



Performance Examination - Soils

Standard Method of Test for Determining the Liquid Limit of Soil (AASHTO T 89-13)

Candidate Name: _____ NICET ID: _____

Apparatus	Trial 1	Trial 2
Liquid Limit Device		
Base: hard rubber Resilience rebound of 77 to 90% (7.577 to 8.856 in.) (19.25 to 22.50 cm) Rubber feet hardness, A-durometer < 60 (feet attached to base) Wear of base, spot < 10 mm		
Base Dimensions: 125 ± 5 mm x 150 ± 5 mm x 50 ± 5 mm		
Wear of Cup: > 0.1 mm (0.004 in.) groove		
Wear of Cup Hanger: pivot does not bind, no side to side movement > 3 mm (1/8 in)		
Wear of cam, not worn to lose contact		
Grooving tool inspected frequently		
Height of Drop: 10 ± 0.2 mm drop height		
Cup, Brass: mass including hanger of 185 to 215 g		
Cam: 180 degree of cam rotation		
Carriage: removable pin		
Motor Drive: 2 ± 0.1 revolutions per second		
Curved Grooving Tool		
Gauge End: (square) 9.80 – 10.20 mm		
Cutting Edge Width: 1.9 – 2.1 mm		
Curved End Thickness: 9.9 – 10.1 mm		
Gauge Block: 50 mm by 25 mm by 9.95-10.05 mm (0.392-0.396 in.) Edge of Gauge Block: > 10 mm (3/8 in.) wide		
Specimen Containers: 2-in. diameter by 1-in. high with snug fitting lids		
Balance: readable to 0.01 g and accurate to 0.02 g		
Flat Grooving Tool (Alternate)		
Plastic or non-corroding metal		
Tip Width: 1.9 - 2.1 mm		
Depth of Tip: 7.9 - 8.1 mm		
Storage Containers: porcelain, glass, or plastic dish		
Drying Oven: 110 ± 5 °C		
Washing Pan		

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Procedures	Trial 1	Trial 2
Sample Preparation		
1. The sample obtained by T87 or T146.		
2. The sample consists of about 100 g of passing soil 425- μ m (No. 40) sieve.		
3. Soil mixed with 15 to 20 ml of distilled or demineralized water in mixing dish (other than a brass cup). <i>Note: Tap water may be used for routine testing if comparative tests indicate no differences in results.</i>		
4. Mixing done by stirring, kneading and chopping with a spatula.		
5. Additional increments of water added (1 to 3 ml) until the mass is uniform and has a stiff consistency.		
6. No additional dry soil added to wet sample once testing has begun.		
7. If too wet, sample either discarded or mixed to evaporate water.		
Determining the Liquid Limit of Soils (Dry Preparation)		
1. Dry preparation should only be used when the dry preparation method is specified, otherwise use a wet preparation method.		
2. Specimen sufficient to provide 150 to 200 g of material passing 425- μ m (No. 40) sieve.		
3. Sample dried at no more than 60 °C (140 °F).		
4. Soil pulverized with rubber covered pestle or by other means that does not cause sample particle breakdown.		
5. Sample separated on a 425- μ m (No. 40) sieve and pulverized until all fine material passes through the sieve.		
6. Material retained on 425- μ m (No. 40) sieve soaked in a small amount of water and poured over a 425- μ m sieve, catching the wash water and suspended fines.		
7. Plus 425- μ m material discarded and wash water with suspended fines added to minus 425- μ m dry material.		
8. Water content adjusted by mixing the sample with a spatula on a glass plate or in mixing dish while adding distilled or demineralized water (sample may be soaked in a dish before mixing).		
9. If using Method A (Multipoint), water content adjusted to 25-35 blow consistency.		
10. If using Method B (One-Point), water content adjusted to 20-30 blow consistency.		
11. The sample placed in a covered storage container for at least 16 hours and remixed immediately before the test.		

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Procedures (continued)	Trial 1	Trial 2
Multipoint Procedure		
1. Liquid limit device previously inspected for wear and height of cup drop checked.		
2. Part of mixture put in a cup and spread with a spatula until 10 mm deep at maximum thickness.		
3. As few strokes of a spatula as possible using care to avoid entrapment of air bubbles.		
4. Excess soil returned to mixing dish.		
5. The unused wet soil in storage dish covered with a wet towel (or other means) during the test.		
6. Flat Grooving Tool: Groove formed in soil by drawing tool, beveled edge forward, through soil on a line joining highest point through lowest point on the rim of the cup or curved grooving tool.		
7. Soil in dish divided through the centerline of the follower with no more than six strokes of the curved tool and only last stroke of grooving tool scrape the bottom of the cup.		
8. Tearing along groove and slippage of cake avoided. Cup lifted & dropped twice per second until the bottom of groove closes about 13 mm (0.5 in.) in 25 to 35 blows.		
9. Container covered and then weighed to 0.01 g.		
10. Water content determined according to T 265.		
11. Soil remaining in cup returned to mixing dish.		
12. Steps repeated for closure in 20 to 30 blows.		
13. Steps repeated for closure in 15 to 25 blows.		
14. Range of three determinations at least ten blows.		
15. Lids removed before specimens are placed in the oven to dry.		
16. Water content calculated (to nearest whole percent) by the following equation: % moisture = mass of water x 100 mass of oven dry soil		
17. The liquid limit value reported to the nearest whole number.		
One-Point Method (B) Procedures		
1. Liquid limit device previously inspected for wear and height of cup drop checked.		
2. Once testing has begun, no additional dry soil added to the sample.		
3. Part of mixture put in a cup and spread with a spatula until 10 mm deep at maximum thickness.		

