

DETERMINING THE PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS FOP FOR AASHTO T 90 (07)

Scope

This procedure covers the determination of the plastic limit and plasticity index of soil in accordance with AASHTO T 90. It is used in conjunction with the FOP for AASHTO T 89, Determining the Liquid Limit of Soils. The three values are used for soil classification and other purposes. This FOP will cover the hand rolling method only. If the plastic limit device method is approved by the agency, see the FOP for AASHTO T 90 for that procedure.

Apparatus

- Dish: preferably unglazed porcelain or similar mixing dish, about 115 mm (4.5 in.) in diameter.
- Spatula: having a blade 75 to 100 mm (3 to 4 in.) long and about 20 mm (3/4 in.) wide.
- Rolling Surface: a ground glass plate or piece of smooth, unglazed paper.
- Containers: corrosion resistant, suitable for repeated heating and cooling, having close fitting lids to prevent the loss of moisture. One container is needed for each moisture content determination.
- Balance: conforming to AASHTO M 231, class G1, sensitive to 0.01 g with a 1200 g capacity.
- Oven: thermostatically controlled, capable of maintaining temperatures of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$).

Sample

The plastic limit procedure is often run in conjunction with the liquid limit procedure. If this is the case, the plastic limit sample should be obtained from the soil prepared for the liquid limit test at any point in the process at which the soil is plastic enough to be easily shaped into a ball without sticking to the fingers excessively when squeezed. Obtain approximately 8 g of soil to run the plastic limit test.

If the plastic limit only is to be determined, the sample must be prepared per AASHTO T 87 or T 146. Obtain about 20 g of material passing the 0.425 mm (No. 40) sieve. Mix the soil with distilled or demineralized water until the mass becomes plastic enough to be easily shaped into a ball. Obtain approximately 8 g of soil to run the plastic limit test.

Note 1: Tap water may be used for routine testing if comparative tests indicate no differences in results between using tap water and distilled or demineralized water.

Procedure (Hand Rolling Method)

1. From the sample pull a 1.5 to 2 g mass.

2. Squeeze and form the test sample into an ellipsoidal-shape mass.
3. Roll this mass between the fingers or palm and the rolling surface with just sufficient pressure to roll the mass into a thread of uniform diameter along its length. Roll out between 80 and 90 strokes per minute, counting a stroke as one back and forth motion. The sample must be rolled into the 3 mm (1/8 in.) thread in no longer than 2 minutes.
4. Break the thread into six or eight pieces when the diameter of the thread reaches 3 mm (1/8 in.).
5. Squeeze the pieces together between the thumbs and fingers of both hands into an ellipsoidal-shape mass and reroll.
6. Continue this process of alternately rolling to a thread 3 mm (1/8 in.) in diameter, cutting into pieces, gathering together, kneading and rerolling until the thread crumbles under the pressure required for rolling and the soil can no longer be rolled into a thread.

Note 2: Crumbling may occur when the thread has a diameter greater than 3 mm (1/8 in.). This shall be considered a satisfactory end point, provided the soil has been previously rolled into a thread 3 mm (1/8 in.) in diameter. The crumbling will manifest itself differently with various types of soil. Some soils fall apart in many pieces; others form an outside tubular layer that splits at both ends; splitting progresses toward the middle, and the thread falls apart in small platy particles. Heavy clay requires much pressure to deform the thread, particularly as it approaches the plastic limit, and the thread breaks into a series of barrel-shaped segments each 6 to 9 mm (1/4 to 3/8 in.) long. At no time shall the tester attempt to produce failure at exactly 3 mm (1/8 in.) diameter. It is permissible, however, to reduce the total amount of deformation for feebly plastic soils by making the initial diameter of the ellipsoidal-shaped mass nearer to the required 3 mm (1/8 in.) final diameter.
7. Gather the portions of the crumbled soil together and place in a suitable, tared container & cover.
8. Repeat steps one through seven until 8 g of sample have been tested and placed in the covered container.
9. Determine the moisture content of the sample in accordance with the FOP for AASHTO T 255/T 265 (Soil).

Plastic Limit

The moisture content, as determined in Step 9 above, is the Plastic Limit. It is advisable to run several trials on the same material to ensure a proper determination of the Plastic Limit of the soil.

Plasticity Index

The Plasticity Index (PI) of the soil is equal to the difference between the Liquid Limit (LL) and the Plastic Limit (PL).

$$PI = LL - PL$$

Examples: #1

$$LL = 34 \text{ and } PL = 17$$

$$PI = 34 - 17 = 17$$

#2

$$LL = 16 \text{ and } PL = 10$$

$$PI = 16 - 10 = 6$$

Example Calculation

Container	Container Mass, g	Container and Wet Soil Mass, g	Wet Soil Mass, g	Container and Dry Soil Mass, g	Dry Soil Mass, g
1	14.44	22.65	8.21	21.45	7.01
2	14.18	23.69	9.51	22.81	8.63

Water Mass, g	Moisture Content	Plastic Limit
1.20	17.1	17
0.88	10.2	10

Report

Results shall be reported on standard forms approved by the agency. Report the PL and PI to the nearest whole number.

EMBANKMENT AND BASE
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WAQTC

AASHTO T 90