भारतीय मानक

Indian Standard

IS 228 (Part 2) : 2024

इस्पात के रासायनिक विश्लेषण की पद्धतियाँ

भाग 2 आर्सेनाइट पद्धति द्वारा प्लेन-कार्बन और अल्प मिश्रधातु इस्पात में मैंगनीज़ का निर्धारण

(चौथा पुनरीक्षण)

Methods for Chemical Analysis of Steels

Part 2 Determination of Manganese in Plain-Carbon and Low Alloy Steels by Arsenite Method

(Fourth Revision)

ICS 77.080.20

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Methods of Chemical Analysis of Metals Sectional Committee, MTD 34

FOREWORD

This Indian Standard (Part 2) (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Methods of Chemical analysis of Metals Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1952 and subsequently revised in 1959, 1972 and 1987 covered the chemical analysis of plain carbon and low alloy steels, along with pig iron and cast iron. It was revised again to make it comprehensive in respect of steel analysis and to exclude pig iron and cast iron which were being covered in separate standards. During its second revision the standard has been split up in several parts.

This revision has been brought out to bring the standard in the latest style and format of the Indian Standards. Photometric method for determination of manganese up to 5 percent has been covered in IS 228 (Part 12).

This part covers method for the determination of manganese from 0.1 percent to 1.5 percent in plain-carbon and low alloy steels by arsenite method. The other parts of this series are:

Part 1	Determination of carbon by volumetric method (for carbon 0.05 percent to 2.50 percent)
Part 3	Determination of phosphorus by alkalimetric method
Part 4	Determination of total carbon by gravimetric method (for carbon greater than or equal to 0.1 percent)
Part 5	Determination of nickel by dimethyl glyoxime (gravimetric) method (for nickel greater than or equal to 0.1 percent)
Part 6	Determination of chromium by persulphate oxidation method (for chromium $\geq$ 0.1 percent)
Part 7	Determination of molybdenum by alpha benzoinoxime method (for molybdenum 1 percent and not containing tungsten)
Part 8	Determination of silicon by gravimetric method (for silicon 0.05 percent to 5.00 percent)
Part 9	Determination of sulphur in plain carbon steels by evolution method (for sulphur 0.01 percent to 0.25 percent)
Part 10	Determination of molybdenum by thiocyanate (photometric) method in low and high alloy steels (for molybdenum 0.01 percent to 1.5 percent)
Part 11	Determination of silicon by reduced molybdosilicate spectrophotometric method in carbon steels and low alloy steels (for silicon 0.01 percent to 0.05 percent)
Part 12	Determination of manganese by periodate spectrophotometric method in plain carbon, low alloy and high alloy steels (for manganese 0.01 percent to 5.0 percent)
Part 13	Determination of arsenic
Part 14	Determination of carbon by thermal conductivity method (for carbon 0.005 percent to 2.000 percent)
Part 15	Determination of copper by thiosulphate iodide method (for copper 0.05 percent to 5 percent)
Part 16	Determination of tungsten by spectrophotometric method (for tungsten 0.1 percent to 2 percent)
Part 17	Determination of nitrogen by thermal conductivity method
Part 18	Determination of oxygen by instrumental method
Part 19	Determination of nitrogen by steam distillation
Part 20	Determination of carbon and sulphur by infrared absorption method

(*Continued on third cover*)

Indian Standard

METHODS FOR CHEMICAL ANALYSIS OF STEELS

PART 2 DETERMINATION OF MANGANESE IN PLAIN-CARBON AND LOW ALLOY STEELS BY ARSENITE METHOD

(Fourth Revision)

1 SCOPE

This standard (Part 2) covers method for the determination of manganese in plain carbon and low alloy steels by arsenite method.

2 REFERENCES

The standard given below contain provisions, which through reference in this text, constitute provision of this standard. At the time of the publication, the editions indicated below were valid. All the standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

IS No.	*Title*
IS 264 : 2005	Nitric acid — Specification (*third revision*)
IS 1070 : 2023	Reagent grade water — Specification (*fourth revision*)

3 SAMPLING

The samples shall be drawn and prepared as prescribed in the relevant Indian Standard.

4 QUALITY OF REAGENTS

Unless specified otherwise, analytical grade reagents and distilled water (*see* IS 1070) shall be employed in the test.

5 DETERMINATION OF MANGANESE (0.1 PERCENT TO 1.5 PERCENT) IN PLAIN CARBON AND LOW ALLOY STEELS BY THE ARSENITE METHOD (IN ABSENCE OF TUNGSTEN)

5.1 Outline of the Method

Manganese is oxidized, in presence of silver nitrate, to permanganic acid by ammonium persulphate and titrated with sodium arsenite solution.

5.2 Reagents

5.2.1 *Dilute Nitric Acid* — 1 : 2 (*v/v*)

5.2.2 *Phosphoric Acid* — 85 percent

5.2.3 *Dilute Sulphuric Acid* — 1 : 4 (*v/v*)

5.2.4 *Concentrated Nitric Acid* — relative density 1.42 (conforming to IS 264)

5.2.5 *Ammonium Persulphate Solution* — freshly prepared, 10 percent (*m/v*)

5.2.6 *Silver Nitrate Solution* — 1 percent (*m/v*)

5.2.7 *Sodium Chloride Solution* — 1 percent (*m/v*)

5.2.8 *Standard Sodium Arsenite Solution*

Take 1.6 g of arsenious oxide in a 800 ml beaker. Add 10 g of sodium carbonate and 500 ml of water in the beaker and heat at low temperature until the solution is complete. Filter the solution through a filter pad in a bottle and make up the volume of the solution to 2 litres by addition of water. Shake the bottle vigorously. Standardize the arsenite solution as in 5.3 against 0.2 g of steel sample (having approximately similar composition as the sample under test) of known manganese content.

Adjust the strength of the sodium arsenite solution in such a way that each millilitre of the solution will be equivalent to 0.1 percent manganese when 0.2 g of sample is taken.

5.3 Procedure

5.3.1 *Dissolution*

5.3.1.1 *Plain carbon steel*

Take 0.2 g of an accurately weighed sample in a 250 ml conical flask. Add 10 ml of dilute nitric acid and 3 ml to 4 ml of phosphoric acid, and heat to dissolve the sample, boil to expel oxides of nitrogen and dilute to 100 ml.

5.3.1.2 *Low alloy steel*

Take 0.2 g of an accurately weighed sample in a 250 ml conical flask. Add 20 ml sulphuric acid and 2 ml to 3 ml of phosphoric acid. Heat until the reaction ceases. Add concentrated nitric acid drop

by drop until the dissolution is complete, boil off nitrous fumes and dilute to 100 ml with water.

5.3.2 Add 20 ml of ammonium persulphate solution and boil. After few minutes of boiling, when the solution becomes clear, add 10 ml of silver nitrate and allow the colour of permanganic acid to develop. Boil to destroy the excess of persulphate. Cool quickly to room temperature.

5.3.3 Add 10 ml of sodium chloride solution to precipitate silver chloride. Titrate rapidly the permanganic acid with standard sodium arsenite solution until the pink colour is discharged.

6 CALCULATION

6.1 Calculate the manganese content of the steel as follows:

$$\text{Manganese, percent} = \frac{A \times B}{C} \times 100$$

where

A = volume, in ml, of standard sodium arsenite solution used for titration;

B = manganese equivalent of standard sodium arsenite solution, in g/ml; and

C = mass, in g, of sample.

6.2 Reproducibility

a) ± 0.01 percent for manganese content below 0.06 percent;

b) ± 0.02 percent for manganese content between 0.06 percent to 1 percent; and

c) ± 0.03 percent for manganese above 1 percent.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Methods of Chemical Analysis of Metals Sectional Committee, MTD 34

Organization	*Representative*(*s*)
CSIR - National Metallurgical Laboratory, Jamshedpur	DR SANCHITA CHAKRAVARTY **(*Chairperson*)**
Arcelor Mittal Nippon Steel, Mumbai	SHRI MANOJ GUPTA SHRI KIRIT TAILOR (*Alternate*)
Bhabha Atomic Research Centre, Mumbai	MS SANJUKTA A. KUMAR SHRI M. V. RANA (*Alternate*)
CSIR - National Metallurgical Laboratory, Jamshedpur	DR ASHOK K. MOHANTY (*Alternate*)
Defence Metallurgical Research Laboratory, Ministry of Defence, Hyderabad	SHRI S. S. KALYAN KAMAL
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	SHRI A. MITRA SHRI D. KARTIKEY (*Alternate*)
Geological Survey of India, New Delhi	SHRI NITIN PURUSHOTTAM SHRIMATI SANJUKTA DEY PAL (*Alternate*)
Hindalco Industries Limited, Mumbai	SHRI KRISHANU MAHAPATRA SHRI ASHUTOSH ACHARYA (*Alternate*)
Indian Metals and Ferro Alloys Limited, Bhubaneswar	SHRI DINESH KUMAR MOHANTY
JSW Steel Limited, Mumbai	SHRI KOTRABASAVARAJU SHRI MARULASIDDESHA U. M. (*Alternate*)
Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur	DR UPENDRA SINGH
National Aluminium Company Limited, Bhubaneswar	SHRIMATI SUKLA NANDI SHRI DEBANANDA BHATTACHARYYA (*Alternate*)
National Test House, Kolkata	DR RAJEEV KUMAR UPADHYAY SHRI AKBAR H. (*Alternate*)
Shriram Institute for Industrial Research, Delhi	DR LAXMI RAWAT SHRI PUNEET KAPOOR (*Alternate*)
Steel Authority of India Limited - Salem Steel Plant, Salem	SHRI L. SIVAKUMAR SHRI VIVEKANANDHAN G. (*Alternate*)
Tata Steel Limited, Kolkata	DR JATIN MOHAPATRA DR RAVIKRISHNA CHATTI (*Alternate*)
BIS Directorate General	SHRI SANJIV MAINI, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (METALLURGICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI ASHISH PRABHAKAR WAKLE
SCIENTIST 'C'/DEPUTY DIRECTOR
(METALLURGICAL ENGINEERING), BIS

(*Continued from second cover*)

Part 21 Determination of copper by spectrometric method (for copper 0.02 percent to 0.5 percent)

Part 22 Determination of total hydrogen in steel by thermal conductivity method (hydrogen 0.1 ppm to 50 ppm)

Part 23 Determination of total nitrogen in steel by optical emission spectrometer (nitrogen 0.002 percent to 1.0 percent)

Part 24 Determination of nitrogen in steel by inert gas fusion — Thermal conductivity method (nitrogen 0.001 percent to 0.2 percent)

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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