

Department of Sustainable Natural Resources

SOIL SURVEY STANDARD TEST METHOD

LINEAR SHRINKAGE

ABBREVIATED NAME	LS
TEST NUMBER	P6
TEST METHOD TYPE	A
VERSION NUMBER	1

SCOPE

This test covers the determination of the linear shrinkage of a disturbed soil sample. It is a tedious and expensive test that is done only on soils (other than sands) when the dispersion percentage is >50 or volume expansion tests fail to saturate or shrink. This test is performed on dispersive soils only.

PRINCIPLE

Linear shrinkage is the decrease in length of a soil sample when oven-dried, starting with a moisture content of the sample at the liquid limit.

SPECIAL APPARATUS

- 100 mm spatula.
- Shrinkage moulds in the form of semi-cylindrical troughs 250 mm long and 25 mm diameter, with brazed-on square ends. (See Note 1.)
- A 300 mm steel rule graduated in mm.
- Enamel, plastic, glass or porcelain mixing bowl of about 150 mm diameter.
- A liquid limit machine conforming to the essential details of AS1289.C4.1:1977 or BS1377:1967. (See Note 2).
- A grooving tool compliant with the above standards.
- Drying oven capable of maintaining from 105 °C to 110 °C.
- Petroleum jelly (Vaseline) or silicone grease.
- Wash bottle containing deionised water.

PROCEDURE

1. By riffing or quartering, obtain a sample of at least 300 g of the material passing the No 36 B.S. sieve (0.425 mm) prepared according with the procedure for the preparation of disturbed soil samples for testing. Place this sample in the mixing bowl and thoroughly mix with deionised water using the spatula, until the mass becomes a thick homogeneous paste. Add sufficient water to bring it to a consistency equal to or slightly wetter than the liquid limit. (See Note 3.) When the sample is tested in the liquid limit machine, the groove should close with between 15 and 25 blows. (See Note 4).
2. Grease the inside of a clean shrinkage mould. Place the wet soil in the mould, taking care to thoroughly remove all air bubbles from each layer by lightly tapping the base of the mould. Slightly overfill the mould and then level off the excess material with the spatula. Remove all soil adhering to the rim of the mould.
3. Allow the specimen to dry at room temperature for about 24 hours until a distinct change in colour can be noticed. Transfer into an oven and dry at between 105 °C and 110 °C.
4. Allow the specimen to cool and then measure its longitudinal shrinkage L_s to the nearest millimetre. If the specimen cracks into pieces, firmly hold the separate parts together and measure the shrinkage L_s . If the specimen curls in the mould carefully remove it and measure the length of the top and bottom surfaces. Subtract the mean of these two lengths from the internal length of the mould to obtain the shrinkage. (See Note 5).

CALCULATIONS

Calculate the percentage linear shrinkage (LS) of the specimen. (See Note 6.)

$$LS (\%) = \frac{L_s}{L} \times 100$$

Where:

L = Length of the mould (mm)
L_s = Longitudinal shrinkage of the specimen (mm)

REPORTING THE RESULTS

Report the linear shrinkage (LS) to the nearest 0.5% when determined with a 250 mm mould and to 1% with a 135 mm mould. Record the size of mould used and any unusual conditions or problems experienced.

PRECISION OF TEST

No specific information on the precision of the test is available. However, with experienced operators only one determination is necessary for each soil sample. It is generally preferable, for soil characterisation, to conduct the test on a number of samples rather than duplicate determinations of the one sample.

REFERENCE

Standards Association of Australia. *AS 1289.C4.1-1977 Methods of testing soils for engineering purposes - Soil classification tests - Determination of the linear shrinkage of a soil - Standard method.*

NOTES

1. Moulds approximately 135 mm long may be used where the amount of soil available is limited.
2. The Australian Standard is identical to the British Standard. A device to American Society of Testing and Materials ASTM D423-1966 is equally acceptable. In all cases, the height to which the cup is lifted should be adjusted so that the point on the cup that comes in contact with the base is exactly 10 mm above the base. Refer to Liquid Limit of a Soil Test (P2A/1).
3. In the case of heavy clay soils, it is desirable to allow the wet soil to stand for about 24 hours in an airtight container before performing the test to allow the water to permeate throughout the soil mass. After curing, it is necessary to re-mix before testing. Highly aggregated soil may require as much as 40 minutes continuous mixing immediately before testing.
4. As operators gain experience, it will not be necessary to test the mixture in the liquid limit machine as moisture content is not critical within a few per cent.
5. The curling of a specimen can generally be prevented by extremely slow drying. Alternatively, when excessive curling is expected, the specimens may be air-dried for 24 hours and then weighted in three places in such a manner to prevent undue curling but to allow moisture to evaporate.
6. It is possible to prepare a special scale calibrated for the length of the mould to read off linear shrinkage direct. For a 250 mm mould, scale subdivision of 1.25 mm correspond to 0.5% increments of linear shrinkage. For a 135 mm mould, scale subdivision of 1.35 correspond to 1% increments of linear shrinkage.