Test Procedure for

TUBE SUCTION TEST

TxDOT Designation: Tex-144-E

Effective Date: August 2020

1. SCOPE

1.1 The Tube Suction Test (TST) method evaluates the moisture susceptibility of granular base materials used in pavements. The potential degree of moisture susceptibility is based on the surface dielectric value of laboratory compacted specimens using a dielectric probe. The compacted specimens are subjected to a 10-day capillary soak and the dielectric value is measured daily during this period.

1.2 The dielectric value (DV) reading is an indicator of the ability for moisture to migrate through the material by capillary rise. Flexible base material with a high dielectric value may absorb excessive moisture that may potentially migrate through the base course and compromise the durability and integrity of the base course and weaken the subgrade layer.

2. APPARATUS

2.1 As outlined in test methods:

- Tex-101-E, Part II
- Tex-103-E, Part I
- Tex-113-5.

2.2 Dielectric meter & probe; capable of measuring surface dielectric values up to 50; readable to 0.1 with an accuracy of ±0.5.

2.3 Filter paper, 6 in. in diameter, general-purpose grade.

2.4 Flat-bottomed plastic or steel pan, of sufficient dimensions to contain the specimens with the required water depth.

2.5 Latex or rubber membrane; 6 in. inside diameter, 12 in. height, with 0.025 in. thickness.

2.6 Membrane stretcher.

2.7 Plastic disc, 6 in. in diameter, flexible, non-porous plastic material of minimum thickness to prevent moisture evaporation from the surface of the specimen.
3. **REPORTING AND DOCUMENTATION**

3.1 Report all data and information pertinent to this testing using SiteManager form ‘tx144-14.xlsm’.

**Note 1**-This form is available from the Materials & Tests Division/Soils & Aggregates Section. It is also available online at the following link http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html.

4. **MATERIAL SAMPLING AND PREPARATION**

4.1 Obtain a minimum of 200 lbs. of representative sample and prepare in accordance with Tex-101-E to determine a moisture-density (M-D) curve and produce two specimens for Tube Suction Test (TST).

4.2 Obtain a minimum of 100 lbs. of representative sample to perform the TST only when a M-D curve is available.

5. **PROCEDURES**

5.1 *This test procedure does not claim to address the safety concerns associated with its use. It is the responsibility of the user of this test procedure to establish the appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

5.2 Determine the optimum moisture content and the maximum dry density for the material from Section 5 in accordance with Tex-113-E.

5.3 *Molding Specimens*

5.3.1 Prepare two samples using the optimum moisture content and the weight of material to meet the height requirement of 8.000 ± 0.250 in. from Section 6.1 for the tube suction test specimens.

5.3.2 Weigh two clean, porous stones dried to a constant weight at 140 ± 5°F for each specimen. Use these porous stones as the same top and bottom porous stone for the compacted specimen throughout this test.

**Note 1**–Constant weight will be considered achieved when the weight loss is less than 0.1% of the initial sample weight in four hours of oven drying. The time required to obtain constant weight will vary depending on the type of material, size of specimen, oven type and capacity, and other factors. The influence of these factors generally can be established by good judgment and experience with the materials being tested and the apparatus being used.

5.3.3 Compact each specimen in accordance with Tex-113-E.

**Note 2**–Prior to completing Section 6.30 of Tex-113-E, place a piece of filter paper on the bottom porous stone instead of a non-porous disc prior to extruding the compacted specimen from the mold.
5.3.4 Report the weight and height of the specimens and the weight of the porous stones into the “Compaction Info” worksheet in the ‘tx144-14.xlsx’ Excel SiteManager template.

5.4 Drying Back Specimens

5.4.1 Place all specimens along with the porous stones in an oven at 140 ± 5°F for 48 ± 2 hr.

5.4.2 After the specimens are dried for 48 hr., remove the specimens from the oven. Allow the specimens to cool to room temperature for a minimum of 2 hr. or until the specimens can be handled comfortably with bare hands.

