Preparing Activity: USACE

Superseding
UFGS-32 11 20 (August 2017)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 32 11 20

[BASE COURSE FOR RIGID][AND][SUBBASE] [SELECT-MATERIAL] [FOR FLEXIBLE PAVING]
05/22

NOTE: This guide specification covers the requirements for base course for rigid pavements and subbase or select-material for flexible airfield pavements, 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 subbase courses for airfield pavements, roads and streets including select-material courses in the lower levels of the pavement structure. Use this specification for any subbase course that has a design California bearing ratio (CBR) between 20 and 50 or any select-material with design CBR less than 20. Select-material does not require processing or blending.

This specification can also be used for:

a. The base course directly beneath the bituminous surface of a pavement design for roads and streets where the required CBR value of the material is 50 or less and the material conforms to Gradation No. 1.

b. The base course beneath rigid pavements.

c. Select-Materials are typically locally available coarse grained soils with a maximum CBR of 20 when used in a flexible pavement section.

When this guide specification is used for aggregate base course under rigid pavement, edit section title of the project specification to: BASE COURSE FOR RIGID PAVING and select the words "rigid pavement base course" throughout.

When this guide specification is used in combination for a subbase course under flexible pavements and a base course under rigid pavements, edit the section title to: BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING and include the words "or rigid pavement base course" after "subbase" throughout.

If Select-Materials are specified in this section, revise the title to include the words "SELECT-MATERIAL" and edit the appropriate paragraphs throughout the section

****

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 [subbase] [and] [select-material] [or] [rigid pavement base] course completed and accepted in square meters yards.

1.1.1.2 Volume

Measure the quantity of [subbase] [and] [select-material] [or] [rigid pavement base] course 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 Course Material

Quantities of [subbase] [and] [select-material] [or] [rigid pavement base] course, 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 [subbase] [and] [select-material] [or] [rigid pavement base] course.

1.1.2.2 Stabilization

Cohesionless subgrade or underlying 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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C29/C29M	(2017a) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
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 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 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 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 9.0 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 9.0 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.

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

****
NOTE: Require testing in accordance with ASTM D7928when the materials need to be tested for the 0.02 mm particle size.
****

Perform gradation 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 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 the ASTM publication. 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, in ASTM D6938, on each different type of material to be 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

****
NOTE: Wear tests are not required for select-material course materials.
****

Perform wear tests on [subbase course] [and] [or] [rigid pavement base course] material in conformance with ASTM C131/C131M.

1.5.2.6 Weight of Slag

****
NOTE: Omit this paragraph when it is unlikely that slag will be supplied.
****

Determine weight per cubic meter foot of slag in accordance with ASTM C29/C29M.

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. Otherwise, retain this requirement, but 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

****

NOTE: Determine compaction requirements for select-material from UFC 3-260-02, paragraph 7-3 and insert values in Table 1. Delete select-material row from the table if not used.

Specify 100 percent compaction For Navy airfield rigid pavement base courses.

****

Acceptance of [rigid pavement base course] [subbase course] [select-material] is based on compliance with the tolerances presented in Table 1. Remove and replace any course identified by the failing tests.

TABLE 1	
Measurement	Tolerance
Grade	Plus 0, Minus 13 mm 1/2 inch
Smoothness	Plus/Minus 12 mm 1/2 inch
Total Thickness	Plus/Minus 13 mm 1/2 inch
Average Job Thickness	Plus/Minus 6 mm 1/4 inch
Compaction	
[Subbase]	Mimimum 100 percent
[Rigid Pavement Base Course]	Mimimum [95] [100] percent
[Select-Material]	[_____]

1.7.2 Test Section

****

NOTE: A test section is required for subbases and rigid pavement base courses under airfield pavement.

