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## Coal — Ultimate analysis

*Charbon — Analyse élémentaire*

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## 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. [www.iso.org/directives](http://www.iso.org/directives)

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. [www.iso.org/patents](http://www.iso.org/patents)

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 27, *Solid mineral fuels, Subcommittee SC 5, Methods of analysis*.

This second edition cancels and replaces the first edition (ISO 17247:2005), of which it constitutes a minor revision. It also incorporates the Technical Corrigendum ISO 17247:2005/Cor. 1:2006.

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# Coal — Ultimate analysis

## 1 Scope

This International Standard establishes a practice for the ultimate analysis of coal and is intended for general utilization by the coal industry to provide a basis for comparison of coals.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 334, *Solid mineral fuels — Determination of total sulfur — Eschka method*

ISO 351, *Solid mineral fuels — Determination of total sulfur — High temperature combustion method*

ISO 589, *Hard coal — Determination of total moisture*

ISO 609, *Solid mineral fuels — Determination of carbon and hydrogen — High temperature combustion method*

ISO 625, *Solid mineral fuels — Determination of carbon and hydrogen — Liebig method*

ISO 1171, *Solid mineral fuels — Determination of ash*

ISO 1213-2, *Solid mineral fuels — Vocabulary — Part 2: Terms relating to sampling, testing and analysis*

ISO 11722, *Solid mineral fuels — Hard coal — Determination of moisture in the general analysis test sample by drying in nitrogen*

ISO 19579, *Solid mineral fuels — Determination of sulfur by IR spectrometry*

ISO 29541, *Solid mineral fuels — Determination of total carbon, hydrogen and nitrogen content — Instrumental method*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions and those given in ISO 1213-2 apply with one exception: the definition of “ultimate analysis” applicable is that specified below.

### 3.1

#### **ultimate analysis**

analysis of a solid mineral fuel reported in terms of its carbon, hydrogen, nitrogen, sulfur, ash, moisture, and oxygen by difference

Note 1 to entry: This definition includes hydrogen and oxygen present in the water of constitution of the mineral matter associated with the coal substance and carbon and oxygen present in mineral carbonates.

### 3.2

#### **oxygen by difference**

sum of carbon, hydrogen, nitrogen, sulfur, ash, and moisture of a solid mineral fuel, expressed as percent mass fraction, subtracted from 100

## 4 Principle

Coal is analysed for carbon, hydrogen, nitrogen, sulfur, ash, and moisture. The oxygen by difference is calculated and the results are reported, to the preferred basis, as an *ultimate analysis*.

## 5 Preparation of sample

Prepare the sample so that it satisfies the requirements of the various test methods (see [Table 1](#)).

## 6 Test methods

Carry out the determination in accordance with the test methods specified in [Table 1](#).

**Table 1 — Standard test methods used for ultimate analysis**

Component	Classical test method	Instrumental test method
Carbon and hydrogen	ISO 609 or ISO 625	ISO 29541
Nitrogen	-	ISO 29541
Total sulfur	ISO 334 or ISO 351	ISO 19579
Ash	ISO 1171	-
Moisture in the air-dried sample	ISO 11722	-
Total moisture (if an "as received" reporting basis is required)	ISO 589	-

## 7 Expression of results

The parameters as analysed in the sample or calculated by difference, expressed as percentage mass fraction, may be calculated to different bases using the formulae in [Table 2](#).

See [Annex A](#) for an example of ultimate data reported to different bases.

Table 2 — Formulae for calculation of results to different bases

		Reporting basis	
As analysed <sup>a</sup>	Excluding hydrogen and oxygen from moisture	Dry	Including hydrogen and oxygen from moisture
	Air dried (ad)	As received (ar)	As received (ar,m)
<b>Parameter</b> (ash, carbon, nitrogen or sulfur)			
<i>P</i>	$P_{ad} = P$	$P_d = P_{ad} \times \left( \frac{100}{100 - M_{ad}} \right)$	$P_{ar,m} = P_{ad} \times \left( \frac{100 - M_{ar}}{100 - M_{ad}} \right)$
<b>Hydrogen</b>			
<i>H</i>	$H_{ad} = H - 0,1119M_{ad}$	$H_d = H_{ad} \times \left( \frac{100}{100 - M_{ad}} \right)$	$H_{ar,m} = H_{ad} \times \left( \frac{100 - M_{ar}}{100 - M_{ad}} \right) + 0,1119M_{ar}$
<b>Oxygen (by difference)</b>			
$O = 100 - (C + H + N + S + A)$	$O_{ad} = O - 0,8881M_{ad}$	$O_d = O_{ad} \times \left( \frac{100}{100 - M_{ad}} \right)$	$O_{ar,m} = O_{ad} \times \left( \frac{100 - M_{ar}}{100 - M_{ad}} \right) + 0,8881M_{ar}$
	or	or	or
	$O_{ad} = 100 - (C_{ad} + H_{ad} + N_{ad} + S_{ad} + A_{ad} + M_{ad})$	$O_d = 100 - (C_d + H_d + N_d + S_d + A_d)$	$O_{ar,m} = 100 - (C_{ar} + H_{ar} + N_{ar} + S_{ar} + A_{ar})$
<sup>a</sup> including hydrogen and oxygen from moisture			
where			
<i>C, H, N, S, A</i> are the percentage mass fractions of carbon, hydrogen, nitrogen, sulfur and ash, respectively, expressed on the sample as analysed (i.e. no corrections);			
Note: Hydrogen and oxygen reported on the as-analysed basis include hydrogen and oxygen in the free moisture that is associated with the analysis sample.			
<i>M</i> is the moisture content, expressed as a percentage mass fraction;			
<i>O</i> is the oxygen by difference.			

## 8 Test report

The test report shall include the following information:

- a) reference to this International Standard, i.e. ISO 17247;
- b) identification of the coal sample tested;
- c) method or methods used;
- d) results and basis of reporting.

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## Annex A (informative)

### Ultimate analysis example

Parameter % m/m	As ana- lysed	Excluding hydrogen and oxygen from moisture Air dried (ad)	Excluding hydrogen and oxygen from moisture As received (ar)	Dry (d)	As received (ar,m)
Carbon	70,0	70,0	66,4	72,2	66,4
Hydrogen	4,34	4,00	3,79	4,12	4,69
Nitrogen	1,50	1,50	1,42	1,55	1,42
Sulfur	0,50	0,50	0,47	0,52	0,47
Ash	10,0	10,0	9,5	10,3	9,5
Oxygen by difference	13,7	11,0	10,4	11,3	17,5
Moisture in air-dried sample	—	3,0	—	—	—
Total moisture	—	—	8,0	—	—
<b>Total</b>	100,0	100,0	100,0	100,0	100,0

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