

Australian Standard®

Methods of testing soils for engineering purposes

Method 4.4.1: Soil chemical tests— Determination of the electrical resistivity of a soil—Method for fine granular materials

AS 1289.4.4.1:2017

1 SCOPE

This Standard sets out a procedure for the measurement of electrical resistivity of fine granular materials with a maximum particle size of 2.36 mm. This test is used for the quality control of bedding and backfilling materials for cast iron and steel pipe, buried metallic structures and reinforcement. This test does not indicate the corrosion hazards to buried metals as these are largely controlled by the nature of the groundwater.

The compacted density, moisture content and water type all influence the final value. The results obtained using this test method are specific to the conditions created within the method.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1289 Methods of testing soils for engineering purposes

1289.0 Part 0: Definitions and general requirements

1289.2.1.1 Method 2.1.1: Soil moisture content tests—Determination of the moisture content of a soil—Oven drying method (standard method)

ISO

3310 Test sieves—Technical requirements and testing (series)

3 APPARATUS

The following apparatus is required:

- (a) A plastic soil box.

NOTE: See Figure 1.

The box shall be approximately 220 mm long with internal dimensions of 40 mm wide × 30 mm deep. It shall be fitted with plate electrodes at each end and potential measurement pins on one side spaced so that the distance between their axes in centimetres is numerically equal to the cross-sectional area of the box in square centimetres. Potential measuring pins shall span the full width of the box.

- (b) A suitable rectangular tamping tool.
- (c) An instrument for measuring soil resistance readable and accurate to 1 Ω.
- (d) A balance of sufficient capacity with a limit of performance not exceeding 0.5 g.

- (e) A drying oven complying with AS 1289.0.
- (f) A 2.36 mm sieve, complying with the ISO 3310 series.
- (g) Distilled water.

NOTE: The test may be performed using other water sources if required by the specifier.

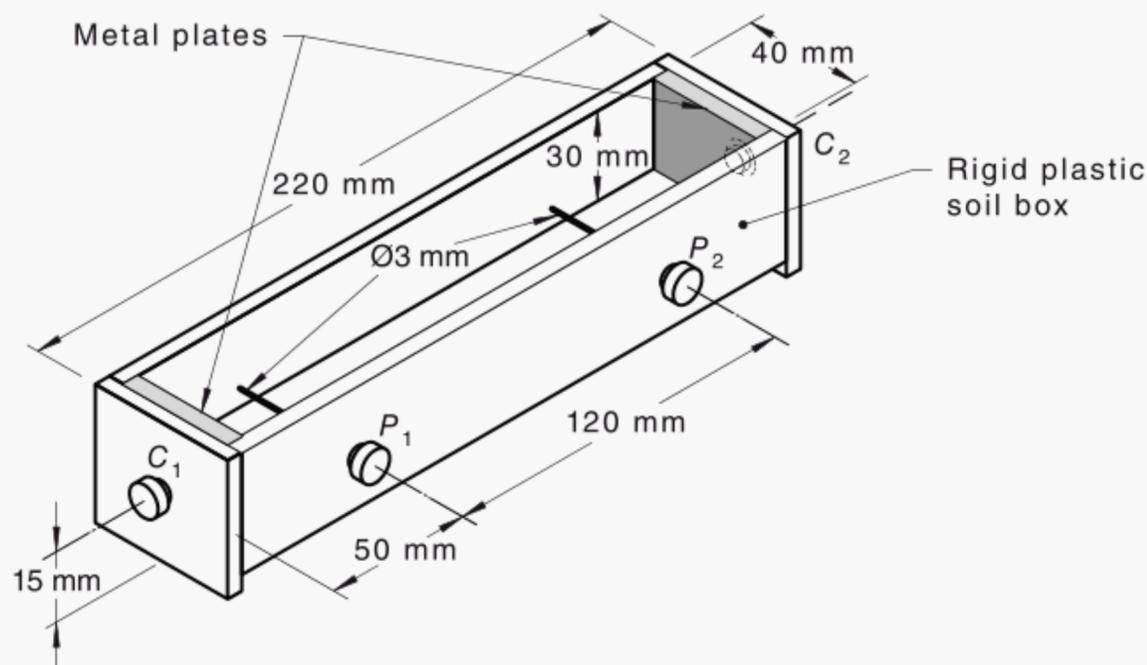


FIGURE 1 EXAMPLE OF SOIL BOX

4 PROCEDURE

The procedure shall be as follows:

