



DPC: 24/30483287 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 17505

Soil and waste characterization — Temperature dependent differentiation of total carbon (TOC400, ROC, TIC900)

ICS: 13.080.10

ISO/TC 190/SC 3

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Foreword iv

Introduction v

1 Scope 1

2 Normative references 1

3 Terms and definitions 1

4 Principle 2

5 Interferences..... 2

5.1 Interference due to carbides..... 2

5.2 Interference due to sulfur and nitrogen compounds..... 2

5.3 Interference due to carbonates..... 3

5.4 Peak does not reach the baseline 5

5.5 Difficulties in separating ROC₆₀₀ peak and TIC_{900A} peak 6

5.6 Interferences due to premature releases and deflagrations..... 6

5.7 Interferences due to catalytic active substances in samples..... 6

6 Reagents 6

6.1 General 6

6.2 Standards for system control..... 7

7 Apparatus..... 7

8 Procedure..... 8

8.1 General 8

8.2 Sample preparation and processing 8

8.3 Calibration 8

8.4 Measurement (Oxidative method A) 8

8.5 Measurement (Mixed oxidative/non-oxidative method B) 9

9 Evaluation 11

9.1 General 11

9.2 Control measurements..... 12

10 Expression of results..... 13

11 Test report 13

Annex A (informative) Performance characteristics..... 14

Annex B (informative) Cooling procedure for method B 24

Bibliography..... 25

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 3, *Chemical and physical characterization*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Carbon occurs in soils and materials similar to soil in a variety of compounds and forms. When determining carbon in soils or soil-like materials, an overall determination of the different mass fractions is most feasible. The summarized declaration of carbon is yet done by differentiating organic and inorganic carbon (EN 15936, ISO 10694). In the proportion classified as “organic carbon”, a fraction of very stable highly aromatic and highly condensed carbon compounds can be present, sometimes in significant mass fractions. Since this black (pyrogenic) carbon is only very slowly decomposed and released, its environmental relevance has to be differently evaluated than the proportions of organic carbon which are faster chemical-biologically decomposed. The environmental relevance is estimated if e.g. the suitability of soils and soil-like materials for disposal in landfill is assessed. For a differentiated assessment, a separate declaration of the different mass fractions of organic, black (pyrogenic) and inorganic carbon is necessary. Using the specified temperature-gradient method and utilizing the combustion characteristic(s), the carbon fractions established according to this standard in soil and soil-like materials can be differentiated.

In respect of the hazard potential, the content of solely organically bonded carbon in solids determined with the described method can be important for disposal and/or recycling.

The method has been validated with the materials listed in Table 1, see also Annex A.

Table 1 — Materials used for validation

Material type	Materials used for validation
soils from natural material	mineral soils soil with anthropogenic admixtures (urban soils)
tailing material (tailings)	tailing material from coal mining
sediment	sediment
waste	waste incineration ash foundry sand construction waste

Soil and waste characterization — Temperature dependent differentiation of total carbon (TOC₄₀₀, ROC, TIC₉₀₀)

1 Scope

This document specifies a method for the differentiated determination of the organic carbon content (TOC₄₀₀) which is released at temperatures up to 400 °C, the residual oxidizable carbon (ROC) (including e.g. lignite (brown coal), hard coal, charcoal, black carbon, soot) and the inorganic carbon (TIC₉₀₀) which is released at temperatures up to 900 °C.

The basis is the dry combustion or decomposition of carbon to CO₂ in the presence of oxygen or non-oxygen conditions using temperatures ranging from 150 °C to 900 °C in dry solid samples of sediment, soil, soil with anthropogenic admixtures and solid waste (see Table 1) with carbon contents of more than 1 g per kg (0,1 % C) (per carbon type in the test portion).

NOTE TIC₉₀₀ includes the TIC measured after acid addition e.g. by ISO 10694 or EN 15936. TOC₄₀₀ is a fraction of TOC measured according to e.g. ISO 10694 or EN 15936.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 16179, *Sludge, treated biowaste and soil — Guidance for sample pretreatment*

EN 15002, *Characterization of waste — Preparation of test portions from the laboratory sample*

ISO 11464, *Soil quality — Pretreatment of samples for physico-chemical analysis*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1

total organic carbon which is released up to 400 °C

TOC₄₀₀

quantity of carbon which is determined in the range between 150 °C – (400 ± 20) °C to the 1st signal minimum after the minimum holding time at (400 ± 20) °C, in the case of dry combustion in the presence of oxygen

Note 1 to entry: TOC₄₀₀ is a fraction of TOC measured e.g. by ISO 10694 or EN 15936.

3.2

residual oxidizable carbon measured at 600 °C

ROC₆₀₀

quantity of carbon which is determined between the signal minima at (400 ± 20) °C and at (600 ± 20) °C after the minimum holding time at (600 ± 20) °C, in the case of dry combustion in the presence of oxygen following method A (procedure see 8.4)

Note 1 to entry: ROC₆₀₀ may differ from ROC₉₀₀ for some materials.

3.3**residual oxidizable carbon measured at 900°C****ROC₉₀₀**

quantity of carbon which is determined during dry combustion in the presence of oxygen after the completed carbon release for the TOC₄₀₀ and TIC_{900B} measurement at (900 ± 20) °C to the first signal minimum after the minimum holding time at (900 ± 20) °C following method B (procedure see 8.5)

Note 1 to entry: ROC₉₀₀ may differ from ROC₆₀₀ for some materials.

3.4**total inorganic carbon which is released up to 900 °C in the presence of oxygen****TIC_{900A}**

quantity of carbon which is determined between the signal minima at (600 ± 20) °C and at (900 ± 20) °C after the minimum holding time at (900 ± 20) °C, in the case of dry combustion in the presence of oxygen following method A (procedure see 8.4)

Note 1 to entry: TIC_{900A} may differ from TIC_{900B} for some materials.

3.5**total inorganic carbon which is released up to 900 °C during non-oxidizing conditions****TIC_{900B}**

quantity of carbon which is determined during non-oxidizing conditions between the signal minima at (400 ± 20) °C and at (900 ± 20) °C after expiry of the minimum holding time at (900 ± 20) °C before the ROC_{900B} measurement following method B (procedure see 8.5)

Note 1 to entry: TIC_{900B} may differ from TIC_{900A} for some materials.

3.6**total carbon****TC**

quantity of carbon present in the sample representing the sum of organic (TOC₄₀₀), inorganic (TIC_{900A} or TIC_{900B}) and residual oxidizable carbon (ROC₆₀₀ or ROC₉₀₀)

4 Principle

The determination of organic carbon (TOC₄₀₀), residual oxidizable carbon (ROC₆₀₀ or ROC₉₀₀) and inorganic carbon (TIC_{900A} or TIC_{900B}) in solids is affected by means of thermal oxidation or decomposition of the different fractions of carbon at different temperatures to CO₂, if necessary, supported by changing between oxidizing and non-oxidizing carrier gases.

The application of the gradient method with a suitable temperature program allows the determination of organic carbon (TOC₄₀₀), residual oxidizable carbon (ROC) and inorganic carbon (TIC₉₀₀) and the calculation of total carbon (TC) by sum up these contents.

The final analysis of CO₂ can be performed with different methods, e.g. by means of infrared detection or CO₂ sensitive sensors.

5 Interferences**5.1 Interference due to carbides**

Several carbides can interfere with this method.

5.2 Interference due to sulfur and nitrogen compounds

Depending on the measuring technique used, high contents of sulfur or nitrogen compounds can result in overestimations or underestimations. This can be controlled by means of selected standard samples