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USACE / NAVFAC / AFCEC UFGS-02 66 16 (February 2021)

Preparing Activity: USACE

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Superseding without Revision  
UFGS-02 66 10 (February 2010)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2024

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02/21

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### SECTION 02 66 16

TEST FILL  
02/21

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NOTE: This guide specification covers the requirements for a test fill for a landfill liner or cover.

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).

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## PART 1 GENERAL

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NOTE: This guide specification must be used in conjunction with and coordinated with the referenced sections. Multiple borrow sources may be required for large projects; in that case, more than one test fill may need to be constructed. Test fills are generally listed as a lump sum item on the bidding schedule.

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### 1.1 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 Reference Identifier (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 D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643	(2017) Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D5084	(2016a) Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
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

## 1.2 SYSTEM DESCRIPTION

Submit a [construction plan](#) for the test fill. Do not begin test fill construction until the test fill construction plan is approved. The materials proposed for use in the test fill and interface friction testing must also be approved prior to the start of test fill construction. The plan includes, but is not limited to, the following items:

- a. Proposed modifications to the test fill design;
- b. Placement sequence;
- c. Surface water control and diversion;
- d. Equipment to be used including operating speeds, traffic patterns, and number of passes;
- e. Geosynthetics products to be used and geosynthetics manufacturer's equipment recommendations.

## 1.3 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 and Air Force 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 and Air Force projects, or choose the second bracketed item for Army projects.

\*\*\*\*\*

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

Construction Plan

QC Inspector

SD-06 Test Reports

Weekly Reports

Final Report

#### 1.4 QUALITY ASSURANCE

\*\*\*\*\*  
NOTE: This paragraph and references to the QC  
inspector should be removed if a QC inspector will  
not be used.  
\*\*\*\*\*

The QC inspector must be present during test fill construction, review the Contractor's test data, and ensure that the Contractor has constructed each layer of the test fill as specified. The QC inspector must meet the qualifications identified in Section [02 56 13.13 GEOMEMBRANE WASTE CONTAINMENT] [\_\_\_\_]. Submit the QC inspector qualifications, as specified.

#### PART 2 PRODUCTS

\*\*\*\*\*  
NOTE: Not all of the materials described below will  
be included in each test fill. Delete materials  
that are not applicable. The layer thicknesses  
specified should be modified on a site specific  
basis.  
\*\*\*\*\*

##### 2.1 RANDOM FILL

Provide random fill consisting of a [300] [\_\_\_\_] mm [12] [\_\_\_\_] inch layer as specified in Section [31 00 00 EARTHWORK] [\_\_\_\_] and as shown on the drawings.

##### 2.2 CLAY BARRIER LAYER

Provide clay barrier layer consisting of a [600] [\_\_\_\_] mm [24] [\_\_\_\_] inch compacted clay layer as specified in Section 02 56 13.16 CLAY WASTE CONTAINMENT and as shown on the drawings.

##### 2.3 GEOMEMBRANE

Provide geomembrane barrier layer as specified in Section 02 56 13.13

GEOMEMBRANE WASTE CONTAINMENT and as shown on the drawings. Place a [smooth geomembrane] [geomembrane textured on the [top] [bottom] side] [geomembrane textured on both sides] in the test fill.

#### 2.4 GEOSYNTHETIC CLAY LINER

Provide geosynthetic clay liner as specified in Section 02 56 13.19 GEOSYNTHETIC CLAY LINER WASTE CONTAINMENT and as shown on the drawings.

#### 2.5 GEOSYNTHETIC DRAINAGE LAYER

Provide geosynthetic drainage layer as specified in Section 31 32 19.13 GEOSYNTHETIC DRAINAGE LAYER and as shown on the drawings.

#### 2.6 GEOTEXTILE

Provide geotextile layer as specified in Section 31 32 19.16 GEOTEXTILE and as shown on the drawings.

#### 2.7 GRANULAR DRAINAGE LAYER

Provide granular drainage layer consisting of a [300] [\_\_\_\_\_] mm [12] [\_\_\_\_\_] inch layer as specified in Section [32 11 13.13 LIME TREATED SUBGRADE] [\_\_\_\_\_] and as shown on the drawings.

