



Designation: D8186 – 18

Standard Test Method for Measurement of Impurities in Graphite by Electrothermal Vaporization Inductively Coupled Plasma Optical Emission Spectrometry (ETV-ICP OES)¹

This standard is issued under the fixed designation D8186; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of mass fractions of the elements silver (Ag), aluminum (Al), arsenic (As), boron (B), barium (Ba), beryllium (Be), bismuth (Bi), calcium (Ca), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), potassium (K), lithium (Li), magnesium (Mg), manganese (Mn), molybdenum (Mo), sodium (Na), nickel (Ni), phosphorus (P), lead (Pb), sulfur (S), antimony (Sb), silicon (Si), tin (Sn), strontium (Sr), titanium (Ti), vanadium (V), tungsten (W), yttrium (Y), zinc (Zn), and zirconium (Zr) in graphite.

1.2 Provided that an appropriate validation procedure is carried out, this test method is also applicable to other carbon materials such as coal, coke, carbon black, graphite-felt, graphite-foil, graphite-foam, and fiber reinforced carbon-carbon composites.

1.3 This test method is applicable to element contents from approximately 0.0001 mg/kg to 1000 mg/kg (0.1 ppmw to 1000 ppmw), depending on element, wavelength, measurement parameters, and sample mass.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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2. Referenced Documents

2.1 *ASTM Standards*:²

D1193 Specification for Reagent Water

2.2 *ISO Standards*:³

ISO 5725-2 Accuracy (trueness and precision) of measurement methods and results—Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method

3. Terminology

3.1 *Definitions*:

3.1.1 *ETV, n*—electrothermal vaporization.

3.1.2 *ICP OES, n*—inductively coupled plasma optical emission spectrometry.

4. Summary of Test Method

4.1 The ETV unit consists of an electrically heated graphite tube furnace. Graphite boats which fit into the graphite tube are used for inserting the sample, crushed and milled if necessary, into the furnace. Handling of graphite boats is preferably done using an automated system. One end of the furnace, which is sealed with a movable door, is used for inserting the graphite boats (furnace inlet). The other end of the furnace (furnace outlet) is connected via a tube to the injector tube of the ICP-torch. The graphite tube furnace is heated rapidly to a temperature where evaporation of analyte elements takes place. For complete volatilization of analyte elements, a halogenating reaction gas is added to the argon carrier gas stream. The evaporation products containing the analyte elements are transported as dry aerosol with the argon carrier gas stream from the furnace outlet to the ICP-torch where they are excited to emit optical radiation. The emitted radiation is dispersed and detected by a simultaneous spectrometer. The intensity of radiation of emission lines and background (optional) is

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.