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ECISS Information Circular 11 - Iron and steel - Review of available methods of chemical analysis

ECISS Mitteilung 11 - Eisen und Stahl - Überblick von verfügbaren chemischen Analysenverfahren

Circulaire d'information ECISS 11 - Aciers et fontes - Méthodes d'analyse chimique

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Iron and Steel -
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This CEN REPORT has been established by Technical Committee ECISS/TC 20 and has been approved by COCOR on 1994-04-14.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

The ECISS Information Circular is an agreed document containing data, information, recommendations and other appropriate material which is not appropriate to an EN or HD but relating to the aims and work of ECISS.

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INFORMATION CIRCULAR

Steel and iron - Review of available methods of analysis

1 Scope

This Information Circular lists under clause 2 the European Standards, EN and EURONORM methods 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.

Annex A contains a list of Euronorms and ECISS Information Circulars relevant for chemical analysis of ferrous materials.

Annex B contains a list of items which are under preparation as European Standards or ECISS Information Circulars.

Annex C contains a list of withdrawn European Standards and Euronorms.

NOTE: Where a European Standard is identical (IDT) with an International Standard (ISO) it is indicated in clause 2.

2 List of European Standards and Euronorm

2.1 Aluminium

Reference	Title
EN 29 658:1991 (IDT ISO 9658:1990)	Steel - Determination of aluminium content Flame atomic absorption spectrometric method.

2.2 Arsenic

Reference	Title
prEN 10 212:1991	Chemical analysis of ferrous materials - Determination of arsenic in steel and iron. Spectrophotometric method (draft in preparation).

2.3 Boron

Reference	Title
EN 10 200:1991	Chemical analysis of ferrous materials. Determination of boron in steel. Spectrophotometric method.

2.4 Calcium

Reference	Title
EN 10 177:1989	Chemical analysis of ferrous materials. Determination of calcium in steels. Flame atomic absorption spectrometric method.

2.5 Carbon

Reference	Title
EN 10 036:1989	Chemical analysis of ferrous materials. Determination of total carbon in steels and irons. Gravimetric method after combustion in a stream of oxygen.

2.6 Chromium

Reference	Title
EN 10 188:1989	Chemical analysis of ferrous materials. Determination of chromium in steels and iron. Flame atomic absorption spectrometric method.
EN 24 937:1990 (IDT ISO 4937:1986)	Steel and iron - Determination of chromium content. Potentiometric or visual titration method.
EN 24 937:1990/ AC 1991	Steel and iron - Determination of chromium - content - Potentiometric or visual method

2.7 Copper

Reference	Title
EN 24 946:1989 (IDT ISO 4946:1986)	Steel and iron - Determination of copper content. 2,2' diquinolyl spectrophotometric method.
EN 24 946:1990/ AC 1991 Editorial correction	Steel and cast iron - Determination of copper content. 2.2' diquinolyl spectrophotometric method.
EN 24 943:1990 (IDT ISO 4943:1985)	Chemical analysis of ferrous metal - Determination of copper content - Flame atomic absorption spectrometric method

EN 24 943:1990/ AC 1991 Editorial correction	Steel and cast iron - Determination of copper content - Flame atomic absorption spectrometric method

2.8 Lead

Reference	Title
EN 10 181:1989	Chemical analysis of ferrous materials - Determination of lead in steels. Flame atomic absorption spectrometric method.

2.9 Manganese

Reference	Title
EN 10 071:1989	Chemical analysis of ferrous materials. Determination of manganese in steels and irons. Electrometric titration method.
EN 24 159:1989 (IDT ISO 4159:1978)	Ferromanganese and ferrosilicomanganese - Determination of manganese content. Potentiometric method.
EN 24 159:1989/ AC 1:1989 Editorial correction	Ferromanganese and ferrosilicomanganese - Determination of manganese content - Potentiometric method
Euronorm 70:1971	Chemical analysis of ferrous materials - Determination of manganese in steels and irons - Photometric method

2.10 Molybdenum

Reference	Title
Euronorm 75:1978	Chemical analysis of ferrous materials. Determination of the molybdenum in steels and cast irons. Photometric method.

2.11 Nickel

Reference	Title
EN 10 136:1989	Chemical analysis of ferrous materials - Determination of nickel in steels and irons. Flame atomic absorption spectrometric method.

EN 24 938:1990 (IDT ISO 4938:1988)	Steel and iron - Determination of nickel content - Gravimetric or titrimetric method
EN 24 938:1990/ AC 1991 Editorial correction	Steel and iron - Determination of nickel AC content - Gravimetric or titrimetric method

2.12 Niobium

Reference	Title
EN 10 178:1989	Chemical analysis of ferrous materials - Determination of niobium in steels. Spectrophotometric method.

