United States Department of Agriculture
Soil Conservation Service
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GN-5

GEOLOGY NOTE NO. 5
210-VI

SUBJECT: ENG - SOIL SAMPLE SIZE REQUIREMENTS FOR SOIL MECHANICS LABORATORY TESTING

Purpose. To distribute Geology Note (GN) No. 5.

Effective Date. Effective when received.

Making laboratory tests on soils using prescribed equipment and testing apparatus requires a sufficient amount of the soil available at the laboratory. The Soil Mechanics Laboratories (SMLs) are sometimes limited in the tests they can make because samples submitted are not the correct size.

Updates in the testing procedures and apparatus have been made by the profession over the years and are reflected in testing standards established by the American Society for Testing and Materials (ASTM). The Soil Conservation Service (SCS) SMLs use ASTM standard methods and have kept current with testing procedures accepted by the profession.

The SCS National Engineering Handbook (NEH), Section 8, Chapter 3, contains guidance for sample sizes. The current Chapter 3, published in 1963, is under revision, but it will take some time to complete. GN-5 is prepared as a guide for selecting sample sizes until the revised edition is available. Tables 3-1 and 3-2 of the NEH, Section 8, Chapter 3, are to be disregarded and Tables 3-1, 3-1A, and 3-2 included in GN-5 are to be used until further notice.

Filing Instructions. File with other Geology Notes, Soil Mechanics Notes, NEH, Section 8, and other guide material on sampling and testing soil for engineering uses.

Distribution. GN-5 is of interest to all SCS geologists, engineers, and others who may conduct investigations or sample soil for engineering testing. The initial distribution to each state and NTC is shown on the reverse side. Additional copies may be obtained by ordering GN-5 from the Consolidated Forms and Distribution Center, 3222 Hubbard Road, Landover, Maryland 20785.

Edgar H. Nelson

EDGAR H. NELSON
Associate Deputy Chief
for Technology

Enclosure

DIST: GN-5 (see reverse side)

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GEOLOGY NOTE 5

SOIL SAMPLE SIZE REQUIREMENTS FOR

SOIL MECHANICS LABORATORY TESTING

November 1991

U.S. Department of Agriculture
Soil Conservation Service
Engineering Division

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I. PURPOSE

The purpose of this note is to establish new minimum requirements regarding soil samples submitted for laboratory testing. Recent changes in ASTM Standards for several laboratory tests are the principal reason for this revision.

Many of these changes concern both sample and specimen preparation as well as the actual testing procedures. Affected tests include Atterberg limits, compaction, double hydrometer and pinhole dispersion as well as certain soil chemistry tests. In addition, proposed revisions in the gradation standards, if adopted by ASTM, will require laboratories to begin using wet preparation methods.

II. SCOPE

Sample size requirements are listed in Tables 3-1 and 3-2 of the National Engineering Handbook, Section 8, Chapter 3, pp. 3-8 and 3-9, Engineering Geology. Section 8 is scheduled for revision but the completion date is not known. Until the revision is completed, the requirements stated in this Note should be followed. Tables 3-1 and 3-2 of National Engineering Handbook, Section 8, Chapter 3, dated September, 1963, are to be disregarded and Tables 3-1, 3-1A, and 3-2 included in this Note used until further notice.

III. REQUIREMENTS

Revised Tables 3-1 and 3-1A define the four sample sizes and list the size of sample required to perform the major laboratory tests.

Revised Table 3-2 indicates minimum sizes required based on gradation.

In order to comply with many ASTM standards and to simplify field procedures as well as laboratory storage, handling, and record keeping, all future soil samples should be taken, stored, and shipped by methods which preserve natural water content. Shipment of samples from quarantined areas should be in accordance with the National Engineering Manual, Part 531, Subpart F.

IV. SAMPLE BAGS

Shipment of samples to maintain their natural water content may be accomplished using one of the three methods listed below:

1. Plastic bag only. In this case, use bags made of 8 mil or heavier plastic to prevent puncture.
2. Light weight plastic bag placed inside of a canvas bag. For non-gravelly soils, use 4 mil or heavier plastic. For gravelly soils, use 6 mil or heavier plastic.
3. Canvas bag with built-in plastic bag. These bags can be purchased with the inner plastic bag already in place.

The mass of individual sample bags or boxes should be limited to 70 pounds for shipment by UPS or U.S. Postal Service and for ease of handling in the field and laboratory.

NEH 8 Chapter 3 Tables

Table 3-1.--Sample Size For Soil Test Requirements[1]

Sample size	Tests to be performed
Extra Small - "XS"	Hydrometer analysis, sand sieve, soluble salt, and natural water content. (Blow count samples are examples of "XS" samples).
Small - "S"	Hydrometer analysis, sieve analysis (gravel and sand), soluble salt, Atterberg limits, pinhole test, chemical test for dispersion, and specific gravity.
Large - "L"	Tests described in "S" samples plus compaction, shear, consolidation, permeability, chemical treatments for dispersive clays,[2] and sealing tests.[2]
Extra Large - "XL"	Tests described in "S" and "L" samples plus special filter-design tests, large diameter shear tests, soil-cement tests, breakdown on degradable rocks, and riprap durability tests.

[1] The size of the sample to be sent to the laboratory varies with the maximum size of the material sampled. Most laboratory tests are performed on materials passing a No. 4 sieve. Larger samples are therefore needed of materials that contain significant amounts of larger particles. The minimum sizes of field samples for various gradations of materials are shown in table 3-2.

[2] If fly ash or agricultural lime chemical treatments are desired, samples of these chemicals from the expected source must also be submitted with the soil samples. Approximately five pounds of these chemicals are needed.

TABLE 3-1A.--Sample Sizes Required For Soil Mechanics Tests

Type of Test Requested	Minimum Size of Sample Required			
	Extra Small "XS"	Small "S"	Large "L"	Extra Large "XL"
Hydrometer & Sand Sieve	X	X	X	X
Soluble Salts	X	X	X	X
Natural Water Content	X	X	X	X
Gravel Sieve Analysis		X	X	X
Atterberg Limits		X	X	X
Pinhole Dispersion		X	X	X
Chemical Dispersion		X	X	X
Specific Gravity		X	X	X
Double Hydrometer Dispersion		X	X	X
Chemically Treated Pinhole Tests for Dispersion			X	X
Compaction			X	X
Sealing Tests			X	X
Shear			X	X
Consolidation			X	X
Permeability			X	X
Filter Design Tests				X
Large Diameter Shear				X
Large Diameter Consolidation				X
Soil Cement				X
Breakdown on Degradable Rocks				X
for Earthfill				X
Riprap Durability Tests[1]				X

[1] Use unbroken blocks of ledge rock. Each block should have a minimum mass of 20 to 25 pounds and the cumulative mass of all blocks should be a minimum of 150 pounds. The equipment used for preparation of samples for these tests is capable of handling only rocks up to 8 inches in diameter with safety. Select rock samples of this diameter or smaller to facilitate testing procedures if at all possible.

TABLE 3-2. Minimum Field-sample Size For Various Gradations of Material[1]

Gradation of material and sample size group	Maximum particle size	Minimum field sample size
		pounds
Gradation No. 1, natural materials with 90 % or more passing No. 4 sieve:		
"XS" sample	≤3/4 inches	1
"S" sample	3 inches	10
"L" sample	3 inches	50
"XL" sample	3 inches	100
Gradation No. 2, natural materials with 50 to 89 % passing No. 4 sieve:		
"S" sample	3 inches	20
"L" sample	3 inches	75
"XL" sample	3 inches	150
"XL" sample	6 inches	200
Gradation No. 3, natural materials with less than 50 % passing No. 4 sieve:		
"S" sample	3 inches	40
"L" sample	3 inches	100
"XL" sample	3 inches	200
"XL" sample	6 inches	250

[1]Note that the maximum particle size to be included in field samples ranges from 3 inches for "S" and "L" samples to 6 inches for "XL" samples. Estimate the percentage of over-size materials excluded from the field samples and record it along with descriptions of the samples on forms SCS-533 (Log of Test Holes) and SCS-534 (Soil Sample List). It is not necessary to screen samples to determine the exact amounts of the various particle sizes. Visual estimates of the particle sizes and the quantities involved are adequate.

[All samples should be taken and shipped so as to keep material at its natural water content.]

V. SAMPLE TAGS:

All samples submitted to the SML should be properly tagged for easy identification. Relying on permanent ink marking on canvas or plastic bags without also using sample tags is inadvisable since the ink can be rubbed off bags during shipment. Sample tags should have the following information printed on them in **Permanent Ink**.

1. State
2. Site name and number
3. Field Sample Number
4. Location (Centerline dam, borrow, etc.)
5. Grid or Station (if known)
6. Depth
7. Financial Project (08, 01, etc.)

One sample tag should be placed on the outside of the sample and one tag should be placed on the inside of the sample bag. If the outside tag should get lost the one on the inside should identify the sample. Placing the inside sample tag in a separate plastic zip-lock bag will help keep the tag dry and easily read. **Please DO NOT** use cloth tags. Cloth tags are starched to make them rigid. When they become wet the starch dissolves and printing on the tag washes away completely or smudges so badly they cannot be read.

VI. SAMPLE LISTS:

All samples submitted to the SML should have a sample list to accompany the shipment. The sample list should provide a description of the material, an estimate of the percentage of oversize materials not included in the sample, and the location and depth where each sample was obtained. This sample list and tags on the samples submitted should read the same and contain the same information. The sample list is to provide the name of a contact person (geologist, project engineer, area engineer, etc.) who can answer questions about the samples. Standard Form SCS-ENG-534, Soil Sample List-Soil and Foundation Investigation, is a good form to use. The sample list submitted and tags on samples must not contain conflicting information.

VII. TIES FOR SAMPLE BAGS

The use of "wire flags" to tie sample bags works well in securing the bags but pose a safety hazard. Several laboratory employees have been injured on the sharp ends of the wires. "Wire flags" are extremely stiff, and when the ends are cut, become very sharp and dangerous. The use of cord string or wire similar to that used for tying construction steel (pigtails) is recommended. These wire ties have rounded loops and are less stiff.

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