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## Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes<sup>1</sup>

This standard is issued under the fixed designation D 3282; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

<sup>ε1</sup> NOTE—The title was corrected and Section 1.3 was added editorially in January 1999.

### 1. Scope

1.1 This standard describes a procedure for classifying mineral and organomineral soils into seven groups based on laboratory determination of particle-size distribution, liquid limit, and plasticity index. It may be used when a precise engineering classification is required, especially for highway construction purposes. Evaluation of soils within each group is made by means of a *group index*, which is a value calculated from an empirical formula.

NOTE 1—The group classification, including the group index, should be useful in determining the relative quality of the soil material for use in earthwork structures, particularly embankments, subgrades, subbases, and bases. However, for the detailed design of important structures, additional data concerning strength or performance characteristics of the soil under field conditions will usually be required.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.3 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

<sup>1</sup> This standard is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

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### 2. Referenced Documents

#### 2.1 ASTM Standards:

- D 420 Guide to Site Characterization for Engineering Design and Construction Purposes<sup>2</sup>
- D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants<sup>2</sup>
- D 422 Test Method for Particle-Size Analysis of Soils<sup>2</sup>
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids<sup>2</sup>
- D 1140 Test Method for Amount of Material in Soils Finer Than the No. 200 (75- $\mu$ m) Sieve<sup>2</sup>
- D 1452 Practice for Soil Investigation and Sampling by Auger Borings<sup>2</sup>
- D 1586 Test Method for Penetration Test and Split-Barrel Sampling of Soils<sup>2</sup>
- D 1587 Practice for Thin-Walled Tube Geotechnical Sampling of Soils<sup>2</sup>
- D 2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants<sup>2</sup>
- D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils<sup>2</sup>

#### 2.2 AASHTO Document:

- M 145 The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes<sup>3</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 The following terms are frequently used in this standard. These terms differ slightly from those given in Terminology D 653, but are used here to maintain consistency with common highway usage.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.08.

<sup>3</sup> Available from American Association of State Highway and Transportation Officials, 444 N Capitol St., NW, Suite 225, Washington, DC 20001.

3.1.2 *boulders*—rock fragments, usually rounded by weathering or abrasion, that will be retained on a 3-in. (75-mm) sieve.

3.1.3 *coarse sand*—particles of rock or soil that will pass a No. 10 (2-mm) sieve and be retained on a No. 40 (425- $\mu$ m) sieve.

3.1.4 *fine sand*—particles of rock or soil that will pass a No. 40 (425- $\mu$ m) sieve and be retained on a No. 200 (75- $\mu$ m) sieve.

3.1.5 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 10 (2-mm) sieve.

3.1.6 *silt-clay (combined silt and clay)*—fine soil and rock particles that will pass a No. 200 (75- $\mu$ m) sieve.

3.1.7 *silty*—fine-grained material that has a plasticity index of 10 or less.

3.1.8 *clayey*—fine-grained material that has a plasticity index of 11 or more.

#### 4. Significance and Use

4.1 The standard described classifies soils from any geographic location into groups (including group indexes) based on the results of prescribed laboratory tests to determine the particle-size characteristics, liquid limit, and plasticity index.

4.2 The assigning of a group symbol and group index can be used to aid in the evaluation of the significant properties of the soil for highway and airfield purposes.

4.3 The various groupings of this classification system correlate in a general way with the engineering behavior of soils. Also, in a general way, the engineering behavior of a soil varies inversely with its group index. Therefore, this standard provides a useful first step in any field or laboratory investigation for geotechnical engineering purposes.

#### 5. Apparatus

5.1 *Apparatus for Preparation of Samples*—See Practices D 421 or D 2217.

5.2 *Apparatus for Particle-Size Analysis*—See Test Methods D 1140 and D 422.

5.3 *Apparatus for Liquid Limit and Plastic Limit Tests*—See Test Method D 4318.

