Test Procedure for

MANUAL PROCEDURE FOR DESCRIPTION IDENTIFICATION OF SOILS

TxDOT Designation: Tex-141-E

Effective Date: August 1999

1. SCOPE

1.1 This method describes and identifies naturally occurring soils based on visual examination and simple manual tests. Perform the procedure in the field during sampling and/or in the laboratory prior to detailed testing.

1.1.1 The user's familiarity with Tex-142-E will greatly improve the effectiveness of this method.

1.1.2 One can group similar soil samples so that only a minimum number of laboratory tests need to be performed for positive soil classification.

1.1.3 Use the descriptive information required by this method to describe a soil to aid in the evaluation of its significant properties for engineering use. Use this method to enter pertinent information on the "Field Log of Boring" during the geotechnical exploration and sampling operation.

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. DEFINITIONS

2.1 *Clay*—Clay is a fine grained soil that can be made to exhibit plasticity (putty-like properties) within a range of water contents and that exhibits considerable strength when air dry.

2.2 *Silt*—Silt is soil passing the 75 µm (No. 200) sieve that is non-plastic or very slightly plastic and that exhibits little or no strength when air dry.

2.3 *Organic Clay*—Organic clay is a soil that would be classified as a clay except that its liquid limit (LL) after oven drying (dry sample preparation) is less then 75% of its LL before oven drying (wet sample preparation).

2.4 *Organic Silt*—Organic silt is a soil that would be classified as a silt except that its LL after oven drying (dry sample preparation) is less then 75% of its LL before oven drying (wet sample preparation).

2.5 *Peat*—Peat is a soil composed of vegetable tissue in various stages of decomposition usually with a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

2.6 *Gravel*—Gravel consists of unconsolidated or loose detrital sediment (aggregate resulting from natural disintegration and abrasion of rock) with particle sizes passing the 76.2 mm (3 in.) sieve and retained on the 2.00 mm (No. 10) sieve.

2.7 *Sand*—Sand consists of fine aggregate particles that are retained on the 75 µm (No. 200) sieve, either as natural sand resulting from natural disintegration and abrasion of rock, or as manufactured sand, which is produced by the crushing of rock, gravel, slag, etc.

3. APPARATUS

3.1 *Pocket knife or small spatula*.

3.2 *Hydrochloric acid*, small bottle of diluted hydrochloric acid (HCl), one part HCl (10N) to three parts water.

CAUTION: Do not add water to acid.

4. PERTINENT INFORMATION FOR SOIL DESCRIPTION

Table 1—Soil Description Information

Item	Description
Color	▪ Color is very useful in identifying organic soils and materials of similar origin and/or stratum. ▪ Describe color for moist soils in accordance with Figure 1.
Consistency	▪ For intact fine-grained and plastic soils, describe the consistency as very soft, soft, stiff, medium stiff, very stiff, or hard. ▪ Pocket Penetrometer (PP) measurements in kg/cm^2 (TSF) may be used to aid in estimating consistency.
Density	For intact fine-grained soil, predominantly sand, describe the density as very loose, loose, medium dense, dense, or very dense.
Moisture Condition	Describe the moisture condition as dry, moist, or wet.
Structure	Description of soils secondary structures such as fissures, slickensides, lenses, layers, etc. are important in understanding the weathering and depositional history of the material.
Odor	▪ Describe the odor if organic or unusual. This is especially apparent in fresh samples. ▪ If the samples are dried, revive the odor by heating a moistened sample.
Foreign Materials	The observation of materials such as glass, roots, bricks, etc. that are foreign to the natural soil is a strong indication of fill material.
HCl Reaction	The reaction of the soil with diluted HCl indicates the relative amount of calcium carbonate (calcareous materials) in the soil.
Cementation	Describe the cementation of intact coarse-grained soils as weak, moderate, or strong.

Item	Description
Hardness	The relative difficulty of particles cracking, fracturing, or crumbling under a hammer blow.
Angularity	▪ Describe the angularity of sand and gravel as angular, sub-angular, sub-rounded, or rounded. ▪ A range of angularity such as sub-rounded to rounded or angular to sub-angular may be used.
Shape	The shape of fractured or unfractured gravel, cobbles, and boulders as defined by the width to thickness and length to width ratios. The particle length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Figure 1—Standard Color Chart

5. SAMPLING

5.1 For accurate description and identification, the minimum amount of the specimens being examined should be according to the following schedule:

Table 2—Minimum Specimen Size by Maximum Particle Size Sieve Opening

Maximum Particle Size Sieve Opening	Minimum Specimen Size Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb.)
9.5 mm (3/8 in.)	200 g (0.5 lb.)
19.0 mm (3/4 in.)	1.0 kg (2.2 lb.)
38.1 mm (1-1/2 in.)	8.0 kg (17.6 lb.)
75.0 mm (3 in.)	60.0 kg (132 lb.)

