PD CEN/TR 10261:2013

BSI Standards Publication

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

bsi.

...making excellence a habit.™

National foreword

This Published Document is the UK implementation of CEN/TR 10261:2013.

The UK participation in its preparation was entrusted to Technical Committee ISE/102, Methods of Chemical Analysis for Iron and Steel.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2013

ISBN 978 0 580 77032 6

ICS 77.040.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2013.

Amendments issued since publication

Amd. No.	Date	Text affected

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 10261

February 2013

ICS 77.040.30

Supersedes CEN/TR 10261:2008

English Version

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

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

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

This Technical Report was approved by CEN on 10 June 2012. It has been drawn up by the Technical Committee ECISS/TC 102.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. CEN/TR 10261:2013: E

Contents

Page

Foreword

This document (CEN/TR 10261:2013) 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 [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TR 10261:2008.

In comparison with the previous edition of CEN/TR 10261:2008, the following significant technical changes were made:

— Title;

— Clause 2, Definitions – added;

— In 3.1, for nitrogen, addition of EN ISO 15351:2010 and EN ISO 4945:2009;

— In 3.1, for silicon, addition of EN ISO 439:2010;

— In 3.1, for titanium, addition of EN 10211:1995;

— In 3.2, for Al, Cr, Co, Cu, Mn, Mo, Ni, P, Sn and V, addition of EN 10351:2011;

— In 3.2, for C and S, addition of EN ISO 15350:2010;

— In 4.1.9.1, Principle of the method - reworded for technical correction;

— 4.1.12.3, Summary of EN ISO 15351:2010, added;

— 4.1.12.4, Summary of EN ISO 4945:2009, added;

— 4.1.15.3, Summary of EN ISO 439:2010, added;

— 4.1.17.1, Summary of EN 10211:1995, added;

— 4.2.1.1, Summary of EN 10351:2011, added;

— 4.2.4.1, Summary of EN ISO 15350:2010, added;

— Annex A, updated;

— Annex C, the concentration ranges are represented in three different graphics: one for the referee methods, one for the routine methods and one for all the methods available.

1 Scope

This Technical Report lists, under Clause 3, the European Standards, which are currently available for the determination of the chemical composition of steel and iron. In Clause 4, it provides details of the range of application and gives the principle of the method for 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 http://www.cen.eu/cen/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/WP.aspx?param=733643&title=ECISS/TC%20102.

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

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

Annex C gives graphical representations of the concentration ranges of the methods available in this Technical Report. Figure C.1 gives the concentration ranges of the referee methods, Figure C.2 gives the concentration ranges of the routine methods and Figure C.3 represents the fields of application of all the methods available.

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

2 Terms and definitions

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

2.1
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

2.2
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)

3 European Standards available for the determination of the chemical composition of steel and iron

3.1 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**

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

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

— **Lead, Pb**

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

— **Manganese, Mn**

EN 10071:2012, *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/AC1:1989 (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)*

— **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)*

— **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), *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 24829-2:1990, *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)*

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 10211:1995, *Chemical analysis of ferrous materials — Determination of titanium in steel and iron — 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)*

3.2 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*

— **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*

4 Range of application and principle of the methods

4.1 Mono-elemental methods

4.1.1 Aluminium, Al

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

Range of application:

— Determination of aluminium contents from 0,005 % 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.

4.1.2 Arsenic, As

4.1.2.1 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 % 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.

4.1.3 Boron, B

4.1.3.1 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. Spectrophotometric measurement at a wavelength of 543 nm of the complex formed between boric acid and curcumin in buffered acetic medium.

4.1.3.2 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 0,000 05 % to 0,001 0 % (m/m) in steel.

Principle of the method:

a) 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;

b) Distillation of the solution after the addition of methanol and collection of methylborate in a receiver containing sodium hydroxide solution;

c) Evaporation of the solution to dryness. Formation of a coloured complex between orthoboric acid and curcumin in a methanol medium;

d) Spectrophotometric measurements at a wavelength of about 550 nm.

4.1.4 Calcium, Ca

4.1.4.1 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 0,000 2 % (m/m) in non-alloyed and low-alloy steels.

Principle of the method:

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.

4.1.5 Carbon, C

4.1.5.1 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.

Principle of the method:

a) Combustion of a test portion in a stream of oxygen in a high temperature furnace (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.

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

Principle of the method:

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.

4.1.5.3 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 % to 4,5 % (m/m) in steel and iron.

Principle of the method:

a) 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;

b) Measurement by infrared absorption of the carbon dioxide and/or carbon monoxide carried by a current of oxygen.

4.1.6 Chromium, Cr

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

Range of application:

— Determination of chromium contents from 0,002 % to 2,0 % (m/m) in non-alloy and low-alloy steels and irons.

Principle of the method:

a) Dissolution of a test portion with hydrochloric acid followed by oxidation with nitric acid. Filtration and ignition of the acid insoluble residue. Removal of silica with hydrofluoric acid. Fusion of the residue with potassium hydrogen sulphate, extraction of the melt in acid and addition of the extract to the reserved filtrate;

b) Determination of the chromium by means of the spectrometric measurement of the atomic absorption of the 357,87 nm line emitted by a chromium hollow cathode lamp when the solution is nebulised into a nitrous oxide acetylene flame.

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

Range of application:

— Determination of chromium contents from 0,25 % to 35 % (m/m) in steel and iron.

Principle of the method:

a) Dissolution of a test portion with appropriate acids;

b) Oxidation of chromium in an acid medium to chromium (VI) by ammonium peroxydisulfate in the presence of silver sulphate. Reduction of manganese (VII) by hydrochloric acid;

c) Reduction of chromium (VI) by ammonium iron (II) sulphate standard solution;

d) In the case of potentiometric detection, determination of the equivalence point by measurement of the potential variation when the ammonium iron (II) sulphate standard solution is being added;

e) In the case of visual detection, titration of the excess ammonium iron (II) sulphate by potassium permanganate standard solution which also acts as the indicator.

4.1.7 Copper, Cu

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

Range of application:

— Determination of copper contents from 0,004 % to 0,5 % (m/m) in steel and cast iron.

Principle of the method:

a) Dissolution of a test portion in mixture of hydrochloric, nitric and perchloric acids. Spraying of the solution into an air-acetylene flame. Spectrometric measurement of the atomic absorption of the 324,7 nm spectral line emitted by a copper hollow cathode lamp.

4.1.7.2 EN 24946:1990, *Steel and cast iron — Determination of copper content — 2,2'diquinolyl spectrophotometric method (ISO 4946:1984)*.

