
USACE / NAVFAC / AFCEC / NASA UFGS-02 66 00 (February 2010)

Preparing Activity: USACE Superseding
UFGS-02 66 00 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2020

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SECTION 02 66 00

SELECT FILL AND TOPSOIL FOR LANDFILL COVER
02/10

NOTE: This guide specification covers the requirements for select fill and topsoil layers for landfill cover systems. Select fill is the term used by USACE to describe soil layers placed directly on geosynthetic materials.

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

1.1 UNIT PRICES

NOTE: Delete this paragraph when work is covered by a lump sum contract price. Weight measurement may be used to supplement volume measurement surveys if significant subgrade settlement is anticipated.

Measurement and payment for "select fill" and "topsoil" shall be based on the respective unit prices for each cubic meter yard of "select fill" and "topsoil" in place. This unit price shall include the cost for development of borrow sources, cost of materials, excavation, hauling, equipment, placement, testing, and other work required to construct the

"select fill" or "topsoil" layers.

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 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 D422 | (1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils |
| ASTM D698 | (2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)) |
| 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 D2487 | (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D2974 | (2020; E 2020) Moisture, Ash, and Organic Matter of Peat and Other Organic Soils |
| ASTM D4318 | (2017; E 2018) Standard Test Methods for |

Liquid Limit, Plastic Limit, and
Plasticity Index of Soils

ASTM D4972

(2018) Standard Test Methods for pH of
Soils

ASTM D6938

(2017a) Standard Test Method for In-Place
Density and Water Content of Soil and
Soil-Aggregate by Nuclear Methods (Shallow
Depth)

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit
the following list to reflect only the submittals
required for the project.

The Guide Specification technical editors have
designated 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 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,
Air Force, and NASA projects.

The "S" following a submittal item indicates that
the submittal is required for the Sustainability
eNotebook to fulfill federally mandated sustainable
requirements in accordance with Section 01 33 29
SUSTAINABILITY REPORTING. Locate the "S" submittal
under the SD number that best describes the
submittal item.

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" designation;
submittals not having a "G" designation are for [Contractor Quality
Control approval.] [information only. When used, a designation following
the "G" designation identifies the office that will review the submittal
for the Government.] Submittals with an "S" are for inclusion in the

Sustainability eNotebook, in conformance to Section 01 33 29
SUSTAINABILITY REPORTING. Submit the following in accordance with Section
01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Handling Plan

SD-04 Samples

Select Fill
Topsoil

SD-06 Test Reports

Borrow Source Assessment Report; G[, [_____]]
Select Fill and Topsoil Material Tests
Moisture Content and Density Tests of In-Place Select Fill

PART 2 PRODUCTS

2.1 Select Fill

NOTE: The default maximum allowable particle size is
25 mm 1 inch. If the select fill layer will be
placed directly on top of a geomembrane, this value
may have to be reduced and restrictions regarding
angularity may have to be included. Manufacturers
should be consulted for recommendations on select
fill based on the type and thickness of geomembrane
being used.

Selection of suitable select fill should be based on
the type and availability of soils at or close to
the site. The designer must verify that these soils
will not clog underlying drainage layers. The soil
types listed in Table 1 are generally acceptable for
use as select fill.

Sands must be analyzed to ensure they are internally
stable. A soil is internally stable if it is
self-filtering (i.e., the fine particles do not move
through the pores of the coarser fraction). Federal
Highway Administration Publication No.
FHWA-HI-95-038 describes procedures for determining
the clogging potential and internal stability of
soil.

The designer must also ensure the select fill is
compatible with the underlying filter. For landfill
applications, the filter is typically a geotextile.
Filter design is based on a comparison of the grain
size distribution (ASTM D422) of the select fill and
the apparent opening size (AOS) of the underlying
geotextile. Geotextile filter design procedures are
outlined in Federal Highway Administration
Publication No. FHWA-HI-95-038.

Criteria for Atterberg limits are sometimes included in Table 1 to control the properties of the select fill.

Hydraulic conductivity criteria may also need to be added to Table 1 for the select fill soil. The hydraulic conductivity of the select fill layer controls the rate at which precipitation infiltrates into the underlying drainage layer.

Select fill shall comply with the criteria listed in Table 1 and shall be free of debris, frozen materials, angular rocks, roots, and organics. Submit a minimum of 23 kg 50 pounds of select fill from each proposed borrow source to the Government's designated laboratory at least [15] [_____] days prior to placement.

