

**Department of Sustainable Natural Resources**

**SOIL SURVEY STANDARD TEST METHOD**

**BULK DENSITY OF A SOIL: CLOD METHOD**

<b>ABBREVIATED NAME</b>	BD
<b>TEST NUMBER</b>	P14
<b>TEST METHOD TYPE</b>	B
<b>VERSION NUMBER</b>	1

**SCOPE**

The bulk density of clods, or coarse peds, is calculated from their mass and volume. The volume is determined by coating the clod with a water-repellent substance and by weighing it first in air, then again while immersed in a liquid of known density, making use of Archimedes' principle. (See Note 1.)

**SPECIAL APPARATUS**

- Balance.
- Fine thread (preferably synthetic fibre).
- Hard paraffin in a container kept at 60 °C (or a few degrees above 60 °C) into which the soil sample can be dipped.

## PROCEDURE

1. Select a representative air-dry clod or ped. It must be sufficiently stable to cohere during coating, weighing and handling. Carefully tie a length of thread around the clod, leaving about 20 cm free. Weigh the clod suspended in air.
2. Holding onto the end of the free thread, dip the clod momentarily in the melted paraffin and allow the excess to drain. (See Note 2.) When the adhering paraffin solidifies, weigh the clod and paraffin together.
3. Suspend the clod with paraffin coating in water and weigh it again. (See Note 3.) Record the water temperature.
4. To obtain a correction for moisture content of the soil, break open the clod, remove a sample of soil and determine moisture content according to [Soil Moisture Content \(P1A/1\)](#).

## CALCULATION

$$\text{Bulk Density (Mg/m}^3\text{)} = \frac{DW \times ODS}{SA - SPW + PA - (PA \times DW/DP)}$$

Where:

DW	=	Density of water at temperature of determination (Mg/m <sup>3</sup> )
ODS	=	Oven dry weight of soil sample (g)
SA	=	Net weight of soil sample in air (g)
SPW	=	Net weight of soil sample plus paraffin in water (g)
PA	=	Weight of paraffin coating in air (g)
DP	=	Density of paraffin (Mg/m <sup>3</sup> )

## REPORTING THE RESULTS

Report bulk density (Mg/m<sup>3</sup>) to the nearest 0.01 Mg/m<sup>3</sup>.

## REFERENCE

Blake, GR Bulk density, in Black, CA (ed) 1965, *Methods of Soil Analysis, part 1*, American Society of Agronomy.

## NOTES

1. The clod method usually gives higher bulk density values than do other methods. One reason is that the clod method does not take the inter-clod spaces into account. A second reason is that the soil volume is the air-dry volume, which is likely to be slightly less than the volume of a field-moist sample used in other methods.
2. Paraffin is best used between 60 °C and 70 °C, a few degrees above the melting point, when clods are dipped. At this temperature, it quickly solidifies upon removal of the clod and is less likely to penetrate the pores of the clod than at higher temperatures. Furthermore at higher temperatures, pin-sized air leaks through the paraffin seal are more likely because of penetration of heat into the clod with consequent expansion of soil gases that continues after solidification of the paraffin.
3. If bubbles appear on the paraffin when the sample is weighed in water or if the weight in water increases with time, water is penetrating the clod and the sample must be discarded.