
**Steel and iron — Review of available
methods of analysis**

Aciers et fontes — Vue d'ensemble des méthodes d'analyse disponibles

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 1, *Methods of determination of chemical composition*.

This fourth edition cancels and replaces the third edition (ISO/TR 9769:1991), which has been technically revised to update all the standard methods for the determination of chemical composition of steel and iron.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Steel and iron — Review of available methods of analysis

1 Scope

This document gives guidelines for the determination of the chemical composition of steel and iron by reference to published International Standards, including their range of application and principles of the methods.

Graphical representation of the precision data for the methods is given in [Annex A](#).

The list of International Standards is summarized in [Annex B](#).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

routine method

method calibrated against reference materials, certified reference materials or against standard solutions commercially available that is widely used for control purposes (day-to-day analysis)

4 International Standards for determining the chemical composition of steel and iron, their range of application and principles of the methods

4.1 Mono-elemental methods

4.1.1 Aluminium, Al

Document: ISO 9658:1990, *Steel — Determination of aluminium content — Flame atomic absorption spectrometric method*.

Range of application:

- determination of acid-soluble and/or total aluminium contents between a mass fraction of 0,005 % and a mass fraction of 0,20 % in non-alloyed steel.

Principle of the method:

- a) dissolution of a test portion in dilute hydrochloric and nitric acids;
- b) fusion of the acid-insoluble material with a mixture of orthoboric acid and potassium carbonate;
- c) spraying of the solution into a dinitrogen monoxide-acetylene flame;

- d) spectrometric measurement of the atomic absorption of the 309,3 nm spectral line emitted by an aluminium hollow cathode lamp.

4.1.2 Antimony, Sb

Document: ISO 10698:1994, *Steel — Determination of antimony content — Electrothermal atomic absorption spectrometric method.*

Range of application:

- determination of the antimony content between a mass fraction of 0,000 5 % and a mass fraction of 0,010 % in steel.

Principle of the method:

- a) dissolution of a test portion in hydrochloric and nitric acids and dilution of the solution to a known volume;
- b) introduction of a known volume of the solution into an electrothermal atomizer of an atomic absorption spectrometer;
- c) measurement of the atomic absorption of the 217,6 nm spectral resonance line energy emitted by an antimony lamp, using background correction;
- d) calibration by the standard additions technique.

4.1.3 Arsenic, As

Document: ISO 17058:2004, *Steel and iron — Determination of arsenic content — Spectrophotometric method.*

Range of application:

- determination of the arsenic content between 0,000 5 % (mass fraction) and 0,10 % (mass fraction) in steel and iron.

Principle of the method:

- a) dissolution of a test portion in a hydrochloric acid and nitric acid mixture;
- b) prolonged heating with sulfuric acid until white fumes are given off;
- c) reduction of arsenic in the presence of hydrazine sulfate and potassium bromide, then separation by distillation as the trivalent chloride, absorbed in the nitric acid solution, in which the As(III) is oxidized back to the pentavalent state As(V);
- d) formation of the molybdenum blue complex between ammonium molybdate and arsenic, which is reduced by hydrazine sulfate;
- e) spectrophotometric measurement at a wavelength of approximately 840 nm.

4.1.4 Boron, B

4.1.4.1 Document: ISO 10153:1997, *Steel — Determination of boron content — Curcumin spectrophotometric method.*

Range of application:

- determination of the boron content between a mass fraction of 0,000 1 % and a mass fraction of 0,000 5 % only in unalloyed steel, and between a mass fraction of 0,000 5 % and a mass fraction of 0,012 % in steel.

Principle of the method:

- a) dissolution of a test portion in hydrochloric and nitric acids;
- b) decomposition of boron compounds (nitrides etc.) with orthophosphoric and sulfuric acids at a temperature of 290 °C;
- c) formation of a coloured complex between orthoboric acid and curcumin in a buffered acetic medium;
- d) spectrophotometric measurement at a wavelength of about 543 nm.

4.1.4.2 Document: ISO 13900:1997, *Steel — Determination of boron content — Curcumin spectrophotometric method after distillation.*

Range of application:

- determination of the boron content between a mass fraction of 0,000 05 % and a mass fraction of 0,001 0 % in steel.

Principle of the method:

- a) dissolution of a test portion in hydrochloric and nitric acids;
- b) decomposition of boron compounds (nitrides etc.) with orthophosphoric and sulfuric acids at a temperature of 290 °C;
- c) distillation of the solution after the addition of methanol and collection of methylborate in a receiver containing sodium hydroxide solution;
- d) evaporation of the solution to dryness; formation of a coloured complex between orthoboric acid and curcumin in a methanol medium;
- e) spectrophotometric measurement at a wavelength of about 550 nm.

4.1.5 Calcium, Ca

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4.1.5.1 Document: ISO 10697-1:1992, *Steel — Determination of calcium content by flame atomic absorption spectrometry — Part 1: Determination of acid-soluble calcium content.*

Range of application:

- determination of acid-soluble calcium content between a mass fraction of 0,000 5 % and a mass fraction of 0,003 % in steel.

Principle of the method:

- a) dissolution of a test portion in hydrochloric and nitric acids;
- b) addition of potassium chloride/lanthanum nitrate solution as a spectrochemical buffer;
- c) spraying of the solution into a dinitrogen monoxide-acetylene flame;
- d) spectrometric measurement of the atomic absorption of the 422,7 nm spectral line emitted by a calcium hollow cathode lamp.

4.1.5.2 Document: ISO 10697-2:1994, *Steel — Determination of calcium content by flame atomic absorption spectrometry — Part 2: Determination of total calcium content.*

Range of application:

- determination of the total calcium content between a mass fraction of 0,000 5 % and a mass fraction of 0,005 % in steel.