2.2 TOPSOIL

Topsoil shall consist of natural, friable soil that is representative of soils in the vicinity which produce heavy growths of crops, grass, or other vegetation and is reasonably free from underlying subsoil, clay lumps, objectionable weeds, litter, brush, matted roots, toxic substances, or any material that might be harmful to plant growth or be a hindrance to grading, planting, or maintenance operations. Submit a minimum of 2 kg 5 pounds of topsoil from each proposed borrow source to the Government's designated laboratory at least [15] [_____] days prior to placement. Topsoil shall also comply with the criteria listed in Table 1.

| TABLE 1 REQUIRED PHYSICAL PROPERTIES OF SELECT FILL AND TOPSOIL | | |
|--|--|-------------|
| Property | Test Value | Test Method |
| Select Fill | | |
| Soil classification | Lean clay (CL) Clayey sand (SC) Clayey gravel (GC) [_____]] | ASTM D2487 |
| Max. particle size (mm)Max. particle size (inches) | 25 [_____] 1.0 [_____]] | ASTM D422 |
| Max. particle size (mm)Max. particle size (inches) | 251 | ASTM D422 |
| pH | 5-7 | ASTM D4972 |
| Organic content (percent) | 5-20 | ASTM D2974 |

2.3 EQUIPMENT

Equipment used to place the select fill and topsoil layers shall be as described in the approved Materials Handling Plan, including ground pressures. Equipment shall not accelerate or brake suddenly, turn sharply, or be operated at speeds exceeding 8 km 5.0 miles per hour.

PART 3 EXECUTION

3.1 BORROW SOURCE ASSESSMENT REPORT

Submit a Borrow Source Assessment Report at least [15] [_____] days prior to select fill and topsoil placement. No select fill or topsoil may be placed until the Borrow Source Assessment Report is approved. Include the following in the report: location of each borrow source; estimated quantity of borrow available; logs of subsurface explorations; and laboratory test results.

3.1.1 Select Fill

NOTE: A test fill should be required when needed to demonstrate placement technique or to determine cover or liner stability. Section 02 66 10 TEST FILL can be edited and included in the specification package if a test fill will need to be constructed.

Shear strength testing is often required for landfill covers and liners which contain geosynthetics. Criteria for shear strength testing are described in Section 02 56 13 WASTE CONTAINMENT GEOMEMBRANE or Section 02 56 15 GEOSYNTHETIC CLAY LINER (GCL).

3.1.1.1 Classification Testing

Borrow source assessment tests shall be performed on each principal type or combination of materials proposed for use in the select fill layer to ensure compliance with specified requirements. At least one set of borrow assessment tests shall be performed on each borrow source proposed for use. A set of borrow source assessment tests shall consist of Atterberg limits (ASTM D4318), particle size analysis (ASTM D422), and moisture content (ASTM D2216). Based on borrow source assessment testing, soils shall be classified in accordance with ASTM D2487.

3.1.1.2 Moisture-Density (Compaction) Testing

NOTE: Delete this paragraph if compaction requirements will not be specified for the select fill layer.

A representative sample from each principal type or combination of borrow materials shall be tested to establish compaction curves using ASTM D698. At least one compaction test shall be performed on each borrow source proposed. A minimum of [5] [_____] points shall be used to develop each compaction curve. During construction, placement of select fill shall conform to the following requirements:

- a. The minimum allowable dry density shall be no less than [90] [_____] percent of maximum dry density.
- b. The allowable moisture content range shall be [+/- 3] [_____] percent

of optimum.

3.1.2 Topsoil

Testing shall be performed on representative samples of each principal type or combination of topsoil materials. At least one set of tests shall be performed on each borrow source proposed. Testing shall consist of the determination of maximum particle size in accordance with ASTM D422, pH in accordance with ASTM D4972, and organic content in accordance with ASTM D2974.

3.1.3 Chemical Contamination Testing

Borrow used for the select fill and topsoil layers shall be free of contamination. Each proposed borrow source shall be sampled and analyzed for chemical contamination in accordance with [_____].

3.2 INSTALLATION

3.2.1 Select Fill Placement

NOTE: Large landfills may require the construction of temporary haul roads to allow access for large construction equipment during select fill placement. The haul roads are typically a minimum of 1 m 3 feet in thickness and are constructed using select fill layer soil.

No equipment shall be operated directly on the top surface of geosynthetics without permission from the Contracting Officer. Select fill shall be pushed out over geosynthetics in an upward tumbling motion so that wrinkles in geosynthetics do not fold over. Soil shall not be dropped directly onto geosynthetics from a height greater than 915 mm 3 feet. On slopes, select fill shall be placed from the bottom of the slope upward.

3.2.1.1 Initial Lift of Select Fill Placed Over Geosynthetics

The first lift of soil placed over geosynthetics shall be a minimum of [305][380] mm [12][15] inches in loose thickness. Equipment with ground pressures less than 49 kPa 7 psi shall be used to place and traffic compact the first lift of select fill. Traffic compaction shall consist of a minimum of 2 passes over all areas.

3.2.1.2 Subsequent Lifts of Select Fill

NOTE: Maximum loose lift thickness should be no greater than 200 mm 8 inches if a density criteria will be applied to the lift. The criteria for minimum number of passes can be omitted if the Contractor must meet a density criteria.

The loose lift thickness of each subsequent lift shall be no greater than [205][305] mm [8][12] inches. Full scale placement and compaction equipment shall be allowed on areas underlain by geosynthetics after the

[first][second]loose lift of soil has been placed. [Compaction shall consist of a minimum of 2 passes over all areas.]