****

[Construct a test section consisting of 1000 square meters square yards of [rigid pavement base course] [subbase] [select-material] 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 the 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 MATERIALS

2.1.1 Subbase Course

****

NOTE: As written, this paragraph applies to general conditions. Other materials such as disintegrated granite, volcanic ash or cinders, limerock, caliche, or asphalt millings can be specified when supported by adequate performance data. If recycled concrete aggregate (RCA) is proposed, evaluate the source using the protocol of Section 32 11 23 [AGGREGATE BASE COURSE] [AND/OR][GRADED CRUSHED AGGREGATE BASE COURSE] FOR FLEXIBLE PAVINGbefore specifying use of the material.

Delete the requirement for percentage of wear when local experience indicates the material is satisfactory.

As an option for specifying subbase course for roads, streets, or similar-use pavements, incorporate the material requirements from State or other local highway agency specifications if conditions a, b, c, and d below are met:

a. The percentage of material by weight passing the 0.075 mm (No. 200) sieve not to exceed 8.

b. When local conditions dictate a nonfrost-susceptible material, limit particles having a diameter of less than 0.02 mm to a maximum of 3 percent.

c. Limit the portion of the material passing the 0.425 mm (No. 40) sieve to a liquid limit not greater than 25 and a plasticity index not greater than 5.

d. The project requires less than 600 cubic meters (750 cubic yards) of material and it is not an airfield pavement. (See item e below if project does not meet this requirement).

e. Approval from AFCEC, the Navy EFDs, or USACE TSMCX is required before state or other local highway specifications can be used for airfield projects of any size. Project specific information will be submitted to AFCEC, the Navy EFDs, or USACE TSMCX with the request for approval.

Insert the desired maximum top size in the blank. The necessity for meeting grades dictates that

maximum top size does not exceed 75 mm (3 inches). When this specification is to be used as base course for roads, streets, and parking areas, limit the top size to a maximum of 50 mm (2 inches) for a layer thickness of less than 150 mm (6 inches). Delete the inapplicable gradation.

Gradation No.	Design CBR
1	50 Max
2	40 Max
3	30 Max
Select Material	20 Max

Use gradation band No. 1 or 2 for lower design CBR values than specified above where no increase in price results. Exceptions to the gradation requirements will be permitted when supported by adequate in-place CBR data.

Both a graded aggregate and a geotextile can act as a separation later beneath the drainage layer. Graded aggregates are typically selected since a geotextile is not a structural component of the pavement system and does not provide extra stability for compaction of the drainage layer. Consult UFC 3-230-06, Subsurface Drainage, for guidance on selecting and specifying a geotextile.

Use gradation No. 1 when a drainage layer will be placed above the subbase and the subbase is designed as a separation layer. Limit the maximum size to 1/4 of the separation layer thickness and include the bracketed sentence for separation layer piping criteria.

Where local conditions dictate a nonfrost-susceptible material, retain the sentence in brackets requiring particles having a diameter of less than 0.02 mm not to exceed 3 percent by weight of the total aggregate, as determined in accordance with ASTM D 7926.

****

Provide aggregates consisting of crushed stone or [slag,] gravel, shell, sand, [on-site recycled concrete aggregate (RCA),] or other sound, durable, approved materials processed and blended or naturally combined. Provide aggregates which are free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Limit the percentage of loss to a maximum of 50 percent after 500 revolutions when tested in accordance with ASTM C131/C131M. Provide aggregate that is reasonably uniform in density and quality. [Provide slag that is an air-cooled, blast-furnace product having a dry weight of not less than 1120 kg/cubic meter 70 pcf.] Provide aggregates with a maximum size of [_____] mm inch, a minimum of 70 percent passing the 37.5 mm 3/4 inch sieve, and within the limits specified as follows:

Table 2

Maximum Allowable Percentage by Weight Passing Square-Mesh Sieve			
Sieve Designation	No. 1	No. 2	No. 3
2 mm No. 10	50	80	100
0.075 mm No. 200	8	8	8

[Provide a gradation for the separation layer meeting the gradation requirements of Table 2 Gradation No. 1 and the additional requirement that the 15 percent particle size (D15) of the separation layer is less than or equal to 5 times the 85 percent particle size (D85) of the underlying layer.]

