

STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1289.5.8.5—1998

Methods of testing soils for engineering purposes

Method 5.8.5: Soil compaction and density tests—Nuclear surface moisture-density
gauges—Density of a Type A or Type C standard density block

RECONFIRMATION NOTICE

Technical Committee CE-009 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 15 February 2013.

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NOTES

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Methods of testing soils for engineering purposes

Method 5.8.5: Soil compaction and density tests — Nuclear surface moisture-density gauges — Density of a Type A or Type C standard density block

1 SCOPE This Standard sets out the method for determination of the density of a Type A or Type C standard density block to be used in the calibration of nuclear surface moisture-density gauges in accordance with AS 1289.5.8.4. The Type A or Type C standard density blocks are defined in AS 1289.5.8.4. The density is determined by obtaining separately the mass of the block and the volume of the block either by direct measurement or by displacement of water. Guidance on the number of blocks required for a set of standard density blocks is given in AS 1289.5.8.4.

2 REFERENCED DOCUMENTS The following document is referred to in this Standard:

AS
1289 Methods of testing soils for engineering purposes
1289.5.8.4 Method 5.8.4 Soil compaction and density tests — Nuclear surface moisture-density gauges — Calibration using standard blocks

3 APPARATUS The following apparatus shall be used:

- (a) Standard density block (Type A or Type C), complying with the requirements of AS 1289.5.8.4.
- (b) Balance, or load cell and load indicator, of sufficient capacity to determine the mass of the block, with a limit of performance not exceeding 200 g.
- (c) Suitable lifting apparatus.
- (d) Vernier callipers or micrometers, with an uncertainty of measurement not exceeding 0.1 mm, one of sufficient opening to span the longest dimension of the block.
- (e) Steel ruler, of length at least 50 mm, and graduated in 0.5 mm divisions.
- (f) Straightedge and feeler gauges, or a suitable alternative capable of determining flatness of a plane, with an uncertainty of measurement not exceeding 0.1 mm.
- (g) Water bath of about 400 L capacity, filled to about 250 L with potable water.
- (h) Thermometer, covering a range of 0–50°C, with an uncertainty of measurement not exceeding 0.5°C.
- (i) Other incidental items which become necessary for the determination, such as a balance of about 10 kg capacity, tape, potting clay or an abrasive stone.

NOTE: Mass and volume may be determined using apparatus with uncertainties greater than that specified above, provided that the uncertainty of density of the block, calculated at Clause 5.6, does not exceed the limit specified in AS 1289.5.8.4.

4 PROCEDURE

4.1 General Ensure that the block is clean and dry to constant mass at ambient temperature.

4.2 Mass of the block Proceed as follows:

- (a) Determine the mass of the block (m_{B1}), using either the balance or the load cell and load indicator.
- (b) Repeat Step (a) twice, to obtain m_{B2} and m_{B3} .
- (c) Determine the contributions ($M_{p(j)}$) to mass in air, of materials either permanently in the block or necessary for the determination but not part of the known density material.

NOTE: Materials permanently in the block, but not part of the known density material may, for metal blocks, include bolts, nuts, bolt holes or end plates, and for natural stone blocks, materials necessary for the determination may include waterproof plastic film, or potting clay. The contributions ($M_{p(j)}$) to mass in air may require calculation from a set of dimensions producing a volume measurement ($V_{p(j)}$) and a suitable assumption for density of material. These calculations and their assumptions influence the magnitude (normally 0.01) of the uncertainty proportion on $M_{p(j)}$ at Step 5.2.

