

SECTION 2A

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

Military Standards (Mil. Std.):

MIL-STD-619B	Unified Soil Classification System for Roads, Airfields, Embankments, and Foundations
MIL-STD-621A and Notices 1 and 2	Test Method for Pavement Subgrade, Subbase, and Base-Course Materials

American Society for Testing and Materials (ASTM) Publications:

D 1556-82	Density of Soil in Place by the Sand-Cone Method
D 2167-66 (R 1977)	Density of Soil in Place by the Rubber-Balloon Method
D 2922-81	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 2937-83	Density of Soil in Place by the Drive-Cylinder Method
D 3017-78	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

2. **DEFINITIONS:**

2.1 **Satisfactory Materials:** Satisfactory materials include materials classified in MIL-STD-619 as GW, GP, SW, GM, GC, SP, SM, SC and CL. CH materials shall be considered satisfactory only for use as impervious fill. Additionally any material classified as SM shall not have more than 25 percent by weight passing the No. 200 sieve. Earth fill over arches shall contain no stones heavier than 10 pound or larger than 6 inches in any dimension.

2.2 **Unsatisfactory Materials:** Unsatisfactory materials include materials classified in MIL-STD-619 as Pt, OH, OL, ML, MH and any material containing roots and other organic matter, trash, debris, or frozen materials.

2.3 **Cohesionless and Cohesive Materials:** Cohesionless materials include materials classified in MIL-STD-619, as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH.

Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.4 Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in MIL-STD-621, Method 100, compaction effort designation CE 55, abbreviated hereinafter as percent CE 55 maximum density.

2.5 Impervious Fill: Impervious fill shall be satisfactory material classified in MIL-STD-619 as CL or CH, with liquid limit greater than 30 and plasticity index greater than 15.

2.6 Filter Materials: Filter materials shall be washed sand, sand and gravel, crushed stone, crushed-stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter materials shall be uniformly graded between the limits specified hereinafter. Points on the individual grading curves obtained from representative samples of filter materials not only shall lie between smooth curves drawn through a plot of the tabulated grading limits specified, but also shall exhibit no abrupt changes in slope denoting skip grading, scalping of certain sizes, or other irregularities that would be detrimental to the proper functioning of the filter.

2.6.1 Sand filter material shall be a uniformly graded material conforming to the following gradation:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
3/8 inch	
No. 4	
No. 10	
No. 20	
No. 40	
No. 100	
No. 200	

2.6.2 Gravel filter material shall be uniformly graded material conforming to the following gradation:

<u>Sieve Size</u>	<u>Percent by Weight Passing</u>
1-1/2 inch	
1-inch	
1/2-inch	
3/8-inch	
No. 4	
No. 10	

2.7 Non-Frost Susceptible (NFS) Material: NFS materials shall be uniformly graded cohesionless materials such as crushed rock, gravel, sand, slag, and cinders with a maximum particle size of inch, with less than 5 percent by weight passing a No. 200 sieve, and with not more than 3 percent by weight finer than 0.02 mm.

2.8 Capillary Water Barrier: Capillary water barrier under concrete floor and area-way slabs on grade shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1-1/2 inches and not more than 2 percent by weight shall pass the No. 4 sieve size.

3. CLEARING AND GRUBBING: The area within limits of grading shall be cleared and grubbed of trees, stumps, roots, brush, and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic material shall be completely removed and the resulting depressions shall be filled with satisfactory material placed and compacted in accordance with paragraph FILLING AND SUBGRADE PREPARATION. Materials removed shall be disposed of in areas designated by the Contracting Officer.

4. TOPSOIL: Topsoil shall be stripped to a depth of inches within the designated excavations and grading lines and deposited in storage piles for future use. Topsoil shall be processed to remove stones larger than 2 inches, litter, stumps, roots and other material that would interfere with planting and maintenance operations.

5. EXCAVATION:

5.1 General: The excavation shall conform to the dimensions and elevations indicated for each building and structure, except as specified hereinafter, and shall include trenching for utility and foundation drainage systems for each building and structure, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material; payment therefor will be made in conformance with the CHANGES clause of the GENERAL PROVISIONS. Satisfactory material removed below the depths indicated without specified direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock specified in paragraph FILLING AND SUBGRADE PREPARATION. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

5.2 Drainage: Excavation shall be performed so that the area of the site and area immediately surrounding the site and affecting operations at the site will be continually and effectively drained. Water shall not be permitted to accumulate in the excavations. Excavations shall be drained by pumping or other approved methods to prevent softening of the foundation bottom, undercutting of footings, or other actions detrimental to proper construction procedures. Ditches, dikes, sumps and drains shall be provided as necessary to direct surface and ground water away from excavations.

5.3 Shoring: Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

5.4 Classification of Excavation: (Excavation will be unclassified regardless of the nature of material encountered.) (Excavation shall be done on a classified basis in accordance with the following definitions.

5.4.1 Rock excavation shall consist of the removal and disposal of boulders 1/2-cubic yard or more in volume; solid rock; materials that cannot be removed without systematic drilling and blasting such as rock material in ledges or aggregate conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock; and concrete or masonry structures exceeding 1/2-cubic yard in volume, except sidewalks and paving. Hard and compact materials such as cemented-gravel, glacial till, and relatively soft or disintegrated rock that can be removed without continuous and systematic drilling and blasting will not be considered as rock excavation. Rock excavation will not be considered as such because of intermittent drilling and blasting that is performed merely to increase production. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned and classified by the Contracting Officer.

