भारतीय मानक **IS 14650 : 2023**

Indian Standard

(*Superseding IS 2830 : 2012, IS 2831 : 2012, IS 8052 : 2006, IS 8951 : 2001 and IS 8952 : 1995*)

पुनर्वेल्लन के लिए मिश्रित और अमिश्रित इंगट और अर्ध-समाप्त इस्पात की उत्पाद — विशिष्टि

(पहला पुनरीक्षण)

Unalloyed and Alloyed Steel Ingot and Semi-finished Products for Re-Rolling Purposes — Specification

(First Revision)

ICS 77.140

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

September 2023 **Price Group 5**

Wrought Steel Products Sectional Committee, MTD 04

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1999. Previously, various standards co-existed for semi-finished steel for a particular use as well as for any steel product irrespective of its use. On the request of manufacturing as well as user industry, the committee examined the issue and decided to formulate a single standard for all semi-finished steels which may be used for re-rolling into any steel product irrespective of its use.

In this revision, the requirements of unalloyed and alloyed steel ingots and semi-finished products for rolling into different steel products conforming to various product standards are covered.

With this revision, Indian Standards pertaining to ingots/semi-finished products for a particular use and covered under IS 2830 : 2012, IS 2831 : 2012, IS 8052 : 2006, IS 8951 : 2001 and IS 8952 : 1995 shall stand withdrawn subsequently.

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

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off 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 the same as that of the specified value in this standard.

Indian Standard

UNALLOYED AND ALLOYED STEEL INGOT AND SEMI-FINISHED PRODUCTS FOR RE-ROLLING PURPOSES — SPECIFICATION

(*First Revision*)

1 SCOPE

1.1 This standard covers the requirement of unalloyed and alloyed steel ingots and semi-finished products for rolling into different products conforming to applicable Indian Standard. Semi-finished products include continuously cast products and products generally obtained by forging or rolling ingots and intended for transformation into different steel products.

1.2 The requirements of this standard shall not be applicable to carbon and alloyed steel ingots and semi-finished products for forging.

1.3 The requirements of this standard shall not be applicable to mild steel for metal arc welding electrodes.

2 REFERENCES

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

IS No.	*Title*
IS 228 (all parts)	Methods of chemical analysis of steels
IS 1956 (Part 3) : 2019	Glossary of terms relating to iron and steel: Part 3 Long products (including bars, rods, sections and wires) (*second revision*)
IS 4163 : 2021/ ISO 4967 : 2013	Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams (*fourth revision*)
IS 7598 : 1990	Classification of steels (*first revision*)
IS 8910 : 2022/ ISO 404 : 2013	Steel and steel products — General technical delivery requirements (*second revision*)
IS 11371 : 2022	Method for macroetch testing, inspection and rating of wrought steel products (*first revision*)
IS 12037 : 1987	Specification for macrographic examination of steel by sulphur print (baumann method)

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to those given in IS 1956 (Part 3) shall apply.

3.1 Ingot — Products obtained by pouring liquid steel into moulds of a shape appropriate to the subsequent processing into semi-finished products, or flat or long products, generally by hot rolling or forging.

NOTES

1 The shape generally resembles a truncated pyramid or truncated cone; the side surfaces may be corrugated and the corners more or less rounded. Depending on subsequent conversion requirements, ingots may be dressed and/or hot scarfed or cropped without altering their status as ‘ingots’.

2 According to the cross-section, a distinction is made between the following:

a) Ingots, having a cross-section that may be square, rectangular (of width up to twice the thickness), polygonal, round, oval or shaped according to the profile to be rolled; and

b) Slab ingots, of rectangular cross-section of width twice the thickness or over.

3.1.1 *Cast Billet Ingots* **—** For the purpose of this standard, cast billet ingot shall be defined as ingot, generally of cross-section not more than 200 mm square which can be rolled directly into merchant products. Cast billet ingot is also sometimes known as ‘pencil ingot’.