[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.] Limit the portion of any blended component and of the completed course passing the 0.425 mm No. 40 sieve to be either nonplastic or have a Liquid Limit not greater than 25 and a Plasticity Index not greater than 5.

2.1.2 Select-Material Course

****

NOTE: When used as material for embankment, use the applicable specification to determine the maximum size of particles. The requirement on the amount passing the 0.075 mm (No. 200) sieve can be increased for locally available materials but will not be relaxed to the point where materials with insufficient CBR under ASTM D4429 will pass.

Where local conditions dictate a nonfrost-susceptible material, retain the sentence in brackets requiring particles having a diameter of less than 0.02 mm not to exceed 3 percent by weight of the total aggregate, as determined in accordance with ASTM D7928.

****

Provide materials consisting of selected soil or other materials from field excavation, stockpiles, or other sources and free from lumps and balls of clay and from organic and other objectionable matter. Provide materials with not more than 25 percent by weight passing the 0.075 mm No. 200 sieve. Limit the portion of material passing the 0.425 mm No. 40 sieve to a Liquid Limit less than 35 and a Plasticity Index less than 12. Provide materials having a maximum particle size not exceeding 75 mm 3 inches. [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.]

2.1.3 Rigid Pavement Base Course

****

NOTE: For airfields, reduce the maximum allowable percentage passing the No. 200 sieve to 8 and increase the maximum plasticity index to 8.

Do not adjust the percentage passing the No. 10 sieve, this protects against pumping of fines

through the concrete pavement joints.
****

Provide aggregates consisting of crushed stone or [slag,] gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Provide aggregates which are durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Limit the percentage of loss to a maximum of 50 percent after 500 revolutions when tested in accordance with ASTM C131/C131M. Provide aggregates with at least 75 percent by weight retained on each sieve having one freshly fractured face with the area at least equal to 75 percent of the smallest midsectional area of the piece. Provide aggregate that is reasonably uniform in density and quality. [Provide slag that is an air-cooled, blast-furnace product having a dry weight of not less than 1120 kg/cubic meter 70 pcf.] Provide aggregates having a maximum size of 50 mm 2 inches, a minimum of 70 percent passing the 37.5 mm 3/4 inch sieve, and within the limits specified as follows:

TABLE 3	
Maximum Allowable Percentage by Weight Passing Square-Mesh Sieve	
Sieve Designation	Rigid Pavement Base Course
2 mm No. 10	85
0.075 mm No. 200	15

[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.] Limit the portion of any blended component and of the completed course passing the 0.425 mm No. 40 sieve to be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 6. Provide any additional stability required to maintain a working platform for construction equipment. If a test section can demonstrate that a material has adequate stability to support construction equipment, the fractured face requirement can be deleted, subject to approval by the Government.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 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 prior to installation. Complete this testing for each source if materials from more than one source are proposed.

a. Gradation [including 0.02 mm size material].

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. [Wear.]

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

f. [_____].

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

2.2.2 Approval of Material

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

2.3 EQUIPMENT, TOOLS, AND MACHINES

****
NOTE: If desirable or based on local conditions, include requirements for types of equipment applicable to methods of construction.
****

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

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

****
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.
****

[Condition aggregate sources on private lands in accordance with local laws and 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

****

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

****

Clean the underlying course or subgrade of all foreign substances prior to constructing the [subbase] [or] [select-material] [or] [rigid pavement base] course. Do not construct [subbase] [or] [select-material] [or] [rigid pavement base] course 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 overlying course. Stabilize by mixing the overlying course material into the underlying course and compacting by approved methods. 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 satisfactory condition until the overlying course is placed.]

3.5 GRADE CONTROL

Provide a finished and completed [subbase] [select-material] [and] [or] [rigid pavement base] course[s] conforming to the lines, grades, and cross sections shown. Place line and grade stakes as necessary for control.

3.6 MIXING AND PLACING MATERIALS

****

NOTE: Include more details on applicable methods of placing, mixing, and spreading when appropriate.

****

Mix and place the materials to obtain uniformity of the material at the water content specified. Make such adjustments in mixing or placing procedures or in equipment as directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to provide a satisfactory course.