#### 6. Sampling

6.1 Conduct field investigations and sampling in accordance with one or more of the following procedures:

6.1.1 Guide D 420,

6.1.2 Practice D 1452,

6.1.3 Method D 1586,

6.1.4 Practice D 1587.

#### 7. Test Sample

7.1 Test samples shall represent that portion of the field sample finer than the 3-in. (75-mm) sieve and shall be obtained as follows:

7.1.1 Air-dry the field sample,

7.1.2 Weigh the field sample,

7.1.3 Separate the field sample into two fractions on a 3-in. (75-mm) sieve,

7.1.4 Weigh the fraction retained on the 3-in. (75-mm) sieve. Compute the percentage of plus 3-in. material in the field sample, and note this percentage as auxiliary information, and

7.1.5 Thoroughly mix the fraction passing the 3-in. (75-mm) sieve and select the test samples.

NOTE 2—If visual examination indicates that no boulder size material is present, omit 7.1.3 and 7.1.4.

7.2 Prepare the test sample in accordance with Practices D 421 or D 2217. Determine the percentage of the sample finer than a No. 10 (2-mm) sieve.

NOTE 3—It is recommended that the method for wet preparation be used for soils containing organic matter or irreversible mineral colloids.

#### 8. Testing Procedure

8.1 Determine the percentage of the test sample finer than a No. 200 (75- $\mu$ m) sieve in accordance with Test Methods D 1140 or D 422.

NOTE 4—For granular materials the percentage of the sample finer than a No. 40 (425- $\mu$ m) sieve must also be determined.

8.2 Determine the liquid limit and the plasticity index of a portion of the test sample passing a No. 40 (425- $\mu$ m) sieve in accordance with Test Method D 4318.

#### 9. Classification Procedure

9.1 Using the test data determined in Section 8, classify the soil into the appropriate group or subgroup, or both, in accordance with Table 1 or Table 2. Use Fig. 1 to classify silt-clay materials on the basis of liquid limit and plasticity index values.

**TABLE 1 Classification of Soils and Soil-Aggregate Mixtures**

General Classification	Granular Materials (35 % or less passing No. 200)				Silt-Clay Materials (More than 35 % passing No. 200)			
	Group Classification	A-1	A-3 <sup>A</sup>	A-2	A-4	A-5	A-6	A-7
Sieve analysis, % passing:								
No. 10 (2.00 mm)	...	...	...	...	...	...	...	...
No. 40 (425 $\mu$ m)	50 max	51 min	...	...	...	...	...	...
No. 200 (75 $\mu$ m)	25 max	10 max	35 max	36 min	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 (425 $\mu$ m):								
Liquid limit	...	...	<sup>B</sup>	40 max	41 min	40 max	40 max	...
Plasticity index	6 max	N.P.	<sup>B</sup>	10 max	10 max	11 min	11 min	11 min
General rating as subgrade			Excellent to Good			Fair to Poor		