6. DESCRIPTION CRITERIA

6.1 *Describing the Reaction with HCl*:

Table 3—Reaction with HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

6.2 *Describing Consistency:*

Table 4—Consistency

Description	Pocket Pen.	Criteria
Very Soft	Less than 0.5	Thumb will penetrate soil more than 25 mm (1 in.)
Soft	0.5 to 1.0	Thumb will penetrate soil about 25 mm (1 in.)
Medium Stiff	1.0 to 2.0	Thumb will indent soil about 12.5 mm (1/2 in.)
Stiff	2.0 to 3.5	Thumb will indent soil about 6 mm (1/4 in.)
Very Stiff	3.5 to 4.5	Thumb will indent soil about 3 mm (1/8 in.)
Hard	Greater than 4.5	Thumb will not indent soil but readily indented with thumbnail.

6.3 *Describing Structure:*

Table 5—Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm (1/4 in.) thick
Laminated	Alternating layers of varying material or color with the layers less than 6 mm (1/4 in.) thick
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular fragments
Lensed	Inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay
Homogeneous	Same color and appearance throughout

7. PROCEDURES AND CRITERIA

7.1 *Describing Dilatancy:*

7.1.1 Select enough material from the specimen to mold into a ball about 13 mm (1/2 in.) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

7.1.2 Smooth the soil ball in the palm of one hand with the blade of a knife or spatula. Shake horizontally by striking the side of the hand vigorously against the other hand several times.

7.1.3 Note the reaction of water appearing on the surface of soil.

7.1.4 Squeeze the sample by closing the hand or pinching the soil between the fingers, and describe the reaction as none, slow, or rapid in accordance with the criteria listed in Table 6. The reaction is the speed with which water appears while shaking, and disappearing while squeezing.

Table 6—Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

7.2 *Describing Toughness:*

7.2.1 Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 3 mm (1/8 in.) in diameter. (If the sample is too wet for rolling, spread sample into a thin layer and allow some of the moisture to evaporate.) Continue the kneading and rolling of the specimen until it has reached its plastic limit.

7.2.2 Note the pressure required to roll the sample into the 3 mm (1/8 in.) thread when it is near the plastic limit. Also note the strength of the thread when it is near the plastic limit.

7.2.3 Describe the toughness of the material as low, medium, or high based on the criteria listed in Table 7.

Table 7—Criteria for Describing Toughness

Description	**Criteria**
Low	▪ Only slight pressure is required to roll the thread near the plastic limit ▪ The thread and the lump are weak and soft
Medium	▪ Medium pressure is required to roll the thread to near the plastic limit ▪ The thread and lump have medium stiffness
High	▪ Considerable pressure is required to roll the thread to near the plastic limit ▪ The thread and the lump have very high stiffness

7.3 *Describing Plasticity:*

7.3.1 Based on observations made during the toughness test, describe the plasticity of the material according to the criteria listed in Table 8.

Table 8—Criteria for Describing Plasticity

Description	**Criteria**
Nonplastic	A 3 mm (1/8 in.) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	▪ The thread is easy to roll and not much time is required to reach the plastic limit ▪ The thread cannot be rolled after reaching the plastic limit ▪ The lump crumbles when drier than the plastic limit.
High	▪ Considerable amount of time is required for rolling and kneading to reach the plastic limit ▪ The thread can be re-rolled several times after reaching the plastic limit. ▪ The lump can be formed without crumbling when drier than the plastic limit

7.4 *Describing Dry Strength:*

7.4.1 Select enough material from the specimen to mold into a ball about 25 mm (1 in.) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

7.4.2 Make at least three test specimens from the molded material. A test specimen will be a ball of material about 13 mm (1/2 in.) in diameter. If the specimen contains natural dry lumps, use those that are about 13 mm (1/2 in.) in diameter in place of the molded balls.

7.4.3 Allow the test specimens to dry in air or sun, or by artificial means, as long as the temperature does not exceed 60°C (140°F).

7.4.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accordance with the criteria listed in Table 9.

Table 9—Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

8. IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS

8.1 *Identification:*

8.1.1 The results of manual testing of soils for toughness, plasticity, dilatancy, and dry strength can be used to identify the common inorganic soils as shown in Table 10.

Table 10—Identification of Inorganic Fine-grained Soils

Soil Symbol	Dry Strength	Dilatancy	Plasticity	Toughness
ML – Silt	None to Low	Slow to Rapid	None to Low	Low or thread cannot be formed
CL – Lean Clay	Medium to High	None to Slow	Low to Medium	Medium
MH – Elastic Silt	Low to Medium	None to Slow	Medium	Low to medium
CH – Fat Clay	High to Very High	None	High	High

8.2 *Criteria:*

8.2.1 *Describing Particle Shape:*

Table 11—Particle Shape Criteria for Identifying Fine-grained Soils

Description	Criteria
Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat & elongated	Particles with width/thickness > 3 and Particles with length/width > 3

8.2.2 *Describing Cementation:*

Table 12—Cementation Criteria for Identifying Fine-grained Soils

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

8.2.3 *Describing Angularity of Coarse-Grained Particles:*

Table 13—Angularity Criteria for Identifying Fine-grained Soils

Description	Criteria
Angular	Particles have sharp edges and relative plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.