1304 PLASTIC LIMIT and PLASTICITY INDEX of SOILS

AASHTO Designation T 90 (Mn/DOT Modified)

1304.1 GENERAL

The plastic limit of a soil is the lowest water content determined in accordance with the following procedure at which the soil remains plastic.

1304.2 APPARATUS

A. Evaporating Dish - A porcelain dish about 115mm (4 1/2 inches) in diameter.

B. Spatula - A spatula having a blade about 75mm (3 inches) in length and about 20mm (3/4 inches) in width.

C. Surface for rolling - A ground glass plate or piece of smooth, unglazed paper on which to roll the sample.

D. Containers - Suitable containers which will prevent loss of moisture during weighing (0.3kg [1 oz.] "salve" can). **See Section 1303.2E.**

E. Balance - A balance conforming to the requirements of AASHTO M 231 (Class C) having a readability and sensitivity of 0.01 grams and an accuracy of 0.02 grams.

F. Oven - A thermostatically controlled, drying oven capable of maintaining a temperature of 110 ± 5 °C (230 ± 9 °F) for drying the samples.

1304.3 SAMPLE

A. For plastic limit only, take a 20 gram sample (approximate) from the thoroughly wet and mixed portion of the soil prepared for the liquid limit of soils (See Section 1303.4A, Liquid Limit Determination).

B. Take the sample at any stage of the mixing process at which the mass becomes plastic enough to be easily shaped into a ball without sticking to the fingers excessively when squeezed. If the sample is taken before completion of the liquid limit test set it aside and allow to season in air until the liquid limit test has been completed. If the sample is taken after completion of the liquid limit test and is still too dry to permit rolling to a 3.2mm (1/8 inch) diameter thread, add more water and re-mix.

1304.4 PROCEDURE

A. Slice the approximate 20 gram "seasoned" sample in half.

B. Squeeze and form one of the sample halves into an ellipsoidal shaped mass. Set the other half aside.

C. Roll this mass between the fingers and the ground- glass plate with just sufficient pressure to roll the mass into a thread of uniform diameter throughout its length.

D. The rate of rolling shall be between 80-90 strokes per minute; a stroke being one complete motion of the hand forward and back to the starting position.

E. When the diameter of the thread becomes about 3.2mm (1/8 inch), break the thread up into 6 or 8 pieces. Squeeze the pieces together into a uniform mass, roughly ellipsoidal in shape and reroll.

F. Continue this re-rolling to 3.2mm (1/8 inch), gathering together the pieces, kneading and re-rolling until the thread crumbles under the pressure required for rolling and the soil can no longer be rolled into a thread.

G. The crumbling may occur when the diameter of the thread is greater than 3.2mm (1/8 inch). This shall be considered as satisfactory if the soil has been previously rolled, at least once, into a thread 3.2mm (1/8") in diameter.

NOTE 1: The crumbling will manifest itself differently with various soil types. Some soils fall apart in numerous, small aggregations of particles. Others may form an outside tubular layer that starts splitting at both ends. This splitting progresses toward the middle and the thread falls apart into small, platy pieces. Heavy clay soils require much heavy pressure to deform the thread; particularly, as they approach the plastic limit. Finally the thread breaks into a series of barrel-shaped segments, each 6.4 to 9.5mm (1/4 to 3/8") in length.

H. Gather the portions of the crumbled soil together and place in a suitable, tared container. Weigh and record the weight of the soil and container.

I. Take the other sample half and repeat steps B - H.

J. Dry to a constant weight at 110 ± 5 °C (230 ± 9 °F) and weigh. Record this weight and record the loss in weight as the weight of water. See Example in Section 1303.8.

NOTE 2: Reproducibility of results is difficult unless the exact procedure is used each time. For good reproducibility use a "seasoned" soil and carefully follow the above steps.

1304.5 CALCULATIONS

$$\textbf{\% Plastic Limit} = \frac{\text{Weight of Water}}{\text{Weight of Oven-dry Soil}} \times 100$$

As in the example (Section 1303.8):

$$\textbf{\% Plastic Limit} = \frac{0.81}{3.93} \times 100 = 20.61 \text{ (Sample 1)}$$

$$\textbf{\% Plastic Limit} = \frac{0.74}{3.48} \times 100 = 21.26 \text{ (Sample 2)}$$

$$\textbf{Average \% Plastic Limit} = \frac{20.61 + 21.26}{2} \times 100 = 20.93$$

NOTE 3: The two results should not differ by more than 10% from the mean.

Report to the nearest whole number (21). See Form #2485. (See Section 1303.8)

1304.6 PLASTICITY INDEX

The plasticity index of a soil is the numerical difference between its liquid limit and its plastic limit.

1304.7 CALCULATIONS

A. Plasticity Index = liquid limit - plastic limit

As in the example (Section 1303.8):

Plasticity Index = 26 - 21 = 5

See Form #2485

B. Report the difference calculated as indicated, as the plasticity index, except under the following conditions:

1. When the liquid limit or plastic limit cannot be determined, report the plasticity index as NP (non-plastic).

2. When the plastic limit is equal to, or greater than, the liquid limit, report the plasticity index as NP (non-plastic).

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