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## Solid mineral fuels — Determination of total fluorine in coal, coke and fly ash

*Combustibles minéraux solides — Détermination de la teneur totale  
en fluor dans le charbon, le coke et les cendres*

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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 (see [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 (see [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.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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 11724:2004), of which it constitutes a minor revision. This document incorporates changes related to dated references and other minor items following its systematic review.

ISO 11724:2016

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# Solid mineral fuels — Determination of total fluorine in coal, coke and fly ash

## 1 Scope

This document specifies a method for the determination of total fluorine in coal, coke and fly ash.

From measurement of the total fluorine alone, it is not possible to estimate the amount of fluorine released to the environment by utilization of the coal and subsequent disposal of the ash residue.

## 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.

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

ISO 687, *Solid mineral fuels — Coke — Determination of moisture in the general analysis test sample*

ISO 5068-2, *Brown coals and lignites — Determination of moisture content — Part 2: Indirect gravimetric method for moisture in the analysis sample*

ISO 5069-2, *Brown coals and lignites — Principles of sampling — Part 2: Sample preparation for determination of moisture content and for general analysis*

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

ISO 13909-4, *Hard coal and coke — Mechanical sampling — Part 4: Coal — Preparation of test samples*

ISO 13909-6, *Hard coal and coke — Mechanical sampling — Part 6: Coke — Preparation of test samples*

## 3 Terms and definitions

No terms and definitions are defined in this document.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

## 4 Principle

Mixing of the sample of coal, coke or fly ash with silica, and pyrohydrolysis in a tube furnace at approximately 1 200 °C in an atmosphere of oxygen and water vapour. Absorption of the volatilized fluorine compounds in a suitable solution and processing for determination by ion-selective electrode (ISE) or ion chromatographic (IC) techniques.

## 5 Reagents

**CAUTION — Care shall be exercised when handling reagents, some of which are toxic and corrosive.**

During the analysis, use only reagents of recognized analytical grade and only distilled water, or water of equivalent purity.

**5.1 Silica** of top size 75 µm, ignited at 1 000 °C for 1 h.

**CAUTION — Fine silica is dangerous to health if inhaled.**

## 5.2 Solutions for ISE measurement

### 5.2.1 Standard fluorine solution (1 g contains 200 µg of F).

a) For direct-comparison method

Dissolve 0,221 0 g ± 0,000 2 g of dry (110 °C for 1 h) sodium fluoride in approximately 400 ml of water contained in a tared plastic bottle, dilute to 500 g ± 0,5 g net with water, and mix.

b) For analyte-addition method

Dissolve 0,221 0 g ± 0,000 2 g of dry (110 °C for 1 h) sodium fluoride in a tared plastic bottle containing 150 ml of water and 100 g of buffer (5.2.3). Dilute to 500 g ± 0,5 g net with water and mix.

### 5.2.2 Absorption solution (0,025 mol/l NaOH).

Dissolve 2,0 g of sodium hydroxide in about 500 ml of water. Transfer to a tared 2,5 l plastic bottle, dilute to 2 000 g net with water, and mix.

### 5.2.3 Buffer (pH 6,5).

Dissolve 10,0 g of potassium nitrate, 5 g of 1,2-cyclohexylenedinitrilotetraacetic acid (CDTA) and 115 g of ammonium acetate in 350 ml of water. Adjust the pH to 6,5 with glacial acetic acid. Dilute to 500 g net with water and mix.

### 5.2.4 Solution for conditioning fluoride ISE.

Weigh 20 g of water, 20 g of absorption solution (5.2.2) and 10 g of buffer (5.2.3) into a polystyrene vial (6.2). Add approximately 200 mg of standard fluorine solution [of 5.2.1 a) or 5.2.1 b)] and mix.

## 5.3 Solutions for IC measurement

### 5.3.1 Standard fluorine solution (1 g contains 200 µg of F).

Dissolve 0,221 0 ± 0,000 2 g of dry (110 °C for 1 h) sodium fluoride in approximately 400 ml of water contained in a tared plastic bottle, dilute to 500 g ± 0,5 g net with water, and mix.

### 5.3.2 Absorption solution for IC measurement.

Dissolve 0,300 g of sodium hydrogen carbonate and 1,120 g of sodium carbonate in approximately 500 ml of water and dilute to 2 l.

## 5.4 Oxygen, compressed.

## 6 Apparatus

**6.1 Vials**, made of glass or polystyrene, of capacity 10 ml to 30 ml with tightly fitting snap-on plastic caps.