5.4.3 Weigh and report the weight of the specimens into the “Compaction Info” worksheet in the ‘tx144-14.xlsx’ Excel SiteManager template.

5.5 Measuring Dielectric Values

5.5.1 Mark five (5) locations on the top surface of each specimen as shown in Figure 1 without damaging or scarifying the surface.

Note 3—Space the first four readings equally around the circumference of the specimen and place the fifth reading in the center. Use a permanent marker to mark the five locations. The circular location may overlap with the other four locations around the perimeter of the test specimen. This will depend on the diameter of the percometer probe.

5.5.2 Place a surcharge with a load of 5.0 ± 0.5 lb. on the top of the dielectric probe as shown in Figure 2 to ensure adequate contact between the sensor and the top surface of the specimen.

Figure 1—Locations of readings using the dielectric probe.
5.5.3 Measure and record five readings on the top surface of the specimen using the dielectric probe at the locations marked in Section 5.5.1.  
**Note 4**—These readings are the data for day one of the testing.

5.5.4 Report the five readings for each compacted specimen into the “DV Readings” worksheet in the ‘tx144-14.xlsm’ Excel SiteManager template.

5.5.5 Place a plastic disc on top of the specimen and then place a clean, oven-dried porous stone on the disc.

5.5.6 Place a latex membrane around the specimen with the aid of a membrane stretcher. Roll the membrane upward from the bottom end to cover a top half of the bottom porous stone.

5.5.7 Roll the membrane downward from the up end to cover the side of the top porous stone to prevent moisture evaporation as shown in Figure 2.

5.5.8 Repeat Sections 5.5.1-5.5.7 for the other compacted specimens.

5.5.9 Place the specimen in a flat-bottomed stainless steel or plastic pan. Fill the pan with tap water to a level of approximately 0.25 in. above the bottom porous stone as shown in Figure 3.
Ensure that the membrane and the plastic disk seal the top of the specimen from any evaporation.

Exposue half of the stoneside to the water.

Figure 3—Tube suction test specimen configuration.

5.5.10 After 24 ± 2 hr. from completing Section 5.5, expose the top surface of each specimen by rolling the membrane from the top porous stone downward to approximately a half inch below the plastic disc. Remove the porous stone and plastic disc.

5.5.11 Measure and record five readings from the top surface of the specimen using the same dielectric probe at the locations marked in Section 5.5.1. **Note 5**—These readings are the data for day two of the testing.

5.5.12 Place the plastic disc and the porous stone back on the specimen. Roll the membrane upward to the top of the porous stone.

5.5.13 Repeat steps in Sections 5.5.11 and 5.5.12 for an additional nine consecutive days. Maintain the water level in the pan at the depth shown in Figure 3 throughout testing.

5.5.14 Continue taking readings when the difference of the average DV from the 10th day is greater than or equal to 0.5 from the average DV from the 9th day. The test is considered complete when this difference is less than 0.5.

**5.6 Determining Moisture Content**

5.6.1 At the end of the test, determine the moisture content of each specimen in accordance with *Tex-103-E*, Part I. **Note 6**—Use the whole specimen to determine the moisture content for the moisture distribution may not be uniform.

5.6.2 Report the weights of samples before and after oven-dry for each specimen and the weights of pans into the “Compaction Info” worksheet in the ‘tx144-14.xlsx’ Excel SiteManager template.
6. REPORT

6.1 Use the ‘tx144-14.xlsm’ Excel SiteManager template to report all data and information.

6.2 The final dielectric value is the average of the DV readings from the final three days of testing.

7. RECOMMENDED CRITERIA FOR DIELECTRIC VALUES

7.1 Material with final dielectric values less than 10.0 are not considered moisture susceptible.

7.2 Material with final dielectric values in the range between 10.0 and 16.0 are considered marginally moisture susceptible.

7.3 Material with final dielectric values greater than 16.0 are considered moisture susceptible.