



Designation: ~~E841-04~~ Designation: E841 - 12

# Standard Test Method for Determination of Copper in Iron Ores and Related Materials by Atomic Absorption Spectrometry<sup>1</sup>

This standard is issued under the fixed designation E841; 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 test method covers the determination of copper in iron ores, concentrates, agglomerates, and related materials in the concentration range from 0.003 to 1%.~~

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NOTE 1—As used in this test method (except as related to the term “relative standard deviation”, “%” refers to a mass fraction (wt / wt %) (g/100g).

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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:*<sup>2</sup>

D1193 Specification for Reagent Water

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

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

E173 Practice for Conducting Interlaboratory Studies of Methods for Chemical Analysis of Metals

E276 Test Method for Particle Size or Screen Analysis at No. 4 (4.75-mm) Sieve and Finer for Metal-Bearing Ores and Related Materials

E663 Practice for Flame Atomic Absorption Analysis<sup>3</sup>

E877 Practice for Sampling and Sample Preparation of Iron Ores and Related Materials for Determination of Chemical Composition

E882 Guide for Accountability and Quality Control in the Chemical Analysis Laboratory

~~E1601 Practice for Conducting an Interlaboratory Study to Evaluate the Performance of an Analytical Method~~ Practice for Conducting an Interlaboratory Study to Evaluate the Performance of an Analytical Method

E1763 Guide for Interpretation and Use of Results from Interlaboratory Testing of Chemical Analysis Methods

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology E135.

## 4. Summary of Test Method

4.1 The sample is dissolved in ~~hydrochloric acid—HCl~~ with the addition of a small amount of ~~nitric—HNO<sub>3</sub>~~ and ~~hydrofluoric—HF~~ acids. After evaporation to fumes with ~~perchloric acid—HClO<sub>4</sub>~~, the solution is diluted with water and filtered. A portion of the solution is examined by atomic absorption ~~spectroscopy~~ spectrometry using standards containing approximately the same amount of iron as the test sample.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.02 on Ores, Concentrates, and Related Metallurgical Materials.

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<sup>2</sup> 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.

## 5. Significance and Use

5.1 In the making of iron and steel during the reduction of iron ores, copper forms alloy with iron and steel hence the necessity of determining the copper ~~concentration~~content for metallurgical consideration.

5.2 This test method is intended to be used for compliance with compositional specifications for copper content. It is assumed that all who use these procedures will be trained analysts capable of performing common laboratory procedures skillfully and safely. It is expected that work will be performed in a properly equipped laboratory and that proper waste disposal procedures will be followed. Appropriate quality control practices must be followed, such as those described in Guide E882.

## 6. Interferences

6.1 None of the elements normally found in iron ores interfere with this test method.

## 7. Apparatus

7.1 *Atomic Absorption Spectrometer*, meeting the following criteria:

7.1.1 *Minimum Sensitivity*—The absorbance of the highest calibration solution (see 8.6) must be at least 0.3.

7.1.2 *Curve—Linearity*—The difference between the readings of the two highest calibration solutions must be more than 1.4 times the difference between the readings for the zero solution and the lowest calibration solution (see 8.6).

7.1.3 *Minimum Stability*—The ~~coefficient of variation~~relative standard deviation of a number of measurements of the highest calibration solution and of the zero calibration solution must be less than 1.5 % and 0.5 % respectively, relative to the measurement of the highest calibration solution.

NOTE 1—A ~~2~~3 strip chart recorder or digital readout device, or both is advisable to measure the criteria in 7.1 and for all subsequent measurements.

NOTE 2—A ~~3~~3 background corrector equipped with a hydrogen or a deuterium hollow cathode lamp is advisable for the ~~concentration~~compositional range from 0.003 % to 0.010 % Cu.

NOTE 3—Instrument parameters will vary with each instrument. The following parameters were successfully used in several laboratories and they can be used as guidelines. Solutions were aspirated into an air – acetylene flame of a premix burner.

Hollow cathode lamp, mA	3
Wavelength, nm	324.7
Air flow-rate, L/min	10
Acetylene flow-rate, L/min	2.5

## 8. Reagents and Materials

8.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available<sup>3</sup>. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water ~~as defined by conforming to Type I or II of Specification D1193~~. Type III or IV may be used if they effect no measurable change in the blank or sample.

8.3 *Copper Standard Solution A (1 mL = 1.0 mg Cu)*—Dissolve 1.000 g of copper metal (minimum 99.5 %) in 30 mL of nitric acid (1+1) HNO<sub>3</sub> (1 + 1) and dilute to 1 L.

8.4 *Copper Standard Solution B (1 mL = 0.10 mg Cu)*—Transfer 100 mL of Standard Solution A to a 1-L volumetric flask, dilute to volume, and mix.

8.5 *Copper Standard Solution C (1 mL = 0.01 mg Cu)*—Transfer 100 mL of Standard Solution B to a 1-L volumetric flask, dilute to volume, and mix.

8.6 *Copper Standard Calibration Solution*—Depending on the expected copper ~~concentration in content~~range of copper content of the sample, prepare a calibration solution using copper Standard Solution B or C. For the ~~concentration range of copper content~~range of copper content from 0.01 % to ~~0.2 %~~0.2 %, use copper Standard Solution B and for the ~~concentration range of copper content~~range of copper content from 0.003 % to 0.02 %, use copper Standard Solution C.

8.6.1 Transfer (1.0, 3.0, 5.0, 7.0, and 10.0)-mL portions of copper Standard Solution B or C to 100-mL volumetric flasks. Add 20.0 mL of background solution, dilute to volume, and mix.

8.7 *Hydrochloric Acid (HCl) (1+1)*—Mix 1 volume of hydrochloric acid (HCl) with 1 volume of water.

8.8 *Iron Background Solution*—Dissolve 15 g of high-purity iron metal in 150 mL HCl (1 + 2) and oxidize by the dropwise addition of HNO<sub>3</sub>. Add 250 mL of perchloric acid (HClO<sub>4</sub>) and evaporate to fumes. Allow to fume for 10 min, cool, and dilute to 1 L.

8.9 *Nitric Acid (HNO<sub>3</sub>) (1+1)*—Mix 1 volume of nitric acid (HNO<sub>3</sub>) with 1 volume of water.

8.10 and evaporate to fumes. Allow to fume for 10 min, cool, and dilute to 1 L.

8.8 *Reference Solution*—Transfer 20 mL of the background solution to a 100-mL volumetric flask, dilute to volume, and mix.

<sup>3</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.