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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 02 66 13

SELECT FILL AND TOPSOIL FOR LANDFILL COVER
02/21

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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).
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PART 1 GENERAL

1.1 UNIT PRICES

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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.
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Base measurement and payment for "select fill" and "topsoil" on the respective unit prices for each cubic meter yard of "select fill" and "topsoil" in place. 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 in the unit cost.

1.2 REFERENCES

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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.

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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 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)
ASTM D7928	(2017) Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis

1.3 SUBMITTALS

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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.

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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

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 D7928) 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.

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Provide select fill in compliance with the criteria listed in Table 1 and 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

Provide topsoil consisting 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. Also, provide topsoil complying 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 D7928
Max. particle size (mm)Max. particle size (inches)	251	ASTM D7928
pH	5-7	ASTM D4972
Organic content (percent)	5-20	ASTM D2974

2.3 EQUIPMENT

Use equipment to place the select fill and topsoil layers as described in the approved Materials Handling Plan, including ground pressures. Do not use equipment that accelerates or brakes suddenly, turns sharply, or operates 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

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NOTE: A test fill should be required when needed to demonstrate placement technique or to determine cover or liner stability. Section 02 66 16 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 13.13 GEOMEMBRANE WASTE CONTAINMENT or Section 02 56 13.19 GEOSYNTHETIC CLAY LINER WASTE CONTAINMENT.

****

3.1.1.1 Classification Testing

Perform borrow source assessment tests on each principal type or combination of materials proposed for use in the select fill layer to ensure compliance with specified requirements. Perform at least one set of borrow assessment tests on each borrow source proposed for use. A set of borrow source assessment tests consists of Atterberg limits (ASTM D4318), particle size analysis (ASTM D7928), and moisture content (ASTM D2216). Based on borrow source assessment testing, classify soils in accordance with ASTM D2487.

3.1.1.2 Moisture-Density (Compaction) Testing

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

****

Test a representative sample from each principal type or combination of borrow materials to establish compaction curves using ASTM D698. Perfrom at least one compaction test on each borrow source proposed. Use a minimum of [5] [_____] points to develop each compaction curve. During construction, conform to the following requirements for placement of select fill:

a. Minimum allowable dry density less than [90] [_____] percent of maximum dry density is not acceptable.

b. The allowable moisture content range must be [+/- 3] [_____] percent

of optimum.

3.1.2 Topsoil

Perform testing representative samples of each principal type or combination of topsoil materials. Perform at least one set of tests on each borrow source proposed. Perform testing consisting of the determination of maximum particle size in accordance with ASTM D7928, pH in accordance with ASTM D4972, and organic content in accordance with ASTM D2974.

3.1.3 Chemical Contamination Testing

Use borrow for the select fill and topsoil layers that is free of contamination. Sample and analyze each proposed borrow source for chemical contamination in accordance with [_____].

3.2 INSTALLATION

3.2.1 Select Fill Placement

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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.

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Do not operate equipment directly on the top surface of geosynthetics without permission from the Contracting Officer. Push select fill out over geosynthetics in an upward tumbling motion so that wrinkles in geosynthetics do not fold over. Do not drop soil directly onto geosynthetics from a height greater than 915 mm 3 feet. On slopes, place select fill 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 must be a minimum of [305][380] mm [12][15] inches in loose thickness. Use equipment with ground pressures less than 49 kPa 7 psi to place and traffic compact the first lift of select fill. Traffic compaction consists of a minimum of 2 passes over all areas.

3.2.1.2 Subsequent Lifts of Select Fill

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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.

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Loose lift thickness of each subsequent lift greater than [205][305] mm [8][12] inches is unacceptable. Allow full scale placement and compaction equipment on areas underlain by geosynthetics after the [first][second]loose lift of soil has been placed. [Compaction consists

of a minimum of 2 passes over all areas.]

3.2.2 Topsoil Placement

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

3.3 CONSTRUCTION TOLERANCES

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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.

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Provide finished surfaces that are uniformly graded and free from depressions, mounds, or windrows. Top surfaces of the select fill layer and topsoil layer greater than [76] [_____] mm [3] [_____] inches above the lines and grades shown on the drawings are prohibited. No minus tolerance will be permitted. Do not drive rigid grade stakes into the select fill layer to control placement.

3.4 CONSTRUCTION TESTS

3.4.1 Select Fill and Topsoil Material Tests

Do not place select fill or topsoil until the Borrow Source Assessment Report is approved. During construction of the select fill layer, take representative samples 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 meters2,000 cubic yards	ASTM D7928
Atterberg limits	1,500 cubic meters2,000 cubic yards	ASTM D4318

TABLE 2 SELECT FILL AND TOPSOIL MATERIAL TESTING FREQUENCIES		
Property	Frequency	Test Method
Compaction (Note 1)	4,000 cubic meters5,200 cubic yards	ASTM D698
Topsoil		
Grain size analysis for maximum particle size	1,500 cubic meters2,000 cubic yards	ASTM D7928
pH	1,500 cubic meters2,000 cubic yards	ASTM D4972
Organic content	1,500 cubic meters2,000 cubic yards	ASTM D2974
Note 1: Compare compaction test results with the results obtained during the borrow source assessment. When there are significant differences, adjustments to the acceptable moisture content or density ranges must be proposed by the Contractor for approval.		

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

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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.

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Perform moisture content and density tests 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 meters10,000 square feet	ASTM D6938
Standard moisture content	1 for every 20 nuclear tests	ASTM D2216
Nuclear density	925 square meters10,000 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, perform a minimum of one set of standard moisture content and density tests. Check nuclear density and moisture content tests at the frequencies shown in Table 3. Perform standard tests 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

Take nuclear density readings in the direct transmission mode. When ASTM D6938 is used, check and adjust the calibration curves 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, 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 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

Compare field moisture content and density test results 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, perform [3] [_____] additional tests near the location of the failed parameter. If all retests pass, take no additional action. If any of the retests fail, repair the lift of soil out to the limits defined by passing tests for that parameter. Retest the area as directed.

3.5 PROTECTION

3.5.1 Damage

Repair erosion rills or other damage that occurs and re-establish grades. Document repairs to the select fill layer or topsoil layer 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 --