3.2.2 Topsoil Placement

Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading. Topsoil shall be placed in one lift and shall be evenly spread to a final compacted thickness of [150] [_____] mm [6] [_____] inches. Topsoil shall be traffic compacted using approved placement equipment. On slopes, topsoil shall be placed from the bottom of the slope upward.

3.3 CONSTRUCTION TOLERANCES

NOTE: The U.S. Environmental Protection Agency document, EPA/600/R-93/182 Quality Assurance and Quality Control for Waste Containment Facilities discourages the use of grade stakes which penetrate the select fill layer to control lift thickness. Grade stakes can potentially damage underlying geosynthetic materials.

Finished surfaces shall be uniformly graded and shall be free from depressions, mounds, or windrows. The top surface of the select fill layer and topsoil layer shall be no greater than [76] [_____] mm [3] [_____] inches above the lines and grades shown on the drawings. No minus tolerance will be permitted. Rigid grade stakes shall not be driven into the select fill layer to control placement.

3.4 CONSTRUCTION TESTS

3.4.1 Select Fill and Topsoil Material Tests

No select fill or topsoil shall be placed until the Borrow Source Assessment Report is approved. During construction of the select fill layer, representative samples shall be taken for testing at the frequencies listed in Table 2 from the borrow source prior to placement. Test results must comply with the requirements listed in Part 2 Products or the material will be rejected for use. Submit test results as specified.

| TABLE 2 SELECT FILL AND TOPSOIL MATERIAL TESTING FREQUENCIES | | |
|---|---|-------------|
| Property | Frequency | Test Method |
| Select Fill | | |
| Grain size analysis | 1,500 cubic meters 2,000 cubic yards | ASTM D422 |
| Atterberg limits | 1,500 cubic meters 2,000 cubic yards | ASTM D4318 |

| TABLE 2 SELECT FILL AND TOPSOIL MATERIAL TESTING FREQUENCIES | | |
|---|---|-------------|
| Property | Frequency | Test Method |
| Compaction (Note 1) | 4,000 cubic meters 5,200 cubic yards | ASTM D698 |
| Topsoil | | |
| Grain size analysis for maximum particle size | 1,500 cubic meters 2,000 cubic yards | ASTM D422 |
| pH | 1,500 cubic meters 2,000 cubic yards | ASTM D4972 |
| Organic content | 1,500 cubic meters 2,000 cubic yards | ASTM D2974 |
| Note 1: Compaction test results shall be compared with the results obtained during the borrow source assessment. When there are significant differences, adjustments to the acceptable moisture content or density ranges shall be proposed by the Contractor for approval. | | |

3.4.2 Moisture Content and Density Tests of In-Place Select Fill

NOTE: Density testing requirements are usually waived for the first 300 to 460 mm 12 to 18 inches of select fill placed over geosynthetics to prevent damage to the underlying geosynthetics. Remove this paragraph if moisture content and density testing will not be performed on any of the select fill lifts.

Moisture content and density tests shall be performed in accordance with Table 3. Density requirements will not be enforced for the first lift of the select fill layer. Submit test results as specified.

| TABLE 3 MOISTURE CONTENT AND DENSITY TESTS OF IN-PLACE SELECT FILL | | |
|---|---|-------------|
| Property | Frequency per Lift | Test Method |
| Nuclear moisture content | 925 square meters 10,000 square feet | ASTM D6938 |
| Standard moisture content | 1 for every 20 nuclear tests | ASTM D2216 |
| Nuclear density | 925 square meters 10,000 square feet | ASTM D6938 |

| TABLE 3 MOISTURE CONTENT AND DENSITY TESTS OF IN-PLACE SELECT FILL | | |
|---|------------------------------|------------------------------------|
| Standard density | 1 for every 20 nuclear tests | ASTM D1556/D1556M or ASTM D2167 |

3.4.2.1 Test Frequencies and Locations

Each day that select fill is placed, a minimum of one set of standard moisture content and density tests shall be performed. Nuclear density and moisture content tests shall be checked at the frequencies shown in Table 3. Standard tests shall be performed at locations which are as close as possible to the locations of the nuclear tests being checked.

3.4.2.2 Nuclear Density and Moisture Content Tests

Nuclear density readings shall be taken in the direct transmission mode. When ASTM D6938 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D1556/D1556M. ASTM D6938 results in a wet unit weight of soil and when using this method ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer.

3.4.2.3 Test Results

Field moisture content and density test results shall be compared to the compaction curve for the appropriate material type being tested. If test results are not within the acceptable range for moisture content or density, as described in subparagraph Moisture-Density (Compaction) Testing, [3] [_____] additional tests shall be performed near the location of the failed parameter. If all retests pass, no additional action shall be taken. If any of the retests fail, the lift of soil shall be repaired out to the limits defined by passing tests for that parameter. The area shall then be retested as directed.

3.5 PROTECTION

3.5.1 Damage

Erosion rills or other damage that occurs shall be repaired and grades re-established. Repairs to the select fill layer or topsoil layer shall be documented including location and volume of soil affected, corrective action taken, and results of retests.

3.5.2 Stockpiles

Storage or stockpiling of material on the completed surface of the select fill or topsoil layers will not be permitted.

-- End of Section --