



Standard Practice for Describing Atomic Absorption Spectrometric Equipment¹

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1. Scope

1.1 This practice covers those features that are important for evaluating atomic absorption spectroscopy equipment. It also discusses performance characteristics and identifies parameters that should be recorded in analytical procedures.

1.2 *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 warning statements are given in the Note in 5.3 and specific precautionary statements are given in Section 7.

2. Referenced Documents

2.1 ASTM Standards:

E 135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials²

E 416 Practice for Planning and Safe Operation of a Spectrochemical Laboratory³

E 520 Practice for Describing Detectors in Emission and Absorption Spectroscopy³

E 1770 Practice for Optimization of Electrothermal Atomic Absorption Spectrometric Equipment³

E 1812 Practice for Optimization of Flame Atomic Absorption Spectrometric Equipment³

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology E 135.

4. Significance and Use

4.1 This practice provides criteria for instrument selection and should be useful for setting up an atomic absorption facility.

5. Description of Equipment

5.1 *Optical System*—Both single-beam and double-beam optical systems are in use. A single-beam system employs one

optical path to measure both incident and transmitted radiation. The two measurements are separated in time. A double-beam system separates the incident radiation into two portions. One of these portions (often designated I) is measured after traversing the analytical cell; the other portion (often designated I_0) represents the radiation incident on the analytical cell. Signals from the two portions are used to compensate for baseline variability. In single-beam systems, instability of either the incident intensity or the detector-amplifier sensitivity-gain contributes to the variability of the signal. Double-beam systems can correct completely for either type of instability. Neither single-beam or double-beam systems can correct for fluctuations occurring in the flame.

5.2 *Radiation Sources*—The most widely used source of absorbing lines is the hollow cathode lamp. It emits narrow spectral lines, has low background, and is applicable to virtually all elements amenable to atomic absorption analysis. The high-frequency electrodeless discharge lamp (EDL) is also an excellent source of sharp line spectra. It provides more intensity than the hollow cathode lamp, but is not as universally applicable. EDLs require a special power supply.

5.2.1 The hollow cathode lamp shall emit stable, low-drift radiation of usable intensity, free of interfering spectral lines due to filler gas or cathode impurities.

5.2.2 *Stability*—Intensity drift shall not exceed 3 % per 15 min after a 30-min warm up. Many lamps available now are better than 1 % per 15 min after warm up.

5.2.3 *Lamp Life*—The hollow cathode lamp or EDL shall maintain the above characteristics over the manufacturer's warranted life. The expected life of hollow cathode lamps is approximately 5 Ah.

5.3 *Flames*—Flames are classified as diffusion or premixed. The characteristics of the diffusion flame are determined by the rate at which the fuel diffuses into the ambient oxygen or the oxidant supplied through a separate orifice.⁴ In the premixed flame, the characteristics are determined by the kinetics of the chemical combustion producing the flame. In general, diffusion flames are more turbulent than pre-mixed flames and the flame reactions are not spatially resolved. Premixed acetylene and air or acetylene and nitrous oxide flames are the most commonly used atomic absorption flames. Acetylene is the most common fuel. Hydrogen, natural gas, propane, and similar fuels are

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² *Annual Book of ASTM Standards*, Vol 03.05.

³ *Annual Book of ASTM Standards*, Vol 03.06.

⁴ "Guidelines for the Purity and Handling of Gases Used in Atomic Absorption Spectroscopy", *AI2.1a*, 1978, Scientific Glass Makers Association, 1140 Connecticut Ave., N.W., Washington, DC 20036.