Range of application:

— Determination of copper contents from 0,02 % to 5 % (m/m) in steel and cast irons.

Principle of the method:

a) Dissolution of a test portion with appropriate acids;

b) Fuming with perchloric acid to remove hydrochloric and nitric acids and dehydrate silicic acid;

c) Reduction of copper (II) to copper (I) in hydrochloric acid solution by means of ascorbic acid. Formation of a coloured compound of copper (I) with 2,2'-diquinolyl;

d) Spectrophotometric measurement at a wavelength of about 545 nm.

4.1.8 Lead, Pb

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

Range of application:

— Determination of lead contents from 0,003 % to 0,5 % (m/m) in non-alloy and low-alloy steels.

Principle of the method:

a) Dissolution of a test portion with hydrochloric acid followed by oxidation with nitric acid;

b) Spraying of the solution into an air-acetylene flame. Determination of the lead by means of the spectrometric measurement of the atomic absorption of the 283,3 nm line emitted by a lead radiation source;

c) The instrument is calibrated by addition of a lead standard solution to a similar matrix to that of the test solution.

4.1.9 Manganese, Mn

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

Range of application:

— Determination of manganese contents greater than or equal to 0,5 % (m/m) in unalloyed, low alloy or alloyed steels and irons.

Principle of the method:

a) Dissolution of the test portion with appropriate acids, followed by a partial neutralisation of the acids with sodium hydrogen carbonate;

b) Precipitation of the interfering cations with zinc oxide;

c) Titration of Mn (II) with a potassium permanganate solution, in a pyrophosphoric medium at a pH of about 6,5;

d) The oxidation-reduction reaction [oxidation of Mn (II) to Mn (III)] is controlled by an electrometric measurement.

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

Range of application:

— Determination of manganese content of ferromanganese and ferrosilicomanganese alloys containing from 55 to 95 % (m/m) of manganese.

Principle of the method:

a) Dissolution of a test portion with hydrochloric, hydrofluoric and perchloric acids. Potentiometric determination of manganese with potassium permanganate in a pyrophosphoric medium at a controlled pH, according to the reaction:

$$4\ Mn^{2+} + MnO_4^- + 8\ H^+ + 15\ (P_2O_7H_2)^{2-} \rightarrow 5\ Mn(P_2O_7H_2)_3^{3-} + 4\ H_2O$$

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

Range of application:

— Determination of manganese contents from 0,002 % to 2,0 % (m/m).

Principle of the method:

a) Dissolution of a test portion in hydrochloric and nitric acids followed by evaporation with perchloric acid until white fumes appear;

b) Spraying of the solution into an air-acetylene flame;

c) Spectrometric measurement of the atomic absorption of the 279,5 nm spectral line emitted by a manganese hollow cathode lamp.

4.1.10 Nickel, Ni

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

Range of application:

— Determination of nickel contents from 0,003 % to 2 % (m/m) in steels and irons.

Principle of the method:

a) Dissolution of a test portion in a mixture of appropriate acids and fuming with perchloric acid;

b) Spraying of the solution into an air-acetylene flame; determination of the nickel by means of the spectrometric measurement of the atomic absorption of the 232,0 nm or 352,5 nm line emitted by a nickel hollow cathode lamp;

c) The instrument is calibrated by addition of a nickel standard solution to a similar matrix to that of the test solution.

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

Range of application:

— Determination of nickel contents from 0,5 % to 30 % (m/m) in steel and iron.

Principle of the method:

a) Dissolution of a test portion with appropriate acids. Precipitation of the nickel as nickel dimethylglyoxime:

   1) Cobalt, if present, is oxidised by potassium hexacyanoferrate (III);

   2) Copper, if present with cobalt, preferably is removed by controlled-potential electrolysis.

b) Acid dissolution of the precipitate followed by a second precipitation of the nickel as nickel dimethylglyoxime;

c) In the case of the gravimetric finish, weighing of the dried nickel dimethylglyoxime precipitate;

d) In the case of titrimetric finish, acid dissolution of the precipitate, addition of excess EDTA.Na_2 solution and back titration of the excess EDTA.Na_2 by zinc solution using xylenol orange as an indicator.

4.1.11 Niobium, Nb

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

Range of application:

— Determination of niobium contents from 0,002 % to 1,3 % (m/m) in steels.

Principle of the method:

a) Dissolution of a test portion with hydrochloric acid followed by oxidation with hydrogen peroxide. Precipitation of niobium and tantalum with phenylarsonic acid using zirconium as a carrier;

b) Formation of a complex of niobium with 4-(2-pyridylazo)-resorcinol (PAR) in a buffered sodium tartrate medium; spectrophotometric measurement of the coloured compound at a wavelength of 550 nm.

4.1.12 Nitrogen, N

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

Range of application:

— Determination of nitrogen contents from 0,000 5 % to 0,005 % (m/m) in steels.

Principle of the method:

a) Dissolution of the test portion with hydrochloric acid and separation of the acid-insoluble residue by means of a centrifuge;

b) Decomposition of the acid-insoluble residue by intense fuming with sulphuric acid and addition of the extract to the solution of the test portion containing the acid soluble nitrogen;

c) Recovery of the total nitrogen as ammonia by steam distillation over sodium hydroxide;

d) Spectrophotometric measurement of the coloured complex produced by the indophenol blue reaction.

4.1.12.2 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)*.

Range of application:

— Determination of nitrogen contents from 0,000 8 % to 0,5 % (m/m) in steels and irons.

Principle of the method:

a) Fusion of a test portion in a single-use graphite crucible under helium gas at a high temperature (e.g. 2 200 °C). Extraction of the nitrogen in the form of molecular nitrogen in the stream of helium;

b) Separation from the other gaseous extracts and measurement by thermal conductimetric method.

4.1.12.3 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)*.

Range of application:

— Determination of nitrogen contents from 0,002 % to 0,6 % (m/m) in steels and irons.

Principle of the method:

a) Fusion of a test portion in a single-use graphite crucible under helium gas at a high temperature (e.g. 2 200 °C). Extraction of the nitrogen in the form of molecular nitrogen in the stream of helium;

b) Separation from the other gaseous extracts and measurement by thermal conductimetric method;

c) Calibration graph established using steel or iron certified reference materials (CRM).

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

Range of application:

— Determination of nitrogen contents from 0,002 % to 0,050 % (m/m), in non-alloy and low-alloy steels containing less than 0,6 % (m/m) of silicon.