- (a) Screen the prepared sample over a 2.36 mm sieve. Determine the mass of the retained 2.36 mm material and calculate the percentage retained on the 2.36 mm sieve from the following equation:

$$P_o = \frac{100m_o}{m} \quad \dots 4$$

where

P_o = percentage by mass of + 2.36 mm (oversize) material

m_o = wet mass of + 2.36 mm (oversize) material, in grams

m = wet mass of the total sample, before screening, in grams

- (b) Obtain, by quartering or riffing, four sub-samples of the fine granular material of about 600 g. From each sub-sample, take the mass of material sufficient to fill the soil box.
- (c) Add sufficient water to the material to cause saturation, and allow the material to soak for at least 30 min.
- (d) Weigh the soil box as M_1 to the nearest 0.1 g.
- (e) Fill the base of the soil box with distilled water to an approximate depth of 3 mm.
- (f) Place the fine granular material carefully into the water in the soil box filling the soil box to half its volume.
- (g) Tap the soil box gently on a firm surface to remove any air bubbles.
- (h) Add further water to saturate the material until a thin film of free water appears at the surface.

- (i) Fill the remainder of the soil box with material and lightly tamp the surface with the tamping tool.
- (j) Add water to the final layer saturating the material.
NOTE: If the soil box is not completely full, further material may be added to create a level surface. A final addition of water is required to saturate the sample expelling as much air as possible from the material.
- (k) Connect the four terminals on the soil box to the appropriate terminals on the measuring instrument.
- (l) Record the soil resistance 1 min after connection.
- (m) Weigh the soil box and material after test and record as M_2 to the nearest 0.1 g.
- (n) Remove all the material from the soil box and dry at 105–110°C to constant mass. Determine the mass of dry material (M_3) to the nearest 0.1 g.
- (o) Repeat Steps (e) to (n) for remaining sub-samples.
- (p) Calculate the mean of the four resistance values obtained (R). If any value departs from the mean by more than 10%, obtain another sub-sample and repeat the procedure.
- (q) Fill the soil box with distilled water or the water used for the test, as appropriate.
- (r) Connect the four terminals on the soil box to the appropriate terminals on the measuring instrument.
- (s) Record the water resistance 1 min after connection.

5 CALCULATIONS

The following shall be calculated:

- (a) Calculate the resistivity using the following formula:

$$\rho = RA/L \quad \dots 5.1$$

where

ρ = resistivity (Ω m)

R = resistance of the soil

A = cross-sectional area of soil box (mm^2)

L = length between potential measurement pins (mm)

- (b) Calculate the dry density of all four sub-samples tested using the following formula:

$$\rho_d = M_3/V \quad \dots 5.2$$

where

ρ_d = dry density t/m^3

V = volume of soil box (cm^3)

- (c) Calculate the moisture content of all four sub-samples tested in accordance with AS 1289.2.1.1 using the following formula:

$$\omega = ((M_2 - M_1) - M_3) / M_3 \times 100 \quad \dots 5.3$$

where

ω = moisture content (%)

- (d) Calculate the mean dry density and moisture content values for the four sub-samples.

6 TEST REPORT

The following shall be reported:

- (a) The mean resistivity value of the soil in ohm metres ($\Omega\cdot\text{m}$) and the resistivity of the water to the following accuracy:
 - (i) Mean resistivity greater than $50 \Omega\cdot\text{m}$ —report to nearest $5 \Omega\cdot\text{m}$.
 - (ii) Mean resistivity between $10 \Omega\cdot\text{m}$ and $50 \Omega\cdot\text{m}$ —report to nearest $2 \Omega\cdot\text{m}$.
 - (iii) Mean resistivity less than $10 \Omega\cdot\text{m}$ —report to nearest $1.0 \Omega\cdot\text{m}$.
- (b) The mean dry density—report to nearest 0.01 t/m^3 .
- (c) The mean moisture content—report to the nearest 0.1% .
- (d) Sample identification.
- (e) Source of material.
- (f) Percentage oversize retained on the 2.36 mm sieve.
- (g) Date of sampling.
- (h) Soil description.
- (i) If a specified water other than distilled water was used.
- (j) The number of this Standard, i.e. AS 1289.4.4.1.

NOTES

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