

# **SB103 Materials Analysis Specialist**

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## HMAT CERTIFIED SPECIALIST & APPLICANTS FOR CERTIFICATION: RIGHTS AND RESPONSIBILITIES

This agreement (the "Agreement") affirms that, \_\_\_\_\_, the below Applicant for Certification or the current Certified Specialist (collectively, the "Specialist") seeks to meet or has successfully met the requirements for certification by the Texas Asphalt Pavement Association ("TXAPA"), a/k/a the Hot Mix Asphalt Center (HMAC) as a certified technician. In that connection, the Specialist agrees as follows:

**RIGHTS AND RESPONSIBILITIES** - HMAC certification includes the exclusive right to perform certified sampling, testing and reporting on Texas Department of Transportation (TxDOT) projects involving Hot Mix Asphalt (HMA) and Soils & Base (SB) in accordance with TxDOT specifications and test procedures (as may be amended by TxDOT from time to time) for the level of certification issued. Specialists are required to perform and report test results with the accuracy and precision required of a certificated HMA or SB Specialist. It is important that the Specialist fully understands the significance of performing these duties in accordance with the certification level received by the Specialist.

Each Specialist is responsible for performing their own independent sampling, testing and reporting in accordance with TxDOT specifications, test procedures and standard operating procedures. These duties must be performed in a diligent and professional manner to produce TxDOT projects of the highest possible quality.

**CONTACT INFORMATION** - It is the Specialist's responsibility to provide the HMAC with current contact information by logging into [www.txhmac.org](http://www.txhmac.org). Communications from the HMAC will primarily be sent electronically to the most recent contact information provided by the Specialist.

**ANNUAL PROFICIENCY** - Once certified, Specialists are required to complete annual proficiency testing and the reporting of results to the HMAC. The testing and reporting must be timely and independently performed by the Specialist and, where applicable, in conformance with the requirements of the Specialist's certifications. TxDOT will ship the annual proficiency samples to the Specialist's address of record. (If this address is not current, the Specialist may not timely receive a proficiency sample and his/her certification may be danger of lapsing.)

Failure to submit proficiency test results or to respond to low rating(s) by the appointed deadlines may result in a change of certification status from active to inactive. Specialists whose certifications are inactivated because their annual proficiency testing/reporting is not current or whose certifications have been revoked or inactivated are prohibited from performing the duties associated with all certifications held by that Specialist.

**RECERTIFICATION** - Certification(s) are valid for three (3) years from the date originally issued, after which the Specialist must be recertified by again passing the requirements for certification. Specialists may seek recertification up to one year prior to the expiration of their certificate(s).

Failure to timely obtain recertification will cause all dependent certifications held by a Specialist to be inactivated. It is the Specialist's responsibility to maintain an active certification(s). (The HMAC will not provide reminders of pending expiration dates.)

**ALLEGATIONS OF MISCONDUCT** - Allegations of misconduct should be submitted to the HMAC, P.O. Box 149, Buda, TX 78610 and must include the name, address and signature of the individual asserting the allegations as well as a brief description of the allegations.

If the allegations are properly submitted and appear to have merit, the HMAC Steering Committee (the "Committee") the individual asserting misfeasance and the person so accused will be asked to meet in person (but at separate dates/times) with members of the Committee. At the conclusion of the meeting(s), the Committee will issue its determination.

Misconduct generally consists of (i) neglect, (ii) abuse and/or (iii) breach of trust which are generally defined as:

1. Neglect: unintentional deviation(s) from specifications or testing procedures;
2. Abuse: careless or deliberate deviation from specifications or testing procedures; and
3. Breach of Trust: violation of the trust placed in Certified Specialists including, but not limited to, acts such as:
  - a. Falsification of or deliberate omission from material records or information; or
  - b. Awareness of improprieties in sampling, testing and/or production by others and the failure to timely report those improprieties to the appropriate project supervision.

The Committee may issue written reprimands (private or public) and/or revoke or inactivate a certification (if the Specialist has made a false representation or misstatement to the Committee or to the public or has engaged in misconduct) or take such other actions as the Committee, in its sole discretion, determines to be appropriate with respect to the Specialist's certification(s).

Specialists who do not achieve recertification or whose certification is revoked or inactivated by the Committee may appeal to a separate appeals committee comprised of industry members (the "Appeal Committee"). The exhaustion of this right of appeal to the Appeal Committee is a prerequisite to the exclusive remedy of administrative review by final and binding arbitration in Hays County, Texas, as administered by the American Arbitration Association by a single-member panel. Any and all other claims related in any way to this Agreement are exclusively subject to final and binding arbitration in Hays County, Texas as administered by the American Arbitration Association by a single-member panel.

In consideration for the HMAC certification/recertification process, Specialist hereby waives any and all claims of whatsoever kind or character related, directly or indirectly, to this Agreement, against the TXAPA, HMAC (including, but not limited to, the Committee and the Appeal Committee and their members), that s/he may have (including claims for attorney's fees) and further agrees to save, indemnify and hold TXAPA, the HMAC (including, but not limited to, the Committee and the Appeal Committee and their members) harmless from any claim, action or cause of action arising as a result of, or relating to this Agreement including, but not limited to, Specialist's certification, or any refusal, reprimand, revocation and/or suspension of certification or recertification of Specialist.

**ACKNOWLEDGED & AGREED:**

**SPECIALIST:**

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**SIGNATURE**

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**DATE**

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**PRINTED NAME**

# WEBSITE

**IT IS YOUR  
RESPONSIBILITY  
TO KEEP YOUR  
INFORMATION  
UP TO DATE**



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www.txhmac.org

# FIRST TIME LOGIN

- Username: Capitalize the **FIRST LETTER OF YOUR FIRST AND LAST NAME** then spell out the rest of your last name in lower case, followed by the last 4 digits of your SSN.
- Password: The same but add a "+" at the end.

**Example: John Doe**

**Username: JDoe1234**

**Password: JDoe1234+**

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Contact Info

Username: jDoe  
E-mail: \* jdoe@txhmac.org  
First Name: \* John  
Last Name: \* Doe  
Company: \* HMAAC  
Company Type: \* Lab / Other (\*)  
Last 4 Digits of SSN: \* 1234

Work Address

Address: \* 140 Commercial Drive  
City: \* Buda  
State: \* Texas  
Zip: \* 78610  
District: \*

Work Phone: (Select only for TxDOT Employees)  
Work Email: \* jdoe@txhmac.com

Residential Address: Same as Work Address

Address: \* 140 Commercial Drive  
City: \* Buda  
State: \* Texas  
Zip: \* 78610  
Home Phone: (1012) 555-5555  
Cell Phone: (1012) 555-5555

Password

Change Password: To change password, enter new password here.  
(Leave it blank if not changing.)  
Type your new password again.  
Password must be at least 8 characters and must contain at least one lower case letter, one upper case letter, one digit, and one symbol.

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Certification

Hot Mix

CERT NAME	CERT DATE	CERT NUM	EXPIRATION DATE	STATUS	
1A	07/27/2015	3082	07/27/2018	Active	<a href="#">View Certificate</a>
1B	01/27/2015	2723	01/27/2018	Active	<a href="#">View Certificate</a>
2	02/06/2015	647	02/06/2018	Active	<a href="#">View Certificate</a>

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Soils Class

CERT NAME	CERT DATE	CERT NUM	EXPIRATION DATE	STATUS	
SB101	02/23/2006	002	02/23/2009	Inactive Expired	<a href="#">View Certificate</a>
SB102	02/22/2006	45	02/22/2009	Inactive Expired	<a href="#">View Certificate</a>
SB103					
SB201					
SB202				Prerequisite: <b>SB201</b> is required.	

