



# Standard Practice for Describing and Specifying Inductively Coupled Plasma Atomic Emission Spectrometers<sup>1</sup>

This standard is issued under the fixed designation E1479; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice describes the components of an inductively coupled plasma atomic emission spectrometer (ICP-AES) that are basic to its operation and to the quality of its performance. This practice identifies critical factors affecting accuracy, precision, and sensitivity. It is not the intent of this practice to specify component tolerances or performance criteria, since these are unique for each instrument. A prospective user should consult with the manufacturer before placing an order, to design a testing protocol that demonstrates the instrument meets all anticipated needs.

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 13.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

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

**E158 Practice for Fundamental Calculations to Convert Intensities into Concentrations in Optical Emission Spectrochemical Analysis** (Withdrawn 2004)<sup>3</sup>

**E172 Practice for Describing and Specifying the Excitation Source in Emission Spectrochemical Analysis** (Withdrawn 2001)<sup>3</sup>

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

**E416 Practice for Planning and Safe Operation of a Spectrochemical Laboratory** (Withdrawn 2005)<sup>3</sup>

**E520 Practice for Describing Photomultiplier Detectors in Emission and Absorption Spectrometry**

## 3. Terminology

3.1 *Definitions*—For terminology relating to emission spectrometry, refer to Terminology E135.

## 4. Summary of Practice

4.1 An ICP-AES is an instrument used to determine elemental composition. It typically is comprised of several assemblies including a radio-frequency (RF) generator, an impedance matching network (where required), an induction coil, a plasma torch, a plasma ignitor system, a sample introduction system, a radiant energy gathering optic, an entrance slit and dispersing element to sample and isolate wavelengths of light emitted from the plasma, one or more devices for converting the emitted light into an electrical current or voltage, one or more analog preamplifiers, one or more analog-to-digital converter(s), and a dedicated computer with printer (see Fig. 1<sup>4</sup>).

4.1.1 The sample is introduced into a high-temperature (>6000 K) plasma that is formed from the inductive energy transfer to and subsequent ionization of the gas stream contained in the torch. The torch is mounted centrally in a metal structure, which is called the load coil. Energy is applied to the load coil by means of an RF generator.

4.1.2 The term inductively coupled refers to the fact that the physical phenomenon of induction creates a plasma by transferring energy from the load coil to the gas stream that has been momentarily preionized by a high voltage ignitor spark that functions only during plasma ignition.

4.2 When material passes through the plasma, it is vaporized, atomized, and partly ionized. The produced atoms and ions are excited into an energetically higher state. Free atoms and ions are excited from their ground states mainly by collision with the major plasma constituents. The excited atoms or ions subsequently decay to a lower energy state and emit photons, some of which pass through the entrance slit of

<sup>4</sup> Courtesy of PerkinElmer, Inc., 761 Main Ave., Norwalk, CT 06859.