3.2 Semi-finished Products — Continuously cast products and products generally obtained by forging or rolling ingots and intended for transformation into finished products. The cross-section is generally square, rectangular with angles more or less rounded, the section has

uniform dimension all along the length of the piece. The tolerances are generally wider than those for finished products. The surfaces can be partially or totally conditioned by scarfing, chipping, grinding, planning or milling and turning.

3.2.1 *Semi-finished Products of Square Cross-Section* — Semi-finished products with sides of 50 mm or over, generally described as blooms, if the sides are greater than 200 mm or as billets, if smaller.

NOTE — These dimensions may be less for certain types of steel, for example high-speed steels.

3.2.2 *Semi-finished Products of Rectangular Cross-Section* — Semi-finished product of cross-sectional area of 2 500 mm^2 or over of width up to twice the thickness, generally described as blooms, if the cross-sectional area is greater than 40 000 mm^2 or as billets, if smaller.

3.2.2.1 *Slab* — A semi-finished product of rectangular cross-section with a thickness of at least 50 mm and a width of at least twice the thickness, described as a slab.

3.2.2.2 *Sheet bar* (*slab bars*) — Semi-finished products of rectangular section, of a thickness not less than 6 mm, width not less than 150 mm and of such dimensions that the thickness does not exceed one quarter of the width. This product also includes the product tinplate bars.

3.2.3 *Round Semi-finished Products* — Continuously cast or forged semi-finished products of circular cross-section.

3.2.4 *Blank for Sections* — Semi-finished products intended for the manufacture of specific sections that have been pre-formed for that purpose.

3.2.5 *VAR Ingot* — Semi-finished product, usually shaped as round ingots or blooms, obtained by melting press-formed metallic raw material or by remelting ingots or blooms using a vacuum arc remelting (VAR) furnace.

NOTE — Vacuum arc remelting results in products with improved chemical homogeneity and inclusion cleanliness.

3.2.6 *ESR Ingot* — Semi-finished product, usually shaped as round ingots or blooms, obtained by melting press-formed metallic raw material or by remelting ingots or blooms using an electro slag remelting (ESR) furnace.

NOTE — Use of electro slag remelting results in products with improved chemical homogeneity and inclusion cleanliness.

4 SUPPLY OF MATERIAL

General requirements relating to the supply of steel shall conform to IS 8910.

5 PRODUCT DESIGNATION

5.1 The product designation shall follow the sequence below:

a) Number of this Indian Standard with prefix IS;
b) Corresponding product standard (CPS);
c) Number of Indian Standard of the corresponding hot-rolled product; and
d) Grade/designation of the hot-rolled steel product as per (c) above.

5.2 The designation of steel grade shall include a set of characters as follows:

a) First character: To indicate this IS number;
b) Second character CPS; and
c) Third &fourth characters: To represent corresponding hot-rolled product standard and grade/designation of the hot-rolled product.

Examples:

1) IS 14650 CPS 2062/E250 BR
2) IS 14650 CPS 1786/Fe 500D

5.2.1 Steel designated as per a product standard can be used to produce another grade of product provided the chemical composition fulfills the requirement of that grade.

6 MANUFACTURE

6.1 The steel shall be manufactured by any process of steel making at the discretion of the manufacturer. It may be followed by secondary refining.

6.2 Steel shall be supplied rimmed/semi-killed/ killed as per the product standard. For cases, where it is not mentioned in product standard, it may be supplied as agreed to between the purchaser and the supplier.

6.3 Sufficient discard shall be given from each ingot to ensure freedom from pipe, segregation and other harmful defects.

6.4 Removal of surface defects shall be permitted provided that finish dimensions are not less than that specified and that the operation is not likely to affect the end use of the product.

7 CHEMICAL COMPOSITION

7.1 The chemical composition of steel shall conform to the ladle analysis requirements of the

relevant product standard under which the ingots and semi-finished products have been ordered.