#### 2.8 SELECT FILL

\*\*\*\*\*  
**NOTE: Top soil is usually not placed on the test fill. However, the weight of the top soil may be simulated by the placement of additional select fill.**  
\*\*\*\*\*

Provide select fill consisting of a [600] [\_\_\_\_\_] mm [24] [\_\_\_\_\_] inch layer of select fill material as specified in Section 02 66 13 SELECT FILL AND TOPSOIL FOR LANDFILL COVER and as shown on the drawings.

#### 2.9 EQUIPMENT

Construct the test fill to demonstrate that the proposed equipment and procedures are acceptable for construction of the full scale landfill [liner] [cover]. Use equipment as specified in the sections referenced. Contact the geosynthetics manufacturers for recommendations on geosynthetics and soil placement equipment.

### PART 3 EXECUTION

#### 3.1 GENERAL

##### 3.1.1 Location

\*\*\*\*\*  
**NOTE: The location of the test fill along with plan and section views should be included on the drawings.**  
\*\*\*\*\*

Construct the test fill at the location shown on the drawings. Make [photographs] [and] [videotape] during construction of each layer of the test fill to document construction techniques.

### 3.1.2 Size

\*\*\*\*\*  
NOTE: The test fill should be a minimum of 3 to 4  
times wider than the compaction equipment proposed.  
The demonstration area should be long enough to  
allow construction equipment to achieve normal  
operating speed for a distance of 8 m 25 feet.  
\*\*\*\*\*

The top surface of the test fill must be a minimum of [30] [\_\_\_\_\_] meters  
[100] [\_\_\_\_\_] feet long and [22] [\_\_\_\_\_] meters [70] [\_\_\_\_\_] feet wide.  
Extend the random fill layer a minimum of [1.5] [\_\_\_\_\_] meters [5]  
[\_\_\_\_\_] feet beyond the edge of the upper surface of the test fill.

### 3.1.3 Slope

\*\*\*\*\*  
NOTE: In situations where compaction of soil on  
side slopes is a concern, the specified slope for  
the test fill should represent the steepest designed  
slope.  
\*\*\*\*\*

Place the completed slope of each layer in the test fill [\_\_\_\_\_] horizontal on 1 vertical.

## 3.2 PLACEMENT

\*\*\*\*\*  
NOTE: Benches and haul roads are other potential  
components of a landfill cover that can be modeled  
by a test fill. A good deal of construction  
activity is required to construct benches. This  
increased construction activity may result in damage  
to the underlying cover system. The movement of  
large vehicles on haul roads may also cause damage  
to the cover system.  
\*\*\*\*\*

### 3.2.1 Clearing and Grubbing

Clear and grub the area beneath the test fill and [3] [\_\_\_\_\_] meters [10]  
[\_\_\_\_\_] feet beyond the edges of the test fill in accordance with Section  
31 11 00 CLEARING AND GRUBBING.

### 3.2.2 Subgrade Compaction

After clearing and grubbing, compact the existing landfill surface beneath  
the test fill and [3] [\_\_\_\_\_] meters [10] [\_\_\_\_\_] feet beyond the edges of  
the test fill as described in Section [31 00 00 EARTHWORK] [\_\_\_\_\_].

### 3.2.3 Drainage Controls

Before beginning construction, construct drainage controls around the test  
fill to protect it from erosion damage. Maintain drainage control until  
completion of the post-construction monitoring period.



### 3.2.4 Anchor Trench

\*\*\*\*\*  
**NOTE:** Anchor trenches are often not required for the construction of a test fill. An anchor trench allows specific interfaces to be tested for interface stability. Delete this paragraph when an anchor trench will not be a component of the test fill.  
\*\*\*\*\*

Construct an anchor trench along the full width of the top edge of the test fill to anchor the [geomembrane,] [geosynthetic drainage layer,] [geotextile,] and [\_\_\_\_\_]. Provide anchor trench that is a minimum of [450] [\_\_\_\_\_] mm [18] [\_\_\_\_\_] inches wide and [600] [\_\_\_\_\_] mm [24] [\_\_\_\_\_] inches deep. Backfill and compact the anchor trench as specified in Section [31 00 00 EARTHWORK] [\_\_\_\_\_].

### 3.2.5 Test Fill Placement

Construct all components of the test fill as described in the specification sections previously referenced. Extend geosynthetics a minimum of [300] [\_\_\_\_\_] mm [12] [\_\_\_\_\_] inches beyond the edge of the overlying layer.

