Australian Standard™

Methods of testing soils for engineering purposes

Method 5.3.2: Soil compaction and density tests—Determination of the field density of a soil—Sand replacement method using a sand pouring can, with or without a volume displacer

1 SCOPE

This Standard sets out a procedure for determining the field density of fine-grained, medium-grained and coarse-grained soils (as defined in AS 1289.0), by sand replacement with or without the use of volume displacers.

NOTE: The choice of hole diameter and depth depends on the maximum particle size of the material. Normally a 200 mm diameter hole is used for medium-grained materials and a 150 mm diameter hole is used for fine-grained materials. Care should be taken that the hole size is at least 4 times, and the hole depth at least 2.5 times, the nominal maximum particle size. However the method may be used to any depth provided that the appropriate apparatus is used.

The gross mass per unit volume (wet density) may be calculated, and the dry mass per unit volume (dry density) obtained by correcting for the moisture content.

The field density is determined for the total material at the test site.

Any of the following procedures may be used:

(a) Procedure A—without a volume displacer, layer thickness about 50–250 mm.

(b) Procedure B—with a known-volume displacer, layer thickness not less than about 100 mm.

(c) Procedure C—with an IPCAD volume displacer device, layer thickness about 75–250 mm.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS		
1152	Specification for test sieves	
1289	Methods of testing soils for engineering purposes	
1289.0	Method 0:	General requirements and list of methods
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)
1289.2.1.2	Method 2.1.2:	Soil moisture content tests—Determination of the moisture content of a soil—Sand bath method (subsidiary method)
1289.2.1.4	Method 2.1.4:	Soil moisture content tests—Determination of the moisture content of a soil—Microwave-oven drying method (subsidiary method)
1289.2.1.5	Method 2.1.5:	Soil moisture content tests—Determination of the moisture content of a soil—Infrared lights method (subsidiary method)

STANDARDS AUSTRALIA

1289.2.3.1	Method 2.3.1:	Soil moisture content tests—Establishment of correlation—Subsidiary method and the standard method
1289.3.5.1	Method 3.5.1:	Soil classification tests—Determination of the soil particle density of a soil—Standard method

3 APPARATUS

3.1 Without a volume displacer

The following apparatus is required:

(a) A can of about 4 L capacity having a pouring spout (e.g., a watering can).

(b) A field density ring and anchor pins or tray with ring similar to those illustrated in Figure 1 or Figure 3.

NOTE: The internal diameter and depth of the ring has to be determined to the nearest 0.1 mm if the volume calculated in Clause 5.1(b)(ii) is to be used

(c) Clean, dry, one-size sand, the particles approximately uniform in size, e.g., 90% passing a 1.18 mm sieve and 90% retained on a 600 μm sieve.

NOTE: Other sand or grits with particles roughly uniform in size, e.g. 2.36 mm/1.18 mm or 600 μm/300 μm sieves, may be used. The size of the particles to use in a field density test depends upon the size of the largest particles and voids in the compacted soils. The sand should be shielded at all times from any moistening, e.g., rain, as bulking may invalidate volume calculations.

(d) Tools for excavating holes, e.g., scoop, spoon, trowel, chisel, mallet or brush.

(e) A calibrating cylinder of the type illustrated in Figure 2 having internal diameter and depth similar to that of the hole to be excavated and with a depth not less than 100 mm.

NOTE: It is necessary that the dimensions of the calibrating cylinder and the excavated hole be about the same so that the calibrated poured density of the sand will be applicable to the field test. Thus, when the depth and diameter of the hole have been determined, a calibrating cylinder with appropriate diameter, with depth within 50 mm of the depth of the hole, can be selected.

(f) A balance of adequate capacity with a limit of performance not greater than ±5 g.

(g) A steel straightedge of appropriate length, for the calibrating cylinder.

(h) Sealable containers, for excavated material.

NOTE: It is important to ensure that moisture is not lost from the sample of soil during excavation of the hole, during transport to the laboratory and during storage. Containers have to be covered during excavation of the hole after material has been placed in them. When plastic bags are used extra protection may be necessary to prevent damage.

(i) Sealable containers of appropriate capacity for the sand.

(j) Sieves, complying with AS 1152.

(k) Displacement can and container—can of about 150 mm diameter and 300 mm height with side outlet about 200 mm above the base; graduated or ungraduated container of about 1 L capacity (optional).

(l) Clay or plastic moulding material, if required.

3.2 With a known-volume displacer

The apparatus listed in Clause 3.1 with the addition of a known-volume displacer (KVD) of calibrated volume (V_d)—a sealed metal cylinder of known volume with a conical base angled at about 105° to the sides and with an inset handle fitted to the top. The KVD and the excavated hole should match (see Figure 4).