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## Test Procedure for

# SURVEYING AND SAMPLING SOILS FOR HIGHWAYS



## TxDOT Designation: Tex-100-E

**Effective Date: August 1999**

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### 1. SCOPE

- 1.1 This method provides definitions of some basic terms and describes the procedures for surveying and sampling soils for highways. It describes the information required from the survey and the sampling methods required, and it discusses the apparatus necessary to carry out the sampling process.
  - 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 *Aggregate*—Aggregate is granular material of mineral composition such as sand, gravel, shell, slag, crushed stone or lightweight. Aggregate may be used with a cementing medium to form mortars or concrete, or alone in base courses or as a surface treatment.
  - 2.2 *Bank Gravel*—Bank Gravel is found in natural deposits, usually intermixed with fine material, such as sand or clay, or combinations thereof; the terms “gravelly clay,” “gravelly sand,” “clayey gravel,” or “sandy gravel” indicate the varying proportions of the materials in the mixture.
  - 2.3 *Blast Furnace Slag*—Blast furnace slag is a non-metallic by-product, developed in a blast furnace simultaneously with iron in a molten condition, essentially consisting of silicates and alumina-silicates of calcium and other bases.
  - 2.4 *Bottom Ash*—Bottom Ash is the heavy residue from the combustion of ground or powdered coal or lignite.
  - 2.5 *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.
  - 2.6 *Clay Size*—Clay size refers to any material finer than 0.002 mm (2  $\mu$ m), though not necessarily exhibiting clay characteristics.
-

- 2.7      *Coarse Aggregate*—Coarse aggregate is the portion of aggregate retained on the 2.00 mm (No. 10) sieve for Bituminous Concrete or retained on the 4.75 mm (No. 4) sieve for Portland Cement Concrete.
- 2.8      *Concrete*—Concrete is a composite material consisting of a binding medium within which are embedded particles or fragments of aggregate; in hydraulic cement concrete, the binder is formed from a mixture of hydraulic cement and water.
- 2.9      *Conglomerate*—Conglomerate is the coarse grained, clastic, sedimentary accumulation of particles, composed of rounded to sub-angular fragments larger than 2 mm (0.08 in.) in diameter, set in a fine-grained matrix of sand or silt and commonly cemented by calcium carbonate, iron oxide, silica or hardened clay.
- 2.10     *Crushed Face*—Crushed face is a fractured surface produced by the mechanical crushing of an aggregate. Crushed aggregate faces are identified by fresh fractures and lack of evidence of weathering.
- 2.11     *Crushed Gravel*—Crushed gravel is the product resulting from the mechanical crushing of gravel, with substantially all fragments having at least one face resulting from a fracture.
- 2.12     *Crushed Stone*—Crushed stone is the product excavated from an in-situ deposit of rock, crushed and processed for construction purposes with substantially all faces resulting from the crushing operation.
- 2.13     *Detrital (Weathered)*—Detrital material consists of particles that have been formed through the disintegration of other particles by erosion or weathering.
- 2.14     *Fine Aggregate*—Fine aggregate is the portion of the aggregate passing the 2.00 mm (No. 10) sieve for Bituminous Concrete or passing the 4.75 mm (No. 4) sieve for Portland Cement Concrete.
- 2.15     *Fly Ash*—Fly ash is the finely divided residue from the combustion of ground or powdered coal or lignite that is transported from the firebox through the boiler by flue gases.
- 2.16     *Granite*—Granite is an igneous rock consisting of quartz and alkali feldspars.
- 2.17     *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.
- 2.18     *Lightweight Aggregate*—Lightweight aggregate consists of expanded shale, clay, or slate, and is produced by the rotary kiln method.
- 2.19     *Limestone Rock Asphalt*—Limestone rock asphalt is limestone impregnated with naturally occurring asphalt.
- 2.20     *Lithification*—Lithification is the process of hardening, induration, and compaction of sediments, leading to the formation of solid materials.

- 2.21 *Mineral Filler*—Mineral filler is a fine aggregate or manufactured material used to supply particle sizes where the mix design is deficient in gradation.
- 2.22 *Quarry*—A quarry is an open surface excavation of minerals or construction materials.
- 2.23 *Riprap*—Riprap is quarried stone especially selected, graded, and placed to prevent erosion and thereby preserve the shape of a surface, slope, or underlying structure.
- 2.24 *Rock*—Rock is a mass of solid, naturally occurring material from an in-situ deposit, excluding conglomerates. The formation may or may not be laminated.
- 2.25 *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.
- 2.26 *Sandstone*—Sandstone is sedimentary rock consisting predominantly of weathered sand-sized particles naturally cemented together.
- 2.27 *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.
- 2.28 *Silt Size*—Silt size is any material passing the 75 µm (No. 200) sieve that is coarser than 0.002 mm (2 µm), though not necessarily exhibiting silt characteristics.
- 2.29 *Slag*—Slag is a non-metallic by-product of the smelting or refining of metals and consists of calcium and alumina-silicates.
- 2.30 *Soil*—Soil is a superficial, unconsolidated deposit of disintegrated and decomposed rock material produced by surface weathering.
- 2.31 *Source*—A source is a geographical location of naturally occurring material that can be mined or quarried from the original in-situ deposit. In the case of manufactured or by-product material, it is the location of the plant at which the material is produced.
- 2.32 *Stone*—Stone consists of crushed, angular particles of rock.
- 2.33 *Traprock*—Traprock consists of various fine-grained, dense, dark colored igneous rocks, typically basalt or diabase; also called “trap.”
- 2.34 *Virgin Material*—Virgin material is material not previously used in construction.

**Note 1**—The Specification Committee has approved the above definitions.

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### 3. APPARATUS

- 3.1 Many factors, such as the nature of the terrain, the kind of material, the depth of material below the surface, the equipment available, and the use to be made of the survey information, will affect the type and amount of equipment to be used in sampling.



- 3.2 Small hand tools are satisfactory for sample collection where the materials are at a shallow depth and can be easily dug. However, if the materials are very hard, power equipment may be more economical. The only feasible method of sampling strata located at a considerable depth below the surface is the use of a power drill machine with a core or auger attachment.
- 3.3 The following equipment should suffice for ordinary conditions:
- *Sample bags and moisture cans* for disturbed samples
  - *Materials*, to maintain moisture content, and *boxes* for packing undisturbed cores
  - *Power drill rig*, with core and/or auger attachments
  - *Metallic tape*, 30 m (100 ft.) long
  - *Post hole digger, shovel, prospector's pick, other hand tools*
  - *Jackhammer and air compressor*
  - *Sample splitter or quartering cloth*
  - *Engineer's level and level rod*
  - *Stakes*
  - *Gasoline burner and pan*
  - *Ruler*, 2 m (6 ft.)
  - *Soil auger.*
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## 4. SOIL SURVEY

- 4.1 The soil survey is an important part of the engineering survey for the design, location and construction of a highway. The investigation should furnish the following information:
- The extent and location of each type of soil or rock in the subsurface
  - The condition of subsoils (moisture and density) upon which embankments will be constructed
  - The design of ditches and backslopes in cut sections to prevent slides
  - The location and selection of suitable material for fills, sub-grade treatment and backfill adjacent to structures
  - The location of local material for base and aggregate
  - The need for stabilization of sub-grade, sub-base and base materials
  - The supporting values of soils as foundation materials.
- 

## 5. SAMPLING

- 5.1 A representative sample of disturbed soil consists of a combination of the various particles in exactly the same proportion as they exist in the natural ground, roadway, or pit.
-

- 5.1.1 The proper method of obtaining a sample will depend on the place, the quantity of material, the proposed treatment, and tests to be performed in the laboratory.
- 5.1.2 Unless different types of materials are to be uniformly mixed in certain proportions, samples should contain only materials of like color and texture, and should not be composite of materials apparently different in character.
- 5.2 It is impossible to obtain a sample from the earth that is entirely undisturbed, because the removal of the surrounding soil releases the pressure from the specimen, which causes a certain amount of disturbance.
- 5.3 The intent of sampling, however, is to obtain a core of soil from the earth with as little disturbance as possible to the natural density, moisture content, and structural arrangement of the particles.
- 5.3.1 Such a soil core is satisfactory for all practical purposes and can be classified as an undisturbed sample of soil.

