1.1 General

This recommended method statement for the minimum dry density of sand is based on the procedure in DIN 18126:1996-11.

1.2 HSE

The test should preferably be performed in a room with evacuation (active ventilation) or the laboratory operator should wear a dust mask.

1.3 Preparation of sample

The method is valid for:

- sand with grains less than 4 mm, hence material larger than 4 mm shall be removed.
- sand with less than 12% fines content (particles less than 0.063 mm).

The sample shall be dried in an oven at 110 ± 5°C. Care should be taken to prevent absorption of moisture before testing.

If the sample has a fines content exceeding 5%, the sample should be air dried or dried at a low temperature (50°C) and the sand gently pestled in a mortar before final drying at 110 ± 5°C.

For fines contents exceeding 12% the method should be validated independently at this stage.

1.4 Equipment

a)

b)

Figure 1 a) Mould and funnel recommended, b) Dimensions of the mould.

- A cylindrical test mould of steel with an inner diameter of 71±0.3 mm, a height of 112±0.3 mm, see Figure 1 for geometry details. The volume of the mould shall be water calibrated (to 0.1 cm^3). Calibration of the mould shall be carried out annually or after 200 tests (equivalent to 1000 runs) which ever occurs first. The water calibrated volume shall be used in the calculations.
- A steel funnel with smooth internal stem diameter of 12±0.2 mm. The length of the funnel stem shall be sufficient so that the tip of the stem can rest easily, with no gap, on the mould base, internally, at the start of a run. The volume of the funnel and stem shall be sufficient to hold enough material so that the mould can be fully filled with a small dome of material left above the mould rim.
- Calibrated balance readable to 0.1 g (or better).
- Sand. A trial run (points 1 to 5 below) is recommended to tune the amount of sand required to fill the mould with a cone of material on top.
- Steel straightedge or palette knife
- Brush

1.5 Procedure

1) Ensure the mould has a water calibrated value of volume (V). Weigh the mould empty (M).
2) Place the funnel on the mould base and fill it with enough sample material so that it will form a cone above the rim of the mould (ref. trial run in section 1.4).
3) After filling, raise the funnel vertically as slowly as possible (without pausing) but at such a rate as to ensure that the funnel end is continuously in contact with the top of the cone of materials that it forms. This typically takes about 25+ seconds, but will depend on material being tested.
4) After the sample material has been introduced, carefully level off the soil so that it is flush with the top of the mould, using a steel straightedge or palette knife. Avoid any transfer of movements to the specimen or the mould during this operation. It is important to be very careful when levelling the top of the sand – any vibration could affect result (tapping of the table, putting the equipment down on the table etc.). Once levelled, tap the side of the mould to let the sand settle inside the mould to avoid spilling of material when transferring to the balance.
5) Using a brush, carefully remove any soil particles adhering to the outer surface of the mould.
6) Weigh the mould with the sand in it on a calibrated balance (readable to 0.1 g or better) (M_1).
7) Calculate the weight of sand (m_{s1}) as weight of the mould and sand (M_1 from point 6) and subtract the weight of the mould (M from point 1).
8) Carry out at least five runs of the procedure (points 1 to 7) in succession using the same sample until five consistent values within a range not exceeding 1%, are obtained. Calculate the average weight of sand:

$$m_s = \frac{m_{s1} + m_{s2} + m_{s3} + m_{s4} + m_{s5}}{5}$$

9) Calculate the minimum dry density of the sample $\rho_{d\ min}$ from the equation reporting the result to two decimal places:

$$\rho_{d\,min} = \frac{m_s}{V} \qquad [g/cm^3]$$

$m_s =$ average weight of dry specimen [g]
$V =$ mould volume [cm^3]

The sand can be reused after proper mixing.

1.6 Reporting

The report shall contain the following information:

- Water calibrated volume of the mould (V; cm^3)
- Weight of the mould (M; g)
- Weight of sand for each run made (m_{s1}, m_{s2}, ….; g)
- Average weight of sand (m_s; g)
- Calculated minimum dry density ($\rho_{d\,min}$, g/cm^3)
- Any deviations from the method above shall be reported

2 Reference

DIN (1996). Bestimmung der Dichte nichtbindiger Böden bei lockerster und dichtester. Lagerung. DIN 18126: 1996-11 Deutsches Institut für Normung, Berlin, Germany.