



Standard Practice for Determination of Elements by Graphite Furnace Atomic Absorption Spectrometry¹

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1. Scope

1.1 This practice covers a procedure for the determination of microgram per millilitre ($\mu\text{g/mL}$) or lower concentrations of elements in solution using a graphite furnace attached to an atomic absorption spectrometer. A general description of the equipment is provided. Recommendations are made for preparing the instrument for measurements, establishing optimum temperature conditions and other criteria which should result in determining a useful calibration concentration range, and measuring and calculating the test solution analyte concentration.

1.2 The values stated in SI units are to be regarded as 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.* Specific safety hazard statements are given in Section 9.

2. Referenced Documents

2.1 ASTM Standards:²

E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

E131 Terminology Relating to Molecular Spectroscopy

E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

E406 Practice for Using Controlled Atmospheres in Spectrochemical Analysis

D1193 Specification for Reagent Water

¹ This practice is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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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. Terminology

3.1 Refer to Terminologies **E131** and **E135** for the definition of terms used in this practice.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *atomization*—the formation of ground state atoms that absorb radiation from a line emission source. The atomization process in graphite furnace atomic absorption spectrometry (GF-AAS) analysis is covered in 6.2.

3.2.2 *pyrolysis*—the process of heating a specimen to a temperature high enough to remove or alter its original matrix, but not so high as to volatilize the element to be measured. The purpose of the pyrolysis step in GF-AAS analysis is to remove or alter the original specimen matrix, thereby reducing or eliminating possible interferences to the formation of ground state atoms that are formed when the temperature is increased during the atomization step. Many publications and references will refer to pyrolysis as *charring* or *ashing*.

3.2.3 *pyrolytic graphite coating*—a layer of pyrolytic graphite that coats a graphite tube used in GF-AAS analysis. Pyrolytic graphite is formed by pyrolyzing a hydrocarbon, for example, methane, at 2000 °C.

3.2.4 *ramping*—a slow, controlled increase of the temperature in the graphite tube. Ramping will provide for an efficient but not too rapid removal or decomposition of the specimen matrix. Most graphite furnaces allow for ramping during the drying, pyrolysis, and atomization steps. It is usually employed during the drying and pyrolysis steps. However, some instrument manufacturers may recommend ramping during the atomization step depending on the specimen matrix and the element being measured (for example, the analysis of cadmium or lead in hair or blood). The power supplies for most instruments also allow the rate of the temperature increase to be varied.

4. Significance and Use

4.1 This practice is intended for users who are attempting to establish GF-AAS procedures. It should be helpful for establishing a complete atomic absorption analysis program.

5. Theory of Atomic Absorption Spectrometry (AAS)

5.1 In flame atomic absorption spectrometry (Flame-AAS), a test solution is aspirated into a flame through which passes