



Designation: E354 – 25

Standard Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys¹

This standard is issued under the fixed designation E354; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These test methods cover the chemical analysis of high-temperature, electrical, magnetic, and other similar iron, nickel, and cobalt alloys having chemical compositions within the following limits:

Element	Composition Range, %
Aluminum	0.005 to 18.00
Beryllium	0.001 to 0.05
Boron	0.001 to 1.00
Calcium	0.002 to 0.05
Carbon	0.001 to 1.10
Chromium	0.10 to 33.00
Cobalt	0.10 to 75.00
Columbium (Niobium)	0.01 to 6.0
Copper	0.01 to 10.00
Iron	0.01 to 85.00
Magnesium	0.001 to 0.05
Manganese	0.01 to 3.0
Molybdenum	0.01 to 30.0
Nickel	0.10 to 84.0
Nitrogen	0.001 to 0.20
Phosphorus	0.002 to 0.08
Silicon	0.01 to 5.00
Sulfur	0.002 to 0.10
Tantalum	0.005 to 10.0
Titanium	0.01 to 5.00
Tungsten	0.01 to 18.00
Vanadium	0.01 to 3.25
Zirconium	0.01 to 2.50

1.2 The test methods in this standard are contained in the sections indicated below:

	Sections
Aluminum, Total, by the 8-Quinolinol Gravimetric Method (0.20 % to 7.00 %)	100 – 107
Carbon, Total, by the Combustion-Thermal Conductivity Method— <i>Discontinued 1986</i>	124 – 134
Carbon, Total, by the Combustion Gravimetric Method (0.05 % to 1.10 %)— <i>Discontinued 2014</i>	79 – 89
Chromium by the Atomic Absorption Spectrometry Method (0.006 % to 1.00 %)	165 – 174

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 E01.01 on Iron, Steel, and Ferroalloys.

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Chromium by the Peroxydisulfate Oxidation—Titration Method (0.10 % to 33.00 %)	175 – 183
Chromium by the Peroxydisulfate-Oxidation Titrimetric Method— <i>Discontinued 1980</i>	116 – 123
Cobalt by the Ion-Exchange-Potentiometric Titration Method (2 % to 75 %)	53 – 60
Cobalt by the Nitroso-R-Salt Spectrophotometric Method (0.10 % to 5.0 %)	61 – 70
Copper by Neocuproine Spectrophotometric Method (0.01 % to 10.00 %)	90 – 99
Copper by the Sulfide Precipitation-Electrodeposition Gravimetric Method (0.01 % to 10.00 %)	71 – 78
Iron by the Silver Reduction Titrimetric Method (1.0 % to 50.0 %)	192 – 199
Manganese by the Metaperiodate Spectrophotometric Method (0.05 % to 2.00 %)	9 – 18
Molybdenum by the Ion Exchange—8-Hydroxyquinoline Gravimetric Method (1.5 % to 30 %)	184 – 191
Molybdenum by the Thiocyanate Spectrophotometric Method (0.01 % to 1.50 %)	153 – 164
Nickel by the Dimethylglyoxime Gravimetric Method (0.1 % to 84.0 %)	135 – 142
Phosphorus by the Molybdenum Blue Spectrophotometric Method (0.002 % to 0.08 %)	19 – 30
Silicon by the Gravimetric Method (0.05 % to 5.00 %)	46 – 52
Sulfur by the Gravimetric Method— <i>Discontinued 1988</i>	Former 30 – 36
Sulfur by the Combustion-Iodate Titration Method (0.005 % to 0.1 %)— <i>Discontinued 2014</i>	37 – 45
Sulfur by the Chromatographic Gravimetric Method— <i>Discontinued 1980</i>	108 – 115
Tin by the Solvent Extraction—Atomic Absorption Spectrometry Method (0.002 % to 0.10 %)	143 – 152

1.3 Methods for the determination of carbon and sulfur not included in this standard can be found in Test Methods E1019.

1.4 Some of the composition ranges given in 1.1 are too broad to be covered by a single method and therefore this standard contains multiple methods for some elements. The user must select the proper method by matching the information given in the Scope and Interference sections of each method with the composition of the alloy to be analyzed.

1.5 *Units*—The values stated in SI units are to be regarded as standard.

1.6 *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 hazards statements are given in Section 6 and in special “Warning” paragraphs throughout these test methods.

1.7 *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

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

E60 Practice for Analysis of Metals, Ores, and Related Materials by Spectrophotometry

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 (Withdrawn 1997)³

E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E351 Test Methods for Chemical Analysis of Cast Iron—All Types

E352 Test Methods for Chemical Analysis of Tool Steels and Other Similar Medium- and High-Alloy Steels

E353 Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

E882 Guide for Accountability and Quality Control in the Chemical Analysis Laboratory (Withdrawn 2025)³

E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Combustion and Inert Gas Fusion Techniques

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

E1806 Practice for Sampling Steel and Iron for Determination of Chemical Composition

2.2 Other Document:⁴

ISO 5725 Precision of Test Methods—Determination of Repeatability and Reproducibility for Inter-Laboratory Tests

3. Terminology

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

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

4. Significance and Use

4.1 These test methods for the chemical analysis of metals and alloys are primarily intended as referee methods to test such materials for compliance with compositional specifications, particularly those under the jurisdiction of the ASTM Committee A01 on Steel, Stainless Steel and Related Alloys. It is assumed that all who use 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 under appropriate quality control practices such as those described in Guide E882.

5. Apparatus, Reagents, and Instrumental Practice

5.1 *Apparatus*—Specialized apparatus requirements are listed in the “Apparatus” section in each method.

5.1.1 In the methods specifying spectrophotometric testing, the cells utilized to contain the reference material solutions and sample solutions in spectrophotometers are referred to as “absorption cells.” Please note that the radiant energy passed through the cells can be measured as absorbance or transmittance. These methods refer to absorbance measurements. Refer to Practices E60 for details.

5.2 Reagents:

5.2.1 *Purity of Reagents*—Refer to Practice E50, 5.2, for the purity of reagents provision.

5.2.2 *Purity of Water*—Refer to Practice E50, 5.1, for the purity of water provision.

5.3 *Spectrophotometric Practice*—Spectrophotometric practice prescribed in these test methods shall conform to Practice E60.

6. Hazards

6.1 For precautions to be observed in the use of certain reagents and equipment in these methods, refer to Practices E50.

7. Sampling

7.1 For procedures to sample the material, refer to Practice E1806.

8. Interlaboratory Studies and Rounding Calculated Values

8.1 These test methods have been evaluated in accordance with Practice E173 (withdrawn 1997) or ISO 5725. Practice E173 has been replaced by Practice E1601. The Reproducibility, R₂, of Practice E173 corresponds to the Reproducibility Index, R, of Practice E1601. The Repeatability, R₁, of Practice E173 corresponds to the Repeatability Index, r, of Practice E1601.

8.2 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.