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Procedures (continued)	Trial 1	Trial 2
4. Care was taken to avoid entrapment of air bubbles and a few strokes of a spatula as possible used.		
5. Excess soil returned to mixing dish.		
6. The unused wet soil in storage dish covered during the test.		
7. Flat Grooving Tool: Groove formed in soil by drawing tool, beveled edge forward, through soil on a line joining highest point through lowest point on the rim of the cup or curved grooving tool.		
8. The soil in dish divided through the centerline of the follower with no more than six strokes of the curved tool and only last stroke of grooving tool scrape the bottom of the cup.		
9. Tearing along groove and slippage of cake avoided.		
10. Cup lifted and dropped twice per second until the bottom of groove closes about 13 mm (0.5 in.) in 22 to 28 blows.		
11. The base of the device not held with a hand while turning crank.		
12. If the target number of blows is not met, water content adjusted and steps 2 through 10 repeated.		
13. If the groove closes inside the target blow range, number of blows recorded.		
14. Sample immediately returned to mixing dish and combined with unused soil, with no additional water added.		
15. Steps repeated.		
16. Is the test restarted (and closure data/moisture sample discarded)?		
17. Second closure obtained is within 2 blows of the first closure.		
18. Second closure obtained within the 22 to 28 blow range.		
19. If the second closure is acceptable the number of blows for the second closure recorded.		
20. Slice of soil, the width of a spatula, extending across cake at right angles to groove and including the portion that flowed together removed from the dish and placed in a		
21. Container covered and then weighed to 0.01 g.		
22. Lids removed before specimens are placed in the oven to dry.		
23. Water content determined according to T 265		
24. Water content calculated (to nearest whole percent) by the following equation: % moisture = mass of water x 100		
25. Mass of oven dry soil.		
26. Liquid limit calculated.		

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Procedures (continued)	Trial 1	Trial 2
Determining the Plastic Limit and Plasticity Index of Soils:		
27. Sample is either at least 20 g of minus 425-µm (No. 40) material obtained by T87 or T146, or about 8 g.		
28. If 20-g sample of dry material:		
29. Mixed with distilled or demineralized water in a mixing dish.		
30. 1.5 to 2-g portion of the 8-g ball selected and formed into an ellipsoidal mass.		
31. Ellipsoidal mass placed on the bottom plate.		
32. Top plate placed in contact with simultaneous downward force and back and forth motion applied to top plate.		
33. Plate comes in contact with side rails within 2 minutes.		
34. Soil thread not allowed to contact side rails during rolling.		
35. Mass rolled between fingers or palm and plate/paper (or between the top and the bottom plate of rolling device) to form 3-mm diameter thread.		
36. The rate of rolling between 80 to 90 strokes per minute (counting stroke as one complete motion of hand forward and back to the starting position).		
37. Mass rolled for no more than two minutes to obtain correct thread diameter.		
38. When thread diameter is 3 mm, thread broken into several pieces.		
39. Pieces squeezed together between thumbs and fingers into ellipsoidal mass.		
40. Steps repeated until thread crumbles and soil can no longer roll into a thread.		
41. The operator does not attempt to produce failure at exactly 3 mm diameter.		
42. Crumbled pieces placed in tared container and container immediately covered.		
43. Steps repeated until the 8-g specimen is tested.		
44. Mass of specimen and container determined to 0.01 g.		
45. Specimen dried and water content determined according to T 265.		
46. Plastic limit calculated by the following equation: % moisture = mass of water x 100		
47. Mass of oven dry soil.		
48. Plastic limit reported to at least the nearest whole number.		
49. Plastic index calculated from: $PI = \text{Liquid limit} - \text{Plastic limit}$.		

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First Attempt: Pass: _____ Fail: _____ Second Attempt: Pass: _____ Fail: _____

Exam Administration: Remote _____ In-Person _____

Comments:

Examiner Name: _____ Examiner Signature: _____ Date: _____