Principle of the method:

a) Dissolution of a test portion in dilute sulphuric acid;

b) After concentration, progressive increasing of the temperature to above 300 °C;

c) Separation of ammonia from the ammonium salt formed, by displacement and distillation in a boiling sodium hydroxide medium and collecting in an acid medium;

d) At ambient temperature, formation of a blue-coloured complex between the ammonium ions and phenol in the presence of sodium hypochlorite and sodium pentacyanonitrosylferrate (II) (sodium nitroprusside). Spectrophotometric measurement of the complex at a wavelength of about 640 nm.

4.1.13 Oxygen, O

4.1.13.1 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*.

Range of application:

— Determination of oxygen contents < 0,005 0 % (also applicable for higher contents). This standard is applicable to steels having a hardness of < 400 HBW 10/3000.

Principle of the method:

a) Samples for oxygen determination are machined to a suitable shape and size within the restrictions imposed by the instrument used. In order to ensure that the surface has the minimum possible oxygen content, samples for analysis are prepared either by punching (Method A) or by turning (Method B).

4.1.13.2 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*.

Range of application:

— Determination of oxygen contents from 0,000 5 % to and 0,01 % (m/m) in steels and irons.

Principle of the method:

a) Fusion of a test portion in a single-use graphite crucible under helium gas at a minimum temperature of 2 000 °C. Combination of the oxygen from the sample with carbon from the crucible to form carbon monoxide. Eventually transformation of carbon monoxide into carbon dioxide;

b) Measurement of infrared absorption of the carbon monoxide or dioxide and use of a calibration curve plotted using the measurements obtained with potassium nitrate.

4.1.14 Phosphorus, P

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

Range of application:

— Determination of phosphorus content from 0,005 % to 0,25 % (m/m) in non-alloyed steels and irons.

Principle of the method:

a) Dissolution of a test portion in nitric and hydrochloric acids and controlled addition of perchloric acid;

b) Formation of the phosphomolybdate complex after removal of silicon and arsenic and reduction with hydrazine sulphate to molybdenum blue;

c) Spectrophotometric measurement of the blue complex at a wavelength of 680 nm or 825 nm.

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

Range of application:

— Determination of phosphorus contents from 0,001 0 % to 1,0 % (m/m) in steels and irons.

Principle of the method:

a) Dissolution of a test portion in an oxidising acid mixture;

b) Fuming with perchloric acid and removal of chromium as volatile chromyl chloride;

c) Conversion of phosphorus to phosphovanadomolybdate in perchloric and nitric acid solution;

d) Extraction of phosphovanadomolybdate by 4-methyl-2-pentanone with citric acid present to complex arsenic;

e) Spectrophotometric measurement at a wavelength of 355 nm.

4.1.15 Silicon, Si

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

Range of application:

— Determination of total silicon contents from 0,05 % to 1,0 % (m/m) in steels and cast irons.

Principle of the method:

a) Dissolution of a test portion in an acid mixture appropriate to the alloy composition. Fusion of the acid-insoluble residue with sodium peroxide. Formation of the oxidised molybdosilicate (yellow) in weak acid solution;

b) Selective reduction of the molybdosilicate complex to reduced blue complex with ascorbic acid, after increasing the sulphuric acid concentration and adding oxalic acid to prevent the interference of phosphorus, arsenic and vanadium;

c) Spectrophotometric measurement of the reduced blue complex at a wavelength of about 810 nm.

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

Range of application:

— Determination of total silicon contents from 0,01 % to 0,05 % (m/m) in steels and cast irons.

Principle of the method:

a) Dissolution of a test portion in a hydrochloric acid/nitric acid mixture. Fusion of the acid-insoluble residue with sodium peroxide. Formation of the oxidised molybdosilicate (yellow) complex in weak acid solution;

b) Selective reduction of the molybdosilicate complex to a blue complex with ascorbic acid, after increasing the sulphuric acid concentration and adding oxalic acid to prevent the interference of phosphorus, arsenic and vanadium;

c) Spectrophotometric measurement of the reduced blue complex at a wavelength of about 810 nm.

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

Range of application:

— Determination of total silicon contents from 0,10 % to 5,0 % (m/m) in steels and cast irons.

Principle of the method:

a) Attack of a test portion by hydrochloric and nitric acids;

b) Conversion of acid-soluble silicon compounds to hydrated silicon dioxide by evaporation with perchloric acid until white fumes appear. Filtration of the hydrated silicon dioxide and acid-insoluble silicon compounds, ignition to form impure silicon dioxide and then weighing;

c) Treatment of the ignited residue with hydrofluoric and sulphuric acids, followed by ignition and weighing.

4.1.16 Sulphur, S

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

Range of application:

— Determination of sulphur contents from 0,002 % to 0,10 % (m/m) in steels and irons.

Principle of the method:

a) Combustion of a test portion with accelerator at a high temperature in a high-frequency induction furnace in a current of pure oxygen;

b) Transformation of sulphur into sulphur dioxide;

c) Measurement by infrared absorption of the sulphur dioxide carried by a current of oxygen.

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

Range of application:

— Determination of sulphur content from 0,003 % to and 0,35 % (m/m) in steels and irons.

Principle of the method:

a) Dissolution of a test portion in dilute nitric acid in the presence of bromine, or in the mixed acid of nitric acid and hydrochloric acid in the presence of bromine (with the aid of an appropriate device to prevent sulphur losses);

b) Addition of perchloric acid and evaporation of the solution until white fumes of perchloric acid are evolved;

c) Filtration of the solution and removal of the dehydrates of silicon, tungsten, niobium, etc;

d) Addition of a determined quantity of sulphur ions to aid precipitation;

e) Chromatographic separation of the sulphur ions from the test solution by adsorption on an alumina column, and elution using an ammonium hydroxide solution;

f) Precipitation of the sulphate ions as barium sulphate under controlled conditions and filtering, washing, heating and weighing.

4.1.17 Titanium, Ti

4.1.17.1 EN 10211:1995, *Chemical analysis of ferrous materials — Determination of titanium in steel and iron — Flame atomic absorption spectrometric method*.

Range of application:

— Determination of titanium contents from 0,01 % to 1 % (m/m) in alloyed and non-alloyed steels and irons.

Principle of the method:

a) Acid dissolution of a test portion;

b) Fusion of the residue with sodium carbonate and boric acid, if necessary;

c) Addition of aluminium chloride as interaction buffer;

d) Nebulisation of the solution in a nitrous oxide-acetylene flame;

e) Measurement at the wavelength of 365,3 nm.

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

Range of application:

— Determination of titanium contents from 0,002 % to 0,80 % (m/m) in steels and irons.

