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**SIST-TP CEN/TR 10261:2008**

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**Železo in jeklo - Pregled razpoložljivih metod za kemično analizo**

Iron and steel - Review of available methods of chemical analysis

Eisen und Stahl - Übersicht über verfügbare Verfahren der chemischen Analyse

Aciers et fontes - Méthodes d'analyse chimique disponibles

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| 77.040.30 | Kemijska analiza kovin    | Chemical analysis of metals |
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TECHNICAL REPORT  
RAPPORT TECHNIQUE  
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**CEN/TR 10261**

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English Version

## Iron and steel - Review of available methods of chemical analysis

Aciers et fontes - Méthodes d'analyse chimique disponibles

Eisen und Stahl - Übersicht über verfügbare Verfahren der chemischen Analyse

This Technical Report was approved by CEN on 9 April 2007. It has been drawn up by the Technical Committee ECISS/TC 20.

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## Foreword

This document CEN/TR 10261:2008 has been prepared by Technical Committee ECISS/TC 20 "Methods of chemical analysis of ferrous products", the secretariat of which is held by SIS.

This document supersedes CEN/CR 10261:1995.

This report is a review of European standards methods of chemical analysis of steel and iron. Principles and fields of application for the methods are also indicated.

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**CEN/TR 10261:2008 (E)****1 Scope**

This CEN Technical Report lists, under Clause 2, the European Standards which are currently available for the chemical analysis of steel and iron. In Clause 3, it also provides details of range of application and method principle for each standard.

Items which are under preparation as European Standards or as CEN Technical Reports by ECISS/TC 20 are available on the webpage of CEN, through the link

<http://www.cen.eu/CENORM/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/WP.asp?param=6357&title=ECISS%2FTC+20>.

Annex A contains a list of European Standards, CEN Technical Reports and ECISS Information Circulars relevant for chemical analysis of ferrous materials.

Annex B contains a list of withdrawn Euronorms, together with the corresponding replacement European Standards.

Annex C is a graphical presentation of the concentration ranges for the methods presented in this Technical Report.

**2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

**2.1 Mono-elemental methods****Aluminium, Al**

<https://standards.iteh.ai/catalog/standards/sist/adcb6fc9-0ea7-4716-9f19-41e9ff17507f/sist-tp-cen-tr-10261-2008>

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 10200:1991, *Chemical analysis of ferrous materials — Determination of boron in steel — Spectrophotometric method*

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

**Calcium, Ca**

EN 10177:1989, *Chemical analysis of ferrous materials — Determination of calcium in steels — Flame atomic absorption spectrometric method*

**Carbon, C**

EN 10036:1989, *Chemical analysis of ferrous materials — Determination of total carbon in steels and irons — Gravimetric method after combustion in a stream of oxygen*

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

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, *Steel and iron — Determination of chromium content — Potentiometric or visual method*

### Copper, Cu

EN 24946:1990, *Determination of copper content in steel and cast iron*

EN 24946:1990/AC 1991 (Editorial correction), *Steel and cast iron — Determination of copper content — 2,2' diquinolyl spectrophotometric method (ISO 4946:1984)*

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)*

### Lead, Pb

<https://standards.iteh.ai/catalog/standards/sist/adcb6fc9-0ea7-4716-9f19-41e9817507f6/sist-tp-cen-tr-10261-2008>

EN 10181:1989, *Chemical analysis of ferrous materials — Determination of lead in steels — Flame atomic absorption spectrometric method*

### Manganese, Mn

EN 10071:1989, *Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Electrometric titration method*

EN 24159:1989, *Ferromanganese and ferrosilicomanganese — Determination of manganese content — Potentiometric method (ISO 4159:1978, ed. 1)*

EN 24159:1989/AC 1:1989 (Editorial correction), *Ferromanganese and ferrosilicomanganese — Determination of manganese content — Potentiometric method (ISO 4159:1978, ed. 1)*

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

### Nickel, Ni

EN 10136:1989, *Chemical analysis of ferrous materials — Determination of nickel in steels and irons — Flame atomic absorption spectrometric method*

EN 24938:1990, *Steel and iron — Determination of nickel content — Gravimetric or titrimetric method (ISO 4938:1988)*

EN 24938:1990/AC 1991 (Editorial correction), *Steel and iron — Determination of nickel content — Gravimetric or titrimetric method (ISO 4938:1988)*

**CEN/TR 10261:2008 (E)****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 steel — 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)*

**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 10714:2002)*

**Silicon, Si**

EN 24829-1:1990, *Steel and cast iron — Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 1: Silicon content between 0,05 and 1 % (ISO 4829-1:1986)*

EN 24829-1:1990/AC 1991(Editorial correction), *Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 1: Silicon content between 0,05 and 1,0 % (ISO 4829-1:1986)*

EN 24829-2:1990, *Steel and cast iron — Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 2: Silicon content between 0,01 and 0,05 % (ISO 4829-2:1988)*

EN 24829-2:1990/AC 1991 (Editorial correction), *Steel and cast iron — Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 2: Silicon content between 0,01 and 0,05 % (ISO 4829-2:1988)*

**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 sulphur content — Gravimetric method (ISO 4934:2003)*

**Titanium, Ti**

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



**Vanadium, V**

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

**2.2 Multi-elemental methods**

**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*

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

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

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

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*

**3 Range of application and method principle****3.1 Mono-elemental methods****3.1.1 Aluminium, Al**

<https://standards.iteh.ai/catalog/standards/sist/adcb6fc9-0ea7-4716-9f19-41e9ff17507f/sist-tp-cen-tr-10261-2008>

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

Range of application:

— determination of aluminium contents between 0,005 % (m/m) and 0,20 % (m/m) in non-alloyed steel.

Method principle:

- 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.

**3.1.2 Arsenic, As****3.1.2.1 EN 10212:1995, Chemical analysis of ferrous materials — Determination of arsenic in steel and iron — Spectrophotometric method**

Range of application:

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

Method principle:

- 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;
- 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;
- absorption of the evolved arsine in a solution of silver diethyldithiocarbamate and l-ephedrin in trichloromethane;
- spectrophotometric measurement of the reddish-violet coloured colloid at a wavelength between 500 nm and 520 nm.

**3.1.3 Boron, B****3.1.3.1 EN 10200:1991, Chemical analysis of ferrous materials — Determination of boron in steel — Spectrophotometric method**

Range of application:

— determination of boron content from 0,0004 % to 0,0120 % (m/m) in non-alloyed and alloyed steels.

Method principle:

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

**3.1.3.2 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 0,00005 % to 0,0010 % (m/m) in steel.

Method principle:

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

### 3.1.4 Calcium, Ca

#### 3.1.4.1 EN 10177:1989, Chemical analysis of ferrous materials — Determination of calcium in steels — Flame atomic absorption spectrometric method

Range of application:

— determination of calcium contents greater than 0,0002 % (m/m) in non-alloyed and low-alloy steels.

Method principle:

- a) dissolution of a test portion with hydrochloric acid followed by oxidation with nitric acid;
- b) addition of potassium chloride solution and spraying of the solution into an acetylene-nitrous oxide flame. Determination of the calcium by means of the spectrometric measurement of the atomic absorption of the 422,67 nm line emitted by a calcium hollow cathode lamp.

NOTE Potassium chloride is added to suppress ionization of calcium and the instrument is calibrated by addition of a calcium standard solution to a similar matrix to that of the test solution.

### 3.1.5 Carbon, C

#### 3.1.5.1 EN 10036:1989, Chemical analysis of ferrous materials — Determination of total carbon in steels and irons — Gravimetric method after combustion in a stream of oxygen

Range of application:

— determination of carbon content equal to or greater than 0,1 % (m/m) in steels and irons.

Method principle:

- a) combustion of a test portion in a stream of oxygen in a high temperature furnace iron (1 200 °C – 1 400 °C), with the addition of a fluxing agent to assist combustion;
- b) absorption of the evolved carbon dioxide in soda asbestos contained in a weighed absorption bulb;
- c) calculation of the carbon content from the increase in mass of the absorption bulb.

#### 3.1.5.2 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 between 0,0003 % (m/m) and 0,010 % (m/m) in unalloyed steel.

Method principle:

- a) 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;
- b) transformation of carbon into carbon dioxide and/or carbon monoxide;
- c) measurement of infrared absorption of the carbon dioxide or carbon dioxide/carbon monoxide evolved from steel and carried by a current of pure oxygen;
- d) calibration graph is established using sucrose or calcium carbonate.