



# Test method T1023

Determination of the organic matter in  
soils (Dichromate method)

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## Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
		Reformatted and Revision Summary Added	D. Dash	Jun 2001
Ed 2/ Rev 0	All	Reformatted RMS template	J Friedrich	November 2012

Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T1023 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

# Test method T1023

## Determination of the organic matter in soils (Dichromate method)

### 1. Scope

This test method sets out the procedure for determination of the percentage by mass of organic matter present in a soil. This method conforms with that set out in Australian Standard 1289.

### 2. Apparatus

- (a) A thermostatically controlled oven with good air circulation capable of maintaining a temperature within the range of 105°C to 110°C.
- (b) A balance readable and accurate to 0.001 g within the operating range.
- (c) Two, 1 litre volumetric flasks.
- (d) Two, 50 mL burettes, graduated in 0.1 mL.
- (e) A 10 mL pipette and a 1 mL pipette fitted with a rubber teat.
- (f) Two conical flasks of 500 mL capacity.
- (g) A 250 mL and a 50 mL graduated measuring cylinders.
- (h) A dessicator (a convenient size is one about 200 - 250 mm diameter), containing anhydrous silica gel.
- (i) A glass weighing-bottle approximately 25 mm diameter and 50 mm high, fitted with a ground glass stopper.
- (j) 9.5 mm and 425 µm AS sieve.
- (k) Sample dividers of the multiple-slot type (riffle boxes) with 6 mm and 13 mm widths of opening or similar, a suitable design is shown in AS 1289.
- (l) A suitable mechanical or hand operated pulverizer.
- (m) A wash bottle, preferably plastic, containing distilled water.

### 3. Reagents

Use reagents of recognized analytical reagent quality:

- (a) Potassium dichromate 1N solution. Dissolve 49.035 g of potassium dichromate in distilled water to make 1 litre of solution.
- (b) Ferrous sulphate approximately 0.5N solution. Dissolve approximately 140 g of ferrous sulphate in 0.5N sulphuric acid to make 1 litre of solution. (Add 14 mL of concentrated sulphuric acid to distilled water to make 1 litre of solution for 0.5N sulphuric acid).

**NOTE:** Keep this solution tightly stoppered as it is unstable in air. Standardize it against the dichromate solution at least once per week.

**CAUTION: Sulphuric acid can cause severe burns. Avoid contact with eyes, skin and clothing. Always dilute by carefully adding acid to water - NEVER THE REVERSE. Always wear safety glasses when handling acid.**

- (c) Sulphuric acid, concentrated. (Density = 1.84g/mL).
- (d) Orthophosphoric acid 85%. (Density = 1.70 to 1.75g/mL).
- (e) Indicator Solution. Dissolve 0.25 g of sodium diphenylamine - sulphonate in 100 mL of distilled water.