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## Test Procedure for

# PREPARING SOIL AND FLEXIBLE BASE MATERIALS FOR TESTING



## TxDOT Designation: Tex-101-E

**Effective Date: January 2010**

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### 1. SCOPE

- 1.1 This method describes three procedures for preparing of soil and flexible base samples for soil constants and particle size analysis, compaction and triaxial, and sieve analysis of road-mixed material.
  - 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.
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### 2. DEFINITIONS

- 2.1 *Soil Binder*—Soil binder is any material passing the 425  $\mu\text{m}$  (No. 40) sieve.
  - 2.2 *Percent Soil Binder*—Percent soil binder is equal to 100 times the ratio of the oven-dry mass of the soil binder to the oven-dry mass of the total.
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### 3. APPARATUS

- 3.1 *Set of standard U.S. sieves*, meeting the requirements of Tex-907-K.
  - 3.2 *Scale*, with a minimum capacity of 36 kg (80 lb.), with a minimum accuracy and readability of 5 g or 0.1% of the test load, whichever is greater.
  - 3.3 *Drying oven*, maintained at 60°C (140°F).
  - 3.4 *Crusher* (optional), which can be adjusted to produce material passing a 2.00 mm (No. 10) sieve.
  - 3.5 *Mechanical pulverizer* (optional).
  - 3.6 *Wedgewood mortar and pestle*.
  - 3.7 *Scoop*.
  - 3.8 *Small siphon tube* (optional).
-

3.9            *Sample containers, metal pans, cardboard cartons.*

3.10          *Filter paper, non-fibrous.*

3.11          *Sample splitter, quartering machine, or quartering cloth.*

3.12          *Mechanical mixer (stirring device).*

3.13          *Dispenser cup.*

3.14          *Plaster of Paris molds (optional).*

**Note 1**—Dry the plaster of Paris molds at a temperature not to exceed 60°C (140°F) after forming, and wash and dry after each use.

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## 4.            **MATERIALS**

4.1           *Tap water.*

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## 5.            **SAMPLE IDENTIFICATION**

5.1           Give each sample an identification number on a suitable card. This card should remain with the sample throughout the processing and testing.

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# PART I—PREPARING SAMPLES FOR SOIL CONSTANTS AND PARTICLE SIZE ANALYSIS

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## 6.            **SCOPE**

6.1           If only soil constants are desired, use either “Dry Preparation (Method A)” or “Wet Preparation (Method B).” However if particle size analysis or percent soil binder is also desired, use Method A. Furthermore, use Method A when preparing a referee test.

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## 7.            **PREPARING SAMPLES**

7.1           *Dry Preparation (Method A)*—to be used for analysis of soil constants, particle size, or percent soil binder, or when preparing a referee test

7.1.1        Select a representative sample according to the appropriate test method (Tex-100-E or Tex-400-A) large enough to yield at least 300 g of soil binder.

7.1.2        Dry the sample in a 60°C (140°F) oven.

7.1.3        Examine the sample by visual inspection or slake small portions in water to determine if the material has any particles larger than 425 µm (No. 40).

- 7.1.4 If the amount of aggregate larger than 425  $\mu\text{m}$  (No. 40) is easily distinguishable, remove these particles by hand and proceed to Section 7.1.27.
- 7.1.5 For materials containing a considerable amount of aggregate, separate the fine loose binder from the coarse particles by sieving over a 425  $\mu\text{m}$  (No. 40) sieve.
- 7.1.6 Set the soil binder passing the sieve aside to recombine with the additional binder obtained from Sections 7.1.8 through 7.1.24.
- 7.1.7 If desired, slake the total material.
- 7.1.8 Place the material to be slaked into a pan.
- 7.1.9 Cover the material completely with water and soak for a minimum of 12 hours, unless Tex-102-E determines a shorter time.
- 7.1.10 Place the empty 425  $\mu\text{m}$  (No. 40) sieve into a clean pan and pour the liquid from the wet sample through it.
- 7.1.11 Transfer the wet sample to the sieve in increments not exceeding 450 g.
- 7.1.12 Pour water over the sieve until the water level is about 12.5 mm (0.5 in.) above the sample on the sieve.
- 7.1.13 Alternately agitate the sieve up and down and stir the sample by hand.
- 7.1.14 If the material retained on the sieve contains lumps that have not disintegrated, crumple any that can be broken down between thumb and fingers and wash through the sieve.
- 7.1.15 After all the soil binder appears to have passed through the sieve, hold the sieve above the pan and wash the retained aggregates clean by pouring a small amount of water over it and letting the water drain into the pan.
- 7.1.16 Transfer the retained aggregate from the sieve to a clean pan.
- 7.1.17 Repeat the procedure in Sections 7.1.10 through 7.1.16 until all of the soaked sample has been washed.
- 7.1.18 Dry the retained aggregate portion of the sample in a 60°C (140°F) oven.
- 7.1.19 Re-screen over the 425  $\mu\text{m}$  (No. 40) sieve and add the binder passing the sieve to the soil binder obtained in Section 7.1.6.
- 7.1.20 Weigh the mass of the aggregate and retain for use in Tex-110-E, Part I.
- 7.1.21 Place the pan containing the soil binder and wash water aside, where it will not be disturbed, until all the soil has settled to the bottom of the pan and the water above the soil is clear.
- 7.1.22 Decant the water off the soil.

- 7.1.23 Dry the remaining soil in a 60°C (140°F) oven.
- 7.1.24 In cases where the materials fail to settle overnight, evaporate the water by placing the sample in a 60°C (140°F) oven until it is dry, or siphon the water on to a plaster of Paris mold lined with filter paper.
- 7.1.25 When the water has disappeared, place the filter paper with adhering soil in a pan and dry in the oven.
- 7.1.26 Sweep the dry soil from the filter paper with a stiff brush into the pan of fines.
- 7.1.27 Break down the dried soil binder with a mortar and pestle or use a suitable mechanical pulverizer with an opening set from 635 to 889 µm (0.025 to 0.035 in.)
- 7.1.28 If a pulverizer is used, any material still aggregated in lumps larger than 425 µm (No. 40) should be broken down with a mortar and pestle.
- 7.1.29 Combine all of the soil binder obtained and weigh the mass to the nearest 5 g.
- 7.1.30 Mix thoroughly to produce a uniform sample of all of the particles.
- 7.1.31 Add the masses obtained in Sections 7.1.20 and 7.1.29, and record the sum as the Total Dry Mass of the sample.
- 7.2 *Wet Preparation (Method B)*—to be used for the analysis of soil constants only
  - 7.2.1 Select a representative sample according to Tex-100-E or Tex-400-A.
  - 7.2.2 Make the sample large enough to yield at least 300 g of soil binder.
  - 7.2.3 Place the sample in a clean pan.
  - 7.2.4 Cover the sample completely with clear water.
  - 7.2.5 Soak soils with moderate to high Plasticity Indices (PI) for a minimum of 12 hours, unless Tex-102-E determines a shorter time.
  - 7.2.6 Soak flexible base and low PI materials for a minimum of two hours.
  - 7.2.7 Sieve the wet sample into a clean pan in increments of approximately 450 g over a 2.00 mm (No. 10) sieve to remove large aggregate particles.
  - 7.2.8 Wash the aggregate retained on the sieve with a small amount of water.
  - 7.2.9 Discard the portion of material retained on the sieve.
  - 7.2.10 For soils and base materials with low PI, go to Section 7.2.14.
  - 7.2.11 For soils with moderate to high PI, place the wet material passing the 2.00 mm (No. 10) sieve into the dispersion cup of a mechanical malt mixer.

- 7.2.12 Do not fill the cup more than half-full.
- 7.2.13 Mix the material for three to five minutes or until the soil binder is separated.
- 7.2.14 Pour the material through a 425  $\mu\text{m}$  (No. 40) sieve into a plaster of Paris bowl lined with filter paper.
- 7.2.15 Vigorously agitate the sieve up and down over the bowl while occasionally stirring the sample by hand to allow as much material as possible to pass the 425  $\mu\text{m}$  (No. 40) sieve.
- 7.2.16 If the material retained on the sieve contains lumps that have not disintegrated, return to the dispersion cup, and remix and wash through the sieve.
- 7.2.17 Sieve until at least 95% of the soil binder appears to have passed through the sieve.
- 7.2.18 Reduce the water content of the material in the plaster of Paris bowl to below the liquid limit.
- 7.2.19 When the sample can be divided into pie-like wedges, and each wedge can be easily removed, it can be used for testing of soil constants.
- 7.2.20 If the soil constants are not to be determined immediately, place the material into an airtight container to prevent moisture loss.