2.13 Nitrogen

Reference	Title
EN 10 179:1989	Chemical analysis of ferrous materials - Determination of nitrogen (trace amounts) in steels. Spectrophotometric method.
Euronorm 50:1986	Chemical analysis of ferrous materials. Determination of nitrogen in steels. Spectrophotometric method. (The text of this Euronorm corresponds to the text of ISO 4945:1977).

2.14 Phosphorus

Reference	Title
EN 10 184:1989	Chemical analysis of ferrous materials. Determination of phosphorus in steels and iron. Spectrophotometric method.
EN 10 184:1989/ AC 1991 Technical correction	Chemical analysis of ferrous materials. Determination of phosphorus in steels and irons. Spectrophotometric method.

2.15 Silicon

Reference	Title
EN 24 829-1:1990 (IDT ISO 4829-1)	Steel and cast iron - Determination of total silicon content - Reduced molybdosilicate spectrophotometric method. Part 1: Silicon contents between 0,05 and 1 %.

EN 24 829-2:1990 (IDT ISO 4829-2)	Steel and cast iron - Determination of total silicon content - Reduced molybdosilicate spectrophotometric method. Part 2: Silicon contents between 0,01 and 0,05 %.
EN 24 829-2:1990/ AC 1991 Editorial correction	Steel and cast iron - Determination of total silicon content - Reduced molybdosilicate spectrophotometric method. Part 2: Silicon contents between 0,01 and 0,05 %
Euronorm 40:1962	Chemical analysis of ferrous materials. Determination of total silicon in steels and irons. Gravimetric method.

2.16 Sulfur

Reference	Title
EN 24 934:1989 (IDT ISO 4934:1980)	Steel and cast iron - Determination of sulfur content. Gravimetric method.
EN 24 935:1991 (IDT ISO 4935:1989)	Steel and iron - Determination of sulfur content. Infrared absorption method after combustion in an induction furnace.

2.17 Titanium

Reference	Title
prEN 10 211:1991	Chemical analysis of ferrous materials - Determinaiton of titanium in steel and iron Flame atomic absorption spectrometric method.
Euronorm 182:1986	Chemical analysis of ferrous materials. Determination of titanium in steels. Spectrophotometric method.

2.18 Vanadium

Reference	Title
EN 24 947:1991 (IDT ISO 4947:1986)	Steel and cast iron - Determination of vanadium content. Potentiometric titration method.

3 Range of application and method principle

3.1 Aluminium, Al

3.1.1 EN 29 658:1991 - Steel - Determination of aluminium content - Flame atomic absorption spectrometric method (ISO 9658:1990)

Range of application:

Aluminium contents between 0,005 % (m/m) and 0,20 % (m/m) in non-alloyed steel.

Method principle:

Dissolution of a test portion in dilute hydrochloric and nitric acids.

Fusion of the acid-insoluble material with a mixture of orthoboric acid and potassium carbonate.

Spraying of the solution into a dinitrogen monoxide-acetylene flame.

Spectrometric measurement of the atomic absorption of the 309,3 nm spectral line emitted by an aluminium hollow cathode lamp.

3.2 Arsenic

3.2.1 prEN 10 212:1991 - Chemical analysis of ferrous materials - Determination of arsenic in steel and iron. Spectrophotometric method (draft in preparation).

Range of application:

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 iodide, 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.

3.3 Boron, B

3.3.1 EN 10 200:1991 - Chemical analysis of ferrous materials - Determination of boron in steel - Spectrophotometric method

Range of application:

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 phosphoric and sulphuric acids at a temperature of 290°C. Spectrophotometric measurement at a wavelength of 543 nm of the complex formed between boric acid and curcumin in buffered acetic medium.

3.4 Calcium, Ca

3.4.1 EN 10 177:1989 - Chemical analysis of ferrous materials - Determination of calcium in steels - Flame atomic absorption spectrometric method

Range of application:

Calcium contents greater than 0,0002 % (m/m) in non-alloy and low-alloy steels.

Method principle:

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

3.5 Carbon, C

3.5.1 EN 10 036 - 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:

Carbon content equal to or greater than 0,1 % (m/m) in steels and irons.

Method principle:

Combustion of a test portion in a stream of oxygen in a high temperature furnace iron (1200 - 1400°C), with the addition of a fluxing agent to assist combustion.

Absorption of the evolved carbon dioxide in soda asbestos contained in a weighed absorption bulb.

3.6 Chromium, Cr

3.6.1 EN 10 188:1989 - Chemical analysis of ferrous materials - Determination of chromium in steels and irons - Flame atomic absorption spectrometric method

Range of application:

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

Method principle:

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.

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 nebulized into a nitrous oxide acetylene flame.

3.6.2 EN 24 937:1990 - Steel and iron - Determination of chromium content - Potentiometric or visual titration method

Range of application: