

SLOVENSKI STANDARD

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SIST-TP CEN/TR 10261:2013

Železo in jeklo - Evropski standardi za določevanje kemijske sestave

Iron and steel - European standards for the determination of chemical composition

Eisen und Stahl - Europäische Normen für die Bestimmung der chemischen Zusammensetzung

Aciers et fontes - Normes européennes pour la détermination de la composition chimique

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Ta slovenski standard je istoveten z: **CEN/TR 10261:2018**

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77.040.30	Kemijska analiza kovin	Chemical analysis of metals
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TECHNICAL REPORT

CEN/TR 10261

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Iron and steel - European standards for the determination of chemical composition

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détermination de la composition chimique

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Bestimmung der chemischen Zusammensetzung

This Technical Report was approved by CEN on 13 August 2018. It has been drawn up by the Technical Committee ECISS/TC 102.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (CEN/TR 10261:2018) has been prepared by Technical Committee ECISS/TC 102 “Methods of chemical analysis for iron and steel”, the secretariat of which is held by SIS.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TR 10261:2013.

In comparison with the previous edition of CEN/TR 10261:2013, the following significant technical changes were made:

- Clause 1: updating the link to the webpage of CEN;
- in 4.1, for carbon, withdrawal of EN 10036;
- in 4.1, for calcium, reference updated;
- in 4.1, for chromium, addition of prCEN/TR 10367;
- in 4.1, for copper, replacement of EN 24946:1990 and EN 24946:1990/AC:1991 with EN ISO 4946;
- in 4.1, for lead, reference updated;
- in 4.1, for manganese, EN 24159:1989 moved to Annex A;
- in 4.1, addition of EN 10361, for nickel;
- in 4.1, for nickel, replacement of EN 24938:1990 and EN 24938:1990/AC:1991 with EN ISO 4938;
- in 4.1, for nickel, reference updated;
- in 4.1, for selenium, addition of CEN/TR 10364;
- in 4.1, for silicon, replacement of EN 24829-2:1990 and EN 24829-2:1990/AC:1991 with EN ISO 4829-2;
- in 4.1, for titanium, updating the date of publication of EN 10211;
- in 4.2, addition of EN 10355.

CEN/TR 10261:2018 (E)

1 Scope

This document lists, under Clause 4, the European Standards which are currently available for the determination of the chemical composition of steels and cast irons.

In Clause 5, this document provides details on the range of application and gives the principle of the method described in each standard.

Items which are under preparation as European Standards or as CEN Technical Reports by ECISS/TC 102 are available on the webpage of CEN, through the link https://standards.cen.eu/dyn/www/?p=204:22:0:::FSP_ORG_ID:733643&cs=123E58BF77E3DE921F548B80C5FF2E5D4.

Annex A gives a list of other European Standards and CEN Technical Reports applicable for the determination of the chemical composition of steels and cast irons.

Annex B gives a list of withdrawn Euronorms, together with the corresponding replacement European Standards, if any.

Annex C shows graphical representations of the content ranges of the methods listed in this document. Figure C.1 gives the content ranges of the referee methods, Figure C.2 gives the content ranges of the routine methods and Figure C.3 represents the fields of application of all the methods described.

Annex D provides a trilingual key of the abbreviations used in the Figures given in Annex C.

NOTE Three methods applicable for the analysis of some ferro-alloys are listed in Annex A.

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:

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

3.1 referee method

stoichiometric method or a method calibrated against pure metals or stoichiometric compounds, which is to be used for certification analysis or in case of arbitration

3.2 routine method

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

4 European Standards for the determination of the chemical composition of steels and irons

4.1 Mono-elemental methods

— Aluminium, Al

EN 29658:1991, *Steel — Determination of aluminium content — Flame atomic absorption spectrometric method (ISO 9658:1990)*

— Arsenic, As

EN 10212:1995, *Chemical analysis of ferrous materials — Determination of arsenic in steel and iron — Spectrophotometric method*

— Boron, B

EN 10200:2012, *Chemical analysis of ferrous materials — Determination of boron in steels — Spectrophotometric method*

EN ISO 13900:2002, *Steel — Determination of boron content — Curcumin spectrophotometric method after distillation (ISO 13900:1997)*

— Calcium, Ca

prEN 10177:2018, *Steels — Determination of calcium content — Flame atomic absorption spectrometric method (FAAS)*

— Carbon, C

EN ISO 15349-2:2003, *Unalloyed steel — Determination of low carbon content — Part 2: Infrared absorption method after combustion in an induction furnace (with preheating) (ISO 15349-2:1999)*

EN ISO 9556:2001, *Steel and iron — Determination of total carbon content — Infrared absorption method after combustion in an induction furnace (ISO 9556:1989)*

— Chromium, Cr

prCEN/TR 10367, *Alloyed steels — Determination of chromium content — Inductively coupled plasma optical emission spectrometric method*

EN 10188:1989, *Chemical analysis of ferrous materials — Determination of chromium in steels and irons — Flame atomic absorption spectrometric method*

EN 24937:1990, *Steel and iron — Determination of chromium content — Potentiometric or visual method (ISO 4937:1986)*

EN 24937:1990/AC:1991 (Editorial correction), *Steel and iron — Determination of chromium content — Potentiometric or visual method (ISO 4937:1986)*

— Copper, Cu

EN 24943:1990, *Chemical analysis of ferrous metal — Determination of copper content — Flame atomic absorption spectrometric method (ISO 4943:1985)*

EN 24943:1990/AC:1991 (Editorial correction), *Steel and cast iron — Determination of copper content — Flame atomic absorption spectrometric method (ISO 4943:1985)*

EN ISO 4946:2016, *Steel and cast iron — Determination of copper — 2,2'-Biquinoline spectrophotometric method (ISO 4946:2016)*

CEN/TR 10261:2018 (E)**— Lead, Pb**

prEN 10181:2018, *Steels — Determination of lead content — Flame atomic absorption spectrometric method (FAAS)*

— Manganese, Mn

EN 10071:2012, *Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Electrometric titration method*

EN ISO 10700:1995, *Steel and iron — Determination of manganese content — Flame atomic spectrometric method (ISO 10700:1994)*

— Nickel, Ni

prEN 10136:2018, *Steels and cast irons — Determination of nickel content — Flame atomic absorption spectrometric method (FAAS)*

EN 10361:2015, *Alloyed steels - Determination of nickel content - Inductively coupled plasma optical emission spectrometric method*

EN ISO 4938:2016, *Steel and iron — Determination of nickel content — Gravimetric or titrimetric method (ISO 4938:2016)*

— Niobium, Nb

EN 10178:1989, *Chemical analysis of ferrous materials — Determination of niobium in steels — Spectrophotometric method*

— Nitrogen, N

EN 10179:1989, *Chemical analysis of ferrous materials — Determination of nitrogen (trace amounts) in steels — Spectrophotometric method*

EN ISO 10720:2007, *Steel and iron — Determination of nitrogen content — Thermal conductimetric method after fusion in a current of inert gas (ISO 10720:1997)*

EN ISO 15351:2010, *Steel and iron — Determination of nitrogen content — Thermal conductimetric method after fusion in a current of inert gas (Routine method) (ISO 15351:1999)*

EN ISO 4945:2009, *Steel — Determination of nitrogen content — Spectrophotometric method (ISO 4945:1977)*

— Oxygen, O

EN 10276-1:2000, *Chemical analysis of ferrous materials — Determination of oxygen in steel and iron — Part 1: Sampling and preparation of steel samples for oxygen determination*

EN 10276-2:2003, *Chemical analysis of ferrous materials — Determination of oxygen content in steel and iron — Part 2: Infrared method after fusion under inert gas*

— Phosphorus, P

EN 10184:2006, *Chemical analysis of ferrous materials — Determination of phosphorus in non-alloyed steels and irons — Molybdenum blue spectrophotometric method*

EN ISO 10714:2002, *Steel and iron — Determination of phosphorus content — Phosphovanadomolybdate spectrophotometric method (ISO 10714:1992)*

— **Selenium, Se**

CEN/TR 10362:2014, *Chemical analysis of ferrous materials - Determination of selenium in steels - Electrothermal atomic absorption spectrometric method*

— **Silicon, Si**

EN ISO 4829-1:2018, *Steel and cast iron — Determination of total silicon contents — Reduced molybdosilicate spectrophotometric method — Part 1: Silicon contents between 0,05 % and 1,0 % (ISO 4829-1:2018)*

EN ISO 4829-2:2016, *Steels — Determination of total silicon contents - Reduced molybdosilicate spectrophotometric method — Part 2: Silicon contents between 0,01 % and 0,05 % (ISO 4829-2:2016)*

EN ISO 439:2010, *Steel and iron — Determination of total silicon content — Gravimetric method (ISO 439:1994)*

— **Sulphur, S**

EN 24935:1991, *Steel and iron — Determination of sulphur content — Infrared absorption method after combustion in an induction furnace (ISO 4935:1989)*

EN ISO 4934:2003, *Steel and iron — Determination of sulfur content — Gravimetric method (ISO 4934:2003)*

— **Titanium, Ti**

EN 10211:2013, *Chemical analysis of ferrous materials — Determination of titanium in steels and cast irons — Flame atomic absorption spectrometric method*

EN ISO 10280:1995, *Steel and iron — Determination of titanium content — Diantipyrylmethane spectrophotometric method (ISO 10280:1991)*

— **Vanadium, V**

EN 24947:1991, *Steel and cast iron — Determination of vanadium content — Potentiometric titration method (ISO 4947:1986)*

4.2 Multi-elemental methods

— **Aluminium, Al; Chromium, Cr; Cobalt, Co; Copper, Cu; Manganese, Mn; Molybdenum, Mo; Nickel, Ni; Phosphorus, P; Tin, Sn and Vanadium, V**

EN 10351:2011, *Chemical analysis of ferrous materials — Inductively coupled plasma optical emission spectrometric analysis of unalloyed and low alloyed steels — Determination of Mn, P, Cu, Ni, Cr, Mo, V, Co, Al (total) and Sn [Routine method]*

— **Aluminium, Al; Lead, Pb; Nickel, Ni; Silicon, Si and Zinc, Zn**

EN 10318:2005, *Determination of thickness and chemical composition of zinc- and aluminium-based metallic coatings — Routine method*

— **Carbon, C; Chromium, Cr; Copper, Cu; Manganese, Mn; Nickel, Ni; Phosphorus, P; Silicon, Si and Sulphur, S**

CR 10320:2004, *Optical emission analysis of low alloy steels (routine method) — Method for determination of C, Si, S, P, Mn, Cr, Ni and Cu*

CEN/TR 10261:2018 (E)**— Carbon, C and Sulphur, S**

EN ISO 15350:2010, *Steel and iron — Determination of total carbon and sulfur content — Infrared absorption method after combustion in an induction furnace (routine method) (ISO 15350:2000)*

— Chromium, Cr; Cobalt, Co; Copper, Cu; Manganese, Mn; Molybdenum, Mo; Nickel, Ni; Niobium, Nb; Phosphorus, P; Silicon, Si; Titanium, Ti and Vanadium, V

EN 10315:2006, *Routine method for analysis of high alloy steel by X-ray Fluorescence Spectrometry (XRF) by using a near by technique*

— Chromium, Cr; Copper, Cu; Manganese, Mn; Molybdenum, Mo; Nickel, Ni; Phosphorus, P; Silicon, Si and Tin, Sn

EN 10355:2013, *Chemical analysis of ferrous materials — Inductively coupled plasma optical emission spectrometric analysis of unalloyed and low alloyed steels — Determination of Si, Mn, P, Cu, Ni, Cr, Mo and Sn, following dissolution with nitric and sulphuric acids [Routine method]*

5 Range of application and principle of the methods**5.1 Mono-elemental methods****5.1.1 Aluminium, Al**

EN 29658:1991, *Steel — Determination of aluminium content — Flame atomic absorption spectrometric method (ISO 9658:1990)*

Range of application:

- Determination of aluminium contents from 0,005 % (m/m) to 0,20 % (m/m) 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.

5.1.2 Arsenic, As

EN 10212:1995, *Chemical analysis of ferrous materials — Determination of arsenic in steel and iron — Spectrophotometric method*

Range of application:

- Determination of arsenic contents from 0,001 % (m/m) to 0,08 % (m/m) in all types of steel and iron.

Principle of the method:

- a) Dissolution of a test portion in a mixture of nitric and hydrochloric acids followed by evaporation to dryness and prolonged heating of the dried residue;

- b) Extraction of the residue with acid, reduction of the arsenic (As V to As III) by addition of potassium iodine, ascorbic acid and tin (II) chloride. Conversion of the arsenic to arsenic hydride (arsine) with zinc;
- c) Absorption of the evolved arsine in a solution of silver diethyldithiocarbamate and l-ephedrin in trichloromethane;
- d) Spectrophotometric measurement of the reddish-violet coloured colloid at a wavelength between 500 nm and 520 nm.

5.1.3 Boron, B

EN 10200:2012, *Chemical analysis of ferrous materials — Determination of boron in steels — Spectrophotometric method*

Range of application:

- Determination of boron content from 0,000 4 % to 0,012 0 % (m/m) in non-alloyed and alloyed steels.

Principle of the method:

- a) Dissolution of a test portion with hydrochloric and nitric acids;
- b) Decomposition of boron compounds (nitrides etc.) with orthophosphoric and sulphuric acids at 290 °C;
- c) Spectrophotometric measurement at a wavelength of 543 nm of the complex formed between boric acid and curcumin in buffered acetic medium.

EN ISO 13900:2002, *Steel — Determination of boron content — Curcumin spectrophotometric method after distillation (ISO 13900:1997)*

Range of application:

- Determination of boron content from 0,000 05 % (m/m) to 0,001 0 % (m/m) 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 sulphuric 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 measurements at a wavelength of about 550 nm.

5.1.4 Calcium, Ca

prEN 10177:2018, *Steels — Determination of calcium content — Flame atomic absorption spectrometric method (FAAS)*

Range of application:

CEN/TR 10261:2018 (E)

- Determination of calcium contents between 0,000 4 % (m/m) and 0,012 0 % (m/m) in non-alloyed and low-alloy steels

Principle of the method:

- Dissolution of a test portion in hydrochloric acid followed by oxidation with nitric acid;
- Addition of a solution of potassium chloride and nebulisation of the test solution into an acetylene/nitrous oxide flame of an atomic absorption spectrometer;
- Spectrometric measurement of the atomic absorption of the 422,7 nm spectral line emitted by a calcium hollow-cathode lamp.

5.1.5 Carbon, C

EN ISO 15349-2:2003, *Unalloyed steel — Determination of low carbon content — Part 2: Infrared absorption method after combustion in an induction furnace (with preheating) (ISO 15349-2:1999)*

Range of application:

- Carbon contents from 0,000 3 % (m/m) to 0,010 % (m/m) in unalloyed steel.

Principle of the method:

- Preheating of a test portion at low temperature and combustion of a test portion with accelerator at a high temperature in an induction furnace in a current of pure oxygen;
- Transformation of carbon into carbon dioxide and/or carbon monoxide;
- Measurement of infrared absorption of the carbon dioxide or carbon dioxide/carbon monoxide evolved from steel and carried by a current of pure oxygen;
- Calibration graph is established using sucrose or calcium carbonate.

EN ISO 9556:2001, *Steel and iron — Determination of total carbon content — Infrared absorption method after combustion in an induction furnace (ISO 9556:1989)*

Range of application:

- Determination of carbon contents from 0,003 % (m/m) to 4,5 % (m/m) in steel and iron.

Principle of the method:

- Combustion of a test portion with accelerator at a high temperature in a high-frequency induction furnace in a current of pure oxygen; transformation of carbon into carbon dioxide and/or carbon monoxide;
- Measurement by infrared absorption of the carbon dioxide and/or carbon monoxide carried by a current of oxygen.

5.1.6 Chromium, Cr

prCEN/TR 10367, *Alloyed steels — Determination of chromium content — Inductively coupled plasma optical emission spectrometric method*

Range of application:

- Determination of the chromium contents (mass fraction) between 5,0 % (m/m) and 27,0 % (m/m) in alloyed steels.