### 3.2.6 Survey Control Points

\*\*\*\*\*  
**NOTE:** Control points should be shown on plan and section views of the test fill. Permanent marks should be placed on each geosynthetic layer which will be surveyed.  
\*\*\*\*\*

Provide the location of survey control points as shown on the drawings. For soil layers, survey control points consist of 450 mm 18 inch steel pins. Install steel pins without damaging underlying geosynthetics. Place three straight rows of control points horizontally across the test fill. The rows must be parallel to the top and bottom edges of the test fill. Ensure each row consists of the following:

- a. Steel pins placed outside of the test fill, [3] [\_\_\_\_\_] meters [10] [\_\_\_\_\_] feet away from each side.
- b. Steel pins placed in the select fill layer, [3] [\_\_\_\_\_] meters [10] [\_\_\_\_\_] feet from the outside edge of the select fill layer on both sides of the test fill.
- c. Permanent marks on the upper surface of each geosynthetic layer, on both sides of the test fill.

### 3.2.7 Permanent Bench Mark

Tie surveys to a permanent bench mark outside the boundaries of the landfill.

## 3.3 TESTS

Test each layer of the test fill as specified below. For random fill,

clay barrier layer, and select fill layers, rapid methods may be used to perform moisture and density tests in accordance with ASTM D6938, or ASTM D4643. However, perform at least [1] [\_\_\_\_\_] density test per lift using the methods described in ASTM D1556/D1556M or ASTM D2167 and perform at least [1] [\_\_\_\_\_] moisture content test per lift using the methods described in ASTM D2216.

### 3.3.1 Random Fill Tests

Perform a minimum of [2] [\_\_\_\_\_] sets of classification tests on each lift of random fill placed. Perform classification tests in accordance with ASTM D7928 and ASTM D4318. Perform a minimum of [5] [\_\_\_\_\_] density and [5] [\_\_\_\_\_] moisture content tests per lift.

### 3.3.2 Clay Barrier Layer Tests

\*\*\*\*\*  
NOTE: Sealed double ring infiltrometer (SDRI) tests can be used to determine the hydraulic conductivity of the clay barrier layer. However, SDRI tests are not commonly performed due to the cost and length of time required to complete the test. SDRI tests should not be performed on slopes greater than 3 percent. EPA/600/R-93/182 provides additional information on double ring infiltrometer tests.  
\*\*\*\*\*

The QC Inspector must inspect the clay barrier layer during construction to verify material and placement methods are acceptable. Take a minimum of [5] [\_\_\_\_\_] 75 mm 3 inch Shelby tube samples from the completed clay layer at locations directed by the QC inspector. Extrude and visually examine Shelby tube samples for signs of inadequate bonding between lifts. Perform a set of classification tests and a hydraulic conductivity test on each Shelby tube sample taken. Perform classification tests in accordance with ASTM D7928 and ASTM D4318. Perform hydraulic conductivity tests in accordance with ASTM D5084. Perform a minimum of [5] [\_\_\_\_\_] field density tests and [5] [\_\_\_\_\_] moisture content tests on each lift of clay placed.

### 3.3.3 Geosynthetics Tests

\*\*\*\*\*  
NOTE: Geomembrane seam tests are sometimes performed on test fills. If seam tests are going to be performed, requirements for seam types and locations should be specified. Vertical pipes are also sometimes placed in the test fill to simulate gas vents in the cover system. A geomembrane boot is then installed around the pipe. Delete this paragraph if geomembrane seam tests will not be performed.  
\*\*\*\*\*

Perform [3] [\_\_\_\_\_] sets of quality control and [3] [\_\_\_\_\_] sets of quality assurance shear and peel tests on geomembrane seams at approved locations. Perform nondestructive testing for leaks on all geomembrane seams. Perform seam tests as specified in Section 02 56 13.13 GEOMEMBRANE WASTE CONTAINMENT.

### 3.3.4 Granular Drainage Layer Tests

\*\*\*\*\*  
NOTE: Granular drainage layer material is normally not compacted for landfill applications. Therefore, density tests are typically not required for a granular drainage layer.  
\*\*\*\*\*

Perform a minimum of [2] [\_\_\_\_\_] sets of classification tests on each lift of the granular drainage layer, in accordance with [ASTM D7928](#).

### 3.3.5 Select Fill Tests

\*\*\*\*\*  
NOTE: The select fill layer placed above geosynthetic layers can be constructed using both method and performance specifications. Modify this paragraph if a method specification will be used. The first lift of soil placed immediately above a geosynthetic layer is generally placed with low ground pressure equipment. No density testing requirements are generally specified for this first lift.  
\*\*\*\*\*

Perform a minimum of [2] [\_\_\_\_\_] sets of classification tests on each lift of select fill placed. Perform classification tests in accordance with [ASTM D7928](#) and [ASTM D4318](#). Perform a minimum of [5] [\_\_\_\_\_] density and [5] [\_\_\_\_\_] moisture content tests per lift. Density testing is not required on the first lift of soil placed above a geosynthetic layer.

### 3.3.6 Surveys

Perform the following surveys to monitor horizontal and vertical movement of the test fill. Provide horizontal and vertical accuracy of the surveys to the nearest [\[0.003\] \[\\_\\_\\_\\_\\_\] meter](#) [\[0.01\] \[\\_\\_\\_\\_\\_\] foot](#).

- a. During construction, survey all installed control points immediately after each layer is placed.
- b. During the post-construction monitoring period, survey all control points once every [7] [\_\_\_\_\_] days.

### 3.3.7 Post-Construction Monitoring

\*\*\*\*\*  
NOTE: The duration of post-construction monitoring depends on the site specific testing which will be performed. If the only purpose of the test fill is to demonstrate construction methods and monitor for damage to geosynthetics, no post-construction monitoring period is necessary. A 14 to 60 day monitoring period is typical if surveys to monitor for horizontal movement will be performed.  
\*\*\*\*\*

Monitor the test fill for [\_\_\_\_\_] days following construction. Inspect the test fill daily and report its condition in the Construction Quality

Control Daily Reports. After every precipitation event, inspect the condition of the test fill.

#### 3.3.8 Weekly Reports

Include test results and survey data related to test fill construction and post-construction monitoring during the previous 7 days in weekly reports. The QC inspector must certify that the weekly reports are accurate. The presentation of survey data for control point monitoring includes tables and graphs which present down-slope and vertical displacement. Update these tables and graphs weekly. Submit weekly reports within [3] [\_\_\_\_\_] days of the end of the week in which data was obtained.

#### 3.3.9 Final Geosynthetics Inspection

After the post-construction monitoring period, remove [select fill] [and] [granular drainage layer material] from a [3] [\_\_\_\_\_] by [6] [\_\_\_\_\_] meter [10] [\_\_\_\_\_] by [20] [\_\_\_\_\_] foot area of the test fill at a location selected by the QC inspector. Remove soils from the geosynthetics without damaging and maintain their relative positions. Visually inspect each layer of geosynthetics and document areas of damage. At the QC inspector's discretion, examine additional areas of the test fill in a similar manner. [Photograph] [and] [video tape] the inspection operation.

#### 3.3.10 Final Report

Include the following in the final report: construction and monitoring test results; final geosynthetic inspection data; and conclusions related to test fill construction and monitoring. The QC inspector must review the final report and certify its accuracy. Include a copy of the [photographs] [and] [videotape] of the test fill construction and monitoring. Submit final report within [7] [\_\_\_\_\_] days of the completion of the "Final Geosynthetics Inspection". Allow [7] [\_\_\_\_\_] days for review and approval of the final report.

#### 3.4 APPROVAL

Do not begin full-scale construction until the Contracting Officer has approved the final report. The test fill will be rejected if the Contractor's placement methods result in damage to system components or there is down-slope movement of any of the test fill survey control points. If rejected, remove the test fill. Submit a new test fill construction plan and construct and monitor another test fill at no additional cost to the Government. Use only materials, methods, and equipment from the approved test fill for full-scale construction.

#### 3.5 REMOVAL

\*\*\*\*\*  
NOTE: In some cases, the test fill may be  
incorporated into the final cover or liner.  
Connection requirements should be specified if this  
option is utilized.  
\*\*\*\*\*

After approval of the final post-construction monitoring report, remove the test fill. [Select fill] [and] [granular drainage] material may be salvaged for use during full scale construction unless otherwise directed

by the Contracting Officer. If reused, stockpile and protect these materials from contamination. Remove and discard the clay layer, or use as random fill. Remove and discard geosynthetics .

-- End of Section --