7.1.1 The ladle analysis of steel shall be carried either by the method specified in the relevant parts of IS 228 or any other established instrumental/chemical method. In case of dispute, the procedure given in the relevant part of IS 228 shall be referee method. However, where the method is not given in IS 228 or its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

7.1.2 Elements not quoted in the relevant product standard should not be intentionally added to the steel without the agreement of the purchaser, except those intended for finishing the heat.

7.1.3 In order to get the desired properties, restricted chemistry may be mutually agreed to between the purchaser and the supplier.

7.2 Check Analysis

7.2.1 Check analysis shall be carried out on the product from the standard position (*see* **9**). Permissible variations in the case of check analysis from the limits of ladle analysis shall be as specified in the relevant product standard.

7.2.2 Variation shall not be applicable both over and under the specified limits in several determinations in one heat.

7.2.3 Check analysis shall not apply to rimming steel.

8 SAMPLING

At least one ladle analysis shall be taken from each cast.

9 SELECTION OF TEST SAMPLE FOR CHECK ANALYSIS

9.1 In the case of ingots, if required, the samples for product analysis shall be prepared by forging/rolling down to 30 mm round section.

9.1.1 Drilling shall be taken from the sample representing two-third, one half and one-third of height from bottom of the ingot separately.

9.2 In case of billets, blooms and slabs, the sample for check analysis shall be taken from the location as shown in Fig.1.

9.3 For other products, the location of sample shall be as mutually agreed between the purchaser and the manufacturer.

10 DIMENSIONS

10.1 The size and shapes shall be subject to mutual agreement between the purchaser and the manufacturer.

10.2 The length shall be subject to mutual agreement between the purchaser and the manufacturer.

11 TOLERANCES

11.1 In case of cast billet ingots, a tolerance of ± 5 mm shall be permitted on the specified width across flat.

11.2 In case of billets, blooms and slabs, the following tolerances shall apply:

Sl No.	*Product*	*Width Across Flat*	*Thickness*	*Tolerances on Width/Thickness*
		mm	mm	mm
(1)	(2)	(3)	(4)	(5)
i)	Billets	Up to and including 75	—	± 1.5
		> 75 to 125	—	± 3.0
		> 125 to 150	—	+ 4.0 - 3.0
		Over 150	—	+ 6.0 - 3.0
ii)	Blooms	Up to and including 150	—	+ 4.0 - 3.0
		Over 150	—	+ 6.0 - 3.0
iii)	Slabs	—	Up to and including 150	+ 3.0 - 4.0
		—	Over 150	+ 3.0 - 6.0
		Up to and including 300	—	+ 3.0 - 6.0
		Over 300	—	+ 5.0 - 10.0

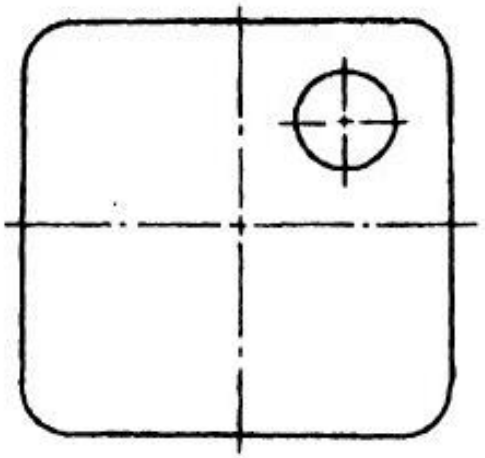

FIG. 1 LOCATION FOR TAKING SAMPLE FOR CHECK ANALYSIS

11.3 For other products, tolerances shall be subject to mutual agreement between the purchaser and the manufacturer.

11.4 A tolerance of ± 150 mm shall be permitted on the specified length.

11.5 Bend

In the case of slabs, the bend shall not exceed 8 mm per meter of slab length subject to a maximum of 40 mm. In the case of billets and blooms, the bend shall not exceed 5 mm per meter.

11.6 Camber

In the case of slabs, the camber shall not exceed 8 mm per meter of slab length subject to a maximum of 40 mm.

11.7 The following supplementary requirements of tolerance that are considered suitable for use with each material shall be applicable when mutually agreed to and specified in the order:

Sl No.	*Defects*	*Product*	*Tolerances*
(1)	(2)	(3)	(4)
i)	Out of square	Slab	≤ 0.01 x width in mm
		Bloom/billet up to & including 150 mm	5 mm *Max* — measured as diagonal difference in cross-section
		Over 150 mm	7 mm *Max* — measured as diagonal difference in cross-section
ii)	Round corners	Rolled slab	Plain thickness at the extreme edge shall be ≥ 0.5 x thickness in mm
iii)	Ridges due to gas cutting	Slab	Less than or equal to uniform ridges spread over the entire cross-section. A single ridge of 20 mm or limited number of ridges with more than 5 mm depth
iv)	Taper (width variation on top and bottoms surface at one location)	Slab	6 mm, *Max*
v)	Edge slanting (width variation on top and bottom surface at one location)	Slab	10 mm, *Max*

Sl No.	*Defects*	*Product*	*Tolerances*
(1)	(2)	(3)	(4)
vi)	Convexity (difference in thickness from edge to curve)	Slab	6 mm, *Max*
vii)	Chamfering (length variation on top and bottom surface at one location)	Slab	10 mm, *Max*
viii)	Wedge(thickness variation at the edges along the cross section)	Slab	3 mm, *Max*
ix)	Scarfing pits	Slab/bloom/billet	Depth ≤ 0.05 x thickness Width ≥ 6 x depth in mm

12 FREEDOM FROM DEFECTS

12.1 Ingots shall either be supplied free from harmful defects, such as, segregation, piping, cracks, inclusions and blow-holes by appropriate top and bottom discard and dressing or supplied with suitable surface dressing only, without top and bottom discard if mutually agreed to between the purchaser and the manufacturer.

12.2 The semi-finished products shall be free from all harmful defects, such as cracks, surface flaws, laminations and rough, jagged & imperfect edges.

12.3 Billets, blooms and slabs shall be reasonably free from camber, off flat, out of square, round corners, ridges of gas cutting, tapers and pit of scarfing.

13 OPTIONAL TESTS

13.1 If mutually agreed to between the purchaser and the manufacturer, the following tests may be carried out wherever applicable:

a) Macro examination (*see* IS 11371);
b) Sulphur print tests (*see* IS 12037); and
c) Inclusion content (*see* IS 4163).

13.2 The acceptable limits for the above tests shall be mutually agreed to between the purchaser and the manufacturer, unless specified in the product standard.

13.3 Besides the tests mentioned at **13.1**, any other test considered essential for ensuring the final quality of product may also be carried out as agreed to between the manufacturer and the purchaser.

14 MARKING

14.1 Unless agreed otherwise, the material shall be marked as given in **14.2** and **14.3**.

14.2 Each material shall be legibly stamped or painted or affixed with any heat proof label with the cast number; and optionally with the name or trade mark of the manufacturer.

14.3 The ends may be suitably painted as per the agreement between the purchaser and the manufacturer.

14.4 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

15 ORDERING INFORMATION

While placing an order for the product(s) covered by this standard, the purchaser should specify clearly the following:

a) Steel grade;
b) Size;
c) Tests and test report required;
d) Optional tests, if any as per **13**;
e) Supplementary requirement, if any as per **11.6**; and
f) Special requirements, if any.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Wrought Steel Products Sectional Committee, MTD 04

Organization	*Representative(s)*
SAIL, Research & Development Center for Iron & Steel, Ranchi	SHRI NIRVIK BANERJEE **(*Chairperson*)**
All India Induction Furnace Association, New Delhi	SHRI A. K. SHARMA SHRI PRABHAKAR MISHRA (*Alternate*)
AM/NS Steel Hazira, Surat	SHRI DEEPAK GUPTA SHRI KALPESH DAVE (*Alternate*)
Bharat Heavy Electrical Ltd, Bhopal	SHRI S. K. MAHAJAN SHRI ARUN KHARE (*Alternate*)
Central Boilers Board, New Delhi	SHRI S. K. JAIN
Cold Rolled Steel Manufacturers Association of India, New Delhi	SHRI SHIVAJEE PATHAK SHRI N. K. SOOD (*Alternate*)
DMRL, Ministry of Defence, Hyderabad	SHRI R. V. S. NAGESH
Indian Machine Tools Manufacturers Association Bengaluru	SHRI Y. BALARAMAIAH
Institute of Steel Development and Growth, Kolkata	SHRI P. L. RAO SHRI SAJAL KUMAR GHORAI (*Alternate*)
Jindal Steel & Power Ltd (JSPL), Raigarh	SHRI JOY DUTTA
JSW Ltd, Bellary	SHRI DEVASISH MISHRA SHRI G. V. RAMANA (*Alternate*)
JSW Steel Ltd, Dolvi/Salem	SHRI SUBHASIS CHAKRABORTY SHRI B. M. HASAN (*Alternate*)
Ministry of Defence (DGOFB), Kolkata	SHRI R. D. BARMA
Ministry of Defence (DGQA), Ichapur	SHRI K.YADAV SHRI G. SUBBA RAO (*Alternate*)
Ministry of Shipping, New Delhi	SHRI ANIL PRUTHI SHRI RAMJI SINGH (*Alternate*)
Ministry of Steel (Government of India), New Delhi	SHRI PARMJEET SINGH SHRI BHAGIRATHI PRADHAN (*Alternate*)
Power Grid Corporation, Gurugram	SHRI MANOJ KUMAR GUPTA SHRI DEEPAK KUMAR SAHOO (*Alternate*)

Organization	*Representative(s)*
Rashtriya Ispat Nigam Limited, Vishakapatnam	SHRIMATI RUCHIRA GUPTA SHRI SHANKAR JEE (*Alternate*)
Research Designs and Standards Organization (RDSO), Lucknow	SHRI MANOJ KUMAR GUPTA SHRI SHAILESH ORAON (*Alternate*)
SAIL, Bhilai Steel Plant, Bhilai	SHRI SHRIRANG KHANKHOJE SHRI K. V. SHANKAR (*Alternate*)
SAIL, Bokaro Steel Plant, Bokaro	SHRIMATI BISWASI SUNITA MINZ SHRIMATI ROSELIN DODRAE (*Alternate*)
SAIL, Research & Development center for Iron & Steel, Ranchi	SHRI P. PATHAK SHRI S. SRIKANTH (*Alternate*)
SAIL, Rourkela Steel Plant, Rourkela	SHRI KUNTAL PATWARI SHRI RAMAKRISHNAN P. (*Alternate*)
Society of Indian Automobile Manufacturers (SIAM), New Delhi	SHRI KARTIKE KARWAL SHRI KANISHKA CHANA (*Alternate*)
Steel Authority of India Limited, IISCO Steel Plant, Barddhaman	SHRI A. DASGUPTA SHRI SAIKAT DE (*Alternate*)
Tata Blue Scope Steel Ltd, Pune	SHRI RAJESH MAHESHWARI
Tata Motors Ltd, Pune	SHRI PRADEEP KULKARNI SHRI LOKESH PALIWAL (*Alternate*)
Tata Steel Ltd, Jamshedpur	SHRI AVTAR SINGH SAINI SHRI SUDIPTO SARKAR (*Alternate*)
The Tin Plate Company of India Ltd, Jameshedpur	SHRI S. J. DEY SHRI SUBRATA SADHU (*Alternate*)
In Personal Capacity, New Delhi	SHRI A. C. R. DAS
BIS Directorate General	SHRI SANJIV MAINI, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (METALLURGICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI ARUN PUCCHAKAYALA
SCIENTIST 'D'/JOINT DIRECTOR
(METALLURGICAL ENGINEERING), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

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

This Indian Standard has been developed from Doc No.: MTD 04 (21561).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi