



Designation: E415 – 17

Standard Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry¹

This standard is issued under the fixed designation E415; 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 This test method covers the simultaneous determination of 21 alloying and residual elements in carbon and low-alloy steels by spark atomic emission vacuum spectrometry in the mass fraction ranges shown [Note 1](#).

Element	Composition Range, %	
	Applicable Range, Mass Fraction % ^A	Quantitative Range, Mass Fraction % ^B
Aluminum	0 to 0.093	0.006 to 0.093
Antimony	0 to 0.027	0.006 to 0.027
Arsenic	0 to 0.1	0.003 to 0.1
Boron	0 to 0.007	0.0004 to 0.007
Calcium	0 to 0.003	0.002 to 0.003
Carbon	0 to 1.1	0.02 to 1.1
Chromium	0 to 8.2	0.007 to 8.14
Cobalt	0 to 0.20	0.006 to 0.20
Copper	0 to 0.5	0.006 to 0.5
Manganese	0 to 2.0	0.03 to 2.0
Molybdenum	0 to 1.3	0.007 to 1.3
Nickel	0 to 5.0	0.006 to 5.0
Niobium	0 to 0.12	0.003 to 0.12
Nitrogen	0 to 0.015	0.01 to 0.055
Phosphorous	0 to 0.085	0.006 to 0.085
Silicon	0 to 1.54	0.02 to 1.54
Sulfur	0 to 0.055	0.001 to 0.055
Tin	0 to 0.061	0.005 to 0.061
Titanium	0 to 0.2	0.001 to 0.2
Vanadium	0 to 0.3	0.003 to 0.3
Zirconium	0 to 0.05	0.01 to 0.05

^A Applicable range in accordance with Guide [E1763](#) for results reported in accordance with Practice [E1950](#).

^B Quantitative range in accordance with Practice [E1601](#).

NOTE 1—The mass fraction ranges of the elements listed have been established through cooperative testing² of reference materials.

1.2 This test method covers analysis of specimens having a diameter adequate to overlap and seal the bore of the spark stand opening. The specimen thickness can vary significantly

according to the design of the spectrometer stand, but a thickness between 10 mm and 38 mm has been found to be most practical.

1.3 This test method covers the routine control analysis in iron and steelmaking operations and the analysis of processed material. It is designed for chill-cast, rolled, and forged specimens. Better performance is expected when reference materials and specimens are of similar metallurgical condition and composition. However, it is not required for all applications of this standard.

1.4 *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.*

1.5 *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:³

- [E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)
- [E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials](#)
- [E305 Practice for Establishing and Controlling Atomic Emission Spectrochemical Analytical Curves](#)
- [E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron](#)
- [E406 Practice for Using Controlled Atmospheres in Spectrochemical Analysis](#)
- [E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt](#)

¹ 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 [E01.01](#) on Iron, Steel, and Ferroalloys.

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² Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:E01-1122. Contact ASTM Customer Service at service@astm.org.

³ 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.