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**भारतीय मानक**

**गढ़ाइयों के लिए कार्बन इस्पात के बिलेट, ब्लूम,  
सिल्लियाँ एवं छड़ें — विशिष्ट**

( पाँचवाँ पुनरीक्षण )

*Indian Standard*

**CARBON STEEL BILLETS, BLOOMS, SLABS AND  
BARS FOR FORGINGS — SPECIFICATION**

( *Fifth Revision* )

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

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**Price Group 3**

## Steel Forgings Sectional Committee, MTD 18

### FOREWORD

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

This standard was first issued in 1961 and subsequently revised in 1966, 1970, 1971 and 1978. Based on the experience gained during these years in the use of this standard, it has been decided to further revise this standard.

Class 1 Steel is again incorporated in this revision based on the need of users. For the benefit of the purchaser, an informative annex ( *see* Annex A ) has been included giving particulars to be specified while ordering for these steels.

This standard contains clauses 5.4(e), 5.4.1, 5.4.2, 11.1 and Note in Table 2 which call for agreement between the purchaser and the supplier; clauses 5.1, 6.2 and 10.2 which permit the purchaser to use his option; and clause 12 gives supplementary requirements.

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 : 1960 'Rules for rounding off numerical values ( *revised* )'. 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

# CARBON STEEL BILLETS, BLOOMS, SLABS AND BARS FOR FORGINGS — SPECIFICATION

( Fifth Revision )

### 1 SCOPE

1.1 This standard covers the requirements for nine classes of carbon steel billets, blooms, slabs and bars for forgings designated as class 1, 1A, 2, 2A, 3, 3A, 4, 5 and 6 ( see Table 1 ).

### 2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard.

IS No.‡	Title
228	Methods for chemical analysis of steels ( <i>revised</i> )
1387 : 1967	General requirements for the supply of metallurgical materials ( <i>first revision</i> )
1500 : 1983	Method for brinell hardness test for metallic materials ( <i>second revision</i> )
1599 : 1985	Method for bend test ( <i>second revision</i> )
1608 : 1972	Method for tensile testing of steel products ( <i>first revision</i> )
1762 ( Part 1 ) : 1974	Code for designation of steels: Part 1 Based on letter symbols ( <i>first revision</i> )
1852 : 1985	Rolling and cutting tolerances for hot rolled steel products ( ( <i>fourth revision</i> ) )
1956 ( Part 6 ) : 1976	Glossary of terms relating to iron and steel : Part 6 Forging ( including drop forging )
3739 : 1987	Dimensional tolerances for carbon and alloy constructional steel ( <i>first revision</i> )
4075 : 1985	Method for macrostreak flaw test for steel ( <i>first revision</i> )
4748 : 1988	Method for estimating average grainsize of metals ( <i>first revision</i> )
9684 : 1980	Technical conditions for the supply of hot rolled billets, blooms, slabs and bars for closed die forgings
10138 ( Part 3 ) : 1983	Macroscopic method for determination of non-metallic inclusion content in wrought steel : Part 3 Magnetic particle inspection method
11371 : 1985	Method for macroetch test for wrought steel products

### 3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1956 ( Part 6 ) shall apply.

### 4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of material shall be as laid down in IS 1387 : 1967.

4.2 The steels covered by this standard shall be ordered and delivered on the following basis:

- Chemical composition; and
- Tensile properties and/or hardness.

### 5 MANUFACTURE

5.1 Billets, blooms, slabs and bars for forgings shall be manufactured from killed steel made by open-hearth, electric, basic oxygen, combination of these processes, or any other suitable method which will meet the requirements of the standard. The stock may be manufactured by hot rolling or forging.

5.2 Sufficient discard shall be made from each ingot to secure freedom from piping and undue segregation.

5.3 The material shall be made from ingot having at least four times the cross-sectional area of the products.

5.3.1 For blooms 300 × 300 mm and larger size or its equivalent cross sectional area, though not meeting the requirement of 5.3, may also be supplied with prior permission from the purchaser. In case of reduction by forging process prior permission from the user is not necessary if the reduction is more than 2.5 : 1.

5.4 The conditioning method should be so chosen that it shall not have any injurious effects in the billet, bloom and bar. Material required for forging may be conditioned to remove injurious surface defects provided that the following limitations shall apply:

- Conditioning shall be allowed only in the longitudinal direction. Conditioning in the transverse direction shall not be allowed, except for surface inspection purposes.
- The depth of conditioning shall not exceed 1 mm for every 15 mm of the

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dimension concerned subject to a maximum depth of 20 mm.