Principle of the method:

a) Dissolution of a test portion in hydrochloric, nitric and sulphuric acids;

b) Fusion of the residue with potassium hydrogen sulphate;

c) Formation of a yellow complex with 4,4'-diantipyrylmethane;

d) Spectrophotometric measurement of the coloured complex at a wavelength of about 385 nm.

4.1.18 Vanadium, V

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

Range of application:

— Determination of vanadium content from 0,04 % to 2 % (m/m) in steels and cast irons.

Principle of the method:

a) Dissolution of a test portion with appropriate acids; addition of hydrofluoric acid to keep tungsten in solution;

b) Oxidation of chromium and vanadium by potassium peroxydisulphate. Partial oxidation of chromium;

c) While checking the potential of the solution:

   1) reduction of chromium (VI) and vanadium (V) by ammonium iron (II) sulphate;

2) oxidation of vanadium by slight excess of potassium permanganate; reduction of the excess permanganate by sodium nitrite, and reduction of the excess sodium nitrite by sulphamic acid:

d) Potentiometric titration of vanadium by ammonium iron (II) sulphate standard solution.

4.2 Multi-elemental methods

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

4.2.1.1 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].*

Range of application:

— Determination of aluminium (total) contents from 0,020 % to 0,30 % (m/m);

— Determination of chromium contents from 0,010 % to 1,60 % (m/m);

— Determination of cobalt contents from 0,002 % to 0,10 % (m/m);

— Determination of copper contents from 0,005 % to 0,80 % (m/m);

— Determination of manganese contents from 0,005 % to 2,00 % (m/m);

— Determination of molybdenum contents from 0,005 % to 0,80 % (m/m);

— Determination of nickel contents from 0,010 % to 2,00 % (m/m);

— Determination of phosphorus contents from 0,005 % to 0,05 % (m/m);

— Determination of tin contents from 0,001 % to 0,10 % (m/m);

— Determination of vanadium contents from 0,002 % to 0,40 % (m/m).

Principle of the method:

a) Dissolution of a test portion with nitric and hydrochloric acids. Filtration and ignition of the acid insoluble residue. Removal of silica with hydrofluoric acid. Fusion of the residue with a mixture of orthoboric acid and potassium carbonate, dissolution of the melt with acid and addition of this solution to the reserved filtrate;

b) After suitable dilution and, if necessary, addition of an internal reference element, nebulisation of the solution into an inductively coupled plasma optical emission spectrometer and measurement of the intensity of the emitted light (including, where relevant, the intensity of the internal reference element).

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

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

Range of application:

— Determination of aluminium contents from 0,01 % to 60 % (m/m);

— Determination of lead contents from 0,005 % to 0,1 % (m/m);

— Determination of nickel contents from 0,01 % to 15 % (m/m);

— Determination of silicon contents from 0,01 % % to 3 % (m/m);

— Determination of zinc contents from 40 % to 100 % (m/m).

Principle of the method:

The analytic method described here involves the following processes:

a) Cathodic sputtering of the surface coating in a direct current glow discharge device;

b) Optical excitation of the analyte atoms in the plasma formed on the glow discharge device;

c) Spectrometric measurements of characteristic emission spectral lines of the analyte atoms as a function of sputtering time (depth profile);

d) Conversion of the depth profile in units of intensity versus time to mass fraction versus depth by means of calibration functions (quantification); calibration of the system is achieved by measurements on calibration samples of known chemical composition and measured sputtering rate.

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

4.2.3.1 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*.

Range of application:

CR 10320 does not specify the range of application of the routine method described.

Nevertheless, from the composition of the samples used for the evaluation of the precision data, the following INFORMATIVE ranges may be listed:

— Determination of Carbon contents from 0,001 % to 1,0 % (m/m);

— Determination of Chromium contents from 0,01 % to 0,3 % (m/m);

— Determination of Copper contents between 0,01 % and 0,45 % (m/m);

— Determination of Manganese contents from 0,4 % to 1,3 % (m/m);

— Determination of Nickel contents between 0,01 % and 0,14 % (m/m);

— Determination of Phosphorus contents from 0,008 % to 0,12 % (m/m);

— Determination of Silicon contents from 0,05 % to 0,25 % (m/m);

— Determination of Sulphur contents from 0,007 % to 0,04 % (m/m).

Principle of the method:

The principle of the method is not described in CR 10320. It can however be summarised as follows:

a) Measurement of the intensity of the radiation, whose wavelength is characteristic of each element, generated by the spark resulting from the application of an electrical discharge between the sample, as one electrode, and an inert counter-electrode;

b) The intensity measured is compared with the calibration of the element intensities and then converted to the element content.

4.2.4 Carbon, C and Sulphur, S

4.2.4.1 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).*

Range of application:

— Determination of carbon contents from 0,005 % to 4,3 % (m/m);

— Determination of sulfur contents from 0,000 5 % to 0,33 % (m/m).

Principle of the method:

a) The carbon is converted to carbon monoxide and/or carbon dioxide by combustion in a stream of oxygen. Measurement is by infrared absorption of the carbon monoxide and carbon dioxide carried by a current of oxygen;

b) The sulfur is converted to sulfur dioxide by combustion in a stream of oxygen. Measurement is by infrared absorption of the sulfur dioxide carried by a current of oxygen.

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

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

Range of application:

— Determination of Chromium contents from 10 % to 25 % (m/m);

— Determination of Cobalt contents from 0,015 % to 0,30 % (m/m);

— Determination of Copper contents from 0,02 % to 1,5 % (m/m);

— Determination of Manganese contents from 0,05 % to 5,0 % (m/m);

— Determination of Molybdenum contents from 0,1 % to 6,5 % (m/m);

— Determination of Nickel contents from 0,1 % to 30 % (m/m);

— Determination of Niobium contents from 0,05 % to 1,0 % (m/m);

— Determination of Phosphorus contents from 0,005 % to 0,035 % (m/m);

— Determination of Silicon contents from 0,05 % to 1,5 % (m/m);

— Determination of Titanium contents from 0,015 % to 0,50 % (m/m);

— Determination of Vanadium contents from 0,015 % to 0,15 % (m/m).

Principle of the method:

a) The sample is finished to a clean uniform surface and then irradiated by an X-ray beam of high energy;

b) The secondary X-rays produced are dispersed by means of crystals and the intensities are measured by detectors at selected characteristic wavelengths; the measuring time is set to reach below a specified counting statistical error;

c) Preliminary concentrations of the elements are determined by relating the measured intensities of unknown samples to analytical curves prepared from reference materials, CRM or RM, of known compositions; the final concentrations are calculated by using the results obtained by measuring a CRM of the same grade;

d) The correction is made for the elements of interest by using the difference between the certified value and the value obtained during the measurement of the CRM (the "near by technique");

e) A fixed channel or a sequential system may be used to provide simultaneous or sequential determinations of element concentrations.