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## 8. CALCULATION

- 8.1 Use the following to calculate the percent soil binder:

$$\text{Percent Soil Binder} = 100(W_I / W_T)$$

Where:

$W_I$  = dry mass of soil binder

$W_T$  = dry mass of total sample.

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## 9. REPORT

- 9.1 Report the percent soil binder to the nearest whole percent.

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# PART II—PREPARING SAMPLES FOR COMPACTION AND TRIAXIAL TESTS

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## 10. SCOPE

- 10.1 Use this part to prepare samples for the compaction and triaxial tests. This procedure applies to all materials, except stabilized material, in the roadway or stockpile condition.

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**11. PREPARING SAMPLES**

11.1 Select approximately a 90 kg (200 lb.) representative sample according to Tex-100-E or Tex-400-A.

11.2 Check specifications for maximum aggregate size.

11.3 Spread sample on a clean floor to air dry or use a forced draft of warm air not to exceed 140°F (60°C) for soils and 230°F (110°C) for flexible base material.

11.4 Dry soils in accordance with Section 11.4.1 and flexible base in accordance with Section 11.4.2.

11.4.1 Reduce the water content of soil samples to slightly below the estimated optimum moisture content.

11.4.2 Dry flexible base materials to constant weight. Constant weight will be considered achieved when the weight loss is less than 0.1% of the sample weight in four hours of drying.

11.5 Process soils in accordance with Section 11.5.1 and flexible base in accordance with Section 11.5.2.

11.5.1 Process moist clay and other soils (which form hard lumps when dried or contain aggregates) so that it will pass a 6.3 mm (1/4 in.) wire-mesh.

11.5.2 Separate flexible base by dry sieving into the following sizes:

- 1 3/4 in. (44.5 mm)
- 1 1/4 in. (31.7 mm)
- 7/8 in. (22.2 mm)
- 5/8 in. (16 mm)
- 3/8 in. (9.5 mm)
- No. 4 (4.75 mm)
- No. 40 (0.425 mm).

**Note 2**—Do not overload the screens. The material passing the No. 4 and retained on the No. 40 sieve may need to be shaken separately and in several small batches to avoid overloading the screen.

11.5.3 When material contains aggregate retained on the 44.5 mm (1-3/4 in.) sieve, add the material passing the 1-3/4 in. (44.5 mm) sieve and retained on the 1-1/4 in. (31.7 mm) sieve for recombining individual specimens.

**Note 3**—Do not use particles larger than 1-3/4 in. (44.5 mm) in the compacted specimens.

11.6 When aggregate between 1- 3/4 in. (44.5 mm) and 1-1/4 in. (31.7 mm) is needed, crush particles larger than 1-3/4 in. (44.5 mm) or obtain additional material from the project.



**Note 4**—Do not crush the material if it is an uncrushed gravel.

- 11.7 Mix each size to make moisture as uniform as possible.
- 11.8 Weigh each size of material to the nearest 0.1 lb (5 g).
- 11.9 Calculate the cumulative percentages retained on each sieve size as shown under Section 12.
- 11.10 These values are to be used in recombining the sample for compaction specimens.

---

## 12. CALCULATION

- 12.1 Calculate the cumulative percentages retained on each sieve.

$$\text{Percent Retained} = 100(\text{Mass Retained} / \text{Total Mass of Sample})$$

---

## PART III—SIEVE ANALYSIS OF ROAD-MIX STABILIZED MATERIAL

---

### 13. SCOPE

- 13.1 This procedure applies to chemically stabilized materials sampled from the roadway during construction. These materials may be tested in the roadway condition for adequate pulverization, using sieves required by the governing Department Standard Specifications.

---

### 14. PROCEDURE

- 14.1 Select a representative sample from the roadway according to Tex-100-E.
- 14.2 Reduce the sample, using a sample splitter or other approved method, to a minimum of 4.5 kg (10 lb.)
- 14.3 Remove all non-slakable aggregates retained on the specified sieves.
- 14.4 Weigh the sample to the nearest 5 g and record as the Total Mass under Section 15.
- 14.5 Use the specified sieves to separate the sample into different size fractions.
- 14.6 Use either a sieve shaker or the hand method in the sieving operation.
- 14.7 Sieve the sample with a lateral and vertical motion of the sieves, accompanied by a jarring action to keep the material moving over the surface of the sieve.
- 14.8 Continue the sieving operation until no more than one percent of the test sample, by mass, passes through any sieve after one minute of continuous shaking.

- 14.9 Weigh the material passing each of the required sieves and record its mass to the nearest 5 g.
- 

**15. CALCULATION**

- 15.1 Use the following to determine percent material passing each sieve.

$$\text{Percent Passing} = 100( \text{Mass Passing a Sieve} / \text{Total Mass of Sample} )$$

---

**16. REPORT**

- 16.1 Report test results to the nearest whole percent.
- 

**17. ARCHIVED VERSIONS**

- 17.1 Archived versions are available.

---

**Test Procedure for****DETERMINING SOIL pH****TxDOT Designation: Tex-128-E****Effective Date: August 1999**

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**1. SCOPE**

- 1.1 This method describes the procedure for determining the pH of soils in an aqueous solution.
  - 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. APPARATUS**

- 2.1 *pH meter*, with glass electrode, pH range 0–14  $\pm$  0.1.
  - 2.2 *Buffer solutions*, such as pH 4.0, 7.0, and 9.0.
  - 2.3 *Glass stirring rod*.
  - 2.4 *Glass beaker*, 250 mL (8.5 fl. oz.)
  - 2.5 *Balance*, Class G1 in accordance with Tex-901-K.
  - 2.6 *Thermometer*, 0–100°C (32–212°F).
  - 2.7 *Stirring device*, mechanical or magnetic.
- 

**3. MATERIALS**

- 3.1 *Distilled or deionized water*.
- 

**4. PREPARING SAMPLES**

- 4.1 *Soil Sample:*
    - 4.1.1 The pH test is performed on the soil binder, minus 425  $\mu$ m (No. 40) material prepared in accordance with Tex-101-E, Part I.
-

**4.2 Compost Sample:**

- 4.2.1 The pH test is performed on minus 4.75 mm (No. 4) material prepared according to the following:
    - 4.2.1.1 Obtain a representative sample of approximately 200 g and dry to constant weight at 60°C (140°F).
    - 4.2.1.2 Dry sieve material over a 4.75 mm (No. 4) sieve and test material passing.
- 

**5. PROCEDURE**

- 5.1 Heat sample and approximately 200 mL (7 fl. oz.) of distilled water to 45–60°C (112–140°F) in separate containers.
- 5.2 Add 30 g of the prepared dry soil binder to 150 mL (5 fl. oz.) of distilled water.
- 5.3 Stir the sample vigorously and disperse the soil well.
- 5.3.1 Stir the sample every 15 minutes for one hour to disperse the soil and make sure all soluble material is in solution.
- 5.4 After the sample has been added to the water for a period of one hour, record the temperature of the mixture and adjust the pH meter to that temperature.
- 5.5 Standardize the meter (buffer solution of pH 7.0) according to the manufacturer's recommendations.
- 5.6 Clean electrode with water.  
**Note 1**—If scratches are noticed on glass bulb of electrode, replace with new electrode.
- 5.7 Immediately before immersing electrode into mixture, stir and remove glass stirring rod. Place electrode into solution and use stirring bar to make good contact between the solution and the electrode.
- 5.8 Place the tip of the electrode approximately 76 mm (3/4 in.) into the mixture. Allow reading to stabilize.
- 5.9 Read and record the pH value to the nearest tenth of a whole number.  
**Note 2**—If the pH reading appears unstable, leave the electrode immersed until the reading has stabilized, approximately five minutes.
- 5.10 Remove electrode and rinse with water.
- 5.11 If the pH of sample is below 5 or above 9, standardize meter with appropriate buffer and repeat Sections 5.4 through 5.9.

