



Designation: E1915 – 20

Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials for Carbon, Sulfur, and Acid-Base Characteristics¹

This standard is issued under the fixed designation E1915; 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 These test methods cover the determination of total carbon, sulfur, and acid-base characteristics in metal bearing ores and related materials such as leach residues, tailings, and waste rock within the following ranges:

Analyte	Application Range, %	Quantitative Range, %
Total Carbon	0 to 10	0.08 to 10
Total Sulfur	0 to 8.8	0.023 to 8.8

NOTE 1—The test methods were tested over the following ranges:

Total Carbon	0.01 % to 5.87 %
Total Sulfur	0.0002 % to 4.70 %
Residual Carbon from Pyrolysis	0.002 % to 4.97 %
Residual Sulfur from Pyrolysis	0.014 % to 1.54 %
Pyrolysis Loss Sulfur	0 % to 4.42 %
Hydrochloric Acid Insoluble Carbon	0.025 % to 0.47 %
Hydrochloric Acid Loss Carbon	0 % to 5.78 %
Hydrochloric Acid Insoluble Sulfur	0.012 % to 4.20 %
Acid Neutralization Potential Acidity Titration	-1.0 % to 100 %
Acid Neutralization Potential Acidity Titration Low Range	-1.0 % to 2 % CaCO_3
Nitric Acid Insoluble Sulfur	0.006 % to 0.924 %
Nitric Acid Loss Sulfur	-0.08 % to 4.19 %
Sodium Carbonate Insoluble Sulfur	0.007 % to 3.78 %

1.2 The quantitative ranges for the partial decomposition test methods are dependent on the mineralogy of the samples being tested. The user of these test methods is advised to conduct an interlaboratory study in accordance with Practice E1601 on the test methods selected for use at a particular mining site, in order to establish the quantitative ranges for these test methods on a site-specific basis.

1.3 The test methods appear in the following order:

	Sections
Carbon and Sulfur, Total	10.1 – 10.9
Carbon and Sulfur, Residual from Pyrolysis	10.10 – 10.18
Carbon and Sulfur, Hydrochloric Acid Insoluble	10.19 – 10.27
Acid Neutralization Potential Acidity Titration	10.28 – 10.36
Acid Neutralization Potential Acidity Titration Low Range	10.37 – 10.46
Sulfur, Nitric Acid Insoluble	10.47 – 10.55
Sulfur, Sodium Carbonate Insoluble	10.56 – 10.64

¹ These test methods are under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and are the direct responsibility of Subcommittee E01.02 on Ores, Concentrates, and Related Metallurgical Materials.

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1.4 The values stated in SI units are to be regarded as 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. Specific warning statements are given in Section 6.*

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.*

2. Referenced Documents

2.1 ASTM Standards:²

- D1067 Test Methods for Acidity or Alkalinity of Water
- D1193 Specification for Reagent Water
- D1976 Test Method for Elements in Water by Inductively-Coupled Plasma Atomic Emission Spectroscopy
- D5673 Test Method for Elements in Water by Inductively Coupled Plasma—Mass Spectrometry
- D5744 Test Method for Laboratory Weathering of Solid Materials Using a Humidity Cell
- D6234 Test Method for Shake Extraction of Mining Waste by the Synthetic Precipitation Leaching Procedure
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- 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
- E882 Guide for Accountability and Quality Control in the Chemical Analysis Laboratory
- E1019 Test Methods for Determination of Carbon, Sulfur,

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.

Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques

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

E1950 Practice for Reporting Results from Methods of Chemical Analysis

E2242 Test Method for Column Percolation Extraction of Mine Rock by the Meteoric Water Mobility Procedure

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *accuracy, n*—qualitative term that involves precision and bias. The closeness of agreement between a measured quantity value and a true quantity value of a measurand.

3.2.2 *standardization, v*—analysis of samples with known values or known additions, prior to and within groups of test samples to assure accuracy.

3.2.3 *standardization sample, n*—calibration mixtures or samples with known values or known additions that are analyzed with test samples to assure accuracy of analysis.

4. Significance and Use

4.1 These test methods are primarily intended to test materials for compliance with compositional specifications and for monitoring.

4.1.1 The determination of carbon and sulfur and acid neutralization potential in ores and related materials is necessary to classify ores for metallurgical processing and to classify waste materials from the mining and processing of ores such as leach residues, waste rock, and tailings according to their potential to generate acid in the environment. This information is useful during mine development to assist in mining and mineral processing operations and for proper disposal of waste materials.

4.1.1.1 The use of the acid neutralization potential titration low range method is most useful where acidity is present in the samples and when acid potential by titration is desired in the uncertain range below 2 % CaCO₃.

4.1.2 These test methods are also used to isolate minerals based on carbon and sulfur contents of metal-bearing ores and related materials so that acid-base accounting can be performed (that is, carbonate mineral acid neutralization potential (ANP) minus sulfide-sulfur mineral acid generation potential (AGP) = net calcium carbonate (NCC)).

4.1.3 Additionally, the carbon hydrochloric acid insoluble test method has utility to identify the amount of organic carbon contained in gold ores so that potential for preg-robbing can be identified and rectified through established pretreatment methods prior to cyanidation. **Warning**—Pyrolysis pretreatment at 550 °C has a potential to thermally decompose some carbonate minerals: (1) transition metal carbonates (for example, siderite, FeCO₃, and rhodochrosite, MnCO₃) decompose, yielding carbon dioxide (CO₂) in the range of 220 °C to 520 °C; (2) calcite decomposes slightly between 300 °C and 500 °C, although

most decomposition occurs above 550 °C; (3) dolomite decomposes at 800 °C to 900 °C (Hammack, 1994, p. 440).³

4.2 These test methods also may be used for the classification of rock to be used in construction, where the potential to generate acid under environmental conditions exists.

4.3 It is assumed that the users of these test methods 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 such as those described in Guide E882 must be followed.

5. Reagents and Materials

5.1 *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.⁴ 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.

5.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined in Type I of Specification D1193.

6. Hazards

6.1 For hazards to be observed in the use of reagents and apparatus in these test methods, refer to Practices E50. Use care when handling hot crucibles or boats and when operating furnaces to avoid personal injury by either burn or electrical shock.

7. Rounding Calculated Values

7.1 Rounding of test results obtained using this Test Method shall be performed as directed in Practice E29 Rounding Method, unless an alternative rounding method is specified by the customer or applicable material specification.

8. Interlaboratory Studies

8.1 These test methods have been evaluated in accordance with Practice E1601 unless otherwise noted in the precision and bias section. The lower limit in the scope of these test methods specifies the lowest analyte content that may be analyzed with an acceptable error. A warning statement is included in the scope for test methods not observing this convention.

³ Hammack, R. W., “Evolved-Gas Analysis: A Method for Determining Pyrite, Marcasite, and Alkaline-Earth Carbonates,” *Environmental Geochemistry of Sulfide Oxidation*, Alpers, C., and Blowes, D., eds., Chapter 28, ACS Symposium Series 550, American Chemical Society, Washington, D.C., 1994, pp. 431–444.

⁴ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC, www.chemistry.org. 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, http://www.usp.org.