



Standard Test Methods for Chemical Analysis of Cast Iron—All Types¹

This standard is issued under the fixed designation E351; 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 pig iron, gray cast iron (including alloy and austenitic), white cast iron, malleable cast iron, and ductile (nodular) iron having chemical compositions within the following limits:

Element	Composition Range, %
Aluminum	0.003 to 0.50
Antimony	0.005 to 0.03
Arsenic	0.02 to 0.10
Bismuth	0.001 to 0.03
Boron	0.001 to 0.10
Cadmium	0.001 to 0.005
Carbon	1.25 to 4.50
Cerium	0.005 to 0.05
Chromium	0.01 to 30.00
Cobalt	0.01 to 4.50
Copper	0.03 to 7.50
Lead	0.001 to 0.15
Magnesium	0.002 to 0.10
Manganese	0.06 to 2.50
Molybdenum	0.01 to 5.00
Nickel	0.01 to 36.00
Phosphorus	0.01 to 0.90
Selenium	0.001 to 0.06
Silicon	0.10 to 6.0
Sulfur	0.005 to 0.25
Tellurium	0.001 to 0.35
Tin	0.001 to 0.35
Titanium	0.001 to 0.20
Tungsten	0.001 to 0.20
Vanadium	0.005 to 0.50
Zinc	0.005 to 0.20

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

	Sections
Carbon, Graphitic, by the Direct Combustion Infrared Absorption Method (1 % to 3 %)	108
Carbon, Total by the Combustion Gravimetric Method (1.25 % to 4.50 %)— <i>Discontinued</i>	97
Cerium and Lanthanum by the Direct Current Plasma Atomic Emission Spectrometry Method (Ce: 0.003 % to 0.5 %; La: 0.001 % to 0.30 %)	237

Chromium by the Atomic Absorption Method (0.006 % to 1.00 %)	208
Chromium by the Peroxydisulfate Oxidation—Titration Method (0.006 % to 1.00 %)	218
Chromium by the Peroxydisulfate-Oxidation Titrimetric Method (0.05 % to 30.0 %)— <i>Discontinued</i>	
Cobalt by the Ion-Exchange—Potentiometric Titration Method (2.0 % to 4.5 %)	53
Cobalt by the Nitroso-R-Salt Spectrophotometric Method (0.01 % to 4.50 %)	61
Copper by the Neocuproine Spectrophotometric Method (0.03 % to 7.5 %)	116
Copper by the Sulfide Precipitation-Electrodeposition Gravimetric Method (0.03 % to 7.5 %)	81
Lead by the Ion-Exchange—Atomic Absorption Method (0.001 % to 0.15 %)	126
Magnesium by the Atomic Absorption Method (0.002 % to 0.10 %)	71
Manganese by the Periodate Spectrophotometric Method (0.10 % to 2.00 %)	8
Manganese by the Peroxydisulfate-Arsenite Titrimetric Method (0.10 % to 3.5 %)	152
Molybdenum by the Ion Exchange—8-Hydroxyquinoline Gravimetric Method	257
Molybdenum by the Spectrophotometric Method (0.01 % to 1.5 %)	196
Nickel by the Dimethylglyoxime Gravimetric Method (0.1 % to 36.00 %)	168
Nickel by the Ion Exchange-Atomic Absorption Method (0.005 % to 1.00 %)	176
Phosphorus by the Alkalimetric Method (0.02 % to 0.90 %)	160
Phosphorus by the Molybdenum Blue Spectrophotometric Method (0.02 % to 0.90 %)	18
Silicon by the Gravimetric Method (0.1 % to 6.0 %)	46
Sulfur by the Gravimetric Method— <i>Discontinued</i>	30
Sulfur by the Combustion-Iodate Titration Method (0.005 % to 0.25 %)— <i>Discontinued</i>	37
Sulfur by the Chromatographic Gravimetric Method— <i>Discontinued</i>	
Tin by the Solvent Extraction-Atomic Absorption Method (0.002 % to 0.10 %)	186
Tin by the Sulfide-Iodometric Titration Method (0.01 % to 0.35 %)	89
Titanium, Total, by the Diantiprylmethane Spectrophotometric Method (0.006 % to 0.35 %)	246
Vanadium by the Atomic Absorption Method (0.006 % to 0.15 %)	227

1.3 Procedures for the determination of carbon and sulfur not included in these test methods 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 The values stated in SI units are to be regarded as standard.

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.

Current edition approved Feb. 1, 2013. Published May 2013. Originally approved in 1968. Last previous edition approved in 2006 as E351 – 93 (Reapproved 2006). DOI: 10.1520/E0351-13.