3.7 LAYER THICKNESS

****

NOTE: When subbase or rigid pavement base courses are constructed less than 150 mm (6 inches) in total thickness, limit all deficiencies to not more than 6 mm (1/4 inch). Revise Table 1 to match.

****

Compact the completed 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 course(s) to a total thickness that is within the tolerances of paragraph ACCEPTANCE. 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 the overlying 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.

3.8 COMPACTION

****

NOTE: Insert appropriate percentage 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. .

****

Compact each lift of the material, as specified, with approved compaction equipment. For cohesive soils, maintain water content during the compaction procedure to within plus or minus [2] [_____] percent of optimum water content determined from laboratory tests as specified in this Section and for cohesionless soils, maintain a 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 of the [subbase] [rigid pavement base] [or select-material] 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 ensure a compliant [subbase] [and] [select-material] [rigid pavement base] course. Remove any materials that are 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

****

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

Air Force Bases. Proof roll top of subbase 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 subbase 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 top of subbase in Type A traffic areas and center 23 meters (75 feet) of runways with 30 coverages.

Proof rolling the separation layer (subbase course gradation 1) under a drainage layer is recommended, but not required. If used, specify six passes.

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 90 kN 20,000 lb. and inflated to at least 620 kPa 90 psi.

Apply a minimum of six coverages, where a coverage is the application of one tire print over each point in the surface of the designated area. During proof rolling, monitor the action of the separation layer for any sign of excessive movement or pumping that would indicate soft spots in the separation layer or the subgrade. Remove, replace and retest all weak spots.

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In addition to the compaction specified, proof roll subbase course in 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 lift of the completed subbase course. Maintain water content of the top lift of the subbase course as specified in paragraph COMPACTION from start of compaction to completion of proof rolling. Remove any subbase course materials that produce permanent deformation exceeding 13 mm 1/2 inch and replace with satisfactory materials. Then recompact and proof roll to meet specifications.

3.10 EDGES OF [SUBBASE] [AND] [SELECT-MATERIAL] [RIGID PAVEMENT BASE COURSE]

Place approved material along the outer edges of the [subbase] [and] [select-material] [rigid pavement 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 [subbase] [and] [select-material] [rigid pavement base] course, as directed.

3.11 FINISHING

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NOTE: Delete paragraph if rigid pavement base course is not included in the project.

****

Finish the surface of the top lift of rigid pavement 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 rigid pavement base course to meet grade. If the elevation of the top lift of rigid pavement 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 to bring to grade. Make adjustments to rolling and finishing procedures to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable rigid pavement base course. If the surface becomes 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 m 12 foot straightedge. Test the entire area in both a longitudinal and a transverse direction on parallel lines. Perform the transverse lines 4.5 m 15 feet or less apart, as directed. Perform the longitudinal lines at the centerline of each placement lane and at the 1/8th point in from each side of the lane. Hold the straightedge in contact with the surface and move 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 surface and measuring the maximum gap between the straightedge and the surface. Determine measurements along the entire length of the straight edge. Correct deviations exceeding the tolerances of Table 1 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

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NOTE: 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 square 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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3.13.1 In-Place Tests

Perform one of each of the following In-Place Tests on samples taken from the placed and compacted [subbase] [and] [select-material] [rigid pavement base] course. Determine sample locations using random sampling in accordance with ASTM D3665. Take samples and test at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 500 [_____] square meters yards, or portion thereof, of completed area.

b. Perform gradation [including 0.02 mm size material] on every lift of material placed and at a frequency of one gradation for every 1,000 [_____] square meters yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the gradation.

d. Measure the thickness of each course at intervals providing at least one measurement for each 500 [_____] square meters yards or part thereof. Measure the thickness using test holes, at least 75 mm 3 inches in diameter through the 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 rigid pavement 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 rigid pavement base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed rigid pavement base course, protect the area against marring or damage to the completed work. Repair damage to meet these specifications.

3.15 MAINTENANCE

Maintain the completed 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 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 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 --