<sup>A</sup>The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

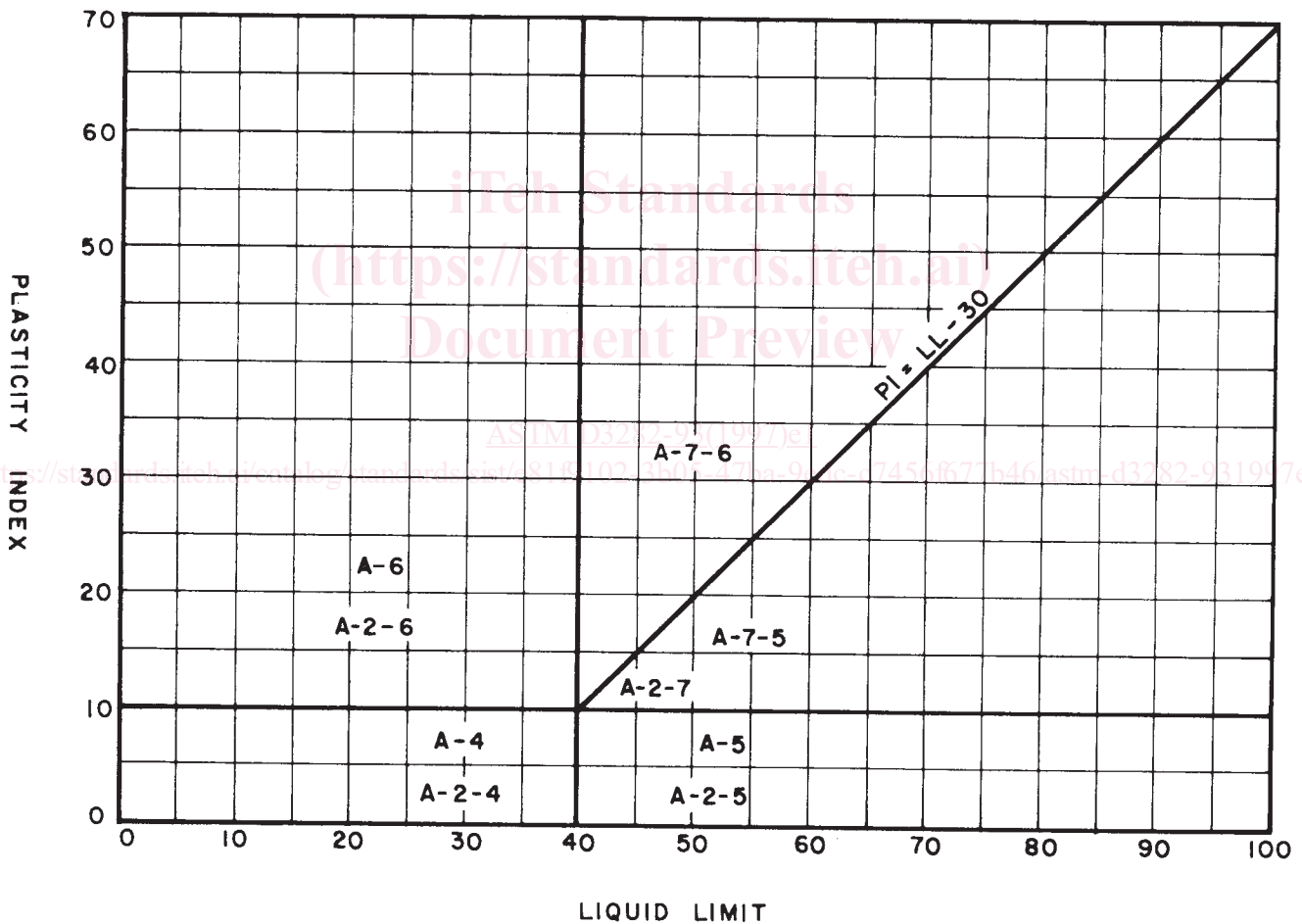
<sup>B</sup>See Table 2 for values.

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TABLE 2 Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35 % or less passing No. 200)							Silt-Clay Materials (More than 35 % passing No. 200)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, % passing:											
No. 10 (2.00 mm)	50 max	...	...	...	...	...	...	...	...	...	...
No. 40 (425 μm)	30 max	50 max	51 min	...	...	...	...	...	...	...	...
No. 200 (75 μm)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40 (425 μm):											
Liquid limit	...	...	...	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max	...	N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min <sup>4</sup>
Usual types of significant constituent materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayey Gravel and Sand			Silty Soils			Clayey Soils	
General rating as subgrade	Excellent to Good							Fair to Poor			

<sup>4</sup>Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Fig. 1).  
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NOTE 1—A-2 soils contain less than 35 % finer than 200 sieve.  
**FIG. 1 Liquid Limit and Plasticity Index Ranges for Silt-Clay Materials**

NOTE 5—All limiting values are shown as whole numbers. If fractional numbers appear on test reports, convert to the nearest whole numbers for the purpose of classification.