---

**6. REPORT**

6.1 Report the pH to the nearest 0.1.



## Tex-128-E, Determining Soil pH

pH = \_\_\_\_\_

Report to the nearest 0.1

Notes:

pH < 7 is acidic

pH = 7 is neutral (distilled water has a pH of 7)

pH > is alkaline

Most soils range from pH 4.5 to pH 8. In this range, pH is generally not considered to be a problem for steel. A pH < 4.5 can cause rapid metal corrosion and serious risks to common construction materials.

---

**Test Procedure for****MEASURING THE RESISTIVITY OF SOIL MATERIALS****TxDOT Designation: Tex-129-E*****Effective Date: August 1999***

---

**1. SCOPE**

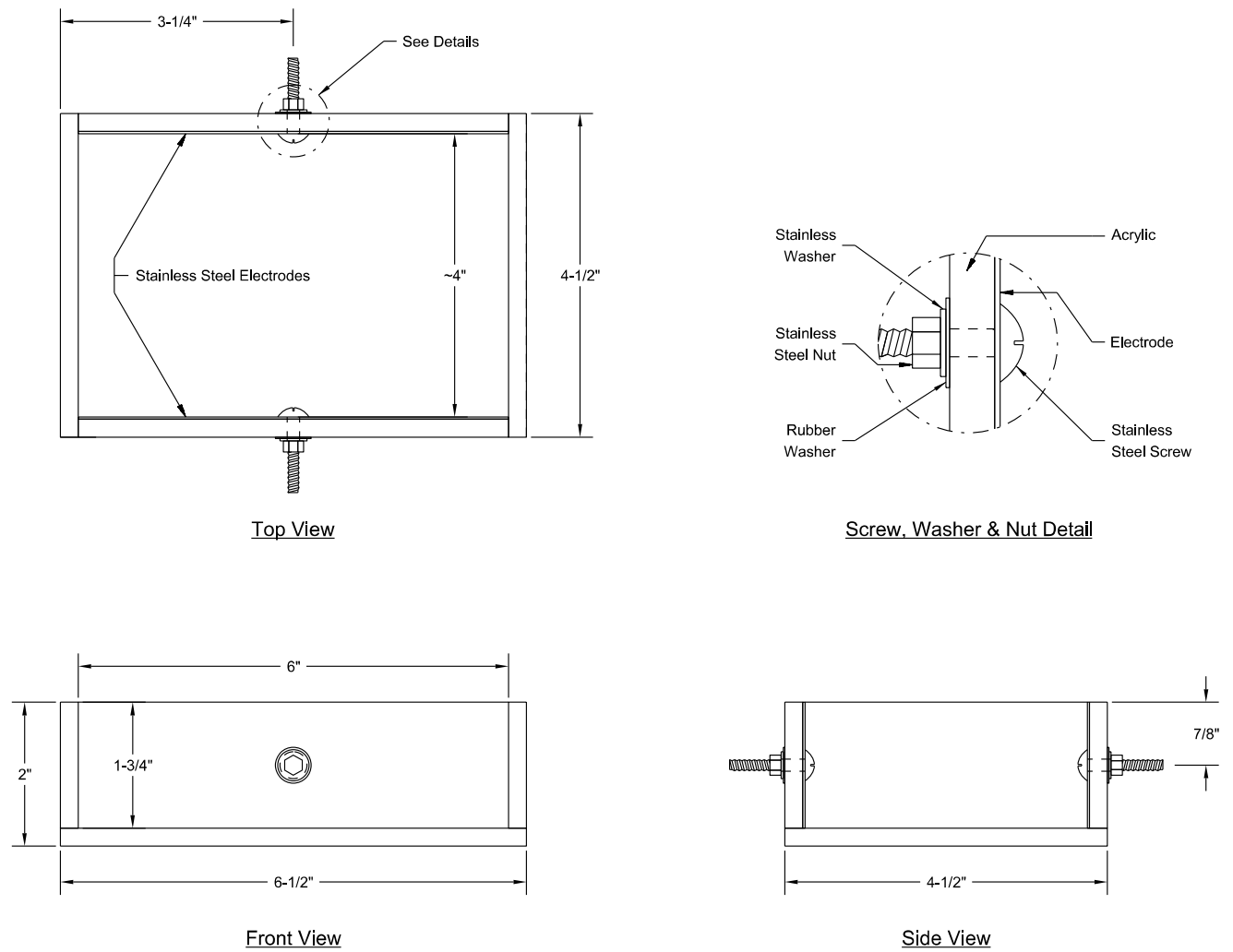
- 1.1 This method determines the resistivity of soil and aggregate materials.
  - 1.2 Resistivity is an important factor in considering the corrosion potential of soils and aggregates to metal pipe, earth-reinforcing strips, and other metal items in earthwork.
  - 1.3 The values given in parentheses (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 *Resistivity*—Resistivity decreases with an increase in moisture content of the material until the minimum resistivity is obtained. This minimum resistivity value is the resistivity of the material.
- 

**3. APPARATUS**

- 3.1 *Portable resistivity meter*, Vibroground Model 293 or equal.
  - 3.2 Small box with inside dimensions of  $102 \times 152 \times 45$  mm ( $4 \times 6 \times 1\text{-}3/4$  in.) (See Figure 1.)
  - 3.3 *Straightedge*.
  - 3.4 *Drying pans, mixing pans, trowel, and small scoop*.
  - 3.5 *Standard U.S. Sieve*, 2.36 mm (No. 8), meeting the requirements of Tex-907-K.
  - 3.6 *Graduated beaker*, 200 mL (7 fl. oz.)
  - 3.7 *Balance*, Class G2 in accordance with Tex-901-K, minimum capacity of 1500 g.
-



ITEM	QTY.	LENGTH	WIDTH	THICK.
The following items are to be made of plastic (acrylic/plexiglass).				
Bottom	1	6-1/2"	4-1/2"	1/4"
Ends	2	4-1/2"	1-3/4"	1/4"
Sides	2	6"	1-3/4"	1/4"
The following item is to be made of stainless steel.				
Electrodes	2	6"	1-3/4"	20 Gauge
Two of each of the following items are required.				
No. 8-32 x 3/4" Machine Screws, Round Head, Stainless Steel				
Washers, Rubber				
Washer & Nut Set, Stainless Steel or Brass				

**Figure 1—Soil Box for Laboratory Resistivity Determination**



---

## 4. MATERIAL

- 4.1 *Distilled or deionized water.*
- 

## 5. PROCEDURE

- 5.1 Follow Tex-100-E to secure a representative sample of sufficient size to yield approximately 1300 g of material passing the 2.36 mm (No. 8) sieve.
- 5.2 Dry the sample to constant mass in an oven at a temperature of  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 9^{\circ}\text{F}$ ) and allow it to cool at room temperature.
- 5.3 Pass the sample over a 2.36 mm (No. 8) sieve.
- 5.3.1 When there is 1300 g or more passing the sieve, proceed to Section 5.4.
- 5.3.2 When there is less than 1300 g passing the sieve, crush to pass the sieve, then proceed to Section 5.4.
- 5.4 Reduce the sample using a sample splitter or quartering cloth to make a soil sample of approximately 1300 g.
- 5.5 Weigh sample to nearest 0.5 g.
- 5.6 Clip one set of wires on the left side of the soil box and plug into the left of the meter dial. Clip the other set of wires on the right side of the soil box and plug into the right side of the meter dial.
- Note 1**—The dial reads resistance in ohms, measured between electrodes separated by 102 mm (4 in.) of soil.
- 5.7 Add 100 mL of distilled or deionized water to dry soil at room temperature.
- 5.8 Mix until water is dispersed uniformly throughout soil.
- 5.9 Fill soil box by lightly hand-compacting wet soil, making sure soil completely fills box.
- 5.10 Level top with a straightedge.
- 5.11 Move power switch to the adjust position to make a preliminary adjustment.
- Note 2**—If dial is below 0.1 after adjustment, switch the multiplier to the next power down. If dial is above 0.9 after adjustment, switch the multiplier to the next power up.
- 5.12 Next, place power switch in a read position, read and record the resistance, in ohms, on [Form 1961](#), “Resistivity of Soils Material.” Resistivity varies with temperature; therefore, it is important that the soil and added moisture be at uniform room temperature when mixed and tested.
- Note 3**—Click on [ex1961](#) to see an example of a completed Resistivity worksheet.