Annex A
(informative)

List of other European Standards and CEN Technical Reports applicable for the determination of the chemical composition of steels and irons

Reference	Title
EN ISO 14284:2002	*Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*
CR 10299:1998	*Guidelines for the preparation of standard routine methods with wavelength-dispersive X-ray fluorescence spectrometry*
CR 10316:2001	*Optical emission analysis of low alloy steels (routine method) — Guidelines for the preparation of standard routine method for optical emission spectrometry*
CEN/TR 10317:2013	*European certified reference materials (EURONORM-CRMs) for the determination of the chemical composition of iron and steel products prepared under the auspices of the European Committee for Iron and Steel Standardization (ECISS)*
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*
CR 10321:2003	*Chemical analysis of ferrous materials — Recommendations for the drafting of standard methods of analysis employing flame atomic absorption spectrometry for the chemical analysis of iron and steel*
CR 10322:2003	*Chemical analysis of ferrous materials — Operational guidelines for the application of flame atomic absorption spectrometry in standard methods for the chemical analysis of iron and steel*
CEN/TR 10345:2008	*Guideline for statistical data treatment of inter laboratory tests for validation of analytical methods*
CEN/TR 10350:2013	*Analysis of steels and irons — Internal laboratory procedure for checking the accuracy of an analytical method by using Certified Reference Materials*
CEN/TR 10353:2011	*Chemical analysis of ferrous materials — Analysis of ferro-silicon — Determination of Al, Ti and P by inductively coupled plasma optical emission spectrometry*
CEN/TR 10354:2011	*Chemical analysis of ferrous materials — Analysis of ferro-silicon — Determination of Si and Al by X-ray fluorescence spectrometry*

Annex B
(informative)

List of withdrawn Euronorms and of the corresponding replacement European standards

Withdrawn Euronorms		Replaced by	
EU 36:1983	*Chemical analysis of ferrous materials — Determination of total carbon in steels and irons — Gravimetric method after combustion in a stream of oxygen*	EN 10036	*Chemical analysis of ferrous materials — Determination of total carbon in steels and irons — Gravimetric method after combustion in a stream of oxygen*
EU 39:1962	*Chemical analysis of steel and iron — Determination of manganese content in steels and irons — Titrimetric method after oxidation with peroxidosulphate*	EN 10071	*Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Electrometric titration method*
EU 40:1962	*Chemical analysis of ferrous materials — determination of total silicon in steels and irons — Gravimetric method*	EN ISO 439	*Steel and iron — Determination of total silicon content — Gravimetric method (ISO 439)*
EU 41:1965	*Chemical analysis of ferrous materials — Determination of phosphorus in steels and irons — Alkalimetric method*	-	-
EU 42:1966	*Chemical analysis of ferrous materials — Determination of sulphur in steels and irons — Method combustion in a stream of oxygen*	EN 24935	*Steel and iron — Determination of sulphur content — Infrared absorption method after combustion in an induction furnace (ISO 4935)*
EU 50:1986	*Chemical analysis of ferrous materials — determination of nitrogen in steels — Spectrophotometric method*	EN ISO 4945	*Steel — Determination of nitrogen content — Spectrophotometric method (ISO 4945)*
EU 70:1971	*Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Photometric method*	-	-
EU 71:1983	*Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Electrometric titration method*	EN 10071	*Chemical analysis of ferrous materials — Determination of manganese in steels and irons — Electrometric titration method*
EU 72:1971	*Chemical analysis of ferrous materials — Determination of aluminium in steels — Gravimetric method*	EN 29658	*Steel — Determination of aluminium content — Flame atomic absorption spectrometric method (ISO 9658)*
EU 74:1972	*Chemical analysis of ferrous materials — Determination of copper in steels and irons — Photometric method*	EN 24946	*Determination of copper content in steel and cast iron*
EU 75:1978	*Chemical analysis of ferrous materials — determination of the molybdenum in steels and cast irons — Photometric method*	-	

(continued)

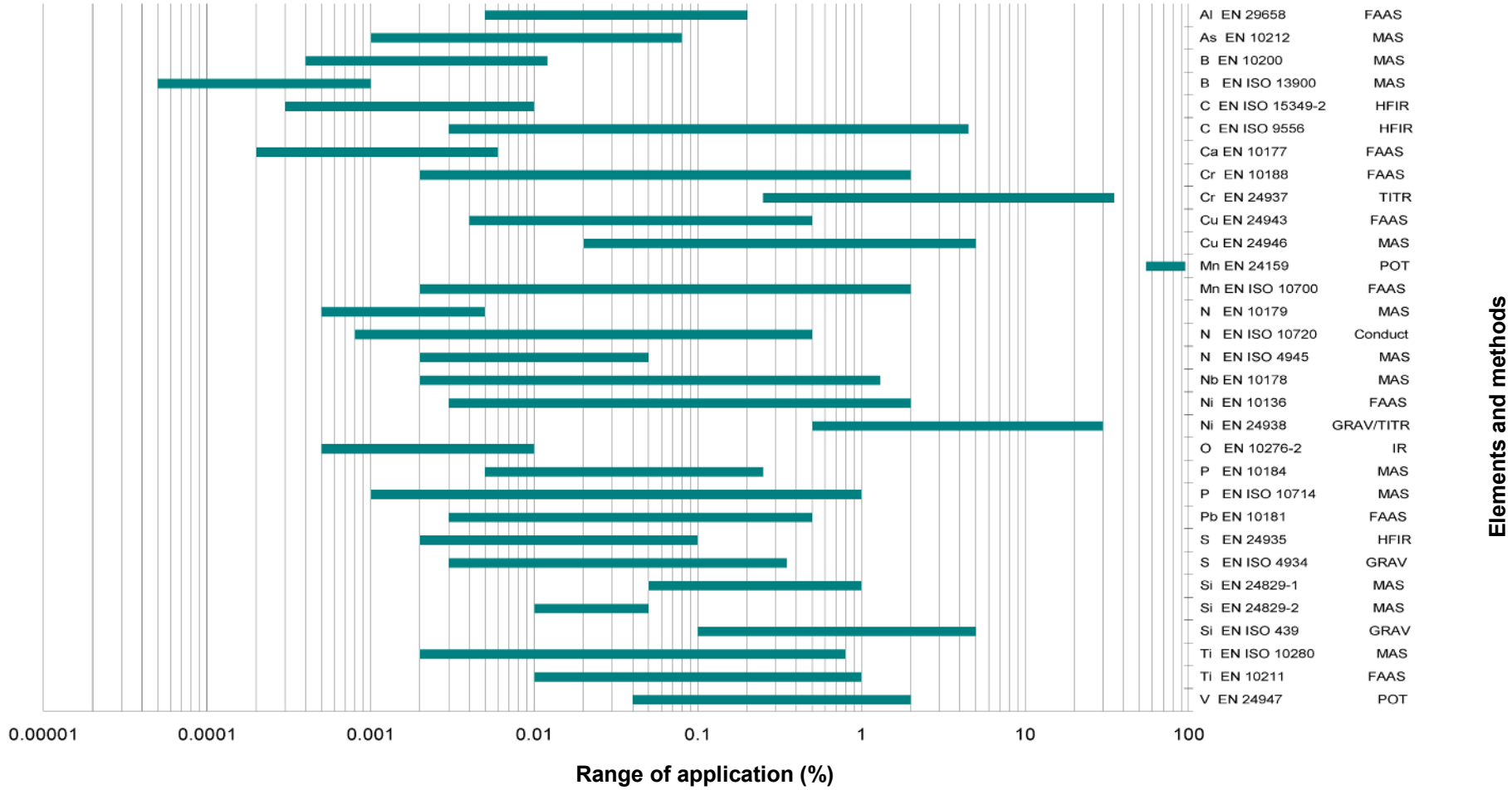
Withdrawn Euronorms		Replaced by	
EU 76:1966	*Chemical analysis of ferrous materials — Determination of silicon in steels and irons — Spectrophotometric method*	EN 24829-1	*Steel and cast iron — Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 1: Silicon contents between 0,05 and 1 % (ISO 4829-1)*
		EN 24829-2	*Steel and cast iron — Determination of total silicon content — Reduced molybdosilicate spectrophotometric method — Part 2: Silicon contents between 0,01 and 0,05 % (ISO 4829-2)*
EU 99:1980	*Chemical analysis of ferrous materials — Determination of chromium in steels and irons — Method by photometric and visual titration*	EN 24937	*Steel and iron — Determination of chromium content — Potentiometric or visual titration method (ISO 4937)*
EU 100:1972	*Chemical analysis of ferrous materials — Determination of chromium in steels and irons — Photometric method*	-	
EU 102:1982	*Chemical analysis of ferrous materials — Determination of nickel in steels and irons — Gravimetric or volumetric method*	EN 24938	*Steel and iron — Determination of nickel content — Gravimetric or titrimetric method (ISO 4938)*
EU 110:1980	*Chemical analysis of ferrous materials — Determination of vanadium in steels and irons — Method by potentiometric titration*	EN 24947	*Steel and cast iron — Determination of vanadium content — Potentiometric titration method (ISO 4947)*
EU 134:1978	*Chemical analysis of ferrous materials — Determination of aluminium in non-alloy steels — Method by atomic absorption spectrometry*	EN 29658	*Steel — Determination of aluminium content — Flame atomic absorption spectrometric method (ISO 9658)*
EU 136:1985	*Chemical analysis of ferrous materials — Determination of nickel in steels and irons — Flame atomic absorption spectrometric method*	EN 10136	*Chemical analysis of ferrous materials — Determination of nickel in steels and irons — Flame atomic absorption spectrometric method*
EU 174:1983	*Ferromanganese and ferrosilicomanganese — Determination of manganese content — Potentiometric method*	EN 24159	*Ferromanganese and ferrosilicomanganese — Determination of manganese content — Potentiometric method (ISO 4159)*
EU 177:1985	*Chemical analysis of ferrous materials — Determination of calcium in steels — Flame atomic absorption*	EN 10177	*Chemical analysis of ferrous materials — Determination of calcium in steels — Flame atomic absorption spectrometric method*
EU 178:1985	*Chemical analysis of ferrous materials — Determination of niobium in steels — Spectrophotometric method*	EN 10178	*Chemical analysis of ferrous materials — Determination of niobium in steels — Spectrophotometric method*
EU 179:1985	*Chemical analysis of ferrous materials — Determination of nitrogen (trace amounts) in steels — Spectrophotometric method*	EN 10179	*Chemical analysis of ferrous materials — Determination of nitrogen (trace amounts) in steels — Spectrophotometric method*
EU 180:1985	*Chemical analysis of ferrous materials — Determination of sulphur in steels and irons — Gravimetric method*	EN ISO 4934	*Steel and iron — Determination of sulfur content — Gravimetric method (ISO 4934)*
EU 181:1985	*Chemical analysis of ferrous materials — Determination of lead in steels — Flame atomic absorption spectrometric method*	EN 10181	*Chemical analysis of ferrous materials — Determination of lead in steels — Flame atomic absorption spectrometric method*
EU 182:1986	*Chemical analysis of ferrous materials — Determination of titanium in steels — Spectrophotometric method*	EN 10280	*Steel and iron — Determination of titanium content — Diantipyrylmethane spectrophotometric method (ISO 10280)*

(continued)

Withdrawn Euronorms		Replaced by	
EU 184:1987	*Chemical analysis of ferrous materials — Determination of phosphorus in steels and irons – Spectrophotometric method*	EN 10184	*Chemical analysis of ferrous materials — Determination of phosphorus in non-alloyed steels and irons — Molybdenum blue spectrophotometric method*
EU 188:1987	*Chemical analysis of ferrous materials — Determination of chromium in steels and irons — Flame atomic absorption spectrometric method*	EN 10188	*Chemical analysis of ferrous materials — Determination of chromium in steels and irons — Flame atomic absorption spectrometric method*

Annex C
(informative)

Graphical representation of the scope for methods available in this technical report



NOTE: C EN 10036:1989 GRAV Low limit 0,1 % (m/m). High limit no information
Mn EN 10071:2012 POT Low limit 0,5 % (m/m). High limit no information

Figure C.1 — Graphical representation of the scope of the referee methods

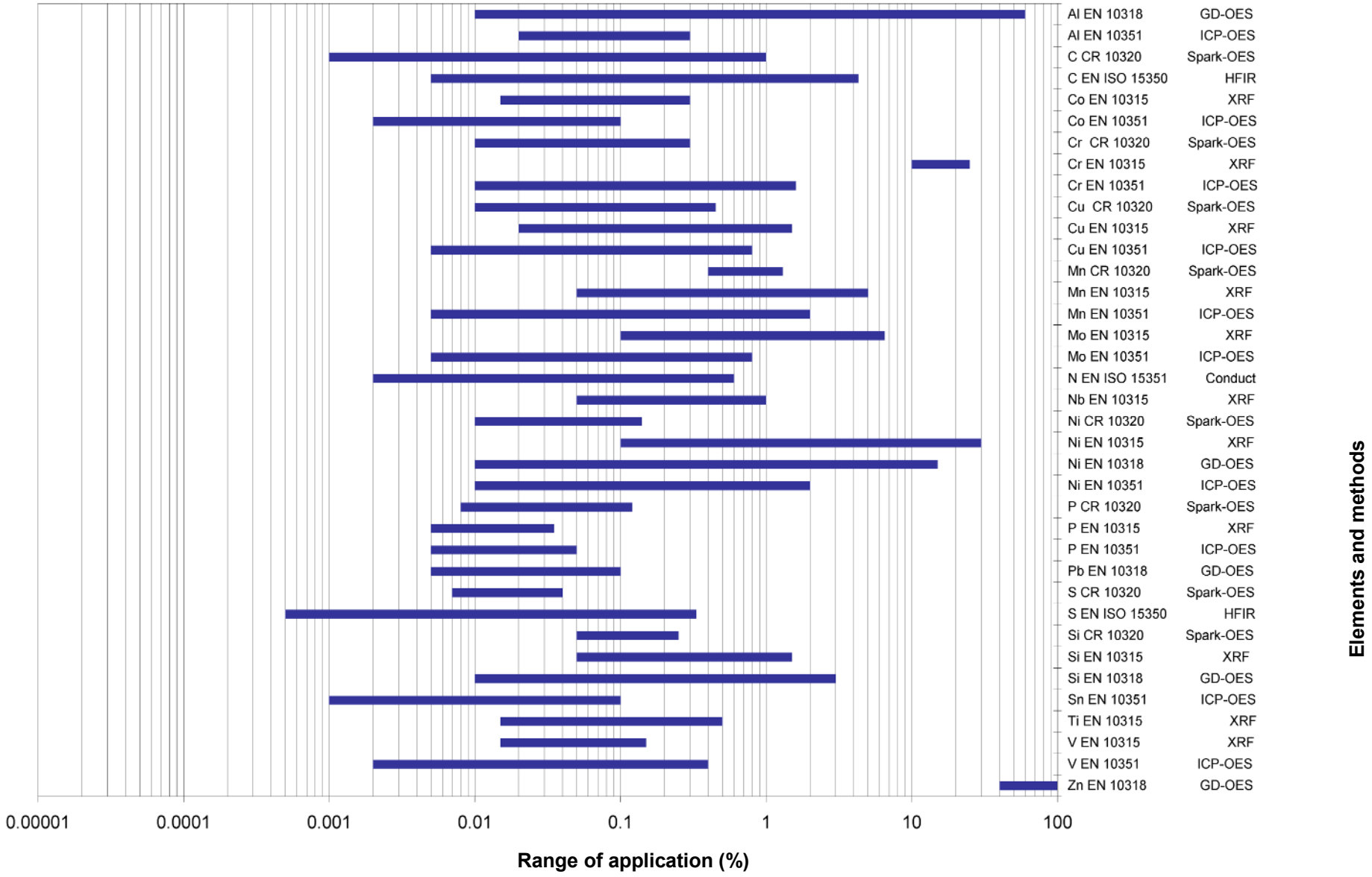


Figure C.2 — Graphical representation of the scope of the routine methods

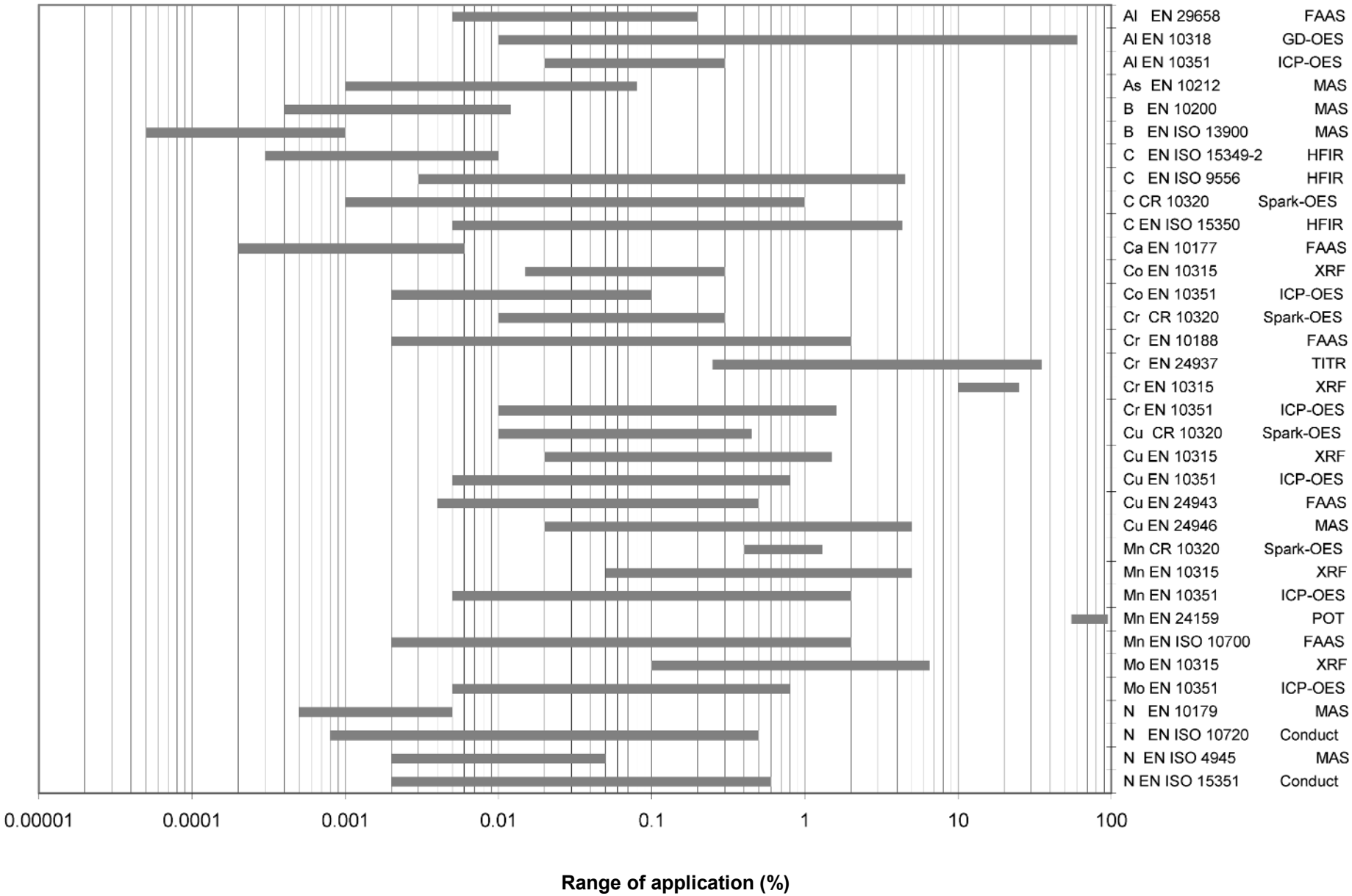


Figure C.3 — Graphical representation of the scope of all the methods available *(continued)*