- c) The width of conditioning shall be at least four times its greatest depth.
- d) An exception is made in the case of slabs whose width is at least twice the thickness. The depth of conditioning in the case of slabs shall not exceed 1 mm for every 10 mm of the dimensions concerned subject to a maximum depth of 20 mm.
- e) While conditioning the material, the dimensions of the product may go below the minimum dimensions permitted according to the tolerances specified. When reduced amount of dressing than what is permitted by such clauses (b), (c) and (d) is required, the extent of dressing shall be mutually agreed to between the manufacturer and the purchaser.
- f) When required by the users for the material to be used for closed die forging, the dressing may be allowed to such an extent that its cross sectional area as defined by the dimensional tolerances does not go below the minimum of the tolerance limit.

**5.4.1** In special cases, particularly where it is necessary on large material and where conditioning is not injurious, greater depth of conditioning may be permitted by special agreement between the supplier and the purchaser.

**5.4.2** In other cases, conditioning of material for removing injurious defects shall be as agreed to between the purchaser and the manufacturer.

**6 CHEMICAL COMPOSITION**

**6.1 Ladle Analysis**

The ladle analysis of steel, when carried out

either by the methods specified in the relevant parts of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of any dispute, the procedure given in relevant parts of IS 228 shall be the referee method.

**6.2 Check Analysis**

The purchaser may specify check analysis on blooms, billets, slabs and bars. The number of samples on which the analysis has to be carried out shall be at the rate of one sample per 100 products of same section subject to a minimum of one sample per section.

**6.2.1** The permissible deviation in check analysis from the specified composition limits given in Table 1 shall be as given below:

Constituent, Percent	Permissible Variation, Percent, Max	
	For Sections 250 mm <sup>2</sup> or less	For Sections 250 mm <sup>2</sup> to 500 mm <sup>2</sup>
Carbon:		
Up to 0.25	± 0.02	± 0.04
Over 0.25 up to and including 0.50	± 0.03	± 0.05
Over 0.50	± 0.04	± 0.06
Silicon	± 0.03	± 0.04
Manganese	± 0.04	± 0.07
Phosphorus	+ 0.005	+ 0.010
Sulphur	+ 0.005	+ 0.010

**6.3** The following elements wherever not specified in Table 1 shall not be added to the steel, except where agreed to, other than for the

**Table 1 Chemical Composition**  
( Clauses 1.1, 6.1, 6.2.1, 6.3 and 12.1.1 )

Class	Designation [ See IS 1762 ( Part 1 ): 1974 ]	Constituent, Percent				
		Carbon	Silicon	Manganese	Sulphur Max	Phosphorus Max <sup>1</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	14C6	0.10—0.18	0.15—0.35	0.40—0.70	0.04	0.04
1A	15C8	0.10—0.20	0.15—0.35	0.60—0.90	0.03	0.04
2	20C8	0.15—0.25	0.15—0.35	0.60—0.90	0.04	0.04
2A	25C8	0.20—0.30	0.15—0.35	0.60—0.90	0.04	0.04
3	30C8	0.25—0.35	0.15—0.35	0.60—0.90	0.04	0.04
3A	35C8	0.30—0.40	0.15—0.35	0.60—0.90	0.04	0.04
4	45C8	0.40—0.50	0.15—0.35	0.60—0.90	0.04	0.04
5	55C8	0.50—0.60	0.15—0.35	0.60—0.90	0.04	0.04
6	65C6	0.60—0.70	0.15—0.35	0.50—0.80	0.04	0.04

**NOTES**

**1** When the steel is aluminium killed or killed (with both aluminium and silicon, the requirements of minimum silicon content shall not apply. For aluminium killed steel the total aluminium content shall be within 0.02 to 0.05 percent.

**2** Sulphur to the order of 0.05 to 0.12 percent may be supplied by mutual agreement between the supplier and the purchaser.

purpose of finishing the heat and shall not exceed the following limits:

Constituent	Percent
Nickel	0.30
Chromium	0.30
Copper	0.25
Molybdenum	0.05
Vanadium	0.05
Boron	0.0003
Tin	0.05

**NOTES**

- Trace elements (Cr + Ni + Mo) when added together shall not exceed 0.50 percent.
- Percent copper + 10 × (Percent tin) shall not exceed 0.50 percent.

**7 FREEDOM FROM DEFECTS**

7.1 Billets, blooms, slabs and bars shall be reasonably free from any external or internal cracks, flakes, laps, rough, jagged and imperfect edges and other injurious surface imperfections. Unless specified in the order, the suitable method of parting may be used by the manufacturer and after parting the material shall be sufficiently straight.

**8 DIMENSIONAL TOLERANCES**

8.1 Rolled steel bars for general engineering forgings shall be true to the prescribed dimensions within the tolerances specified in IS 1852 : 1985.

8.2 Tolerances for rolled billets (square and R.C.S. ) blooms and slabs for general engineering forgings shall be as given below:

Cross-Sectional Dimensions	Permissible Variation
mm	mm
Less than 100	± 1.5
100 to 150	+ 4.5 - 2.0
Over 150	+ 6.0 - 3.0

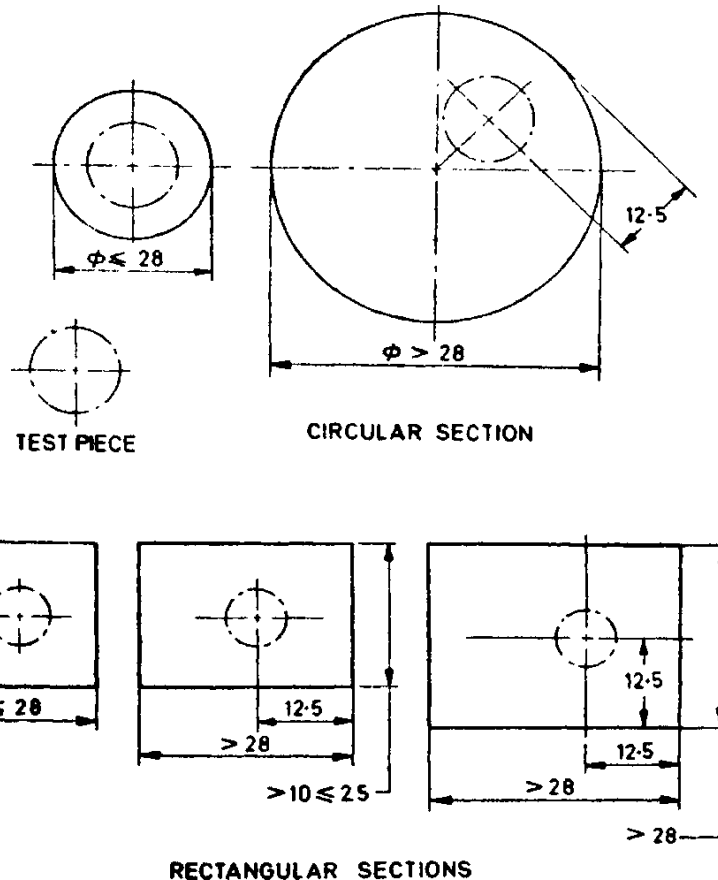
8.2.1 For forged blooms, billets and slabs, the tolerances shall be in accordance with IS 9684 : 1980.

8.3 For special requirements, the dimensional tolerances shall be in accordance with Grade I of IS 3739 : 1987.

**9 MECHANICAL TEST**

**9.1 Tensile Test**

The tensile tests shall be carried out in accordance with IS 1608 : 1972. The test pieces shall be machined lengthwise from each test sample selected as prescribed in 10. The tensile properties shall conform to the requirements given in Table 2. The properties given in Table 2 are applicable to test piece taken on rounds in the direction of the fibre, the axis of which corresponds to Fig. 1. For rectangular sections the ranges for equivalent section shall be as given in Fig. 2.



All dimensions in millimetres.  
**FIG. 1 LOCATION OF THE TENSILE TEST PIECES IN THE PRODUCTS TO BE DELIVERED**