- 5.13 Repeat above procedure, using the same sample, adding distilled or de-mineralized water in increments of 50 mL for sandy soils and 100 mL for clay soils.
- 5.14 Ensure that each addition of water is dispersed evenly throughout the sample.
- 5.14.1 The resistivity readings should decrease for several readings before an increase is noted.
- 5.14.2 The lowest resistivity reading before an increase will be the reading to use for calculating the resistivity of the soil, as shown on the data sheet.
- 5.14.3 The resistivity for sandy soils is generally higher than for clay soils. The sandy soils may contain higher levels of soluble salts and not always increase after decreasing readings.
- 5.14.4 For sandy soils, the reading used to calculate the resistivity value will be the point at which total saturation occurs. This happens when water is observed rising to the surface during compaction of the sample.
- 

## 6. CALCULATIONS

- 6.1 Calculate the Soil Box Factor (SBF):

$$SBF = A / D$$

Where:

A = Area of one electrode, cm<sup>2</sup>

D = Distance between electrodes, cm.

- 6.2 Calculate the Resistivity, in ohm-cm = SBF x Resistance using resistivity meter:

$$R = SBF( R_{OHM} )$$



## Tex-129-E, Measuring the Resistivity of Soil Materials

Water Added (mL)	Multiplier	Dial Reading	Resistance (ohms)

Minimum Resistance Reading: \_\_\_\_\_

Resistivity (Ohm – cm) = Box Factor x Minimum Resistance: \_\_\_\_\_

---

## Test Procedure for

# DETERMINING SULFATE CONTENT IN SOILS — COLORIMETRIC METHOD



## TxDOT Designation: Tex-145-E

**Effective Date: February 2005**

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### 1. SCOPE

- 1.1 This method determines the soluble sulfate content of soil by using turbidimetric techniques.
  - 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 *Turbidimetric Technique*—The process of measuring the cloudiness of a liquid and translating it into concentration. A reagent (sulfate test tablet) is combined with a sample, which causes cloudiness or turbidity in the sample.
  - 2.2 *PPM*—Parts per million; measure of concentration.
  - 2.3 *Filtrate*—(Soil/water) material that has passed through a filter.
- 

### 3. APPARATUS

- 3.1 *Colorimeter and the following accessories:*
    - 10 mL glass sample vial
    - Sulfate test tablets
    - White plastic rod.
  - 3.2 *9 V battery.*
  - 3.3 *Auger sampler.*
  - 3.4 *Core sampler, 2 in. diameter × 4 ft. long.*
  - 3.5 *Balance, Class G2 in accordance with Tex-901-K, minimum capacity of 3500 g.*
  - 3.6 *Sieves, U.S. Standard No. 4 (4.75 mm) and No. 40 (425 μm).*
-

- 3.7 *Mortar and pestle.*
  - 3.8 *Crusher.*
  - 3.9 *Oven, capable of maintaining a temperature of  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 9^{\circ}\text{F}$ ).*
  - 3.10 *Beakers (glass or plastic), 250 mL.*
  - 3.11 *Beakers (glass or plastic), 600 mL.*
  - 3.12 *Graduated cylinder TD (ex) (glass or plastic), 10 mL.*
  - 3.13 *Graduated cylinder (glass or plastic), 100 mL.*
  - 3.14 *Wide-mouth round high-density poly ethylene (HDPE) bottles, 8 oz. (250 mL).*
  - 3.15 *Wide-mouth round HDPE bottles, 16 oz. (500 mL).*
  - 3.16 *Funnel (glass or plastic), 80 mm diameter with short wide stems.*
  - 3.17 *Filter paper (fine porosity), 15 cm diameter.*
  - 3.18 *2 mL disposable pipettes.*
  - 3.19 *Wash bottle, 16 oz. (500 mL), for distilled or deionized water.*
  - 3.20 *Dessicator.*
  - 3.21 *Latex gloves.*
  - 3.22 *Tweezers.*
  - 3.23 *Pans, brush, and spatula.*
  - 3.24 *Sample splitter.*
- 

#### **4. MATERIAL**

- 4.1 *Distilled or deionized water.*
- 

### **PART I—FIELD DETERMINATION OF SULFATES**

---

#### **5. SCOPE**

- 5.1 The following procedure describes preparing soil samples for determining sulfate content in the field.

---

## 6. PROCEDURES

### 6.1 *Preparing Sample:*

- 6.1.1 Sample soil within the depth of proposed stabilization with a hand auger at the sampling frequency required by the guide schedule.
- 6.1.2 Obtain a 300 g representative sample.
- 6.1.3 Air-dry the sample to constant weight.
- 6.1.4 Pulverize the 300 g to pass the No. 40 (425  $\mu$ m) sieve.
- 6.1.5 Split the sample and obtain 10 g of representative sample. Do replicates for more accuracy. This means split the material to obtain three samples of 20 g each and run on each sample the colorimetric test.
- 6.1.6 Weigh 10 g to the nearest 0.1 g.

### 6.2 *Measuring Sulfate Content:*

- 6.2.1 Place the 10 g soil sample in an 8 oz. (250 mL) HDPE bottle.
- 6.2.2 Add 200 mL of distilled or deionized water. This provides an initial dilution ratio of 1:20.
- 6.2.3 Vigorously shake the bottle of soil/water solution by hand for 1 min. Wait for 12 hr.
- 6.2.4 After a minimum of 12 hr. has elapsed, place one filter paper along the inside of the funnel and place the funnel into an 8 oz. (250 mL) beaker to capture the filtrate.
- 6.2.5 Shake the bottle of soil/water solution again for 1 min. and pour the solution into the funnel. Allow all the solution to filter and drain into the beaker.
- 6.2.6 Using a clean, 2 mL disposable pipette, fill the 10 mL graduated cylinder with the filtrate. Place the 10 mL filtrate into a sample vial. Wipe the outside of the vial clean with a Kimwipe® or equivalent delicate task wipe to remove dirt, fingerprints, or anything else that will obstruct a light beam from passing through the glass and filtrate.  
**Note 1**—Insure the test vial is clean and free from any residue from previous testing.
- 6.2.7 Switch the colorimeter unit to “ON.”
- 6.2.8 Press the *MODE* key until “SUL” method is displayed.
- 6.2.9 Place the sample vial into the sample chamber with the  $\Delta$  vial mark aligned with the  $\Delta$  housing mark.
- 6.2.10 Press the *ZERO/TEST* key. The method symbol flashes for approximately 3 sec. and confirms zero calibration.

- 6.2.11 After zero calibration, remove the vial from the sample chamber.
- 6.2.12 Add one sulfate test tablet to the vial without touching the tablet with hands and crush immediately with the white plastic rod provided.  
*CAUTION:* Use latex gloves and tweezers when handling the sulfate test tablet. The tablets are toxic and care should be taken to avoid contact with the skin, eye, or ingestion.
- 6.2.13 Tamp the sulfate test tablet with the rod in a random motion until it is completely dissolved and dispersed throughout the sample vial.
- 6.2.14 Cap the vial, wipe the outside of the glass clean again, and immediately place the sample in the chamber with the  $\Delta$  marks aligned.
- 6.2.15 Press the *ZERO/TEST* key. The method symbol flashes for approximately 3 seconds and the result will appear in the display.
- 6.2.16 Take a minimum of three readings per sample and average the results.  
**Note 2**—If an error message is displayed, go to Section 6.2.19.
- 6.2.17 Multiply the average result times the dilution.  
  