## 4. Procedure

- (a) **Standardization of Ferrous Sulphate**  
Run 10 mL of the 1N potassium dichromate from a burette into a 500 mL conical flask. Add 20 mL of concentrated sulphuric acid very carefully, swirl the mixture and allow it to cool for some minutes. Add 200 mL of distilled water to the mixture, followed by 10 mL of phosphoric acid and 1 mL of the indicator and shake the mixture thoroughly. Then add ferrous sulphate from the second burette in 0.5 mL increments, swirling the contents of the flask, until the colour of the solution changes from blue to green. Add a further 0.5 mL of potassium dichromate, changing the colour back to blue. Then add ferrous sulphate drop by drop, with continued stirring, until the colour of the solution changes from blue to green after the addition of a single drop. Note the total volume of ferrous sulphate used (x) to the nearest 0.05 mL (1 mL ferrous sulphate is equivalent to 10.5/ x mL potassium dichromate).
- (b) **Preparation of Sample for Analysis**
- (i) Dry the bulk sample at 105°C to 110°C. Weigh it to the nearest 0.1 percent and record the mass (M1). Sieve the sample on a 9.5 mm sieve crushing all aggregations, other than discrete particles, to pass through the sieve. Record the mass (M2) of material passing the sieve, to the nearest 0.1 percent of its total mass. Ensure through these and all subsequent operations that there is no loss of fines.
- (ii) Divide the material passing the 9.5 mm sieve by successive riffing on the 13.0 mm divider or by quartering to produce a sample weighing approximately 100 g (See Clauses 6(a) and 6(b)). Pulverize this sample so that it passes the 425  $\mu$ m sieve, then subdivide the sample by riffing on the 6 mm divider until a sample weighing approximately 5 g is obtained. Throughout this and any subsequent operations, thoroughly mix the material available for any division and take precautions to avoid segregation during riffing. Place the sample in the glass weighing bottle and dry at a temperature of 105°C to 110°C. Consider the sample to be dry when the differences in successive weighings at intervals of 4 hours do not exceed 0.1 percent of the original mass of the sample.
- (c) **Estimation of the Organic Matter**
- (i) Remove the weighing-bottle containing the dried soil from the oven, cool in the desiccator and weigh to 0.001g. Transfer a small quantity between 5.0 g and 0.2 g, depending on the organic content (see Clause 6 (c)) to a dry 500 mL conical flask, remove the weighing-bottle and calculate the mass of soil reweighed (M3) by difference.
- (ii) Run 10 mL of the 1N potassium dichromate solution into the conical flask from a burette and add 20 mL concentrated sulphuric acid very carefully from a measuring cylinder.
- (iii) Swirl the mixture thoroughly for about 1 minute and then stand it on a heat insulating surface, such as wood, for 30 minutes to allow oxidation of the organic matter to proceed. Protect the flask from cold air and draughts during this period. Next add to the mixture 200 mL of distilled water followed by 10 mL of orthophosphoric acid and 1 mL of the indicator and shake the resultant mixture thoroughly. If the indicator is absorbed by the soil, add a further 1 mL of the solution. Add ferrous sulphate from the second burette in 0.5 mL increments, swirling the contents of the flask, until the colour of the solution changes from blue to green. Then add a further 0.5 mL of potassium dichromate, changing the colour back to blue. Add ferrous sulphate drop by drop with continued swirling until the colour of the solution changes from blue to green after the addition of a single drop. Note the total volume (y) of ferrous sulphate used to the nearest 0.05 mL.

## 5. Calculations and Reporting

- (a) The total volume  $V$  in mL of potassium dichromate used to oxidize the organic matter in the soil is given by:

$$V = 10.5 \left( 1 - \frac{y}{x} \right)$$

Where  $y$  = Total volume of ferrous sulphate used in this test (Clause 4(c)(iii)).

$x$  = Total volume of ferrous sulphate used in the standardization test (Clause 4 (a)).

- (b) Calculate the percentage of organic matter OM present in the oven-dry sample from the formula (see Clause 6(d)).

$$\text{OM} = \frac{0.67M_2 \times V}{M_1 \times M_3}$$

Where  $M_1$  = Mass of sample before sieving.

$M_2$  = Mass of sample passing the 9.5 mm sieve.

$M_3$  = Mass of sample used in the test.

$V$  = Total volume of potassium dichromate used (see (a) above).

- (c) Report the organic matter present to the nearest 0.1 percent of the original mass of oven-dry soil.

## 6. Techniques

- (a) Soils Containing Sulphides

Soils containing sulphides have been found to give high results by this method. The sulphides can be destroyed at this stage by the addition of dilute (2N) sulphuric acid. Add acid until no further evolution of hydrogen sulphide occurs.

- (b) Soils Containing Chlorides

Soils containing chlorides have been found to give high results using this method. The chlorides may be removed at this stage by washing the soil with distilled water until no turbidity is obtained when a drop of the washing water is tested with silver nitrate solution. Alternatively the effect of chlorides on the determination can be partly eliminated by using concentrated sulphuric acid in which silver sulphate has been dissolved in place of the concentrated sulphuric acid specified in

Clause 3 (c). If the molecular equivalent ratio of chloride to carbon does not exceed unity, 25 g of silver sulphate per litre of sulphuric acid will be sufficient to precipitate the chloride.

- (c) Sample Size

The size of sample for chemical analysis will vary with the amount of organic matter present in the soil. As much as 5 g may be required for soil low in organic matter and as little as 0.2 g with very peaty soil. After a number of determinations have been made, experience will indicate the most suitable size of sample to be taken. When in doubt, it is suggested that a series of samples of varying

- (d) Sizes should be weighed out and tested. Take the determination giving a total of 5-8 mL dichromate solution reduced as the correct result.

- (e) Correction Factors

The method is based on the determination of the organic carbon content of the soil and the assumption that soil organic matter contains an average of 58 percent of carbon by weight. With the technique employed, approximately 77 percent of the carbon in the organic material is oxidized. These factors are included in the formula given in Clause 5.