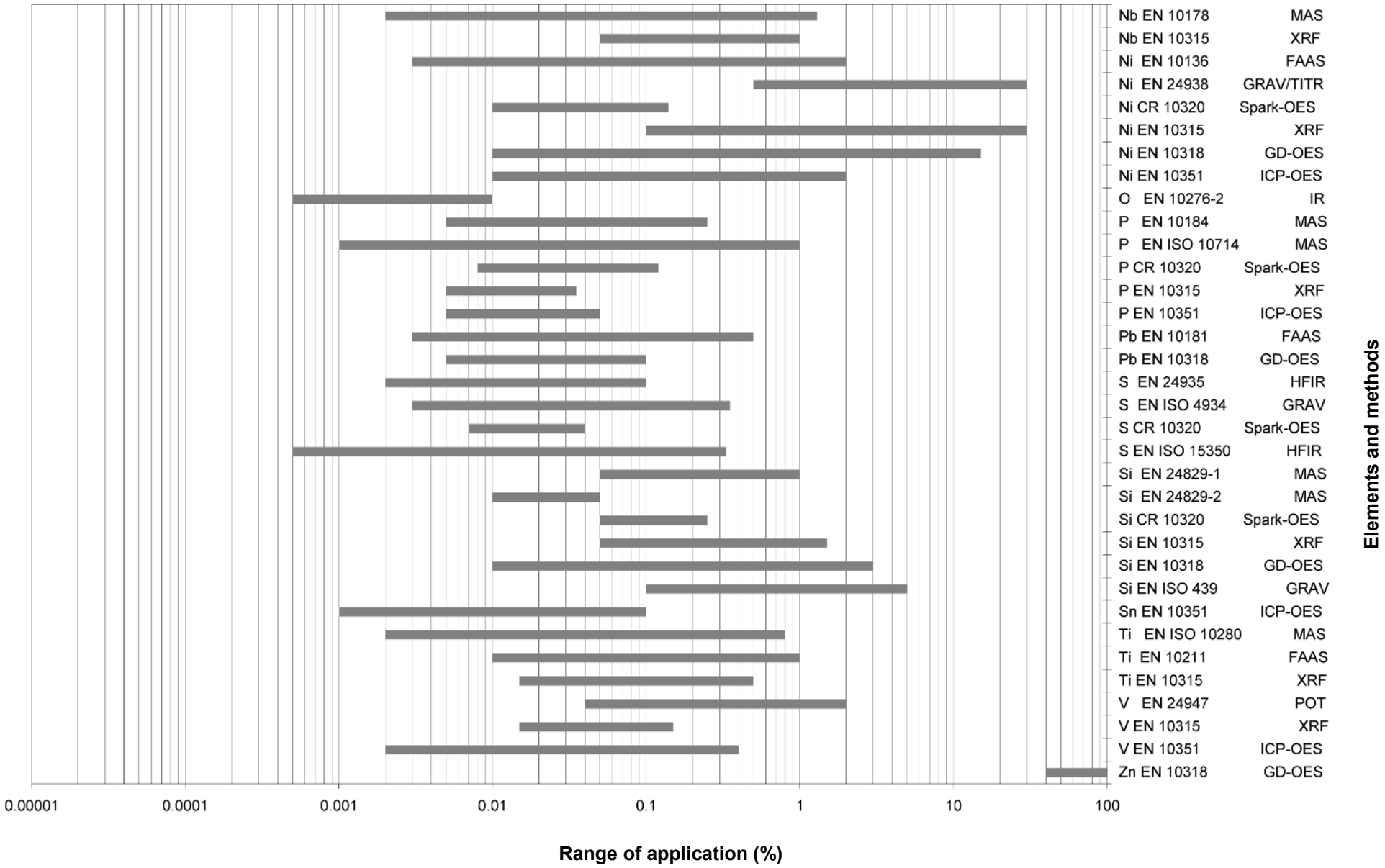


Figure C.3 — Graphical representation of the scope of all the methods available *(concluded)*

Annex D
(informative)

Trilingual key of the abbreviations used in the Figures given in Annex C

Abbreviation	Language	Key
Conduct	English	Thermal conductivity
	French	Conductibilité thermique
	German	Wärmeleitfähigkeitmessung
FAAS	English	Flame atomic absorption spectrometry
	French	Spectrométrie d'absorption atomique dans la flamme
	German	Flammen-Atomabsorptionsspektrometrie
GD-OES	English	Optical emission spectrometry + Glow discharge
	French	Spectrométrie d'émission optique + Source à décharge luminescente
	German	Optische Emissionsspektrometrie + Glimmentladung
GRAV	English	Gravimetric method
	French	Méthode gravimétrique
	German	Gravimetrie Methoden
GRAV/TITR	English	Gravimetry or titration
	French	Gravimétrie ou titrage
	German	Gravimetrie oder Maßanalyse
HFIR	English	Combustion - Infrared absorption
	French	Combustion- Absorption infrarouge
	German	Verbrennung - Infrarot-Absorption
ICP-OES	English	Optical emission spectrometry + Inductively coupled plasma
	French	Spectrométrie d'émission optique + Source à plasma induit
	German	Optische Emissionsspektrometrie + Induktiv gekoppeltes Plasma
IR	English	Infrared
	French	Infrarouge
	German	Infrarot
MAS	English	Spectrophotometry
	French	Spectrophotométrie d'absorption moléculaire
	German	Spektrophotometrie
POT	English	Titration, potentiometric end point
	French	Titrage, détection potentiométrique
	German	Maßanalyse, potentiometrische Endpunkterkennung
Spark-OES	English	Optical emission spectrometry + Spark
	French	Spectrométrie d'émission optique + Etincelle
	German	Optische Emissionsspektrometrie + Funken
TITR	English	Titration method
	French	Titrage
	German	Maßanalyse
XRF	English	X-ray fluorescence spectrometry
	French	Fluorescence de rayons X
	German	Röntgenfluoreszenzanalyse

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™