(Example:  $100 \text{ (average reading)} \times 20 \text{ (1:20 dilution)} = 2000 \text{ ppm.}$ )  
  
**Note 3**—This test will only read concentrations from 5-200 mg/l (100-4000 ppm) for a 1:20 dilution.
- 6.2.18 Report the concentration in parts per million (ppm).
- 6.2.19 If the following error messages are displayed, report the following:
- 6.2.19.1 “– *Err message*: The result is below the measuring range limit.”  
■ Report the sulfate concentration as <100 ppm.
- 6.2.19.2 “÷ *Err message*: The result exceeds the measuring range.”  
■ This requires diluting the sample with more deionized water to bring the reading within the measurable range, as stated below:
- Measure out 5 mL of the filtrate into a 10 mL graduated cylinder and add exactly 5 mL of distilled or deionized water using a clean pipette.
  - The new solution is now at 1:40 dilution ratio, which corresponds to a maximum reading range of 8,000 ppm. Place the new diluted solution in a sample vial and repeat Sections 6.2.8–6.2.18.
  - If a “÷ *Err message*” is displayed again, this means the material has more than 8,000 ppm sulfate content. Report the sulfate concentration as > 8,000ppm.

---

## 7. TEST REPORT

- 7.1 Report average sulfate concentration in ppm to the nearest whole number.

---

## PART II—LABORATORY TEST

---

## 8. SCOPE

- 8.1 The following procedure describes preparing soil samples for determining sulfate content in the laboratory.

---

## 9. PROCEDURES

### 9.1 *Preparing Sample:*

- 9.1.1 Dry the entire Shelby tube or bagged sample in a  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 9^{\circ}\text{F}$ ) oven and allow to cool to  $25 \pm 3^{\circ}\text{C}$  ( $77 \pm 5^{\circ}\text{F}$ ) in a desiccator to constant weight.
- 9.1.2 After the sample is dried, crush, grind, and split to obtain approximately a 1500 g (3.3 lb.) representative sample to pass the 4.75 mm (No. 4) sieve.
- 9.1.3 Pulverize the 1500g sample to pass the 425  $\mu\text{m}$  (No. 40) sieve.
- 9.1.4 Split the sample to obtain three 40 g representative sample and weigh to the nearest 0.1 g.

### 9.2 *Measuring Sulfate Content:*

- 9.2.1 Weigh 20 g to the nearest 0.1 g of oven-dried soil and place the soil in a 16 oz. (500 mL) HDPE bottle.
- 9.2.2 Add 400 mL of distilled or deionized water. This provides an initial dilution ratio of 1:20.
- 9.2.3 Vigorously shake the bottle of soil/water solution by hand for 1 min. Wait for 12 hr.
- 9.2.4 After a minimum of 12 hr. has elapsed, place one filter paper along the inside of the funnel and place the funnel into a 600 mL beaker to capture the filtrate.
- 9.2.5 Agitate the sample again for 1 min. and pour the soil/water solution into the funnel. Allow all the solution to filter and drain into the beaker. Ensure the funnel is covered during the filtration process to ensure soil and other substance does not contaminate the solution.
- 9.2.6 Using a clean, uncontaminated pipette, measure out 10 mL of the filtrate into a 10 mL graduated cylinder. Transfer the 10 mL filtrate from cylinder into a sample vial. Wipe the outside of the vial clean with a Kimwipe® or task wipe to remove dirt, fingerprints, or anything else that will obstruct a light beam from passing through the glass and filtrate.

**Note 4**—Insure the test vial is clean and free from any residue from previous testing.



- 9.2.7 Switch the colorimeter unit to “ON.”
- 9.2.8 Press the *MODE* key until “SUL” method is displayed.
- 9.2.9 Place the sample vial into the sample chamber with the  $\Delta$  vial mark aligned with the  $\Delta$  housing mark.
- 9.2.10 Press the *ZERO/TEST* key. The method symbol flashes for approximately 3 sec. and confirms zero calibration.
- 9.2.11 After zero calibration, remove the vial from the sample chamber.
- 9.2.12 Add one sulfate test tablet to the vial without touching the tablet with hands and crush immediately with the white plastic rod provided.
- CAUTION:* Use latex gloves and tweezers when handling the sulfate test tablet. The tablets are toxic and care should be taken to avoid contact with the skin, eye, or ingestion.
- 9.2.13 Tamp the sulfate test tablet with the rod in a random motion until it is completely dissolved and dispersed throughout the sample vial.
- 9.2.14 Cap the vial, wipe the outside of the glass clean again, and immediately place the sample in the chamber with the  $\Delta$  marks aligned.
- 9.2.15 Press the *ZERO/TEST* key. The method symbol flashes for approximately 3 sec. and the result will appear in the display. Take a minimum of three readings per sample and average the results.
- 9.2.16 If an error message is displayed, go to Section 9.2.19.
- 9.2.17 Multiply the average result times the dilution.
- (Example:  $100 \text{ (average reading)} \times 20 \text{ (1:20 dilution)} = 2000 \text{ ppm.}$ )
- Note 5**—This test will only read concentrations from 5-200 mg/l (100-4000 ppm)
- 9.2.18 Report the concentration in parts per million (ppm).
- 9.2.19 If the following error messages are displayed, take the corresponding actions:
- 9.2.19.1 “- *Err message:* The result is below the measuring range limit.”
- Report the sulfate concentration as < 100 ppm.
- 9.2.19.2 “÷ *Err message:* The result exceeds the measuring range.”
- Dilute the sample with more deionized water to bring the reading within the measuring range, as stated below:
    - Measure out 5 mL of the filtrate into a 10 mL graduated cylinder and add exactly 5 mL of distilled or deionized water using a clean pipette.

- The new solution is now at 1:40 dilution ratio, which corresponds to a maximum reading range of 8,000 ppm. Place the new diluted solution in a sample vial and repeat Sections 9.2.8–9.2.18.
- If “÷ Err message” is displayed again, this means the material has more than 8,000 ppm sulfate content and additional dilutions will be required until an absolute number is obtained. Repeat Sections 9.2.8 through 9.2.15 and Sections 9.2.17 and 9.2.18.

---

**10. TEST REPORT**

10.1 Report average sulfate concentration in ppm to the nearest whole number.



## Tex-145-E

### Determining Sulfate Content in Soils-Colorimetric Method

Dilution Ratio	Meter Reading			Average/ERR	PPM Sulfate Content
	A	B	C		

Dilution Chart				
Filtrate, ml	Plus	Distilled Water	Multiplier	
10.00	+	0.00	20	
5.00	+	5.00	40	
2.50	+	7.50	80	
2.00	+	8.00	100	
1.25	+	8.75	160	
1.00	+	9.00	200	

#### Calculation

$$D_f = \frac{(V_f + V_w)}{V_f}$$

#### Where:

- Df = Dilution ratio of diluted filtrate
- Di = Initial dilution ratio
- Vf = Volume of undiluted filtrate, ml
- Vw = Volume of water added, ml

---

## Test Procedure for

# SAMPLING FLEXIBLE BASE, STONE, GRAVEL, SAND, AND MINERAL AGGREGATES



TxDOT Designation: Tex-400-A

Effective Date: January 2010

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## 1. SCOPE

- 1.1 This method describes procedures for sampling flexible base material, stone, gravel, sand, and synthetic aggregates including shell, slag, riprap, and mineral filler.
  - 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. SECURING REPRESENTATIVE FIELD SAMPLES

- 2.1 Obtain samples that show the true nature and condition of the materials that they represent. Do not combine materials that apparently differ in property or character to make a composite sample. Differences may be indicated by color or texture. Samples taken from a quarry or pit for a source investigation may be taken from various existing layers or strata, and the samples should be combined in proper proportion to represent the entire pit face that will be processed in the same operation.
- 2.2 Use sampling tubes where experience has indicated representative samples cannot be obtained otherwise. Sample fine aggregates (sands) with tubes of at least 31.5 mm (1-1/4 in.) diameter and coarse aggregates up to 19.0 mm (3/4 in.) with tubes of 100 mm (4 in.) diameter.

**Note 1**—The method of sampling will depend on the place, the quantity of the material, and the proposed treatment and tests to be performed in the laboratory. Where practical, take samples of the finished product from commercial plants.