5.4.2 Common excavation shall consist of removal and disposition of material not classified as rock excavation.)

5.5 Blasting: Blasting (will) (will not) be permitted.

5.6 Utility and Drain Trenches: Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material in conformance with paragraph BACKFILLING.

5.7 Disposition of Excavated Materials: Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and unsatisfactory material shall be disposed of in designated spoil areas or outside the limits of Government-controlled land and at the Contractor's responsibility as directed by the Contracting Officer.

5.8 Borrow: Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained from the borrow areas shown or from approved sources outside the limits of Government-controlled land at the Contractor's responsibility, as directed by the Contracting Officer. (The Contracting Officer shall be notified

sufficiently in advance prior to opening any borrow area to permit elevations and measurements of the undisturbed ground surface to be taken. Clearing and grubbing, disposal or, where permitted, burning of debris therefrom, and developing of the borrow area, including access roads and drainage, shall be considered incidental items to borrow excavation.) Borrow areas shall be neatly trimmed and drained after borrow excavations are completed.

5.9 Final Grade of Surfaces to Support Concrete: Excavation to final grade shall not be made until just before concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation approximately 12 inches above the bottom of the footing before driving piles. After all piles are in place, excavation to final grade shall be completed as specified. Rock shall be worked down to a satisfactory bed or sidewall. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking or other erosion resulting from ponding or flow of water.

6. FILLING AND SUBGRADE PREPARATION: Satisfactory materials free from roots, debris or stones larger than 6 inches shall be used in bringing fills to the lines and grades indicated and for replacing unsatisfactory materials. Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill materials will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, moistened or aerated as necessary and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Satisfactory material shall be placed in horizontal layers not exceeding 8 inches in loose depth and then compacted. Materials shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Materials shall be moistened or aerated (as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used) (to within plus or minus percent of optimum moisture content). Each layer shall be compacted to not less than the percentage of maximum density specified below:

	<u>Percent CE 55</u> <u>maximum density</u> <u>Cohesive</u> <u>material</u>	<u>Percent CE 55</u> <u>maximum density</u> <u>Cohesionless</u> <u>material</u>
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, and paved areas	90	95
Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under building slabs, steps and paved areas, top 12 inches	90	95
Under sidewalks, top 6 inches	85	90

Capillary water barrier shall be placed directly on the subgrade meeting density and elevation requirements and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

7. BACKFILLING:

7.1 General Backfilling: Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade using satisfactory materials placed and compacted as specified under paragraph FILLING AND SUBGRADE PREPARATION. Backfill shall not be placed in wet or frozen areas. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 6 inches in uncompacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

7.2 Igloo Backfilling: After the metal arches and concrete walls have been waterproofed as specified, arch cover fill materials shall be carefully placed to avoid damage to the waterproofing and dampproofing, and the sequence and method of placing and compacting the fill shall be such as not to distort the shape, alignment, and dimensions of the arches as shown. Filling over a line of multiple arches shall not be started until all arches in the line have been waterproofed. The sequence and method of placing and compacting the fill shall conform to arch manufacturer's requirements. A technical representative of the arch manufacturer shall witness and advise throughout the backfill operations. Unless specifically directed otherwise by the arch manufacturer's technical representative, fill shall be brought up evenly and simultaneously on both sides of the

arch. Filling operations shall commence at the front and rear of a structure and continue uniformly to the center. At no time shall heavy equipment be run over the fill directly above the arches. Before filling is begun, for maintaining control of arch shape during filling operations, plumb bobs shall be suspended from the inside of the arch at the crown point and at points 30 degrees from each side of the crown point. These plumb bobs shall be spaced at not more than 10 foot intervals for the entire length of each arch. All plumb bobs shall be observed with reference to arch centerline and variations in elevation during filling operation, and if movement of more than 1 inch of any plumb bob in the horizontal or vertical direction is noted, operations shall be modified to correct any movement noted and to prevent further movement or distortion. Distortion or damage to the metal arches, concrete or other work, as determined by the Contracting Officer, shall be repaired or replaced by the Contractor at no additional cost to the Government.

8. TESTING shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Tests shall be performed at a rate of Moisture-density relations shall be determined in accordance with the procedure referenced in paragraph DEGREE OF COMPACTION. Field in-place density shall be determined in accordance with ASTM (D 1556 or MIL-STD-621, Method 106) (D 2167) (D 2922). When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gages shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gages 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. ASTM D 2937 or MIL-STD-621, Method 102 shall be used only for soft, fine-grained, cohesive soils. Approved compacted subgrades that are disturbed by Contractor's operations or adverse weather shall be scarified and compacted as specified hereinbefore to the required density prior to further construction thereon. Recompaction over underground utilities and heating lines shall be by hand tamping.

9. GRADING: Areas outside of each building and structure line shall be constructed true to grade to the limits shown, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

10. SPREADING TOPSOIL: Areas outside the building lines from which topsoil has been removed and the earth cover over the arches shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by discing or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to

the thickness, elevations, and slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

11. PROTECTION: Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes, at no additional cost to the Government.