4.3 Volume of the block

4.3.1 Direct measurement of dimensions If applicable, proceed as follows:

- (a) Determine the flatness of the top, bottom, both side and both end surfaces. If the flatness of any of these surfaces exceeds the relevant requirement of AS 1289.5.8.4, proceed no further with the determination.
- (b) Measure the length of the block at 10 positions between the ends, four equally spaced across both the top and the bottom and one at the midpoint of height of each side.
- (c) Measure the width of the block at 10 positions between the sides, four equally spaced across both the top and bottom and one at the midpoint of height at each end.
- (d) Measure the height of the block at 10 positions between the top and bottom, four equally spaced along the length on both sides and one at the midpoint of width at each end.
- (e) Measure the diameter, in two directions, and the depth of the access hole(s).
- (f) If applicable, measure the dimensions of any edge or surface irregularity with a volume greater than $1 \times 10^{-6} \text{ m}^3$.

NOTE: Naturally occurring vesicles in the block surface do not require measurement.

4.3.2 Measurement of volume by water displacement If applicable, proceed as follows, noting that the detail of the procedure actually followed determines the number of load contributions at Step (j). Allowance for these contributions shall be made in the calculations; for example, water permeating the block, or water penetrating any plastic film, or the use of potting clay, or the presence of voids created by sealing the access hole(s). Surface bubbles shall be removed by pre-wetting or wiping the surface while the block is submerged. The time that the block is submerged while obtaining a stable load reading shall be limited so that water penetration (permeation) is minimal:

- (a) Allow the temperature of the water bath to stabilize for 2 h.
- (b) Measure and record the temperature (T_1) of the water.
- (c) Set the load indicator system to zero.
- (d) Suspend the lifting apparatus and record the load indicator reading (m_{K1}).

- (e) Submerge the lifting apparatus in the water bath to a known or marked depth, which will permit the full submersion of the block. Record the load indicator reading (m_{Z1}). Dry the lifting apparatus after removal from the water bath.
- (f) Suspend the block and record the load indicator reading (m_{T1}).
- (g) Submerge the block in the water bath, to the same depth as in Step (e). Allow the load indicator reading to stabilize and record the reading (m_{S1}).
- (h) Raise the block clear of the water and wipe off excess water. Record the load reading (m_{R1}). The difference ($m_{R1} - m_{T1}$) indicates the amount of water that has penetrated the block.
The difference shall be evaluated for its effect on the uncertainty of the determination.
- (i) Repeat Steps (b) to (h) to obtain at least a second set of readings ($T_2, m_{K2}, m_{Z2}, m_{R2}, m_{S2}, m_{T2}$).
- (j) Determine the load contributions ($M_{Q(j)}$) to mass under water of materials either permanently in the block or necessary for the determination, but not part of the known density material.
- (k) Dry the block to constant mass at ambient temperature prior to use in calibration.

5 CALCULATIONS

5.1 Mass Calculate the mass of the block, using the following equation:

$$M = \frac{(m_{B1} + m_{B2} + m_{B3})}{3} - \sum M_{P(j)} \quad \dots 5(1)$$

where

M = mass of the block, in tonnes

m_{B1}, m_{B2}, m_{B3} = masses, in tonnes, determined at Step 4.2

$M_{P(j)}$ = contribution, in air, of material; either permanently in the block or necessary for the determination but not part of the known density material, determined at Clause 4.2(c), in tonnes

5.2 Uncertainty of mass Calculate the uncertainty of the mass as the variance, using the following equation:

$$(S_M)^2 = \frac{(\delta_M)^2}{3} + \frac{\sum (0.01 \times M_{P(j)})^2}{3} \quad \dots 5(2)$$

where

$(S_M)^2$ = variance of mass

δ_M = limit of performance of the load indicating system, in tonnes

$M_{P(j)}$ = contribution, in air, of material; either permanently in the block or necessary for the determination but not part of the known density material, determined at Clause 4.2(c), in tonnes

5.3 Volume

5.3.1 Volume, using direct measurement readings If applicable, calculate the following:

- (a) The mean length, width and height, using the following equations:

$$L = \frac{\sum L_i}{n}, \quad D = \frac{\sum D_i}{n}, \quad H = \frac{\sum H_i}{n} \quad \dots 5(3)$$