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USACE / NAVFAC / AFCEA / NASA            UFGS-32 11 16.16 (July 2006)  
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Preparing Activity:    NAVFAC            Superseding  
   UFGS-32 11 16.16 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2008

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07/06

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### SECTION 32 11 16.16

[BASE COURSE FOR RIGID] [AND SUBBASE COURSE FOR FLEXIBLE] [SUBBASE COURSE FOR  
PERVIOUS] PAVING  
07/06

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NOTE: This guide specification covers the requirements for select-material base course for rigid pavement and select-material subbase course for flexible pavement and pervious pavement systems.

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).

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NOTE: The guide title must be edited to suit project requirements where the pavement structures so dictate.

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## PART 1 GENERAL

### 1.1 REFERENCES

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

**specifications.**

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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 C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
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 D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft <sup>3</sup> ) (2700 kN-m/m <sup>3</sup> )
ASTM D 1883	(2005) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2940	(2003) Graded Aggregate Material for Bases or Subbases for Highways or Airports
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 5106	(2003) Steel Slag Aggregates for Bituminous Paving Mixtures
ASTM D 6155	(2006) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 6270	(1998; R 2004) Use of Scrap Tires in Civil Engineering Applications
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard

Effort (12,400 ft-lbf/cu. ft. (600  
kN-m/cu. m.))

ASTM D 75

(2003) Standard Practice for Sampling  
Aggregates

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED

(2002; R 2005) Leadership in Energy and  
Environmental Design(tm) Green Building  
Rating System for New Construction  
(LEED-NC)

## 1.2 RELATED SECTIONS

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NOTE: Pervious pavement systems shall be installed  
in areas with gently sloping or flat ground, light  
traffic, limited heavy truck use, and where  
pavements will not receive snow and ice treatments  
(salt, sand, or chemical). Consult manufacturer's  
recommendations for cold regions, arid regions, and  
regions with high wind erosion. Parking lots are  
generally good pervious pavement applications.  
Installing pervious pavement systems contributes to  
the following LEED credit: SS6.

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Pervious pavement systems shall use Section 32 11 24 GRADED CRUSHED  
AGGREGATE BASE COURSE FOR PERVIOUS PAVEMENT, and Section 32 13 13.06  
PERVIOUS PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES or  
Sections 32 10 00 PERVIOUS BITUMINOUS CONCRETE PAVEMENT and 32 12 10  
BITUMINOUS TACK AND PRIME COATS, in addition to this section.

## 1.3 SUBMITTALS

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

A "G" following a submittal item indicates that the  
submittal requires Government approval. Some  
submittals are already marked with a "G". Only  
delete an existing "G" if the submittal item is not  
complex and can be reviewed through the Contractor's  
Quality Control system. Only add a "G" if the  
submittal is sufficiently important or complex in  
context of the project.

For submittals requiring Government approval on Army  
projects, a code of up to three characters within  
the submittal tags may be used following the "G"  
designation to indicate the approving authority.  
Codes for Army projects using the Resident  
Management System (RMS) are: "AE" for  
Architect-Engineer; "DO" for District Office

(Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

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

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

Materials; (LEED)  
Geotextile; (LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

[ Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

#### SD-05 Design Data

Gradation curve

#### SD-06 Test Reports

Bearing ratio

Liquid limit

Plasticity index

Dry weight of slag

Percentage of wear

Gradation tests

Density tests

#### SD-07 Certificates

## Source

Location and name.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

### 1.5 CONSTRUCTION EQUIPMENT

Subject to approval of the Contracting Officer, special equipment as dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and other similar equipment, shall have been calibrated by [a calibration laboratory approved by the Contracting Officer] [a state calibration laboratory] within [12] [\_\_\_\_\_] months of commencing work.

### 1.6 ENVIRONMENTAL REQUIREMENTS

Do not construct course when atmospheric temperature is below 1.5 degrees C 35 degrees F or when weather conditions could detrimentally affect quality of finished course. When temperature falls below 1.5 degrees C 35 degrees F, protect areas of completed course against freezing.

### 1.7 SUSTAINABLE DESIGN REQUIREMENTS

#### 1.7.1 Local/Regional Materials

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NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option for USACE projects. Army projects shall include option only if pursuing this LEED credit.  
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[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500] [\_\_\_\_\_] mile [800] [\_\_\_\_\_] kilometer radius from the project site, if available from a minimum of three sources.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Course materials may be locally available.]

## PART 2 PRODUCTS

### 2.1 MATERIALS

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NOTE: Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section

01 33 29 LEED(tm) DOCUMENTATION. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. If not, write in suitable recycled content values that reflect availability and competition. Use second recycled content option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION.

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NOTE: Use the first grading option when installing a pervious pavement system.

