



Standard Test Method for Major and Minor Elements in Coal and Coke Ash By X-Ray Fluorescence¹

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1. Scope

1.1 This test method covers the analysis of the commonly determined major and minor elements in ash from coal or coke using X-ray fluorescence (XRF) techniques.

NOTE 1—Test Method D 1757 is used for determination of sulfur.

NOTE 2—Although not included in the present method, the determination of barium, strontium, and manganese may be required to yield adequate totals.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 1757 Test Methods for Sulfur in Ash from Coal and Coke²

D 3174 Test Method for Ash in the Analysis Sample of Coal and Coke from Coal²

E 2 Methods of Preparation of Micrographs of Metals and Alloys (Including Recommended Practice for Photography as Applied to Metallography)³

E 11 Specification for Wire-Cloth Sieves for Testing Purposes⁴

3. Summary of Test Method

3.1 The coal or coke to be analyzed is ashed under standard conditions and ignited to constant weight. Previously ashed materials are ignited to constant weight under standard conditions. The ash is fused with lithium tetraborate ($\text{Li}_2\text{B}_4\text{O}_7$) or other suitable flux and either ground and pressed into a pellet

or cast into a glass disk. The pellet or disk is then irradiated by an X-ray beam of short wavelength (high energy). The characteristic X-rays of the atom that are emitted or fluoresced upon absorption of the primary or incident X-rays are dispersed and intensities at selected wavelengths are measured by sensitive detectors. Detector output is related to concentration by calibration curves or by computerized data-handling equipment.

3.2 The K spectral lines are used for all of the elements determined by this procedure.

3.3 All elements are determined as the element and reported as the oxide and include Si, Al, Fe, Ca, Mg, Na, K, P, Ti, Mn, Sr, and Ba.

4. Significance and Use

4.1 A compositional analysis of ash is used in describing the quality of coal for its complete characterization. Ash composition is useful in predicting slagging and fouling characteristics of combusted materials as well as the potential utilization of ash by-products.

4.2 The chemical composition of laboratory prepared coal or coke ash is rarely, if ever, representative of the composition of the mineral matter in the coal because the ashing process can alter some minerals. However, it can approximate the composition of the fly ash and slag resulting from commercial combustion of coal or coke.

5. Apparatus

5.1 *Ashing Furnace*, with air circulation as specified in Test Method D 3174 and capable of having its temperature regulated between 700 and 750°C.

5.2 *Fusion Furnace or Fluxing Device*, with an operating temperature of at least 1000°C.

5.3 *Fusion Crucibles*, either high-purity graphite (22 mm high and 19 mm wide, inside diameter) or platinum-gold alloy of a similar or larger capacity.

5.4 *Pulverizers*, including agate, mullite or tungsten carbide mortar, and pestle, minimum capacity 25 mL.

5.5 *Sieves*, 250-μm (No. 60) and 75-μm (No. 200) U.S.A standard sieve as specified in Specification E 11.

5.6 *Compactor*—A press equipped with a gage enabling reproducible pressures (exceeding 1.72×10^8 Pa (25 000 psi)) if pressed pellets are utilized.

¹ This test method is under the jurisdiction of ASTM Committee D-5 on Coal and Coke and is the direct responsibility of Subcommittee D05.29 on Major Elements in Ash and Trace Elements of Coal.

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² *Annual Book of ASTM Standards*, Vol 05.05.

³ Discontinued, see 1982 *Annual Book of ASTM Standards*, Part 11.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.