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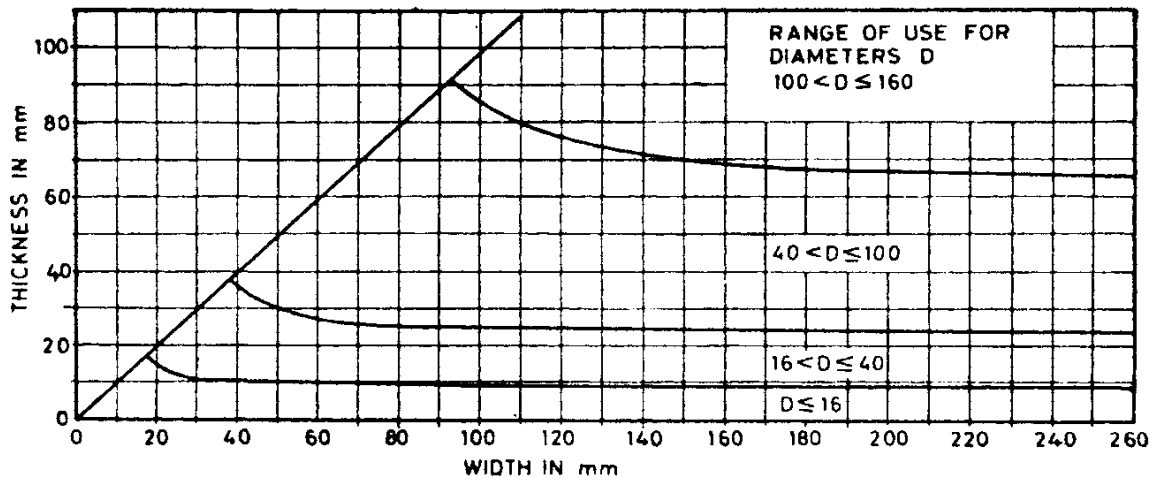


FIG. 2 APPLICABILITY OF THE VALUES, GIVEN IN TABLE 2 FOR ROUND SECTION, TO RECTANGULAR SECTION

Table 2 Tensile Properties and Hardness ( Clause 9.1 )

Class	Tensile Strength <i>Min</i> ( MPa )	Yield Strength <i>Min</i> ( MPa )	Elongation ( $GL = 5.65\sqrt{S_0}$ ), <i>Min</i> , Percent	Hardness <i>Min</i> ( HB )	Normalizing Temperature ( °C ) ( For information only )
(1)	(2)	(3)	(4)	(5)	(6)
1	370	200	26	100	880—910
1A	410	220	25	110	880—910
2	430	230	24	120	880—910
2A	460	250	22	130	880—910
3	490	270	21	140	860—890
3A	540	280	20	155	850—880
4	620	320	15	175	830—860
5	710	350	13	200	810—840
6	740	370	10	210	800—830

NOTE — The properties given in the table refer to ruling section up to 100 mm in the as rolled or as forged and normalized condition and are applicable to test samples taken along the direction of grain flow. For higher section as well as for the supply in hardened and tempered condition, the properties shall be as agreed to between the purchaser and the manufacturer.

## 9.2 Hardness Test

The hardness test shall be carried out in accordance with IS 1500 : 1983.

## 10 SAMPLING

### 10.1 Sampling for Chemical Analysis

The ladle analysis shall be supplied by the manufacturer.

### 10.2 Sampling for Mechanical Tests

In the case of bars up to 100 mm size, the test samples shall be selected from finished parts at the rate of one sample from each lot, provided the quantity from one cast does not exceed 25 metric tonnes. Where the quantity from each cast exceeds 25 metric tonnes, one more test sample shall be selected. When more

than one diameter or thickness of bar is rolled from the same cast, one additional test sample shall be selected from each diameter or thickness of bar if desired by the purchaser.

## 11 RETEST

### 11.1 Retest for Product Analysis

If the results of the check analysis do not conform to the composition requirements given in Table 1 and Steel grade with allowance of variation in case of check analysis from the specified limits, unless otherwise agreed to between the purchaser and the manufacturer, two new samples shall be taken on different pieces from the same cast. Should the two analysis satisfy the requirements, the lot represented shall be accepted, should either of the sample fail, the material shall be taken as not complying with this standard.

## 11.2 Retest for Mechanical Properties

Should any of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from either of these by the test samples additional samples fail, the material represented shall be considered as not having complied with this standard, except that the manufacturer may reheat-treat (not more than twice) the material represented and resubmit it for testing.

## 12 SUPPLEMENTARY REQUIREMENTS

**12.1** The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract and order. Details of these supplementary requirements shall be as agreed to between the manufacturer and the purchaser.

### 12.1.1 Chemical Composition

The purchaser may specify in special cases more restricted range for one or more elements in respect of carbon, sulphur and phosphorus than the compositional limits indicated in Table 1.

### 12.2 Bend Test

When bend test requirements for classes 1, 1A, 2, 2A, 3, 3A and 4 are specified the same shall be carried out in accordance with IS 1599 : 1985. Where the dimensions permit, test pieces 230 mm long and 32 mm square with edges rounded off shall be machined lengthwise from each test sample and bent cold by direct pressure round a former of diameter appropriate to the class of steel as shown in Fig. 3 until the sides of the test piece are parallel.

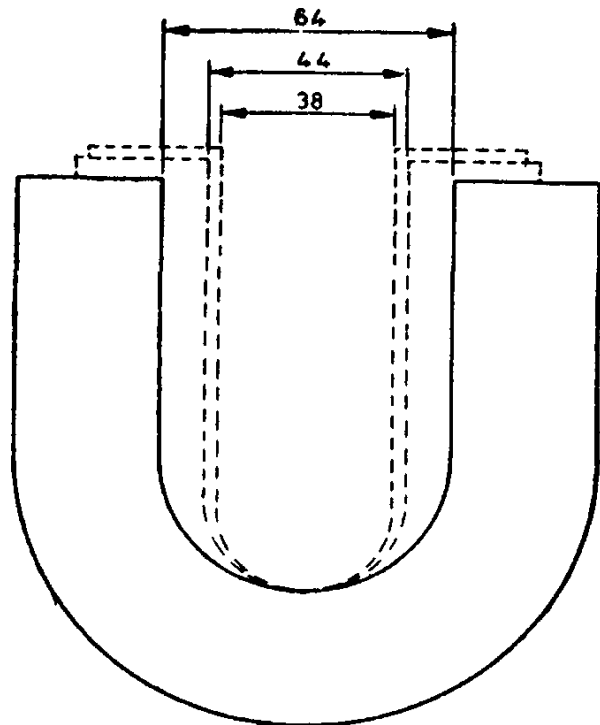
**12.2.1** Smaller sizes shall be bent in full section by a former having a diameter proportional to that specified for a 32 mm square test piece. Each bend test shall comply with the requirements without fracture.

**12.2.2** Subsequently, the ends of the test pieces for classes 1, 1A, 2, 2A, 3 and 3A material shall be brought together by direct pressure and the test piece shall not fracture.

**12.2.3** No bend test shall be required for classes 5 and 6.

### 12.3 Grain Size

When agreed to between the supplier and the purchaser, steel shall be supplied with the specified grain size in accordance with IS 4748 : 1988.



64 For Class 4

44 For Classes 3 and 3A

38 For Classes 1, 1A, 2 and 2A

All dimensions in millimetres.

FIG. 3 BEND TEST

### 12.4 Macrostructure

The macrostructure of steel on the etched transverse sections, when examined in accordance with IS 11371 : 1985, shall be free from harmful shrinkage porosity, blow holes, laminations, cracks, non-metallic inclusions, cavities, flux, dendrits, etc. However, the acceptance norms shall be as agreed to between the supplier and the purchaser.

**NOTE** — The steel rolled from continuously cast route shall also be examined by following the methods of preparation of sample in accordance with IS 11371 : 1985 and the norms of acceptance shall be mutually agreed to between the supplier and the purchaser.

### 12.5 Ultrasonic Test

Ultrasonic examination and the level of acceptance shall be mutually agreed to between the manufacturer and the user.

### 12.6 Magnetic Particle Test

Magnetic particle test shall be carried out in accordance with the method specified in IS 10138 (Part III) : 1983 and level of acceptance shall be mutually agreed to between the supplier and the purchaser.

### 12.7 Blue Fracture Test

The test shall be conducted in accordance with IS 4075 : 1985 and the level of acceptance shall

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be mutually agreed to between the manufacturer and the user.

**13 MARKING**

**13.1** Unless agreed otherwise, the material shall be identified as follows:

- a) Each billet, bloom, slab and bar over 50 mm in diameter or width across flats shall

be legibly stamped with the cast number and, when specified, the class designation; and

- b) Bars up to and including 50 mm diameter or width across flats shall be bundled together and a tag attached bearing the cast number, and when specified, the class designation.

**ANNEX A**  
**( Foreword )**

**INFORMATION TO BE GIVEN BY THE PURCHASER**

**A-1** While placing an order for the steels covered by this standard, the purchaser should specify clearly the following:

- a) Class designation;
- b) Description regarding size, length, etc;
- c) Condition of delivery;
- d) Tests required;
- e) Method of manufacture;
- f) Any special requirements, such as bundling and packing; and
- g) Supplementary tests, if required.



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## Amendments Issued Since Publication

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## BUREAU OF INDIAN STANDARDS

### Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002  
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha  
(Common to all offices)

### Regional Offices :

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	{ 323 76 17 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi CALCUTTA 700 054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160 022	{ 60 38 43 60 20 25
Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600 113	{ 235 02 16, 235 04 42 235 15 19, 235 23 15
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