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ASTM D 2940, except as modified herein. Material shall consist of natural, processed or blends of waste concrete, masonry, cement, tile, or other waste material from on-site work as specified; rock, crushed concrete, concrete block, or crushed slag from off-site grading or demolition work; recycled porcelain, concrete, stone, or other recycled material complying with ASTM D 6155; [Class I Fill] [Class II Fill] tire complying with ASTM D 6270; steel slag complying with ASTM D 5106; gravel; stone; slag; chert; caliche; limerock; coral; shell; quarry and mine waste; sand; or screenings; and soil or other similar binding or filler material. Material [shall contain a minimum of [5] [10] [\_\_\_\_\_] percent post-consumer recycled content, or a minimum of [20] [40] [\_\_\_\_\_] percent post-industrial recycled content, and ]shall be free-draining. [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Material may contain post-consumer or post-industrial recycled content. ]Obtain materials from sources approved by the Contracting Officer. Preliminary approval of pits shall not mean that material found in the deposit will be acceptable. Maximum dimensions of material particles shall not be greater than two-thirds the compacted thickness of the layer in which it is to be placed. Coarse aggregate shall have a percentage of wear of not more than 40 as determined by ASTM C 131. Material shall have a bearing ratio of at least [30] [\_\_\_\_\_] as determined by laboratory test on a four day soaked specimen in accordance with ASTM D 1883; compact the specimen in accordance with ASTM D 1557, Method B, C, or D. Material passing the 425 micrometers No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 in accordance with ASTM D 4318. Slag shall be an air-cooled blast furnace product having a dry weight not less than 1041 kg per cubic meter 65 pounds per cubic foot when tested in accordance with ASTM C 29/C 29M and consisting of angular fragments uniform in density and quality and reasonably free from thin and elongated pieces, dirt, or other objectionable material. [Grading shall be a minimum of 3/4 inch19 mm and a maximum of 1.5 inches38 mm.] [Gradation of the final composite mixture shall conform to the following size and shall be the basis of the gradation curve:

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NOTE: The gradation shown in the following table is the minimum recommended to obtain a California Bearing Ratio (CBR) of 30. If a CBR greater than 30 is required, specify a gradation to suit. Where possible, select a gradation to suit local materials and project requirements. To provide adequate drainage under rigid pavements, the base course should contain little or no fines (material that

passes the 75 micrometers No. 200 sieve).

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Sieve Size (Square Openings)	Design Range (Percent Passing)	Job Mix Tolerance (Percent)
50 mm	100	-3
38 mm	90-100	+5
4.75 mm	30-60	+10
75 mm	0-15	+5

  

Sieve Size (Square Openings)	Design Range (Percent Passing)	Job Mix Tolerance (Percent)
2 inch	100	-3
1 1/2 inch	90-100	+5
No. 4	30-60	+10
No. 200	0-15	+5

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## 2.2 SOURCE QUALITY CONTROL

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 22 kg 50 pounds. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

### 2.2.1 Geotextile

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NOTE: Geotextile fabric shall be required for pervious pavement systems only. Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. If not, write in suitable recycled content values that reflect availability and competition. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION.

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[Fabricated from 100 percent post-consumer recycled plastic.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Geotextile may contain post-consumer or post-industrial recycled content.]

## PART 3 EXECUTION

### 3.1 GRADE CONTROL

Provide line and grade stakes for control. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.



### 3.2 PLACING AND MIXING

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NOTE: In pervious pavement systems, water is conveyed to the subbase (stone reservoir) through the surface of the pavement and infiltrates into the ground through the bottom of this stone reservoir. A geosynthetic liner and sand layer should be placed below the stone reservoir to prevent preferential flow paths and to maintain a flat bottom. Delete geotextiles statement when not installing a pervious system.

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Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course. Verify subsoils have a permeability between 13 and 74 mm0.5 and 3.0 inches per hour. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. [Place geotextiles in accordance with specifications and drawings. ]Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 75 and 200 mm 3 and 8 inches in compacted thickness. Tire shall be installed in accordance with ASTM D 6270.

### 3.3 COMPACTING AND FINISHING

Compact each layer to at least [100] [\_\_\_\_\_] percent of the maximum laboratory density determined in accordance with ASTM D 1557 for areas subject to heavy vehicular traffic. Compact each layer to at least [95] [\_\_\_\_\_] percent Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact material inaccessible to rolling equipment by mechanical tamping. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density. Place and compact earth at edges of course for at least 300 mm one foot of the shoulder.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Sampling During Construction

Take one random sample of each [1000] [\_\_\_\_\_] metric tons [1000] [\_\_\_\_\_] tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D 75.

#### 3.4.2 Testing

##### 3.4.2.1 Material

Make gradation tests from each sample in accordance with ASTM C 136. Determine material passing the 75 micrometers No. 200 sieve in accordance with ASTM C 117.

##### 3.4.2.2 Smoothness Test

Test with a 3 m 10 foot straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of [10] [\_\_\_\_\_] mm [3/8] [\_\_\_\_\_] inch by loosening, adding or

removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.

#### 3.4.2.3 Field Density Tests

ASTM D 1556 or ASTM D 2922, and ASTM D 3017. Take one field density test for each [400] [ ] square meters [500] [ ] square yards of each layer of course. When using ASTM D 2922 and ASTM D 3017 to test field compaction densities, verify the results of the tests by performing one test per day using ASTM D 1556 at locations previously tested by ASTM D 2922 and ASTM D 3017 and one additional test using ASTM D 1556 for every ten tests performed at locations previously tested by ASTM D 2922 and ASTM D 3017.

#### 3.4.2.4 Laboratory Density Tests

ASTM D 1557, Method B, C, or D, for all material.

#### 3.4.2.5 Thickness Test

Determine thickness of course from test holes not less than 75 mm 3 inches in diameter. Obtain a thickness test for each [400] [ ] square meters [500] [ ] square yards of course. Where course deficiency is more than 13 mm 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than 13 mm 1/2 inch, consider the measured thickness as the indicated or specified thickness plus 13 mm 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than 6 mm 1/4 inch.

### 3.5 MAINTENANCE

After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --