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

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2022

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02/21

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SECTION 02 66 16

TEST FILL
02/21

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).

PART 1 GENERAL

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.

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 shall 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, 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.

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 shall be present during test fill construction, shall review the Contractor's test data, and shall ensure that the Contractor has constructed each layer of the test fill as specified. The QC inspector shall 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

Random fill shall consist 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

The clay barrier layer shall consist 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

The geomembrane barrier layer shall be as specified in Section 02 56 13.13 GEOMEMBRANE WASTE CONTAINMENT and as shown on the drawings. A [smooth geomembrane] [geomembrane textured on the [top] [bottom] side]

[geomembrane textured on both sides] shall be placed in the test fill.

2.4 GEOSYNTHETIC CLAY LINER

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

2.5 GEOSYNTHETIC DRAINAGE LAYER

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

2.6 GEOTEXTILE

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

2.7 GRANULAR DRAINAGE LAYER

The granular drainage layer shall consist 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.

The select fill shall consist 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

The test fill shall be constructed to demonstrate that the proposed equipment and procedures are acceptable for construction of the full scale landfill [liner] [cover]. Equipment used shall be 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. [Photographs] [and] [videotape] shall be made 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 shall be a minimum of [30] [_____] meters
[100] [_____] feet long and [22] [_____] meters [70] [_____] feet wide.
The random fill layer shall extend 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.

The completed slope of each layer in the test fill shall be [_____] 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, the existing landfill surface beneath the
test fill and [3] [_____] meters [10] [_____] feet beyond the edges of the
test fill shall be compacted 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. The drainage control shall be
maintained 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 [_____]. The anchor trench shall be a minimum of [450] [_____] mm [18] [_____] inches wide and [600] [_____] mm [24] [_____] inches deep. The anchor trench shall be backfilled and compacted as specified in Section [31 00 00 EARTHWORK] [_____].

3.2.5 Test Fill Placement

All components of the test fill shall be constructed as described in the specification sections previously referenced. Geosynthetics shall extend 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.

The location of survey control points shall be as shown on the drawings. For soil layers, survey control points shall consist of 450 mm 18 inch steel pins. The steel pins shall be installed so as to not damage underlying geosynthetics. Three straight rows of control points shall be placed horizontally across the test fill. The rows shall be parallel to the top and bottom edges of the test fill. Each row shall consist 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

Surveys shall be tied to a permanent bench mark outside the boundaries of the landfill.

3.3 TESTS

Each layer of the test fill shall be tested 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, at least [1] [_____] density test per lift shall be performed using the methods described in ASTM D1556/D1556M or ASTM D2167 and at least [1] [_____] moisture content test per lift shall be performed using the methods described in ASTM D2216.

3.3.1 Random Fill Tests

A minimum of [2] [_____] sets of classification tests shall be performed on each lift of random fill placed. Classification tests shall be performed in accordance with ASTM D7928 and ASTM D4318. A minimum of [5] [_____] density and [5] [_____] moisture content tests shall be performed 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 shall inspect the clay barrier layer during construction to verify material and placement methods are acceptable. A minimum of [5] [_____] 75 mm 3 inch Shelby tube samples shall be taken from the completed clay layer at locations directed by the QC inspector. Shelby tube samples shall be extruded and visually examined by the QC inspector for signs of inadequate bonding between lifts. A set of classification tests and a hydraulic conductivity test shall be performed on each Shelby tube sample taken. Classification tests shall be performed in accordance with ASTM D7928 and ASTM D4318. Hydraulic conductivity tests shall be performed in accordance with ASTM D5084. A minimum of [5] [_____] field density tests and [5] [_____] moisture content tests shall be performed 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.

A minimum of [2] [_____] sets of classification tests shall be performed on each lift of select fill placed. Classification tests shall be performed in accordance with ASTM D7928 and ASTM D4318. A minimum of [5] [_____] density and [5] [_____] moisture content tests shall be performed per lift. Density testing is not required on the first lift of soil placed above a geosynthetic layer.

3.3.6 Surveys

The following surveys shall be performed to monitor horizontal and vertical movement of the test fill. The horizontal and vertical accuracy of the surveys shall be to the nearest [0.003] [_____] meter [0.01] [_____] foot.

- a. During construction, all installed control points shall be surveyed immediately after each layer is placed.
- b. During the post-construction monitoring period, all control points shall be surveyed 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.

The test fill shall be monitored for [_____] days following construction. The QC Inspector shall inspect the test fill daily and report its condition in the Construction Quality Control Daily Reports. After every precipitation event, the QC inspector shall inspect the condition of the test fill.

3.3.8 Weekly Reports

Weekly reports shall include test results and survey data related to test fill construction and post-construction monitoring during the previous 7 days. The QC inspector shall certify that the weekly reports are accurate. The presentation of survey data for control point monitoring shall include tables and graphs which present down-slope and vertical displacement. These tables and graphs shall be updated 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, [select fill] [and] [granular drainage layer material] shall be removed from a [3] [_____] by [6] [_____] meter [10] [_____] by [20] [_____] foot area of the test fill at a location selected by the QC inspector. Soils shall be removed from the geosynthetics such that the geosynthetics are not damaged and their relative positions are maintained. The QC inspector shall visually inspect each layer of geosynthetics and document areas of damage. At the QC inspector's discretion, additional areas of the test fill shall be examined in a similar manner. The inspection operation shall be [photographed] [and] [video taped].

3.3.10 Final Report

The final report shall include the following: construction and monitoring test results; final geosynthetic inspection data; and conclusions related to test fill construction and monitoring. The QC inspector shall review the final report and certify its accuracy. A copy of the [photographs] [and] [videotape] of the test fill construction and monitoring shall be included. 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

Full-scale construction shall not begin until the Contracting Officer has approved the final report. The test fill shall 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, the test fill shall be removed. A new test fill construction plan shall be submitted and another test fill shall be constructed and monitored at no additional cost to the Government. Only materials, methods, and equipment used in the approved test fill shall be used 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. The clay layer shall be removed and discarded or used as random fill. Geosynthetics shall be removed and discarded.

-- End of Section --