meet these specifications.

## 3.10 EDGES OF BASE COURSE

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**NOTE: Coordinate the first sentence with the typical pavement sections shown on the drawings. The extra width of material is a working platform during construction to provide the paving equipment a solid surface to track.**

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[Place the base course(s) so that the completed section is a minimum of [600] [_____] mm [2] [_____] feet wider, on all sides, than the next lift that will be placed above it.] Place approved material along the outer edges of the base course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more lifts, simultaneously roll and compact at least a 600 mm 2 foot width of this shoulder material with the rolling and compacting of each lift of the base course.

## 3.11 FINISHING

Finish the surface of the top lift of base course after [final compaction] [and] [proof rolling] by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin lifts of material to the top lift of base course to meet grade. If the elevation of the top lift of base course exceeds the tolerances of paragraph ACCEPTANCE, scarify the top lift to a depth of at least 75 mm 3 inches and blend new material in and compact [and proof roll] to bring to grade. Make adjustments to rolling and finishing procedures to minimize segregation and degradation, obtain grades, maintain moisture content, and produce an acceptable base course. If the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, scarify the non-compliant portion and rework and recompact it or replace as directed.

## 3.12 SMOOTHNESS TEST

Construct the top lift so that the surface shows no deviations exceeding the tolerances of paragraph ACCEPTANCE when tested with a 3.66 meter 12 foot straightedge. Test the entire area in both a longitudinal and a transverse direction on parallel lines. Perform the transverse lines at a maximum spacing of 4.5 m 15 feet or less apart, as directed. Perform the longitudinal lines at the centerline of each placement lane, regardless of whether multiple lanes are allowed to be paved at the same time, and at the 1/8th point in from each side of the lane. Hold the straightedge in

contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Determine measurements along the entire length of the straight edge. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

## 3.13 FIELD QUALITY CONTROL

### 3.13.1 In-Place Tests

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**NOTE: Include the last bracketed sentence if recycled concrete aggregate (RCA) is proposed as an aggregate source.**

**Adjust frequency of testing as required to produce a minimum of one test for each half-day's production. For example, the frequency of one test of a 125 mm 6-inch lift per 500 square meter yards corresponds to approximately 63 cubic meters 83 cubic yards or 117 tonnes 129 tons of in-place material. This frequency can be too high for a large project.**

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Perform each of the following in-place tests on samples taken from the placed and compacted [ABC] [and] [GCA]. Determine sample locations using random sampling in accordance with ASTM D3665. Take samples and test 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 square yards, or portion thereof, of completed area. Gradations containing more than 30 percent retained on the 37.5 mm ¾ inch sieve can produce inconsistent compacted density values when tested in accordance with paragraph DEGREE OF COMPACTION.

b. Perform gradation analysis [including 0.02 mm size material] on every lift of material placed and at a frequency of one sieve analysis for every 500 [_____] square meters 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 thickness of the base course at intervals providing at least one measurement for each 500 [_____] square meters yards of base course or part thereof. Measure the thickness using test holes, at least 75 mm 3 inch in diameter through the base course.

### 3.13.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).

## 3.14 TRAFFIC

Completed portions of the base course can be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Do not allow heavy equipment on the completed base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed base course, protect the area against marring or damage to the completed work. Repair damage to meet these specifications.

## 3.15 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any base course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area of base course that is damaged as necessary to comply with this specification.

## 3.16 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed [outside the limits of Government-controlled land] [as directed] [in waste disposal areas indicated]. No additional payments will be made for materials that have to be replaced.

-- End of Section --