AS 1289.7.1.2—1992
1992 ED.

Australian Standard®

Methods of testing soils for engineering purposes

Method 7.1.2: Soil reactivity tests—Determination of the shrinkage index of a soil—Loaded shrinkage index

1 SCOPE This Standard sets out a method for the determination of the shrinkage index of a soil (see AS 2870.2) using a spring-loaded shrinkage cell.

2 PRINCIPLE The soil sample is loaded vertically and then slowly dried out in a vacuum desiccator over copper sulphate solution. Total soil suctions and moisture contents are measured before and after the test.

3 REFERENCED AND RELATED DOCUMENTS

3.1 Referenced documents The following documents are referred to in this Standard:

AS	
1289	Methods of testing soils for engineering purposes
1289.0	Part 0: General requirements and list of methods
1289.B1.1	Method B1.1: Soil moisture content tests—Determination of the moisture content of a soil—Oven drying method (standard method)
1289.2.2.1	Method 2.2.1: Soil moisture content tests—Determination of the total suction of a soil
1726	SAA Site Investigation Code

3.2 Related document Attention is drawn to the following related document:

AS	
2870	Residential slabs and footings
2870.2	Part 2: Guide to design by engineering principles

4 APPARATUS

(a) A drying oven complying with AS 1289.0.

(b) A balance of 500 g capacity and limit of performance of 0.05 g.

(c) A spatula or palette knife of convenient size.

(d) A flat glass plate approximately 10 mm thick and at least 400 mm square.

(e) A vacuum desiccator with stopcock to accommodate a vacuum pump.

(f) A vacuum pump or similar system capable of achieving a minimum vacuum pressure of 600 mm Hg (or 80 kPa) (see Note 1).

(g) A loaded shrinkage cell similar to that illustrated in Figure 1.

(h) Vernier callipers to measure spring compression.

(i) A comparator with a reference rod, similar to that illustrated in Figure 2, or other length measuring system. The dial gauge shall be readable to 0.005 mm.

(j) Saturated copper sulphate solution.

(k) Drying room with temperature controlled at 23°C ±2°C.

(l) Apparatus to measure total soil suction in accordance with that described in AS 1289.2.2.1.

5 SAMPLES Obtain an intact cylindrical soil sample having a minimum diameter of 38 mm and a minimum length of 50 mm. Record a visual description of the soil. A Standard class undisturbed sample as defined in AS 1726 meets the minimum requirement of quality for an intact sample for this test.

STANDARDS AUSTRALIA

6 PROCEDURE The procedure shall be as follows:

(a) Determine the mass of the assembled apparatus without the soil sample (m_c) and the height of the sample ring (y).

(b) Taking extreme care to minimize loss of moisture, press the sample into the sample ring of the loaded shrinkage cell and trim the ends level. Retain and seal the sample trimmings. Determine the soil suction (u_o) using the sample trimmings in accordance with AS 1289 2.2.1 and determine the moisture content (w_o) of the remainder of the soil in accordance with AS 1289 B1.1.

(c) Assemble the apparatus with the soil sample and apply a seating pressure of 5 kPa by compressing the calibrated springs the required distance. Measure both the total mass of the assembled apparatus with the soil sample (m_o), and the initial dial gauge reading from the comparator for the apparatus with the soil sample (H_o) (see Note 2).

(d) Increase the sample pressure to 25 kPa and record the dial gauge reading from the comparator (see Note 3).

(e) Place the loaded shrinkage cell in the vacuum desiccator over the saturated copper sulphate solution. Apply a vacuum pressure of not less than 600 mm Hg and close the stopcock.

(f) On each of the first three days thereafter, remove the apparatus and sample from the desiccator, determine the total mass and record the dial gauge reading from the comparator. Then, adjust the spring compression if required to maintain the sample pressure and replace the apparatus and the sample in the desiccator under vacuum.

(g) Thereafter, take mass and comparator dial gauge readings at intervals of not less than one week. Adjust springs as required to maintain the sample pressure. Readings may be terminated once three successive comparator dial gauge readings are within 0.05 mm and three successive readings of mass are within 0.05 g.

(h) Remove the sample from the loaded shrinkage cell and determine the final soil suction (u_f), in accordance with AS 1289 2.2.1, using sub-samples taken near the centre of the sample. Determine the final moisture content (w_f) of the remaining soil in accordance with AS 1289 B1.1.

7 CALCULATIONS

(a) Calculate the sample strain (ϵ_t) at measuring time t from the equation:

$$\epsilon_t = \frac{H_o - H_t}{y} \text{ (see Note 4)}$$

where

ϵ_t = the sample strain at time 't'

H_o = the initial comparator dial gauge reading, in millimetres

H_t = the comparator dial gauge reading at time 't' after recording H_o, in millimetres

y = the sample ring height, in millimetres (see Note 4).

(b) Calculate the soil moisture content (w_t) percentage at each time of measurement (t) after measuring the initial mass, m_o:

$$w_t = w_o + \frac{100\,(m_t - m_o)\,(1 + w_o/100)}{(m_o - m_c)}$$

where

w_t = the soil moisture content at time 't', in percent

w_o = the moisture content of the sample trimmings, in percent

m_t = the total mass of the apparatus and sample at time 't', in grams

m_o = the initial total mass of the apparatus and sample at time $t = 0$, in grams

m_c = the mass of the apparatus without the sample, in grams.

Calculate the final soil moisture content at the time of the final set of measurements on the apparatus with the sample, and record the value as w_f.

(c) Plot sample strain (ϵ_t) versus moisture content (w_t) and compute the slope ($S = \Delta\epsilon_t/\Delta w_t$) of the linear portion of the plot after initial sample compression under loading.