---

## 3. RECORD FORM

- 3.1 Identify samples on [Form 202](#), "Identification of Material Samples." In addition to the general information accompanying all samples, show the:
    - name of the producer,
    - name of the pit or quarry,
    - producer code number,
    - location of the stockpile sampled (pit, HMAC or concrete plant, project, etc.),
-

- approximate quantity of the material in the stockpile or unit sampled, and
- specification item number.

---

#### 4. SAMPLE SIZE

- 4.1 The required sample size depends upon the maximum aggregate size and the number and types of tests to be performed. Use Table 1 to determine the minimum size sample required. Use a sample splitter or quartering cloth to reduce the field sample to laboratory test size.

---

#### 5. SAMPLING PROCEDURES

##### 5.1 *Riprap:*

- 5.1.1 Obtain four to six pieces of riprap representative of the proposed material.
- 5.1.2 Reduce the entire sample to a maximum particle size of 150 mm (6 in.)
- 5.1.3 Submit approximately 50 kg (110 lb.) of the material retained on the 4.75 mm (No. 4) sieve.

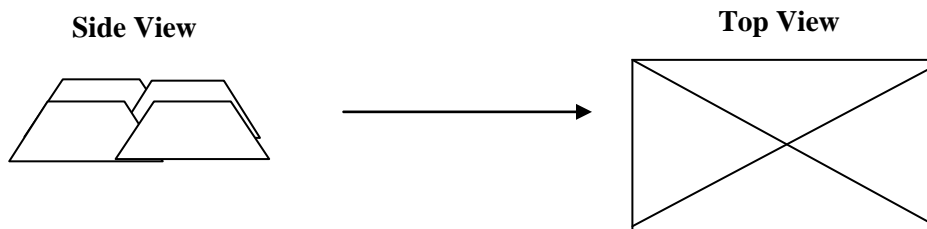
##### 5.2 *From Bins or Belts:*

- 5.2.1 For preliminary investigation work, sample aggregates in their natural condition prior to plant processing.
- 5.2.2 If the materials are being fed to the plant from bins, obtain the sample from the collector belt after materials have passed the scalping screen.
- 5.2.3 The preferred method of sampling from the belt is a mechanical belt sampling device approved by the Engineer. This method does not require the belt to be stopped, but simply diverts the flow of aggregate for a designated period where the sample is collected.
- 5.2.4 When mechanical devices are not used, stop the belt prior to sampling, and take the sample from the entire width of the belt and at least one meter of the length, using a square-nosed scoop.
- 5.2.5 After removing the aggregate, brush all fines from the exposed section of the belt using a stiff bristled brush and add to the sample.

##### 5.3 *From Stockpiles that Contain Coarse and Fine Aggregate:*

- 5.3.1 Identify locations around the perimeter of the stockpile that represent the approximate quarter-points of the stockpile. Clean and level the ground at these locations to prevent contamination of the sampling pile.
- 5.3.2 Sample each quarter-point of the stockpile using the following steps.

- 5.3.2.1 Using a front-end loader large enough to cut into the stockpile from bottom to top in one continuous cut, make enough cuts into the stockpile at the quarter-points so that the cut at ground level is perpendicular to the top edge of the stockpile at that quarter-point. If available, the blade of the loader bucket must be straight and flat, without teeth. Only use a loader with a bucket containing teeth when a loader with a bucket that is straight, flat, and without teeth is not available. Make the cuts from the bottom to the top to expose a clean, interior vertical face representing the full height of the stockpile. Clean out the cut as needed to leave a minimal amount of material on the ground before obtaining the sample.
- 5.3.2.2 Discard this material.
- 5.3.2.3 Using the front-end loader, cut into the exposed interior face to a depth equal to approximately half the depth of the loader bucket, taking care not to overload the bucket in the bottom half of the stockpile. Make the cut from the bottom to the top in one continuous motion.
- 5.3.2.4 Lower the bucket until it is as close as possible to the surface of the ground, and empty the entire contents of the bucket onto the ground in one motion without having to raise the bucket before all contents are emptied. Repeat this process three more times, each time emptying the loader bucket next to the last load. (See Figure 1.)



**Figure 1**—Placement and Sampling of Piles

- 5.3.2.5 Using the loader bucket, strike, and level the sample piles at mid-height in the direction the bucket was emptied (See Figure 1.)
- 5.3.2.6 Using a shovel, identify the approximate mid-point of each bucketload, and dig straight down to remove material for sampling. Deposit the material removed from the hole into sample containers (preferably 5 gal. buckets). Minimize loose material falling from the sides of the hole and loss of material from the shovel into the hole or adjacent ground while filling sample containers. Remove enough material from each hole to fill one sample container for each party who will receive a portion of the sample. This will give you four containers of sampled material for each quarter-point of the stockpile sampled.
- 5.3.2.7 Seal and label the sample containers. Include the quarter point location on the label.
- 5.3.3 Repeat Sections 5.3.2.1–5.3.2.7 at each of the stockpile quarterpoints identified in Section 5.3.1.

- 5.3.4 Department personnel will divide the total sample into three equal portions and offer one portion of the sample to the producer, retain one portion for district testing, and retain one portion for CST/M&P for referee and random blind samples.
- 5.4 *From Stockpiles that Contain Only Coarse or Only Fine Aggregate:*
  - 5.4.1 Take samples from stockpiles near the top of the pile, near the base of the pile, and at an intermediate point.
  - 5.4.2 Shove a board into the pile just above the point of sampling to prevent further segregation during sampling.
  - 5.4.3 Do not use the aggregate on the surface of the stockpile as a part of the sample.
  - 5.4.4 In each instance, dig a small trench or hole into the pile approximately 1 ft. deep and take the sample from the innermost part of the hole.
  - 5.4.5 Take samples from these three points at several places around the stockpile and combine them to form a composite sample.
  - 5.4.6 In lieu of using Section 5.4, steps outlined in Section 5.3 are acceptable.
- 5.5 *From Railroad Cars and Trucks:*
  - 5.5.1 Excavate at least three trenches across the width, evenly spaced across the length of the bed.
  - 5.5.2 Each trench bottom should be approximately 0.3 m (1 ft.) in width and 0.3 m (1 ft.) in depth.
  - 5.5.3 Take samples from at least three locations equally spaced along the length of the trench, and combine all samples to create a single field sample as directed in Tex-100-E.
- 5.6 *From the Plant:*
  - 5.6.1 Make a general inspection of the plant and a record of the screening facilities.
  - 5.6.2 For a weigh-batching type plant, take samples from the aggregate bins that feed into the weigh-box.
  - 5.6.3 For a continuous mix type plant, take samples from the aggregate bins that feed the proportioning mechanism.
  - 5.6.4 For a drum type plant, take samples from the collector belt feeding the aggregate into the drum. When an aggregate flow diversion chute is not available, stop the feed belt prior to obtaining the sample.
  - 5.6.5 Take samples from the entire cross-section of the flow of material from each individual bin as it is being discharged. Prior to sampling, permit the plant to produce a minimum of 4.5 Mg (5 tons) of mixture.

**Table 1—Minimum Size of Samples**

Nominal Maximum Size Of Particles <sup>1</sup>	Approximate Minimum Mass Of Field Samples, kg (lb.)
2.00 mm (No. 10)	10 (25)
4.75 mm (No. 4)	10 (25)
9.5 mm (3/8 in.)	10 (25)
12.5 mm (1/2 in.)	15 (35)
19.0 mm (3/4 in.)	25 (55)
25.0 mm (1 in.)	50 (110)
37.5 mm (1-1/2 in.)	75 (165)
50.0 mm (2 in.)	100 (220)
63.0 mm (2-1/2 in.)	125 (275)
75.0 mm (3 in.)	150 (330)

1. For processed aggregate, the nominal maximum size of particles is the largest sieve size listed in the applicable specification upon which any material is permitted to be retained.

**Note 2**—Obtain the test sample from the field sample by quartering or splitting.

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## 6. ARCHIVED VERSIONS

6.1 Archived versions are available.