Test Procedure for

DETERMINING PLASTIC LIMIT OF SOILS

TxDOT Designation: Tex-105-E

Effective Date: August 1999

1. SCOPE

1.1 This method determines the plastic limit of soils.

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 *Plastic Limit of Soils*—Plastic limit is defined as the lowest moisture content and expressed as a percentage of the weight of the oven dried soil at which the soil can be rolled into threads one-eighth inch in diameter without the soil breaking into pieces. This is also the moisture content of a solid at which a soil changes from a plastic state to a semisolid state.

3. APPARATUS

3.1 *Porcelain evaporating dish*, 102–127 mm (4–5 in.) in diameter.

3.2 *Flexible spatula*, blade approximately 102 mm (4 in.) long × 19 mm (0.75 in.) wide.

3.3 *Plastic Limit Rolling Device (PLRD)*, and paper.

3.4 *Balance*, Class G1 in accordance with Tex-901-K, 100 g minimum capacity.

3.5 *Drying oven*, maintained at 110 ± 5°C (230 ± 9°F).

3.6 *Weighing dishes*, non-absorbent, with lids.

3.7 *Plaster of Paris disks*, approximately 102 mm (4 in.) in diameter (optional).

3.8 *Rolling surface*, minimum area of 300 × 300 mm (12 × 12 in.), non-absorptive, non-corrosive, light surface texture (e.g., ground glass plate, linoleum, or plastic-faced plywood).

Note 1—The hand method may be used; however, PLRD will be used as the referee.

4. PREPARING SAMPLE

4.1 Select approximately 20 g from material prepared for Tex-104-E.

4.2 Reduce water content of soil until it reaches a consistency at which it can be rolled without sticking to hands. Water content can be reduced by one of the following methods:

- place the soil in between two plaster of Paris disks,
- expose the soil to the air current from an electric fan, or,
- roll on paper that does not add any fiber to the soil, such as hard surface paper.

5. PROCEDURE

5.1 From the 20 g mass, select four to five portions of 1.5–2 g.

5.2 Form each portion into an ellipsoidal mass.

5.3 Place the masses in a row on a piece of paper on the PLRD, spaced evenly apart.

5.4 Roll the masses in the device with just sufficient pressure to form threads of uniform diameter.

Note 2—A normal rate of rolling for most soils is 80–90 strokes per minute, counting a stroke as one complete motion forward and backward to the starting position. This rate of rolling may have to be decreased for very fragile soils.

5.5 Taking no more than two minutes, further deform the threads on each stroke so the diameters are continuously reduced and the lengths are extended, until the diameters reach 3.2 ± 0.5 mm (1/8 ± 0.02 in.)

5.6 Reduce the diameter of the threads to 3.2 ± 0.5 mm (1/8 ± 0.2 in.) Break each thread into several pieces. Squeeze the pieces of each thread together, knead between the thumb and first finger, and reform into an ellipsoidal mass.

5.7 Repeat Sections 5.3–5.6 until the soil crumbles under the pressure required for rolling and can no longer be rolled into a 3.2 mm (1/8 in.) diameter thread. There is no problem if the thread breaks into shorter segments before reaching the 3.2 mm (1/8 in.) diameter. Roll each of these shorter segments to 3.2 mm (1/8 in.) diameter.

5.8 Gather the portions of the crumbled threads and place in a tared container. Immediately cover the container.

5.9 Continue the procedure to accumulate at least 10 g of sample rolled to the 3.2 mm (1/8 in.) diameter.

5.10 Weigh and record the mass of the sample and container to the nearest 0.01 g. (See Section 6.) Dry the soil sample in the container to a constant mass in a 110°C (230°F) oven.

5.11 Weigh and record the mass of the dry soil and container to the nearest 0.01 g. (See Section 6.)

- The operator should at no time attempt to produce failure at exactly 3.2 mm (1/8 in.) by reducing the rate of rolling and/or pressure, while continuing the rolling without further deformation.
- For low Plasticity Index (PI) soils, it is permissible to reduce the initial diameter of the ellipsoidal mass to near the required 3.2 mm (1/8 in.) final diameter.
- Use palm, finger, or a flexible spatula to roll low PI materials.
- If crumbling occurs when the thread has a diameter greater than 3.2 mm, this should be considered a satisfactory endpoint, provided the soil has been previously rolled to a 3.2 mm (1/8 in.) thread.
- Crumbling of the thread will manifest itself differently with various types of soil. Some soils fall apart into numerous small aggregations of particles. Others may form an outside tubular layer that starts splitting at both ends. The splitting progresses toward the middle, and finally the thread falls apart in many small platy particles.
- Fat clay soils require much pressure to deform the thread, particularly as they approach the plastic limit. With these soils, the thread breaks into a series of barrel-shaped segments about 3.2–9.5 mm (1/8–3/8 in.) in length.

NOTE 3—The only requirement for continuing the test is that the sample can be reformed into an ellipsoidal mass and rerolled.

6. CALCULATIONS

6.1 Mass of water:

$$W = A - B$$

6.2 Plastic Limit (%):

$$PL(\%) = 100[W/(B - C)]$$

Where:

A = mass of wet soil + tare, g

B = mass of dry soil + tare, g

C = mass of tare, g.

7. REPORT

7.1 Report the PL to the nearest whole percent.